IN VIVO

Newsletter of the University of Tennessee Division of Biology

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From the Director

Otto J. Schwarz, Ph.D.

Welcome once again to the latest edition of your alumni newsletter, *In Vivo*. Spring has come at last to the mountains and valleys of Eastern Tennessee, despite the fact that I am writing to you securely wrapped in a blanket whilst sitting at home in my study. I hope that as I write Mother Nature is satisfying her final need for frosty mornings as the outside temperature bottomed out at 26 F here in rural Knox county.

Even though my personal training and life's interest in things cellular and hormonal placed me almost one hundred percent in the laboratory, I am, I must confess, a closet naturalist. So although I cannot easily arrange a visit to our research laboratories, I can admonish you to take a few moments and to go outside, observe nature's reawakening and marvel at what you see, smell, hear and feel. Best of all its free and never ending. All of these wonderful natural inputs to the senses has again brought a feeling of true optimism for all things personal and

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Bringing new ideas to genetic studies

What began as a general study of the molecular divergence between repetitive sequences among species has turned into a complex study of the molecular mechanisms that control gene expression at the chromatin level. **Dr. Mariano Labrador**, newest member of the Biochemistry, Cellular and Molecular Biology Department (BCMB), has come to UT to find out how and why certain regions of the *Drosophila* (fruit flies) genome remain highly condensed precluding any transcription activation, whereas neighboring adjacent sequences show a dramatically different transcription activity and low chromatin condensation.

To put his work in perspective, Dr. Labrador likes to point to the human genome. In humans, the amount of the genome that actually encodes for the proteins necessary for normal development only accounts for a few percent. Hence, a relatively small number of "good" genes are found embedded in a profusion of sequences, roughly half of which are unique with unknown or no function and the other half consisting of potentially deleterious DNA such as transposable elements or highly repetitive sequences.

Transposable elements (think of them as hundred of thousands of dispersed DNA sequences that can move and change positions inside our genomes) have the ability to generate insertional mutations that can potentially inactivate genes that are vital for the cell. Highly repetitive sequences, on the other hand, tend to amplify themselves through mechanisms such as slippage and can potentially generate unequal recombination events that could unbalance the critical transfer of genetic information during cell division.

Through evolution, eukaryotic cells (the good genes) had to live in permanent conflict with such sequences and had to put in place mechanisms to first accommodate them in a relatively small place, such as the cell nucleus, and second to control their activity and thus minimize the harm they can exert. It is remarkable that these mechanisms turned out to be the same mechanisms that the cells use to control very important processes in the nucleus such as transcription regulation, recombination or mitosis.

Briefly, these mechanisms consist in wrapping up the DNA around a protein complex made by histones and forming a unit called the nucleosome that repeats itself along the DNA in a manner similar to that of pearls in a string. We call the string of DNA plus nucleosomes the chromatin fiber. Cells have devised molecular mechanisms to pack and unpack these nucleosomes in highly condensed chromatin domains (heterochromatin) or in domains of decondensed chromatin (euchromatin). We can envisage chromosomes during

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From the Head

by Dr. Bruce McKee

The BCMB Department is in the midst of what can only be called a "youth movement". When I assumed the headship 3½ years ago, we were a mostly senior department with only two assistant professors, **Chris Dealwis** and **Jae Park**, both of whom had been hired the previous year. In the next two years, we added four more junior faculty members, three in the structural biology area, **Elias Fernandez**, **Nitin Jain** and **Hong Guo**, and a mouse geneticist, **Sundar Venkatachalam**.

These dynamic new members of our faculty, who have been featured in recent issues of *In Vivo*, are bringing new energy and ideas to our research and teaching programs. In the past year we have successfully recruited two new cell biologists.

