

ODYSSEY

FALL

A MAGAZINE OF UNIVERSITY OF KENTUCKY RESEARCH

1986



CHANGING NATURE

UNIVERSITY, INDUSTRY, GOVERNMENT COLLABORATIONS

UNIVERSITY OF KENTUCKY

LEXINGTON, KENTUCKY 40506-0032

OFFICE OF THE PRESIDENT
ADMINISTRATION BUILDING

It is my pleasure to introduce this special issue of ODYSSEY, A Magazine of University of Kentucky Research. This edition highlights examples of the many and varied interactions between the University, industry, and government. I think you will find the articles it contains to be very interesting and informative.

The University of Kentucky is the state's comprehensive research university and is directly involved with the economic future of Kentucky. In large measure, the Commonwealth's future depends on the growth of its educational foundation and its technological base. Major factors in the state's achievement of this future growth are the educational and research programs of the University of Kentucky. In turn, the success of the University's programs is highly dependent on its relationships with industry and government.

With the help of and in collaboration with Kentucky state government, business and industry, and its many generous private supporters, the University is already putting into place the facilities and other resources which will be needed to assist in the economic development of the Commonwealth. Examples of steps being taken abound throughout this issue of ODYSSEY. Of particular significance are: the provision of over \$20 million of bonding authority by the state for the acquisition of major state-of-the-art research equipment; the state appropriation of \$5 million toward the purchase and installation of a supercomputer; and the authorization and funding for a new Agricultural Engineering building and a Robotics and Manufacturing Systems Program and facility. These initiatives, together with major private gifts such as those supporting the Maxwell H. Gluck Equine Research Center, the Lucille Parker Markey Cancer Center, and the Combs Cancer Research Building, will yield substantial dividends throughout the next decade and, indeed, into the next century.

I hope this special edition of ODYSSEY will stimulate further thought and inquiry into the ways the University of Kentucky may continue to serve the needs of the people of the Commonwealth, the region and the nation.

O. A. Singer

ODYSSEY

A MAGAZINE OF UNIVERSITY OF KENTUCKY RESEARCH

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Volume V, No. 1

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

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

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

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Printing Services

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Cover illustration by Shear & Shear; photos on pp.14-17 by Joel Beatty; all other photos by Ken Goad and Bill Wells

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CHANGING NATURE

University, Industry, Government Collaborations

By Susan H. Donohew

America's once overflowing reservoirs of basic discovery, on which technological development is based, are dangerously low—and corporate America and academe know it.

America is no longer the crowned winner in the technology race before the gun even sounds—instead we watch other countries and nations demonstrate the innovation and enterprise we have always claimed as uniquely ours. We are no longer competing with ourselves—the challenge now is coming from other nations throughout the world.

The key may be in changing the nature of the university-industry relationship. Universities have, until quite recently, concentrated on the basic research on which most technological development by industry has been based. Examples include the research that led to the invention of man-made polymers such as nylon, as well as many other commercially important developments in organic chemistry.

Universities were active, according to Dr. Theodore Brown, vice chancellor for research and dean of the graduate college at the University of Illinois at Urbana-Champaign, in both basic and applied research during World War II. Many of the spectacular advances in technology such as the development of synthetic rubber, the invention of radar, and the first sustained nuclear chain reaction occurred in university laboratories in federally sponsored research programs.

But somewhere along the way, university research and industrial research tended to go in different directions, primarily because the tremendous accumulation of knowledge has driven each into their own "corner." As explained by Art Gallaher, chancellor of the University of Kentucky Lexington Campus, "We have become inundated with information and information is different than knowledge. Technology has given us tremendous capabilities for generating and storing knowledge but we, i.e. society, have not been able to keep up with it and convert it into knowledge." For example, he explains, "the information gathered from the space program through experiments, photographs and other data collected will take years to sort through before scientists are able to determine what it all means."

This inundation has meant, among other things, that the U.S.'s technological leadership

suffered as technology transfer between the universities and industries became difficult and sporadic.

Concerns with our technological competitiveness as well as limited resources are causing universities and industries to once again look at ways to pool their resources and collaborate for individual and mutual benefit.

Universities perform over half of the basic research and development (R&D) conducted in the United States. Industries perform about 20 percent but nearly three-quarters of industry's efforts are directed towards development while universities contribute nearly 70 percent of their research efforts to basic research, according to the American Association for the Advancement of Science in a report entitled "Research and Development, FY 1986."

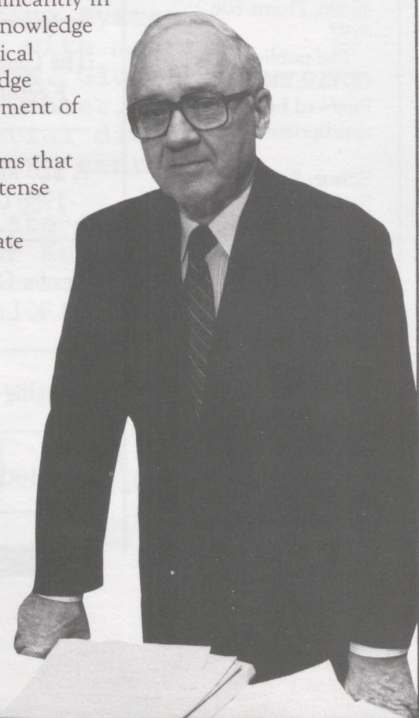
Universities have long assumed the role of primary contributor to and the major repository for new knowledge. Faculty contribute to expanding the knowledge base through basic research, to finding new ways to apply that knowledge and to transmitting that knowledge to students. Industries look to universities for staff support (both students and faculty), and for the basic research necessary for new and improved products.

The factor that has changed so significantly in recent years is the explosion of new knowledge and the incredible speed of technological innovations. How is this new knowledge synthesized, and applied to the betterment of society?

These are the questions and problems that have culminated in a renewed and intense interest in university and industry collaborations. Another partner is state

"The business of the university is creativity. Anything we do that minimizes or subtracts from that system is to do an inherent violence to the system."

Art Gallaher,
Chancellor, UK
Lexington Campus
Sector



"Mastery of the coming technological revolution will clean up much of the world's economic mess by creating new industries and new jobs."

Francois Mitterrand, President of France

government. As economic forces redirect our state's traditional emphasis from agriculture to increasing its technological capabilities, government leaders look to the university and industry for some of the answers.

The dollar amounts to be gained by the universities through increased industry support, as compared to other research support, are relatively minor. In 1982 only about four percent of the total research expenditures by universities were financed with funds from industry.

However, as explained by Mr. James Y. McDonald, executive director of the University of Kentucky Research Foundation, "Greater efforts to work with industry are desirable, not only from the standpoint of economic development, but also within the terms of our education and research missions. If we're working closer with industry we can better educate our students, who then stand a better chance of being employed. The education of our students should be related, at least in part, to the 'real world' and, in the area of research, collaboration with industry gives us a better understanding of technical problems faced by those outside of the university."

Collaborations:

Joint endeavors between industry and the university have been an integral part of the University of Kentucky for a number of years. The College of Agriculture, for example, has a long history of support from the chemical industry - Dow, Dupont, CIBA-Geigy, and Eli Lilly for weed, insect, and disease control in major crops as well as strong industrial liaisons in the areas of tobacco research and animal feed, nutrition and health care.

Research conducted by UK for industry extends from fundamental explorations in the laboratory to extensive product testing in the field, and from problems of world nutrition to the specifics of Kentucky's own thoroughbred

and other industries (See related article on p.38).

The Drug Product Evaluation Unit, a multidisciplinary effort housed in the College of Pharmacy, has worked closely with industry since 1971, and the Department of English has been conducting employee writing programs for various companies for several years. In the areas of mathematical sciences and engineering there are cooperative programs in which students alternate periods of instruction in the university with periods of work in a particular company. Upon graduation they are frequently employed on a permanent basis by the company.

Initiatives:

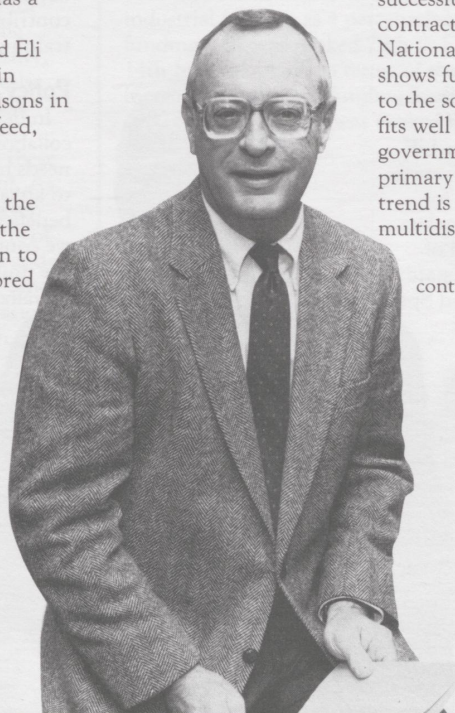
In the fall of 1983 UK President Dr. Otis Singletary appointed UK's Vice Chancellor for Research, Wimberly Royster, to head a committee to study university/industry/state government partnerships. It was the committee's charge to study the university's research relationships with industry, to develop plans for enhancing these relationships, and to recommend policies to guide future relationships.

Many of the ideas and initiatives highlighted in this issue of *ODYSSEY* are outgrowths of the committee's recommendations. For example, encouraging multidisciplinary collaborations was recommended as one method to attract industry interest.

Such collaborations also have been very successful in securing major federal grants and contracts. As explained by Gallaher, "A look at National Science Foundation funding patterns shows funding in the direction of research efforts to the solution of problems," an orientation that fits well with the university/industry/state government collaboration initiatives. One of the primary vehicles UK is using to address this trend is the development of centers of excellence, multidisciplinary arenas that represent faculty

"... in the area of research, collaboration with industry gives us a better understanding of technical problems faced by those outside of the university."

***James Y. McDonald,
Executive Director, UK
Research Foundation***



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strengths and cut across academic disciplines and administrative units.

As Gallaher explains, "Vice Chancellor Royster, Fred Zechman and Leonard K. Peters (associate deans for research for the medical center and Lexington campus, respectively) studied all aspects of research on campus and then identified expertise in areas that involve problems or solutions to problems, rather than 'disciplines'."

The College of Pharmacy has the highest proportion of industry funding among university units and one of the highest in the nation. This has evolved because most of the senior faculty in pharmacy have come from industry and thus have strong linkages there.

Another reason for strong support by industry of pharmacy is that most pharmaceutical companies do not have the extensive in-house research units to perform basic research and to seek, obtain and maintain Food & Drug Administration approvals. UK has recently developed a new model pharmaceutical manufacturing facility which can take a product through the testing necessary to acquire the approvals, even through human testing. This is a strong magnet for industry interest.

A stronger magnet, however, as pointed out by Peter P. Bosomworth, chancellor of the UK Medical Center, is the availability of medical, pharmacy and other faculty to conduct, review, and analyze the testing—capabilities not always available in-house to any but the largest of the pharmaceutical companies.

The university and state government have been partners in economic development for Kentucky for some years. Some of their efforts can be seen in the development of the new UK Center for Robotics and Manufacturing Systems (See related article on p. 30), the Institute for Mining and Minerals Research, the Kentucky Geological Survey, the Kentucky Council of Economic Advisors, the Kentucky Real Estate Center, and the National Aeronautics and Space Administration Technology Applications

"There is now a vague feeling among the American people that the present problems are not just another dip in the old merry-go-round that will go away, but they are new industrial, scientific, political problems that have changed the nature of work, trade and warfare."

James Reston, "New York Times"

"It is clear that we need to know how to do this better than higher education has done it in general."

Peter P. Bosomworth, Chancellor, UK Medical Center Sector

Program (NASA-TAP) - all programs which have strong industry connections and are in direct support of the state's efforts to expand its technological and economic base.

For Dr. Bosomworth, developing and facilitating multidisciplinary programs has been a major goal during his decade of heading the medical center, and he sees the centers of excellence as an ideal way to focus some of these initiatives. For example, the Center of Excellence in Biotechnology and Genetic Engineering involves over 60 faculty throughout the university who together attract federal funding in excess of \$6 million.

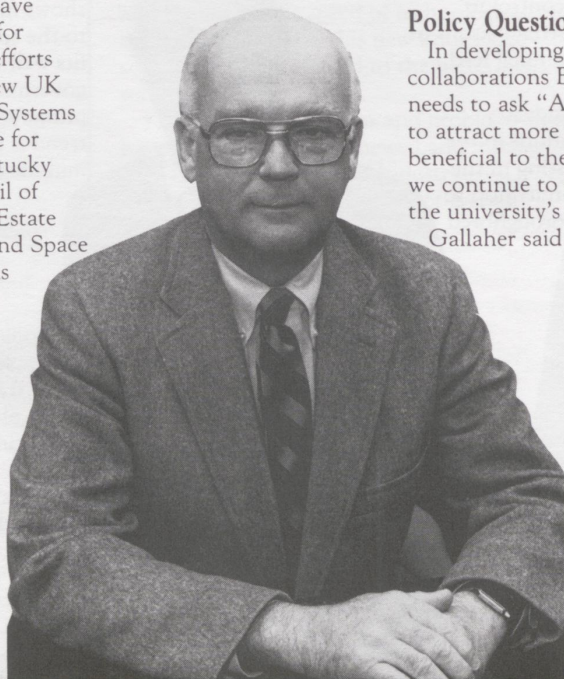
A large scale laboratory for processing biological materials is being developed for the center. Coupled with already existing facilities, this will allow the center to produce methods of diagnosing inherited genetic diseases such as sickle cell anemia and to create antibodies and hormones to treat other diseases like cancer or diabetes. Other researchers will work on ways of altering the genetic structure of tobacco plants, to change the levels of tar and nicotine or to develop entirely new ways of using the tobacco plant to produce valuable new products in the health and nutrition fields.

It is expected that biotechnology industries will directly employ 50,000 to 100,000 new workers in the next ten years. The Center of Excellence in Biotechnology and Genetic Engineering will be a key the commonwealth needs to compete for and contribute to this new area of scientific research, training, and economic growth.

Policy Questions

In developing policies to facilitate these collaborations Bosomworth said the university needs to ask "Are we developing these linkages to attract more money or are they truly beneficial to the university? It is important that we continue to justify these efforts in terms of the university's academic and service missions."

Gallaher said the heart of the issue for the



"As a nation, we are entering a period of intense economic and military competition. Research in our academic institutions has long been an American strength. Academia, industry, and the nation have much to gain if academic research can reinforce our industrial innovation system.

Dr. Edward E. David, Jr., former President of Exxon Research and Engineering Company.

university is: How do you engage in this process (which is one of serving society) without becoming subordinated to it? He suggests that "some would retreat to an almost monastic position and others would yield completely. There is really no answer yet to the right balance.

"The business of the university is creativity. Anything we do that minimizes or subtracts from that system is to do an inherent violence to the system," Gallaher said. Creativity for the university, as he explains, is "an agenda for new knowledge, new applications of existing knowledge, and the storage and delivering of knowledge. We must follow that mandate but remain sensitive to society. I see no conflict in that."

Dr. Royster said that one drawback is that some industries are concerned about the publication of research results and others with proprietary information. "Since a primary university objective is the development and transmission of knowledge in an open manner, such restrictions from industry could inhibit the university's traditional open pursuit of research in certain areas." For now, he said, "we try not to accept those types of agreements."

As Bosomworth has tried to facilitate multidisciplinary programs in the medical center, some changes in structure, policy and organization have been necessary. And, since the major successes in seeking outside support for research on grants and contracts have come when multidisciplinary teams are put together, departmental structures and chairs have to be willing to let their faculty participate in such teams.

Another policy issue arises when one of these endeavors becomes commercially successful. As Bosomworth points out, "It is difficult to keep clear the relationships and to avoid conflicts of interest. If university resources are utilized and it becomes a commercially successful activity, that has to be considered in determining the various interests. If it was, in part, funded through a federal grant or contract, using university resources—what rights and expectations does the inventor (e.g., faculty, staff or student), the university, and the user of the idea or product have?"

Presently, Chancellors Bosomworth and Gallaher and other university administrators are exploring the feasibility of an umbrella corporation in which individual entrepreneurial ventures could be housed within the university. Bosomworth said "It is clear that we need to know how to do this better than higher

education has done it in general. We need to encourage creativity while assuring institutional responsibility and accountability."

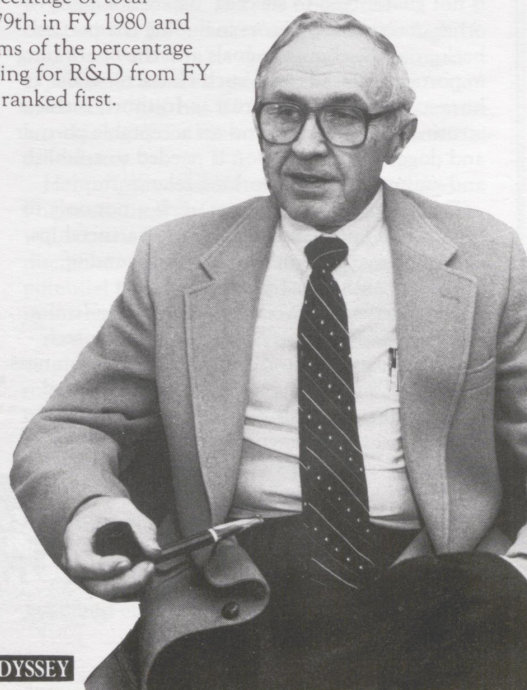
Future:

The University of Kentucky's future in encouraging and supporting technology and economic expansion are addressed throughout this issue of *ODYSSEY*. UK's efforts will be discussed as well as the reasons why so much energy is being directed to increasing university/industry/state government collaboration. In addition, some of the problems or policy questions that these initiatives invoke will be discussed.

The impact of these initiatives, both in the university and in the commonwealth, will be felt for years to come but their full import may not be determined for many more years. However, in assessing the university's determination to encourage and support industry collaboration, one of the strongest indicators may well be found in a recent study published by the Center for the Study of Science Policy at Pennsylvania State University and sponsored by the National Science Foundation.

In this study of the top 100 universities, determined on the basis of industrial R&D (research and development) expenditures for science and engineering, UK was ranked 80th in 1980 and climbed to 26th in 1984. In regard to industrial funding as a percentage of total funding, UK was ranked 79th in FY 1980 and 14th by 1984. And, in terms of the percentage increase in industrial funding for R&D from FY 1980 to FY 1984, UK was ranked first.

Wimberly Royster,
Vice Chancellor for Research and Dean of The Graduate School, heads the committee appointed to study the university's research relationships with industry, to develop plans for enhancing these relationships, and to recommend policies to guide future relationships.



CATCHING THE EYE OF INDUSTRY

by Tawny R. Acker

First you have to have something of quality to attract their attention.

Next, you've got to make sure they are aware of what you have to offer.

If the interest is mutual, you explore each other's interests and decide if a relationship is worthwhile.

With both parties interested, a mutual agreement of terms for conducting the relationship must be established to each's satisfaction.

But, even with careful attention to the wants and needs of both parties and the communication channels clear, the relationship is not guaranteed to succeed. There are many other determining factors including the parties' backgrounds, changing goals and the continuing importance placed upon such character traits as honesty, integrity, and trust. In short, ruthless scrutiny is required to find an acceptable partner and dogged determination is needed to establish and maintain a good working relationship.

This common sense advice applies not only to friends and lovers, but to business partnerships, corporate mergers and the growing trend of university and industry relationships.

