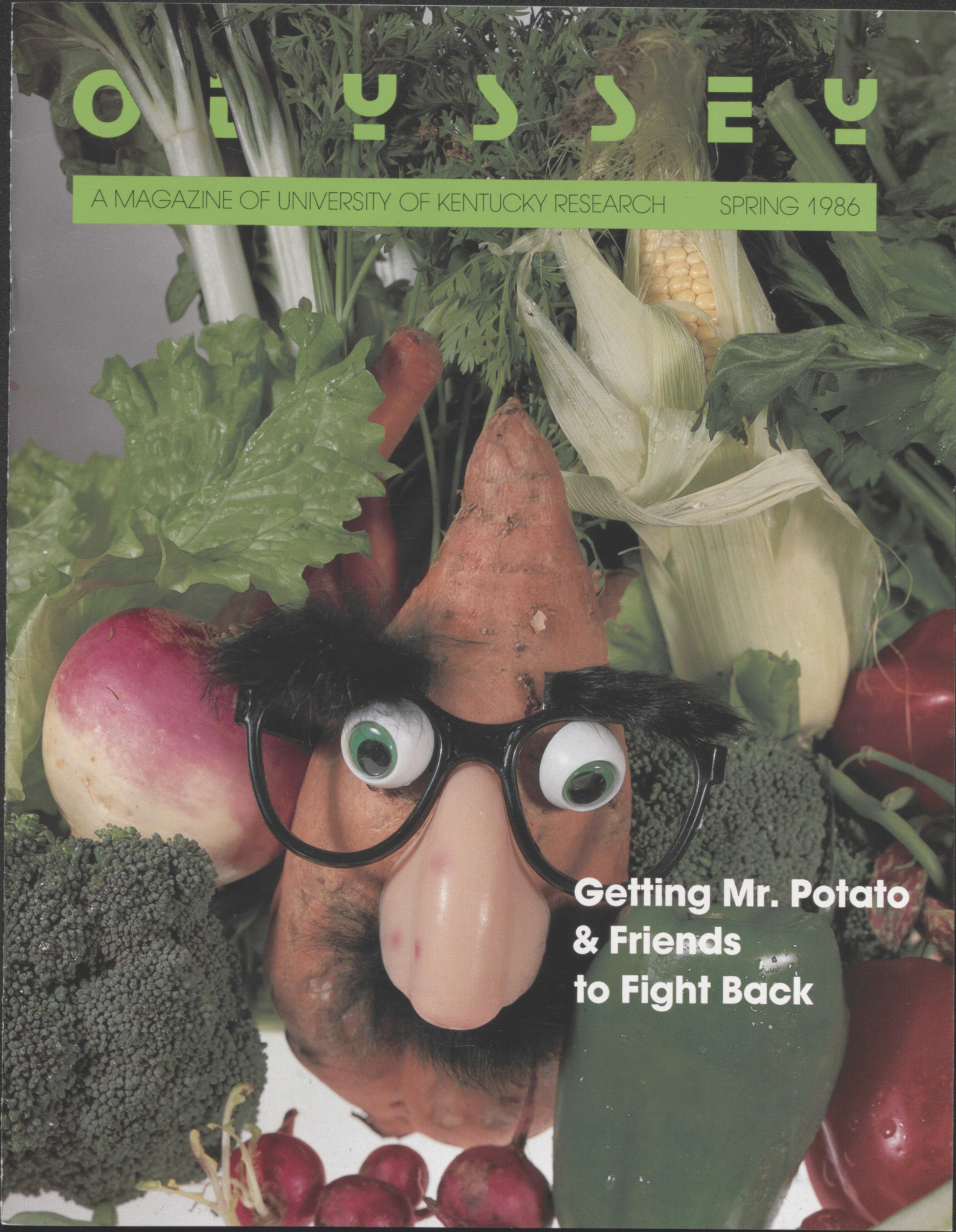


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SPRING 1986



**Getting Mr. Potato
& Friends
to Fight Back**

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Getting Mr. Potato & Friends to Fight Back	2
Violation by Burglary	7
Making Waterpower More Feasible	11
UK's Orient Express: An Inventor, Philosopher & Realist	13
Carriers of Death: Parasites Revenge One-Third of World	15
Disease and Priorities	17
International Genetic Data Enhance Chances for Survival in Organ Transplants	18
The Futile Migration: A Third World Dilemma	23
When Do They Stop the Pain?	21
Research Briefs	25
Reducing Complications for Chemotherapy Patients	
Purifying Water with Membranes They Want You!	
Database Theory	
Directory of UK Researchers	27

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Getting Mr. Potato & Friends to Fight Back

By Moira Skinner

The scientist fills the small hypodermic needle with solution, takes the spindly stem in hand, carefully inserts the needle into the external tissue, just below the "epidermis," and deposits a few drops.

He has deliberately infected a tobacco plant with the dreaded blue mold disease, an act that would make any tobacco farmer cringe. But here the fungus won't result in the telltale yellow lesions, bluish spores, and finally brown spots that signal the plant's destruction. Instead, the needle's contents will protect the plant from onslaught of the fungus and even spur it to greater growth.

Like doctor with patient, the scientist has immunized the plant. It's a common scene in plant pathology laboratories at the University of Kentucky. Dr. Joseph Kuc, internationally renowned expert in the ways plants recognize and resist disease, has spearheaded the research in plant immunization.

(This is the second chapter in Kuc's story. See the Spring 1982 issue of *ODYSSEY* for the first article, "The Plantly Art of Self Defense.")

Besides tobacco, Kuc (pronounced kutch) and his research group have successfully immunized potatoes, green beans, cucumbers, watermelons, and muskmelons to defend themselves against diseases caused by viruses, fungi and bacteria. They now are testing immunization of pine trees, their first perennial.

Tackling several plants and several diseases at once was an ambitious undertaking. "But we felt that was the way to go because we wanted to study organisms in general," said Kuc, a biochemist whose life work has been to apply chemistry to plant pathology.

All the work, all the information, pointed in one direction. The difference between disease-resistant plants and susceptible plants is not the presence or absence of genes for resistance mechanisms, but rather the speed and magnitude with which the plant recognizes an invader and acts to stop the invasion.

"The difference between resistance and susceptibility," explained Kuc, "is not whether you can or can't, but whether you do or don't, how quickly and how much, and how the

environment affects the whole process."

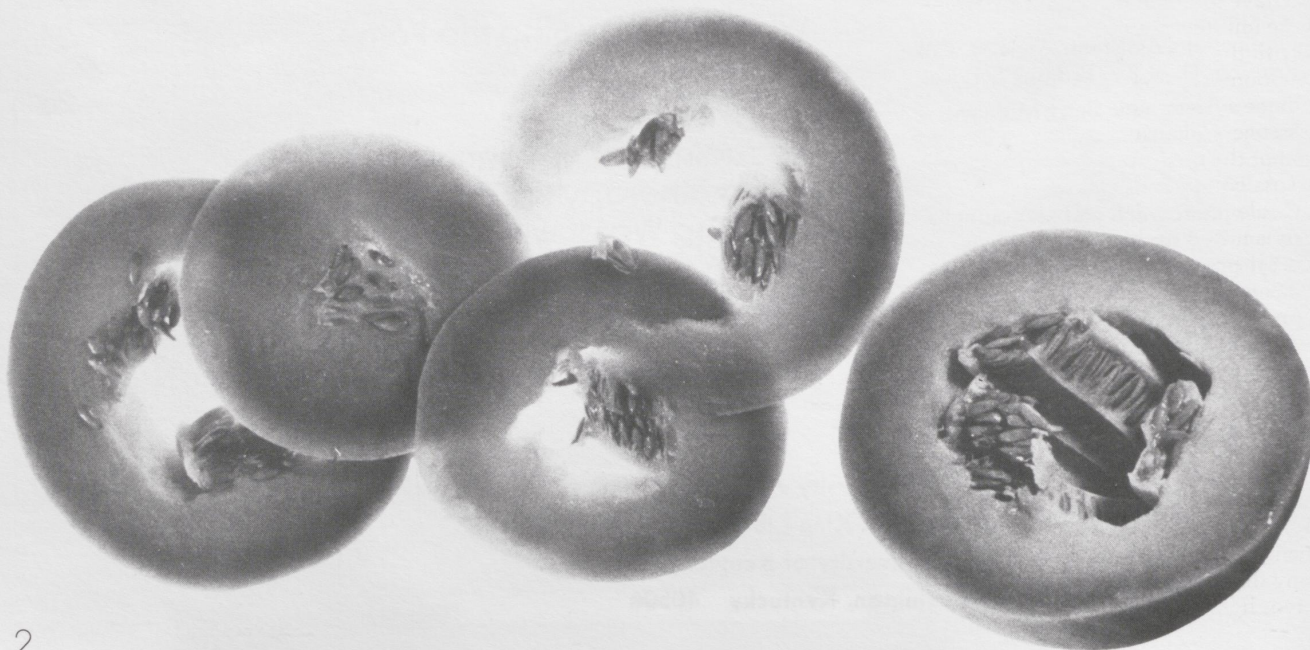
That summation makes immunity in plants sound, in general principle, very similar to immunity in animals. "After all," Kuc added, "we don't have to cross people to get resistant people. When the doctor immunizes us, he doesn't put new genes into our cells. We already have the genetic potential to do what needs to be done."

What Kuc and his colleagues have seen suggests a common thread through all living organisms. Not that the mechanisms are precisely the same, but it seems there's a general plan for metabolism, for immunization.

The UK research team has been able to immunize plants since 1974. But a much-sought breakthrough concerning what prompts plants to defend themselves came four years ago.

In their work with potatoes, they discovered the alarm signals that spur potatoes to fight off a fungus causing late blight disease.

The alarm signals are fatty acids in



the fungus. Because the potato cannot synthesize these acids, it recognizes an intruder and rallies its defenses. Correct identification of these alarm signals removed a bottleneck. Kuc and his researchers have since learned a great deal about how the foreign acids are incorporated into the potato's lipids and membranes, where they act as chemical irritants and put the potato under a low-level but persistent metabolic stress.

They've also found that within the plant, certain enzymes act on the fatty acids. It turns out that in animal tissue, the same enzymes and similar fatty acids produce compounds that affect animal metabolism, especially the immune system of animals—evidence, perhaps, of that common thread in living things.

Another commonality is the role that compounds called beta glucans play in plant and animal immune systems. Kuc learned that besides the fatty acid "alarm signals," the fungus produces compounds that either suppress or enhance a potato's defense reaction.

"Of course, the strain of the fungus that can cause disease on a potato variety is one that can suppress the immune system," said Kuc. "But in some cases we also find compounds that enhance the immune system."

Such enhancers appear to be beta glucans, compounds formed by sugars linked in a particular way. "It's interesting that in animal systems," Kuc pointed out, "these beta glucans also have a role in mediating aspects of the immune system."

With the knowledge that certain compounds enhance a potato's immune system, and also that second messengers—calcium is one—help prompt the plant to produce plant defense compounds called phytoalexins, the UK immunization team is now searching for novel ways to get the most out of the potato's resistance mechanisms.

And plants do indeed employ several defense mechanisms against attacking virus, fungi, or bacteria. When a plant is immunized, it becomes sensitized to respond with many mechanisms rather than a single one.

Kuc compares the immunization with an electrical switch on a wall: when you flick it on, it can control many different things—radio, TV, stereo, lights—and not just one.



Joseph Kuc

"In the process of evolution," explained Kuc, "resistance could not be dependent on a single mechanism or a single compound; otherwise, the resistance would have been lost."

Current examples abound. Chemical companies have produced compounds with a single site of action. After such a compound, say a fungicide, is used in farmers' fields for several years, strains of the pathogen resistant to the chemical begin to crop up.

But with multiple sites of action, with many mechanisms fighting a disease, the chances are nil that a pathogen can always overcome the plant's—or animal's—defenses. "And that's why people survive and plants survive," said Kuc.

His laboratory has received support over the years from the National Science Foundation, Rockefeller Foundation, Herman Frasch

Foundation, USDA, Ciba-Geigy Corporation, the R.J. Reynolds Tobacco Company, Weyerhaeuser Corporation and others, with the grants often providing stipends for post-doctorates and graduate students.

Much of the credit for UK's cutting edge work in induced resistance goes, Kuc insists, to his ever-changing team of top-notch scholars, including several post-doc superstars from the United States and other countries.

"If you have dedicated people, you're a long way to reaching your end. But you can't do big things with hopes and intentions alone," Kuc said. He then described rows of plants in corridors, and make-shift shelves in every inch of lab space—an illustration of the shortage of facilities the UK researchers face.

continued on page 4

Getting Mr. Potato continued

"I have very good people who have been able to make do," he said. "Their ingenuity is incredible."

"Incredible" also describes the UK team's results. They've made great strides, for example, studying immune systems in cucumbers and melons. Much of their early work concentrated on these plants, since they grow in abundance, produce big leaves and good-sized seeds, contain ample tissue, and are plagued by important diseases which show symptoms in a few days.

UK researchers can immunize cucumbers by inoculating a single leaf. It becomes a "factory leaf," producing a chemical that sensitizes the rest of the plant.

Cucumbers & Melons:

The researchers can immunize cucumbers by inoculating a single leaf. It becomes a "factory leaf," producing a chemical that moves through and sensitizes the rest of the plant. The signal is thorough. It penetrates the buds, with their embryonic leaves folded and waiting; when a new leaf opens, it's immunized. Indeed, each new leaf on an immunized plant becomes another factory producing and sending out even more chemical signal when challenged by a pathogen.

With a single immunization, Kuc can protect cucumbers and melons against 13 different fungi, viruses and bacteria. The protection lasts for four to six weeks. If a disease organism challenges the plant during that time, not only does the plant thwart the attack, but the challenge serves as a booster to immunize the plant for its lifetime.

Immunization against virus constitutes quite an achievement. "There aren't any chemicals you can use to protect plants from virus," Kuc said. "So here we have something—something already occurring in nature—that protects against viruses."

