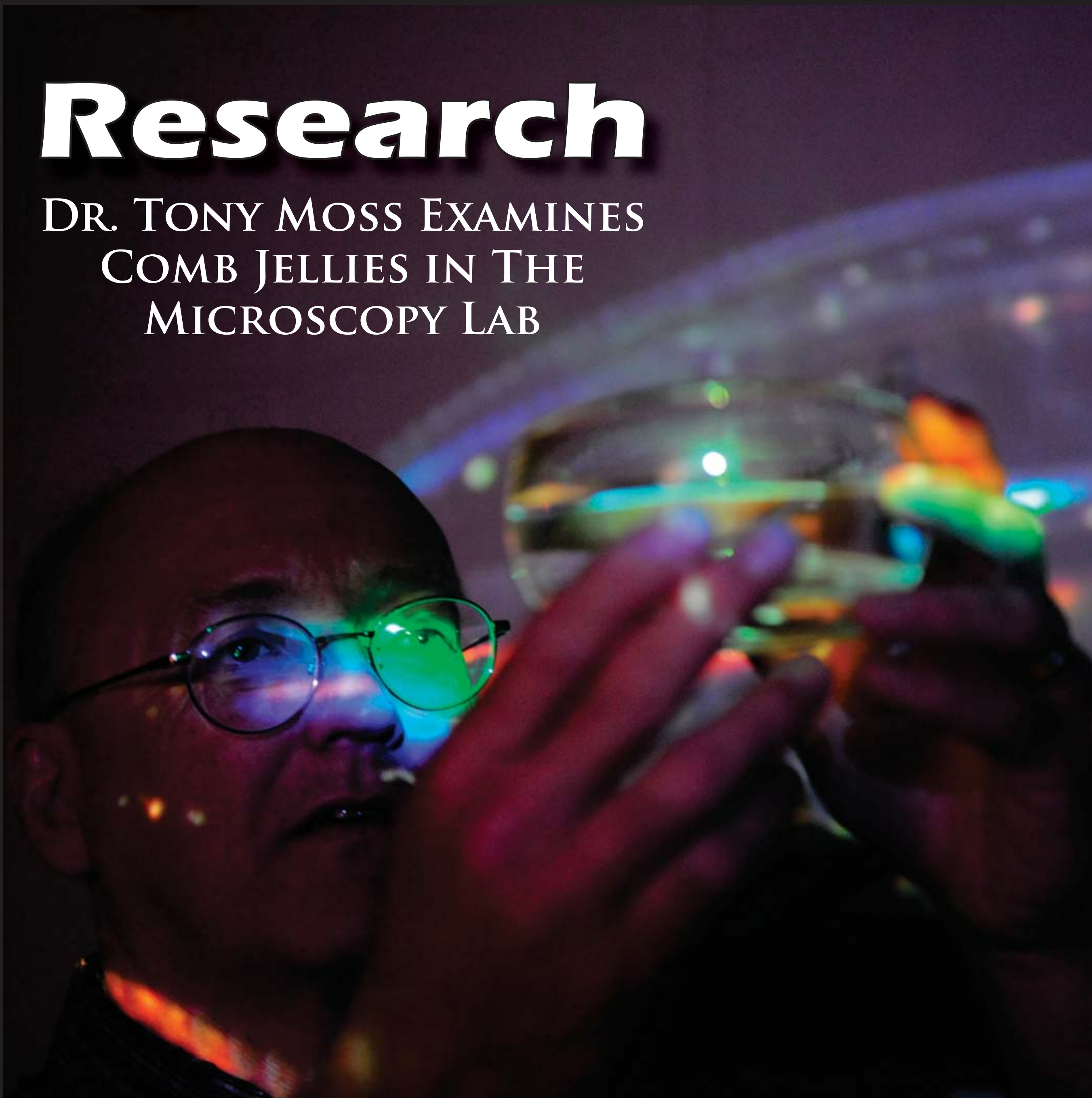
Auburn University

Spectrum

COLLEGE OF SCIENCES AND MATHEMATICS



Research

Dr. Tony Moss Examines Comb Jellies in The Microscopy Lab

Biological Sciences

Geology & Geography

Physics

Mathematics & Statistics

Chemistry & Biochemistry

MESSAGE

From the Associate Dean of Research

Marie Wooten

Spectrum seeks to highlight the creative endeavors of our faculty and students in the College of Sciences and Mathematics. Research fuels the acquisition of new knowledge and in turn underpins a high-quality instructional program. Students at the graduate and undergraduate levels are more competitive for jobs in their respective fields by garnering hands-on experience in a ‘real-world’ setting. In order to pump the pipeline and train the next generation, students are provided scholarships and research support on an annual basis to conduct independent studies in consort with a faculty member.

The creativity exemplified by the articles contained in the faculty profiles provides an insight into the diversity of projects that are ongoing in this college. Internationally renowned faculties in their respective discipline are the cornerstones of this college. The growing prominence of our programs enabled us to recruit an outstanding core of junior faculty who bring with them new cutting-edge technology and training. During the past year we hired: Drs. Yanzhao Cao, Paul Cobine, Christopher Easley, Michael Fogle, Erkane Nane and Haibo Zou.

Support provided by external funds through peer-reviewed grants awarded on a competitive basis, fuel our research programs. The faculty continues to lead the way in securing nationally competitive awards to stimulate research in the sciences, mathematics and outreach. This past year, the faculty secured $9 million in new funding to support research. The college-research portfolio, when considering all three- and five-year ongoing projects, is over $25 million. These funds provide support for faculty salaries, student stipends, small equipment purchases, operations and travel to disseminate research findings to the broader community.

Besides improving the quality of life, research serves as the catalyst to enhance economic development and creation of new jobs. At this time, the college is positioning itself to capture funding provided by the Stimulus Legislation. Additional efforts will be made to train new faculty in the writing of competitive proposals, to seek funding to enhance research infrastructure through acquisition of major multi-user equipment, and promote a renewed commitment to work with the K-12 community through continuation of the math and science partnership.

