IU • CHEMISTRY

Association of Indiana University Chemists Alumni Journal

Vol. 56 • College of Arts and Sciences • Fall 2011

Is your food organic?

Antibiotic agents in nature

Remembering Professors
Lee Todd and George Ewing

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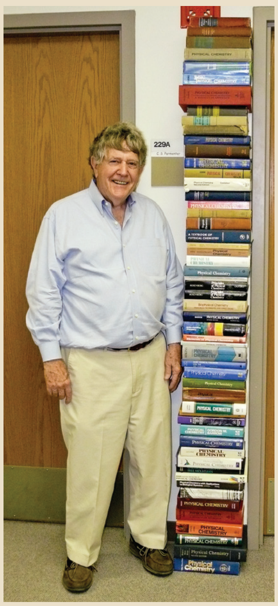

Kate Reck with two meters of freshman and organic texts that arrived in the last year. In contrast, the stack of physical chemistry texts next to Charlie Parmenter took almost 40 years to accumulate. The transient nature of freshman texts is well known. Fittingly, that stack stood only long enough for a picture. (Photos: Charlie Parmenter)

This magazine is published annually for graduates of the IU Department of Chemistry by the Department of Chemistry to encourage alumni interest in and support for IU.

Any questions regarding the content of this publication may be directed to the editor at creck@indiana.edu. The department may be contacted at chemchair@indiana.edu.

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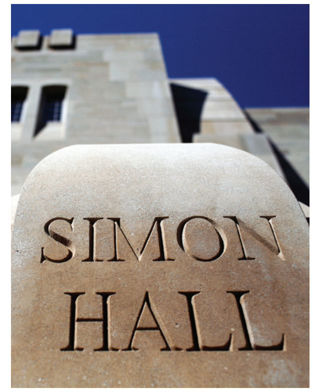




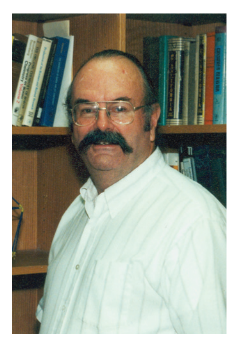

I write with excitement that my first full year as Chair of the Department of Chemistry is now behind me!! These past twelve months have brought significant changes in the way we do business and extraordinary promise for the future. As the campus is bustling with new and returning students and cooler weather is (finally) in the air, we are again establishing a search committee, this time to identify junior faculty candidates in analytical or bioanalytical chemistry to join us in Fall 2012. We are also moving ahead and continuing to grow our significant presence in organic chemistry and chemical biology, as we seek to enhance these key subdisciplines in the department.

David Giedroc

We have two assistant professors up for promotion to Associate Professor with tenure, and one of our physical/materials chemists seeking promotion to Full Professor. We are also adding to our non-tenure track research ranks as we seek qualified applicants for the Director of Biological Mass Spectrometry. This latter effort is the first of several steps that will allow us to refocus our world-renowned expertise in mass spectrometry in order to expand biomedical applications of this key analytical technology.

I take great pleasure in announcing that this past summer ***three*** outstanding new faculty members joined our department. They are **M. Kevin Brown**, an Assistant Professor with expertise in synthetic organic chemistry who comes to us form E.J. Corey's laboratory at Harvard University, Senior Lecturer **Ben Burlingham**, a former IU Ph.D. student that we were able to lure from his tenured position at the University of Mount Union in Ohio, and Lecturer **Laura Brown**, from Harvard Medical School.

In addition, we also successfully recruited **Nicola Pohl** from Iowa State University, who will hold the Marvin Carmack Chair in Bioorganic Chemistry. You may recall from last year's letter that Emeritus Professor Carmack passed away last summer and during a memorial service held in his honor in September 2010, it was announced that the late Prof. Carmack had graciously endowed the department a chair in his memory. Nikki is at the forefront in developing new methods in automated oligosaccharide synthesis geared toward the study of carbohydrates in immune function and has built a company around her technology. Both she and her company arrive in Bloomington sometime next summer 2012. Our recruitment of Kevin, Ben, Laura and Nikki greatly expands our ability to do some creative and highly topical things in the undergraduate classrooms and laboratories in organic chemistry and chemical biology, so this an exciting time of change for our teaching mission as well.

Many of our faculty have received recognition for major university and national awards since our last issue of *IU • Chemistry*. These include the R&D 100 Award (**Gary Hieftje**), the Ralph & Helen Oesper Award (**Hiefjte**), recognition as a 2011 Fellow of the American Chemical Society (**Hieftje**), the R. Bruce Merrifield Award for a lifetime achievement of a

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Organic Chemistry's Changing Role in the World

by Silas Cook

Silas Cook

Courtesy photo

Organic chemistry may be one of the most feared classes among budding undergraduates for many reasons, though it can usually be distilled down to a fear of the unknown. The simple fact is that it is very difficult for one to discern beforehand whether they will perform well in their first organic chemistry course. Students hear the material is "impossible" from some, while others boast about how much they enjoyed the course. Even more confusing is the fact that those who have had difficulties with other science courses can do exceedingly well in organic chemistry, though some students with straight A's ruin their transcript when faced with the "horrific" subject. While most people learn early in life whether they have a penchant for math, a knack for writing or an ear for music, such early realizations about organic chemistry are highly rare. So how does one know whether they have the aptitude to do well in the subject? And more importantly, which classes or skills prepare one for organic chemistry?

Successful organic chemists hail from all walks of life. Wealthy aristocrats, poor farmers, middle-class suburbanites and blue-collar city dwellers have all become auspicious organic chemists. So what do they have in common? Some people confuse memorization abilities with intelligence. While having a good memory benefits students of organic chemistry early in their careers, a photographic memory is no guarantee of an A — in stark contrast to most undergraduate courses. Good organic chemists generally possess above-average spatial perception (or three-dimensional thought), superior strategic thinking and strong work ethic. Games devised by Rubik, summer jobs in landscape design or auto repair, and outdoor activities such as distance hiking, cycling or climbing, all develop acute spatial perception. Strategic thinking can be honed with games like chess or World of Warcraft® (WOW) as well as sports steeped in strategy such as fencing, rugby or American football. And while a strong work ethic develops from a young age, it is usually driven, in my experience, by a desire or fear or some combination thereof and, unfortunately, it seems to be a difficult thing to teach. That said, most people inadvertently prepare for their organic chemistry course through a natural inclination toward these pursuits. Interestingly, it's a two-way street, and the study of organic chemistry can also improve one's abilities in any of the above-mentioned activities — a fact reflected in the medical school requirement for undergraduate organic chemistry.

Once an individual discovers their interest in organic chemistry, developing it into a passionate career allows one to make an impact on any number of fields. Organic chemists are most famous for their ability to build organic molecules with interesting properties (most notably, new medicines). And thanks to the ubiquity of organic molecules, organic chemists have proven useful for developing new polymers for textiles, materials for the aerospace industry, ligands to alter or enhance catalysts, polypeptides and unusual DNA derivatives to study biological processes, sensors for use in various detectors and even tiny molecular motors and machines (now known as nanotechnology). Consequently, organic chemistry laboratories, such as ours at Indiana University, serve as a conduit of creative expression for young organic chemists to make their mark on any number of important global problems. For example, one member of our laboratory recently embarked on an effort to save millions of lives and help lift developing nations out of poverty by lowering the cost of a critical drug used to treat malaria.

Malaria is a global health crisis afflicting 300-500 million people annually and the leading cause of death among African children — causing 20% to 25% of all childhood deaths. The recommended treatment for malaria-causing *Plasmodium falciparum* is artemisinin-based combination therapy (ACT) — which offers the best defense against the development of artemisinin-resistant parasites. Unfortunately, the artemisinin needed for these drugs depends on a key starting material from the Chinese wormwood plant, *Artemesia annua*. While artemisinin production is efficient and cheap by Western standards, the medication is still about an order of magnitude more expensive than what most of the infected can afford (at ~$2.50 per

Malaria is a global health crisis afflicting 300-500 million people annually and the leading cause of death among African children — causing 20% to 25% of all childhood deaths.

treatment). Moreover, crop disruptions caused by natural disasters, poor planning or geopolitical events have led to shortages and price fluctuations. In the last 10 years there have been three primary approaches to combat these issues: 1) using a biosynthetic approach to produce a chemical precursor of artemisinin in bacteria; 2) breeding new varieties of *Artemesia annua* with improved growth or production traits; 3) or synthesizing novel peroxide-containing small molecules and advancing them through clinical trials. Interestingly, the literature over the last decade reveals a disappointing lack of effort focused on discovering a *de novo* synthesis of artemisinin from cheap, readily available chemicals — a significantly more affordable and timely research proposition.

