

IN VIVO

Newsletter of the University of Tennessee Division of Biology

VOLUME 4, NUMBER 2

AUGUST - SEPTEMBER, 2004

From the Director Otto J. Schwarz, Ph.D.



I thought that I might dive right in and start our conversation by doing a little bragging on our faculty. All of you know that a

great deal of time is spent by our Biology faculty in pouring over collected data, searching the literature, and finally writing papers to test hypothesis in the open winds of peer criticism (publications). That's the academic way of things at a modern research university.

This endeavor by its very nature is reasonably costly; in fact it can be hugely expensive by any measure of comparison. The current R account budget of the Division of Biology is slightly in excess of 12.4 million research dollars. This level of governmental and private grant and contract support represents an ever-increasing effort by faculty to maintain and invigorate their research endeavors at UTK. The dollars that run those laboratories

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Microbiology's fearless leader

Professor **Dr. Jeffrey Becker** wears many hats within the Division of Biology. He is the Head of Microbiology, and he is also the Director of the Graduate School for Genome Science and Technology (GST). One would think that facing this mountain of responsibility each day would be daunting, but not to Dr. Becker. He said, "I still love to come to work every morning. I love what I do."

Beyond his administrative duties, Dr. Becker keeps an active laboratory where he works in three different areas. His first area of research has kept him busy for over 30 years. With the collaboration of his long-time friend, **Dr. Fred Naider**

of the City University of New York, Dr. Becker has cloned, sequenced and characterized peptide transport genes in *Saccharomyces cerevisiae* (simple Baker's yeast) and other organisms. He is trying to understand the mechanism by which cells absorb small peptides.

Because yeast cells are a model for other organisms, including humans, it is easy to realize the

benefits of this work. Dr. Becker said. "For example, understanding peptide transmission in the cells lining the small intestines can help pharmaceutical companies design drugs that are easier for the body to absorb."

A second area of research still involves yeast, but looks at the way cells communicate with each other

using peptides. Cells often use peptides as signal molecules similar to the function of hormones. Dr. Becker focuses on a particular receptor that recognizes peptides in yeast, G protein-coupled receptor (GPCR), which is closely related to the largest family of receptors in humans.

The receptor in yeast is located

on the surface of the cell and interacts with approaching peptides without letting them into the cell. These peptides can send messages such as "stop growing" to the cell. This area of research has been almost entirely funded by an NIH grant that has currently reached its 30th year. The reason for the longevity of this research is obvious since GPCRs are

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Dr. Becker relaxing with his grandchildren Reuben and Sophie



From the Head

By Dr. Jeff Becker



Occasionally people I meet ask me what aspect of my profession provides the most

satisfaction. Some of the things that come to mind are: (1) the wonderment of observing an aspect of "nature" that occurs in the process of performing a scientific experiment or in analyzing data from experiments; (2) the great satisfaction that comes from explaining "science" to a student who "gets it"; and (3) the joy of seeing one's work come to fruition in the form of a scientific publication.

However, surely the most enduring and satisfying aspect of my work comes from the accomplishments of my former students after they leave UT and establish their own careers.

A few days ago, I received the following note from **Greg Anderson**, a Microbiology student in my




lab a few years ago: "I just graduated with my second master's degree from Emory with a Master in Public Health with a

concentration in Health Policy and Management. Hope to drop by and visit sometime this fall and introduce you to our son, **William**."

In fact, Greg is on track to a very successful career as a scientific administrator at CDC in Atlanta. He obtained his second degree in his "spare time" while being employed full time at CDC as an assistant in the Office of the Director after working in the CDC infectious

disease unit laboratory upon graduating from UT. His pride in his affiliation with UT and in his son is evident in the picture Greg provided.

I hasten to add that Greg is one amongst many of our former Microbiology students who are doing well in various career pursuits in academic, private, and governmental institutions throughout the country. I love to reminisce with them about their days at UT and to have them share their experiences of their growing careers (and families!). And my experience is reflected by the experience of our entire Microbiology faculty, who take interest in their student's lives and careers.