The cucumber work has advanced to the point that Kuc and his associates also can spray materials on the plants and systemically immunize

them—a much more practical approach than inoculation.

"You can inject people, but from an economic and logistics point of view, you can't very well inject plants," said Kuc with a chuckle.

Another breakthrough occurred when the researchers discovered they can immunize with materials from sources other than pathogens. Surprising enough, they can extract effective chemicals from healthy cucumbers and other plants, like spinach.

When extracted, the chemical from the cucumber is changed somehow, Kuc explained. When the changed

chemical is sprayed on another cucumber, the plant recognizes non-self and becomes sensitized. The same reaction occurs with chemicals obtained from spinach.

"We're right on the trail of what the chemical substance is from the cucumber, and what the substance is from spinach, too," Kuc said.

He and his team are encouraged by another finding. Immunizing with chemicals from spinach and the cucumber itself provides almost immediate protection, a dramatic improvement from the previous lag of four to five days for the immunization to take.

"Now," said Kuc, "with some of these compounds we've extracted from other plants, including spinach, we have to wait only a day or less than a day. That's very exciting."

"What that means," Kuc continued, "theoretically at least, since it has yet to be tested in the field, is that if I expect a disease in a few days, I can go out and quickly immunize plants."

Ideally, there would be a way to produce immunized plants. While immunization can extend through the lifetime of a plant, it cannot be passed on from generation to generation. The UK researchers hope someday to grow immunized plants from seed, through seed treatments, although that capability so far has eluded them.

Each time they have collected seeds

from immunized plants, and have grown plants from the seeds, the immunization was lost. That's not so strange, though, Kuc pointed out. After all, people who are immunized against certain diseases don't pass on the protection to their children.

The UK researchers may perfect a method of treating seeds, possibly with a slow release inoculant, that will protect plants from the beginning. But tissue culture most likely is the key to propagating immunized plants—something Kuc already has achieved with tobacco.

Tobacco:

Kuc's tobacco research sprouted naturally from the previous work with vegetables. Once basic concepts of plant immunity were known, it was time to test them in tobacco—a model crop for testing since it is such an important crop in Kentucky and the United States, a wealth of information exists about it, and it is a plant easily manipulated.

The UK scientists soon discovered they could immunize burley against the serious fungus disease blue mold by injecting the fungus into the tobacco stem.

"We found that the tobacco was extremely well-protected, as well or better than with the best chemical substance available," said Kuc. "It's permanent. And it's the tobacco's own mechanisms providing the defense, so it's nothing artificial."

But the plants were stunted. So the real challenge was to provide protection without inhibiting growth. One of Kuc's graduate students, Sadik Tuzun, soon hit upon the solution: injecting the material in the external tissue only. Then the tobacco not only was protected, but actually grew better—taller, with more leaves and more leaf area, and greater fresh and dry weight. Field tests confirmed it; the marketable yield from the experimental crops exceeded yields from nonimmunized tobacco by 10 to 25 percent, even with no blue mold present.

"We thought we had a good thing going," was Kuc's understated assessment.

Next, he and his associates tried to identify what chemicals sensitized the tobacco to respond to an attack of blue mold, and which ones the plant produced to stop the fungus. The

answers, are being provided by Dr. Steven Salt, a post-doctorate researcher. Some degradation compounds of carotenoids called beta ionones were found to be extremely toxic to the fungus. Immunized plants contained a 50-fold increase in beta ionones and other derivatives.

Greenhouse tests revealed that beta ionone injections protected against blue mold and enhanced growth, almost as well as did inoculating with the fungus. So Kuc and his team took their show on the road. This past summer, in field tests throughout Kentucky and even in Puerto Rico, they compared immunized and nonimmunized plants, plants injected with beta ionone and plants sprayed with beta ionone. The tests bore encouraging results with the sensitized plants—excellent protection, enhanced plant growth, and often greater marketable yield.

But a curious circumstance came to light when Kuc and his researchers brought leaf samples from the field periodically and infected them with blue mold (in the safety of the lab, where there was no danger of starting an outbreak). As predicted, the immunized plant leaves showed no disease symptoms, the nonimmunized plant samples did—until late in the season.

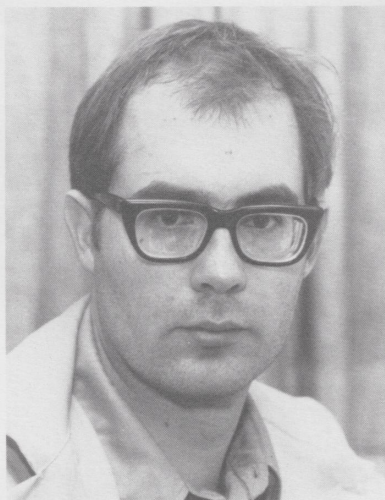
At that point, it didn't matter whether plants were immunized or not; none exhibited blue mold symptoms when inoculated with the fungus. "We looked at this in detail and found that as tobacco plants age, they become more resistant to blue mold," said Kuc.

Doctoral student Tuzun and Moshe Reuveni, a post-doctorate fellow working with Dr. Kuc and professor Dr. Malcolm Siegel, unlocked the secret. The surface of the tobacco leaf contains compounds, duvatriene 1.3 diols (DVTs), that are toxic to the blue mold fungus. As plants age, and when they are under drought, heat and perhaps cold stress, they produce more DVTs.

"In the immunized plant, we get the production of about three times more of these DVTs," Kuc said. "So the immunized plant does many things. It's sensitized to respond quickly, but also it's protecting its outsides."

Now Kuc, Siegel and Dr. Bill

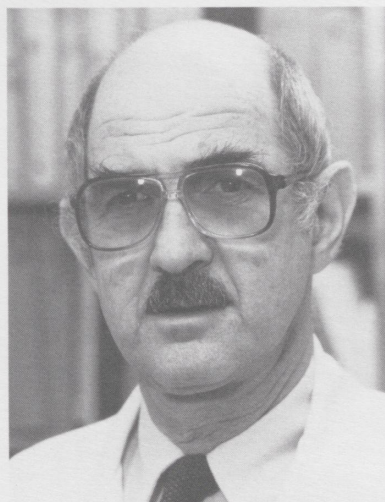
The Research Team



Dr. Steven Salt



Dr. Moshe Reuveni



Dr. Malcolm Siegel



Dr. Bill Nesmith

Dr. Sadik Tuzun, an important member of the research team, was out of the country and unavailable for photographing.



continued on page 6

Getting Mr. Potato continued

Nesmith, Extension plant pathologist and blue mold expert, are studying the relationship between the DVT level, immunization and resistance to blue mold in the field. Perhaps there are times chemical immunizations are not needed at all; the tobacco plant may already be protected.

Grafting:

The most dramatic technique Kuc and his fellow scientists use is reproducing tobacco plants by tissue

"Now this was unbelievable," said Kuc, the veteran researcher in awe. "It suggests there's some chemical way we can permanently modify the genome that is coding for disease resistance, or perhaps modify the expression of the genome.

"It's mind-boggling that you can transfer this on to a plant from one cell."

Kuc and his associates now have the potential to propagate thousands of plants from a single immunized tobacco plant, and they're immunized.

Last summer saw the first field tests of the tissue culture plants, in a plot near Commonwealth Stadium. ("Who

immunization work has the potential to benefit the farmer, agriculture, and hence all of society."

But Kuc is quick to point out that he is not an economist or field scientist; he may discover tremendous conceptual breakthroughs but they may not necessarily be put to use on the farm, for economic or practical reasons.

He nevertheless likes the idea that in the UK College of Agriculture, researchers are encouraged not only to unearth fundamental, conceptual information but also to consider solving practical problems. He emphasizes that a strong benefit of this environment, according to Kuc, is the collaboration with field scientists and UK Extension specialists who present different approaches and perspectives.

He, in fact, presented a different approach at a recent meeting of the New York Academy of Sciences. There he talked about signal transduction in plants, to an audience of medical personnel.

"I think many people are surprised there are immune systems in plants," he said. "The animal scientists just don't think in terms of that. But with some of our work, we're using their literature. The terms and the compounds aren't all the same, but some of the general molecular concepts are very similar.

"The play is the same but the actors are different."

"We found that if we took a nonimmunized root stock and grafted on just a little bud from an immunized tobacco plant, a piece about this big [the size of his fingertip] . . . grows into a tobacco plant, bigger than I am, and it's immunized!" Professor Joseph Kuc

culture. As a preliminary measure, they began grafting tops from immunized burley onto nonimmunized root stock and vice versa, to confirm that the immunization signal moved from one part to the other, as with cucumbers and melons.

Kuc animatedly describes the process.

"We found that if we took a nonimmunized root stock and grafted on just a little bud from an immunized tobacco plant, a piece about this big (he shows a fingertip), that thing grows into a tobacco plant, bigger than I am, and it's immunized. Wow! That was very exciting to us.

"How could there be such a chemical substance that would do such a profound thing?"

The grafting success prompted Kuc and his associates to try growing immunized tobacco plants from tissue culture. That technology allows the scientist to regenerate entire plants from cells in a leaf or stem. Kuc attempted the tissue culture with small leaf sections and succeeded in growing full-size, normal plants—immunized, of course.

knows," said Kuc, "maybe some of the fans can even see our field from the top of the football stadium.") The test was a big success!

He foresees producing blue mold resistant plants from the best burleys available. "The practical implications and the fundamental implications are very profound," he concluded.

As a scientist, Kuc believes his goal is to understand. "But in the process of understanding—it sounds trite, but it's true—we hope to benefit people," he explained. "The plant



Violation by Burglary

By Moira Skinner

She's in her 30's, she lives alone near downtown Lexington, and her house has been burglarized eight times in five years.

"I like my neighborhood, I like my house," she says. "The burglaries? That's life. I figure they won't harm me; they're just after my stuff."

After the burglary, the couple considered moving. They loved their neighborhood, with its well-kept homes and mature trees, near Lexington's Chevy Chase. They had lived there several years and felt established; their children were happily attending good schools nearby. But the break-in, performed in broad daylight when no one was home, left them frustrated and fearful.

Instead of leaving their home, they chopped down the evergreens along the front of the house. (The police said burglars could hide there.) They confined their dog inside, to bark at any intruders. And they invested in a new, state-of-the-art alarm system; they couldn't count on their old burglar alarm anymore.

Burglary is an all-too-common crime that affects people in various ways. For some, it's merely a hassle of filing police and insurance reports and replacing a television or VCR.

But for others, the experience adds anger, stress and fear to their lives, shatters an illusion of invulnerability, and makes them feel "violated."

The uneasy feeling of violation an intruder leaves behind bothers most people more than anything else, even the loss of their material things, said Melissa Himelein, a doctoral student in the University of Kentucky's psychology department.

She is studying how burglary affects victims as the basis of her dissertation, under the direction of psychology professor Dr. Mike Nietzel. Himelein was awarded a competitive grant from the National Institute of Justice in



September 1984 to support her work.

The current project allows Himelein, who has a master's degree from UK in clinical psychology, to further develop her dual interest in psychology and law. She and Dr.

with inmates, assesses court-referred inmates for evaluation, and is involved in crisis intervention.

The research involving burglary victims will evaluate their psychological well-being, coping strategies, social supports, and perceptions of and support from the criminal justice system.

Himelein originally planned to include victims of both violent and non-violent crimes in her research. But her focus shifted when she found few violent crime victims to interview in Lexington—a fortunate circumstance for the city's residents.

"There are plenty of burglaries in Lexington," she said, "but not many violent crimes, relative to other cities its size."

The emphasis on non-violent crimes, namely burglaries, should yield new information for the fields of law and psychology. Previous studies have focused on violent crimes such as rape or assault, which inflict victims with deeper psychological scars.

"But non-violent crimes also can have serious psychological effects," Himelein stressed. "Most people don't realize—I didn't realize—that burglary has as much of an impact as it does on victims, particularly women."

Nietzel foresees that the results of the study will be useful in informing lawyers, police officials, and mental health professionals about some ways

"Most people don't realize—I didn't realize—that burglary has as much of an impact as it does on victims . . ."

Melissa Himelein, UK graduate student and researcher

Nietzel have co-authored papers on probation and parole and the prevention of crime. And she works part-time as a unit psychologist at the Federal Correctional Institute, a minimum security facility in Lexington. There she conducts therapy

that people either successfully or less successfully cope with being victimized by crime.

"There's an assumption that

continued on page 8

Violation by Burglary continued

burglary victims are not going to be as traumatized as victims of violent crime," he said. "But people who have had their home burglarized, especially if the home has been ransacked, have quite an emotional reaction to it."

Himelein has witnessed a wide range of reactions in her interviews with victims—40 men and 40 women. But she expects the data to show that burglaries generally affect women more profoundly than they do men. With a few follow-up interviews plus the data analysis yet to do, she predicts that along with the victim's sex, other prime factors will be whether a victim lives alone and whether the person's home has been burglarized before.

"Married couples or people with roommates tend not to be as traumatized, since they have each other for support and a feeling of security," said Himelein. "And first-time victims seem to experience a more severe impact." To measure both immediate and more lasting reactions, Himelein interviews victims a week or so after the burglary and again three to four months later. Since last January, she has gone to the police station every few days to look through reports. She sends letters to potential interviewees, then follows up with a phone call.

The letter, computer-printed on UK stationery, allows burglary victims to verify the project with the UK psychology department, if they wish. And some do. To further dispel reluctance, Himelein offers the option of holding the interview not only in a person's home, but in her campus office or in the Commonwealth Attorney's office, a neutral setting, and convenient for people who work downtown.

"It's a time when people have heightened fears and suspicions anyway," said Himelein. "Some people could get upset about a stranger calling and asking about the burglary."

Most people she contacts agree to participate. "Many people want to ventilate anger or frustration at that time and it's probably a good thing to do," she said. Research with violent crime victims shows that taking part in such an interview can be helpful in coping with the crime.

"And it helps me feel like less of an ambulance chaser," when people want to talk about their experience, Himelein added. "It helps me feel that I'm not an intrusion on people."

Of course, burglary is much easier for victims to talk about than are rapes or assaults. People seldom are threatened or injured during burglaries; they rarely encounter the intruder.