One of them, **Mariano Labrador**, began his appointment this past November, and he is featured in this issue of *In Vivo*. Mariano is from Spain, where he received his Ph.D. at the Autonomous University of Madrid; he comes to us from a postdoctoral appointment at Johns Hopkins University. Mariano works with *Drosophila* and is an expert in chromatin structure and gene regulation. Mariano's wife **Piedad**, who is also an accomplished Drosophila geneticist and cell biologist, will be assisting Mariano in the laboratory. We are very excited to welcome Mariano and Piedad to the University of Tennessee and the BCMB Department.

Our most recent hire is **Ana Kitazono** from the University of Chicago Medical School. Ana works with yeast cells and is an expert in cell cycle regulation. She will join our department next August. The youth movement is not over, however; we anticipate searching next year for two more assistant professors, and are currently trying to decide which areas of BCMB will be targeted in these searches.

The "downside" of a youth movement is saying farewell to senior colleagues who have chosen to retire or to pursue other career opportunities. Our most recent retirements are **Kwang Jeon** and **Mary Ann Handel**, both very distinguished scientists, who together have provided more than 70 years of service to the University. Fortunately both Kwang and Mary Ann will maintain an association with the BCMB Department as Professors Emeritus.

Kwang will maintain an office in Walters and continue his long-time role as senior editor of the International Review of Cytology. Mary Ann has accepted a staff scientist position at the Jackson Laboratory in Bar Harbor, Maine, where she is pursuing a very exciting collaborative research project to identify mouse genes involved in meiosis and gametogenesis, but she plans to visit Knoxville frequently and has generously agreed to continue contributing lectures to our Advanced Cell Biology class.

The BCMB youth movement also includes many new students and staff members. The 2003 class of eleven new graduate students was our largest ever and we anticipate nearly as large a class this year. Our faculty have recruited several new postdoctoral research associates and research assistants. One of the most important new members of the department is **Melissa Breeden**, our new Senior Administrative Assistant and office manager. Melissa replaced **Anne Upchurch**, who retired last January; Melissa is featured in the current issue of *In Vivo*.

These are exciting times for BCMB. The addition of so many new faculty, students and staff is invigorating in many ways. But so are the accomplishments and new directions of our existing faculty, two of whom are also featured in this issue. **Ranjan Ganguly**, whose research is providing new insights into the genetics and genomics of insecticide resistance, was promoted to professor this past year. **Dan Roberts** runs a very vibrant laboratory investigating several aspects of calcium regulation in plant cells; his research program has recently expanded into plant genomics and cryogenics (the latter in collaboration with **Peter Mazur** of BCMB). These and many other new developments are keeping BCMB faculty and students at the forefront of biological research.

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LABRADOR, *from page 1*

interphase (the transcriptionally active phase of the cell cycle) as a chromatin fiber structured in highly condensed domains intercalated between decondensed domains. Active genes will be found only in the latter.

Dr. Labrador is studying several DNA sequences called insulators or boundaries, found in the borders between these chromatin domains, and the molecular mechanisms at work in the interfaces between chromatin and heterochromatin to keep them separated. He also works with transposable elements trying to identify the mechanisms they use to escape the tight control imposed by the cell through chromatin structure as well as how chromatin structure determines the places the transposable elements land in the chromosomes when they move in the genome.

Studying these problems in *Drosophila is* advantageous because while fly chromosomes are structurally similar to chromosomes in humans, some chromosomes in *Drosophila* are larger and easier to study and to manipulate at the molecular level. Dr. Labrador makes modifications in the DNA sequences he analyzes and then reinserts them into the flies to see what changes in phenotype take place.

He said, "Identifying the principles governing the establishment of structural domains along the chromatin fiber in specific cells or biological tissues and their maintenance through cell division is fundamental to better understand biological processes such as cell and tissue differentiation, the molecular basis of development, cancer and many other human genetic diseases."

For Dr. Labrador the road to conduct research at UT was personally difficult. He was born in Salamanca, Spain and grew up in Barcelona. He received his bachelor's and Ph.D. degrees from Autonoma University, Barcelona. He came to the U.S. for his Postdoctoral work in 1996 and spent seven years with The Johns Hopkins University in Baltimore, Maryland. It is traditional for a scientist educated in Spain to return to their home university and become professors.