Soon after the initial report of the structure and anti-malarial activity of artemisinin, chemists began work to synthesize the natural product. This culminated in several total syntheses of artemisinin. While impressive from an organic chemistry perspective, these syntheses have done little to address the supply issues of artemisinin. The routes suffered from high costs inherent to long reaction sequences, excessive protecting group schemes and expensive terpene-based starting materials. These problems have led the World Health Organization (WHO) in 2005 to declare that a laboratory synthesis of artemisinin is untenable. Sorry WHO, but we disagree.

For the synthesis of any molecule, organic chemists strive for a cheap, efficient process since this will provide savings in both time and effort. The “ideal synthesis” is very much in line with Nobel laureate Sir John Cornforth’s view on “green” chemistry:

It does, for example, no good to offer an elegant, difficult and expensive process to an industrial manufacturing chemist, whose ideal is something to be carried out in a disused bathtub by a one-armed man who cannot read, the product being collected continuously through the drain hole in 100% purity and yield.

— *Chemistry in Britain*, 1975

Of course, many things stand in the way of achieving the perfect “one-armed man” synthesis. To get close, we consider step economy (the fewest number of steps to achieve the desired product), reaction yields, chemical costs, isolation methods and waste streams. Organic chemists initially focus on step economy and starting material costs since the other considerations can be optimized once a viable synthesis is available. For example, if a synthesis begins with material that is more expensive than your target compound, as is the case for most syntheses of artemisinin, then you have no hope in developing an improved process, no matter how few steps are employed.

Our synthesis of artemisinin begins with cyclohexenone (Figure 1 on page 4). Cyclohexenone is an ideal starting material for synthesis since it is available by the metric

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Chair’s Letter

Continued from page 1

peptide scientist (**Richard DiMarchi**), the Manuel M. Baizer Award for Organic Electrochemistry (**Dennis Peters**), the 2012 SEAC Young Investigator Award (**Lane Baker**), three IU Trustee Teaching Award winners (**Jeff Zaleski**, **Kate Reck**, **Martin Jarrold**), an IU President’s Award for Teaching (**Jill Robinson**), a Distinguished Faculty Research Lecturer (**DiMarchi**) and the Cram Lehn Prize (**Amar Flood**). These awards serve as testament to the internationally recognized research and high quality teaching that characterizes our department.

Finally, I note with sadness the passing of two former faculty members during the past year. They are Professor Emeritus **Lee J. Todd**, an inorganic chemist, and Chancellor’s Professor Emeritus of Chemistry, **George E. Ewing**, a physical chemist who was active and held in very high regard up until his death on August 23 at the age of 77. A memorial service was held in Professor Todd’s honor on May 28 at the Quaker Meeting House in Bloomington. A memorial service for Prof. Ewing was held October 15 at the Neal-Marshall Cultural Center.

In addition, I note with some sadness that Distinguished Professor and Lilly Chemistry Alumni Chair **Milos V. Novotny** has retired effective August 31, 2011, completing nearly 40 years of service to the day to the department and university. A retirement party will be held for him during the fall semester with details on date and time to be announced. In addition, the Department will host a scientific symposium in honor of Milos’ many accomplishments likely during the Spring 2012 semester. This change in status to Emeritus Distinguished Professor will allow Milos to take up his new position as Marie Curie Senior International Fellow at the University of South Bohemia, Czech Republic. As a result of this appointment, Milos will be spending a significant fraction of the next couple of years in Europe.

Finally, I note that we lost two key staff members to retirement, each of whom played an important role within the department. They are **Sarah Collins** in the business office and **Mary Swarthout**, an employee of Indiana University for 38 years and long-serving Administrative Assistant to the chair. I wish each of them all the best on moving to the next stage of their lives.

In closing, let me express my gratitude for your continued and very generous support of our department. Your commitment and level of dedication means that we can continue to do more with less in these uncertain financial times. Please stop by the department during your next trip to Bloomington. I’d be happy to say hello.

—David Giedroc

Continued from page 3

ton at the very low cost of $70-$75 per kilogram. Since the cost of artemisinin can easily hit $1000 per kilogram, the low price of cyclohexenone provides a lot of wiggle room for the costs of everything else. Amazingly, we developed a five-step synthesis of artemisinin that requires only three chromatographic separations — making our process almost 50% more "step efficient" and orders of magnitude more cost efficient than previously possible. Furthermore, this synthesis represents the very first to produce multi-gram quantities of artemisinin. While additional improvements could be realized, we believe this synthesis represents an ideal blueprint for cheap, large-scale production of artemisinin. If realized, there might be enough artemisinin available in the world to work on the other major impediment to malaria treatment — actually delivering the medicine to those who need it.

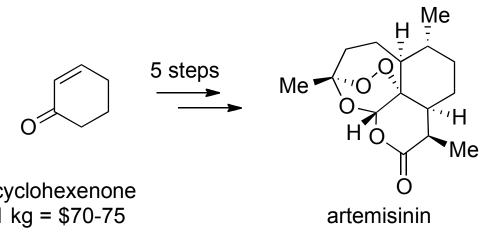
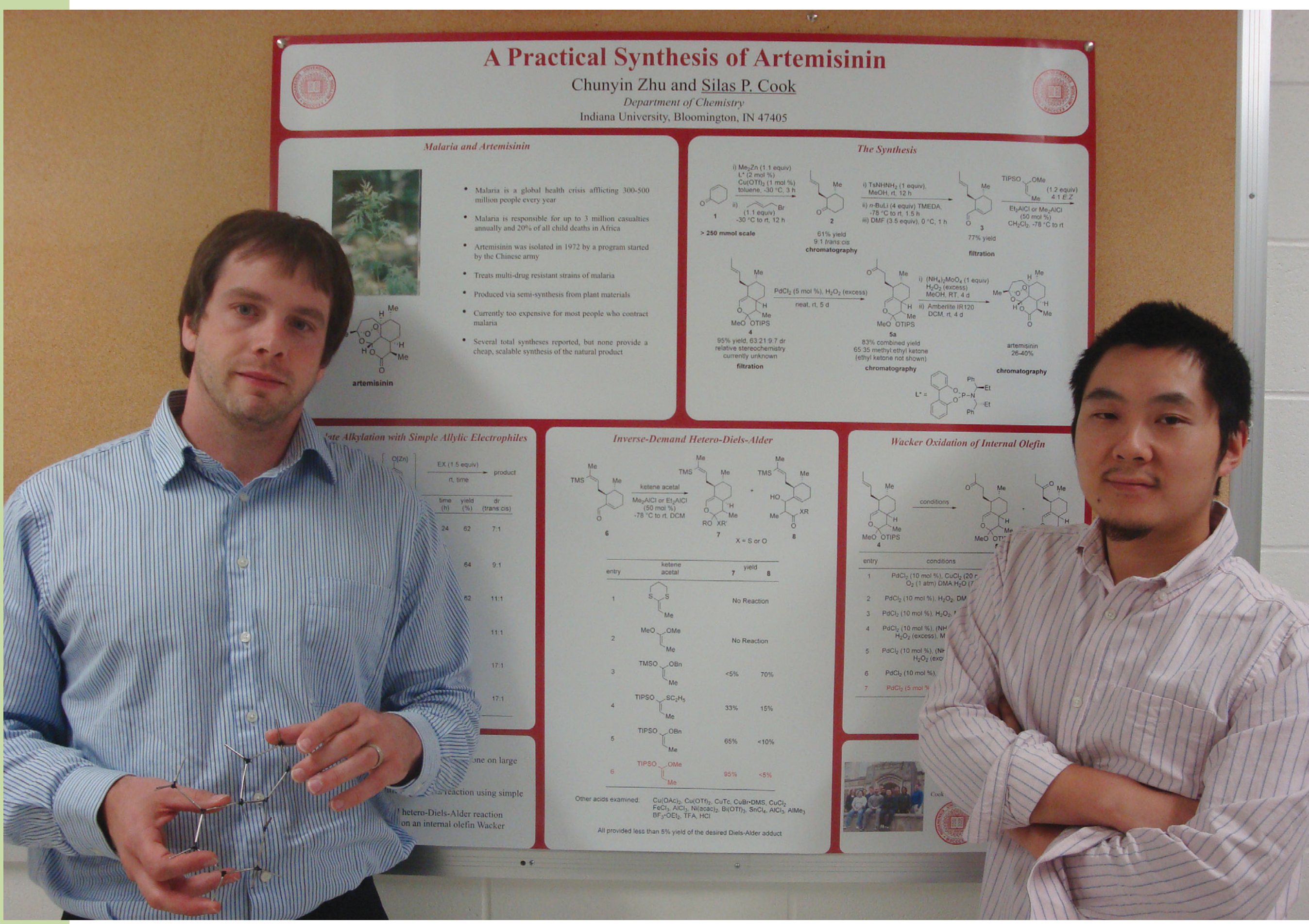