The marriage between ivory tower academics and pragmatic industry is not exactly a match made in heaven, but under certain circumstances there's nothing wrong with a well-chaperoned relationship. After all, such a relationship is a contractual arrangement borne out of necessity and convenience for both parties. And

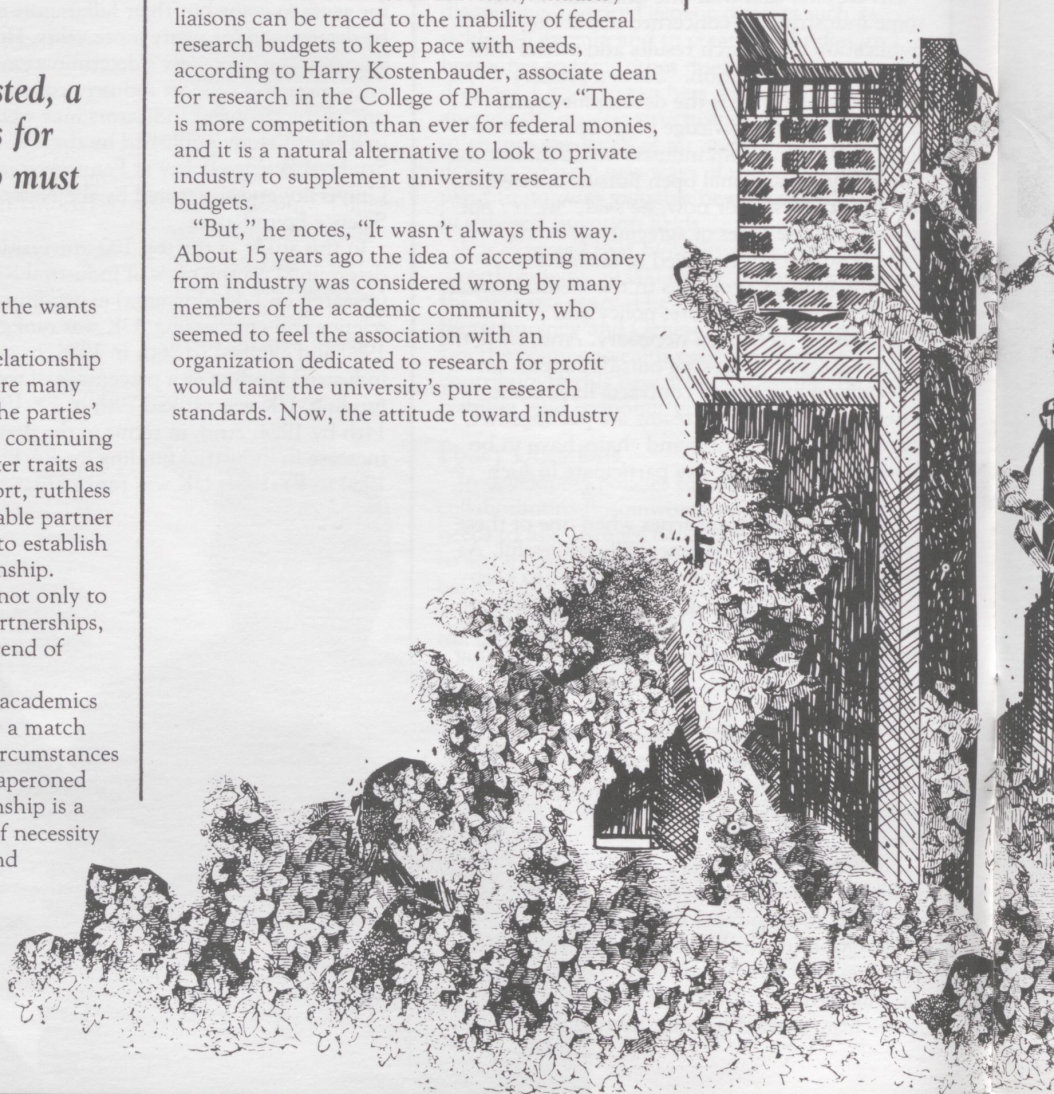
precautions are taken to ensure that each party's reputation will remain unsullied by the alliance.

The University of Kentucky's historical romance with industry began as early as 1887 for the College of Agriculture and as recently as six years ago for the Department of English.

Each relationship between a college or department of UK and an industry is unique in terms of specific arrangements, goals and sponsorship agreements, but all are strictly governed by UK's operating procedures. Such arrangements are often facilitated and administered by the UK Research Foundation.

The trend toward more university/industry liaisons can be traced to the inability of federal research budgets to keep pace with needs, according to Harry Kostenbauder, associate dean for research in the College of Pharmacy. "There is more competition than ever for federal monies, and it is a natural alternative to look to private industry to supplement university research budgets.

"But," he notes, "It wasn't always this way. About 15 years ago the idea of accepting money from industry was considered wrong by many members of the academic community, who seemed to feel the association with an organization dedicated to research for profit would taint the university's pure research standards. Now, the attitude toward industry





Harry Kostenbauder

and academia is vastly different, and everyone appears interested in the potential for funding."

University officials also recognize that funding from private industry provides more leeway in terms of how the research dollar is spent. Federal funds are granted and accepted on the basis of a strict budget and stringent administrative controls; private research funds are not usually provided under such restrictive conditions. Therefore, researchers have more freedom to pursue information or experiments which might arise from the initial research as long as the terms of the agreement are met. Also, graduate student salaries are often paid or supplemented by industry funding.

Pharmacy, medicine, agriculture and agronomy are areas with rather long and involved industry liaisons due in part to the nature of their academic research goals.

The College of Pharmacy became involved with industry-sponsored research in the early 1970's at a time when only a handful of universities were reaching for industry funding.

Pharmacy's bold venture into the uncharted regions of industry-sponsored research was engineered by the dean, Joseph Swintosky, who came from a pharmaceutical industry background and brought with him to UK several professors with industry ties. These faculty, under Dr. Swintosky's direction, approached industry with solutions to problems in the private sector's drug product testing. The professors were aware that industry did not have the internal means to test new drugs and that the hospitals and doctors being used by industry for testing did not have the time or the control to provide the accurate results needed for Federal Drug Administration's approval. UK, on the other hand, had the ability, the desire and the

controlled environment to provide accurate test results. Industry bought the idea, and it was the beginning of a long and profitable relationship resulting in the creation of the UK Drug Evaluation Unit.

Thomas Foster is the director of the unit which designs, conducts and evaluates investigational drugs and delivery systems. In the last decade, the unit has conducted approximately 200 industry-sponsored research projects. Although Dr. Foster said industry support is important, he cautions that a "university needs to maintain a balance between grants and highly competitive industrial contracts."

Dr. Kostenbauder agrees. "I would be concerned with an imbalance in favor of industry support, because, although it is valuable and provides a profit, it does not serve as a mark of excellence for our faculty to attain. Federally funded research requires peer review and sets a benchmark of achievement."

Current figures show that UK's College of Pharmacy research dollars are equally divided in terms of federal and private funding. The National Institutes of Health provided 35 percent, and 37 percent came from private pharmaceutical support. The remainder came from various private health organizations and other federal agencies.

Pharmacy, medicine, biology—the biotechnical fields—are a natural for industry support, Kostenbauder said. But, he noted, the competition for industry support is also high, and a university must demonstrate continued expertise in an area to attract industry's attention. "UK has a lot to offer in certain areas, but this expertise has to be known and accessible to industry."

Hence UK's establishment of a Center for Pharmaceutical Science and Technology which will act as a focal point for more multi-disciplinary research and thereby create the potential for attracting additional federal and industrial support.

Arthur Mlodozeniec, director of the center, emphasizes that the first goal of the center is not to attract industry support. The first goal is to improve the quality of science and scientific research.

"Industry support will help us pick up the slack in federal funding," Dr. Mlodozeniec said. "Working with industry also gives us

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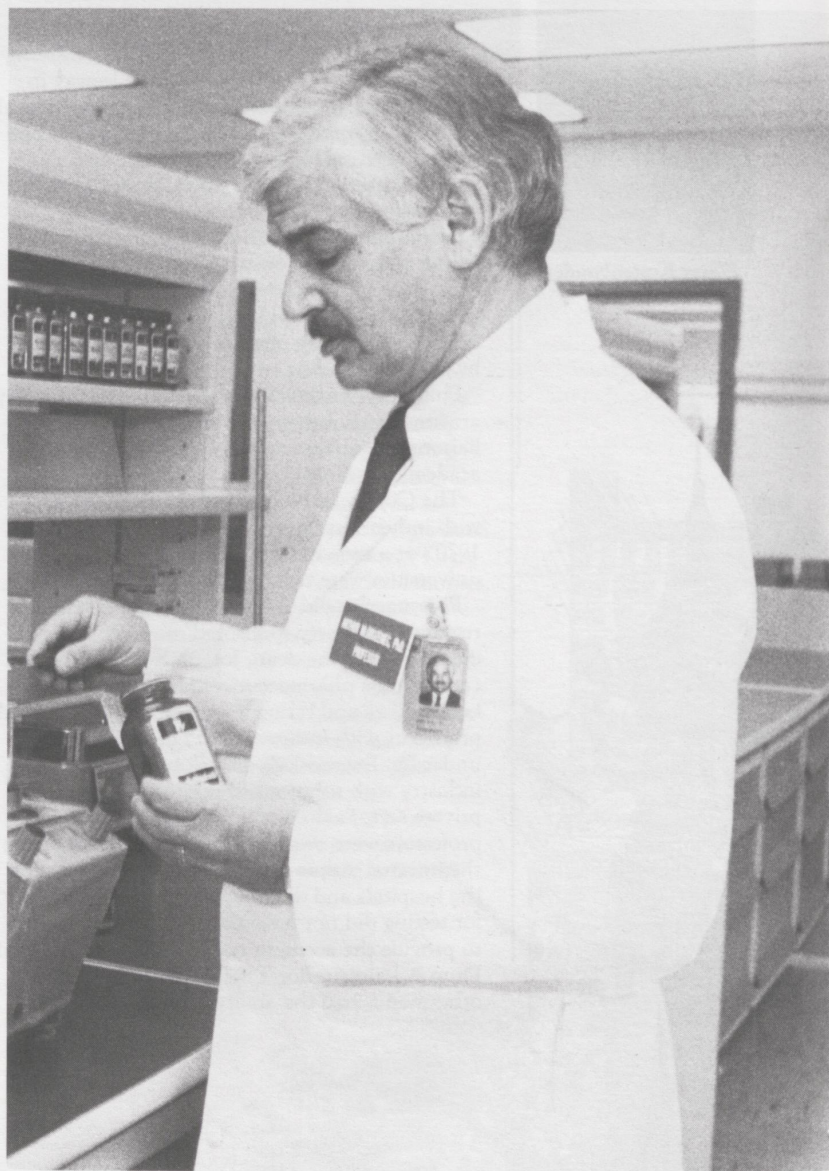
[researchers] the opportunity to form creative partnerships and do research we might not have the opportunity to pursue otherwise." Also, he explains that by attracting industry support and attention to UK, the commonwealth benefits as well. "If we can demonstrate our research potential, perhaps it will attract pharmaceutical industries to Kentucky which would be a more direct benefit to Kentuckians than the usual research and educational avenues. If you examine the potential in university-industry liaisons you find unlimited possibilities. However, private funding will never replace the importance of federal funding. Industry funding is a valuable resource we should use carefully."

Another UK bastion of industry support is the College of Agriculture. "We have a close working relationship with industry," explains Dr. Virgil Hays, chairman of the Department of Animal Sciences in the UK College of Agriculture. "The College of Agriculture is in a unique position to work with the livestock industry because our extension agents are out in the field assessing industry needs as well as individual needs which create industry needs. Many of the needs are mutual and include research, education, and promotion. In addition we relate to the scientist in industrial research groups such as pharmaceutical, chemical, animal health, the feed industry, etc. These groups take some of our basic research findings and assist in applying them to the animal industries."

The animal sciences department receives industry support from sources such as the Kentucky Beef Cattle Association, the Kentucky Pork Producers' Council and the Kentucky Dairy Association.

The agronomy department in the college has no formalized approach to attracting industry funding said its chairman, Jack Hiatt. "It is up to individual faculty researchers to establish contact with industry."

The department does, however, have a strong industry liaison. "We usually receive about \$400,000 per year in industry support and hence grants help supplement public funding. It is a mutually beneficial arrangement, because we



Arthur Mlodozieniec



Fred Zechman

provide the scientific knowledge they need."

Dr. Hiatt said that he expects his faculty members to have long range research goals and any research they do should be consistent and compatible with those goals.

Industry liaisons are not limited to the biotechnical sciences. For example, the English department offers writing programs for several industries, and gifts from industry have sponsored lecture series and visiting professorships.

In the College of Business and Economics, industry sponsorship funds several faculty positions which would otherwise not exist.

The James W. Martin School of Public Administration, an interdisciplinary unit within the UK Graduate School, offers a service to industry through its NASA Technology Applications Program. The service disseminates public administration-oriented information to state and local governments, individuals, and industries. Dr. Phil Roeder, director of the Martin School, estimates that about one-third of the work done through the technology program involves industry.

These are only a few examples of the ways university and industry can work together. And the union looks promising. Fred Zechman, associate dean for research for the UK Medical Center, sees the growing relationship between UK and industry as a positive step. "I think it is important to develop a pattern with industry supporting university research and its researchers," he said. "The additional support will play a major role in elevating UK to a premier research institution."

Dr. Zechman is also an advocate of caution in merging university and industry interests. "One of the issues facing the developing relationship between university and industry is the importance of preserving an appropriate separation in terms of academic values related to research and the needs of industry," he said. "UK should be focusing on the creative aspects of research and not competing with industrial components. If we merely turn out to be doing the sorts of thing that certain components of industry do, we would be putting ourselves in competition with industry and that is not a position we want to be in. Our commitment is to quality scientific research and education and we should use industry to help achieve those goals."

A FEW GOOD REASONS INDUSTRY COMES TO UK

by Lissa Atkins

Grabbing a glass of water, Mrs. Jones gulped down the aspirin. "I must remember to pick up Junior from the dentist," she thought while massaging her temples. "But first, the car needs to go to the mechanic."

Mrs. Jones may not know it, but throughout her hectic morning, the University of Kentucky will have made her way a little smoother. She hasn't attended a class in years yet the university affects her life daily—from developing procedures for testing the safety of her aspirin, to the restorations for Junior's teeth, to insuring that the mechanic can provide her with a smooth-running car.

That help comes because there is a vital community of UK faculty who take on more than their classroom and administrative duties. These faculty researchers—sometimes working alone, sometimes with colleagues or students—are sought by industry to develop new products and techniques which influence the lives of people throughout the world.

Such endeavors are at the heart of the university by adding to the knowledge base and then applying that new knowledge to the solution of some very difficult problems.

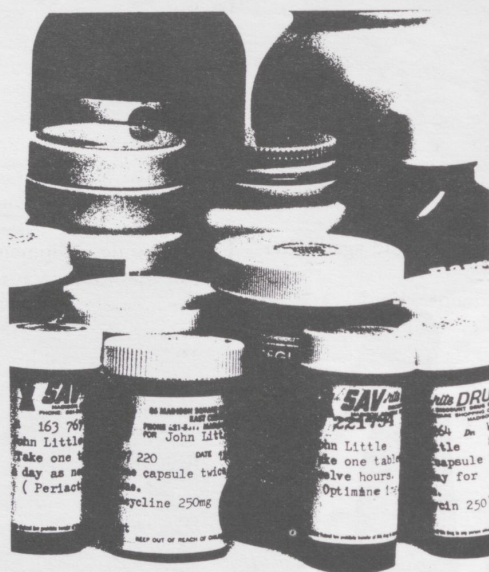
Making Miracles For Your Medicine Cabinet

You grope for the light switch as you tread across the cold tile floor—come to a stop, brace yourself on the sink—and try to focus on the small mirrored cabinet which reflects some disheveled soul rudely peering back at you. It's going to take a miracle to bring you to life this morning.

Open the cabinet door and you may well find a miracle. Aspirin, cold tablets, antihistamines, cough medicines - pills, capsules, liquids - available in all sizes, colors and shapes.

There may not be a vial labeled "Compliments of University of Kentucky Research" sitting among those bottles but chances are excellent that the research of a UK scientist has contributed to the final "miracle drug" on your bathroom shelf.

Before any of those products promising miracles are introduced to the public, extensive studies on humans are done and UK pharmaceutical scientists, Michael Jay, George



Digenis and others, are developing better methods for their testing.

About ten years ago, researchers had two choices for watching the movement of a tablet ingested by a patient: either stick a fiberoptic tube down the subject's throat or use x-ray pictures. These methods either altered the way the stomach reacts or the tablet itself. Furthermore, the x-rays could not provide continuous monitoring because of potentially high radiation doses. "Nobody really knew what happened because we couldn't watch in a noninvasive way," Dr. Jay explained.

To gain accurate information about pharmaceutical dosage forms, Dr. Digenis pioneered the use of gamma scintigraphy—recording images each minute. The method involves using a gamma camera and radioactive tablets.

Unlike repeated doses of radiation from the x-rays, the subject receives one small dose in the tablet (less than 10 percent of the dose allowed by the FDA). With the gamma camera sensitive to this energy, the researchers can create as many images as desired, approximately one per minute.

To make a tablet radioactive, the pharmaceutical company sends the drug to UK where scientists mix the isotope into the bulk formulation and punch out the tablets. Increasingly, though, the tablet is of an unusual formulation, has a special coating, or requires specialized equipment that only the company has.

Yet many drug companies do not want to deal with the radioactive isotopes because they require special handling and would contaminate equipment. The pharmaceutical scientists, unable to make the dosage form, could inject the isotope into the tablet but that would again alter its form.

Alan Parr, a graduate student who devoted most of his doctoral thesis to the project, along with Jay, decided to develop a stable isotope that could be mixed in the bulk formulation by a pharmaceutical company. Because it is not radioactive, the stable isotope doesn't contaminate equipment or require special safety standards.

The company then sends the tablet with the stable isotope in it to UK where it is irradiated with neutrons in a nuclear reactor for one to two minutes. The stable isotope is transformed into a radioactive one. Using blood samples and Digenis's gamma camera techniques, the bioavailability of a drug in relation to its position in the gastrointestinal tract can be determined.

"If you have a drug that works, that's only half the battle," explains Jay. "It has to be absorbed and go to the appropriate area of the body." Their analysis provides the pharmaceutical manufacturers with needed information. For example, the drug might dissolve too rapidly or not be stable enough in the stomach environment. The company would then modify the formulation accordingly.

Since publishing a paper in May of 1985, Jay and Digenis have 10 different neutron activation studies completed or underway. Costing approximately \$25,000 each, the studies are funded by different pharmaceutical companies. "They [Jay and Digenis] are the best people you can get in this field," according to Dr. Munir Hussain, research scientist at the DuPont Company. "There's nobody better."

A High Speed Spin

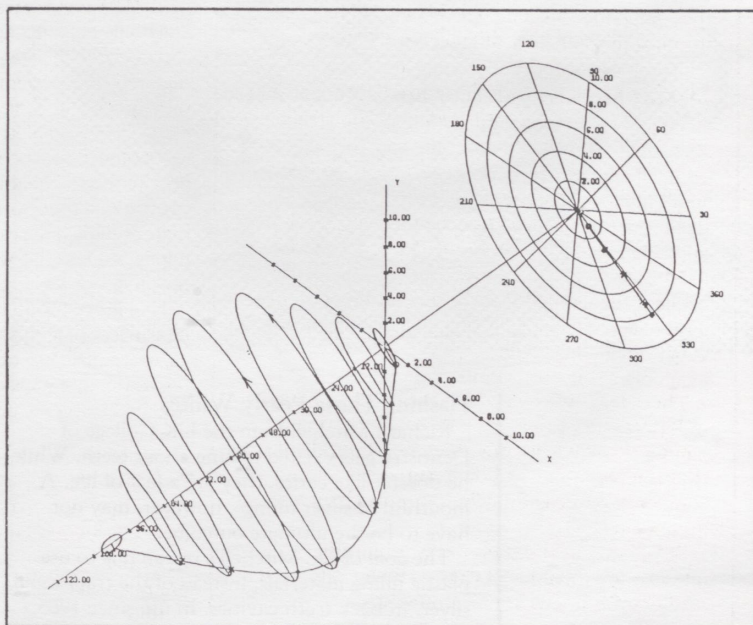
The faster something moves the more vibration it produces. Riding in an old car attempting 80 mph joltingly proves that point. For industries like automotive, aerospace and mining, smooth operation of high speed equipment is a necessity. Keith Rouch, from the College of Engineering, is helping such industries achieve this requirement.

New to UK (he has been here since the summer of 1985), Dr. Rouch has spent a lot of time in industry. Employed for 18 years by Allis-Chalmers—an agricultural, mining and processing equipment, and compressors and turbines manufacturer—he worked primarily in the area of stress analysis and design, vibrations and dynamics, and bearing design analysis. In 1972, he turned his attention to improving some rotor dynamics programs Allis-Chalmers had purchased.

"The programs didn't satisfy our needs," said Ron DeGroot, supervisor of product engineering

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Dynamic response of a high-speed compressor rotor plotted as a 3-D image (magnitude of response exaggerated for visualization).



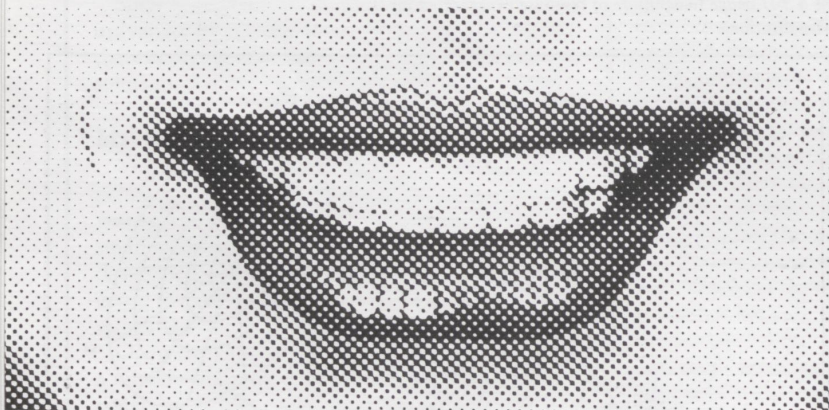
A FEW REASONS COMES

at A-C Compressor Corporation (a former subsidiary of Allis-Chalmers). "We asked him to use the finite element method to develop a faster means of computing this analysis."

With this technique, a machine is broken up into smaller elements to create a mathematical simulation of an action. "This finite element method was used only in the aerospace industry until about 10-15 years ago," said Rouch. "Today it is perhaps the most widely applied numerical technique for mechanical and civil engineering."