However, Dr. Labrador made the difficult decision to stay in the U.S. He said, "It was hard to leave my family and my home, but I felt that I could not give up the independence and the way of doing science I had experienced while working at Johns Hopkins."

While missing the many friends left behind in Baltimore, Dr. Labrador and his wife **Piedad** and son **Daniel** are adjusting well to UT life. He said, "I look forward to making new collaborations among my fellow scientists within Biochemistry and beyond."

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professional.

And so we bring you this issue of the newsletter that tours some of the goings on and highlights of the Division's Biochemistry, Cellular and Molecular Biology Department (BCMB). Those readers that are aficionados of modern molecular biology should be able to follow most of the research descriptions with little trouble. For those readers that have long since entered the world outside academe and are not running their own molecular biology research laboratory I would encourage your reading patience.

I believe that the articles communicate a level of inquiry and fascination with chemical-cellular workings of living things that define an outstanding faculty. The questions asked and research accomplished by the BCMB faculty marks the leading edge of our understanding of the "living process." It is an exciting time in Biology.

The Division office has, as always, encountered its own never ending supply of triumphs and challenges. I believe that in my last visit with you I told you that the Botany Department had been placed on a review list for possible reorganization or dissolution. The Botany faculty have asked and have been granted permission to disband as a department. **Dr. Schilling** has been tasked with formulating a plan for the reorganization and placement of faculty, staff and departmental assets to the remaining Divisional structure. I have been assured that no one will be without a new Division home.

As Division Director, I see my responsibility as keeping a proper level of the broad discipline of Botanical Science strongly represented in our curricular offerings as well as research endeavors within the Division of Biology.

The Botany Department has provided the state of Tennessee through The University of Tennessee a long and rich legacy of dedication to teaching, research and community service. Its students have provided a tapestry of service to our state, our country and our

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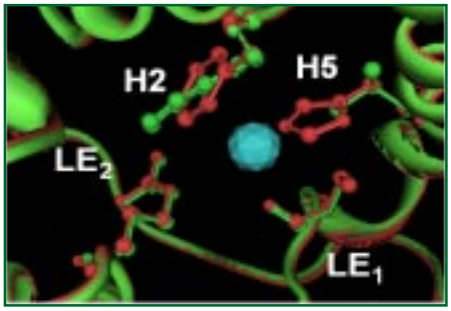
Unusual collaborations and methods lead to strong research

"Taking risks keeps you fresh," said **Dr. Daniel Roberts**, Professor for BCMB. This open-ended approach to science has enabled him to develop unusual collaborations and has exposed him to various tools that are not traditionally used by biochemists, particularly those who study plant biology.

Dr. Roberts focuses on calcium ions and the varying roles they play in cell signal transduction. In particular he has been interested in how calcium interacts with intracellular proteins which decode its signal into cellular responses. While a Howard Hughes Fellow at Vanderbilt Univeristy he began his study of calcium regulatory proteins with a focus on calmodulin and how it aids in cell regulation in plants. He said, "If you had to pick a molecule that is ubiquitous as well as multi-functional, it is calmodulin."

His work on calmodulin soon led to the discovery of other calcium regulatory proteins in plants that are similar in structure but which are involved in other aspects of the calcium regulatory network, including unique calcium-regulated protein kinase enzymes known as CDPKs.



A molecular model of water (aqua sphere) being transported through the pore of the soybean aquaporin nodulin 26

While he has always had an interest in what calcium does to regulate proteins in plant cells, the multitude of events and targets of calcium signaling pathways has led him in research directions which he could not have predicted. As he as worked his way down the chain of command in a cell, he has found that calcium plays a significant role in plant defense mechanisms and how plants respond to environmental stresses. This line of study led to the unexpected finding that a principal target of calcium is a class of membrane channel proteins known as aquaporins.