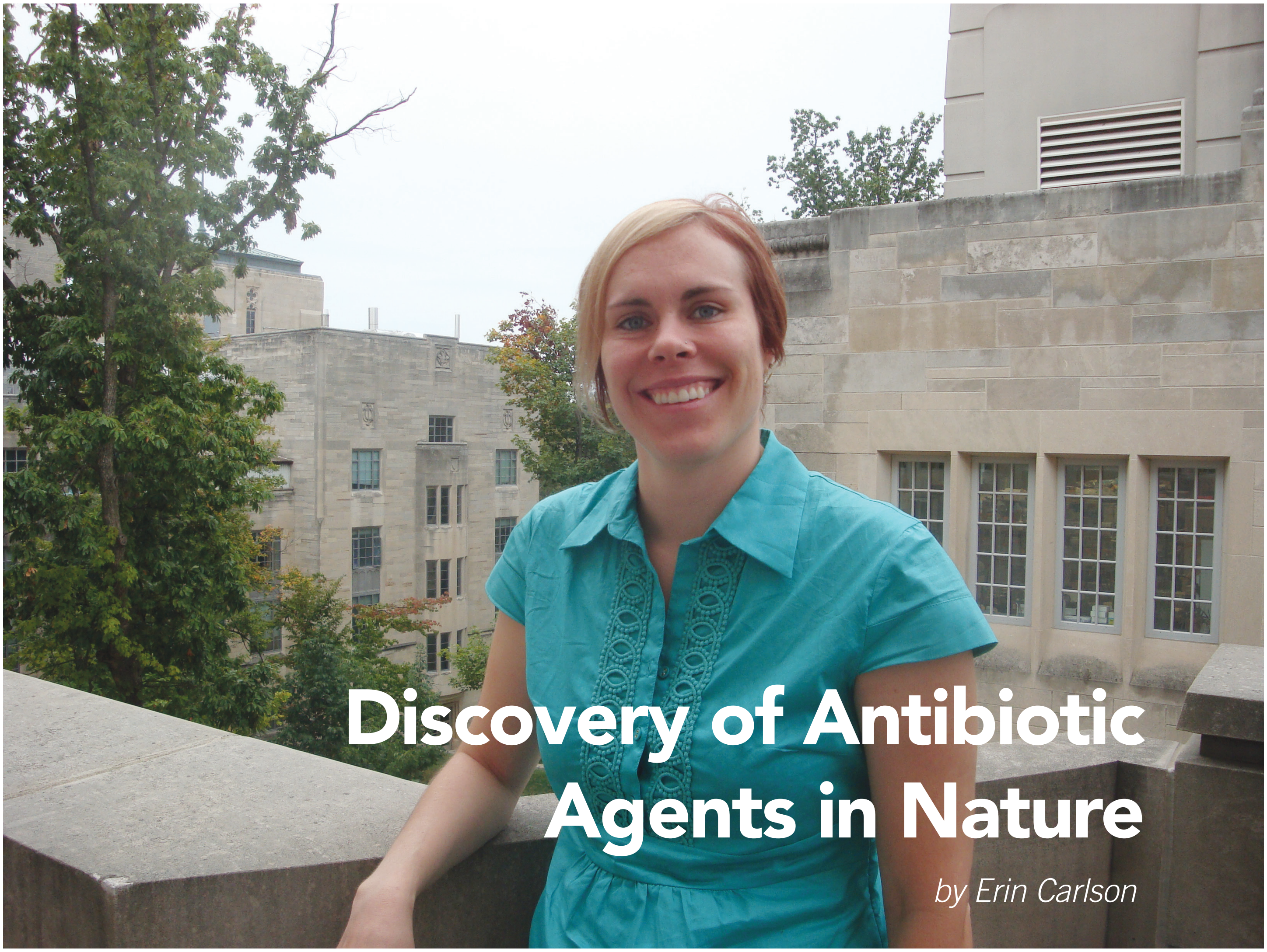
Figure 1. Artemisinin can now be synthesized in five steps from cheap, widely available cyclohexenone.

So as students return to classes this fall, many will be dreading their upcoming roles in 341: Organic Chemistry I and 342: Organic Chemistry II. A select group of strategic, three-dimensional thinkers, however, will be opening their eyes to the possibilities offered by organic chemistry. Will they study the subject in greater detail to discover as yet unknown applications of the discipline? Or will they travel more traditional paths using organic chemistry to develop next-generation fuel cells or catalysts capable of artificial photosynthesis? Although some students of organic chemistry won't go on to battle disease or help solve the world's energy problem, they're newly-honed organic chemistry skills just might give them the edge they need to win the next game of WOW or the Amazing Race. ■

Silas Cook earned a B.A. in biochemistry and molecular biology from Reed College (Portland, OR) in 1999. Immediately after graduation, he took a position at the Genomics Institute of the Novartis Research Foundation (GNF) in San Diego, CA. There he worked to unravel various signal transduction pathways related to kinase and GTPase cell signaling. After a short stint in the biochemistry department at Universidad Complutense (Madrid, ES) in 2001, he began his graduate studies in organic chemistry at Columbia University (New York, NY). Upon the completion of his Ph.D. in 2006, he took a postdoctoral position at Harvard University (Cambridge, MA). Silas joined the Department of Chemistry at Indiana University as an assistant professor in 2009. Projects in the group include synthesizing biologically relevant natural products, developing unique approaches to asymmetric catalysis and devising a new generation of sustainable organic reactions.



Silas Cook shown here with Chunyin Zhu.



Discovery of Antibiotic Agents in Nature

by Erin Carlson

Infectious diseases are the second-leading cause of death worldwide and the third-leading cause of death in economically advanced countries. According to the World Health Organization, infectious diseases killed almost 15 million people in 2002 (over 25% of the total yearly deaths) with the top three killers being HIV/AIDS, tuberculosis and malaria. With the advent of the "age of antibiotics" in the 1940s, many believed that we had conquered these dangerous microbes. Unfortunately, we now know that the ability of bacteria to evolve antibiotic resistance had been sorely underestimated, and that generally, resistant bacteria are observed within four years of the introduction of a new antibiotic. Although the need for new therapeutic agents is dire, the discovery of new, effective antibiotic agents is an arduous and time-intensive process.

The **Carlson** Group seeks to identify new drugs by discovery of effective agents from plants, marine organisms, or microbes. These "natural products" are generally complex small molecules that have been produced by a living organism. Naturally produced compounds are an essential component of today's pharmaceutical arsenal, with nearly half of all currently available drugs and 75% of treatments for infectious disease being of biological origin. This is not surprising considering that biologically-produced therapies have been used for centuries. Even today, 60% of the world's population depends almost exclusively on plant-based remedies (e.g., traditional Chinese medicine).

Commercialization of the first "purified" drug occurred in 1826 when Merck introduced morphine, which was discovered in poppy plants.

Novel antibiotic natural products can be found in marine organisms, terrestrial plants, and microorganisms such as fungi and bacteria, organisms that generally contain hundreds or even thousands of structurally diverse chemical compounds. Accordingly, exploration of nature's small molecule repertoire offers an endless pool of novel compounds that are a valuable resource for the identification of new antibiotics (Carlson, E. E. Natural Products as Chemical Probes. *ACS Chem. Biol.* 2010, 5, 639-653). However, this very diversity also creates an enormous challenge in that efforts to discover new leads from a biological source are frustrated by the time-consuming, expensive, and inefficient process of identification of the active component or "active ingredient."