While other people have developed rotor analysis programs using the finite element technique, DeGroot says Rouch's work is the better method for their specialized equipment. "Everything he has given us to date has been very successful," says DeGroot.

Currently he is adapting his program to a microcomputer so that it can be run on a much smaller computer. As part of his work in the Experimental Program to Stimulate Competitive Research (EPSCoR)(see related article on p. 23), he will be making enhancements on the program too. Rouch is also continually updating his work for A-C Compressor Corporation.



Flashing Those Pearly Whites

Richard Mitchell from the UK College of Dentistry gets excited talking about teeth. While he doesn't like caries, they are a fact of life. A mouthful of silver fillings, however, may not have to be the ultimate outcome.

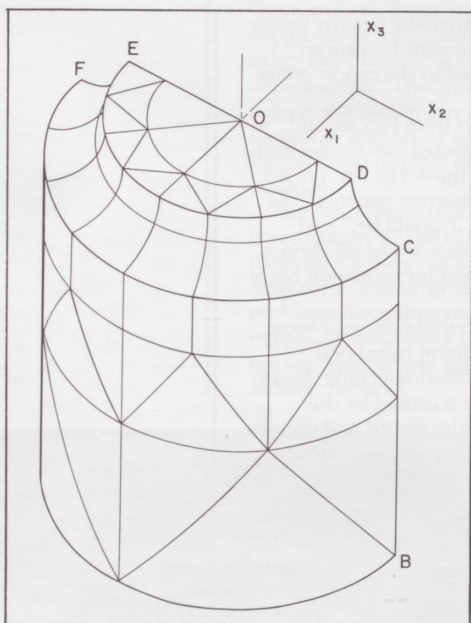
The goal of Dr. Mitchell's research is to use plastic filling materials, instead of the traditional silver, in back teeth cavities. In use since 1965, the glass and plastic composite resins are desirable because they take on a toothlike appearance. However, they are more fragile than

silver and are used usually only on front teeth fractures and cavities. While they wear well in the front teeth, the plastic fillings last only about five years in the back teeth compared to ten years for silver.

These plastic amalgams have other difficulties too. Silver acts like a putty which—once it is applied—hardens and seals itself along the edge of the tooth. This sealing is important to prevent pain and new caries from oral fluids seeping in between the tooth and cavity. Plastic fillings require a more complicated technique for proper sealing. "In theory, the plastic works, but when you start doing millions of them, then you have a much higher percentage of failure," Mitchell said.

Four years ago, Drs. Mitchell, Milt Skeeters, Harold R. Laswell and Jim Timmons started doing studies on a new generation of materials that are more wear resistant. They initially began with four different composite resins when a German manufacturer approached them with two more. The researchers have done about 200 restorations on patients who are called in each year for a chairside evaluation. The researchers look for wear patterns, new caries, discolorations, and ditching or gaps between the tooth and filling. Impressions of the teeth are made with a polymer originally developed for astronauts boots. These impressions are examined under an electron microscope for minute changes in the fillings.

Although the research is not one of a kind (10-12 current clinical studies of this type have been reported), Mitchell said they've developed a unique technique for getting finely detailed replicas. "In terms of high resolution, I don't think anybody has achieved what we've achieved." Skilled manipulation of the polymer permits them to see detail even under 6 to 7,000 times magnification. Best of all, they don't have to remove the fillings to see the detail. By leaving the fillings in place, the researchers can study the changes over a long period of time. Mitchell anticipates using this impression technique to also study the changes over time in crowns, bridges, and other dental amalgams.



Boundary elements used in BIE analysis of stress in a grooved bar.

Tiny Pieces

Imagine having a wonderful idea for a mechanical design but not having the capability to test it except by actually building it. A lot of time and expense would be wasted in correcting problems and modifying the idea. Prior to computers and mathematical analysis, however, engineers had no other choice.

Mathematical modeling by computer is a fundamental aspect of the mechanical design and manufacture of machinery in many industries such as aircraft, road and ship building, and automotive. At the heart of this process is a technique about 30 years old called the finite element method.

This method represents the three-dimensional solid as an assemblage of tiny pieces. While going throughout the volume, the computer keeps track of all the pieces, and for a simple problem this is effective. However, as the motion or behavior becomes more complicated, more tiny pieces are required which places greater demands on the computer. Frank Rizzo and David Shippy in the College of Engineering are among the pioneers in developing a more efficient method.

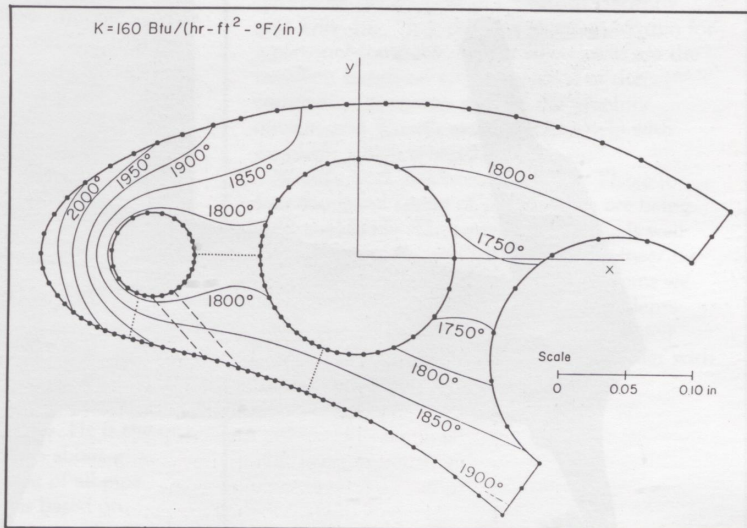
In 1967, they began collaborating on a program now called the Boundary Integral Equation Method (BIE). Their collaboration was

a continuation of Dr. Rizzo's Ph.D work in which he demonstrated that the method could be viably applied to the study of elasticity. "We began with an idea which turned out to have many important practical applications." Their method is to approximate a motion by looking only at the surface of the solid. Using equations different from the finite element method, they accomplish the same results as going throughout the volume. While the equations are more complicated, once they are written, the computer time and capacity and manpower time are greatly reduced.

For Caterpillar, Inc. Drs. Rizzo and Shippy's work is especially valuable. "A model that would take one month to six weeks with the finite element method will now take one week with the boundary element method," explained Bob McCutchen, division manager in a research department of Caterpillar, Inc. "With our modifications, the program is fast and simple enough that a designer can often use it without going to a specialized analyst."

The BIE method has certain limitations acknowledge the engineering mechanics professors, but it can address a large class of problems. Shippy cautions that failures may still occur although not because of the program but because "People have to put the right data in

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Temperature profiles in a turbine blade found through BIE analysis.

and make sensible interpretation of the results."

Presently, Rizzo and Shippy don't spend much time actually solving problems although they may occasionally modify an existing program for someone having difficulty. Instead they are continually developing bigger and better programs for new kinds of problems and have consulted in various capacities with GM, Ford, Caterpillar, GE, and Pratt Whitney Aircraft. "We think quite highly of Rizzo and Shippy," McCutchen said. "We run into their students in upper management positions around the world."

Pain Relief for Cancer Patients

Two different experiences, one at UK and one in industry led Gerald Ferretti to a new research project. Acting as a consultant for Procter and Gamble, he helped develop a mouthrinse for gingivitis. To be released in November, Peridex (trade name) is approved by the Food and Drug Administration for use by physicians and dentists. During this time, Dr. Ferretti was working at the Lucille Parker Markey Cancer Center and realized that the patients were having similar oral problems. Linking the experiences together, he decided to study the effects of the chlorhexidine rinse on cancer patients.

This mouthrinse is used extensively in Europe

for treating gingivitis in otherwise healthy people and those undergoing treatment for cancer. However, no studies related to the cancer group had been done.

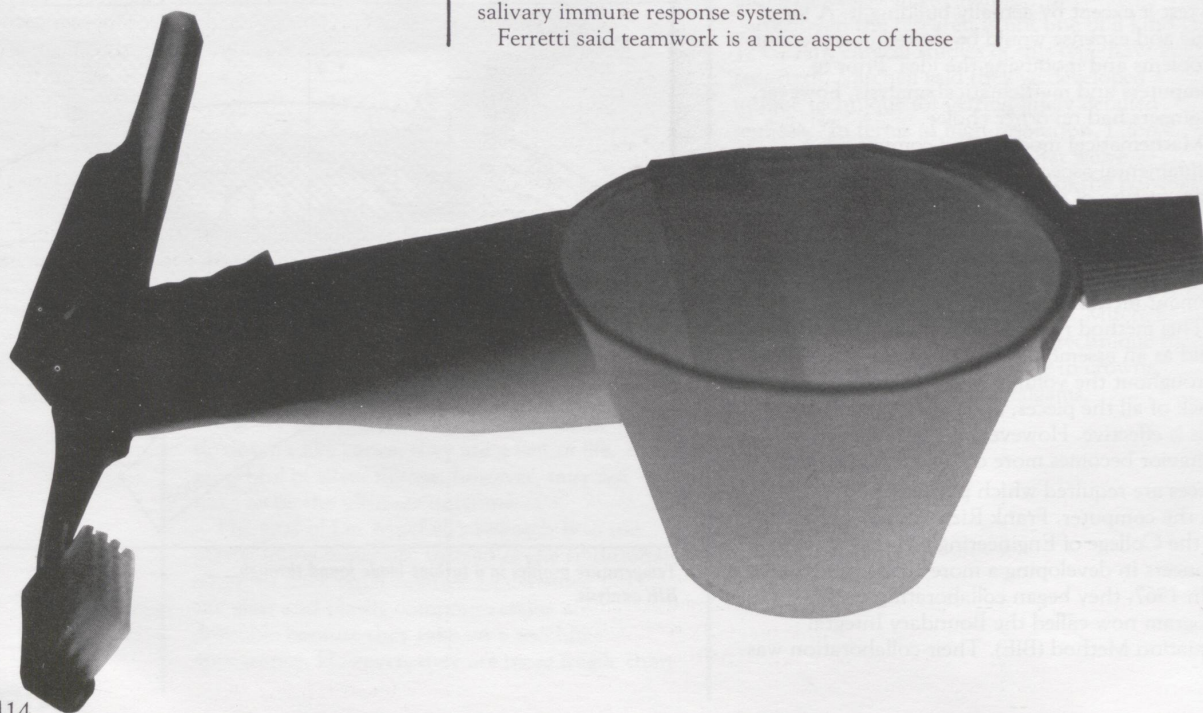
With continuing support from Procter and Gamble, Ferretti has conducted two studies and is currently working on a third. His first project began in 1984 with bone marrow patients. "We had no idea how effective it would be," said Ferretti, director of the Pediatric Dental Service. "It not only reduces the gum inflammation but it helps everything else."

For cancer patients everything else may mean large ulcerations in a condition called oral mucositis or a potentially life-threatening disease called thrush. This disease is caused by the candida (yeast) present in the mouth and centers on the ulcerations. The study also indicated that the amount of intravenous morphine given specifically for mouth pain was reduced. A confirmation study is presently going on at the University of Minnesota.

Ferretti's second study began in January of 1985 to test a broader spectrum of people. The results for the chemotherapy and radiation therapy patients were just as successful.

His present study, begun in June of 1986, focuses again on the most intensively treated cancer victims, the bone marrow patients. In this year-long project, he is monitoring the effects of the mouthrinse on certain oral bacteria and the salivary immune response system.

Ferretti said teamwork is a nice aspect of these



three projects. Eight researchers from six departments participated in the first study. The other two involved seven people from five departments. "This interdisciplinary approach reflects the philosophy of the Markey Cancer Center of supportive patient care," explained Ferretti, also director of the dental residency program.

The mouthrinse is presently under investigation by the FDA for use with cancer patients. Of the close to one million newly diagnosed cases of cancer, 200,000 will have oral problems, according to Ferretti. In addition to improving the quality of life for them, he sees a use for other people with oral complications such as heart patients.



A Pipe Line Hot Line

Don Wood in the College of Engineering gets five to ten calls a day from industry personnel and faculty from other universities. He is the one person who can answer questions about a software program that 50 percent of all pipe network modeling in the U.S. is based on. Developed by the civil engineering professor, the program is called Ky. Pipes or UK Pipe Analysis and models the pressure and flow of large pipe networks. "This is necessary to simulate what the system will do under certain circumstances," said

Dr. Wood. "It would determine if there is enough water for a four hour fire, for example."

Wood's work involved two stages: the development of the idea and the development and distribution of the computer program. While working on a joint appointment between the colleges of engineering and medicine, he was studying flow in capillaries. "This gave me the idea for a better method for modeling a network of pipes."

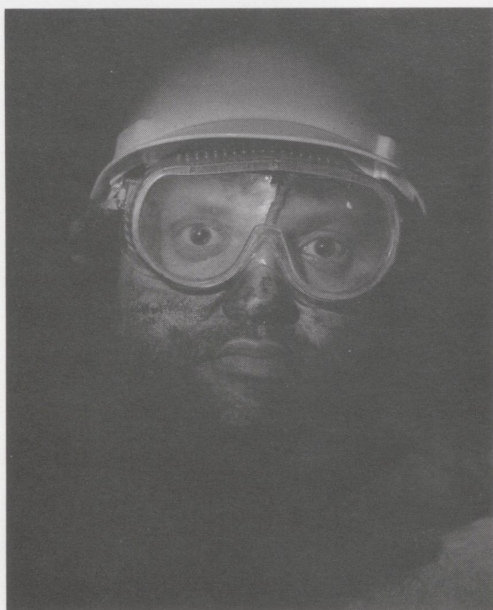
After the publication of his theory, Wood did not stop there. Seeing immediately practical applications, he developed a computer program for the technology and set up a civil engineering software center. Its primary function is to distribute the program to engineering firms and water utilities, although it has been purchased by oil companies and nuclear industries. In 1984, Wood's son Doug created a graphics package that gives visual display to the numbers.

Wood and former student Dr. Lindell E. Ormsbee travel around the country giving three-day courses about Ky. Pipes. Engineers also come to Lexington for instruction, and short courses are held by other universities.

For short course participant James Roth, the decision to purchase the program involved several reasons. "We try to use the most up-to-date programs and his more recent versions are particularly well-suited for our needs," said Mr. Roth, assistant manager of the hydraulic and hydrology department at Crawford, Murphy, and Tilly, Inc. "It is the best program written for a personal computer. Other advantages are the excellent hands-on seminars, some of the companion programs such as the graphics output, and Wood's availability to help with problems which is worth a lot to us."

Wood's work has been successful. Three to four thousand copies of the program are being used worldwide. The university's name is well known in conjunction with it. UK engineering students are benefiting too. "The problems we see and address are presented to the students too," Wood noted. "A number of them have been offered jobs because they were familiar with this technology."

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Hazard Busters

In one week, Arthur Frank and Ronald Ross may find themselves in a coal mine, a lawyer's office or in a computer room. The next week, they may be at an oil refinery, a prison, or laboratory. Part of a nine member Department of Preventive Medicine and Environmental Health team, they are called upon frequently by industry and private citizens for help. This flood of requests is especially large because UK operates the only occupational health program (a division of preventive health) in the state. UK is also only one of 20 places to offer a Ph.D program in this field and only one of 12 associated with a medical school.

The department is young, begun in August 1983 with Dr. Frank as chairman. The department's closest tie to industry is with Cyprus Minerals Company, the third largest coal producing company in Kentucky. Frank visits the approximately 1,000 employees in Middlesboro weekly. As part of a preventive medicine health service begun in 1983, screening for conditions such as dust and noise exposure and back strain is provided. The department works with the safety people to evaluate the mines for potential health hazards. Pre-employment and return-to-work exams are also part of the yearly renewable contract.

"We have no doubt in our minds that our employees have benefited," said Dr. Clarence Kluck, corporate medical director for Cyprus Minerals Company. "We've even found non-occupational problems that the employees were able to correct in early stages."

The other major industrial activity involves Dr. Ross's trips to the Kentucky Center for Energy Research Laboratory (KCERL) in Lexington. "As they develop new coal liquefaction techniques, we are trying to eliminate potential health hazards from the process," Frank explains. "Three years ago, the staff at KCERL recognized this was an important

component and came to us." In particular they are watching a class of cancer-causing components associated with any burning of carbon—such as cigarettes.

When not answering calls to evaluate asbestos in offices or worker's compensation cases, Frank and Ross operate an occupational medicine clinic. Companies will send an employee to the clinic to determine if a problem is work-related.

The department also has received corporate support from CIBA-Geigy, a pesticide company, which gave a gift for the study of green tobacco sickness. The Mobil Oil Foundation has also given funds for general support of the toxicology Ph.D program.

More Effective Pharmaceuticals

The College of Pharmacy associate dean, Patrick P. DeLuca, says the faculty in the college have been extremely successful in establishing good rapport with pharmaceutical companies. "On an individual basis, they have created academic-industry partnerships," DeLuca said. He should know about good rapport. DeLuca has attracted \$1.3 million in funding, the majority of it from industry, since he came to UK 16 years ago.

Prior to coming here, he spent 10 years in the pharmaceutical industry, working first as an analytical chemist and then as a research scientist. For a former employer, DeLuca even built a manufacturing plant for special products. By the time he arrived at UK to establish the pharmaceutical technology area, he was well regarded within the industry.

"Dr. DeLuca's knowledge of industrial processes stood him in good stead when he chaired the Subcommittee on Particulates during the eight years of the existence of the National Coordinating Committee on Large Volume Parenterals," said Dr. William M. Heller, executive director and secretary of the United States Pharmacopeial Convention, Inc. "He was a model of quiet persistence in making sure that the industry, the regulators, the standards-setters, and the professions and the public representatives were all heard and eventually reached consensus."

Dr. DeLuca's three broad areas of research are drug delivery systems, genetically engineered peptides and proteins, and pharmaceutical freeze drying. His work on drug delivery systems involve the use of microspheres to carry a drug to a specific site in the body.

The microsphere's behavior is altered based on size and surface modifications. With this technique, the medicine is localized in the tissue,

and thus minimizes the systemic levels of the drug. For toxic chemotherapeutic drugs, this ability is especially important. The spheres can be injected or inhaled, eliminating the surgery required for some drugs.

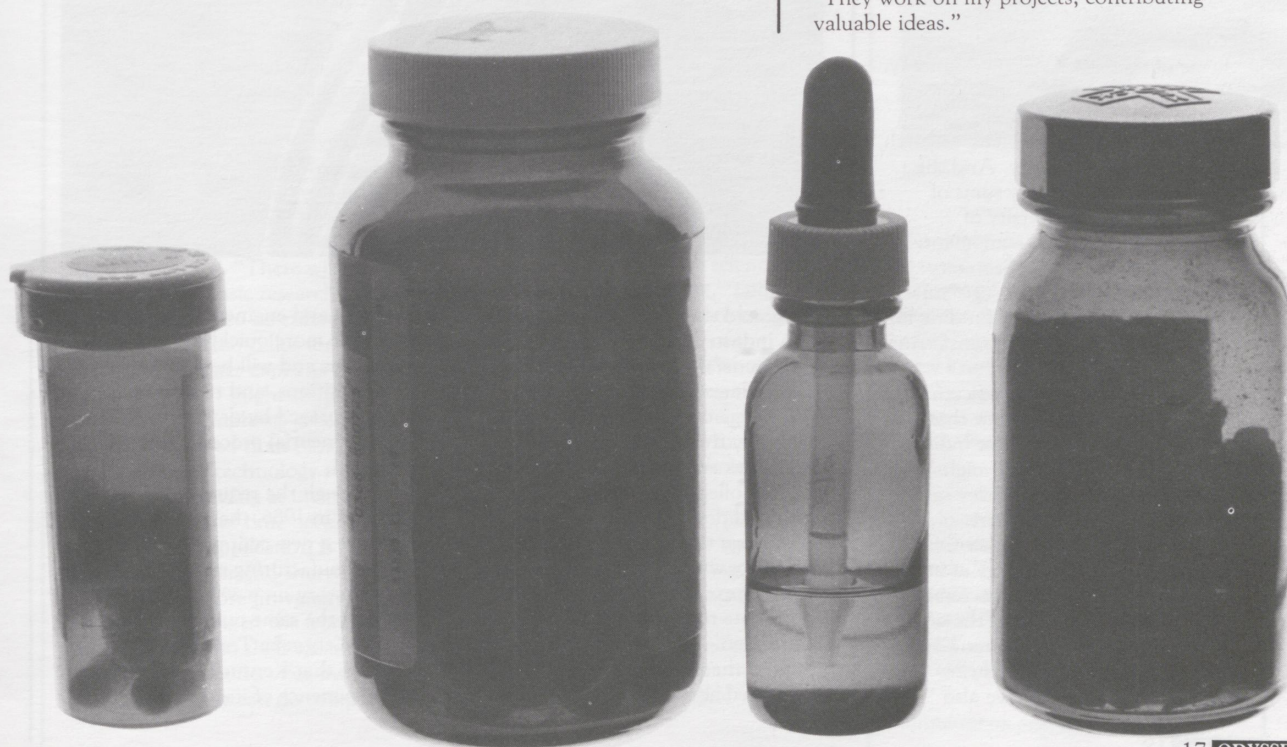
The current widespread interest in drug delivery systems means a lot of innovative work. DeLuca's unique contribution is the development of porous microspheres in which the matrix of the sphere doesn't have to break down for the drug to be released. He has two patents pending.