These proteins facilitate the rapid movement of water throughout the cell and between tissues. Dr. Roberts likens the process to "a plumbing system" between cellular compartments that regulates turgor pressure responsible for plant cell development and extension, as well as adaptation to adverse environmental stresses such as drought and soil salinity.

Ian Wallace (undergraduate), Dr. Roberts and Eric Vincill (graduate student)

With the elucidation of all the genes in the plant genome, it has become clear that aquaporins are crucial in plant cell physiology, since these transport proteins are ten times more prevalent in plants when compared to microbes and animals. Since one of the key roles of calcium signals in higher plants is plant defense and adaptation, calcium-dependent regulation of aquaporin localization and activity may be part of the mechanism through which a plant redirects and reorganizes its "cellular plumbing system", Through the study of calcium-dependent regulation, he hopes to answer the questions of why and when a plant would regulate, how calcium interactions act at the molecular level, and the overall question of how these processes work.

A recent outcome of Dr. Roberts' interest on aquaporin proteins is new and unusual collaboration that has developed with BCMB's **Dr. Peter Mazur**. Dr. Mazur is an expert in the field of cryobiology, and has developed some interesting hypotheses regarding the role of water permeability (and hence aquaporins) on the survivability of animal embryos during freezing. By engineering cells with altered water permeability characteristics by introduction of aquaporins, these hypotheses are being tested.

Dr. Roberts said, "If you had told me 20 years ago that I would be working with a renowned cryobiologist who studies animal embryos, I would have told you that you were crazy." However, through their joint efforts Drs. Roberts and Mazur have attracted funding from the National Institutes of Health to study the interesting properties of aquaporins in cryobiology. Besides applied work on aquaporin proteins in cryobiology, these studies could have other interesting outcomes in both plant and animal biology. Dr. Roberts said, "These proteins have been implicated in disease states in the development of cataracts, brain edema, and diabetes."

Through his collaborations, Dr. Roberts has built a large arsenal of tools that he uses to answer his questions. To study the structure and function of plant calcium binding proteins and membrane channels, he uses protein purification methods and various analytical equipment from the Center for Structural Biology.

He also works with *Arabidopsis* plant gene knock outs in conjunction with Botany's **Dr. Albrecht Von Arnim**. It has been particularly important for him to use *Arabidopsis* as a model system since this represents the first plant for which a completely sequenced and annotated genome is available. As Dr. Roberts said, "Once you know all the players, you can combined molecular with physiological work and knock out different genes as you go."

Dr. Roberts was born and raised in Santa Clara, California. He said, "I was there long before it became Silicon Valley. Back when it was only prune and cherry orchards." He combined his interests in chemistry and biology at Santa Clara University where he received his

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Equal passions for research and community

Dr. Ranjan Ganguly, professor in the BCMB department, has always had an interest in genetics. Even though his test subjects changed from time to time, his research has always dealt with genes, specifically how genes are regulated at the molecular level.

He began his career as a master's student at the University of Calcutta, India in 1970. His research topic was to examine the effect of inversions on X-ray induced somatic crossing over in fruitfly, *Drosophila melanogaster*. During that time he also learned about gene dosage compensation, a global gene regulatory mechanism that equalizes X-linked gene products between males with one and females with two X chromosomes, as found in mammals and *Drosophila*. His interest in gene regulation grew further when a seminar speaker from the University of Nebraska came to Calcutta to speak on tumor genetics and eukaryotic gene regulation. Dr. Ganguly became fascinated with the research and decided to work on gene regulation.

He basically followed the speaker to the states where he entered the Ph.D. program at the University of Nebraska, Lincoln in 1973. While at UNL, Dr. Ganguly switched from *Drosophila* to mouse and started his research on hormonal control of mammary gland differentiation and mammary tumor development. The major portion of the project on mammary gland differentiation was actually focused on the regulation of casein gene expression. He said, "Very little was known about gene regulation at that time mainly because techniques to study gene expression in the 1970's were not readily available. Cloning just started then and it took a few years before it became a routine lab technique. Scientists had to make most of the reagents themselves; there was no biotech company to supply kits and clone the genes for you."