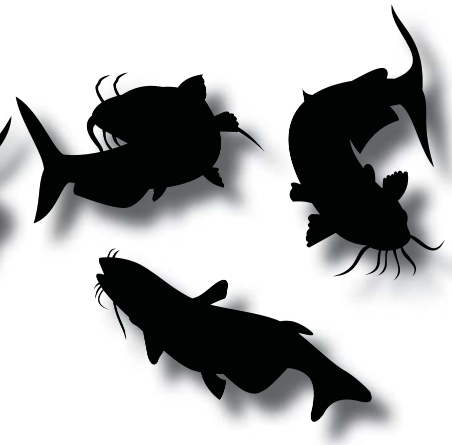
This issue of *Spectrum* provides a glimpse of the creativity and passion that embodies research. Join me in recognizing the innovation and discovery that is shared by faculty and students in the College of Sciences and Mathematics.

Dr. Marie Wooten

Professor and Associate Dean of Research

Mark Liles

Biological Sciences Research Update



"Auburn is a great place to be a professor if you want to be both an educator and a scientist," says Assistant Professor Mark Liles (biological sciences) who began his work at Auburn University in 2005 after completing his Ph.D. in Microbiology at Northwestern University in 1998, as well as postdoctoral research in the laboratories of Dr. Jo Handelsman and Dr. Robert Goodman at the University of Wisconsin-Madison.

In this photo, Liles holds one of the thousands of metagenomic libraries he and his team have screened for clones of interest.

While at Wisconsin, Liles was a National Institute of Health (NIH) postdoctoral fellow, and used methods pioneered in Wisconsin to discover novel natural products like antibiotics that are produced by microorganisms in natural environments. Instead of trying to culture each one of the different microbes that live in soil or other environments, Liles and colleagues cloned DNA from the entire microbial community, producing a microbial community genomic (or "metagenomic") library. These metagenomic libraries can be screened for many different natural products, such as enzymes, antibiotics or anticancer compounds. Prior to leaving Wisconsin, Liles and colleagues were awarded an NIH grant. When Liles came to Auburn University, he brought with him funding from the grant and to-date efforts to discover natural products.

"It is a long and difficult process to find antibiotics that have clinical application," Liles explains, "and since most pharmaceutical companies have abandoned antibiotic-discovery programs, there is a real need for academia to continue the hunt for effective therapeutics, especially with an increasing threat from antibiotic-resistant pathogens."

At Auburn, Liles' research group, which now includes a technician, seven graduate students, and several undergraduate researchers, has screened several metagenomic libraries for clones that either produce antibiotic activity or have the genetic sequences that encode for antibiotic synthesis. After screening tens of thousands of library clones, the Liles team has a large collection of over 50 clones of interest.

"The genetic and biochemical analysis of these clones will keep students and me busy for many years," Liles remarks.

With collaborator Dr. Paul Cobine at Auburn and Dr. Nicole Lopanik at Georgia State University, a grant proposal was recently submitted to the NIH to characterize the best lead candidates for the next stage of development.

In the spirit of finding new ways to control infectious disease, Liles has also developed an interdisciplinary collaboration with a team of scientists from Auburn University to control the bacterial pathogen *Edwardsiella ictaluri*, which causes the loss of $30 to $40 million annually to the channel catfish aquaculture industry.

"With Dr. Jeff Terhune from Fisheries and Allied Aquacultures and Dr. Joe Newton from Pathobiology, we are working to develop a biological control of this disease using naturally occurring microorganisms," Liles says.

Now, thanks to their research, Liles and colleagues have discovered the first bacteriophages (viruses that infect bacteria) that are highly specific to *E. ictaluri*, as well as a collection of bacterial isolates that can inhibit the growth of *E. ictaluri*.

"Thanks to funding from the Alabama Agricultural Experiment Station, and the colleagues and facilities available here at Auburn, we have the ability to experimentally test biological-control strategies both in aquaria models and in pond systems," Liles says.

The work describing *E. ictaluri*-specific bacteriophages was recently published, and the complete genome sequence of different bacteriophages have now been determined. Ongoing work seeks to identify the most effective formulations for biological control of disease in channel catfish.

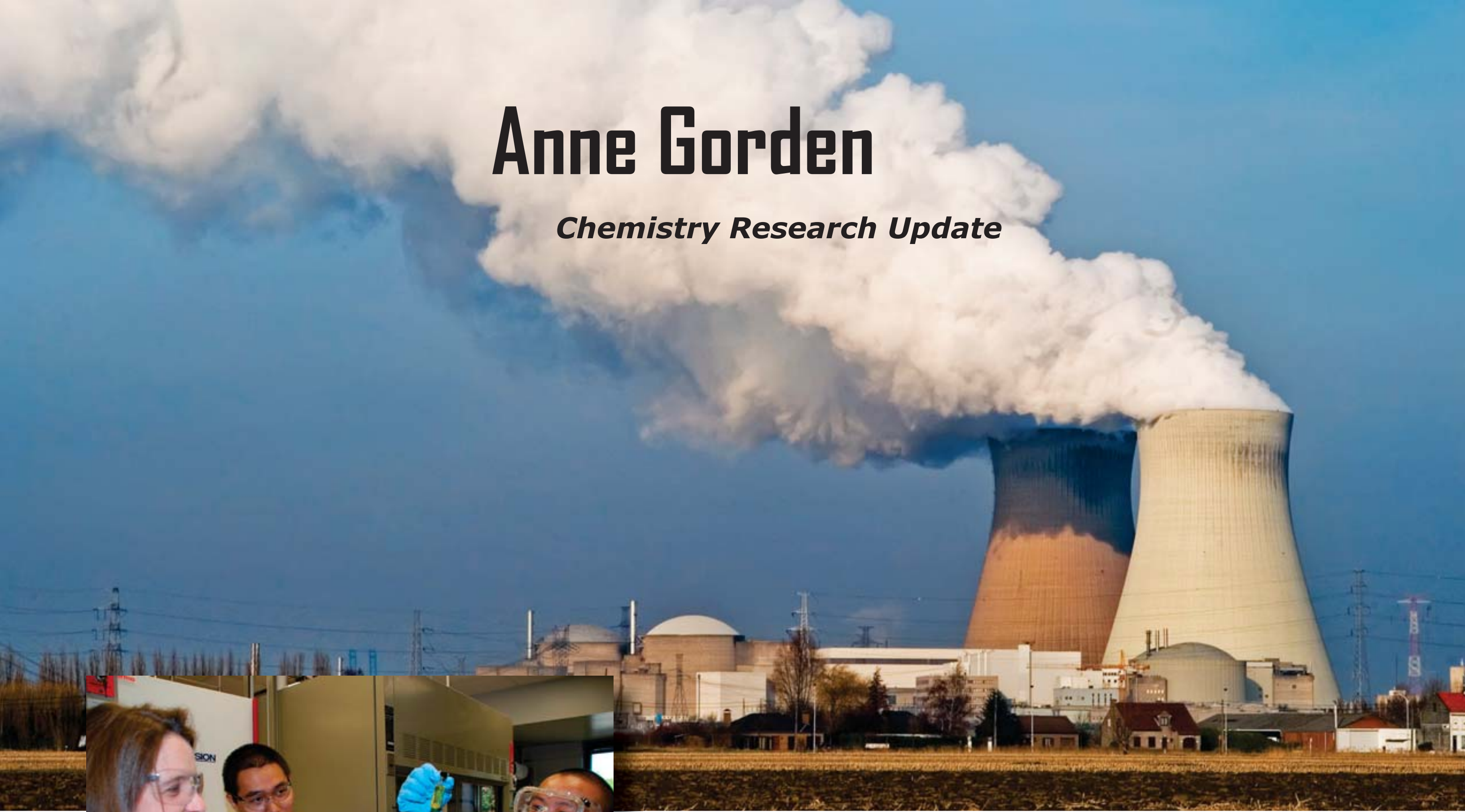
Both of Liles' research projects are conducted with the help of several laboratory technicians and Auburn University undergraduate and graduate students.