The faculty and staff of Microbiology are dedicated to training students who may enter a variety of Microbiology-related areas. We declare continued interest in those students who have trained with us. We look forward to training future Microbiologists approaching this task with humility for the trust placed in us and with the realization that this undertaking eventually pays us back in 100-fold excess to the effort we make when we see their flourishing lives. 

jbecker@utk.edu

Microbiology

M409 Walters Life Sciences Bldg.
Knoxville, TN 37996
(865) 974-3441
(865) 974-4007

Jeffrey Becker, Professor and Head
jbecker@utk.edu

David Brian, Professor
dbrian@utk.edu

Deziree Elliott, Principal Secretary
delliot2@utk.edu

James Fleming, Research Asst. Prof.
jff@utk.edu

Melinda Hauser, Research Asst. Prof.
mhauser@utk.edu

Uday Kumaraguru, Research Asst. Prof.
udayk@utk.edu

Alice Layton, Research Assistant Prof.
alayton@utk.edu

Byung-Kwon Lee, Research Asst. Prof.
bklee@utk.edu

Elizabeth McPherson, Super./Instructor
edfish@utk.edu

Robert Moore, Professor
rmoore1@utk.edu

Susan Pfiffner, Research Asst. Prof.
pfiffner@utk.edu

Todd Reynolds, Assistant Professor
treynol6@utk.edu

Stuart Riggsby, Professor and Dean
sriggsby@utk.edu

Steve Ripp, Research Assistant Prof.
saripp@utk.edu

Barry Rouse, Professor
btr@utk.edu

Mark Sangster, Assistant Professor
msangste@utk.edu

John Sanseverino, Research Asst. Prof.
jsansev@utk.edu

Gary Sayler, Distinguished Professor
sayler@utk.edu

Pamela Small, Professor
psmall@tennessee.edu

Tim Sparer, Assistant Professor
tsparer@utk.edu

Chunlei Su, Assistant Professor
csu1@utk.edu

Carole Vosdingh, Administrative Aide
cvosding@utk.edu

David White, Distinguished Professor
dwhite1@utk.edu

Steven Wilhelm, Associate Professor
wilhelm@utk.edu

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the target of over half of all prescription drugs. Well known treatments for ulcers, asthma, migraine headaches, and heart failure received their start from the understanding of this basic peptide signaling process.

In his third area of research, Dr. Becker leaves Baker's yeast to study the fungal pathogen *Candida albicans*. While similar to Baker's yeast, *C. albicans* can cause disease. Humans already carry *C. albicans* in their intestines, but it does not become pathogenic until the immune system is weakened. Dr. Becker is currently studying the factors that make this opportunistic pathogen virulent. NIH has also funded this research as it pertains to the search for a cure to for infections that cause life-threatening problems in persons with HIV-AIDS and other immunocompromising diseases.


Dr. Becker ultimately attributes his research program to his students and to his collaboration with Dr. Naider. As a chemist, Dr. Naider synthesizes the yeast peptides and returns them to Dr. Becker for study. "The combination of chemistry and biochemistry is synergistic. These two approaches together produce more than they could acting alone."

Even with his important research, Dr. Becker finds that his greatest satisfaction comes from teaching. He said, "I like to think that I contribute to research, but more important to me is that it is a tool to train students." He has had numerous undergraduates, graduate, and doctoral students come through his laboratory over the years. He keeps many of their pictures on his wall above his desk and he enjoys recounting where they are and what they are doing in their careers. He said, "I have Ph.D. students who've gone on to work at the University of California at Berkeley, Harvard, Columbia and Johns Hopkins. I also have some working in regulatory affairs within the FDA and in research in

various biotech companies."

His focus on students was evidenced by his taking over the directorship of the GST program in 1999. The arrangement between Oak Ridge National Laboratory and the University has been enhanced with existing UT faculty to provide an excellent training ground for future scientists.

Dr. Becker was born in Baltimore, but was raised in Orlando, Florida. He completed his undergraduate degree at Emory University in 1965 and received his Master's in Biology at Georgia State University in 1967. In 1970 he received his Ph.D. in Microbiology at the University of Cincinnati. He said that he started his current research work in 1971 at the Weizmann Institute in Israel as a Postdoctoral Fellow. It was there that he also met fellow scientist and long time friend, Dr. Naider.