DeLuca's interest in formulated or genetically engineered peptides and proteins developed from a trend he sees. "In the future, I feel that most of our pharmaceuticals are going to be genetically engineered rather than organic compounds." Recognizing the lack of people who could formulate safe dosage forms for the more potent genetically engineered drugs, he made a decision in 1983 to begin this research. This past spring the College of Pharmacy and AMGen Biotechnology Company entered a yearly renewable formulation agreement. DeLuca is working with five proteins being developed for clinical investigation.

His work with freeze drying pharmaceuticals involves the Smith, Kline and French Pharmaceutical Corporation. Used for injected drugs, this process stabilizes liquids in a dry form. When physicians are ready to use them, they just add water. Working with the company since 1985, DeLuca has been looking at reducing the cycle time needed for freeze drying while increasing the number of compounds that can undergo this process.

"Dr. DeLuca is very well known in several pharmaceutical fields," explained Dr. Lee Gardella, director of pharmaceutical development and process improvement at the Smith Kline and French Laboratories. "We just didn't have the time to do certain projects but they were important to us and Dr. DeLuca has the expertise so we sent them to him."

DeLuca's research has been a team effort as faculty in the departments of pathology, biology, medical microbiology and immunology, surgery, and nuclear medicine have been or are involved. The multidisciplinary research includes work at the Lucille Parker Markey Cancer Center and the Institute for Mining and Minerals Research. "I also have a number of doctoral and postdoctoral people from abroad who come and spend a year or two with me," DeLuca said. "They work on my projects, contributing valuable ideas."



HARVESTING TECHNOLOGY

by Maria Braden

Reaping the Benefits of University Research in the Marketplace

A key to whether Kentucky prospers in the 21st century or merely survives may well lie in UK's research.

"Successful university research and development programs can play a critical role in Kentucky's future," says the ambitious Kentucky Tomorrow Commission's report, which suggests a blueprint for the future of the commonwealth.

"Kentucky must not continue to ignore this important resource. Many companies, including manufacturing industries and particularly those enterprises in the 'new economy,' have an insatiable need for cutting edge knowledge and information," the report says.

Research and its importance to economic development was also a theme of the 1986 General Assembly. There was much talk about technology transfer—the translation and application of university research to business and industry. And the legislature pumped hefty sums of money into the University of Kentucky for research equipment.

But State Commerce Secretary Carroll Kniceley said the legislature must do more in terms of funding for research, with the aim of transferring research into jobs.

"There's no data base indicating what research is lying fallow that might support what current industry is doing or industries that might locate in Kentucky," Kniceley said.

To that end the legislature authorized funding for a new Office of Business and Technology as an adjunct to the commerce secretary's office. Kniceley hopes that the office will establish a line of communication between university and industry.

In fact, UK officials have also



Carroll Kniceley

recognized the need for cooperation with industry, and proposed to the 1986 General Assembly the establishment of a \$8.75 million technology transfer facility to be shared by the colleges of business and economics and engineering.

Both colleges already have several units and programs involved in technology transfer, but the university wanted to designate this a center of excellence that would coordinate research, service and instruction.

"... the results of research conducted at the university in

business and engineering will be available more quickly to existing industries and will help strengthen their positions, and new business will be encouraged by developing the entrepreneurial process," said UK's proposal.

Although the request was not adopted in 1986, the legislature did approve a new center for robotics and manufacturing systems (see related story on p.30), which will serve some of the same purposes.

The Kentucky Tomorrow report suggests that Kentucky learn from the experience of its northern cousin,

Massachusetts, where the economic revival has been attributed in large part to that state's research and development efforts.

"... Measures must be taken to stimulate cooperation between businesses and our institutions of higher learning," the report maintains, "Universities are a necessary factor in the development of a strong economic base, particularly in devising innovations for new and existing industries."

"Research carried on within the university is a major source of new products and processes and may help solve some technological problems for new small firms that do not as yet have their own laboratories."

From the university's point of view, it's easier to persuade the legislature to fund research that can be shown to have practical applications.

"We know that research for itself is hard to finance at the state level," said Jim King, UK vice president for administration. "If we can take the results of research out into the field and apply it, then we can have some rather quick results and gain. Hopefully, that will generate more support from the General Assembly for all research."

Does that mean the university is moving away from basic research to an emphasis on applied research?

"I can't say there will be more emphasis on applied research," Mr. King responded. "There will be better facilities. Our basic research capability will also be enhanced."

UK's Vice Chancellor for Research Wimberly Royster explains that one of the reasons it might seem as though more emphasis is being placed on applied than basic research has to do with technology transfer. "What is happening at universities is that the length of time between discovery and application is becoming shorter and shorter."

"There are more university scientists working at the frontier of their fields and so their ideas are applied much sooner. For instance, now a researcher can do computer

modeling rather than testing out thousands of cases—the effect is that we are able to solve problems we couldn't before because of the magnitude of the computations. The sophisticated equipment available to researchers permits them to perform procedures hardly imaginable even a decade ago. Today we can bring research problems to a solution much faster because of these advances in computational sciences and instrumentation.

"Basic research is, however, what drives applied research and consequently we have no intention of relinquishing interest in our basic research mission," Dr. Royster said.

Leonard K. Peters, associate dean for research for the Lexington campus, doesn't view an emphasis on applied research as a dangerous thing. "It's not a threat to pure research," he said.

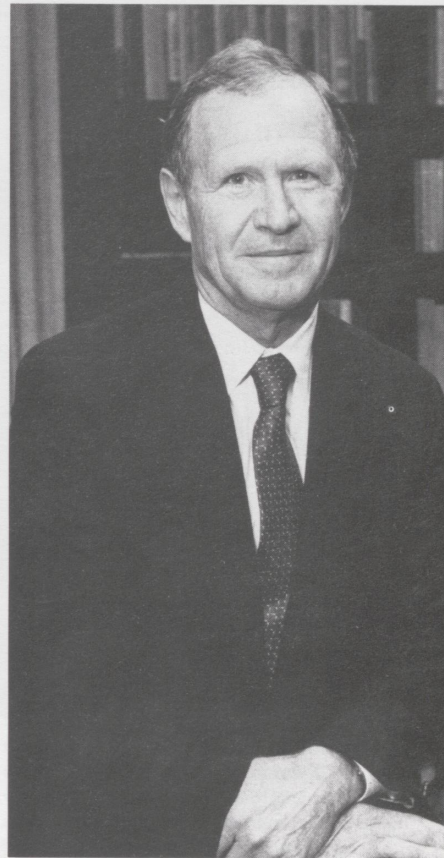
"We're not saying we want to put money only into applied science. We want to put it into basic and applied [research] that in the long run will pay off in economic development. We want to develop an excellent university," Dr. Peters added.

The EPSCoR program funded, in part, by the 1986 General Assembly illustrates the way in which research can go hand in glove with economic development. (see related story on p.23).

"The purpose of this [the EPSCoR program] is to improve science and engineering in the state," said Mr. Ron Carson, deputy state budget director and a member of the EPSCoR committee. "It's one of the best examples of bridging the gap between education and economic development. It fits the focus of the session; it's what the whole legislative session was all about."

But the transfer of technology from university to industry is not limited to science and engineering, although they are probably the most heavily involved.

In fact, the Kentucky Tomorrow report suggests that the university's contribution to economic



Jim King

development not be limited to the natural and physical sciences. Quoting from a Southern Growth Policies Board publication, the report says, "Social science disciplines create new knowledge of management-worker relationships, productivity, community-industry interaction, family functioning, and institution-building—all of which will play vital roles in stimulating industrial productivity and creating a favorable environment for quality economic growth."

Some other UK researchers also stand with one foot in the "ivory tower" and the other in the "real world."

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Lee Todd

Even before he earned his doctorate at MIT, Lee Todd had obtained six patents for his picture tube technology. An engineering undergraduate at UK, Dr. Todd returned to his alma mater to teach. But he was "smitten by the high-technology bug and the small-company bug," and soon, while he was still teaching, he had founded two companies, DataBeam Corporation in November, 1976 and Projectron, Inc. in November, 1981. But it proved too difficult to get a new company off the ground while carrying a teaching load, so Todd took a leave from the electrical engineering department three years ago.

At MIT, he said, professors take leaves, start companies, and come back. They don't always have to teach classes, which gives them greater flexibility, he said.

"Having those kind of people on the faculty excites students," he said.

"It lets them know there's a real world out there."

The university also benefits financially by research support from such companies, and faculty members benefit from consulting opportunities that become available, he said. Small companies benefit from access to research equipment, libraries, and academic consultants.

Todd said entrepreneurs should be associated with universities. "It's a natural thing that should happen," he said. "UK has not traditionally had much of that."

Even if he eventually resigns from his university position, Todd said he would like to be associated with UK as an adjunct professor. He would like to be a model for students, to show them that it is possible to start something on their own. But he said his main goal is "to create jobs for students who don't typically find jobs in Kentucky—who would otherwise leave. The best thing for me to do is

to create jobs in this industry."

In physics, Peter Eklund's work provides a good example of how basic research evolves into applied science.

He has worked in the field of intercalation of layered materials for the last five years, with his research funded by the U.S. Department of Energy. Intercalation refers to the insertion of new atomic layers between the existing layers of a host crystal through a chemical reaction.

Dr. Eklund's laboratory is working mainly on the synthesis and optical characterization of several solids with properties for which there is no easy explanation. The purpose is to collect enough evidence about the nature of the electronic and atom-vibrational properties of the materials to be able to explain them at their lowest—or "atomic" level.

"When a fundamental understanding of a material can be obtained, then large-scale, high-technology applications for that material can be considered," he said. "Without the fundamental knowledge of the material properties, large-scale manufacture of devices or products is a risky business."

Eklund said there's not always a clear connection between basic research in physics and its applications in "the real world." In the case of intercalated graphite, the connection was clear and short-term: Eklund's lab, working with American Cynamid, developed a high electrical conductivity graphite fiber by chemically treating, or intercalating, the fiber.

But another aspect of Eklund's intercalation research is aimed at developing a fundamental understanding of the properties of semiconducting gels. "The connection to technology on this project is obvious, but still the research will focus on the fundamental issues. That is the nature of solid state research in a university physics department," he said.

"Perhaps later, when the material is better understood on the "atomic"

THE EPSCoR PROGRAM

level, applications can be considered and a university/industry partnership will be formed."

Both basic and applied science are done in the College of Agriculture, where the two missions go hand-in-hand: one is to do basic research; and the other is to deal with the day-to-day practical problems of agriculture. The college runs an extension program which is in daily contact with farmers across the state.

Usually, different people are doing basic and applied research, but sometimes the same individual operates on both levels.

Plant Pathology Department Chairman Thomas Pirone cites the work of one of his colleagues, Joseph Kuc, who has discovered certain compounds in plants that make them disease resistant, (see Spring 1986 issue of *Odyssey*, "Getting Mr. Potato

and Friends to Fight Back"). That basic scientific discovery has proved of great interest to chemical companies, Dr. Pirone said.

He cited another example of a discovery which started as a basic science effort to rapidly detect a particular fungus, called an endophyte, in tall fescue, the most important grass grown in pastures. The method is now being utilized for improved cattle production. Pirone explained that plant pathologists developed a technique to detect whether fescue is infected and to what degree. Knowing that the fungus is transmitted only through seed, researchers then developed methods for producing clean seed. That has applications to agriculture in two ways: farmers can tell whether their cattle will become ill because the fescue they are eating is infected,

and if they have to replant the pasture, they can also be sure that the seed they use is free of the fungus.

The research was done by Drs. Malcolm Siegel in plant pathology, Lowell Bush in agronomy, Doug Dahlman in entomology and Roger Hemken in animal sciences.

Pirone said the research is also of interest to the turf grass industry. It was discovered that if the fungus was present in turf, insects which fed on it would become sick and die. "We're now working on trying to get the fungus into certain types of grasses," said Pirone.

In entomology, Kenneth Yeargan is working on pest management with the aim of minimizing the use of pesticides. He describes this research as "grower-oriented."

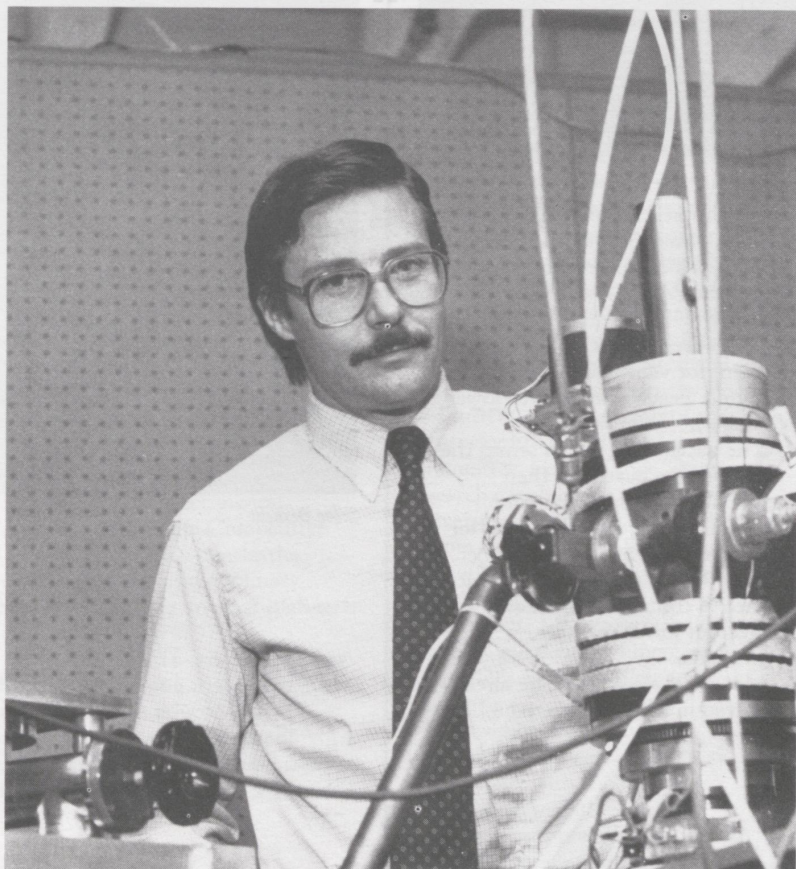
"We're involved, for example, in very routine things," he said, such as providing comparative data on available pesticides so the farmer can know what's available, which is best, and which costs more.

Dr. Yeargan is also working on innovative pest management research. One of his projects involves establishing and propagating parasitic wasps imported from France that attack and kill certain pests on alfalfa.

But underlying the applied research is basic science. "Behind all this, we are involved in behavioral and biological studies of natural enemies," he said.

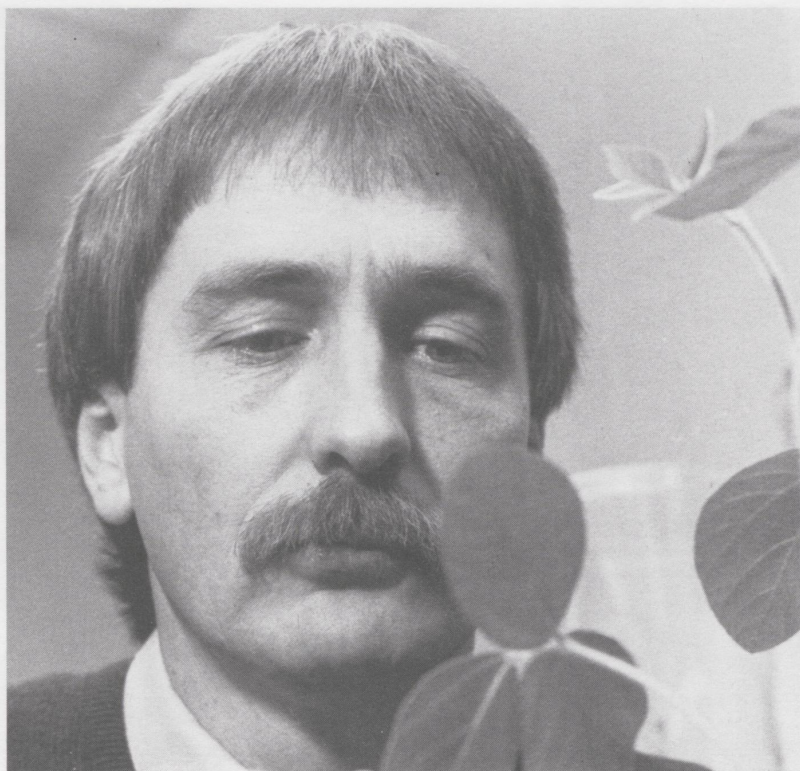
Two of Yeargan's colleagues, Gerry Nordin and Marijo Wilson, are also exploring the use of natural enemies in pest management, but they're using microbes.

Dr. Wilson is experimenting with genetic engineering techniques to



Peter Eklund

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Ken Yeargan

develop microbial insecticides. She said the resulting insecticide is quite specific to the insect that one wants eliminated, so it won't be harmful to other insects or animals. To make the baculoviruses more attractive to chemical companies, one must find ways to increase their virulence and host range so they will kill a wider variety of insects.

Although Wilson's work will ultimately have practical applications, she's interested in the basic science right now. "We're investigating basic biology and molecular genetics. We're in the infancy..when we know more we'll be able to manipulate it."

Across campus, in the College of Medicine, technology transfer takes a twist in the work of Ed Todd, a

cardiothoracic surgeon. Dr. Todd took the fruits of someone else's research—a computerized pacemaker called the PASER—and used it in a new way.

"We were the first in the world to implant for ventricular tachycardia (irregular beats in the heart's lower chamber)," Todd said.

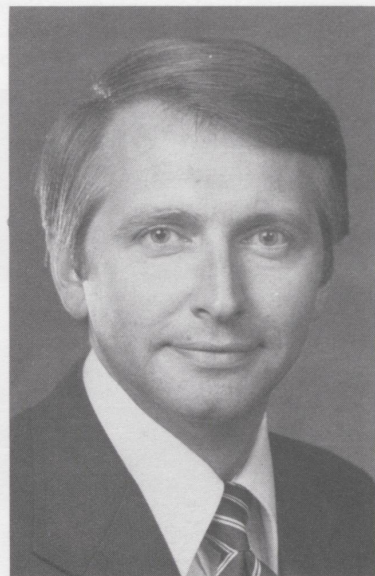
The pacemaker, which senses the patient's own beats and then automatically compensates for abnormal beats, had been used for arrhythmia in the upper chamber. But Todd was the first to implant the device to control the far more dangerous lower-chamber arrhythmia.

Many UK researchers are already involved in what has been dubbed

technology transfer, but there's more to be done.

Lt. Gov. Steven Beshear's ambitious Kentucky Tomorrow Project seems to sum it up best: "Measures must be taken to stimulate cooperation between businesses and our institutions of higher learning. Universities are a necessary factor in the development of a strong economic base, particularly in devising innovations for new and existing industries.

"Research carried on within the university is a major source of new products and processes and may help solve some technological problems for new small firms that do not as yet have their own laboratories."



Steve Beshear

THE EPSCoR PROGRAM:

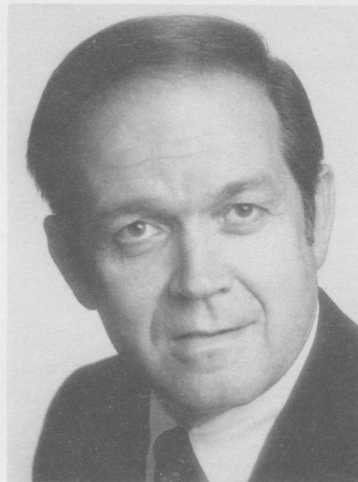
by Lewis Randall

PIONEERING ON THE HIGH-TECH FRONTIER

Recent business trends in Kentucky are opening a vast frontier for new economic growth. As profits from agriculture and coal—the state's traditional economies—continue to lag, an unprecedented movement toward development of high-tech industries promises long-term solutions to unemployment and other economic problems across the commonwealth. We are changing from an agrarian state to a frontier for high-technology.

Much pioneering will be required to settle the new economic territories on a permanent basis. Improved science and engineering research will play an essential role in attracting and keeping major business development. Now underway at the University of Kentucky, the University of Louisville, and the state's six regional universities (Eastern Kentucky, Kentucky State, Morehead State, Murray State, Northern Kentucky and Western Kentucky), a new \$16.4 million program of basic and applied research—called Experimental Program to Stimulate Competitive Research (EPSCoR)—marks the beginning of a multidisciplinary thrust in a dazzling array of high-tech fields.

The result of a 16-month planning effort by a planning committee made up of prominent educational, business, and state government leaders, EPSCoR's immediate goals are to increase the quality of science



and engineering research in the state, and to improve the ability of scientists and engineers in the commonwealth to compete successfully for federal research funds. Accomplishing these goals will enable Kentucky to achieve the long-range goal of greater economic benefits for the whole state.