"Burglars are very unlikely to break into a house when someone is there," Himelein said. "And if they do, it's a mistake and they usually run."

Only four victims in the study said they were home when the burglary occurred, but they didn't wake up. The next morning, they discovered an intruder had stalked through their home.

"That must be a horrible feeling, to realize someone was in your house while you were asleep and you didn't even know it," Himelein said. "But it was clear to those people that the burglar wanted only their things and didn't intend to hurt anyone."

Some victims in the study reported coming home to ransacked houses—another horrible feeling. But many said the burglars were tidy, taking what they wanted and not touching anything else. One woman didn't notice her VCR was missing until she

went to put in a videotape. That's a common occurrence, Himelein said.

The intrusion into their homes and lives distresses victims more than anything else. Nearly everyone agrees with this questionnaire statement: "I felt that someone violated me. Someone was in my house, picking through my things, deciding what to take and what to leave, someone I never would have invited into my home."

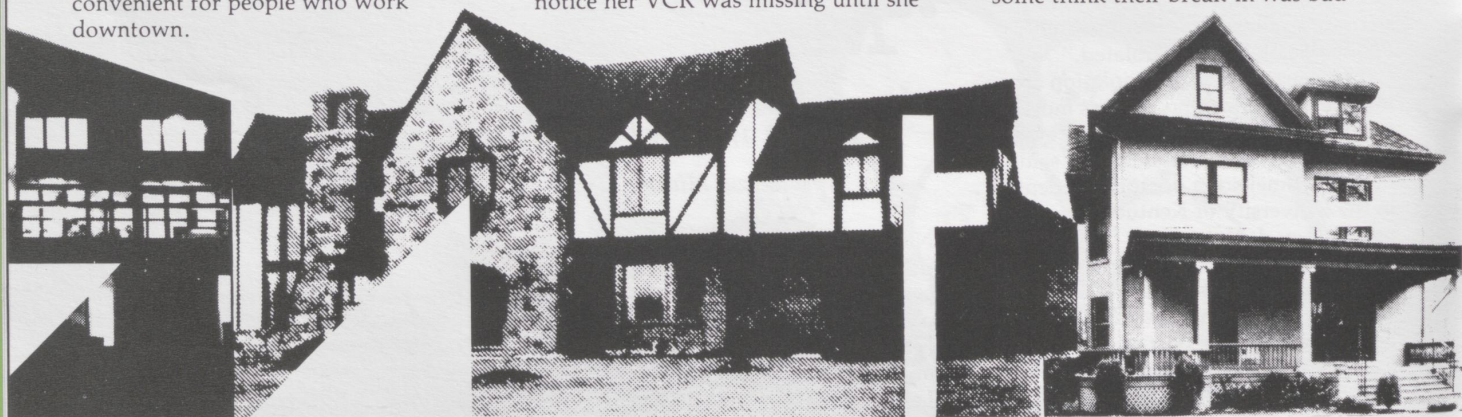
Victims express that feeling over and over again, said Himelein. They react more to the violation than to the loss of their possessions. "In fact," she said, "many people say that after the burglary, they don't feel as tied to their material things. They realize other things, like their health, safety and privacy, are more important."

How people react to getting possessions stolen depends partly on what is taken and whether they have insurance. Losing the family silver, jewelry, other heirlooms, or items with sentimental value can be heartbreaking.

But thieves usually head instead for the TVs, VCRs, stereos and other electronic equipment—items they quickly can convert to cash. VCRs are taken most often, Himelein is finding. VCRs and guns. "I was surprised at how many people owned guns," she said. "And of course they are always stolen if they're found."

People who don't have insurance to help replace stolen valuables are the most frustrated by burglaries. Said Himelein, "They most often express the feeling that 'life isn't fair—you work hard to get ahead, to get nice things, and someone comes along and takes it all away from you.'"

Some victims harbor more suspiciousness and paranoia toward strangers after a burglary. And while some think their break-in was bad



luck or random chance, others take it personally. They agree with the questionnaire statement that "people don't respect me if they think they can come into my house and take my things."

During the interviews, participants complete questionnaires that measure anxiety, depression, distress, and fear. For example, a checklist shows whether victims have had headaches, chest pains, upset stomach, or sore muscles since the burglary—all the physical symptoms that crop up in crisis reactions. Also, respondents tell how often since the burglary they felt relaxed or tense, and how much of the time they thought the future looks hopeful and promising.

A self-esteem inventory reveals whether the person views himself or herself as a person of worth, with a number of good qualities. Crime can jolt a victim's self-esteem. In that case, said Himelein, recovery from psychological effects of a crime can be delayed unless self-esteem is restored.

Self-esteem and recovery can be boosted by caring people around the victim, so Himelein asks about the social networks people have in time of crisis: how many persons the victim can turn to and what is the quality of each relationship.

"Women tend to seek support from friends or family, more often than do men," she said.

And while women admit they cried, vented their outrage, or revealed their terror after a break-in, men rarely said they expressed any emotions—even anger. But that may not always be the case.

"It's interesting to interview both a husband and wife," Himelein said, smiling. "Once I was talking to the husband in the living room. When his wife heard him say he didn't express any emotions after the burglary, she



Professor Mike Nietzel and psychology doctoral student Melissa Himelein have been collaborating on a study of burglary victims and their different methods of coping with the crime.

yelled in from the kitchen, 'Don't be so macho, dear. You were too angry, don't you remember?'"

While some victims (most often men) described the burglaries as "no big deal," others experienced true trauma. One woman started taking tranquilizers after a burglary. Another, a single mother who lived in an often-burglarized apartment complex, cried for days in fear, anger, and worry about her young son; for several nights after the break-in, they stayed with friends.

Four or five people moved within a few months, at least in part because of the burglary.

"Moving is a profound coping behavior," commented Himelein.

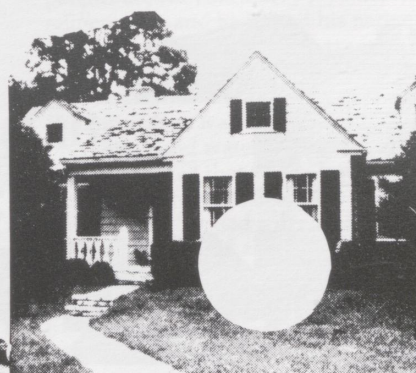
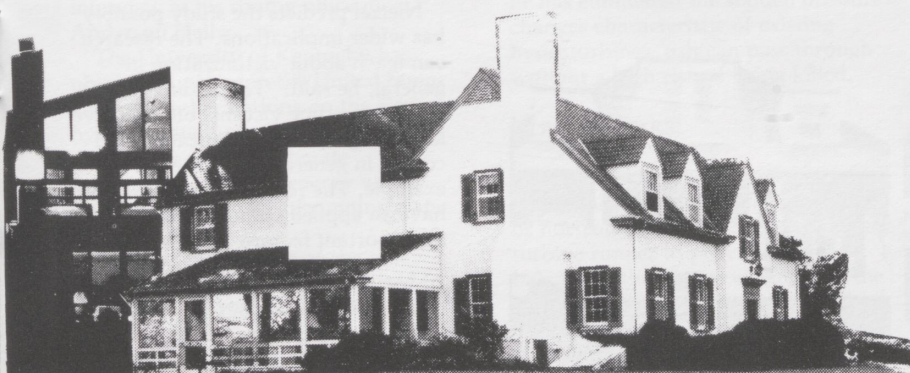
Most victims cope through less drastic methods. Many people attempt

to get their mind off the burglary. They go out to eat, see a movie, exercise. Doing something expressly to relax helps ease the stress of squeezing in visits to the police station, filing reports, and seeing the insurance agent.

A common ploy is to draw a "worse world" scenario, explained Himelein. "They say, 'At least the burglar didn't get the family heirlooms.' Or, 'At least it wasn't as bad as the Smiths' down the street.' Or, 'At least I wasn't here. At least nobody got hurt.'"

Some fortify their houses with deadbolts, burglar alarms and watchdogs, as did the couple who decided to stay in their beloved home and neighborhood.

continued on page 10



Violation by Burglary continued

Many people look for a cause for the burglary, besides the culprit himself. Often they cite their neighborhood, said Himelein, either because it's an affluent one that attracts burglars, or because it's a so-called bad neighborhood with a high crime rate.

Sometimes victims blame neighbors for not being watchful enough, roommates for not locking up, landlords for not securing apartment buildings, or friends for talking about their new VCR. But most often, people see themselves responsible in some way.

Behavioral self-blame, or attributing the burglary at least in part to some mistake they made, is a common and useful coping strategy, said Himelein. One of her hypotheses is that victims who use behavioral self-blame will better cope with the experience; it helps restore a feeling of control.

"The woman who had eight burglaries in five years used behavioral self-blame, and I think it helped her adapt to the situation," Himelein said.

After the previous break-in, almost a year before, she put bars on her windows. But she confessed that she removed the bars from a window to repair it, and neglected putting them back up.

"I can't believe I forgot to put the stupid bars back up before I took off for a week," she told Himelein. And she packed the car during the day when anyone going by could see she was leaving.

"She didn't put herself down, but knew she had engaged in some careless behaviors," Himelein said. After a year or so of no break-ins, this victim starting believing that perhaps

it wouldn't happen again. She revived her "illusion of invulnerability."

Another of Himelein's predictions is that people who have an "illusion of invulnerability" will be more shattered by victimization.

"When people think a crime won't ever happen to them, it's much more devastating if it does," said Himelein. "Someone who's had a burglary is less likely to have those illusions, and is more likely to recover quicker."

P *People who have an "illusion of invulnerability" will be more shattered by crimes such as burglary.*

Most of the study's participants came to accept their experience by the time of their second interview, a few months after the fact. "As another coping strategy," Himelein explained, "victims decide that what happened is out of their hands and there's nothing that can be done. But it usually takes weeks and maybe months to come to terms with it and decide simply that it's over."

Victims who have an impact on the criminal case often can cope better with any ill-effects of their experience. That's another of Himelein's predictions, but she probably won't have enough data to analyze it. Burglary victims rarely get the chance to influence the outcome of cases.

"Burglars are hardly ever apprehended," Himelein said, "for manpower reasons, I surmise. Burglary just can't be the highest priority of the police department."

That situation may influence how burglary victims in the study evaluate the criminal justice system. Himelein foresees that their perceptions of and

satisfaction with police, detectives and prosecutors may change from the first interview, right after their burglary, to the second, three or four months later—especially if no progress is made in the case.

"Some victims say they realize the police did all they could," said Himelein. "Others say they can't believe the police didn't do anything; it's the only time in their life they needed the police and they didn't

come through."

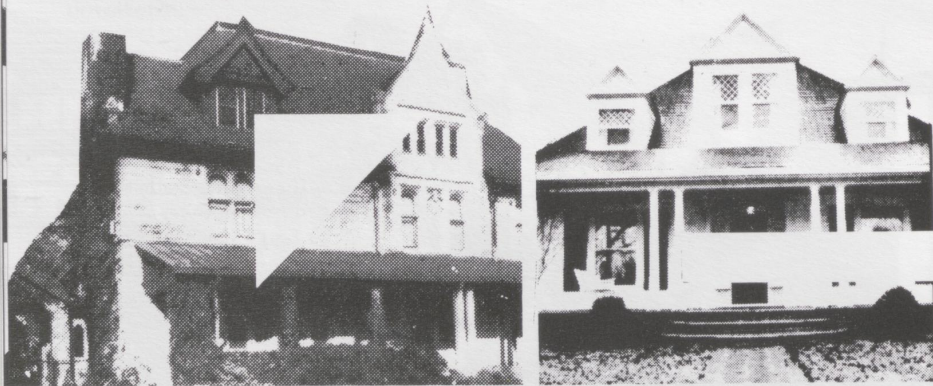
The Commonwealth Attorney and the local police department, both of whom assisted Himelein arrange the data collection, have expressed an interest in the completed study. It's likely to have potential implications for the criminal justice system.

"When you think about it, burglaries probably are the way the most number of people are going to come in contact with the police," said Himelein, "since that crime has the greatest sheer numbers."

But many burglary victims end up feeling anger and resentment toward the police, she pointed out. They think the police didn't care, didn't want to investigate. They get the impression the report goes into a file never to be looked at again.

"It would behoove the police to realize that burglary can evoke quite an emotional reaction, and to learn how to communicate a different message to them," Himelein concluded, "for goodwill and good public relations."

Nietzel predicts the study possibly has wider implications. The research can teach about victimization in general, he said. "The findings aren't limited to crime victims, but will give knowledge about victimization and coping in general, with disease, for example. The research doesn't simply have an applied value, although that's an important feature."



Making Waterpower More Feasible

By Maria Braden

David T. Kao is described by a colleague as "the most creative person I've ever known." This year, he will be honored by a national science magazine as one of the top scientific innovators in the country.

The UK civil engineering professor holds patents or has patents pending on seven inventions as diverse as a coal slurry pump, a versatile baby carrier and a computerized method for translating Chinese characters into Western languages.

Besides inventor, he wears many hats: he is director of the university's Water Resources Research Institute, chair of the UK Department of Civil Engineering, consultant to industry and government, a superb teacher and, with a Ph.D. in philosophy, a champion of the liberal arts.

His latest invention, and the one for which he is being honored nationally, is in an area where he has never worked before—harnessing the power of water. That's in keeping with his personal views:

"I believe that in anything we see there may be room for improvement."

Professor David T. Kao

"I always believe that in anything we see there may be room for improvement," Kao said in an interview at his roomy office in Anderson Hall.

The University of Kentucky has obtained a patent in the United States and in 13 other nations on the Kao hydroturbine—a compact machine that can be used to generate inexpensive electrical energy where only a small amount of running water is available.

For his development of the new hydroturbine, Kao was recognized in the December 1985 issue of *Science Digest* as one of the top 100 innovators in the country.

To compile its list of innovative researchers, the magazine surveyed about 1,200 top corporations with large research and development budgets; universities and colleges; scientific and engineering societies and associations, and all government agencies and departments, according to Helen Howard, a spokesman for *Science Digest*. Kao was chosen from more than 500 nominations.