While he could talk about his long list of grants, contracts and patents, he would much rather talk about his family. He and his wife **Nancy** of 22 years have six children and three grandchildren between them. He likens them to "The Brady Bunch." His wife is the retired Education Director for Heska Amuna Synagogue. She is now the active President of the Synagogue. They are both active in the community through many avenues including charitable organizations such as the East Tennessee Foundation, where Dr. Becker serves as a Board member. 

jbecker@utk.edu

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in their day to day quest for nature's secrets are almost solely financed by these grants and contracts bourn on the creative shoulders of, you guessed it, our faculty.

In general, state appropriations are used to build buildings with faculty offices, teaching class rooms and research laboratories. Every bit of the bricks and mortar expended are necessary in today's educational world to produce our products, well-educated undergraduates, graduate students and well tuned post docs.

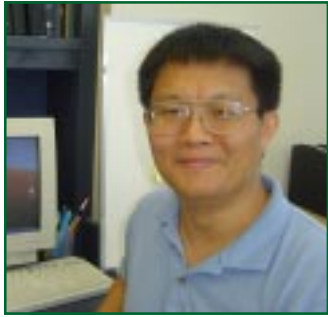
Well, you say, how are these grant and contract dollars actually expended to support this research/educational effort? Thank you... That was a great question. Here is an over simplified answer (Remember, I am relatively new in management...). In general, for every dollar received by a faculty investigator via a grant or contract arrangement, 42 cents is initially retained by the "University." The balance (58 cents) is free to be used according to a previously faculty-proposed and subsequently grantor-approved budget by the faculty investigator to carry out the proposed research.

The vaporized 42 cents is used to cover "overhead costs" that maintain facilities, keep the lights burning, pay the water bill, etc. This sum of money comprises the much maligned "F&A," a category of funds much discussed and sought after by faculty investigators, department heads and Deans.

Fortunately a portion of these monies do make there way back to the college and some fraction of that to the department of the faculty investigator and occasionally to the seminal research program from whence it was born. University folk lore suggests that the remainder of these funds is increasingly neces-

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Dr. Su on the trail of toxoplasmosis



Toxoplasmosis is a serious disease, especially to those with weak-

ened immune systems. While up to 35 million Americans are infected with the *Toxoplasma gondii* pathogen, only a percentage will actually develop the disease toxoplasmosis that causes birth defects, brain inflammation and problems with vision.

Studying this chronic disease is Microbiology's newest Assistant Professor, **Dr. Chunlei Su**. He said, "*T. gondii* is closely related to a number of single-celled parasites of significant medical and veterinary

importance, such as Plasmodium that causes malaria and Neospora that is involved in abortion in cattle."

"It is capable of infecting most animals and birds and has to live and replicate inside host cells. *T. gondii* has recently emerged as a major opportunistic pathogen in immunodeficient patients such as AIDS, cancer chemotherapy and organ transplant. It also causes birth defects in a fetus if a woman gets infected while pregnant."

Humans can be infected by accidentally swallowing spores from contaminated soil, water, cat litter or objects that have had contact with cat feces. Infection can also occur from eating raw or partially cooked meat.

Dr. Su said, "This parasite infects human cells and replicates rapidly. Under human immune attack, the parasite switches into slow-growing

form contained in tissue cysts within skeletal muscle, the central nervous system and other tissues. The parasites in tissue cysts are resistant to human immune attack and stay there for the lifetime of the individual. *T. gondii* in the tissue cysts can switch back to the fast-growing form when a person's immune system is suppressed."

Animals also suffer the possibility of contamination. Dr. Su said, "*T. gondii* infects two types of hosts: intermediate (animals, birds and human) and definitive (cats) hosts. When a cat eats an infected mouse,

analysis to study parasite gene expression. Microarray analysis is a powerful tool to study a large number of genes simultaneously. It can identify candidate virulence genes rapidly.

He then will focus on a few major genes to determine their function in virulence, this may lead to the development of strategies to treat toxoplasmosis in the future. He also studies population genetics of *T. gondii* by genotyping and DNA sequencing.