Ted Lassetter, general manager of International Business Machines Corporation in Lexington, member of the University of Kentucky Board of Trustees, and chairman of the Kentucky EPSCoR Planning Committee, explains that "strong research capability in a strong university system is one of the key factors determining industry's choice of new locations." Instrumental in gaining support of the private sector for EPSCoR, Mr. Lassetter said the program will definitely increase Kentucky's appeal to high-tech businesses.

Statewide awareness of the importance of research increased dramatically with the recent emphasis on scientific and engineering support for the \$800 million Toyota automotive manufacturing plant now under

A strong research capability in a strong university system is one of the key factors determining industry's choice of new locations.

Ted Lassetter, General Manager, IBM, Lexington

construction in Scott County.

Statewide awareness of the importance of research increased dramatically with the recent emphasis on scientific and engineering support for the \$800 million Toyota automotive manufacturing plant now under construction in Scott County. The new UK Center for Robotics and Manufacturing Systems will be one source of support for Toyota. But the implementation of the Kentucky EPSCoR program—initiated, approved and funded (in part) by the National Science Foundation (NSF)—will spawn and support a much broader spectrum of new technologies.

But the implementation of the Kentucky EPSCoR program—initiated, approved and funded (in part) by the National Science Foundation (NSF)—will spawn and support a much broader spectrum of new technologies.

The impetus behind the NSF-initiated program is to assist the research and industrial development of states with lower than average research funding. The EPSCoR

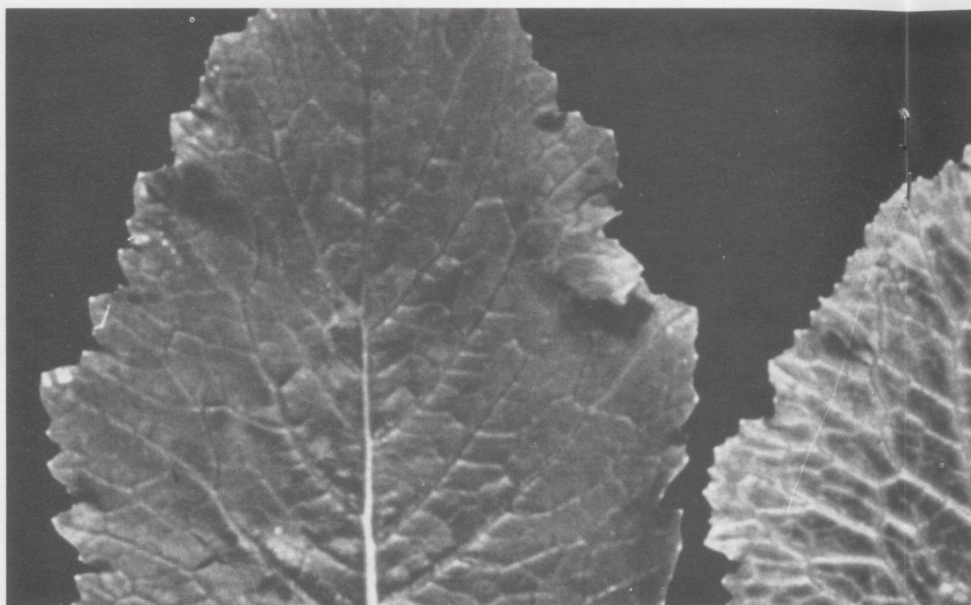
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SYNOPSIS OF EPSCoR PROJECTS SELECTED

program began in 1979-80. Of seven states originally invited to participate (Kentucky was not one), only five qualified for assistance. Then, in 1985, a second round began—eleven states, plus Puerto Rico, were invited to submit proposals. Vermont, Alabama, North Dakota, Oklahoma, Puerto Rico, Nevada, Wyoming, and Kentucky obtained funding, and Mississippi, Idaho, Louisiana, and South Dakota also competed in the competition.

A grant of \$100,000, three-fourths coming from the NSF and the remainder from Governor Collins' Planning Fund, initiated the 16-month planning phase in February of 1985. In August of 1986, the NSF announced the \$3 million implementation grant for Kentucky, a figure that will be matched by the state government. Another \$600,000 will come from Kentucky businesses and industries. The state universities will contribute another \$9.4 million, with \$3.1 million for new personnel, equipment, seminars, and the remainder in the form of "in kind" contributions of existing staff, facilities and equipment.

Projects selected for funding through Kentucky's EPSCoR program cover an astonishingly diverse, but often interconnected, spectrum of research activities. There are five broad areas of research which include chemistry, mathematics, physics, biotechnology, and robotics and manufacturing (see pp. 24, 25, 26, 28 for synopsis of projects). The projects center around multidisciplinary clusters with six to 18 investigators per group. The clusters are based upon the mentor concept in which a few nationally competitive investigators assist the careers of a greater number of nearly competitive (or targeted) faculty. Supplementing the projects are 30 additional faculty from the regional universities who will work one-on-one with the mentor faculty at the doctorate-



BIOTECHNOLOGY:

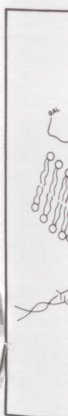
Looking through the other end of the telescope, a rare collaboration of membrane science researchers, from the separate fields of biological membranes, and purely synthetic and biofunctional membranes, will carry out seven interrelated projects. Expertise in these two broad areas is not often mutually accessible. Collaborators from three schools (UK, U of L, and Murray State University) will establish a new Research Center of Membrane Sciences at UK. Research is expected to advance the university and the commonwealth to the forefront of this key technology. Water purification methods, as well as medical technologies, are among current applications.

The burgeoning field of recombinant DNA technology will be represented by investigators from three departments at the University of Louisville—biochemistry, microbiology and immunology, and biology. Together with an investigator from the Department of Biology at Western Kentucky University and an advisor from the Department of Biochemistry at the University of Kentucky, the team will establish a central facility at the University of Louisville for the cloning, base sequence analysis and chemical synthesis of DNA fragments. Applications in agriculture, medicine and other fields seem virtually unlimited.

A very different project, "Facilities for Aquatic Field Experiments" will develop pond tank facilities at the University of Kentucky. Nine concrete stream channels will be constructed near the University of Louisville. Designed to simulate natural aquatic habitats, the artificial environments provide a preferred method of addressing many important ecological questions under carefully controlled conditions.

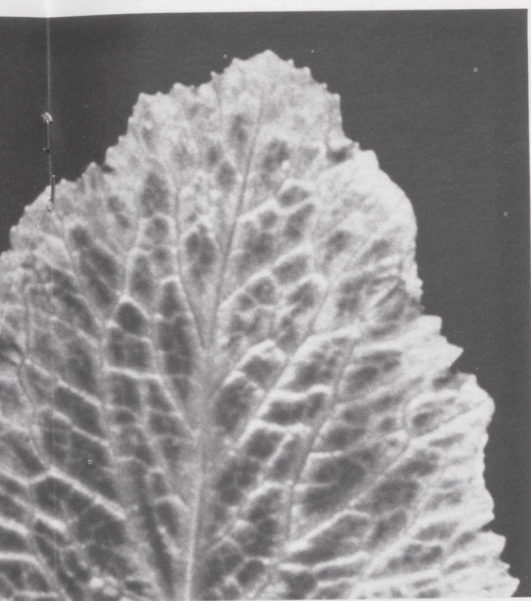
Far removed from pond and stream studies, a project at the University of Louisville entitled "Muscle Fatigue: Effects of Atrophy and Acid-Base Status" will look at metabolism during fatiguing contractions of "atrophied" versus "normal" rat hindlimb muscles. A related inquiry will focus on several other aspects of muscle fatigue, using dog and human muscle groups as models. Investigators seek to establish a nationally recognized center for muscle fatigue research. Applications will result in the areas of professional and amateur athletics.

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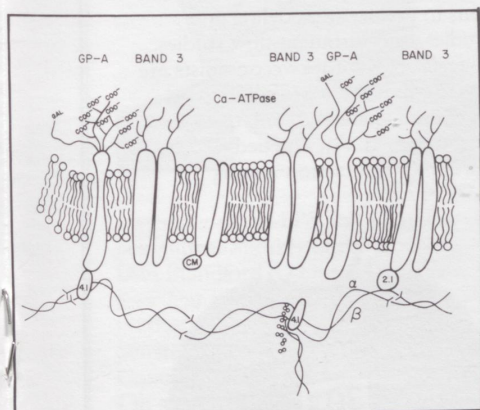


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Sciences

The National Science Foundation initiated the EPSCoR program to assist the research and industrial development of states with lower than average research funding.



The turnip leaf on the left is healthy. The leaf on the right shows symptoms of cauliflower mosaic virus as evidenced by the vein yellowing. One project conducted at the Central Facility for DNA Technology is research on this virus which has the potential for use as a vector for introducing new genetic information into plants.



This schematic drawing shows a cross-section of the human erythrocyte membrane, a structure which serves as a model for many biological membranes and is being used in several projects conducted at the Research Center of Membrane Sciences.

granting institutions of the University of Kentucky and the University of Louisville. This type of collaboration will enable the technology expertise to spread throughout the commonwealth and strengthen the regional universities' research programs.

EPSCoR Project Director Leonard K. Peters, professor of chemical engineering and associate dean for research for the Lexington campus, emphasizes the rigor of the selection process. "Reviewers from out of state and the Kentucky EPSCoR Planning Committee based their selection decisions on the scientific merit of the various proposals and on several other important criteria as well: institutional commitment and capability to support investigators; linkages to economic development; and multidisciplinary and cross-university potential of the proposals. Of the original 146 proposals, fewer than 30 survived this review process." The original proposals were submitted by a total of 399 faculty investigators. Of this number, 15 component projects, involving 119 investigators, were finally chosen.

By combining two or more of the original proposals into a single project, research objectives became more comprehensive, and linkages among the universities were established. According to Dr. Peters, "The quality of these component projects can be a source of pride for the commonwealth and a standard of excellence for Kentucky in these areas of research."

Altogether, the five-year EPSCoR program in Kentucky will implement an impressive array of new research capabilities. Yet this program only initiates a bigger, long-term thrust toward new technologies, research institutes, and ultimately, new economies for the state. Impressive as EPSCoR is, it is only the beginning.

Ronald J. Carson, deputy state budget director in Governor Collins' office, and member of the EPSCoR planning committee, points out that "the state of Kentucky has not been



Leonard K. Peters

on the cutting edge of economic development that coastal areas of the country have enjoyed for the past decade or more—development will take time." Mr. Carson admits he doesn't know how long it will take to see major gains. But citing the example of Arkansas, a state with a traditional economy similar to Kentucky's, he is hopeful for improvements in the not-too-distant future. "Arkansas implemented an EPSCoR program sometime in 1981, and today they point to tangible results—significant high-tech job creation officials say flows directly from EPSCoR." One of the initiatives established in Arkansas as an outgrowth of EPSCoR is the Arkansas Science and Technology Authority which will continue EPSCoR-type programs and promote technology transfer and commercialization of products as well as help small businesses get started.

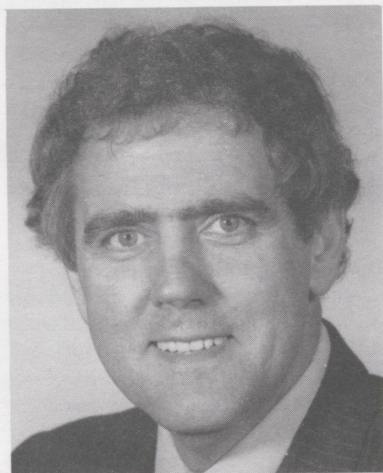
The significance of Kentucky's new research program in spearheading

SYNOPSIS cont.

continued from page 24

development cannot be overestimated. National Science Foundation support is a major gain in and of itself. As Lassetter explains, "research investigators who gain initial funds will become recognized by the NSF, and so they will be able to get funds in the future, enabling us to roll out our whole research base much more quickly." And Carson talks enthusiastically about the NSF's strong approval of the solid coalescence of university, government and business leaders in Kentucky.

The alliance of the private sector with government and higher education to promote growth will have a synergistic effect, according to Carson. Economic development should now proceed unimpeded by



Don Blandford

CHEMISTRY:

In the field of chemistry, "Chemical Catalysis," a project involving faculty in the chemistry department at the University of Kentucky and the biochemistry, chemistry, and chemical engineering departments at the University of Louisville, will focus on catalytic processes at the molecular level. Building on existing expertise, and broadening the present research base beyond its single focus on coal conversion are both major goals in this project. In addition to enhancing support for industries already in Kentucky (Ashland Oil, United Catalysts, and the GAF Corporation), successful results may attract the interest of new firms.

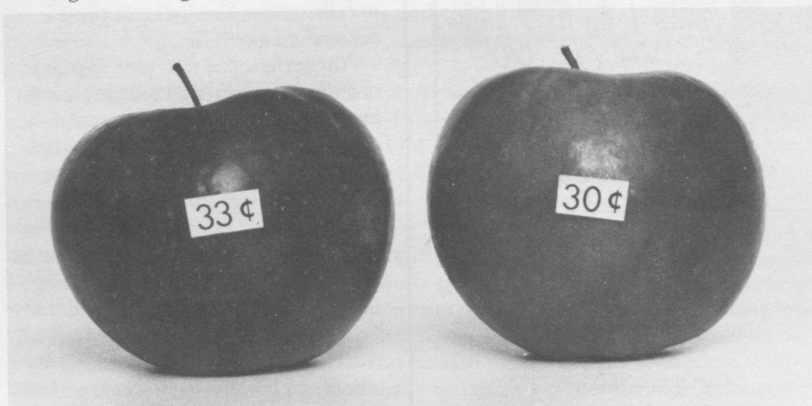
A second project involves nuclear sciences as applied to chemical and biological problems and will be implemented at the University of Kentucky Van de Graff Accelerator Laboratory. "Nuclear Methods in Chemical and Biological Sciences" will provide basic research in this field and will employ two new faculty, one in the Department of Physics and Astronomy, and another in the Department of Chemistry.

MATHEMATICAL SCIENCES

In the area of mathematical sciences, four projects are centered at UK. A project entitled "Partial Differential Equations" is designed to increase the national visibility of investigators in this field of mathematics in a department that is already nationally recognized. A second project centered in the statistics department, "Probabilistic Modeling and Inferential Problems with Applications to Engineering and Medicine," will look at a variety of processes of both theoretical and practical interest, including studies in stochastic hydrology, epidemic theory, and matrix geometric methods.

Recognizing the growing importance of computational sciences in future applied sciences and engineering, the University of Kentucky has established a Center for Computational Sciences, making the development of this facility over the next few years a major priority. A project called "Collaborative Research in Computational Sciences" involves 18 researchers (more than in any of the other projects). Federal recognition and funding of scientific computing capabilities at the university will be enhanced. A new supercomputer will make possible state-of-the-art simulation studies, with applications in pollution modeling and control, DNA research, Big Bang Theory studies, and turbulent flow studies.

In a more traditional area of inquiry, University of Kentucky economists are expected to become nationally competitive as the result of a project entitled "Applied Microeconomics Research Program." Immediate and long-term benefits to the university and the state economy are anticipated. An Applied Microeconomics Workshop will provide a forum for interaction among investigators and graduate students.



Market imperfections may mean similar goods bear different prices. A look at how markets work is one EPSCoR project by UK economists.

most of the barriers that existed in the past. Until recently, there was no political pressure in the state to develop strong research programs in the basic sciences. But Carson said that situation has changed dramatically: "good government support exists at almost every level, from the governor on down."

Citing EPSCoR and similar projects in her budget address to the last general assembly of the state legislature, Governor Collins remarked that "improved economic development means improved research." Strong support for the EPSCoR program has also come from the office of Lieutenant Governor Steven Beshear. Kris W. Kimel, chief administrative assistant to Beshear is



Joe Prather

a member of the EPSCoR planning committee. Speaker of the House Don Blandford (D-Dist. 14); President Pro-tem of the Senate Joe Prather (D-Dist. 10); Chairman of the Senate Appropriations and Revenue Committee Mike Moloney, (D-Dist. 13); and Joe Clarke (D-Dist. 54), chairman of the House Appropriations and Revenue Committee have provided invaluable governmental assistance to EPSCoR and related programs.

As it begins this year, the EPSCoR

program represents a first-stage culmination of earlier policy changes. These changes remove a primary obstacle to quality experimental research in Kentucky: political indifference at the level of state government.

Ironically, though, a special assessment team appointed by the EPSCoR planning committee found that, historically, the universities themselves also erected barriers to new research. In a mail survey of 136 former faculty who left Kentucky's public universities since 1980, findings revealed that a large percentage left for larger, research-oriented institutions.

Respondents indicated their main reasons for leaving included not merely relatively low salaries and other inadequate forms of financial support and the lack of equipment and laboratory facilities, but a perceived lack of interest in scientific research as well. Lack of research-oriented colleagues and a poor intellectual environment—the perception of a pervasive attitude in Kentucky that research is not important—also figured prominently in the respondents' decisions to leave.

continued on page 28



Joe Clarke

The mentor concept promoted by the EPSCoR programs will enable technology expertise to spread throughout the commonwealth and strengthen the regional universities' research programs.

SYNOPSIS cont.

continued from page 26

EPSCoR, of course, stands for major change in this area. But if the new research at Kentucky's state-supported schools is to gain solid footing, the assessment team says dynamic leadership in planning, funding, and accountability will be essential. Peters points out that tremendous care has been taken already in the planning stages of EPSCoR and that the implementation phase is now underway. Accountability will be accomplished through a closely monitored reporting system.

Finally, another, more pervasive problem must be addressed as well. According to the EPSCoR committee, unless general public awareness of the importance of the sciences is increased, it will be difficult to institutionalize—to continue and make permanent—the gains EPSCoR represents. A public information program will sustain an effort throughout the five-year funding period to change prevailing public attitudes. The committee is making decisions now as to effective methods to carry the EPSCoR message across the commonwealth by using various media such as television features, a speaker series for government and business functions, and guest newspaper editorials.

Kentucky's transition from an agrarian to an industrial state—inevitable and necessary from an economic perspective—will depend, in large measure, on basic and applied research. EPSCoR will act as the initial catalyst in a reaction that will dramatically speed this change. Civic and business leaders, joining together in a pioneering collaboration with university officials and faculty scientists, will strive to establish permanent, growing settlements on Kentucky's high-technology frontier.

PHYSICS:

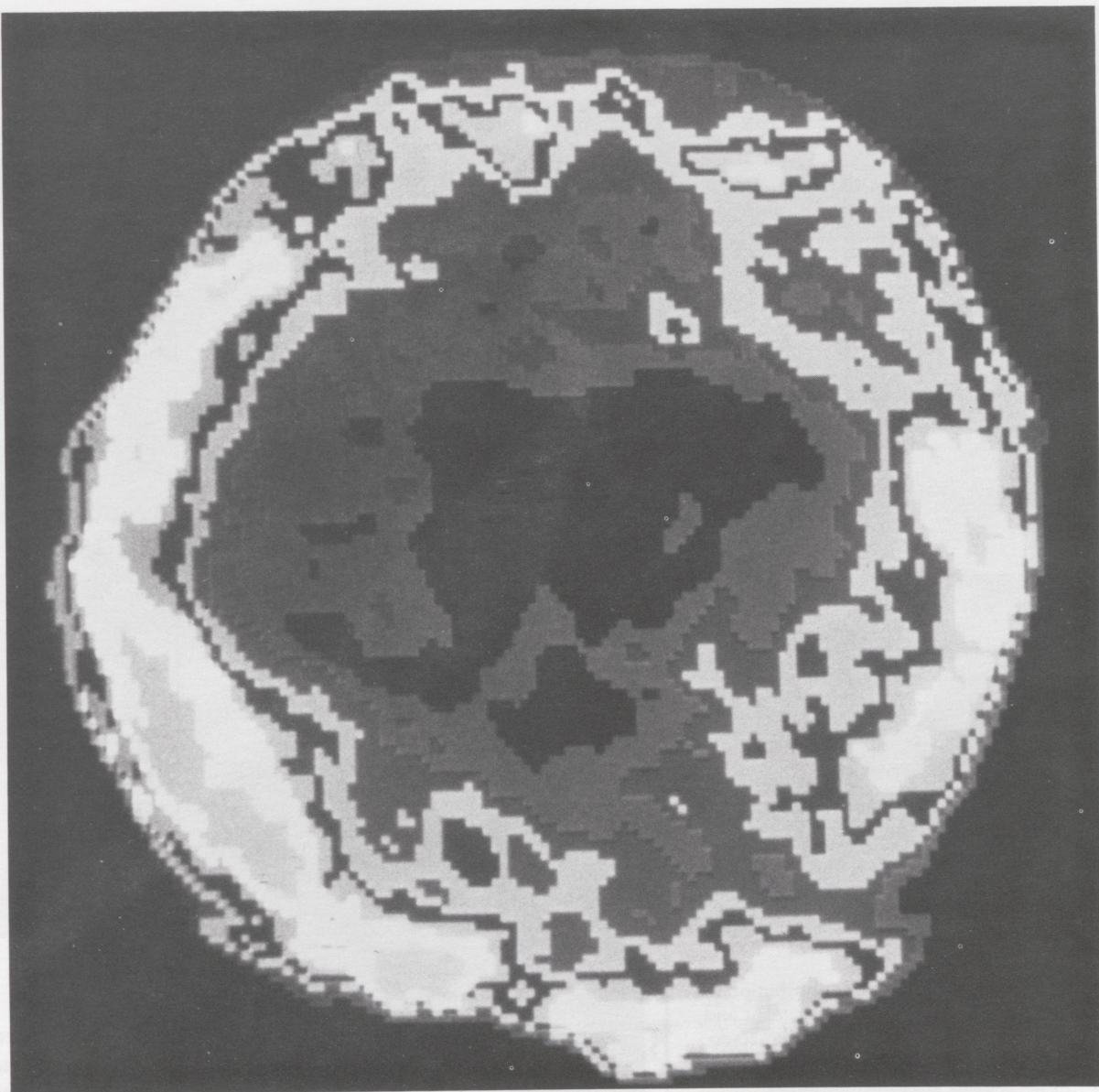
A project in basic nuclear physics will involve researchers in joint theoretical and experimental efforts at the University of Kentucky, Eastern Kentucky University, and Western Kentucky University. A second project in astronomy and astrophysics will establish strong collaborative ties between astrophysics groups at the University of Kentucky and the University of Louisville. The acquisition of an image-processing system at UK, essential for competitive infrared-radio astronomy research, will provide the focus for one part of the project, while a study in stellar convective motions will involve a monitoring program at the University of Louisville's Moore Observatory.