Although water is one of the cleanest renewable energy sources, it has not been used widely in the U.S. to provide electric power. Hydroturbine systems have been expensive to build and maintain and generally have needed large volumes of water.

And even though water is a clean source of energy, environmentalists have criticized hydroturbine system operations because they are believed responsible for large fish kills.

Kao's hydroturbine represents a significant breakaway from conventional hydroturbine system

eliminates the need for a high pressure seal around the torque transmission shaft.

To minimize energy loss and turbine manufacturing costs, Kao's system uses a uniform area reduction flow control device instead of the conventional wicketgates, and a spiral vane flow direction guide in place of Kaplan runner blade pitch adjustment.

By developing an innovative runner design, Kao eliminated the costly draft tube design and construction.

Eliminating the draft tube meant eliminating one of the major causes of fish mortality and erosion damage. It also increases the potential for water aeration, improving downstream water quality, he said.

The advantages of his system will make even marginal sites in the U.S. or developing countries more economically feasible for development, he said. And the hydroturbine unit could also be used as a microhydropower plant to provide electric power for rural residential and factory needs or for the needs of farms or coal mines in remote areas where a small supply of running water is available.

How It Came To Be:

Although the 49-year-old Kao has been interested in water since childhood, his expertise lies in the area of hydraulics/fluid-mechanics and coal slurry transport. Several of his patents are for coal slurry pipeline refinements, and he helped his native China develop a coal slurry transport laboratory.

When he was in grade school in Shanghai, Kao learned about flood prevention and water work in China. And he learned that China leads the world in terms of hydropower potential. "That had a deep influence on me," he said. "I always wanted to work with water."

How It Works:

Kao's system uses a vertical upward rather than conventional downward or horizontal flow passage through the turbine runner to provide counter balance of the runner weight with the hydraulic thrust. That provides a substantial reduction in system structural strength requirements and

continued on page 12

Making Waterpower continued

But his chance didn't come until 1980, fifteen years after he finished his masters degree in civil engineering at Duke University. Kao earned his doctorate in philosophy from Duke in 1967.

The catalyst for the hydroturbine project was a call for proposals for low-head hydropower research grants from the federal Department of Energy in 1980.

Finding an economical, efficient way to generate electricity from water had been "in the back of my mind," Kao said, and the call for proposals renewed his interest.

"I had not done work in this area before . . . but I had always wanted to

"To get research going, it's not enough to have a good idea. It has to be the right time, the right place, and the right people." Professor Kao

work with water," he said. "I began to read."

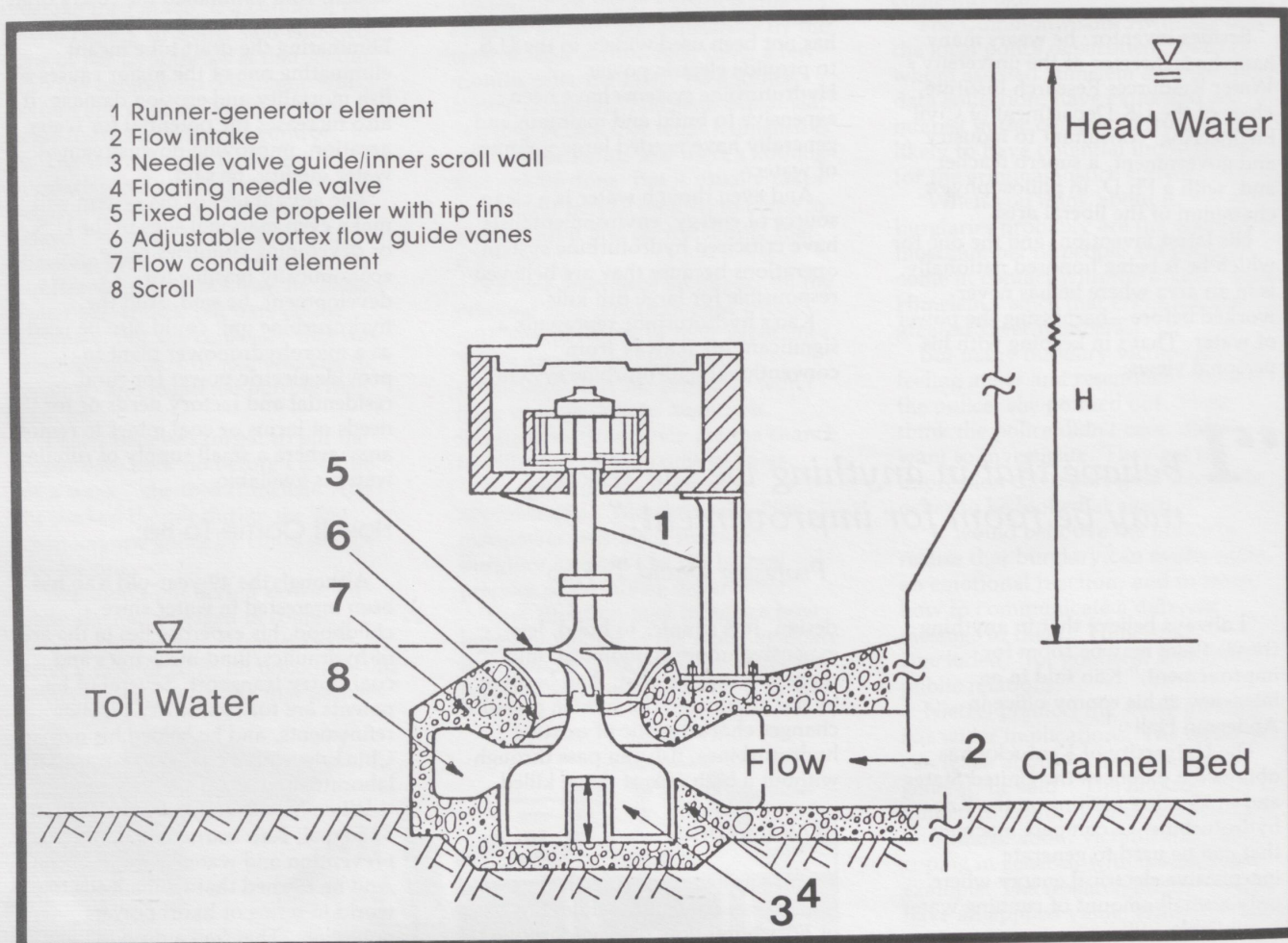
He read about hydropower for a year, going back to early 19th century research, before the pieces began to fit together in his mind. "It took any time I had. I did a lot of reading." But when he finally finished developing his proposal, he was too late to be eligible for a federal grant.

Kao acknowledged the irony of that

situation, saying, "To get research going, it's not enough to have a good idea. It has to be the right time, the right place, and the right people." But he didn't give up on the project.

"I had a small hand-made model,

continued on page 14



Kao's hydroturbine is a new concept in hydraulic turbine system design and represents a significant improvement in efficiency as well as in environmental and economic considerations.



David T. Kao

UK's Orient Express: An Inventor, Philosopher, & Realist

David Kao followed his engineering professor from North Carolina to Lexington nearly 20 years ago, and he says he's never thought of leaving the University of Kentucky.

"I love it," he says. "It has a lot of potential."

Kao has a strong sense of loyalty to the university, attributing that partly to his Chinese heritage.

"These things come naturally," he said. "The typical Oriental has developed a strong belonging to an institution."

Born in Shanghai on May 1, 1936, Kao was educated at the University of Taiwan before coming to the states and earning his Master's degree at Duke University.

He was working on his Ph.D. at Duke when his colleague and mentor, Don Wood, left to come to UK. Since Wood was directing Kao's dissertation and they were working together on a project, Kao came too.

The two were experimenting with a solid to liquid flow system under a National Science Foundation grant,

and when Kao got to Kentucky he immediately began designing and setting up a hydraulics laboratory. "They didn't have much equipment," he recalls.

He says it was an exciting time, a time when UK was expanding. Kao spent a year as instructor, then was made assistant professor. He is now a full professor. Wood's former student also is department chairman and the two have remained colleagues as well as very good friends, says Kao.

Kao came to UK at a time when the state's financial picture was relatively bright, but he is not one to complain about scarcity of money when times are tight.

"I'm a realist. I try to do the best with what we already have," he says. "I also believe deeply that if we don't have a good plan and a show of strength . . . and keep on asking for additional resources, it won't work."

"I like to work for additional resources. That's my philosophy."

On a recent trip to the Far East with Gov. Martha Layne Collins, Kao was

delighted to have time to talk with the governor about elementary and secondary education in Kentucky. He sees higher education as vital to the progress of the state, but is realist enough to know that the public must be convinced of its importance.

Kao draws an analogy between high school graduates and seedlings from a nursery.

"General education is the nutrition they need to grow into a tree," he says. "We have to provide our education in such a way that they go out (of the university) as a transplanted tree. They have to continue to grow and sustain a lot of storms."

He quotes a Chinese proverb that he learned in junior high school: "It takes 10 years to tree a tree; it takes 100 years to tree mankind."

"That's true. Education is a slow process," he said. "If we want to have good education in Kentucky, we had better start."

Making Waterpower continued

and I just didn't want to give up because it was so interesting," Kao said. He received encouragement from civil and mechanical engineering faculty and from federal energy officials and the Kentucky Energy Cabinet awarded him \$34,000 to help build a working model.

With assistance from a graduate student and the engineering machine shop, Kao built everything himself. He remembers hand-welding the turbine's copper runners in the basement of Anderson Hall at 3:00 a.m. "When they overheat they drop off on you," he said, shaking his head in memory of the frustration of that night.

The 1.5-foot by 1-foot plexiglass model can be broken down and fits in a magazine case.

Kao subsequently constructed a second, larger model in order to obtain data to improve the design. One of the key components of that model—the torque control device—is built from a \$150 used motorcycle disk brake.

"You're doing research and you can not buy everything. You just have to be able to think very broadly and design it yourself," Kao said. "That's fun too."

The 3-foot-across fiberglass and casted brass turbine sits in a concrete block and plexiglass test basin in the middle of Anderson Hall's first floor hydraulics teaching and research lab. The hydroturbine is connected to a concrete block water storage tank, rigged with seven light bulbs to vary the electric load. Kao said the hydroturbine system could be built any size, depending on the flow and depth of water.

He is in the process of designing a second generation hydroturbine runner that would improve on the first. "We need to convince the manufacturers," he said. "Industry doesn't go into this without solid data."

So far Kao has no industry backers, but he is not discouraged. "This is not like making coffee machine parts," he notes wryly. And he has had some encouraging responses. He said a representative of one engineering firm told him, "This is a hydropower engineer's dream come true."

But Kao sounds a little weary of having to promote his invention. "You get to the point where you can say 'to heck with it.' You don't have time (to promote it) and U.S. industry is so conservative. That's why we keep trying to improve it, to make it the best we can."

"If it's a potential source of clean energy, it's almost our responsibility to make it known to the public and to see it put to use," he said.

Applying Basic Research:

While he is interested in basic research, Kao also believes strongly that a researcher must try to find applications for his research.

As head of the Water Resources Research Institute for the last two years, Kao has been responsible for soliciting research proposals and handling the review and selection process. He took the job, because, as he put it, "Water will be one of the most important topics on the public's mind for the rest of the century."

"One can exist on half the energy we have today, but one cannot survive on half the water." Professor Kao

"One can exist on half the energy we have today, but one cannot survive on half the water," or without good quality water, he said.

Along with Institute responsibilities, teaching and committee assignments and research, Kao is also involved in a fund-raising effort with the Kentucky civil engineering community to endow a second chair in a new area of civil engineering, construction management. And in mid-October, just weeks after his return from China on another project, he was asked to join Gov. Martha Layne Collins' expedition to that country.

The "major time-eater" is doing what he refers to as "paper shuffling as chairman." Although it only leaves him "two afternoons a week for research, if I'm lucky," he sees the chairmanship as vital work and said he is fortunate to have the dean's support. Kao said that departments are the basic building blocks for the colleges and ultimately determine the quality of the university.

Engineering Dean Ray Bowen said he is pleased that Kao accepted the four-year chairmanship last year. "He gives me good advice," Bowen said. "He's the kind of person that if you didn't have his support, you'd worry that you were doing something wrong."

"If I had to isolate one quality (that led to his appointment of Kao as chairman), it would be his obvious concern for people—faculty, students and staff people," the dean said. "He relates to problems on a human basis. He doesn't shy away from talking to people about problems."

Wimberly Royster, dean of graduate studies, who, like Bowen, knows Kao in his role as administrator, said he is "a very creative, imaginative sort of person, innovative in terms of administration, and very well organized."

Former departmental chairman and colleague Vince Drnevich described Kao as "undoubtedly the most creative person I've ever met."

Despite his busy schedule, Kao is

known for his gracious manner and for taking time to help students with engineering problems.

He sees today's civil engineering as a "high tech" field in which no two products are alike. "You never see two identical bridges. Each has a different set of requirements. No roads are identical, and no two dams are constructed exactly the same way."

Civil engineers must be creative in their approach to problems, he said. Students in his department (as well as the College) must take 30 hours of liberal arts—probably the strictest liberal arts requirement of any professional degree program. The liberal arts courses are for the students' personal enrichment, he said. "A liberal arts education will teach them to think critically."

Kao said engineers must be trained to see individual projects in a larger context. Engineers should focus on "solving that problem with the perspective of fitting it to a whole system—not creating other problems."

Carriers of Death: Parasites Ravage One-Third of World

By Tawny R. Acker

The elderly British colonel adjusted his pith helmet and sipped his gin and tonic as he spoke to his companion a retired British officer who had chosen to stay in Nairobi. "I say, old chap, did you hear about the latest victim of malaria? Sometimes, I cannot understand why you have chosen to stay in such a hot, dusty place where a bite from a creature as damnably small as a mosquito can kill a fellow."