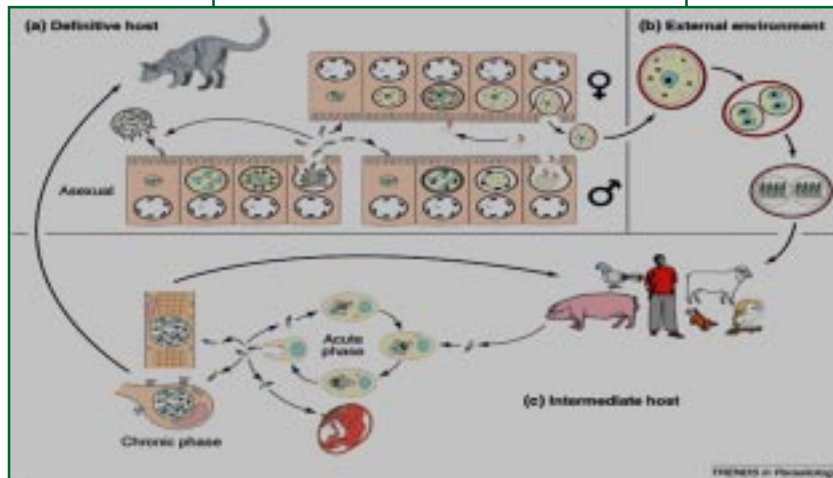
The population genetics study will elucidate how different strains of *T. gondii* collected worldwide are related and evolved. It will help him to develop further studies to understand why only a few strains of the parasite predominant in human populations while so many different strains are circulating in animals in the field.

Dr. Su was born and raised in Aksu, Xinjiang province, China. His parents were workers on a state-owned farm growing crops and

raising animals. He said, "After school, I would normally go out to the fields with one of my brothers to pick up vegetables and then make feed for a few chickens of our own. This was helpful to bring some food to the table for the family because of short supplies at that time."

In 1982 he went to the China Agricultural University in Beijing. He graduated in 1987 with a degree in veterinary medicine. He married his wife, **Ying Qi**, in 1991 and they now have two daughters. His wife has a master's degree in microbiology. He came to the states in 1992 and received his master's degree at Brigham Young University. In 1999, he received his Ph.D. at Pennsylvania State University.

He spent the last five years in



for example, the parasites will infect the small intestine of the cat and replicate rapidly there. After several days, the parasites differentiate into female and male cells, which fuse to form a zygote. The zygotes are shed into the environment through cat feces and then undergo division into progeny called sporozoites.

When ingested by animals, these sporozoites invade animal cells and replicate rapidly for a few days. The infected animals will either being killed by the parasites or become chronically infected until being consumed by cats. The cycle just goes on between intermediate and definitive hosts."

His research focus at UT will be on the search for determining factors of virulence and *T. gondii* population genetics. Dr. Su uses microarray

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Battling hospital-based fungal infections

While it is difficult enough for patients in the ICU units of hospitals to recover from their injuries or surgical procedures, add in a secondary infection, and things can go from normal to dangerous. The most common infections are bacterial, which doctors fight with a broad range of antibiotics. However, the worst infections are fungal because there are fewer weapons in a doctor's arsenal that are effective against them.

Fungal infections, caused by pathogens such as *Candida albicans*, infect the host often through intravascular catheters that tap into the patient's bloodstream. These fungi can generate a complex community, or biofilm, that are very difficult to treat.

Anti-fungal medications are not as effective as anti-bacterial because fungal cells are so similar to the host cell.

Therefore, many of the antifungals are somewhat toxic and must be used sparingly. In addition, when fungi grow as a biofilm they become more resistant to antifungals. The result of this is that the biofilm serves as constant source of infection in the intravascular catheter. Often the only solution is removal of the catheter which can sometimes be dangerous for the patient.

Assistant Professor in Microbiology, **Dr. Todd Reynolds**, is working to find out how the *Candida* cells find their host, attach, and then spread. So far it is known that *Candida* attaches easily to plastics, especially polymer plastics like the ones used in vascular catheters. It is also known that biofilms form quickly.

Dr. Reynolds' approach is from the molecular level, using the Bakers'

yeast, *Saccharomyces cerevisiae*, as a model. Bakers' yeast provides a powerful genetic model system with which to study the molecules involved in biofilm formation. In particular he is studying the signaling molecules that lead to attachment of the fungus. He said, "We are studying the genes that comprise molecular pathways and it is these pathways that play an important role in regulating biofilm formation. Some of these pathways regulate the



Rachel McMullen, Dr. Reynolds and Cindy Peng


expression of a large cell-surface glycoprotein called Flo11p. This particular glycoprotein is necessary for the attachment of *Saccharomyces cerevisiae* cells." Similar molecules are thought to be involved in allowing *Candida albicans* to form a biofilm.