"Auburn is really the ideal place for this research," Liles concludes. "There is no better institution in the United States to conduct this research project – the people, the facilities, and the resources – Auburn University has a lot to offer."

-Candis Hacker Birchfield

Anne Gorden

Chemistry Research Update



From left: Anne Gorden looks on as graduate students Yuancheng Li and Xianghong Wu work in the lab.

As leaders in the United States explore alternative energy options, Auburn University's Anne Gorden, Ph.D., assistant professor of chemistry, and her team of student researchers are actively seeking ways to make nuclear energy a more practical and environmentally safe option.

"If we are going to look at energy independence, then nuclear fuel is a viable option," Gorden says. "It provides an alternative to fossil fuels and some of the new facilities that have been built in places like Canada, Japan and France have been built so that they leave a smaller footprint on the environment."

Leaving a smaller footprint on the environment is important to Gorden. Her research, a cross between organic and inorganic chemistry, will enable early detection of nuclear leaks, as well as shed light on the logistics of quickly and efficiently cleaning nuclear spills.

"Waste storage sites currently monitor storage by using careful measurements," Gorden explains. "They use a Geiger counter and alpha counter to create a map of the area. They can compare old maps to new maps to detect a leak."

According to Gorden, this method is not foolproof.

"A Geiger counter can indicate radioactivity, but not what it is specifically that you need to clean up. How you clean different materials up might be different," Gorden saya. "What we would like to do is come up with a colorimetric or fluorescent sensor for detecting heavy metal ions in the environment."

With this in mind, Gorden has students in the lab, looking at ways to make detection of actinides more selective and more sensitive. Then, using carbon-, nitrogen- and oxygen-based compounds, they look at new ways to detect uranium or to improve methods for more selective uranium extractions. They pay close attention to questions like whether or not other metals in the environment compete, or if natural organic compounds might interfere. They hope to develop a better understanding of the chemistry of the radioactive actinides like uranium, which will also aid in reducing the volumes of waste from electrical power generation using nuclear fuels.

"Right now, we are trying to come up with compounds that are easy to make because when you are doing an extraction, you will need a lot of it. Uranium is a good place to start because we can use depleted uranium to answer these questions without worrying as much about the radioactivity. If we find something that works really well, we could move on to something more radioactive," Gorden says.

In addition to having a sustainable and positive effect on the environment, Gorden's research could protect lives. After all, over exposure to a heavy metal ion like uranium could have lasting effects on the human body such as liver or kidney failure.

"The overreaching goal of the research is, we would like to mitigate some of the problems that might be associated with the use of nuclear fuels," Gorden says.

For more information on Gorden's research, visit her Web site at www.auburn.edu/cosam/departments/chemistry/faculty_staff/agorden.

-Candis Hacker Birchfield

Ron Lewis

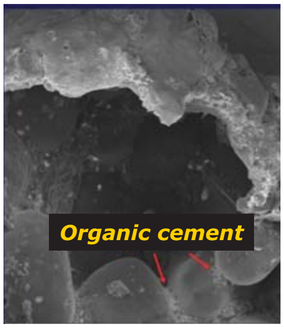
Geology Research Update

Dr. Ronald Lewis's passion for fossils began when he was a child living in Iowa. He would spend much of his free time exploring the rock quarries near his home, looking for invertebrate fossils including echinoderms.

"By the time I was in high school, I had a whole collection of echinoderms," Lewis says. "I sent them to the University of Iowa for identification, and the curator there, a specialist in echinoderms, encouraged me. I ended up getting my undergraduate and master's degree in geology at Iowa."

Lewis, who received his Ph.D. from the University of Texas at Austin, studied echinoderms, especially crinoids, during his graduate school years. However, once Lewis began teaching at Auburn University in 1984, his research interest slowly began to change.

"I was teaching both introductory paleontology and micropaleontology," Lewis says of his early years at Auburn. "It was from teaching micropaleontology that I began to be interested in foraminifera."

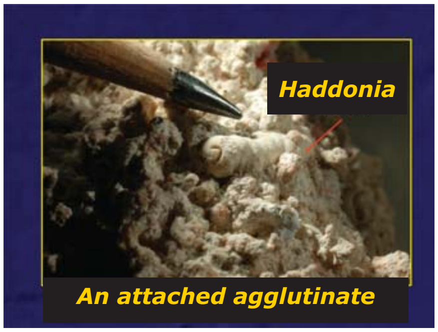


Foraminifera (forams) are single-celled marine organisms that create an outer shell or "test" from minerals they form or by using particles from their environment. Forams may range in size from microscopic to several inches, and are found along ocean floors, attached to rocks, and floating in the water. Both living and fossilized forams are abundant worldwide and in particular, can be found in large numbers in the Bahamas.