ROBOTICS & MANUFACTURING:

In a distinctly non-human realm, University of Kentucky-University of Louisville collaboration on a project called "Analytical Model of Machining—A Computational Plasticity Project," will provide an improved model for the design and control problems of unattended cutting machines increasingly used in the manufacturing industry. A \$100 billion per year activity, machining technology needs studies of the type proposed by this project. Anticipated results will bring long-range funding from industry and various federal agencies.

A related project in mechanical design will improve laboratory capabilities at the University of Kentucky Department of Mechanical Engineering. Pressures of the global marketplace and the dramatic effects of computer-based design and manufacturing techniques make this area extremely important to industry. Entitled "Analytical and Experimental Techniques in Machine Dynamics," this project is complementary to design research that will develop at the University of Kentucky's Center for Robotics and Manufacturing Systems, a facility created to support the automotive industry.

And perhaps to become the ultimate technology—the layperson (and perhaps the scientist as well) can only speculate—basic and applied research in the area of artificial intelligence (AI) and automation will involve the computer science department at the University of Kentucky and the University of Louisville's Speed Scientific School. Laboratories in the colleges of agriculture, business and economics, and medicine at the University of Kentucky will seek the utilization of AI research. Specific applications will include the development of an "intelligent workstation," and the integration of computer vision and speech understanding technologies at the Speed Scientific School.



This image is the remnant of a supernova observed in 1572 by the Danish astronomer Tycho Brahe. It was produced by S.P. Reynolds and R.A. Chevalier using the Very Large Array radio telescope system. This is the kind of picture that the EPSCoR-funded image-processing system will produce. (Courtesy of NRAO/AUI).

KENTUCKY'S EDGE ON ROBOTICS

by Maria Braden

A robot butcher serves customers in a grocery store in Japan. In Australia, robots are being developed to shear sheep. Robots will soon be used to pick ripe oranges from trees in Florida. And in Kentucky, a Center for Robotics and Manufacturing Systems is taking shape at the University of Kentucky.

Funded by the 1986 General Assembly, the \$10 million facility will be furnished with state-of-the-art equipment, including a \$1 million computer. The legislature approved another \$3.2 million for operating funds and salaries for a director and support staff in fiscal 1987.

"This truly places us out front in the field of robotics and manufacturing systems," said Jim King, vice president for administration.

Although a third of the states have robotics institutes, "very few started with this kind of funding," said Don Leigh, associate engineering dean and acting director of the center.

As proposed by Governor Martha Layne Collins, the idea was "to build a nationally recognized center..(to) make Kentucky a leader in the field of robotics and manufacturing engineering."

Ironically, the university had not included the robotics center in its biennial budget. "She proposed it; we enthusiastically supported it," said Mr. King.

Now it's taking shape. The focus of the center is still evolving — and that will continue even when a director is hired, but those who are running the show in the interim are sure of one thing: "We want to do world class research," Dr. Leigh said, "and try to help Kentucky develop businesses that could be assisted."

"We want to leverage the state contribution to obtain funding from the federal government and from private industry," he said. "One way to do that is to have strong research capabilities."

The purpose of the center is not only to provide an interdisciplinary setting which will bring together expertise from engineering and computer science, but also to offer continuing education and extension programs.

The center will have sophisticated television production and transmission facilities. "Part of our budget includes equipment to videotape classes—degree courses and continuing education courses—to reach out all over," Leigh said.

The center will utilize results of the latest

research by companies such as Toyota, IBM, and General Electric to try to help smaller companies with no robotics or automation expertise to determine whether it might be cost-effective for them, Leigh said.

"In the immediate future, we don't feel that Toyota, GE, or IBM will need our expertise. They already have such an understanding of automation," said Ray Bowen, dean of the College of Engineering and head of the search committee for a director. "We see this as being of assistance to small manufacturing firms facing decisions about automation."

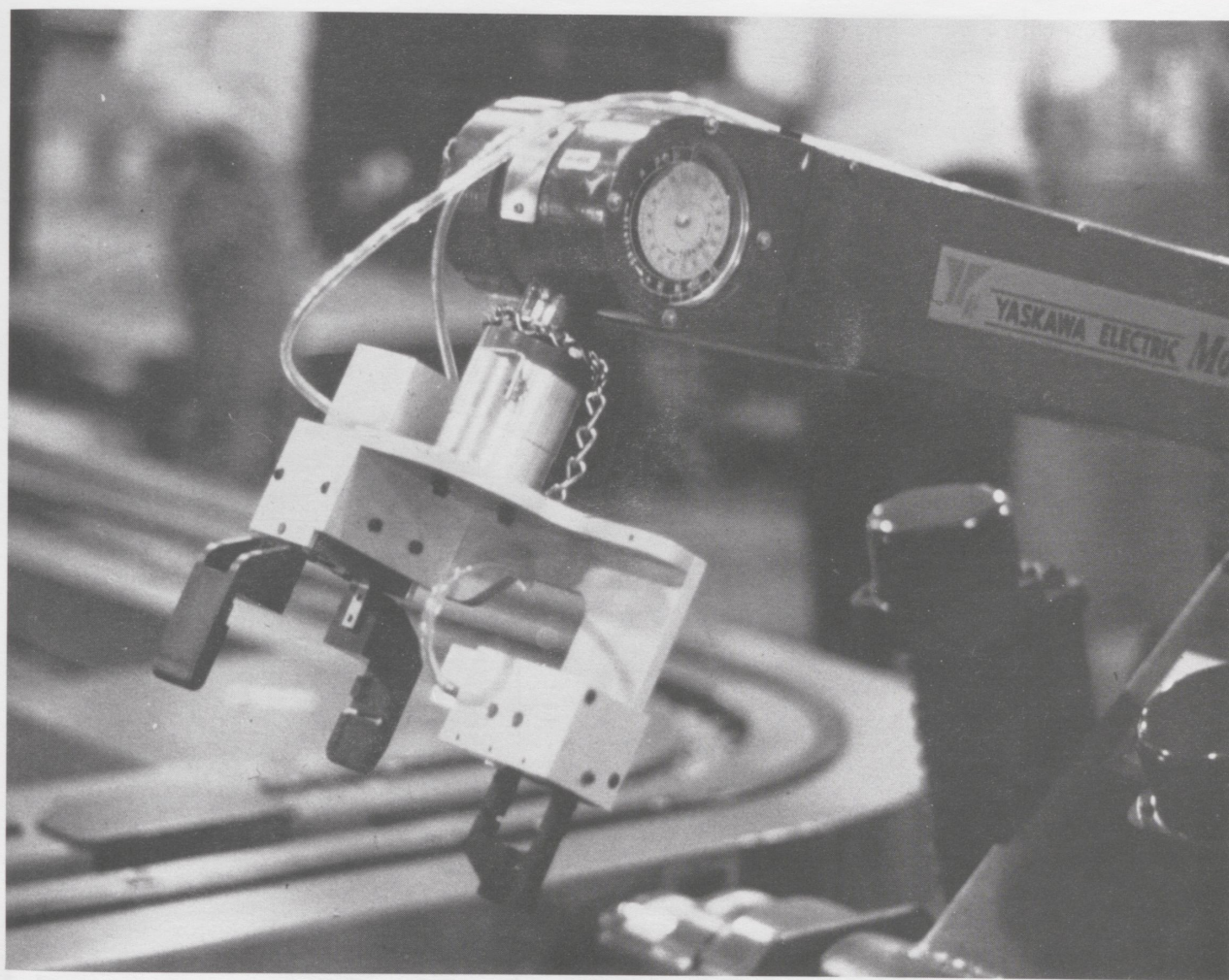
There was speculation that the governor's proposal to establish a robotics center at UK was put forward as part of a package to attract Toyota to Kentucky. But, said State Deputy Budget Director Ron Carson, "I don't think that's ever been contemplated. Obviously there's a relationship," he added, but said that development of the robotics center was part of the administration's emphasis on excellence and economic development.

Toyota President Shoichiro Toyoda, in an interview last year, said that as increasingly sophisticated robots are developed, "... it will



Governor Martha Layne Collins introduced the idea of making Kentucky a leader in the field of robotics and manufacturing engineering which lead to the funding and formation of the new UK Center for Robotics and Manufacturing Systems.

Robots can now be developed to handle tasks traditionally considered human tasks, such as interpreting documents, planning sales programs, and even diagnosing physical or mental illnesses.



be in our interest, to our benefit, that this sort of activity will take place in our proximity."

"Toyota is a driving force," said King, but pointed out that the company has its own robotics center in Japan. "At no place have I ever seen this as part of a package (to attract Toyota). It's bigger than any one industry. It will serve in a broader context."

"All firms will not have robotics," King noted, "but clearly there's a need for research in the area, because it's an area that many industries will be considering for operating efficiency."

The center was proposed and funded as a center of excellence. In her budget message, the governor said the university would compete,

"not at the median level for faculty and staff, but will compete for the very best personnel available."

What that means in terms of dollars cannot be explicitly stated at this time, but Dr. Bowen said, "We're going to put enough money on the line to attract outstanding people. Salaries are not going to be an issue."

A nationwide search is underway for a director. The eight-member search committee has sent about one thousand letters to deans of engineering and chairmen of computer science and mechanical engineering departments across the country. Another 300 letters were sent to

continued on page 32

KENTUCKY'S PLACE ON THE FRONTIER

leaders in the fields of robotics and manufacturing.

"We want somebody who will qualify as a full professor in one of the engineering departments or in computer sciences," Leigh said. "They also have to have some industrial connection and of course be leaders in some area of robotics and manufacturing systems, and have an appreciation of many areas that you would consider part of robotics."

Leigh said the university has provided additional funding that "could allow somebody to take the position January 1 of 1987."

Actually robotics are not altogether new to Kentucky. Lexington's IBM plant and the General Electric dishwasher plant in Louisville are some of the most sophisticated in the nation in terms of automation, Leigh said.

Robots are not just automated machines, however. They can be programmed for a wide variety of tasks and are able to adjust their behavior to respond to changes in their environment. While they are mainly known for their ability to do physical labor, robots are now being developed capable of doing human tasks such as interpreting documents, planning sales programs, and even diagnosing physical or mental illnesses.

"A robot is a computer that can interact with and manipulate its physical surroundings, and which is programmable," said Leigh. "The whole point of the robot is that you can reprogram it."

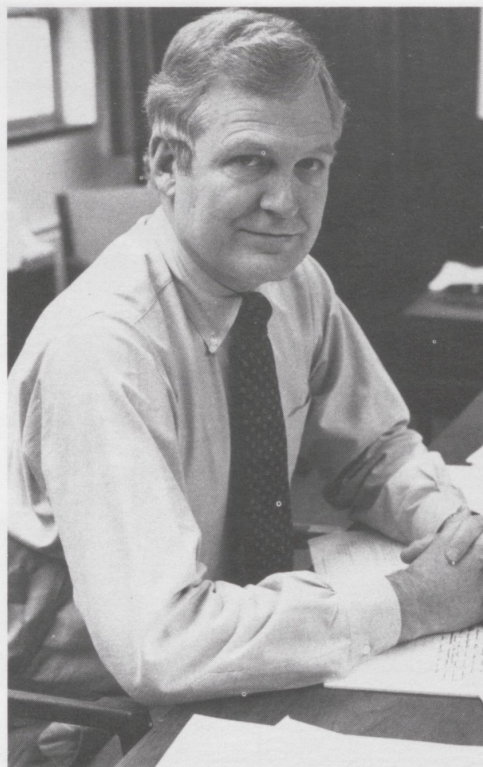
Robotics is a very broad area, said Bowen, and the direction that the center takes will be a reflection of the expertise of the director. "The whole area is so wide open — there's so much that could be done. It's hard to pick one."

"We're going to hire someone with a national reputation. It would be a mistake if we don't give that individual a lot of discretion and flexibility."

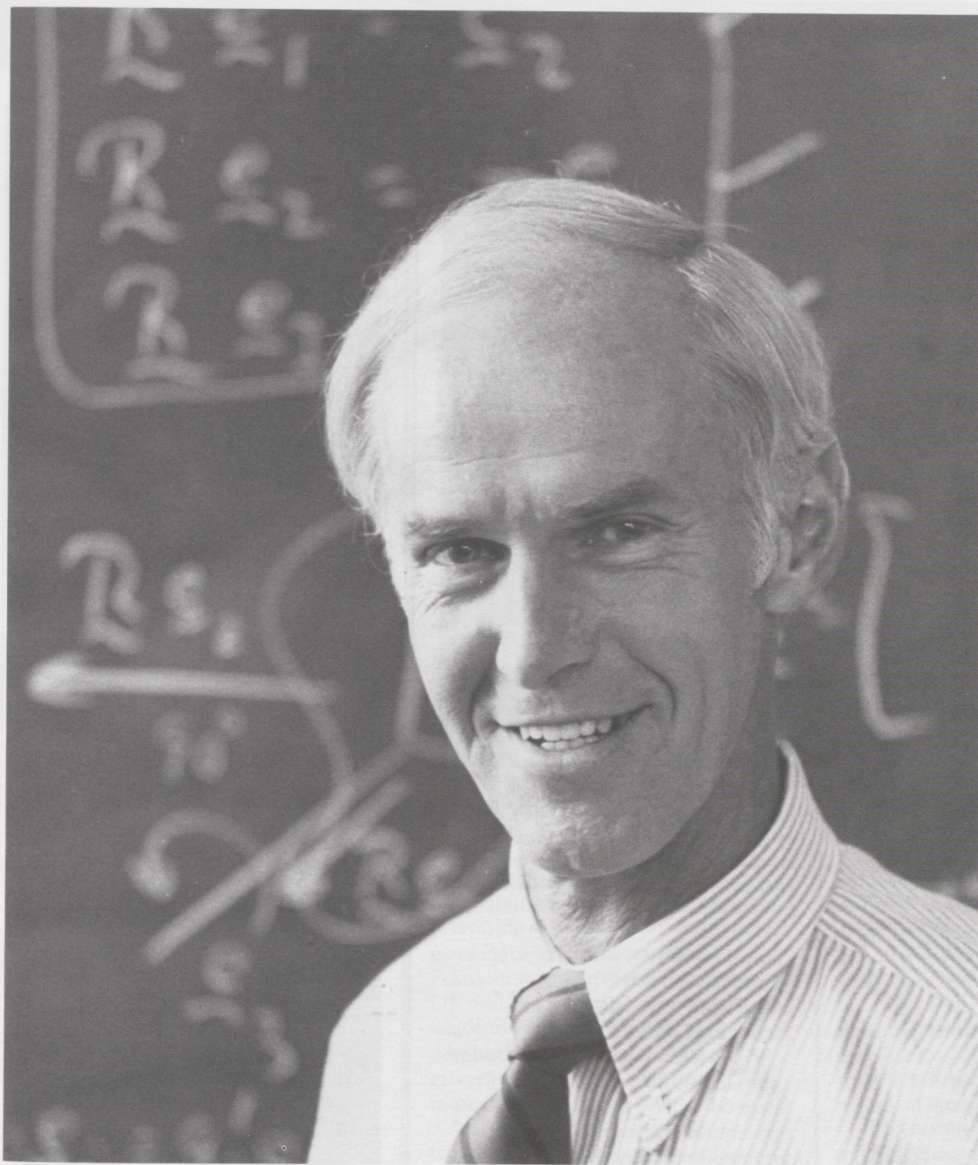
Contemporary areas of research include artificial intelligence, computer vision, tactile sensing, and mobile robots. Bowen pointed out that designing computers compact enough to work in mobile robots is a major problem.

The use of robots in hazardous environments, underground and underwater, is a particularly exciting area of research, Bowen said. Another major concern in factory automation is how to establish communication between robots and the people who do inventory control and accounting, according to Bowen. "It's a new frontier."

"We hope to have national impact in terms of the kinds of industries that give us support. We're not going to restrict this to Kentucky."



Ray Bowen, dean of the UK College of Engineering, indicates that the individual chosen for director of the new center will qualify as a professor in an engineering or computer sciences department, have some industrial connections and be a leader in robotics and manufacturing systems.



Don Leigh is serving as acting director of the new robotics center during its formation and until a nationwide search for a permanent director concludes.

ATTRACTING THE BEST AND THE BRIGHTEST

One indicator of the status of a university is the caliber of the graduate students it attracts. Good lectures and a well-stocked library are essentials. But the brilliant students want more, much more.

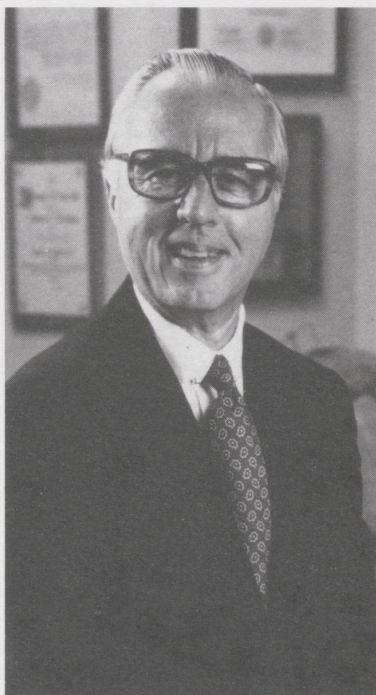
They want to study with a professor who is on the cutting edge of their discipline and that means one with a vital and active research program.

And the top research graduate students also want financial support. According to Daniel Reedy, associate dean for academic affairs in the graduate school, only 40 percent of the University of Kentucky's graduate students receive full financial support, while at larger state schools elsewhere in the nation, the percentage is 50 to 55 percent.

Thus, as Dr. Reedy points out, "Kentucky is having trouble keeping its top research graduate students in engineering, the medical fields, computer science, agriculture, and business. UK isn't as competitive as other schools for the simple reason that there isn't enough money."

Areas in which industry and the university have had longstanding partnerships, such as agriculture and pharmacy, the graduate students are the recipients of higher levels of financial support. As Glenn Collins, associate dean for research in the College of Agriculture explains, "historically, we've had strong industry support from the tobacco companies, as well as support from the chemical companies interested in weed, insect, and disease control in our major crops and the nutrition and health of our animals."

Many of the graduate students who receive assistantship funding are supported by grants, grants-in-aid, and gifts awarded to faculty investigators. Of the 350 M.S. and Ph.D. students in the ten academic departments in agriculture, those funded are R.A.'s (research assistants)



Robert T. McCowan is vice chairman of Ashland Oil and chairman of the UK Board of Trustees. In this dual role he has been instrumental in developing a close and productive industry/university relationship between the two.

regardless of their source of support since research is the major orientation of the College of Agriculture today.

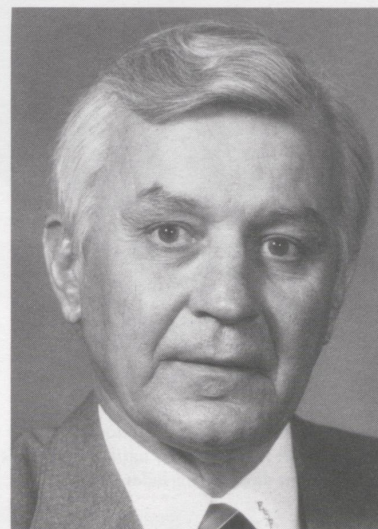
With an estimated research budget approaching \$20 million annually, about \$4 million comes from extramural funds which include the private sector. R. J. Reynolds alone provided \$215,000 to the college for research this year. Over a five-year period, Philip Morris contributed \$600,000 for tobacco production mechanization studies in addition to funding four graduate fellowships. In the area of plant research other major companies such as CIBA-Geigy, Weyerhaeuser, Monsanto, Eli

Lilly, Dupont, Dow, and Chevron contribute substantial amounts. In animal drug, antibiotic, and feed additive research, Pfizer, American Cyanamid, Eli Lilly, Eastman Kodak, and Upjohn are examples of companies that provide significant support. Dr. Collins estimates that nearly 100 companies support research studies in the College of Agriculture today.