Since fungal cells have walls, but human cells do not, Dr. Reynolds is targeting the genes and proteins that are involved in initial attachment of the fungal cells to other cells or plastic surfaces. He said, "We are using genetic, genomic, and proteomic approaches to analyze the genes and proteins in *S. cerevisiae*. Genes that are identified as important for biofilm formation by *S. cerevisiae* will serve as guides for examining the role of homologous genes for biofilm formation by *Candida*." He is currently working on grant proposals for NIH to fund his research.

Dr. Reynolds began his career in

the sciences by earning a bachelor's degree in recombinant genetics and chemistry at Western Kentucky University in Bowling Green. He studied the signaling processes in yeast cells during his work in the laboratory of **Dr. Todd Graham** in the Department of Biological Sciences at Vanderbilt University where he received his Ph.D. in 1999.

His work with fungal biofilms began during his postdoctoral fellowship in the laboratory of **Dr. Gerald Fink** at the MIT affiliated, Whitehead Institute for Biomedical Research in Cambridge, Massachusetts. While on a plane leaving Boston, he met his wife **Rachel**. They were married in June of this year. Her interest is in social work and she hopes to settle into a career here soon.

Dr. Reynolds joined the Department of Microbiology one year ago. He came to East Tennessee in part because he enjoys the mountains and smaller city life of Knoxville. And while those were good reasons to come here, ultimately, he was attracted to UT because of the positive impression he had of his fellow colleagues in Microbiology, the impressive resources at the University, and his desire to be part of a department that was focused on microbiology. In addition he also wanted the opportunity to work with both graduate students and undergraduates in his laboratory. 

trey nol6@utk.edu

"Absolutely essential"



There are those in academic departments who are seen often and known by all. For example, faculty, graduate


students and main office staff members are known at least by name. However, there are also those who work in the background, tirelessly serving others so that research and teaching can be done to the highest standards. One of those behind-the-scenes persons is Laboratory Technician, **Judy Whitaker**.

Judy is has a reputation of being dependable and contentious as she works for ten research laboratories in Microbiology. She washes and sterilizes glassware and then delivers it back to the professors, keeping them amply stocked.

Administrative Aide for the department, **Carol Vosdingh** said of Judy, "She really doesn't like for there to be a steam or water outage in the building. She has to be sent home early if that happens and she would much rather be here getting her work done."

She has been with UT for 25 years and all of that time has been spent with Microbiology. She said, "I have a great relationship with fellow co-workers. It is also very interesting working with people from other countries. Everyone always makes me feel welcome." Department head, **Dr. Jeff Becker** said, "Judy is absolutely essential to Microbiology. Her dependable, high-quality work allows our research program to run smoothly. She is a great co-worker, and we are very fortunate to have her as a staff member of the Department."

Originally from Blountville, Judy has lived in Knoxville since 1969. She has been married for 34 years and her husband, who recently retired from TVA. She has one son and one daughter and four grandchildren.

In her spare time she enjoys yard work, swimming and spending time with her family. 

Field Station News

Two professors have recently used the Field Station located in the Greenbrier area of Gatlinburg. **Dr. Michael Pogue** of the Smithsonian Institution has been studying the "Owlet" moth (Noctuidae). He utilized local teachers and high school students as volunteers.

Dr. Nathan Sanders of UT's Ecology and Evolutionary Biology department has also been using the facility for his ant diversity study.

Alumni News

Betty R. Davis (Bacteriology, 1949, 1955) Recently retired, Ms. Davis was a Research Microbiologist for the Centers of Disease Control, Atlanta. She now lives in Knoxville.

Halkard Mackey, Jr., Ph.D. (Zoology, 1970) After seven years as Associate Professor and Chairperson of the Biology Department at the University of Pittsburgh, Johnstown, and 25 years as Senior Research Scientist with the Savannah River Site (DOE), Dr. Mackey has taken early retirement. His plans are to pursue his interest in floristic studies in western North Carolina and eastern Tennessee. He now lives in Aiken, South Carolina.

Faculty Outreach

Dr. Sandy Echternacht of Ecology and Evolutionary Biology, **Dr. Stan Guffey** of Biology and **Dr. Beth Mullin** of Botany participated in the annual in-service workshop for Knox County school teachers.