"Now that I am in Auburn, I am close enough to establish a good connection in the Bahamas," Lewis says, "and forams are much more abundant than echinoderms. That's why I switched the emphasis of my research."

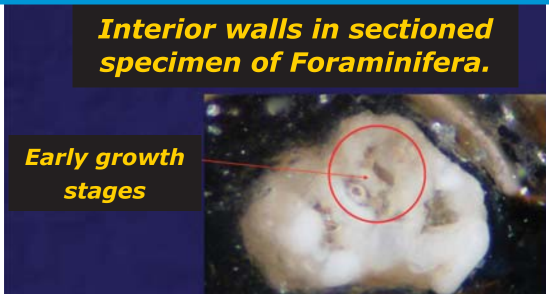
About once a year, Lewis, along with a team of Auburn University students, spends time in San Salvador, Bahamas, researching forams. Thus far they have discovered a type of foram called *Haddonia*, previously thought to be limited almost exclusively to the South Pacific.

"*Haddonia* is very distinctive, and it is sometimes over an inch long, yet it has not been reported before from the Bahamas or anywhere else in the Western Hemisphere. I think this shows how unexplored some of these zones are," Lewis says.



An attached agglutinate

Additionally, Lewis collected what he believes is a new species and genus that uses large grains to form its three-chambered test. He recently submitted a paper to the journal *Micropaleontology* in which he names it *Geracia bahamensis*, after Don and Kathy Gerace, founders of the research station on San Salvador.



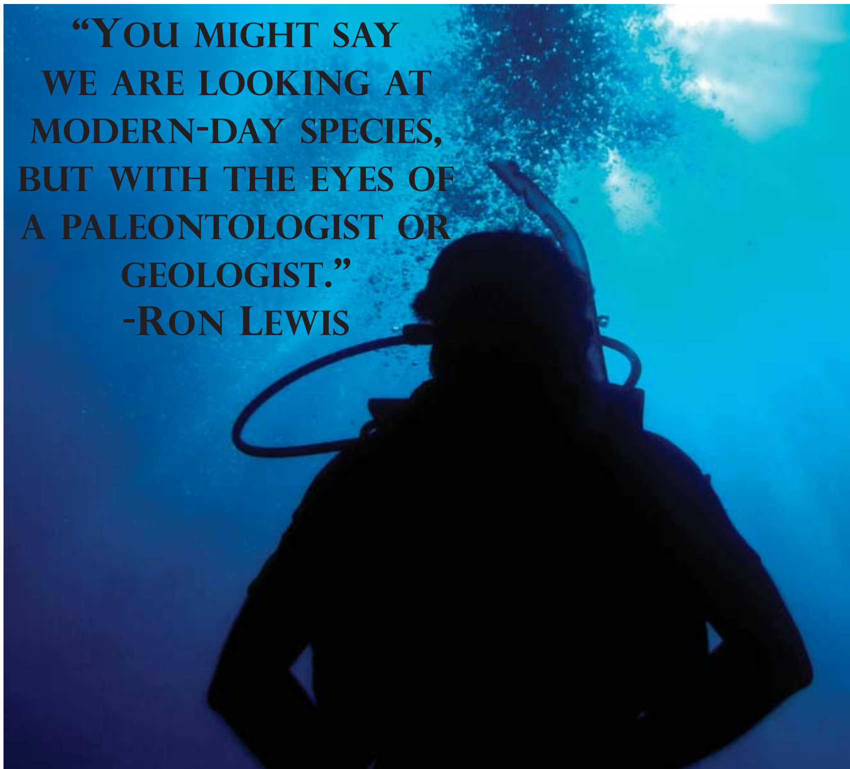
Interior walls in sectioned specimen of Foraminifera.

Despite all of the new knowledge acquired thus far by Lewis and his team, their sole purpose does not consist in identifying types of living forams.

"Unlike a biologist, we are also studying the distribution of dead tests. You might say we are looking at modern-day species, but with the eyes of a paleontologist or geologist," Lewis says.

For example, because their tests can be useful age indicators of ancient rock layers, forams have been used for decades to help find deposits of oil and gas. Also, the distribution of living and dead modern-day forams provides clues about water depth and other environmental conditions at the time of rock formation. With this knowledge, Lewis and his team of students are specifically trying to establish better models for determining the environment and distribution of ancient limestone. Composed of calcium carbonate, limestone is a major contributor to the removing of carbon dioxide from the atmosphere. Thus, forams from limestone-producing environments, such as the Bahamas, are also important in studies of climate change.

-Candis Hacker Birchfield



Pat Goeters

Mathematics Research Update

A list of Goeters' publications can be found at the following link: http://www.auburn.edu/~goetehp For reprints contact Pat Goeters at (334) 844-6587.

From a young age, Pat Goeters, Ph.D., discovered he had an affinity toward mathematics, an area in which he excelled. He also gained an appreciation for higher education through attending his father's lectures at Yale University. However, it was Goeters' mother who had the largest influence on his eventual pursuit of an advanced degree.

"My mother was a great believer in higher education and in learning all that we could. She studied at Rice under Larry McMurtry, and later received a master's degree in public health at Yale," Goeters says.

According to Goeters, he was also influenced to get a college degree because he "came from a large family with limited financial resources and was forced to hold steady employment from the age of 15."

Longing for a better life for himself, he pursued a B.S. in mathematics at the state school in New Haven, Conn. Following graduation, Goeters attended graduate school at the University of Connecticut where he received both a master's degree and Ph.D. in mathematics.

While in graduate school, Goeters spent the summers working in the defense-analysis industry in Bethesda, Md. As a result, upon graduation from the University of Connecticut, Goeters was recruited by several defense agencies.

"I knew from day one that hard work was the main key to success, whether it is in physical activity or mental activity," Goeters says. "By working hard on hard mathematical problems, I was developing my mind fully. As a result, I felt well-prepared for any position requiring problem-solving skills."

Goeters turned down the offers to work in the defense industry, and instead chose to remain in academia. "I felt the main difference between working in academia and industry is that in academia you have more freedom in selecting the problems on which you work," Goeters says.

A year after completing his Ph.D., Goeters was faced with yet another crossroad in his career. He was given the opportunity to either spend a year at Wesleyan University working with J.D. Reid or a year at Tulane University working with Laszlo Fuchs.

"I picked Wesleyan, mainly because my point of reference had become the Northeast," Goeters says.