After completing his Ph.D. and two years of Post-doctoral work at UNL, Dr. Ganguly joined the University of California-Irvine in 1980 for a second Post-doc. Even then, his research was always one step ahead of current technology. This time he switched back to *Drosophila* to study dosage compensation. He knew that switching would delay his career. However, he could not pass the opportunity to use recombinant DNA technology to study dosage compensation, which always fascinated him.

For these studies he cloned several X linked genes of *Drosophila melanogaster* and *Drosophila miranda*, which has a new Y chromosome (neo-Y) in the process of degeneration and a new evolving X chromosome (neo-X).

He continued working on this project when he joined the Zoology department at UT in 1986. He and his graduate students discovered that the degenerating neo-Y chromosome of *Drosophila miranda* is associated with hundreds of copies of a mobile DNA element, which he named the NY-element. Other investigators have also identified similar mobile elements, which have the potential to knock out genes on neo-Y via random insertions. Via transgenic experiments Dr. Ganguly identified a piece of DNA that allows dosage compensation of the X-linked *Arrestin* gene of *Drosophila miranda* in the genome of *Drosophila melanogaster*. His lab was the first to identify and study the expression pattern of *Drosophila 14-3-3* gene and the gene encoding the gamma subunit of Drosophila G protein (*DGγ1*).

Continuing with his interest in gene structure and gene regulation in 1992 he started a collaborative project with **Dr. Larry Waters** of Oak Ridge National Lab to work on molecular and genetic basis of insecticide resistance using *Drosophila* as a model organism. It has been shown by Dr. Ganguly and other scientists that resistant strains have higher expression of a family of genes that make cytochrome P450 enzymes. P450s confer chemical defense to the living organisms. Dr. Ganguly and his colleagues found that out of eighty-three P450 genes in *Drosophila* only a few of these genes show overexpression in resistant strains relative to the susceptible ones.

Although it is known that P450s are involved in insecticide resistance, the mechanism of overexpression of P450 genes in insects is not known. Dr. Ganguly says, "Since P450 enzymes are known to be involved in various cellular metabolisms and detoxification of many xenobiotic (foreign) compounds, overexpression of *CYP* genes in resistant insects became an important research topic in molecular entomology."

Using cell culture, transgenic and genetic techniques he identified the regions of *Cyp6a2* and *Cyp6a8* genes that act as molecular switches and control expression of these genes. He and his students also found that susceptible strains have genetic factors that suppress expression of P450 genes including *Cyp6a2* and *Cyp6a8*.

"Since P450 enzymes are known to be involved in various cellular metabolisms and detoxification of many xenobiotic (foreign) compounds, overexpression of CYP genes in resistant insects became an important research topic in molecular entomology"

Currently, his lab is trying to map the location of these factors on the chromosome. If the mechanism of overexpression is understood well, it may help develop genetic engineering tools to control insects causing a lot of economic damage to society. Such tools may be more desirable than the toxic pesticides and insecticides.

Recently, Dr. Ganguly's research took an interesting turn. He found that caffeine, a widely used compound, would induce

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Taking care of BCMB business

Knoxville native, **Melissa Breeden** has been with the Department of Biochemistry, Cellular and Molecular Biology since last spring. Her title is Administrative Specialist, but she feels she is more of an office supervisor. She oversees the undergraduates and work study students who work in the offices and laboratories, processes personnel forms, manages the budget and handles the tedious paperwork for international hires.

Her "take command" personality

enables her to easily make decisions from personnel issues to office décor. She said, "I just tell others to blame me if there is any complaining going on in the department. At least it gets done."

Melissa graduated from Carter High School in 1986 and spent a year at UT. She suspended her education when she got married to her husband **Michael**. After her daughter **Ashley** was born, she knew she would go back to college, but it would have to wait for a time. She worked at various office supervisor positions around Knoxville until Michael was disabled as a result of chronic back problems.