Bits of blood-soaked muslin were wrapped around the child's thin neck. The Moslem mother fidgeted with her veils, as the doctor examined the sores protruding from the side of the child's neck. "Ah," he said, "the child has been bitten by an infected insect"—perhaps a sandfly.

These scenarios are not true, but they represent the very real threat of disease and often death from the bites of insects carrying deadly parasites. The parasites are transmitted into the human blood stream through the insect stings or bites.

As a whole, over one half of the world's population is afflicted by diseases caused by some type of parasites, either worms or protozoan parasites. In the United States, worm parasites, such as hook worms or tape worms, are the most prevalent and the most easily treated. Elsewhere, protozoan parasites, such as malaria and leishmania parasites, continue to ravage the populations causing disease, disfigurement and death.

Malaria is the most commonly known disease caused by parasites initiated by insect bites. Contrary to the belief of most Americans, malaria still afflicts annually nearly one billion natives and travelers in third world countries.

A lesser known parasitic disease is leishmaniasis, caused by the

protozoan parasite leishmania. Leishmaniasis afflicts nearly 200 million people primarily in third world countries, such as South America, Africa, the Middle East and Eastern Asia.

The most deadly variety of the leishmania parasite is the leishmania

Over one half of the world's population is afflicted by diseases caused by some type of parasite.

donovoni parasite which lives in the stomach of its insect carrier the sand fly. When an infected sandfly bites a human, the parasites are injected into the human blood stream. Once inside the blood stream, the parasites, ironically, invade and thrive in the macrophages or disease fighting cells. Eventually, the macrophages burst and spew the parasites back into the blood stream. Then, when a sandfly bites an infected human, the cycle is complete.

The symptoms of leishmaniasis include canker sores, high fever, disfigurement and, in the case of leishmania donovani, death. Death often occurs from secondary infections, because the parasites have destroyed the macrophages or bacteria fighting cells.

continued on page 16



The research team assembled by Dr. Turco to study Leishmaniasis includes - from left to right - Rebecca Layton, Frankfort, Ky.; Marie Wilkerson, Chattanooga, Tennessee; Palmer Orlandi, Rosetto, Pennsylvania; Stephen Shephard, Russell Springs, Ky.; and, Diane Kine, Erlanger, Ky.

Carriers of Death continued

There is no existing vaccine or acceptable treatment available for the leishmani donovani parasite or any other protozoan parasite. The drugs available are non-specific and, while killing the parasites, they also destroy a variety of important human cells and produce many undesirable side effects. Designing drugs which are specifically targeted cannot be effectively done until more is known about the parasite.

Adding to the minimal information currently available on leishmania donovani is the research underway in the laboratory of Dr. Sam Turco, associate professor of biochemistry at the University of Kentucky. "We are studying the unusual cell surface of the leishmani donovani parasite, because the parasite is able to survive and multiply in two unlikely environments, the stomach of the

sandfly and the macrophages of humans—both highly hostile environments."

Turco explains, "We have identified an unusual substance that these parasites make. Our evidence suggests the substance may play a vital role in the lifecycle of the parasite. Our strategy is to first determine the chemical structure of this compound, which we have termed physophglycan. We now know that it is a complex carbohydrate with phosphate and a lipid component and is located on the surface of the parasite." This research was initially begun by Turco, D. R. Clawson, who was a U.K. medical student and is now in residency the University of Washington School of Medicine, and Marie Wilkerson, who was a laboratory technician and is now a second year student in UK's Pharm D. program.

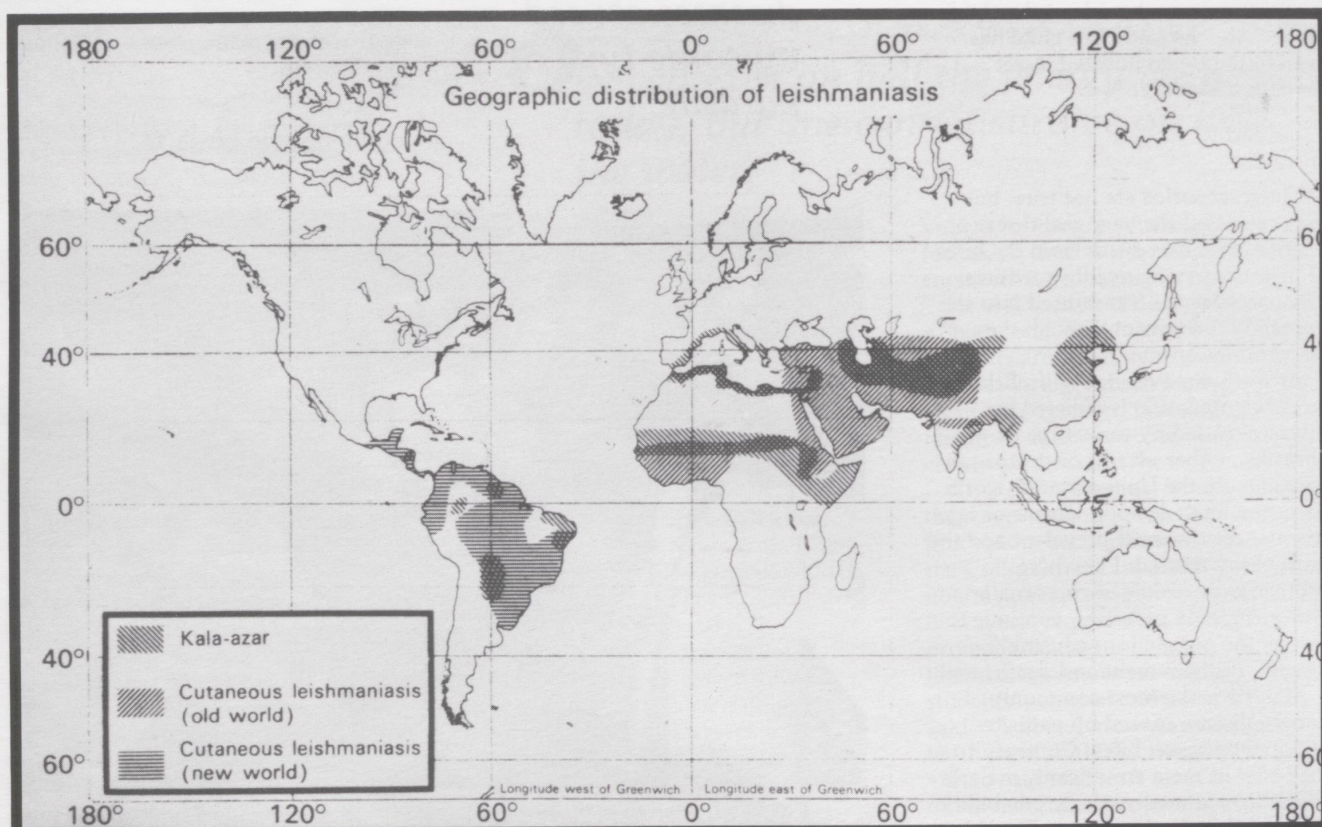
Currently, Turco is being assisted by Biochemistry graduate student

Palmer Orlandi, second year medical student Rebecca Layton, and lab technicians Diane King and Stephen Shephard. They are working on the complete structure of phosphoglycan and determining how it is made in the parasite.

Turco is also trying to determine the phosphoglycan's function in relationship to the parasite's ability to survive in hostile environments, like the disease fighting cells in humans.

"Once we know how the phosphoglycan is made, specific drugs can be designed to prevent the parasite from making it," Turco says. However, Turco points out that it will be years before enough is known to effectively design drugs targeted at stopping the synthesis of the phosphoglycan without harming human cells.

Turco's research is sponsored by grants from the World Health Organization and the National Institutes of Health and from a NIH Research Career Development Award.



The map shows the regions of the world afflicted by particular types of leishmania parasites. The Kala-azar region refers to the area afflicted by visceral leishmani which Dr. Turco is studying.

Disease and Priorities

Cancer, Aids—headline-grabbing-diseases that create fear and dread in American's minds and rightly so. The deadly diseases have too many unknowns and no sure, easy cures.

Malaria, Leishmaniasis—parasitic diseases that rarely appear in headlines and most Americans never consider as a health threat. However, they cause death and disfigurement to millions of people in third world countries.

Dr. Sam Turco, University of Kentucky associate professor of biochemistry, is keenly aware of the lack of concern and public awareness that surrounds parasitic diseases. His research for the last four years has centered around the parasitic disease, Leishmaniasis.

"I only really heard about or realized the large need for research in parasitic diseases in the past four years," Turco says. "So, it's not just the public, but the scientific community as well, that are for the most part unaware of parasitic diseases as a major world health problem."

But, indeed they are. The World Health Organization has listed parasitic diseases as five of the six most harmful diseases affecting mankind today—more than a billion people in tropical countries.

"Unfortunately," Turco says, "These diseases are accepted as a way of life in third world countries. And what little money is allocated to help with medications or research often never reaches its intended source because of the political structures of many of the countries." Also, he says, most of the developing countries involved do not have the money necessary to devote to research and planning needed to alleviate or control these diseases.

In fact, Turco says that by helping alleviate parasitic diseases, not only the populations health, but the country's economy would improve. For example, livestock used for food and which could be used as export commodities are affected by parasitic diseases.

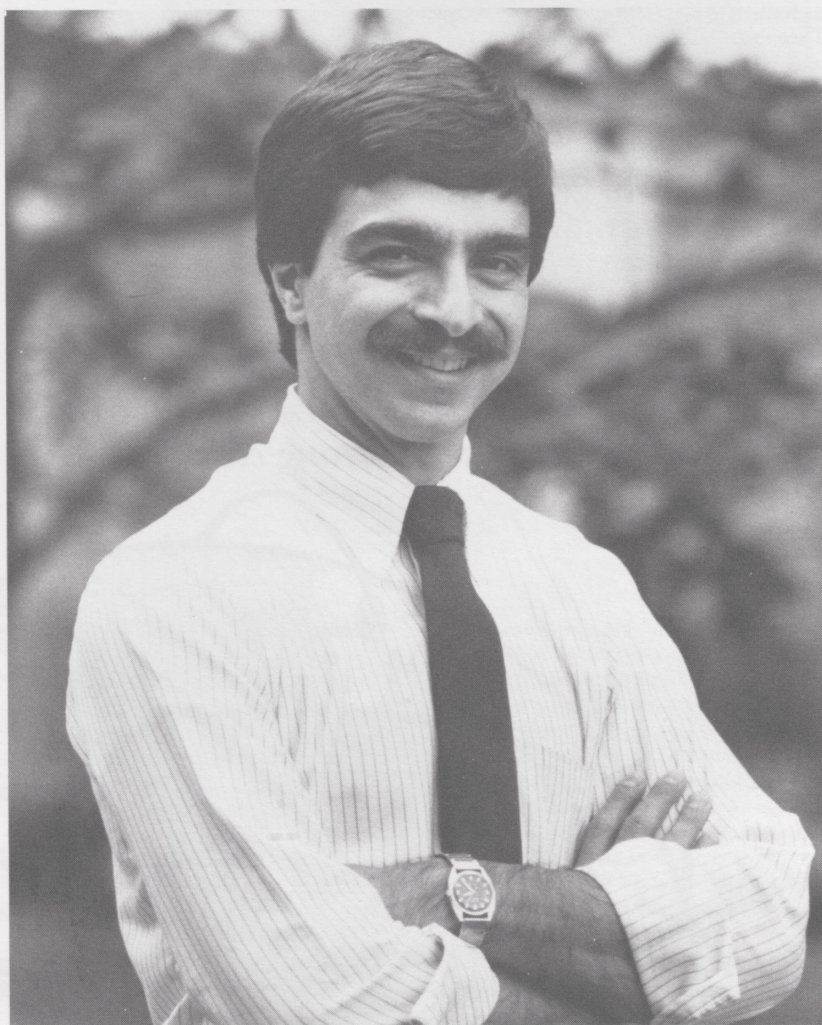
Indirectly, even projects designed at

improving life in these countries, such as man-made lakes and irrigation schemes often impede whatever efforts may be aimed at controlling parasitic diseases. The water projects alter the ecology of the area and often serve as new breeding grounds for insects carrying the parasites.

Turco sees little hope for improvement in the control or potential alleviation of parasitic diseases unless attention in terms of large sums of money becomes

available as an encouragement for researchers.

"Look at the money allocated for Aids research—Aids which only affects thousands of people," Turco says. "With all of this money available scientists are devoting a lot of time toward it and soon, hopefully, there will be a vaccine or maybe a cure. Then you have parasitic diseases, like Leishmaniasis, which affects many more people with relatively few federal funds targeted for research.



Sam Turco

International Genetic Data Enhance Chances for Survival in Organ Transplants

By Maria Braden

Large color photographs of snow-covered mountains are displayed in his bookcase and on his desk. Ask about them and Dr. John Thompson is apt to prop his long legs on a chair and reminisce about mountain climbing in the Himalayas, where he took one of the pictures.

Mountain climbing is a special love of the UK chairman of medicine, who travels around the world in pursuit of a challenging summit. But Thompson's international interests go well beyond conquering the next mountain.

For nearly 20 years he has been involved in an unusual international medical project which has produced significant results.

Working with scientists from around the world, Thompson has helped identify the pieces of a huge and complex jigsaw puzzle—a genetic system in man that is critical to organ transplants, sheds light on a variety of diseases and makes a strong case for evolution.

"It's an unusual level of international cooperation," Thompson observed during an interview at his

sixth floor office in the Albert B. Chandler Medical Center. "If I could do the work (by myself), which I can't, it would take a lifetime (to obtain the data)."