Continued from page 5

Prior to the 1800s, the active constituents of most medicines were unknown. Commercialization of the first "purified" drug occurred in 1826 when Merck introduced morphine, which was discovered in poppy plants. Since then, many clinically useful drugs that have been isolated from plants such as the anticancer agent paclitaxel (Taxol) from the yew tree, the painkiller, morphine, and quinine, a compound used to treat malaria. Exploration of bacteria and fungi has also been fruitful, yielding the discovery of antibacterial agents such as the tetracyclines, aminoglycosides and rifamycins. Despite these victories, a major roadblock to the identification of pharmacologically active natural products is purification, as they are generally present as minor components of biological extracts.

To assign the identity of a novel antibacterial agent, it must be separated from the other components of the biological material from which it originates. The separation methods used for the purification of nearly all natural products have depended upon a small number of physical properties, especially size and solubility (the ability of the compound to dissolve in various solvents). There are often dozens or even hundreds of compounds in a biological extract that are very similar when compared using these criteria. Thus, methods based upon size and/or solubility often result in poor separation of the components. Typically, many steps (often ≥ 5) are required to obtain a purified antibacterial agent. Thus, development of a method that separates compounds by a novel but complementary mechanism would represent a major advance in the field of natural product discovery.

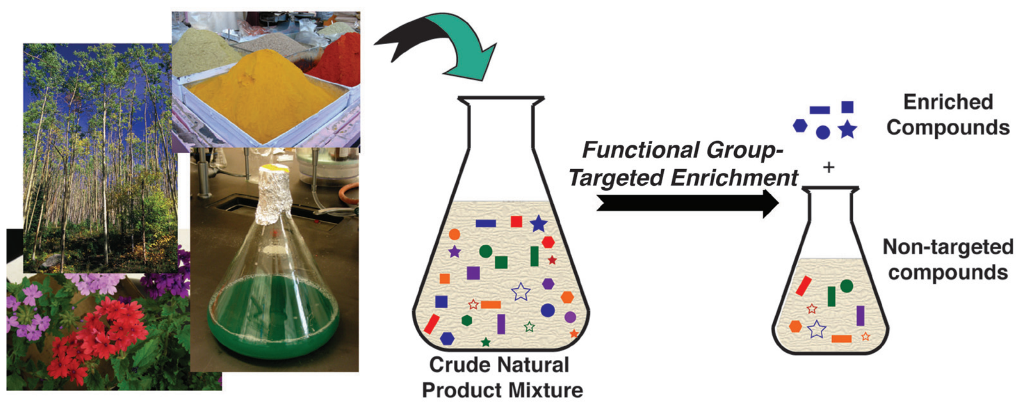


Figure 1. Natural products can be separated based upon the functional groups that they contain. This will enable us to discover new therapeutic leads for treatment of infectious disease.

We are working to develop an innovative technology that separates natural products based upon a distinct chemical property: functional group composition. Functional groups are specific arrangements of atoms within a molecule. There are many different types of functional groups; thus, the total number of compounds isolated by any one functional group will be much smaller than the number isolated based upon a particular solubility or size property (i.e., better separation will be achieved; Figure 1).

To develop a functional group-targeted method, we perform chemical reactions on the biological extracts. The functional groups in a compound will determine which chemical reactions it can participate in. Accordingly, we are developing reactions that are targeted specifically at a single functional group to enable separation of only compounds containing this group. We have generated strategies to target several functional groups, alcohols and carboxylic acids, resulting in publication (Odendaal, A. Y.*; Trader, D.J.*; Carlson, E. E. Chemoselective Enrichment for Natural Products Discovery. *Chem. Sci.* 2011, 2, 760-764; Trader, D.J. and Carlson, E. E. Siloxyl-Ether Functionalized Resins for Chemoselective Enrichment of Carboxylic Acids. *Submitted*).

We are currently working to use these separation methods to identify novel antibacterial natural products. Our lab is focusing on the discovery of compounds produced by microorganisms and plants to target *Pseudomonas aeruginosa*, an opportunistic pathogen, which is the main cause of death in cystic fibrosis patients and a major threat within the hospital environment causing nosocomial pneumonia, catheter and urinary tract infections, and sepsis in burn wound and immunocompromised patients. We will also pursue natural products to target *Mycobacterium tuberculosis*, the causative agent of tuberculosis, which kills approximately 3 million people annually and has recently made a huge resurgence due to the evolution of antibiotic resistant bacteria. ■

Erin E. Carlson earned her B.A. (Summa Cum Laude) at St. Olaf College (Northfield, MN) in 2000. She went on to graduate studies funded by the NIH Predoctoral Biotechnology Training Program at the University of Wisconsin-Madison and earned a Ph.D. in organic chemistry in 2005 under the direction of Professor Laura L. Kiessling. Subsequently, she was awarded an American Cancer Society Postdoctoral Fellowship for studies at The Scripps Research Institute with Professor Benjamin F. Cravatt. In 2007, Dr. Carlson received an NIH Pathway to Independence Award (K99/R00). She joined the faculty at IU in the summer of 2008.

Isn’t all food organic?

by Kate Reck

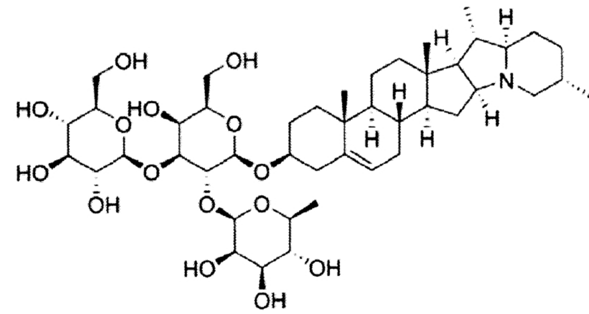
After sitting on my shelf for over three years, I finally sat down this summer to read Michael Pollan’s *The Omnivore’s Dilemma*. If you like food (which I do) it was informative and enjoyable, and one term that repeatedly cropped up (pardon the pun) was the term ‘organic’ and how the word has become perverted by the agricultural industry. Most people strive to eat the healthiest food possible, and while wandering up and down the aisles of the local market, most of us face the decision at some point: ***should I buy organic***?

Advocates recommend organic food for being safer, more nutritious and tasting better than non-organic food, while its production is touted as being better for the environment and the animals. With many buyers convinced, some experts say there is not enough evidence to prove any real advantage to warrant the cost of purchasing organic foods. Taken from the USDA website, “No distinctions should be made between organically and non-organically produced products in terms of quality, appearance, or safety.” An organic label should be thought of as a ‘production philosophy’ and should not imply that it is superior.

Although organic foods typically cost more — sometimes a lot more — than non-organic foods, organic products have seen a 20% growth in sales since 1990 (based on the Organic Trade Association). Unfortunately, there really is very limited research data to harvest on health outcomes in humans with consumption of organic foods. Before you decide whether organic food is worth the price, let’s take a look at some obvious questions.

What Qualifies as Organic?

Organic foods fall into two categories: *raw foods*, like fruits and vegetables, and *processed food*, like chips, crackers and bread. Rules and regulations governing raw foods are strict and straight-forward, and rules on processed foods are a bit less so. For this dialogue I have avoided discussing the word organic as it applies to non-foods, like cotton fibers or clothing, because in this arena, regulations and oversight is rather minimal.



Solanine, a natural toxin formed in potatoes when they turn green; as little as 3 to 6 mg/kg of body weight can be fatal.

Prior to October 2002, organic regulations were set by each state and they were all over the map. Since October 2002, all organic foods are supposedly grown and processed according to strict national standards set by the U.S. Department of Agriculture. To meet these standards, organic crops must be produced:

- without conventional pesticides (including herbicides), synthetic fertilizers, sewage sludge, bioengineering, or ionizing radiation,
- must be raised on organic feed,
- must be kept free of growth hormones and antibiotics, and
- organic farm animals must have access to the outdoors, including pastureland for grazing.

To warrant carrying an “USDA organic” label, a product must contain at least 95% organic ingredients, and a government-approved USDA professional has inspected the farm where it was produced to ensure the farm follows USDA requirements. Since 2002, consumers can be more confident that when you buy something organic that it has a good chance that it adheres to certain established criteria.

To warrant carrying an “USDA organic” label, a product must contain at least 95% organic ingredients, and a government-approved USDA professional has inspected the farm where it was produced to ensure the farm follows USDA requirements.

Is Organic Food Safer?