Both Reid and Fuchs would remain constant influences on Goeters' career in mathematics, primarily through published research articles and books.

While living in the Northeast, Goeters developed another important relationship based on a mutual passion for mathematics with Auburn University professor, Ulrich Albrecht, Ph.D. Albrecht encouraged Goeters to apply for an open position at Auburn. At the same time, Goeters was offered a position designing radar systems for Hughes Aircraft in Los Angeles, Ca. However, Goeters', "love for pure intellectual pursuit and life in the South," prompted him to forgo the job offer in the private sector, and he began what is now a 23-year career at Auburn University.

His work at Auburn includes extensive research in Commutative Rings and involves a constant inter-play between himself and colleagues. Together, Goeters and his colleagues extend their common research interests through published articles and books, e-mail, and both private and public communications.

"Some of the leading research texts in my field contain unsolved problems. Occasionally my research perspective will afford the opportunity to address those problems. Still, other problems are gleaned from published research," Goeters explains.

Goeters, along with Auburn University professors Jack Brown, Ph.D., Jerry Veeh, Ph.D, and Thomas Pate, Ph.D., have taught actuarial mathematics courses since the 1980s. Actuarial mathematics provides a framework which allows insurance companies to set rates for their products, and investment firms to place a value on stocks and other monetary instruments.

"After taking several actuarial exams, I sought work at AFLAC, hoping to balance my teaching career with practical experience that I could pass along to our students," Goeters says.

About seven years ago, Goeters, Brown, Veeh, and Pate developed an actuarial-curriculum model that was subsequently adopted by the department. The curriculum prepares students for well-paying and vital jobs in the field of actuarial mathematics.

"I love math, and I love Alabama. I am thankful to Auburn for the opportunity to spend these years here," Goeters says. -Candis Hacker Birchfield

Allen Landers

Physics Research Update

Twice a year Allen Landers, Ph.D., associate professor of physics at Auburn University, brings a team of Auburn University students to the Lawrence Berkeley National Laboratory (Berkeley Lab) to collaborate with teams from Frankfurt University in Germany, Kansas State University, and the Berkeley Lab to study how energy and matter interact.

"I study basic atomic molecular physics," Landers says. "What we do is study how energy and matter interact. We discover how nature works on a very basic, fundamental level."

For this team of physicists, the discovery begins at Berkeley Lab's Advanced Light Source facility. The facility contains a large storage ring with a diameter that is two-thirds the size of a football field. Inside the storage ring is a tubular vacuum chamber. This chamber can hold an electron beam as it travels around the ring at nearly the speed of light. As the electron travels, a light that is 100-million times brighter than an X-ray one would use in a doctor's office, or a "soft" X-ray, is directed at the atom. As photons from the light source hit the atom, electron rearrangements occur.

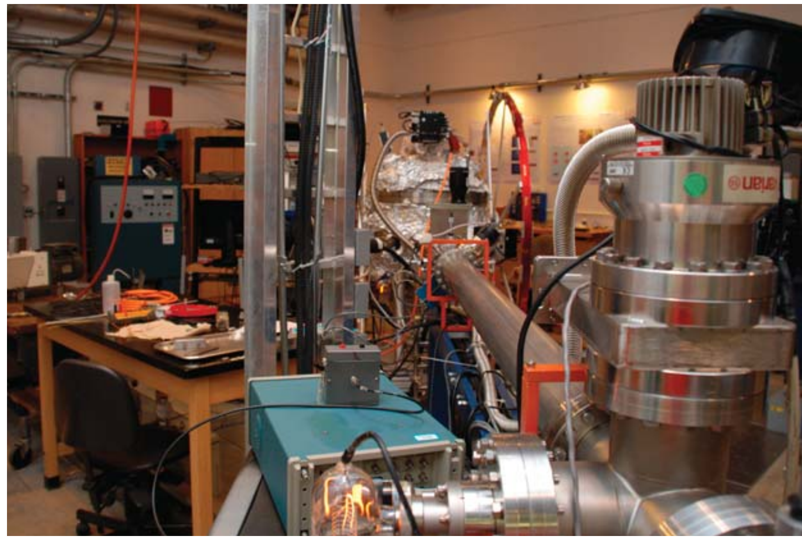
"A Reaction Microscope allows us to look at really simple, one-atom to one-photon interactions," Landers says. "Sometimes the electrons are knocked out of the atom; sometimes they are knocked from the center to the outside; and sometimes they are knocked from the outside to the center. Quantum physics has us look at probability so we distribute over, and over, and over again to get a probability."

As the electron travels around the storage ring, photons will hit electrons anywhere from 3,000 to 5,000 times per second. Landers and his team analyze each instance of electron redistribution.

"We study the cause and effect of photons hitting the atoms. We have noticed that sometimes the effect seems to precede the cause because sometimes an electron acts in a way as if it knows what is about to happen," Landers says.

Because the Department-of-Energy-supported Berkeley Lab is one of the few places in the world where scientists can detect and analyze escaping or redistributing electrons, demand for use of the center is high and time spent there is limited.

"Since we are only at Berkeley two times a year, the beam time is precious, and it is a big deal. Lots of collaboration takes place before we get there," Landers says. "It is also expensive so we do similar types of experiments here at Auburn so the students can gain experience before we go to California for the more delicate experiment where there is both high risk and high reward." -Candis Hacker Birchfield



Above and below: Some of the equipment located in the Auburn University Leach Science Center used by Landers and his team in preparation of spending time at the Berkeley Lab. Landers and his Auburn University students are in scientifically elite company at Berkeley Lab. According to the Berkeley Lab Web site, 11 scientists associated with the Laboratory have won the Nobel Prize and 55 Nobel Laureates either trained at Berkeley Lab or had significant collaborations with the Laboratory. Thirteen Berkeley Lab scientists have won the National Medal of Science, the nation's highest award for lifetime achievement in fields of scientific research. As of 2008, there have been 61 Berkeley Lab scientists elected into the National Academy of Sciences, considered one of the highest honors for a scientist in the United States. For more information on Berkeley Lab, visit the Web site: www.lbl.gov.

Moss Lab: Ctenophore research

Figure 1.
Mnemiopsis leidyi. About 4 cm long.