Representing the biological science arm of this endeavor, these three worked with the UT Office of Academic Outreach to bring new tools and ideas to local middle and high school science teachers.

Dr. Guffey said, "Working with public school teachers is especially gratifying to me because of the level of commitment the teachers bring to their work and the interest and appreciation they have for any helpful interaction with UT faculty and staff."

Faculty Awards

Dr. Beth Mullin of Botany recently received the L.R. Hesler Award. **Dr. Randy Small**, also of Botany, received the Professional Promise in Research and Creative Achievement Award.

A Thank you to our Donors:

Ira Deep
Betty R. Davis



Science Alliance Award recipients for the 2003-2004 academic year:

Left to right: **Nathan Verberkmoes** -
GST; **Lori Stinnett** - BCMB;
Kaustav Banerjee - Microbiology;
Joey Shaw - Botany;
Yu Chen - GST (not pictured);
Kevin Smith - EEB (not pictured)



Alexander Hollaender Fellow- ship for 2004-2005: **Joey Shaw** - Botany

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sary for the continued well being and growth of the greater University, all in the light of essentially flat state funding.

In the coming issues of *IN VIVO* several of many exciting research programs currently underway in the Division will be described. These are programs that were born of widely differing intellectual interests from programs delving into the private life of bats to the cooperative efforts of chemical engineering and biological sciences in the quest for new and renewable sources of energy.

This issue of *IN VIVO* highlights our Department of Microbiology headed by **Dr. Jeffery Becker**. Jeff, as you will read, is also busy as Director of the Graduate School of Genome Science and Technology, a joint effort between The University of Tennessee and Oak Ridge National Laboratory. In his "spare" time Jeff continues to guide a robust research program supported through long term federal funding.

The interesting and important work of two of Microbiology's junior faculty members **Dr. Chunlei Su** and **Dr. Todd Reynolds** is also included in this issue. Don't forget to visit the "Focus on Staff" section, a long time contributor to Microbiology's success in teaching and research, **Judy Whitaker**, is profiled. Finally, it is with great sadness that I relay to you the recent passing of a longtime faculty member of the Botany Department, **Professor Patricia Walne**. A memorial will appear in the next issue of *IN VIVO*.

It is important that all we enjoy the gifts of life that surround us. Have a pleasant and peaceful Thanksgiving.


Cheers
Otto 

oschwarz@utk.edu

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postdoctoral work at Washington University School of Medicine in St. Louis. He said, "My first time to Tennessee was the job interview back in April of this year. The reason I chose UT is that it has the best environment and resources for me to reach my goals in my scientific career and it is also a wonderful place for raising a family."

He is happy with his new home in Microbiology. He said, "It is a great time to join the department. My interactions with the faculty members have been pleasant and wonderful. The department head **Dr. Jeff Becker** is very supportive. With his help, I have already contacted **Drs. Sharon Patton** and **Charles Faulkner**, who are in the parasitology diagnostic lab in the College of Veterinary Medicine, to develop collaborative research projects in the near future."

Dr. Su is interested in teaching molecular parasitology and microbial parthogenesis. He hopes to win grants from NIH, USDA and other local and private funding agencies in the near future. 

csu1@utk.edu

In Vivo

An alumni newsletter published by the
Division of Biology
Otto Schwarz, Director
Laura Maples, Primary Writer/Editor
lmaples@utk.edu

The University of Tennessee
Division of Biology
M303 Walters Life Science Building
Knoxville, TN 37996-0830
(865) 974-6841 Fax (865) 974-4057
<http://web.bio.utk.edu/Division>



The University of Tennessee
Division of Biology
M303 Walters Life Science Bldg.
Knoxville TN 37996-0830

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VOLUME 4, NUMBER 2

AUGUST - SEPTEMBER, 2004

Faculty Showcase

On Saturday, November 27 **Dr. Barry Bruce**, of Biochemistry, Cellular and Molecular Biology, will be the featured speaker for the Faculty Showcase held on campus in the Shiloh Room of the University Center two hours before kick-off of the Kentucky football game.

He will be speaking on "Genetically Modified Organisms and the Bio-Technology of Agriculture: America's Cornucopia or Environmentally Threatening 'Franken-foods'?"

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