The largest study regarding this question was done on more than 94,000 food samples and 20 different crops. The USDA data found that 73% of conventionally-grown foods had at least one pesticide residue, while only 23% of organically grown samples of the same crops had any residues. More than 90% of the USDA’s samples of conventionally-grown apples, peaches, pears, strawberries and celery had residues, and conventionally-grown crops were six times as likely as organic to contain multiple pesticide residues.[1]

Plants produce their own natural toxins in order to protect themselves from insects and to fight off neighboring weeds, so synthetic pesticides may not be the only threat when it comes to food safety. A plant’s natural pesticide may end up being just as harmful, or even more harmful, than the synthetic pesticide used in conventional farming. For example, solanine, a glycoalkaloid in the same family as deadly nightshade, is produced by potatoes as they turn green.

Use of manure fertilizers is another common safety concern. Some critics fear that using manure to fertilize organic crops might increase the risk of contamination by microbes such as *E. coli*. While the USDA guidelines have strict regulations on composting and application of manure, there has been little evidence that organic food has bacterial contamination any more often than conventional foods. Organic farming follows strict agricultural standards that prohibit the use of raw manure before it’s time to use on crops for human consumption. Most often bacterial contamination can be traced to improper food handling after it has left the farm. Thoroughly soaking and then rinsing all fruits and vegetables can help mitigate any problems associated with bacteria or pesticides.

Since little or no money is being spent on the research, there are no conclusive statements on whether organic food is any more nutritious than conventional food. A few studies have reported that organic produce has higher levels of vitamin C, certain minerals, and antioxidants, thought to protect the produce against aging, cardiovascular disease, and cancer, but the differences are so small that they probably have no impact on overall nutrition.

Perhaps the best you can do is to eat food when it’s freshest and highest in its nutritional value, and that is best done by purchasing products grown closer to home, such as at your local farmer’s market or co-op, and eating them in a timely manner. Even nutrients like vitamin C oxidize over time so letting food sit in the refrigerator will have it lose any original benefits by buying organic in the first place. Organic-food advocates boast that organic food has more “farm-fresh” flavor and it may be because organic farms tend to be smaller operations that sell their products closer to home. According to the U.S. Department of Agriculture the number of farmers’ markets has jumped to 7,175 in

[1] B. P. Baker, C. M. Benbrook, E. Groth III, and K. Lutz Benbrook, Food Additives and Contaminants, V19, No. 5, May 2002, 427-446.

2011 from 4,093 in 2005; among these 1,043 were established this year.

Is It Worth the Cost?

You may not be convinced that organic foods are better for you and more nutritious and better for animals that produce them. However, one thing that we know to be true as chemists is that toxic and persistent pesticides and fertilizers do accumulate in the soil, water and in our bodies. Eliminating this chain of contamination during organic farming is beneficial for society in the long run.

Everyone must make a best decision based on the big picture and what they can afford. One must not skimp on healthier conventional foods in order to purchase less organic. Our country does not eat enough fruits and vegetables as it is, so your goal should be just making sure you eat a variety of healthy foods and if you throw in some organic food along the way, that's your choice. Perhaps the best thing you can do is to buy local, support your community and to get to know the farmers in your community.

Personally, I cannot survive without my organic dairy products (they just taste so much better to me!), and I look forward to farmer's market every Saturday in summer. ■

Cathrine "Kate" Reck, Ph.D. is Clinical Associate Professor and Director of Undergraduate Studies in the Department of Chemistry at Indiana University. She earned a B.A. in chemistry from Kalamazoo College (Kalamazoo, MI). Her Ph.D. is in inorganic/organometallic chemistry, specifically the synthesis of highly metalated aromatic compounds (Wayne State University; Professor Charles H. Winter). Her postdoctoral work in the synthesis of highly electrophilic olefin polymerization catalysts (The University of Iowa and The University of Chicago; Professor Richard F. Jordan). After teaching at Michigan Technological University (Houghton, MI) for one year, she accepted a teaching faculty position here at IU in 2001. She teaches courses within the areas of freshmen chemistry, non-majors chemistry, inorganic chemistry and organic chemistry.

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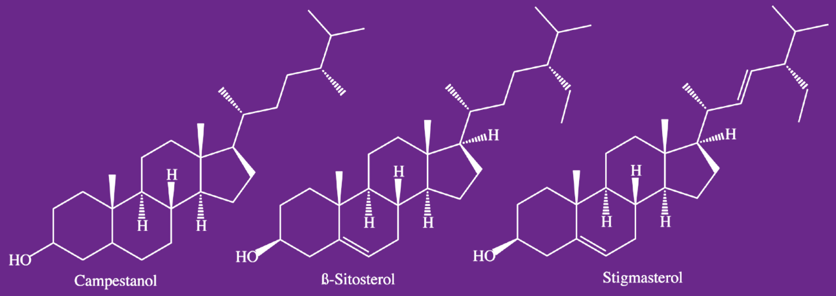
Kim displays her beautifully growing fields.

Portrait of a Local Organic Farmer

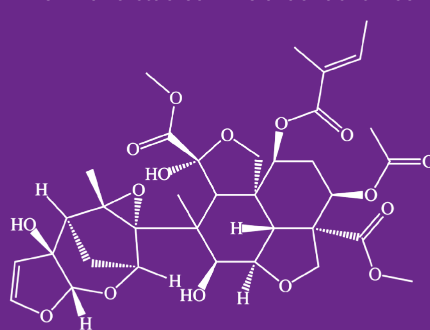
Kim Bryant (Bryant Farm) is an Ellettsville native and has been farming in Ellettsville since the early 1990's. Once her five children were all in school, she turned to organic farming on her three-acre homestead. After a great deal of research, she turned to using Fox Farm line of products which sells organic fertilizers and soil conditioners. Her initial goal was to provide nutritious and affordable produce for her family. But once she got the hang of things, her farm produced more every year and she starting selling it at the local farmer's market in Bloomington every summer.

Kim started out using sesame seed oil on the plants as an insecticide, but it became impractical as her crops became larger. About seven years ago she switched to neem oil as it works well as an insecticide, fungicide and pesticide. Neem is a fast growing evergreen tree, found in the Indian subcontinent, which grows to 50-60 feet in tropical and sub-tropical regions. Neem oil is a vegetable oil pressed from the fruits and seeds of the neem tree.



Examples of steroids found in neem oil (campesterol, beta-sitosterol, stigmasterol).

Neem oil is a complex mixture of steroids and many triterpenoids of which azadirachtin is the most well-known and studied. The azadirachtin content in neem oil ranges from 300ppm – 2500 ppm depending on the extraction technology and quality of the neem seeds crushed.

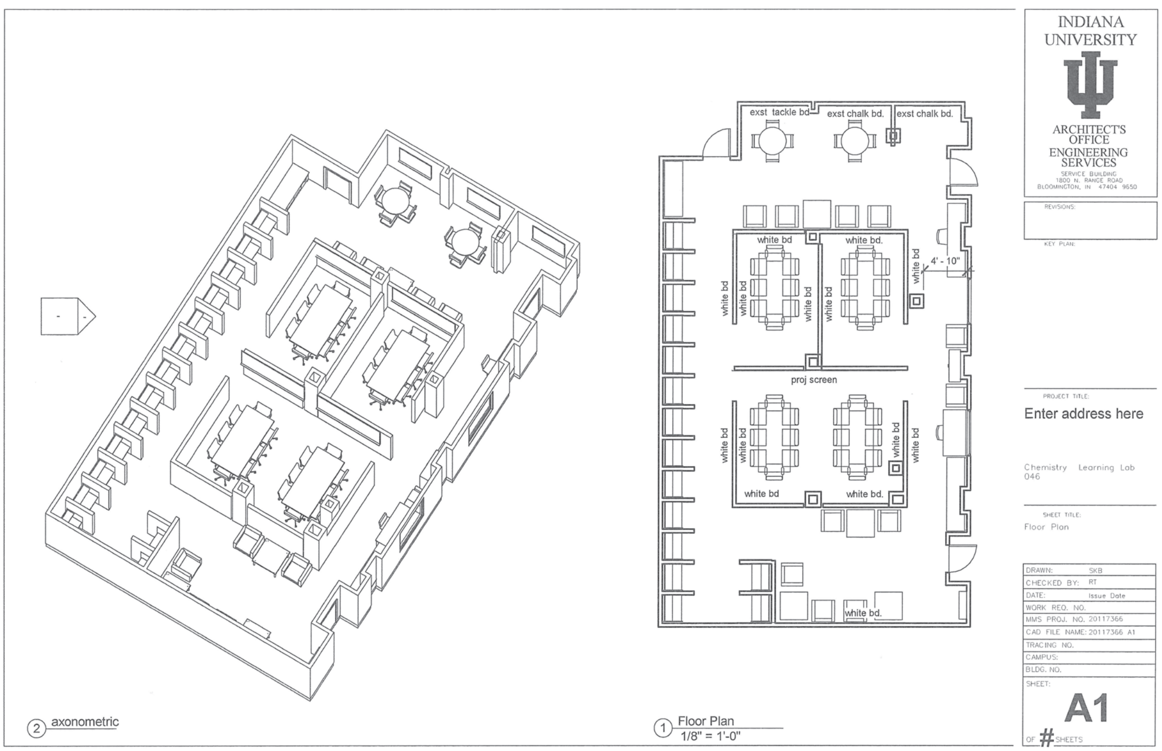


Azadirachtin, a triterpenoid, found in neem oil. The azadirachtin content in neem oil ranges from 300ppm – 2500ppm depending on the extraction technology and quality of the neem seeds crushed.