Ctenophores, or comb jellies, are among the most common and beautiful of marine organisms. Many glow bright blue at night, but during the day shimmer with a rainbow of colors from eight rows of swimming paddles. The paddles, which are made of many thousands of parallel cilia, act as diffraction gratings and catch the sunlight, breaking it up into the full spectrum of color. Comb jellies look like jellyfish, but do not bear stinging cells or cnidocytes. Ctenophores eat crab, oyster and fish larvae, and many other small crustacea. Some eat other ctenophores or even small jellyfish. They are all very important predators wherever they occur.

In our lab we examine the microbes that inhabit ctenophores. *Mnemiopsis leidyi*, the most common ctenophore of the U.S. coastal region, is our main research animal (Figure 1). I first discovered protists (eukaryotic single-celled microbes) living on *Mnemiopsis* in the Gulf Coast in 1993. This group includes amoebae (Figure 2), a dinoflagellate (Figure 3) and a ciliate (Figure 4). The microbial assemblage has moved northward over the past decade, probably as a function of global warming. Indeed, on the day that Hurricane Katrina hit the Louisiana coastline in August 2005, I first saw the amoebae on ctenophores in waters off Cape Cod. Masters-degree students Matt Dodson and Khristian Smith have shown that the amoebae are found on ctenophores all along the coastline of the Eastern U.S. up to the Chesapeake Bay. Khristian's molecular analyses, as well as those of collaborators at the Woods Hole Oceanographic and San Jose State University, suggest that the amoeba is previously unknown to science. Khristian (Figure 5) has further shown through his morphological and molecular studies, that the dinoflagellate is closely related to a species from Naples, Italy, possibly brought to the New World by human maritime activities — it may have rapidly evolved to take advantage of the ctenophore as a food source. In addition, Ph.D. student Erin Donovan has shown that ctenophores carry bacteria in their gut, much like higher organisms.

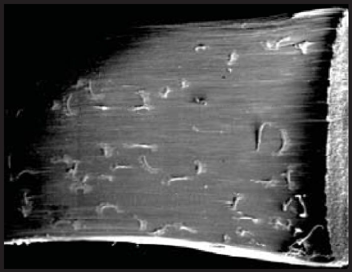


Figure 2.
Comb plate amoebae on a fragment of a comb plate. Scale: 0.8 mm wide

Figure 3.
Dinoflagellate. Bright blue Calcofluor staining by K. Smith reveals the edges of the armored plates surrounding the cell. Cell is approximately 0.025 mm across.

Ctenophores are full of surprises! Undergraduate students Chris Taylor, Amanda Sheffield, Sarah Stephenson, Brett Sprouse, and Deborah Odom, showed that this quintessentially plankonic animal spends about 30 percent of its time on and in the extremely soft, flocculant uppermost layers of marine sediments! Freely swimming animals employ complex behaviors to collect food from the mud, an astonishing behavior for this very soft, fragile animal. This may be a way that *Mnemiopsis* collects food during lean times.

Figure 4.
Scanning electron micrograph of Trichodina ctenophorii, a symbiotic ciliate. Scale, 0.005 mm

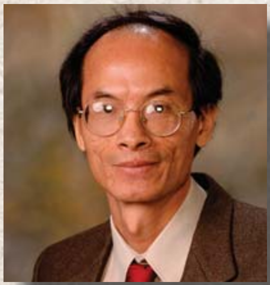
Mnemiopsis is native to the New World. However, it is also a notoriously invasive animal commonly carried in ship ballast water that is being transported worldwide. It is infamous for having invaded the Black Sea in the 1980s, costing the Turkish economy more than $40 billion. In the 1990s it invaded the Caspian Sea, where it again created ecological havoc. In the summer of 2006, *Mnemiopsis* invaded the North Sea and Baltic Sea, its range almost certainly extended by global warming. If *Mnemiopsis* carries its microbial load with it, as suggested by some of our work, then when the ctenophore travels to distant shores, it also carries a population of microbes that have unknown consequences for the organisms that normally live there. I plan to extend my work to study the effects of invasive *Mnemiopsis* in the North Sea, by traveling to Northern Germany this summer.

-Anthony G. Moss, Ph.D., Associate Professor, Biological Sciences, Auburn University

Figure 5.
Khristian Smith, hard at work on board ship.

2008 Dean's Research Award Recipients

Graduate Ph.D.
Xianghong Wu
Chemistry
& Biochemistry



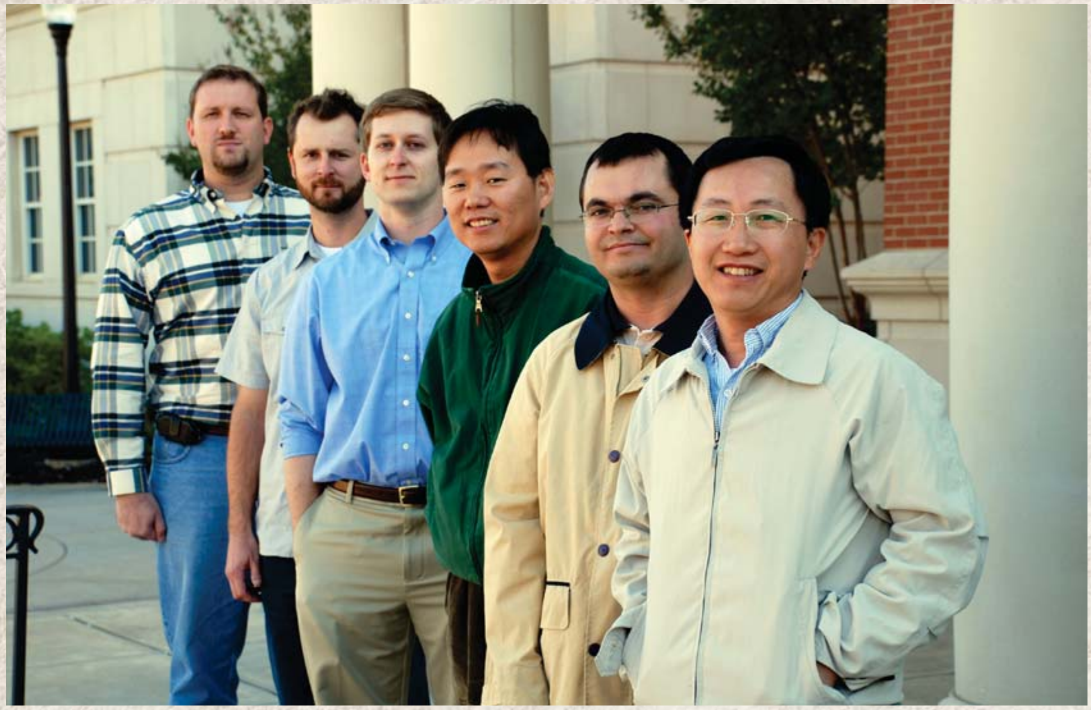
Faculty
Ming-Kuo Lee
Geology &
Geography