She knew this was the time to focus on her education and she felt it would be good to work at UT to take advantage of the course fee waivers offered to employees. She returned to UT as an employee in 1999 in the Student Judicial Affairs Office. She found working directly with the students interesting and challenging. She said, "It is a very pro-student office and I felt we were there more to encourage them than to impose discipline."

Melissa now works full time for BCMB and attends classes part-time. She is a sophomore majoring in education. She would like to teach either elementary or secondary students or work as a guidance counselor. She will apply to the College of Education soon and then will be able to decide which way her future will go. "I'm glad UT offers this education opportunity to me. I hope my daughter will be able to take advantage of this employee benefit in a few years," she said.

Adding their moral support to Melissa's decision to go back to school are her sisters, **Shauna Cook** and **Angela Gilley**. They too take advantage of the UT education benefit as employees. Shauna worked in the Division of Biology office for two years before moving to the College of Education in the Department of Theory and Practice. She is pursuing her degree in Sociology and attends some classes with Melissa. Angela works in the Division in Shauna's former position as Office Supervisor. She is also a part-time student in pre-veterinarian medicine.

Melissa is grateful too for the support she receives from her husband. "Michael is an inspiration to me. He suffers with nerve pain every day, but he still gets up and stays active. He has always supported my decision to go back to school." Beyond her family, Melissa receives support from her co-workers. **Julia Collins** is the department Principal Secretary and has been in the office the longest. Melissa said, "I rely on her for everything because she knows everything." **Tina McConnell** is housed in the BCMB office, but is also a part of the Center of Excellence for Structural Biology. Melissa said, "Although Tina and I have very different job responsibilities we are together everyday and it is so nice to have such a good relationship with the people in your office. We have fun and I think we all try to maintain a positive environment for our faculty and students."

Department Head, **Dr. Bruce McKee** said, "Melissa has learned a very complex job in a remarkably short time, and has already made considerable progress in improving the efficiency of the BCMB office. Her approach of emphasizing open and direct communication has really helped with distributing workloads more equitably. We need another Melissa!"

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The Eight Annual "Friends of Biology" Golf Tournament

Sponsored by Fisher Scientific

Thursday, April 29, 2004
Centennial of Tennessee Golf Course
Oak Ridge, Tenn.
9:00 am Shotgun Start
Lunch Included

Four person best ball format
Entry fee $60.00 per player,
$240.00 per team

Trophies awarded to 1ST and
2ND Place teams
(Only foursomes will be
eligible for trophies)

Door Prizes!
Mulligans for sale

Prizes for longest drive – male and female
Closest to the pin prizes on all par 3's

Make checks payable to:
"Friends of Biology"
Send to: 128 Neyland Biology Annex,
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Attention: **Jan Hudson**
For more information
call Jan at (865) 974-8761

Deadline for team changes by April 26TH

Centennial is a soft-spike facility and
proper dress is required

This tournament has raised several thousand dollars in the last seven years for the Support fund of the Division of Biology. Your participation continues this successful effort.
Thank you!

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several *Cyp* genes in *Drosophila*. His students engineered reporter genes, which have firefly *luciferase* gene under the control of the regulatory switches of *Cyp6a8* or *Cyp6a2* genes. The idea is that the reporter gene would make l*uciferase* protein if the regulatory switches were turned on.

Since presence of *luciferase* protein can be detected very easily, this allows one to screen the effect of various toxic and non-toxic xenobiotic chemicals on the regulatory switches of *Cyp* genes. Interestingly, he found that caffeine induces the regulatory switches of both *Cyp6a8* and *Cyp6a2* genes.

He said, "This technology is not only useful to map gene regulatory switches, it is also useful to study the effect of chemicals that we use daily on the expression of *Cyp* genes. In humans, activity of *CYP* genes is an important factor in designing drugs to fight diseases. It is especially important for those people who take more than one drug due to medical reasons.