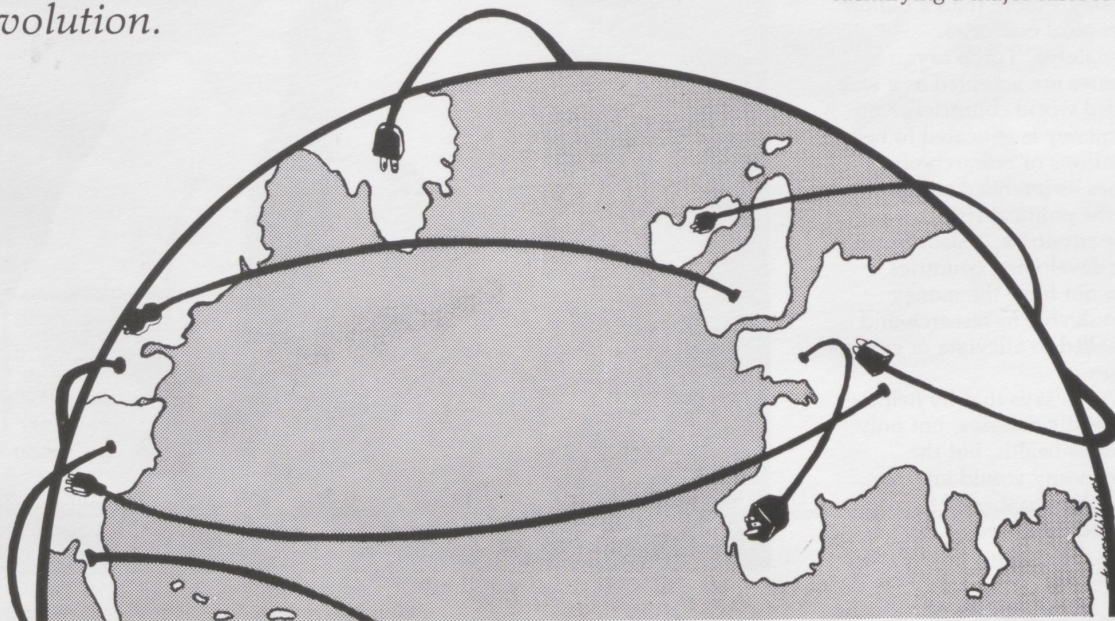
The project began 20 years ago when Nobel Prize winning scientist Jean Dausett and others organized the first of a series of international workshops to explore the genetic system in man.

Previously, scientists had identified a complex of antigens (substances that induce production of antibodies in the blood) in the mouse, called Histocompatibility-2 or H-2 locus. This group of antigens exerts the major effect on compatibility or incompatibility of transplants of virtually all tissues between unrelated mice.

In mice, as in all vertebrates capable of rejecting foreign grafts, a localized complex involving many genes had been found to exert major control over the immune reactions of each species.

As knowledge of H-2 progressed, Dausett and others began work on identifying a major histocompatibility

For nearly 20 years a group of scientists from around the world have been working together to identify the pieces of a huge and complex jigsaw puzzle—a genetic system in man that is critical to organ transplants, sheds light on a variety of diseases and makes a strong case for evolution.



complex in man, in other words, the genetic system responsible for controlling tissue behavior in man. The system has been termed the human leukocyte antigen or HLA system.

Thompson, who directs the Tissue Typing/Cell Marker laboratory at the medical center, became involved in the project in the late 1960's, when the workshops were still "wet." Scientists from several countries spent three or four days together testing blood serum and comparing tests and data, Thompson said.

After the second workshop, the format began to change. As interest in the conferences grew, scientists began exchanging various serums and cells prior to a conference. The lab in the city in which the conference is to be held serves as a clearinghouse, distributing materials to participating scientists.

The work on HLA began to crystallize at a conference held at UCLA in 1972, Thompson said.

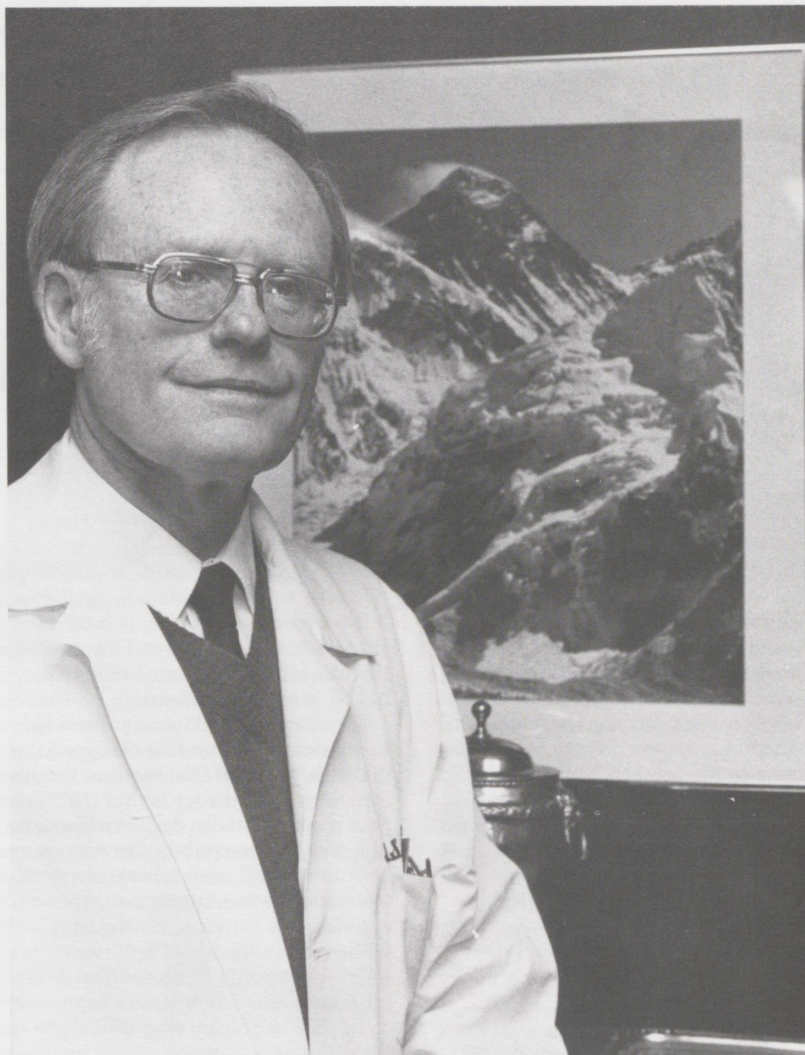
So far, at least three classes of distinct gene products (antigens) of the human MHC have been identified, Thompson said. They vary in chemical structure, functional interplay in the immune system, significance as barriers to transplantation and in their association with, and/or predilection for disease, he said.

"When it started, it was clear that no lab could do it by themselves," he said. "They (the scientists who founded the international workshops) were sufficiently mature that they could share and their own careers were not threatened by this cooperative exchange.

"Lots of scientists are so insular," Thompson continued. "They are afraid to talk to colleagues in their own institutions . . . this is just the reverse. I've profited by sharing everything I have ever been scientifically involved in."

In the 20 some years since its founding, the program has grown from a group of four labs to some 80 or 90, Thompson said.

"Players began coming in from all over the world," Thompson said. "Every European country of the Western block is represented," as well as Venezuela, Mexico, Japan, Taiwan, New Zealand, Australia, South Africa and Canada.



John Thompson

It is an unusual way for scientists to operate.

"This involved lots of cooperation and sharing, little sensitivity," Thompson said. "You have to agree to give up data for the greater good."

He said politics has kept Soviet-aligned nations from joining the endeavor.

When the serum comes to Lexington from labs in other countries, the UK lab tests it against cells obtained from normal individuals, the families of normal individuals and against individuals with a variety of diseases, Thompson said.

The results are sent back to a computer in the conference host city.

Does he miss the opportunity for glory that accompanies a significant scientific breakthrough?

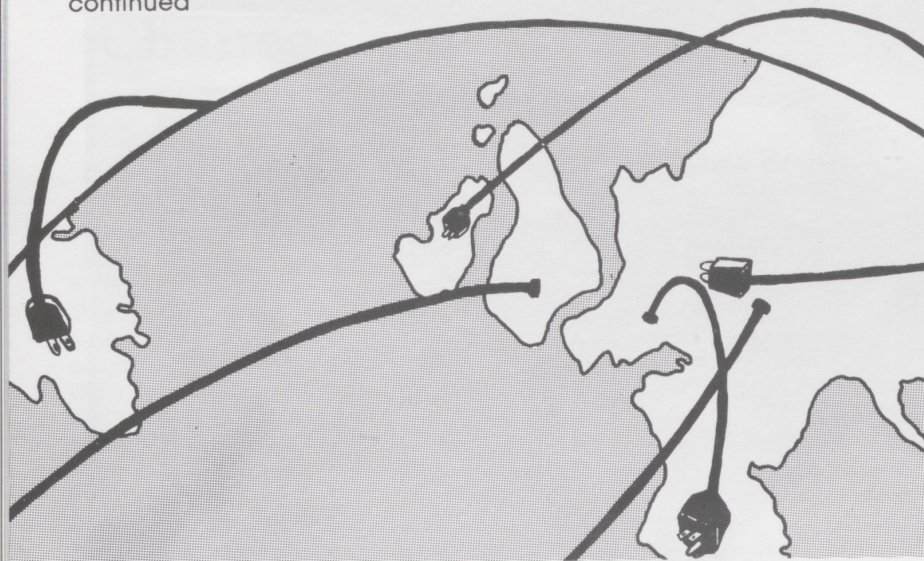
"That's not very important—not in this system," Thompson said. The trade-off is the opportunity to obtain what he calls "world class materials."

"We all get a chance to use this data base that we create," he said. "We can make judgements in this lab that other typing labs can't because they haven't participated. By contributing you get something."

For example, Thompson was able to use serum from the last international

continued on page 20

International Genetic Data
continued



workshop to help type transplant material for bone marrow and kidney transplant patients at UK this fall. Correct typing "makes a difference as to whether the transplant will work," he said.

Because the reagents in the serum obtained from other countries are unusual in this country, the data they provide helps fill in gaps in information. "This becomes very useful," Thompson said, "maybe not so much in Kentucky (because of the homogenous population) as in Los Angeles (where the population is more diverse).

"Bone marrow and kidney transplantation are largely ruled by compatibility of the HLA antigens between donor and patient," he said. "Knowledge of this has particularly

Thompson said scientists have studied many diseases and discovered that the HLA antigens are closely linked to their occurrence.

For example, their studies have led to greater understanding of Type I diabetes, the kind that requires insulin injections. The theory is that the pancreas is partially destroyed because of a genetic susceptibility to what may be routine viral (and other) infections which occurs in individuals with certain HLA antigens. By isolating white cells in the blood and testing them with specific reagents that detect HLA antigens, scientists are beginning to be able to predict who is likely to get diabetes.

Data obtained from the workshops has also shed light on the disease known as rheumatoid spondylitis, a

bacterial and viral diseases seem to be the trigger.

While there is no known cure for spondylitis, people can be told of their genetic disposition toward the disease during genetic counseling, he said.

In another area, scientists have identified an antigen, DR-2, associated with the disease narcolepsy and its companion, cataplexy. The former causes people to fall asleep unexpectedly and the latter to become paralyzed briefly when experiencing a strong emotion such as fear or anger or in the midst of laughing. Nobody knows why, Thompson said.

Endomorphins, associated with "runner's high" and considered a natural pain killer, may also be tied in with this same antigen system, Thompson said.

Another offshoot of the research seems more anthropological than medical: Thompson said that in breaking down the HLA antigens and looking at the amino acids, it is clear the "humans are virtually identical to large apes—and not all that far away from mice.

"That's a strong statement for evolution. We can trace the system from 50 million years ago."

And the international research has yet another spinoff: Thompson is working on the development of what are termed monoclonal antibodies. The idea is to identify different antigens important in transplantation and develop monoclonal antibodies against them as therapeutic agents to get rid of unwanted cells. Donor bone marrow could be treated to get rid of cells that would set up a disease in which the donor or grafted cells actually attract host, called graft versus host disease.

The antibodies may also be useful in cancer therapy. "They are marvelous tags to carry things to tumors," Thompson said. He is working on obtaining an identifying number—somewhat like a patent—from the the Federal Food and Drug Administration for one of these antibodies.

A splinter group from the original HLA workshops has begun meeting to further research in the production of monoclonal antibodies, with the third and next meeting scheduled in Oxford, England in 1986.

The next HLA workshop will be held in Finland in 1987.

"We can achieve an 85 percent kidney transplant survival rate. Six years ago, it was more likely 50 percent."

Professor John Thompson

helped cadaver kidney transplantation to unrelated patients.

"If you had kidney disease, you had a good chance of getting a good donor. We can achieve an 85 percent kidney transplant survival rate. Six years ago, it was more likely 50 percent."

condition seen most commonly in older men, which may eventually prevent them from standing erect. The disease, Thompson said, is associated nearly 100 percent with an HLA antigen called B-27. "If you don't have it (the antigen), you won't get (the disease)." Thompson said a variety of

When Do They Stop the Pain?

By Tawny R. Acker

Press the button. You will feel better. The pain will recede. You will remain alert, but pain-free. Now that's it. Just press the button when you need it, and the pain will go away.

If this sounds wonderful, then you are probably a candidate for a PCA—patient controlled analgesic machine. A candidate that is, if you are in the hospital and require pain medication. PCAs are a new alternative in providing pain medication as opposed to IMAs—inter muscular injections (shots).

For a variety of social, biochemical and physiological reasons, IMAs are not particularly efficient in providing adequate pain relief for patients, says Dr. John Wilson, associate professor in the Department of Behavioral Science in the College of Medicine at the University of Kentucky. The social factors include a reluctance of many patients to ask for pain medication and a tendency of many doctors to under-prescribe. Wilson says the unpleasant feelings surrounding the use of pain medication stem from the outdated notion that it is a sign of weakness to require pain medication and from a fear of doctors to contribute to potential patient addiction.

The biochemical reasons revolve around the absorption curve associated with pain medications,

especially morphine. The curve begins at one end with pain and continues to pain-free and then to sedated.

Just as the biological and psychological makeup of each patient differs, so does their need for pain medication.