Undergraduate
Jonathan Waite
Mathematics &
Statistics

Graduate Ph.D.
Kathleen M. Morrow
Biological Sciences

Graduate M.S.
Scott Varagona
Mathematics &
Statistics

New Faculty in COSAM



From front: Dr. Yanzhao Cao (mathematics), Dr. Erkane Nane (mathematics), Dr. Haibo Zou (geology), Dr. Christopher Easley (chemistry), Dr. Paul Cobine (biological sciences), and Dr. Michael Fogle (physics)

NASA Funds Auburn Professor's Research of Wetumpka Impact Crater Site

Artist Jerry Armstrong was commisioned by the City of Wetumpka to create art that would reflect the landscape and wildlife of the region at the time the astroid hit the area millions of years ago. The image above represents one of the paintings Armstrong provided. In the background is a large ball of fire created from the astroid's impact on the surface of the earth.

"Armstrong asked me about the facts of the region so that the artwork would reflect the reality of Wetumpka millions of years ago. This painting is scientifically correct," King says.

Dr. David King, a professor of geology at Auburn University, has been awarded $190,000 from National Aeronautics and Space Administration (NASA) to further his research on the Wetumpka impact crater site. King has been studying the site, which is located in Elmore County, Ala., for just over 10 years. He has published proof that the site was formed millions of years ago when an asteroid hit the earth, based on his findings of shocked quartz, which only forms in the heat and pressure of an asteroid impact. The first drilling of the site was funded solely by a gift to the Auburn University by Vulcan Materials, and now there is substantial funding from NASA to continue the drilling. The drilling produces core samples, which are then studied in an attempt to learn more about the crater. King hopes to find both undergraduate and graduate students interested in the study to conduct research along with him.

The Wetumpka impact crater research gained international interest when King hosted an international field forum at the site in March 2007. In addition, with his help, the City of Wetumpka and Elmore County have founded a "Crater Commission," and they host public tours of the site once a year each February.

STUDENT RESEARCH

Each year, a committee made up of faculty from each department in COSAM selects senior students to perform research projects. Students are selected for research projects based on GPA, a submitted essay and project outline, and the potential for a career in research. The research project also enhances a student's success for graduate school admission.

Conservation in Captivity: The Challenge of the Maned Wolf

Student Researcher: Anne-Marie Hodge
Mentor: Troy L. Best

When you first see a maned wolf, it is easy to be confused. Where, exactly, does this animal fit in the tree of life? This is a wolf that resembles a cross between a fox and a deer, with reddish fur, radar-like ears, unbelievably long legs, and a distinctive ruff of black fur (the eponymous "mane") adorning its neck. Standing as high as a Great Dane but weighing only 50 pounds, these animals are delicately boned and have an almost ethereal air about them.

The species as a whole, in fact, is becoming increasingly ethereal. The maned wolf (*Chrysocyon brachyurus*) is declining rapidly, due to habitat destruction in its native South America. Without persistent effort by conservation biologists, this species could face extinction in the imminent future. Unfortunately, attempts to breed maned wolves in captivity have been minimally successful. Much of this is due to their extremely unique ecology and behavior. Unlike North American wolves, maned wolves do not live in packs. They are largely solitary, although they live together in monogamous pairs during the breeding season, and males contribute to raising the young. They are also unique in terms of their diet. Unlike their meat-eating relatives, the vast majority of their diet consists of a single plant species, *Solanum lycocarpum*, which is a relative of the tomato.

These interesting traits have contributed to difficulties with maintaining this species in captivity. Initially, zoos fed maned wolves typical meat-based carnivore diets. This species lacks the ability to break down the amino acid cystiene, and eating too much meat causes them to die of renal failure resulting from cystinuria. In addition, behavioral neurosis caused by artificial environments in captivity could cause low breeding success.

My research seeks to identify diet and exhibit design factors that correlate to successful captive breeding for this species. In collaboration with the National Zoo's Conservation Research Center in Front Royal, Va., I am collecting data from all the zoos in the U.S. that currently have maned wolves, gathering information about what they feed their wolves, details about exhibit design (such as size and features that encourage natural behaviors), and information on past success or failure with breeding attempts. This cross-institutional analysis will allow me to create a database of maned wolf husbandry practices and captive breeding efforts. Using this, I will identify any features of diet, exhibit design, or other practices which correlate to successful reproduction.

The goal of my research is to identify practices which contribute to better health and breeding of maned wolves, so that future captive breeding attempts can use and expound upon these successful factors. This information will be crucial for further conservation of the species in captivity. Habitat preservation should always be top priority when conserving endangered species, but maintaining genetic reserves in zoos is crucial as well. With a better understanding of what it takes for these animals to thrive in captivity, we can develop a more effective breeding program to support the rapidly disappearing wild populations.

-Anne-Marie Hodge

Two-Phase Extraction Studies Using Schiff-Base Ligands

Student Researcher: Kathryn L. Heflin
Faculty Mentor: Anne E. V. Gorden

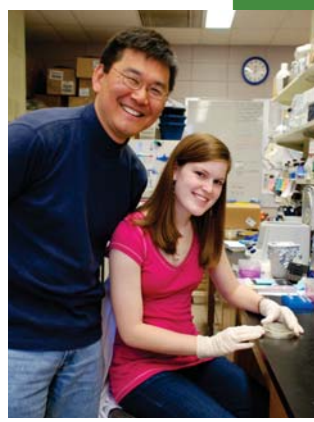
Nuclear power plants are responsible for nearly 30 percent of the world's current energy production. This percentage should continue to rise in response to growing energy demands. Unfortunately, the volume of nuclear wastes produced will also increase. An efficient means of disposing these radioactive wastes is necessary for the future of nuclear energy production.