It is possible that one drug may turn on a *CYP* gene, which may metabolize the second drug making it completely ineffective. Therefore, it is important to study how *CYP* genes respond to various chemicals and drugs that are used in daily life. Induction of *Cyp* genes with caffeine is an example how *Drosophila* can be used as model organism to study molecular toxicology". Currently, his lab is studying in detail how caffeine might induce P450 genes.

Besides graduate students, Dr. Ganguly also gets undergraduate students involved in research. He has hosted nearly seventy undergraduate students in his laboratory over the years to do research in genetics and molecular biology. Five of these students shared authorship in three research articles published in scientific journals.

Dr. Ganguly also hosted several high school students to do summer research projects in his lab. He also shares his knowledge with the Knoxville community. He often speaks to seniors and local civic organizations on the benefits of genetic engineering and gene therapy. He has also mentored middle and high school science students who have expressed an interest in a career in genetics and molecular biology. His research has been funded by USDA.

His family shares his love of biology as well. His wife, **Nivedita**, is a Geneticist by training. She and Dr. Ganguly worked in the same laboratory during their Graduate study and Post-doctoral training. In 1990 Nivedita changed her direction when she became a high school teacher. She is now the Head of the Science Department at Oak Ridge High School. Their son, **Tuhin**, is a Biologist too. He graduated from Washington University, St. Louis with a degree in Biology and Business. Currently, he works for Monsanto Corporation.

One of Dr. Ganguly's many hobbies is cooking and making new recipes. His reputation precedes him and there are not many in the department who turn down an invitation to dinner at the Ganguly house.

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Alumni News

Todd Anderson, Ph.D.

He received his masters in 1988 and his Ph.D. in 1991. He was in the interdepartmental toxicology program with **Walter Farkas.** He conducted his research with **Barbara Walton** at ORNL in the Environmental Sciences Division. After UT he did a postdoc at Iowa State University and then was an Assistant Professor at Clemson University in the Department of Environmental Toxicology. He is now an Associate Professor in the Department of Environmental Toxicology at Texas Tech University and also the Assistant Director for Science at The Institute of Environmental and Human Health at Tech.

Soo Young Choi, Ph.D.

He received his Biochemistry degree in 1986 and then became a Provost for Academic Affairs and Research of Hallym University in Korea.

Niki Stephanie Nicholas

She was recently promoted to Chief of Resources Management at Yosemite National Park.

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world. Please join with me in applauding the memory of service and function well done. I will complete the details of this transition in the next two issues of *In Vivo*.

To those of you who can attend, please join us in the Annual Spring Wildflower Pilgrimage coming up the last week in April. Details may be gleaned from the Division Web site (**http://web.bio.utk.edu/Division**).

Till next time....

Peace
Otto

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ROBERTS, *from page 4*

bachelor's degree. He did not have an interest in the medical side of his field, but instead pursued the pure science side in plant biology. He received his Ph.D. from the University of California Davis in 1983. During this time he met and married his wife, **Jodie**, who was pursuing her degree in art and design.

He made his way slowly to the east, stopping off at the Howard Hughes Medical Institute at Vanderbilt University for three years of Postdoctoral work. He then came to UT in 1987. He has two children **Tony** and **Amanda**. When he can, he finds time to enjoy his hobbies of soccer, fly-fishing, and the bass guitar.

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Focus on Division of Biology Websites:

by Dr. Daniel Simberloff

"Biological invasions are considered second only to habitat destruction in their effects on native biota and entire landscapes and may even jeopardize endangered species. Habitat disturbance often makes systems more invasible, and in turn, invaders alter disturbance regimes in natural systems . This powerful synergism has led to substantial changes in whole ecosystems, particularly in South Florida and Hawaii. Arms races between natives and invaders continue to balance in favor of invaders, to the extent that we may be facing a global homogenization of our planetary biota in the near future." For more information, see his website:
http://invasions.bio.utk.edu .