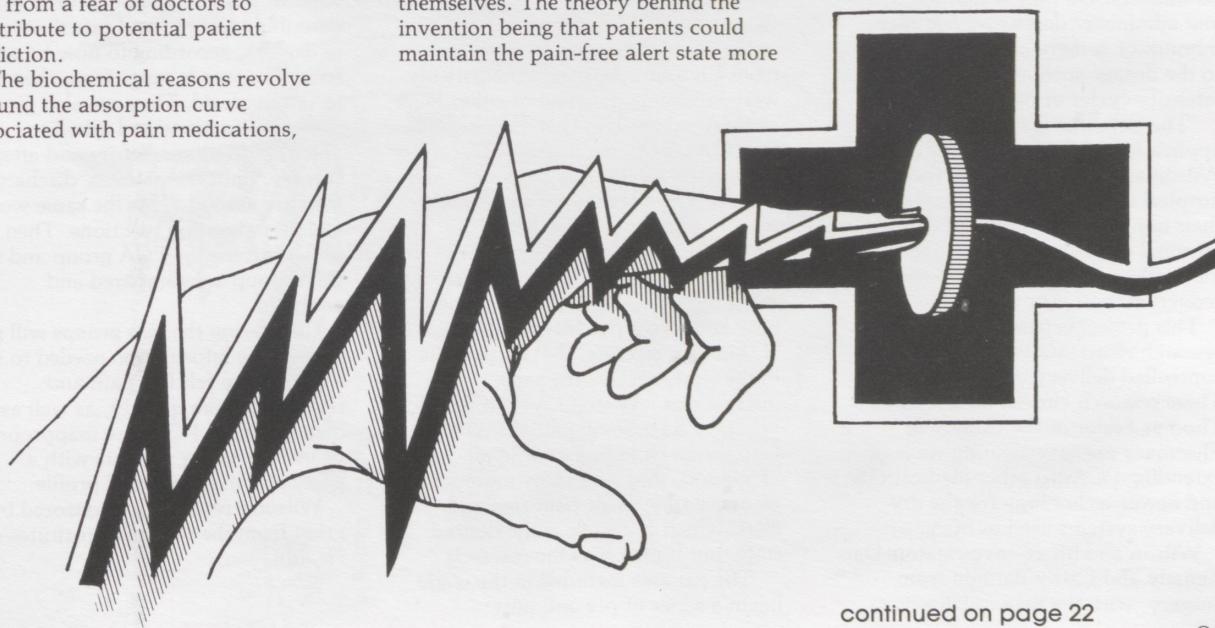
"Ideally, the patient should stay in a pain-free and awake state," Wilson says. "But, because the biological and psychological makeup of each patient varies, so does his or her need for pain medication. The enormous variation in patient needs makes it difficult to prescribe a uniform dose of pain medication. For some patients the uniform dose will over medicate; for others it will not provide adequate relief."

In an attempt to provide a more satisfactory way of providing pain relief for patients, some doctors in Great Britain and Canada developed the PCA, which, within certain boundaries, allows patients to administer pain medication to themselves. The theory behind the invention being that patients could maintain the pain-free alert state more

easily by monitoring pain themselves without involving the medical staff in a more complicated way.

As a psychologist, Wilson is particularly interested in how patients cope with pain and subsequently, how they use the machine. Using the PCA places patients in an active, rather than passive coping style. The psychological factors related to PCAs include altering the patients' feelings of control and anxiety. With PCAs, patients no longer have to ask an authority figure (doctor or nurse) for pain medication, and then, perhaps, for additional doses. The control of pain becomes a completely personal decision and action.

Wilson is also interested in the cues patients use with PCAs. For example,



continued on page 22



the patient knows that he or she can have a dose of the medication every six minutes. Do they watch the clock and administer doses every so many minutes or is there a particular pattern to the dosage such as time of day or intensity cycles of pain.

"The potential for clinical application of PCAs is tremendous," Wilson says. Not only does their in-hospital use provide advantages, but their use in the treatment of chronic or terminal diseases could provide a far more effective treatment of pain reduction than is now possible.

This project is part of a larger research effort studying patient-controlled delivery of medications. These research efforts, directed by Dr. Thomas Foster of the College of Pharmacy are investigating ways of extending PCAs to other medications and newer technology for the dry delivery systems used in PCA.

Wilson and his co-investigators Dan Kenady and Cathy Bannon from Surgery, with the help of UK's Tom

Foster and Dan Wermerling from Pharmacy, and John Haly from Behavioral Science, are testing the PCAs and IMAs for effectiveness. Using gallbladder surgery patients from UK's surgery clinic, the patients were randomly assigned to either PCA or IMA pain relief. Then those using the PCAs are given instructions on how to use the PCAs.

Noting that it may be a personal bias, but one based on clinical observation, Wilson says he thinks the instruction patients receive before using the PCA, has a lot to do with how effectively patients use the PCA. "I think it's essential that all patients in the study receive the same instructions," Wilson says. "If not, you may have some patients with a better understanding and, in all likelihood, they will show more recovery time spent pain-free and alert, which of course is the desired state, but it may bias the research."

The patients included in the study begin a series of pre and post

operative interviews, conducted by UK RN Cathy Bannon, which require them to listen to a list of words describing feelings and rate the words in degrees, according to how he or she feels. The words range from cheerful to sad to afraid. They are also given a series of situations and asked to describe reactions. Before and after surgery, until the patients' discharge, they are asked to rate the same words and give situation reactions. Then, answers from the PCA group and the IMA group are compared and analyzed.

Comparing the two groups will give Wilson the information needed to see which group felt less pain and recovered more quickly, as well as determining if PCAs are inappropriate or ineffective for patients with a particular psychological profile.

Wilson's research is sponsored by a grant from the National Institutes of Health.

The Futile Migration: A Third World Dilemma

By Laith N. Alkohoja

Everyday you cultivate the land. But the land is not your own. Each day and each year are the same. You work dawn til dusk. Most of your profits are paid to your landlord. The rest goes toward food, and other necessities. There is hope in the cities. A friend or relative owns a small business. Success stories of friends repeat in your mind as you work the fields. After harvest you head for the city. The cities are exploding.

One of the major problems of Third World countries is that of internal migration. Every day thousands of rural residents migrate into the very

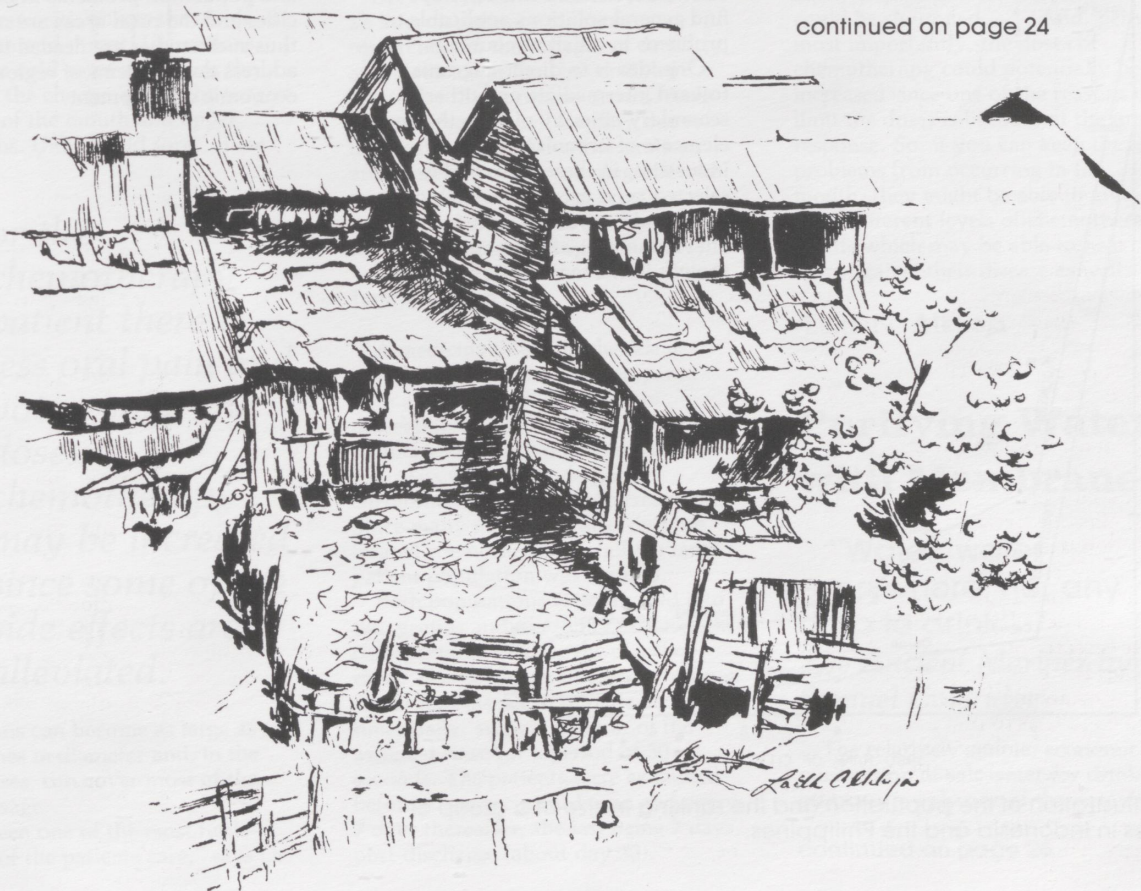
largest cities. These primate cities are growing so fast, due to rural immigrants coupled with a high birth rate, they simply cannot continue to absorb the vast number of migrants who arrive daily.

"The primate cities in Southeast Asia, such as Manila and Jakarta, are growing too fast," stated Dr. Richard Ulack, associate professor of geography at the University of Kentucky. "The cities just can't continue to handle the tremendous population increases." As the migration continues, the problems grow. Though some migrants arrive in

the city with jobs waiting, most do not. Jobs are difficult to find and so is housing. The majority of migrants take jobs in what is termed the informal sector, that is, often low-paying, unskilled jobs in marketing, such as selling goods or crafts on the streets. Some go back to the rural areas. Most remain in the city barely eking out a living. Their condition in the city is poor at best, hardly making enough to cover expenses. The rural employment conditions, however, are usually worse.

The main reasons for this tremendous migration to the large

continued on page 24



The Futile Migration continued

cities is the extremely poor condition of the rural areas coupled with the perceived employment opportunities in the cities. Most of the people are farmers who do not own the land they work. Money or crops pay the rent, but there is not enough to cover their debts. Also, as the natural population growth continues in these rural areas the amount of land available for farming diminishes. Life is one of little hope, with little to no chance for improvement. So, the people turn to the cities.

The cities continue to grow at rapid population growth rates, often over 5 percent annually, and the economic inequalities between the cities and rural areas continue to increase. Partly this is because the primate cities are like an outlet for the Third World. Exporting and importing, with the United States and other First World

countries, is conducted through the very largest port cities. They export goods from both the rural areas and the urban areas, but most of the imports and economic gains don't filter down to the rural areas, or "peripheries."

An important question then is what will take some of the pressure off the major cities and improve the economies of the rural areas? UK Geography Professors Richard Ulack and Thomas Leinbach, in collaboration with a group of Third World researchers are looking for answers in the intermediate-sized cities of these countries.

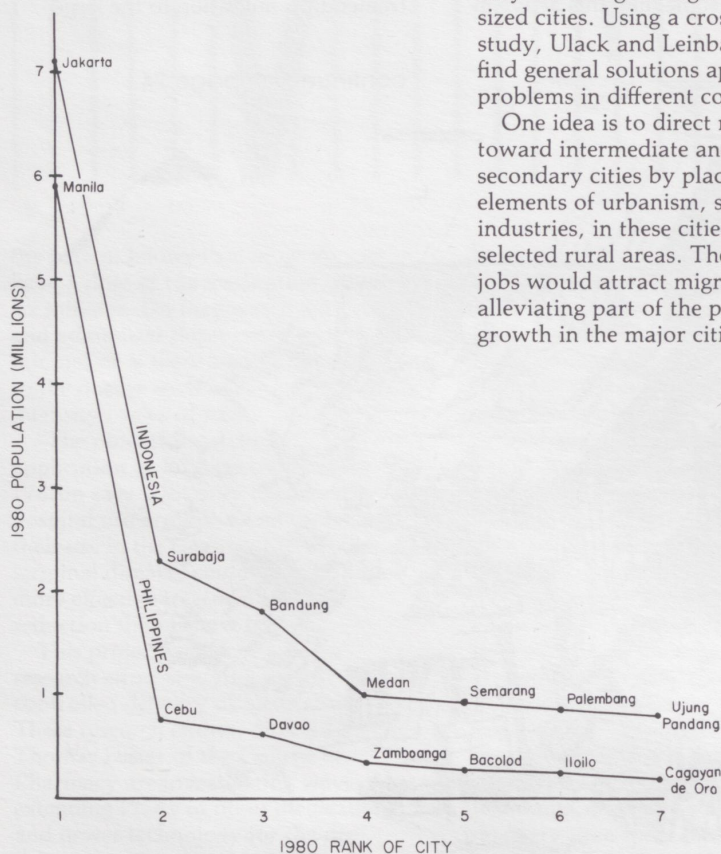
With a grant from the National Geographic Society, National Science Foundation (Sciences in Developing Countries Program), and the International Development Research Centre (Ottawa) three major study sites were chosen in Indonesia and the Philippines: Medan, Indonesia, and Cebu and Cagayan de Oro in the Philippines. They were chosen because they are fast-growing intermediate-sized cities. Using a cross-national study, Ulack and Leinbach hope to find general solutions applicable to problems in different countries.

One idea is to direct migrants toward intermediate and other secondary cities by placing the key elements of urbanism, such as industries, in these cities and in selected rural areas. The birth of new jobs would attract migrants, thus alleviating part of the population growth in the major cities. Also, it

would expand the area of economic concentration toward the rural areas. Circulators and commuters, migrants who work in the cities but live in the rural areas, would transfer the economy homeward.

The possibility of circulators and commuters, that is, temporary migrants, helping to distribute the economy more evenly is another idea being investigated. This circulatory migration has strong potential for economic benefits in rural areas and may help to alleviate conditions in the city. If this type of migratory behavior can be encouraged, for example, through government funding of transportation to make it more feasible, a greater amount of the money made in the cities may be taken back to the rural areas thereby lessening spatial inequalities.