Collins adds, however, that "we will need to increase our funding from private companies in the future because in the last few years federal and state support has remained flat or declined—we must now work to increase research funding from all sources, from state and federal agencies, too."

Reedy believes the university could obtain much more support from the private sector, particularly for graduate research assistantships.

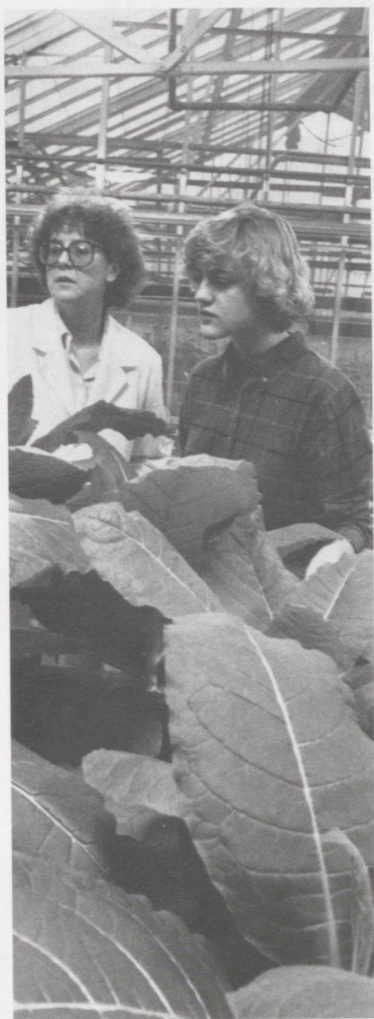
And some sources other than direct industry collaboration already exist. Ashland Oil, Inc. and the



Edward Ford

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WHEN INDUSTRY STEPS IN WITH DOLLARS



Kathleen Franklin (left) and Rachel Krotz are both Philip Morris Fellowship recipients. Franklin, a native of Chicago, Ill., is working on her doctorate in plant pathology and conducting research on a virus infecting tobacco. Krotz was nominated for the fellowship by her advisor and is working toward a master's degree in agronomy. She is from Yorkshire, N.Y.

The impact of industry support to the university is felt directly by many graduate students—both in their pockets and in their learning experiences.

The Philip Morris Fellowship program in the College of Agriculture is a case in point.

Kathleen Franklin, a Ph.D. student and Philip Morris Fellow in the Department of Plant Pathology, investigates tobacco vein mottling virus disease, a member of a group of organisms infecting tobacco—a virus about which little is known. With two years of study remaining to complete her degree, Franklin explained, “I really have no personal contact with Philip Morris at all. My contact is with Dr. Glenn Collins who interacts with the company. On the basis of my grade point average and other factors, the college nominated me for the fellowship.”

Receiving a full remission of tuition fees, plus a living stipend of \$7,800 per year, Franklin speaks enthusiastically about the fellowship program. “I certainly appreciate the support of Philip Morris—it’s comfortable—and I wonder about other sources of funding for other promising students—maybe if I were a good P.R. person I could find out.” Franklin explains that her training at UK will prepare her for jobs either in academia or the private sector but admits that higher salaries in the growing biotechnology industry look more attractive.

Another Philip Morris Fellowship recipient, Rachel Krotz, investigates the problem of finding a protein that will bind with cadmium, a nonessential element in tobacco. Working toward her M.S. in the Department of Agronomy, Krotz began her work under a research assistantship. Then her advisor nominated her for the fellowship

program and she was awarded the support.

“This is better than the assistantship I originally came with—I do get a little more money with Philip Morris,” she said. “I don’t have any contact with Philip Morris, but I have thought about a job with the company after I leave school.”

Glenn Collins, associate dean for research in the College of Agriculture, points out that “industries support the education and training of many more people than they ever hire.” In the College of Agriculture, sponsoring firms often put no restriction on research other than requiring students to work in the area of tobacco, or drugs, or weed control. There is an open commitment to a particular program.

Some contracts negotiated with private companies are a different story. Dan Wermeling, a postdoctoral fellow doing research in the College of Pharmacy’s Drug Product Evaluation Unit (DPEU), explains that the DPEU, under the directorship of Thomas Foster, writes detailed proposals for submission to industry.

Dr. Wermeling, in turn, applied to Dr. Foster for the two-year \$18,000 per year fellowship he receives to carry out studies at UK. With contracts from such companies as Pharmacia, Inc., Bristol Myers, and Travenol Labs, Inc., Wermeling investigates spinal implants for patient-controlled drug delivery systems for cancer patients with intractable pain. Stressing the collaborative nature of the investigations, he explains that the studies are carried out at the Lucille Parker Markey Cancer Center with the aid of physicians from the

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ATTRACTING THE BEST AND THE BRIGHTEST

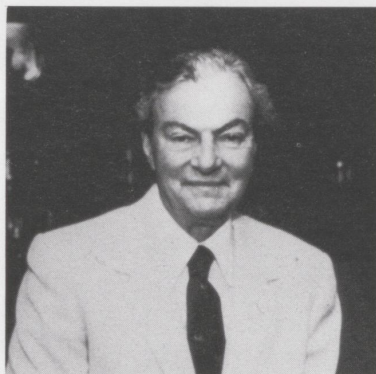
cont. from page 34

Ashland Oil Foundation, The Keeneland Association, and the Grayson Foundation provide substantial financial backing for both research and the university at large.

Created in 1968 by Ashland Oil, Inc. the Ashland Oil Foundation last year announced a five-year, \$1 million pledge to the university. The first year's payment of \$200,000 was designated for the renovation and modernization of the Chemical Engineering Unit Operations Laboratory in the College of Engineering. The remainder of the gift will establish the Otis Singletary chair in the humanities. For the past seven years, a chemistry professorship, five graduate student fellowships, and four summer fellowships in chemistry have been awarded annually. In 1980, Ashland Oil, Inc. made a \$1 million contribution to the College of Business and Economics for improvement and expansion and also gave the university funds to support a visiting professorship. In addition, the company and the foundation



Lucille Parker Markey



Frederick Van Lennep

have provided scholarships and gifts to the College of Medicine, the Mineral Research Law Center, the Department of Chemical Engineering, and the Interdisciplinary Human Development Institute.

Over the years, the Keeneland Association has made generous contributions to the UK research programs, including a total of \$144,000 for the agriculture scholarship endowment; \$102,000 for salary supplements in the College of Agriculture; \$62,000 for trace mineral studies; and \$50,000 for research to improve the state's livestock industry, to name only a few.

The Grayson Foundation supports specific equine research projects at the UK Department of Veterinary Science. According to Dr. Edward Ford, executive director of the foundation, Grayson began its support of research at UK not long after the foundation received its charter in 1940. But in the past three years, its research funding to the university has doubled.

Ford states that "there were more worthy proposals this year than we had money to fund." Grayson support to the university this year totals \$170,000 for six projects

ranging from studies on mare hormones aimed at preventing abortions, to investigations of the herpes virus in stallions. In the past, the foundation has awarded a number of William DuPont Fellowships, and Ford said plans for a new fellowship program are now underway.

Private individuals also make sizable contributions to scientific research at UK. Lucille Parker Markey, for whom the university's new cancer center is named, generously contributed to its construction. In addition, the Lucille Parker Markey Charitable Trust is providing fellowships to 12 Ph.D. students in microbiology and biochemistry. Another important contributor is Frederick L. Van Lennep who donated the start-up funds for the Van Lennep Cancer Immunotherapy Program of the Markey cancer center.

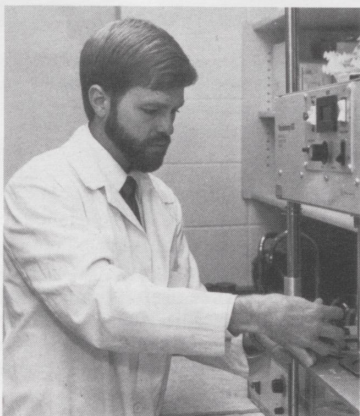
WHEN INDUSTRY STEPS IN WITH DOLLARS

cont. from page 35

departments of surgery and anesthesiology.

The companies which fund Wermeling's studies manufacture the spinal implant equipment.

Alan Parr, another student supported directly by contracts, is a Ph.D. candidate in pharmacy who works in the medicinal chemistry division under the directorship of Dr. George Digenis. Parr, whose studies on *in vivo* evaluation of dosage forms and the development of radio-labelling techniques aim at the empirical substantiation of company



Alan Parr is a Ph.D. candidate in pharmacy who works in medicinal chemistry. The investigations he carries out are to empirically verify an industry's claim that certain of its drug products will remain in the stomach a full 12 hours before breaking down. Parr is a native of Omaha, Nebraska.

claims for drug products, said "private funding is badly needed to support graduate students while they work toward degrees."

"I'm enthusiastic about the form of support I get because it gives me a good feel for both the academic and the industrial work settings." Parr's R.A. stipend, about \$8,000 per year, comes from the InterX Corporation. The investigations he carries out are narrowly prescribed to verify the industry's claim that certain of its

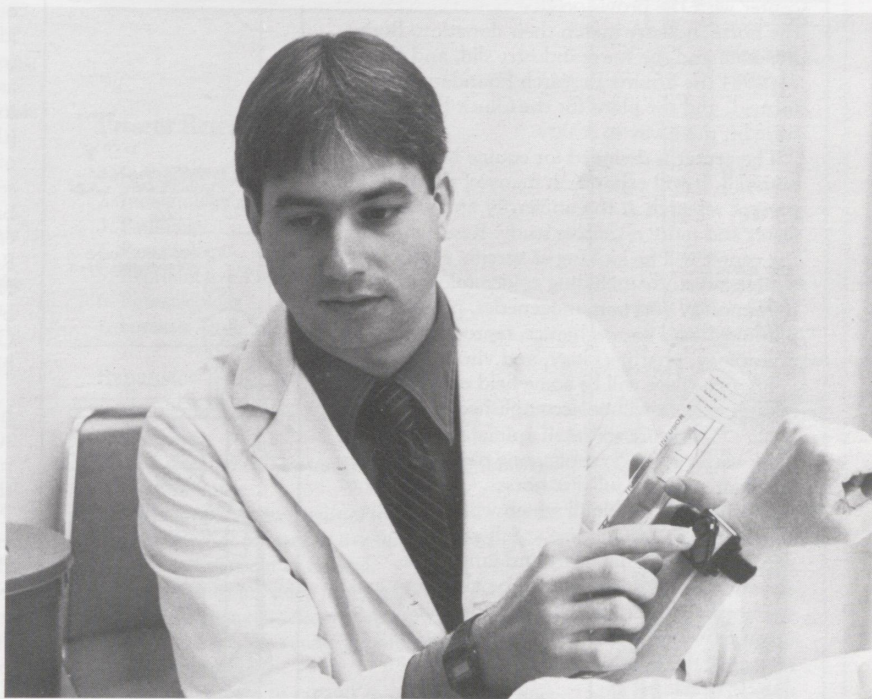
drug products will remain in the stomach a full 12 hours before breaking down. Parr explains that such studies are also designed to bring in new research contracts.

But not all funds for R.A. stipends arrive at UK as the result of proposals or longstanding alliances with industry. Mary Vore, in the Department of Pharmacology, recently received \$7,200 from the Eli Lilly Company to support a doctoral student who will assist her in major research on the liver metabolism of such drugs as oral contraceptives.

One day Dr. Vore got a call from a friend, one of many contacts in her professional network, informing her that she had been awarded the funds.

Earlier in the year, the professional acquaintance had nominated her for the award. The process was entirely informal. Vore said she appreciates the support very much, particularly in the face of a 12 percent cut in her NIH grant. "We need to address the problem of how to get more private money for research," she said. "What other methods can be developed?"

It is a question arising from many quarters on today's campus. Apparently, existing procedures and methods for gaining private sector research sponsorship need to be enhanced in many areas, and perhaps new sources can be found for those fields of study most in need of funding.



Dan Wermeling has a two-year appointment as a post-doctoral fellow and is conducting his research in the College of Pharmacy Drug Product Evaluation Unit where he investigates patient-controlled drug delivery systems. Wermeling received his doctorate from UK and is originally from Edgewood, Ky.

KEEPING A KENTUCKY PASSION HEALTHY

The center, named after the late Maxwell Gluck, is a \$9 million project. Mr. Gluck, a legendary businessman, real estate speculator, art collector, and U.S. ambassador, bought Elmendorf farm near Lexington and turned its breeding program into one of the best in the nation. In 1983 he and his wife, Muriel, donated \$3 million to UK toward the proposed research center with the provision that both the state and the horse industry match their donation. Both the state and the horse industry did, and on July 23, 1984 the Equine Research Foundation was formed, and the plans for the Gluck Building were on their way to reality.

Though there will be some field research, most of the research will be accomplished within the facility. There are six small animal rooms for work with rats and rabbits, one room for ponies, and four stalls for full-size horses. One feature of the facility is a treadmill which will enable the researchers to run a horse at full gait indoors while monitoring its heart and lungs. The elevation of the treadmill can be altered to make the horse work harder, and photographs will be taken to examine the motion of the legs and the impact of the hooves in relation to bone and muscle stress.

[illegible]

in the world, which will be available at the outbreak of any new disease we have failed to identify in the past." Most of these expert researchers will come from within the university, as John Walker, associate dean for development in the College of Agriculture explains, "Their [the UK Veterinary Science Department] record of accomplishment is rather amazing . . . of the seven vaccines used with horses on a regular basis, five of them were developed on this campus." Among the researchers is Dr. James R. Rooney, winner of the prestigious Tierklinik Hochmoor Preis, an international award given by the Hochmoor Veterinary Institute in Germany, for his work on the pathology and biomechanics of the horse.

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The Glucks, Muriel and her late husband, Maxwell, envisioned a facility dedicated to equine health research and challenged the horse industry and state government to match their \$3 million dollar donation. Their challenge was accepted and the Maxwell H. Gluck Equine Research Center is scheduled for completion in April, 1987.

disease problems are paramount, therefore, this is a veterinary science research facility."

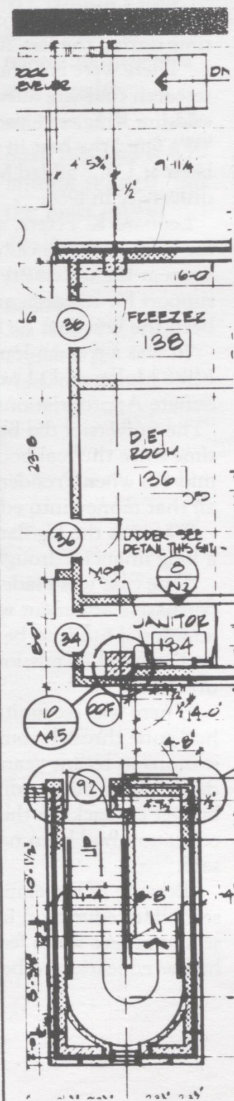
The information the program will provide the horse industry on equine health should prove invaluable. The results of the research, aside from being published in various journals internationally, will be kept on record in the Gluck building for easy access by Kentucky horsebreeders. In addition to the information center, the building will also contain a large auditorium and two conference rooms for short courses and seminars to introduce new techniques and procedures to veterinarian practitioners.

Present Research Programs at UK:

1. Infectious diseases
2. Immunology and Immunogenetics
3. Pathology
4. Parasitology
5. Reproductive Physiology
6. Pharmacology
7. Forensic Drug Investigation

Expansion Plans for Gluck Center

1. More laboratory space for further vaccine development.
2. New research will be undertaken in describing the immune response.
3. Current inadequate facilities for special identification of diseases of live horses will be given space and equipment to expand.
4. Space will be provided for expansion of parasite research, allowing necessary investigations into the life cycles of specific equine parasites and of their metabolic mechanism.
5. Additional space to expand an endocrinology and hormonal assay laboratory.
- 6,7. Space to house a new program in the pharmacology of drugs and to conduct drug research.



A \$20 MILLION PUSH

by Maria Braden

1986 General Assembly Gives Research High Priority

After a long dry spell, state money is once again flowing into the University of Kentucky.

In fact, following the 1986 General Assembly, longtime university officials and veteran state legislators say UK fared better than it has at any time during the last 20 years.

"There were enhancements received for research that will affect us for years to come," said Jim King, vice president for administration. "We fared the best in the 1986 session since I've been at UK," added Mr. King, who came to the university in 1966.

Leonard K. Peters, associate dean for research for the Lexington campus, said that in his 12 years at the university, the 1986 legislative support for research and graduate education has been the best that he has seen.

"It was a tremendous session," said Senator Mike Moloney, D-Lexington, chairman of the Senate Appropriations and Revenue Committee. "The university did better, I suspect, than any time since the real boom years in the early and mid-60s when President Lyndon Johnson poured all that money into education."

Why was the legislature so generous, after such a long financial drought?

"The case was made," said Moloney. The persuasive argument was that UK needed additional funds to be nationally competitive and to fulfill its mission as the state's research university.

"There was recognition of the fact that (UK) had gone through some very tough legislative sessions in recent years," said Ron Carson, deputy state budget director. As a result of budget cutbacks in the early 1980s, higher education had been neglected as a policy area, he said.

"Because of the emphasis on elementary and secondary education in the last legislative session, there was a feeling that it was time for higher education to be in the spotlight."

As Peter Bosomworth, chancellor of the medical center, said, "This has created a more positive environment for higher education in general. It's long overdue."

Mr. Carson also said that for the first time, the higher education community came together, presenting the legislature a united front. "The perception in Frankfort had been every campus for itself. This time they worked together."

UK got the lion's share, but Carson said that was to be expected because of the nature of the higher education funding formula and because of UK's statewide mission.

The 1986 General Assembly authorized funds for a variety of projects at UK, including approval of a \$20 million bond issue for research equipment, \$5 million for a supercomputer, and more than \$3 million for participation in the EPSCoR high technology research program. (See related article on p.23).

Commenting on the \$20 million bond issue, Dr. Bosomworth said he is "enthusiastic about the innovative approach the legislature took. It will be a gigantic step forward in terms of updating equipment."

"If UK is going to be a major research university, then it needs the tools," Carson said.

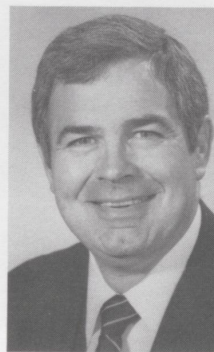
However, Bosomworth also pointed out the scarcity of what he called "flexible dollars."

"There are very limited new dollars for current operating expenses, for new faculty positions or support staff, for instructional equipment as opposed to research equipment, or for library acquisitions."

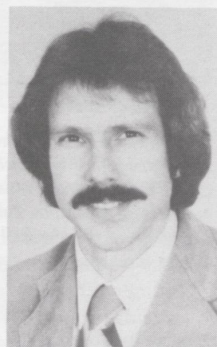
In an indirect way, the legislature supported yet another aspect of research by authorizing an increase in the university's operating funds, thus making it possible to increase stipends paid to graduate students by \$1,250 in the first year of the biennium. That makes UK more attractive for promising researchers.

A total of \$780,000 was added to graduate assistant stipends this year. UK's stipends are still more than one thousand dollars lower than benchmark institutions, but King said UK hopes to reach the benchmark next year. (See related articles on pp. 34-37.)

King, UK's chief liaison with the general assembly, said he believes one of the most significant project funded by the legislature may



Mike Moloney



Ron Carson

be the \$10 million Center for Robotics and Manufacturing Systems. Funds were appropriated not only for construction of a new facility, but also for a \$3.2 million annual operating budget. That will "truly make it a center of excellence in research and graduate education," he said. (See related article on p.35).

The legislature's financial support has "changed the environment substantially," according to King. "We went through a biennium that was very depressing, with two to three percent salary increases. That's not very conducive to recruiting and retaining the faculty we want for this institution."

University officials see the legislature's approval of a \$20 million bond issue for new equipment as a milestone.

The money to purchase new equipment will go far toward making UK competitive, Dr. Peters said. "I don't think there's another (single) university in the nation that's going to invest these kinds of funds. What we will invest in equipment in two years is comparable to what we already have in our current research equipment inventory — about \$20 million - \$25 million.

"But we also don't feel that it's going to meet our needs for all time," he continued. "It's something we're going to have to build on, demonstrate that we've had a major return."

"UK has been grossly underfunded for years, and funding wasn't available," King said. "We couldn't pull money out of operating expenses and faculty salaries."