Uranium and other actinides are major contributors to the long-term radioactivity of nuclear wastes. The ability to separate actinides from lanthanides and other heavy metals could decrease the amount of wastes requiring long-term storage. The separation of actinides and lanthanides is difficult due to their similar ionic radii and oxidation states. Our research focuses on the synthesis of Schiff base ligands that are selective for uranium. A Schiff base ligand contains a carbon-nitrogen double bond and is synthesized by reacting an amine and an aldehyde. The uranyl ion (UO_2^{2+}) forms a complex with the mixed nitrogen and oxygen core of the ligand. A wide variety of Schiff base ligands can be prepared by modifying the chosen reactants.

After the successful synthesis of a ligand, two-phase extraction studies are used to determine the extent of the ligand's selectivity and extraction capabilities. The ligand is dissolved in an organic solvent such as chloroform and is mixed with a solution of metal ions in water. These metals may include uranium, a variety of lanthanides, and transition metals such as copper, cobalt, iron and nickel. The ability of the ligand to extract the metal and form a complex is determined by using methods such as UV/Vis spectroscopy and flame atomic absorption spectroscopy. The extent of uranium extraction is compared to the extraction of other metal ions. It is our goal to extract a large percentage of uranium from the aqueous solution, while extracting a very small percentage of other metals. It is the hope of our group that the synthesis of selective Schiff base ligands will improve the efficiency of cleaning up radioactive wastes.

-Kathryn L. Heflin

Identification of Factors That Regulate Biodegradable Plastic Production in *Pseudomonas Aeruginosa*



Student Researcher: Katheryn Walker (COSAM URF recipient)
Faculty Mentor: Sang-Jin Suh

Pseudomonas aeruginosa is a ubiquitous bacterium that produces biodegradable plastic (polyhydroxyalkanoic acid or PHA) as a nutrient reservoir the organism can access when food becomes scarce. The biodegradable plastic produced by *P. aeruginosa* possesses all of the characteristics of synthetic plastic with the added advantage of environmental friendliness because it can be readily degraded in landfills or in sewage sludge by bacteria, including *P. aeruginosa*. Currently, biodegradable plastic is not commercially utilized because of the prohibitive cost associated with its production. In Dr. Sang-Jin Suh's laboratory, we are trying to understand the factors that control the PHA production in *P. aeruginosa*. Once these factors are determined, the bacterium can be genetically engineered to maximize PHA production. This will reduce the cost and promote increased utilization of biodegradable plastic that will ultimately contribute to greener earth.

My specific research goal is to understand the differential regulation of two genes, *phaC1* and *phaC2*, that catalyze the same last step in PHA production. Interestingly, *P. aeruginosa* carries two genes that appear different and yet carry out the same enzymatic function. We are taking genetic approaches to identify the environmental conditions that control which of the two *phaC* genes are utilized based on the needs of the bacterium. We believe such an understanding will further our efforts to improve the efficiency of biodegradable plastic production from bacteria.

-Katheryn Walker

Determining the Parentage of the Natural Hybrid *Vitis x champinii*

Student Researcher: Camilla Thompson
Faculty Mentor: Leslie Goertzen

Determining the parentage of natural hybrids can aid scientists in better understanding the pressures of evolution. I am looking at a grapevine natural hybrid, *Vitis x champinii*, to try to determine its parentage.

Vitis x champinii is believed to be a natural cross between *V. mustangensis* and *V. rupestris. V. x champinii* is found in Texas, as is *V. mustangensis* and as *V. rupestris* was at one time. *V. x champinii's* main purpose to the wine industry seems to be as rootstock, since it is resistant to pests such as nematodes and phylloxera and does well in drought conditions. Discovering the true origin of this cross could be beneficial to the wine industry, and would also increase our understanding of grapevine phylogeny and the formation of hybrid species in the wild.

Using molecular markers, I plan on determining the parentage of the natural hybrid *Vitis x champinii.* By amplifying and sequencing a target gene (ADH-1), I will determine the nucleotide sequence of part of this plant's DNA. I will then compare this sequence to sequences I already have from a wide variety of *Vitis* species. I will assume that for each of the two alleles, the closest match will be one of its parent species.

Once the two parent species are determined, the traits of *Vitis x champinii* can be examined to determine how the original traits expressed themselves in the cross. Questions about the plant's high level of fitness in a harsh environment can then be answered.

-Camilla Thompson

Actinide-Selective Ligands for Detection of Radioactive Contamination

Student Researcher: Brandon K. Tate
Faculty Mentor: Anne E. V. Gorden

Due to the environmental dangers and health risks associated with the increasing use of nuclear power in our society and the possibility of radioactive contamination, our research group is interested in the development of chemical compounds which can be used to sense radioactive elements as they would be found in environmental conditions, such as in contaminated water and soil. We have developed a class of organic compounds which change color in the presence of certain radioactive elements called actinides, including uranium and plutonium, allowing us to detect and quantify radioactive contamination due to these elements.

The color change occurs because the molecules of these compounds bind chemically to actinide atoms, and these bonds cause a slight alteration in the three-dimensional structure of the molecules, affecting how the molecules interact with light. More specifically, our compounds absorb different frequencies of visible and ultraviolet light depending on whether they are bound to actinides. The absorption of light at different frequencies can be measured very precisely with a spectrophotometer, so that we can determine how much of our ligand binds to actinides and how much remains unbound.

A major problem with many actinide sensors is that they bind not just to actinides but also to some harmless elements such as copper, which is relatively abundant in the environment. This interference due to harmless substances prevents the use of many sensors when many different elements from the environment are present. The ligands that we are researching do indeed bind to some of these more common elements, but the light frequencies they absorb when bound to actinides is different from the light frequencies they absorb when bound to other elements. Due to this difference in light absorption, we can use the ligands to distinguish between actinides and other elements.

-Brandon K. tate

Biological Sciences Professor Jon Armbruster gets into the spirit and period attire of Charles Darwin as part of Auburn University's celebration of Darwin's 200th birthday and the 150th anniversary of the publication of *On The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life.* For more information on the Darwin celebration, co-sponsored by the College of Sciences and Mathematics and College of Liberal Arts, please visit: http://www.auburn.edu/academic/classes/biol/1030/1037/darwin.html

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