The Ulack-Leinbach study was designed to examine the problems of migration and employment in the Third World, to fill a gap in the literature on the intermediate cities and the role they might play in the urbanization process. The economic and population problems in both the cities and the rural areas are many and thus such studies are needed to address the problems of regional economic development.



An illustration of the population and the ranking in size of a group of cities in Indonesia and the Philippines.

Research Briefs:

Reducing Complications for Chemotherapy Patients

Side effects from the use of chemotherapy and radiation treatment in patients with malignant diseases such as leukemia are extensive. The therapy lowers the immune system of the body resulting in a wide variety of physical side effects. Hair loss, diarrhea, nausea and vomiting usually result, but perhaps less known and far more devastating is a condition termed severe oral mucositis.

Oral mucositis affects the inside of the mouth and throat. Ulcerations similar to cold sores appear on the inside of the cheeks, under the tongue, the roof of the mouth and upper esophagus. Unlike cold sores, these

For the chemotherapy patient there is less oral pain and, potentially, the doses of chemotherapy may be increased since some of the side effects are alleviated.

ulcerations can become as large as four inches in diameter and, in the worst cases, can cover most of the oral passage.

"It's been one of the most futile aspects of the patients care," says Dr.

Ferretti, associate professor and director of UK's Pediatric Dental Service. Treating physicians and nursing staff are generally very frustrated by the reaction and the patients suffer from it. The mouth harbors one of the largest bacterial colonies on the body. Under normal circumstances these organisms cause no major problems. The chemo-radiotherapy patient, however, may develop thrush, a disease caused by candida (yeast) in the mouth. The thrush centers on the ulcerations and, compounded with the immunosuppressed condition of the body, the disease can enter into the lungs and blood and become a potentially life-threatening systemic infection.

Dr. Ferretti attributes the ideas to an interdisciplinary team of researchers in the colleges of dentistry and medicine at the University of Kentucky. Since mucositis is a result of an increase in cell fragility due to the treatment, and these ulcerations are at great risk of becoming infected by oral microorganisms, why not try to reduce this complication by use of a topical antimicrobial agent?

Test Design:

A medicinal, i.e. chlorhexidine mouthrinse regimen was compared with a non-medicinal rinse, i.e. placebo in two groups of individuals (adults and children) with malignant disorders who are undergoing chemotherapy or radiation treatments. Since many malignant disorders are treated chemotherapeutically, a large patient population was assured.

Both populations were divided into two groups and randomly assigned the chlorhexidine rinse or the placebo rinse. The nursing staff ensured proper use of the rinses by the patients three times daily, swishing 15 ml. of the assigned rinse for a period of 30 seconds. The patients were examined before the experiment began and every 7 days thereafter, the last being 7 days post-discharge (about day 30).

The results have been rewarding. Only a very small number of the experimental group developed mucositis, and of those that did, the amount of mucosal ulcerations decreased significantly throughout the use of the chlorhexidine. The onset of the ulcerations came a week or two later than normal, were far less severe, and healed much faster than in the control group. Almost everyone in the control group developed severe mucosal ulcerations.

"Essentially, the quality of life of the patient undergoing intensive chemo-radio therapy is increased . . .," says Dr. Ferretti. "There is less oral pain. They can eat better. They're not as at risk of oral infection causing a pneumonia or a septic response. Their hospital stay could be shortened . . . And, perhaps most importantly, the doses of chemotherapy could potentially be increased since one of the reasons they limit the doses is because of the mouth response. So, if you can keep the problems from occurring in the mouth, they might be able to give them different levels of chemotherapy agents which may be able to help them against their disease as well."

-Laith N. Alkhoa

Purifying Water with Membranes

"Water, water everywhere, nor any drop to drink"

The Ancient Mariner by Samuel Coleridge

The relatively simple, economical purification of salt water for drinking purposes is only one of the potential

continued on page 26

Purifying Water continued

uses of membranes, being researched by Dr. Dibkar Bhattacharyya, University of Kentucky professor of Chemical Engineering.

Membranes are porous polymers of thin skin which provide a service similar to that of filters in the separation of materials, but do it more efficiently and economically in terms of simultaneous removal of dissolved materials and particulates. Filters only can provide one separation of particulates. Membranes are used to remove dissolved salts and organics from water. Membranes, because of the unique qualities inherent in their construction, also allow a selectivity of separations within substances passing through their layers and are not sensitive to hot or cold.

Bhattacharyya has been involved with membrane development for about 15 years. During this time he has seen membranes develop from basic filtering devices to ones with micro-filters and molecule-filters. One of his projects involves programing a computer which will be able to recommend appropriate membranes for particular uses. For example if a pharmaceutical company wants to separate a certain substance from one of its drugs, then knowing the size of the molecules and the amount of pressure needed to pump the material through the membrane, the computer would suggest the type of membrane to use.

"Membranes are more economically feasible than distillation or evaporation," Bhattacharyya says. "They save energy because pressure by pump is cheaper than the energy needed to run distillation units and they allow for selective separations without changing the molecules in the original compound."

Membranes have found large uses in desalination of sea water, removal of hazardous organics from water, and in pharmaceutical separations. The University of Kentucky administration has identified nine research priority areas and among these "Centers of Excellence" to be enhanced and developed is the Multidisciplinary Research Center of Membrane Science.

-Tawny R. Acker



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Systolic hypertension in the elderly appears to be linked with cardiovascular diseases, strokes, in particular, as well as coronary heart disease, kidney disease, depression and functional disorders. Systolic refers to the blood pressure in the arteries of the heart during the time the heart contracts.

This suspected link between systolic hypertension and cardiovascular diseases is part of a nationwide study involving over 5,000 elderly participants. Kentucky is one of 17 participating states. Specifically the purpose of the study is to determine if anti-hypertensive drug therapy decreases the risk of stroke and other cardiovascular diseases in older people with systolic hypertension. Half the participants will be given a particular medication; the others will receive a placebo. Dr. Theodore Kotchen is coordinating the UK project which is sponsored by the National Institutes of Health.

Kotchen, chief of UK's Division of Endocrine and Metabolism is working with his spouse, Dr. Jane Kotchen, Dept. of Behavioral Sciences, and Drs. William Markesbery and David Wekstein of the Sanders-Brown Center on Aging. "The strength of the study is dependent on the interaction between the UK Dept. of Medicine and the Sanders-Brown Center on Aging," Kotchen says.

-Tawny R. Acker

Database Theory

Databases in computers organize the data stored in computer memory, says Dr. Wiktor Marek, University of Kentucky professor of Computer Science. Databases logically store the information put in computers for retrieval by the user. However, the theories behind what exactly constitutes a database and the relationship between the information within databases and other databases differs. Marek is examining the exact formulation of the theory of databases and the relationships involved as well as investigating practical ways of expanding information stored in databases.

The information stored in databases can be used to support expert systems. Expert systems form part of the growing volume of artificial intelligence. Artificial intelligence means that a computer has the capabilities of functioning, including reasoning like a human mind, but with fewer errors.

His research which requires the application of classical mathematical logic is an extension of work he started in his native country of Poland.

The research is sponsored by a grant from the National Science Foundation.

-Tawny R. Acker

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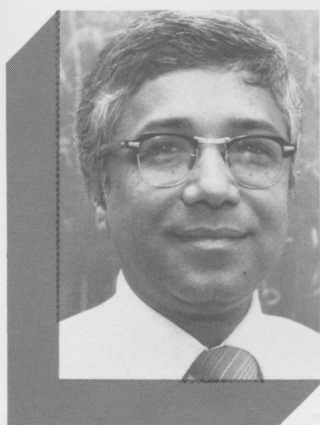
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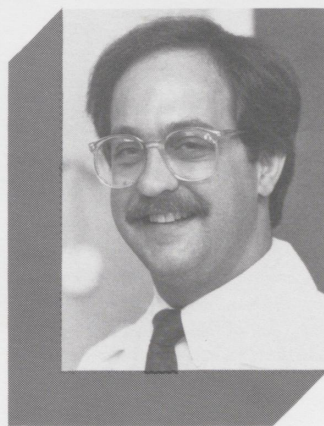
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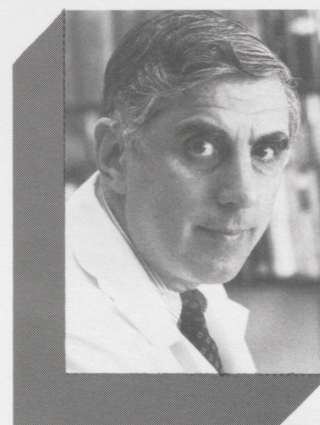


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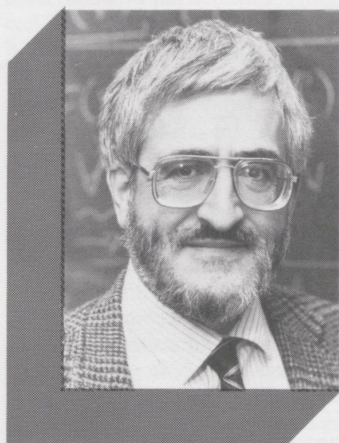
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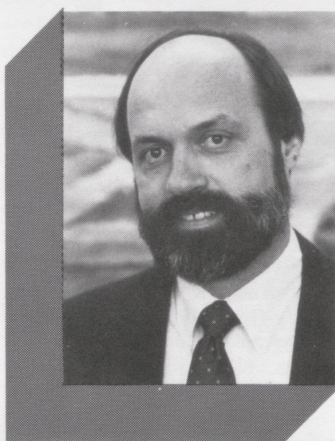
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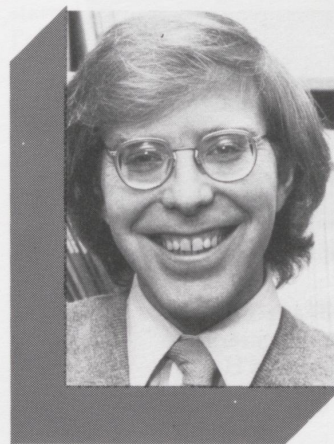
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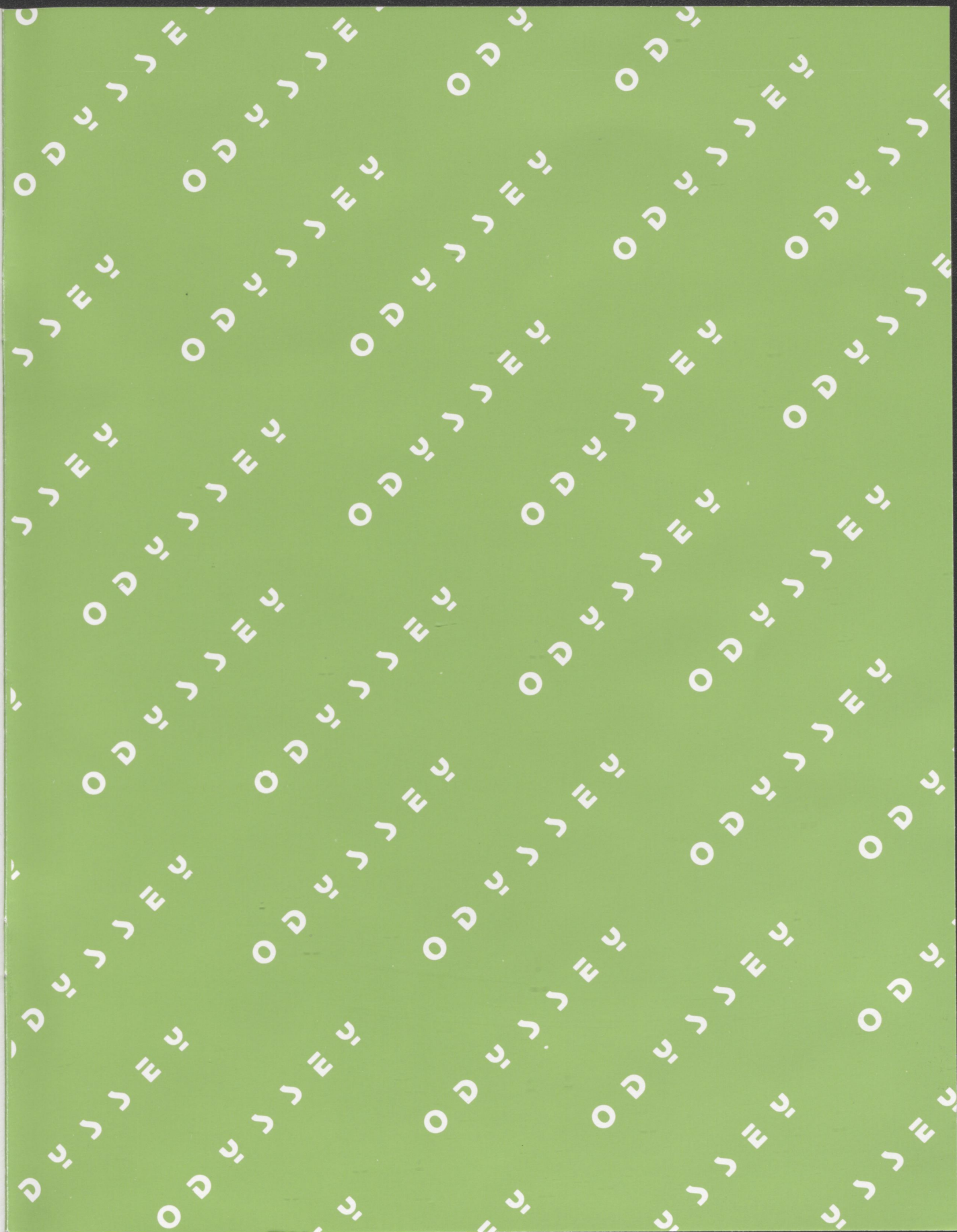
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- Violation by Burglary
- Making Waterpower More Feasible
- Carriers of Death: Parasites Ravage One-Third of World
- International Genetic Data Enhance Chances for Survival in Organ Transplants
- The Futile Migration: A Third World Dilemma