Neem oil is known to repel nearly 500 pests worldwide, including insects, mites, ticks, and nematodes (round worms), by affecting their behavior and physiology. Neem oil repels or affects their growth rather than killing the trespasser. Neem leaves can be used to protect stored grains, and neem made into a cake can be applied to the soil which kills pest insects in the soil while serving as an organic fertilizer high in nitrogen. Neem products are cheap and non-toxic to mammals and most beneficial insects; hence, they are well-suited for pest control in organic farming.

C046: Chemistry Learning Lab Renovation Project

Every semester when classes start, local coffee shops experience a rise in business as students flock to buy $4 coffees in order to sit and study for hours doing homework. *But why are students choosing local coffee shops as sanctuaries for studying and relaxing?* As much as they want to study and be quiet, they want a cool place to hang out while doing it. Students remark it's mainly the inviting atmosphere and comfortable work spaces that allows them to work individually even if they are sitting right next to another person.



Students in the Chemistry Department at Indiana University can look forward to a new renovation project to start in summer 2012 that hopes to create a similar ambience for students to enjoy (yes, enjoy!) studying in the chemistry building. Our current Chemistry Resource Center will transform into a new C046: Chemistry Learning Lab.

We have designed work areas to provide for more focused office hours, small-group, and individualized study. Soft seating will provide more comfortable seating as well as helping cut down on noise pollution, inviting more long-term study. Consideration has been given to design plenty of space between locations so conversations do not run into each other.

Features will include four mini-rooms designated specifically for office hours, equipped with "smarts boards" that allow easier transfer of information between instructor and students, and more private spaces for group and private study. Soft seating adjacent to more available electrical outlets will provide students comfortable seating while working on their laptops.

We hope to provide a positive, inviting and relaxing learning environment where students can be successful working together in this innovative and stimulating atmosphere.

We are presently fundraising for this project, and we hope you will be part of this opportunity and advancement. If you have questions, or wish to discuss development opportunities, please contact Kate Reck in chemistry (812-855-3972; creck@indiana.edu).

Please consider donating now to the next generation of student learning.

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Last year alumni and other friends of Indiana University boosted their contributions through corporate matching gifts. You can double or even triple the value of your contribution by taking advantage of your employer's matching gift program. Simply consult your personnel office to obtain a matching gift form and to find out the details of the program. If your employer participates, please enclose the completed form with your contribution.

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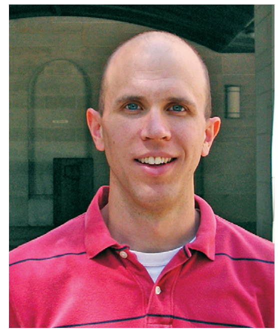
Welcome our new faculty among our ranks

Professor **Kevin Brown** grew up in the suburbs of Chicago and after graduating high school moved to central New York to pursue an undergraduate degree at Hamilton College. Here Professor Brown became interested in organic chemistry by working in the labs of Ian Rosenstein. Upon graduation, Professor Brown moved to Boston College and received his Ph.D. in organic chemistry with Professor Amir Hoveyda in 2008. After completion of his graduate studies he began a Ruth L. Kirschstein National Institutes of Health funded postdoctoral fellowship in the laboratories of Nobel laureate E. J. Corey at Harvard University. In July 2011, Professor Brown joined the faculty at Indiana University.



Single enantiomer molecules have proven to be a rich source for new therapeutics: nearly half of the new drugs approved by the FDA in the last decade are marketed as single enantiomers. In many instances, however, synthesis of these compounds is hampered by inefficient methods to establish the stereogenic center(s). Enantioselective catalysis can potentially provide a means to efficiently access any desired single enantiomer compound. Despite numerous advances in the field of catalytic enantioselective chemical synthesis, there remain many opportunities for the development of simple yet highly useful reactions. Research in the Brown lab is directed toward the development of new and important chemical reactions (which includes new chiral catalysts/reagents) for the enantioselective preparation of chiral molecules. These research problems have direct application toward the synthesis of biologically relevant molecules, contribute to our fundamental understanding of reaction mechanism, and introduce new concepts in organic chemistry.

Laura Brown, Ph.D. received her B.S. in chemistry at Illinois Wesleyan University. During the fall of her sophomore year, she joined the research group of Professor Ram S. Mohan where her research was focused on mild and chemoselective reactions of acetals and ketals promoted by bismuth salts. She then headed to the east coast for graduate school at Boston College, where she earned her Ph.D. in organic chemistry with Professor Amir H. Hoveyda in 2008. Her graduate research was focused on the field of enantioselective catalysis, and she developed two new methods for the catalytic, enantioselective addition of alkyl nucleophiles to ketone and ketoimine substrates.

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FACULTY NEWS

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During her time at BC, she developed an interest in the chemistry and biosynthesis of natural products which led her to the laboratory of Professor Jon Clardy at Harvard Medical School, where she was awarded

a National Institutes of Health Postdoctoral Fellowship. She worked jointly with Dr. Michael Fischbach, who is now an Assistant Professor at the University of California, San Francisco. Laura's postdoctoral research was broadly focused on natural products discovery and biosynthesis. Through a combination of bioinformatic analysis, biochemical, microbiological, and modern analytical techniques, she elucidated the biosynthesis of a class of peptide-derived natural products, discovered two new natural products, produced by bacterial members of the human microbiome, and characterized a regulator of a developmental switch of an important model organism.

Throughout her graduate and post-doctoral studies, Laura maintained an interest in undergraduate education, and she had the good fortune of being provided with many meaningful teaching and mentoring opportunities. She is excited to join the teaching faculty at IU, and is looking forward to leading an active undergraduate research group, where she plans to pursue her interests in organic chemistry and the chemistry of natural products.

Ben Burlingham received a B.S. in biochemistry at Grove City College in 1996. After serving as the program director of a Christian youth camp for one year, he started graduate work in organic chemistry at Indiana

University. Under the direction of Professor **Ted Widlanski**, he conducted research in the synthesis of novel enzyme inhibitors. After completing the Ph.D. in 2002, Dr. Burlingham became Assistant Professor of Chemistry at the University of Mount Union, where he received tenure in 2008. He served as visiting professor at IU for a number of summer sessions, and we are pleased to have him join us as new teaching faculty at IU fulltime starting in fall 2011.

Dr. Burlingham's teaching interests span general chemistry, organic chemistry, and biochemistry. He has spent a significant amount of time in the development of guided-inquiry labs in organic chemistry. Ben is especially interested in developing two-cycle curricular approaches for organic chemistry, which might better serve students in this time of substantial curricular change being proposed by groups such as the Association of American Medical Colleges.

In other faculty news ...

This year has been eventful for Professor **Erin Carlson** and her research group! The Carlson research program is focused on the study of bacterial pathogenesis and the identification of potential therapeutic agents. This year, Dr. Carlson presented this work at seven national and international conferences including invited talks at the National American Chemical Society (ACS) Meeting in Anaheim, CA and the Regional ACS Meeting in Indianapolis. Several group members have also attended scientific meetings and presented our work. Graduate student, **Darci Trader**, won awards for her presentations including a poster award at the Herbert C. Brown Lectures in Organic Chemistry at Purdue University and was First Place Paper Winner in the ACS Fall National Meeting 2011 Industrial and Engineering Chemistry Division Graduate Symposium! In the past year, we have also published several papers highlighting our studies.