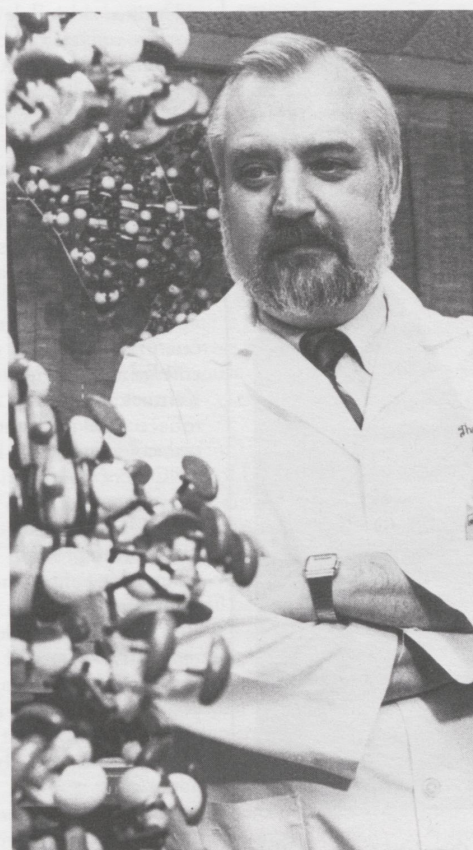
"This one-time purchase will give us the opportunity to fill that backlog and keep it going with the operating budget." King added that UK could have justified a \$50 million request, but that the most urgent equipment needs totalled \$20 million.

University officials see the funds for research equipment as seed money that will be used to obtain additional public and private grants.

"We feel that for that \$20 million — or whatever we expend — we should be able to substantially extend those funds by two methods," Peters said: "federal assistance on individual items and discounts from equipment vendors."

Peters and other administrators are in the process of reviewing requests to decide what equipment to buy. An effort is being made to combine or share equipment, where possible, to avoid duplication.

For example, researchers in chemistry, geology,



Biochemist Thomas Vanaman says that some of the research the new equipment will enhance may eventually enable scientists to engineer molecules that could, for example, activate the immune system to attack cancer cells.

biochemistry and agronomy, medicine and agriculture are looking at ways to share or combine their use of new, highly sophisticated equipment. There's a fringe benefit to these kinds of discussions, Peters said. It accomplishes the "breaking down of barriers, and promotes collaboration." As Bosomworth explains, "Our goal is to try to bring together equipment that has multi-user implications . . . to give the best possible equipment the most use."

Part of the funds earmarked in the \$20 million bond issue are to create new facilities for determining the three-dimensional structure of molecules that can be crystallized, according to Thomas Vanaman, chair of the Department of Biochemistry. He explained that the X-ray

UK has been grossly underfunded for years, and funding wasn't available. We couldn't pull money out of operating expenses and faculty salaries. UK could have justified a \$50 million request, but the most urgent equipment needs totalled \$20 million.

Jim King, UK Vice President for Administration



Bob Heath is director of the UK Computing Center, McVey Hall, where the new supercomputer will be housed.

crystallography equipment will be useful in connection with protein and DNA synthesis. "You have to be able to demonstrate that (what you come up with) is the protein that you're looking for," he said. "It allows you to understand molecules and to engineer them."

Twenty years from now, that understanding could enable scientists to build new molecules. For example, Dr. Vanaman said, researchers could engineer molecules that activate the immune system to attack cancer cells.

The major new piece of research equipment authorized by the legislature is a separate item - an additional \$5 million for the purchase of a supercomputer (\$10 million is authorized for the supercomputer, however UK has to come up with the resources for whatever it costs over \$5 million).

The possible need for a supercomputer was first

identified during development of a five-year plan for the university's computing and information system through 1990.

"We could see the need growing," said Peters, who is also the chair of the University Computing Advisory Committee. "Some faculty have used off-campus (equipment) for several years."

He indicated that the question of whether the university needed a supercomputer was sensitive because some felt that UK's need for micro and mini computers had not been adequately addressed. But several things came together at one time. Economic development began to emerge as an issue, and there was a sense that Kentucky could not continue to exist solely as a tobacco and coal state, but must look at technology options, he explained.

"One of the questions industry asks about is - what is our research posture, and in some cases, do we have a supercomputer?" Peters said.

According to Bob Heath, director of the computing center and associate vice president for information systems planning and policy, a supercomputer would offer a "new frontier" as a research tool, would create new research opportunities for faculty, would help recruit younger faculty and some types of industry, and would increase the status of the university as a research institution both in the state and nationally.

Purchase of a supercomputer continues to be a sensitive issue on campus. Some feel that it could prove to be an expensive white elephant. But Dr. Heath said the critics probably don't understand what a supercomputer can do and the opportunities and advantages it would offer.

One of the advantages the supercomputer will give the university is more active participation in the SURAnet program (Southeast University Research Association Network) which is building a large accelerator as one of its major projects.. SURAnet has received a major grant from NSF to network all the SURAnet universities*. One university in each state has been selected as the

* Universities participating in the SURAnet program include: Univ. of Delaware, Univ. of Maryland, George Washington Univ. (D.C.), Virginia Polytechnic Univ., Triangle Universities' Computing Center (Duke, North Carolina State Univ. and the Univ. of North Carolina), Clemson Univ., Univ. of Georgia, Georgia Institute of Technology, Florida State Univ., Univ. of Alabama at Birmingham, Louisiana State Univ., West Virginia Univ. and the Univ. of Kentucky

link for all of the other universities in the state. UK has been chosen as the site in Kentucky.

This will mean that faculty at any of the universities in Kentucky will have access to UK's supercomputer, the supercomputers at the SURAnet universities and the National Science Foundation's supercomputer centers. Eventually, faculty in Kentucky will be able to go through the UK link to San Diego, Princeton, Cornell, for example, and access their supercomputers when specialized resources of these centers are needed.

The impact of this access means that Kentucky faculty can have ready access to research resources and colleagues throughout the country - to correspond quickly through electronic mail or exchange research papers by viewing or printing out a document that a colleague at Princeton, or Illinois is collaborating on.

A UK researcher, for example, who is studying the dispersion of aerosols into the environment will have access to research on the subject from colleagues throughout the country to compare and exchange data and evaluate the research in much broader terms than previously possible.

Although President Otis Singletary was strongly behind the supercomputer, at times during the legislative session, approval looked doubtful. The university received the authorization to spend \$5 million in state funds for a supercomputer after Sen. Moloney made a personal appearance before the capital construction committee to plead that the computer be included in the budget bill.

"Dr. Singletary mentioned to me the importance of it. They started telling me what it could do," Moloney said. "The more information we got, the more it made sense to me."

University officials are involved in discussions with major vendors to determine what UK needs and how much it will cost.

But because of competition, the price of a supercomputer has dropped sharply. The maximum investment would be \$10 million, but it's likely that UK could get a \$10 million system for about considerably less, Peters said. The university must come up from other sources with whatever it costs in excess of \$5 million.

"We feel that [the initial purchase] may be less of a problem than actual operation and maintenance," Peters said. The issue of operation and maintenance will be a costly one for UK, according to administrators who say a conservative estimate is that it will cost 10 percent of the purchase price annually. Consequently UK must come up with at least \$1 million in recurring costs to operate the equipment.

The main criteria for the new system are that it must meet the needs of UK faculty and staff and that it be state of the art and expandable. Peters said UK must not underestimate its needs. "We don't want a dead-end system. I can guarantee you that the supercomputer we buy today, if we add nothing to it, will be obsolete in two years." "That doesn't mean it's going to be useless, but we will have to upgrade it. We will be determining how these upgrades can be built in over a three to four-year period. You have to have flexibility written into it."

UK administrators are also talking to a number of federal agencies including the National Science Foundation about the possibility of providing support to the supercomputer center at UK and/or of purchasing time on UK's supercomputer. Peters said having a supercomputer at UK will enhance investigators' opportunities to get grants.

But he also said that the system must meet UK's needs. "We don't want to be selling our souls to NSF and NIH [National Institutes of Health] for \$100,000 a year. Unless it really satisfies our needs and those of the state, it's not going to be a wise investment. We will be certain that it does satisfy those needs."

The legislature realized that UK had gone through some very tough legislative sessions in recent years and, as a result of budget cutbacks, higher education had been neglected.

READ A GOOD BOOK LATELY?

UK Libraries Accepts 2,000,001 Volume

by Lissa Atkins

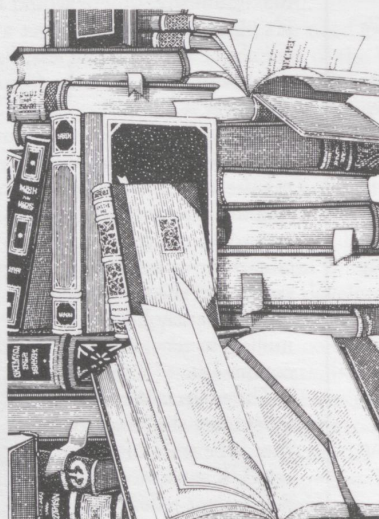
The Civil War and John Updike may not have much in common except that they represent two important milestones for UK Libraries. *An Oration Delivered on the Battlefield at Gettysburg, November 19, 1863* was presented this fall as the 2,000,000 volume to be acquired by the Lexington campus library system. Donated by the Student Government Association, the 2,000,001 book, John Updike's *Picked-Up Pieces*, was also celebrated.

For the estimated 5,000 daily patrons, the libraries are more than dusty buildings with books. "The UK library is a research system with a purpose to provide the information that faculty, staff, and students need for teaching and research," said Paul Willis, director of libraries. He sees his own role as that of spending the budget in the most productive way and providing assistance to the patrons.

This approach is reflected in how Mr. Willis and his staff determine to purchase resources. The specific criteria includes the availability of money, the permanency in terms of value of the materials and their fit into existing collections. Willis works with selectors—people in the libraries and departments who keep abreast of the books available—and receives requests directly from faculty and nonfaculty patrons.

Patrons can find their needed information in several places. Special Collections, home for the latest acquisitions, offer a rich accumulation of primary resource material said Claire McCann, manuscript librarian. Among the 117,000 volumes are rare titles such as John Filson's *The Discovery, Settlement and Present State of Kentucke*, the first history of Kentucky.

Other avenues of research in Special Collections include audio-visual, photographic and university archives; family and 20th century



political papers; and county records. A vast number of manuscripts exist and include the valuable W. Hugh Peel Collection of early English Romantics.

Supplementing the more than two million books are 23,000 periodicals, many of which are microforms. UK is ranked among in the top 20 in number of microforms with more than three million holdings. The periodicals provide faculty and students with the most current work in a particular field. "The collection of journals is extremely good," said Dr. Louis Swift in classics.

Helping to make the most efficient use of M.I. King and the 13 branches are a variety of services. For the more than 20,000 undergraduate and graduate students, getting a paper done quickly is made easier with the LS/2000 Online Public Access System. With about 85 percent of UK's collection entered, this computerized system is replacing the wooden card catalogs. Users can perform a number of searching options and immediately discover the location and status of a book. Implemented in the fall of 1985, 100 terminals are located throughout UK.

Despite the extensive number of resource materials, professors often need books or periodicals not owned by UK. Two services that help bridge these research gaps are the Center for Research Libraries and Interlibrary Loan.

Founded in 1949, the center houses approximately 3.5 million volumes and 1.1 million units of microform. Based in Chicago, the center purchases materials that no other place holds. Foreign dissertations, college catalogs, and area studies in Africa and East Asia are among the topics collected. Ethnic and foreign newspapers, valuable for Spanish and Italian Languages Professor Joseph R. Jones, can be found here too.

"I can be in Lexington and work with far more things, having more access and ease to materials than any European library that I can think of," said Dr. Jones. He also uses Interlibrary Loan extensively.

About 4,000 member libraries with 12 to 14 million records participate in Interlibrary Loan. Often only one or two copies of a book exist in the world. I.L.L. allows many people to use such materials. Available only to graduate students and faculty members, this traditional service has been recently computerized, shortening the waiting time for requests.

"It is very convenient to be able to sit down at the computer in reference and quickly find where a book is," said Dr. William J. Chambliss in history. "Usually the service is very prompt if the book is not on loan."

Many professors find their interests take them throughout the university. A self-described eclectic reader, Dr. Louis Boyarsky of physiology and biophysics uses many of the libraries. "I read anything that looks interesting—but only parts of them. One time I took out so many books that a former director, Lawrence S. Thompson, came over and looked in my office for them while I was gone on vacation."

BRINGING LITERATURE HOME

by Lissa Atkins

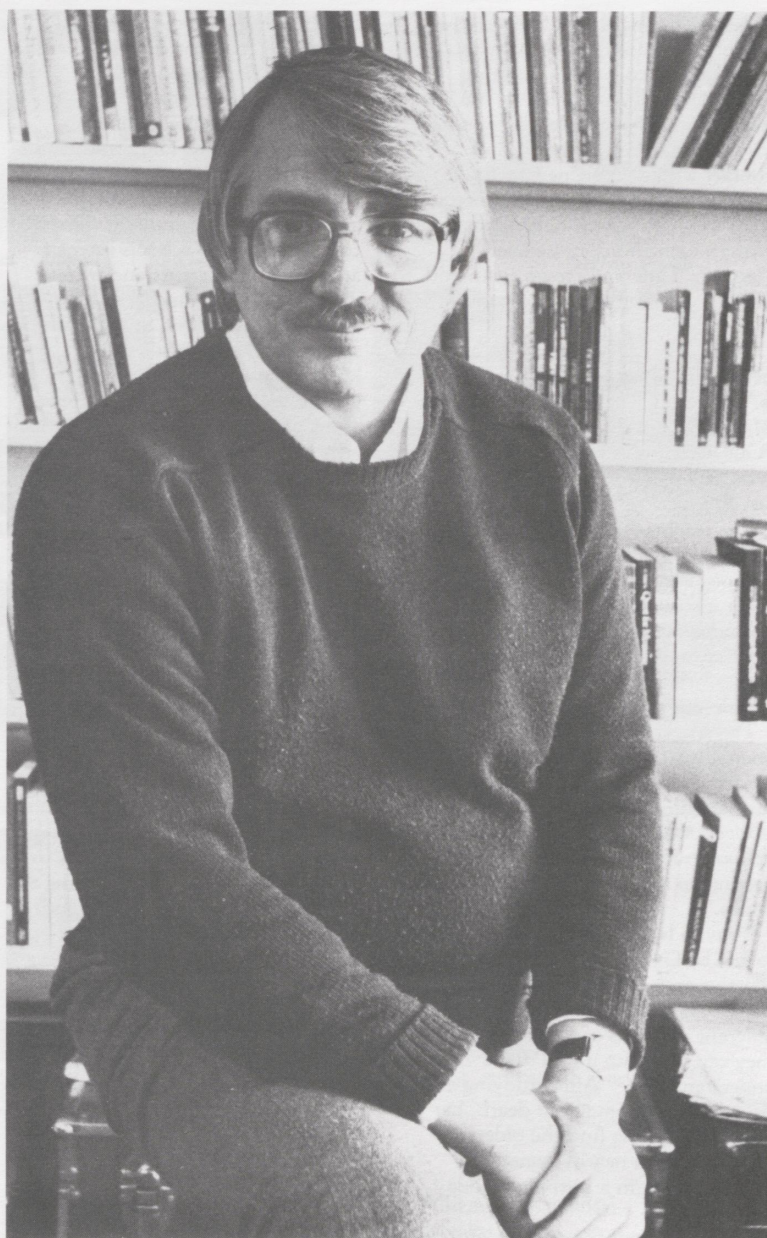
Some Eastern Kentucky public school instructors became UK students last summer in an effort to improve their teaching skills and combat the high dropout rate of Appalachian teenagers. Attending a four week institute, called "Literacy and Locality," the English teachers compared ideas and themes in classical American and Appalachian literature.

"The institute encouraged the schools' teachers to make greater use of regional literature," said Gurney Norman, Project Director. "Our basic premise is that the young people from Appalachia respond better to literature about them and their region. As a result, they have a better educational experience and are motivated to stay in school."

The UK Appalachian Center with an \$111,000 grant from the National Endowment for the Humanities sponsored the graduate level course. The 34 participants came from 21 Appalachian counties. In addition to discussing literary works, the junior high and high school teachers explored methods of presenting the ideas in the classroom. They also discovered effective ways to teach writing skills in conjunction with the texts.

"Many of the participants came away feeling personally empowered and confident in their scholarly abilities," said Norman. "Many of them began to make immediate plans to create this same educational experience for their students."

"The institute gave me a recharging in Appalachian literature," said Mickey McCoy from Sheldon Clark High School in Martin County. "Along with the Shakespeare, we are going to put in the James Still and George Ella Lyon and try to motivate



*Gurney Norman, a native Kentuckian, was recipient of a Wallace Stegner Creative Writing Fellowship to Stanford University in the 1960s and is author of several novels, including *The Divine Rights Trip*, which sold over two million copies.*

continued on page 46

kids who normally aren't motivated."

Librarian Sandra Creech started an Appalachian collection at a grade school level 12 years ago. Not finding much material available, she set the idea aside. "This summer I came in contact with a whole new realm of Appalachian authors," said Creech from Kingdom Come Settlement and Cowan Elementary in Letcher County. "I am ready to go again and begin acquiring more Appalachian materials."

"Basically, I came away with a better idea of how rich our literature is," said Sally Runyon from Sebastian Middle School in Breathitt County. "Our literature is not very old, but it is becoming richer, especially in the last 20 years."

The teachers' enthusiasm has begun to spread throughout the schools, touching both students and other instructors. "I have been encouraging my colleagues to work in the Kentucky literature into their classes," said McCoy. "I am available to help out any way I can."

The students are responding favorably to the new material. "We're having good class discussions because they are finding themselves in the stories," said Judy Lucas at Cordia School in Knott County. "They are coming up and borrowing my books."

Runyon has found two short stories by Gurney Norman to be effective with her remedial reading class. "They are identifying the different elements of a story because they can plug into it and say 'I understand this.'" After studying an Appalachian poem about death, her class competed to find the oldest tombstone in a nearby cemetery. This put them in a historical mode too, she said.

For Floyd County teacher Carol Stumbo, the summer institute provided the topic and contacts for an Appalachian workshop in

**" . . . I came away
with a better idea
of how rich our
literature is."**

**Sally Runyon, Teacher
Sebastian Middle
School, Breathitt Co.**

September. A school-community partnership committee had already decided to do some kind of workshop, but it became Appalachian-oriented after she returned from UK, said Stumbo, a teacher at Wheelwright High School. Gathering at Jenny Wiley State Park, approximately 100 students from the county's five high schools listened and watched 12 artists and writers discuss their work and give demonstrations. Mrs. Stumbo also said that Wheelwright's student oral history magazine is planning to publish an interview with Norman and a piece of his writing.

A magazine for Eastern Kentucky students in grades 7 through 12 also developed from the summer institute where members first formulated the idea. Presently looking for grant money to get started, McCoy, Runyon and Kathye Greene from Bell County hope to see the first issue in the fall of 1987. The journal would encourage students to write since they could get to see it published, said Runyon.

The impact of the institute is not ending there. Two course instructors, Norman and Dr. Harry Brown from Eastern Kentucky University, are planning to visit certain schools to reinforce what was taught during the summer. They will be talking with the students and teachers about Appalachian literature and helping out any way they can, said Jane Bagby from the Appalachian Center. For the spring, a series of in-service training sessions are being scheduled in which institute participants will instruct their colleagues.

**"The institute gave
me a recharging in
Appalachian
literature. Along
with the
Shakespeare, we
are going to put in
the James Still and
George Ella Lyon
and try to motivate
kids who normally
aren't motivated."**

**Mickey McCoy,
Teacher
Sheldon Clark High
School, Martin Co.**

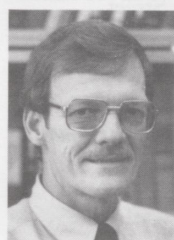
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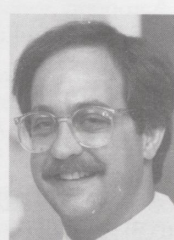
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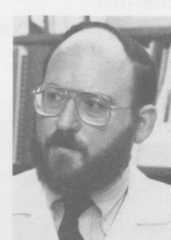
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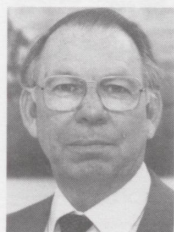
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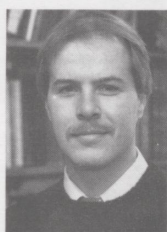
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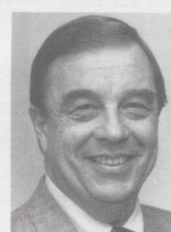
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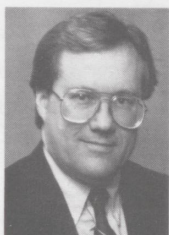
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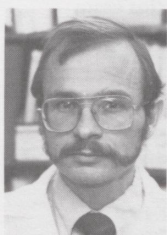
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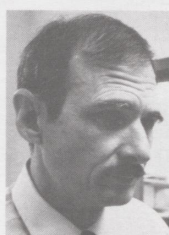
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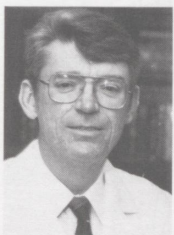
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