Dr. Carlson has also been recognized with several prestigious awards including being named a Pew Biomedical Scholar. The Pew Scholars Program in the Biomedical Sciences provides funding to young investigators of outstanding promise in science relevant to the advancement of human health. In September, Dr. Carlson was notified that she has received the 2011 National Institutes of Health Director's New Innovator Award. This award is given to support exceptionally creative new investigators who propose highly innovative projects that have the potential for unusually high impact. The funds from this award will support research in the Carlson group to develop novel antibiotics from natural organisms, such as marine samples from the eastern Pacific region and the Caribbean Sea and to characterize how antibiotic resistance is developed at the molecular level in bacteria. Through these studies, the Carlson group hopes to identify new compounds that can be used as antibiotic therapies.

Ken Caulton continues teaching and leading a research group of 8–10 people, but increasingly with co-mentoring of researchers with colleague **Dan Mindiola**. Ken has several new research themes under way, and tries to adapt these to national needs like energy-related hydrogen- or oxygen-manipulation chemistry. These themes increasingly involve radical species, the manipulation of unpaired electrons, and the quantum calculation of related reaction energies.There is also a heavy push to replace catalysts containing the rarer and more expensive platinum elements by ones which employ the cheaper and strategically more available first row transition elements, and this is high on Ken's priority list. We cannot depend forever on imported platinum or rhodium, and even lithium, a battery component, is now a competitive planetary resource. Ken was intimidated by a vote of the undergraduate chemistry majors appointing him as graduation speaker for the departmental graduation ceremony in May, 2011. Talking to a group of 200 graduates, parents and siblings, uncles, aunts and grandmas, Ken tried to advocate optimism and confidence that these grads of ours can make the world a better place; if not them, then who will do it?

As many of you know, Professor **Richard DiMarchi** was recruited to the Department of Chemistry in 2003 as Linda & Jack Gill Chair in Biomolecular Sciences upon his retirement as Group Vice President at Eli Lilly & Company. It was announced in February 2011 that the Swiss pharmaceutical company Roche had purchased Marcadia Biotech, a company co-founded by Richard DiMarchi and other former Lilly executives in 2006 (see http://homepages.indiana.edu/news/page/normal/17209.html). Roche plans to license peptide-based diabetes and obesity drugs developed in Prof. DiMarchi's laboratories at IU. For a recent account of this transaction in the Indiana Daily Student, see http://www.idsnews.com/news/story.aspx?id=79901. Prof. DiMarchi is now Cox Professor of Chemistry and holder of the Gill Chair in Biomolecular Sciences and was recently honored as 2011 University Distinguished Faculty Research Lecturer, an occasion marked by his presentation entitled "Miraculous Molecules" (see http://homepages.indiana.edu/web/page/normal/18086.html). In addition, Professor DiMarchi was recently named winner of the R. Bruce Merrifield Award for a lifetime achievement of a peptide scientist. Join me in congratulating Prof. DiMarchi for these outstanding achievements.

During the past year, the **Giedroc** laboratory published a important finding in the Journal of Biology Chemistry that may have uncovered a new metabolic pathway that allows the human pathogen Staphylococcus aureus to obtain the sulfur for the biosynthesis of cysteine and other key processes from a potentially abundant inorganic source, thiosulfate (see http://newsinfo.iu.edu/news/page/normal/18135.html). Alternatively or in addition, these genes may be used to detoxify (oxidize) hydrogen sulfide, a potent toxin that may be produced endogenously by competing bacterial flora or as a signaling molecule by the human host. Staph is a major causative agent of myriad community-acquired and hospital-acquired infections, with the incidence of methicillin-resistant strains dramatically increasing; thus, ne antibiotic strategies are desperately needed. Although the significance of this discovery on host-pathogen interactions is not yet known, Prof. Giedroc was awarded a four-year grant from the National Institutes of Health to study this process in detail.

Prof. Giedroc also co-chaired the 2011 Cell Biology of Metals Gordon Research Conference held in August 2011, a major focus of which was the role of transition metals in infectious and human disease. This is a topic of another long-standing research interest in the Giedroc laboratory.

The **Hieftje** group continues to pursue the development and application of a new source for ambient mass spectrometry (AMS). The field of AMS is itself relatively new, and involves the analysis of solid, liquid, or gaseous samples directly, in the ambient atmosphere, and with little or no sample preparation. The novel source introduced by the Hieftje group is the so-called Flowing Atmospheric-Pressure Afterglow (FAPA). In its simplest form, the FAPA consists of a low-power (~60W) direct-current glow discharge sustained in helium within a ceramic chamber. The products of the discharge then are driven by the helium flow through a hole in the chamber into the open atmosphere, where they react with atmospheric constituents to generate a host of reagent ions that collectively can interact with a sample and with species volatilized from the sample. The result is mainly the molecular ion or protonated molecular ion of most species present in the sample. These ions flow, in turn, into a mass spectrometer for analysis. Because the spectra from samples are surprisingly uncluttered, simple mixtures can be analyzed directly, without prior separation; moreover, the near absence of fragmentation serves to enhance sensitivity. Detection limits range down to the attomole level, making the device useful for a range of applications, including forensics, homeland security, sterility testing, and drug testing. A recent application involves distinguishing among strains of mycobacteria, whose members include leprosy, tuberculosis, and non-pathogenic forms. As few as 100 bacterial cells can be detected. Group members involved in the project are **Jacob Shelley**, **Steven Ray**, and **Kevin Pfeuffer**. The FAPA is being explored for potential commercial development by the Indianapolis firm Prosolia.

At the most recent meeting of The Electrochemical Society, held in Montreal in May 2011, **Dennis Peters** and two of his graduate students — **Lauren Strawsine** and **Elizabeth (Lizzy) Wagoner** — presented two oral papers. Lauren described her work on the electrochemical reduction of 6-bromo-1-phenyl-1-hexyne at silver cathodes in dimethylformamide. Silver has the special ability to promote the facile one-electron reductive cleavage of carbon–halogen bonds; Lauren has found that benzylidenecyclopentane (a carbocyclic product arising from intramolecular cyclization of the electrogenerated 1-phenyl-1-hexyn-6-yl radical) can be formed at potentials much less negative than when a mercury or carbon cathode is employed. Lizzy reported on the direct and nickel(I) salen-catalyzed dechlorination of 1,1,2-trichloro-1,2,2-trifluoroethane (CFC-113), and she is in the final stages of preparing a manuscript describing this work. At the aforementioned meeting, it was announced that Dennis has been selected to receive the Manuel M. Baizer Award for organic electrochemistry to be officially presented in May, 2012 at the spring meeting of The Electrochemical Society in Seattle, Washington.

Dongwhan Lee and his research group continue to work on electronically conjugated molecules and materials as charge transporters and light-emitters. With proper design of π-conjugated molecular core and installation of appropriate functional groups, rigid small molecules can self-assemble in the solid state to function as hopping stations for migrating electrons or optical excitations. In order to better understand "individually weak but collectively strong" non-covalent bonds that guide such structural ordering in the condensed phase, the group has been studying

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polymorphs of organic crystals. As it turned out, a delicate interplay between (more conventional) O–H···O hydrogen bonds and (less conventional) C–H···F hydrogen bonds here results in two distinctively different solid-state packing (and therefore two different polymorphs) of branched π-conjugation. This finding was reported in the Emerging Investigators Issue of Chemical Communications, to which Dongwhan was invited to contribute. This special issue, published in January 2011, was dedicated to young investigator research from "across the broad field of the chemical sciences" in 19 countries, a first of its kind for Chem. Commun. In addition to studies on conformationally dynamic π-conjugated small molecules, the group has also been exploring inorganic cage complexes as bifunctional monomers to make conducting polymers. A dense array of redox-active transition metal centers embedded along the linear backbone of such constructs facilitate vectorial charge transport across multiple layers. Notably, the group recently discovered that cobalt(I) centers, generated in situ under electrocatalytic conditions, mediate reduction of protons to hydrogen by polymer-modified electrodes. Intriguingly, this redox-coupled bond-making process occurs in the primary coordination sphere of a formally "six-coordinate" metal complex, which challenges the prevailing paradigms of catalyst design.

In the past year, the **Mindiola** group has been exploring the organometallic chemistry of the most volatile (and most inert) of paraffins: methane and ethane. In a paper published in *Chem. Science* (2011, 2, 1457), co-workers **Jaime Flores**, **Dominik Buck**, **Vinnie Cavaliere**, **Balazs Pinter**, and **Marco Crestani**, in collaboration with Prof. **Mookie Baik**, report that a titanium alkylidyne (a species where titanium has made a triple bond with carbon), can readily activate methane at room temperature. What is more notable is that the hydrogens of the formal methane molecule can exchange, thus leaving us with the question of whether methane can be dehydrogenated to a carbene such as CH_2^{2-} at room temperature. The paper was highlighted by the Royal Society of Chemistry (RSC Chemistry World, June 2, 2011) as well as our illustration was chosen for the front cover of that issue. In a separate paper that followed (J. *Am. Chem*. Soc. 2011, 133, 10700), graduate student Vinnie Cavaliere and postdoctoral fellow Marco Crestani demonstrate that the same titanium species can dehydrogenate ethane to ethylene at room temperature. The ethylene can be removed from the metal with any two-electron oxidants such as N_2O, or an organic azide N_3R. This work was also highlighted in a *Chem. & Eng. News* in a research concentrate (vol 89, page 26, July 4, 2011). If systems such as these could dehydrogenate methane and ethane catalytically, we could use the two most abundant paraffins present in natural gas for other purposes apart from burning them. Every year, it is estimated that the the pertrochemical industry in the US burns over 32 billion dollars in methane in part because they cannot store or sell all of it. For example, methane could be used as a carbene source to build olefins, which are instrumental in the polymer industry. Likewise, ethane could be similarly transformed to ethene, but under non-energy demanding conditions. Ethane is currently converted by industry into ethene in what is known as the cracking process. This energy intensive process requires extreme temperature and high velocities to avoid over oxidation of the alkane. The process relies in breaking C-C and C-H bonds by an initiation and H-atom abstraction pathway that leads to radical reactions.

In a separate story, graduate student **Ben Wicker** has been exploring C-H activation reactions but in a catalytic manner. Using a scandium complex where the scandium and nitrogen atoms form a double bond (referred to as an imido, Sc=NR), Ben has discovered a catalytic reaction whereby the Sc=N group activates a C-H bond of pyridine (or a derivative), and then insert a substrate such as isocyanide to form mono- and bisimino-substituted pyridines. The process is slow, but it atom-economical since it converts a pyridine into a functionalized imino-pyridine. This fall Ben is expected to defend his thesis and continue studies in a master's program in chemical engineering.

Last but not least is the work of graduate student **Ba Tran**. Ba has been investigating many different projects but one which stands out is the formation and chemistry of terminal metal nitrides of vanadium and titanium. Ba has explored in detailed the chemistry of the vanadium nitride ligand and has found that this ligand type is a conduit for electron transfer: vanadium gets reduced and the substrate attacking the nitride gets oxidized. He has also discovered an unprecedented mechanism to their formation. By performing an isotopically labeled double crossover experiment, he has found that nitride formation (from a vanadium(III)azide precursor, VN_3) must undergo dimerization to form the nitride. This reaction is quite complex because a high-spin V(III) to an S = 0 spin V(V) must be enduring a forbidden spin-transition somewhere along the reaction coordinate. The fact that the system must dimerize suggests that an anti-ferromagnetic mechanism is playing a crucial role despite the entropic penalty. He has indeed found that Lewis acids promote azide to nitride formation (along with N_2 loss) also suggesting that dimerization might be promoting a Lewis-acid catalyzed reaction. Ba is currently performing and learning magnetism as well spectroscopic techniques such as EPR and Mössbauer in the laboratories of Prof. Karsten Meyer in the Friedrich-Alexander-University in Erlangen-Nuremberg, Germany. In addition to finalizing his thesis and defending it this Fall, Ba will spend three months in Germany learning about electronic structure and how it can allow intersystem cross-over or spin-transitions.

Finally, I would like to welcome the following new graduate students into the group: **Felicia Konopka** (Syracuse University), **Brian Cook** (Seton Hall University), and **Rick Thompson** (Iowa State University). All students started working in the lab over the summer. Felicia is currently working on dinitrogen complexes of vanadium, Brian is a joint student with Prof. Ken Caulton working on redox active ligand (tetrazinylpyridine) with iron, and Rick is working on the coordination chemistry of depleted uranium (^{238}U), especially going after "holy grail" targets such as uranium nitrides, alkylidenes, and alkylidynes. Finally, I would also like to take a moment and thank postdoctoral fellows in the group who have worked hard of the past year:

Jaime Flores: after working two years with the Caulton and Mindiola groups, Jaime is now a research associate at Rutgers University working for Prof. Alan Goldman. Jaime was a key player in the methane project as well as in starting a project on silver catalyzed activation and functionalization of paraffins.

Octavio Gonzales: will complete his project (also a joint member with the Caulton group) this fall and return back to Europe to commence a second postdoc. Octavio was working on redox active pincer-type ligands with late transition metals such as Co and Fe.

Komine Nobuyuki "Nobu": will work three months on his JSPS fellowship before heading back to Japan. Nobu has made great progress as a joint member with the Caulton group working with silver catalysts that promote insertion of carbene into the C-H bonds of paraffins.

Marco Crestani: will stay an additional year in the Mindiola group after his fellowship from CONACYT (Mexico) was renewed. He will continue work on titanium alkylidynes.

We are also anxiously awaiting the arrival of Dr. **Skye Fortier**. Skye completed his Ph.D. in actinide chemistry with Prof. Trevor Hayton at UC Santa Barbara. Skye was recently awarded a prestigious American Competitiveness in Chemistry Fellowship sponsored by the NSF. The Program will support Fellows for two years of postgraduate study in collaboration with a National Laboratory. Skye will be working as a joint postdoctoral fellow in the labs of Caulton and Mindiola, but also conducting some of his research at Argonne National Labs with Dr. Marc Johnson. Congrats Skye!

Jill Robinson received the President's Award for Distinguished Teaching, which honors faculty who are considered to be shining examples of excellence. Recipients are selected from more than 4,000 faculty members on all eight campuses. She also received an active learning grant to further project based learning in Analytical chemistry laboratory. This past spring 2011, students worked as a "contract laboratory" for Baxter Biopharma Solutions and the Upland Brewery to perform analyses and report their results back the company. She serves on the advisory board for Themester 2012, "Good Behavior, Bad Behavior: Molecules to Morality." She continues to promote nanoscience education in teacher workshops associated with the Project Based Learning (PBL) Academy and will be demonstrating the use of a portable atomic force microscope in high schools in the upcoming year. For more information on the PBL Academy: http://education.indiana.edu/Feature_Topic_Detail/tabid/11553/Default.aspx?xmid=8275.

Professor **Sara Skrabalak**'s lab continues to focus on the development of new chemical methods towards nanomaterials with precisely-controlled size, shape, and three-dimensional structure. As these new synthetic strategies are validated, prepared materials are applied to energy applications that include photocatalysis and model fuel cell electrocatalysis. In the past year, the Skrabalak Laboratory has expanded, nearly doubling the number of graduate students working on nanomaterial synthesis and relocating to expanded space on the third floor of the chemistry building. Through the hard work and creativity of Skrablab members, we have recently reported the syntheses of several branched metal nanostructures. On account of their unique structural features and at times binary composition, these nanostructures are finding use in catalysis and optical applications. We have also discovered a new salt-assisted aerosol route to shape-controlled nanoplates with complex compositions. We are excited as this approach may provide a scalable and general route to a variety of compositionally complex materials as well-defined crystals. The students working on these projects have presented their work at National and Local ACS conferences, the Materials Research Society's National Conference, and the NOBCChE National Conference. Also with support from NSF, undergraduate researchers in the Skrablab can serve as *Energy Ambassadors*, wherein they return to their former high schools to talk about their research. In spring 2011, **Adam Richter** participated in this initiative and the response was fantastic.

The **Tait** Surface Chemistry Group is studying interfaces between organic materials and inorganic supports, which are critical for the design and function of new organic-based technologies (including OLEDs, organic photovoltaics, and molecular electronics), as well as novel routes to chemical sensors and catalysts. Assistant Professor Steven L. Tait has been at IU since 2008. Molecular self-assembly at surfaces by covalent, metal-organic, ionic, hydrogen bonding and van der Waals interactions are active fields of research in our group, but much remains to be determined with regard to the complex interplay of intermolecular and adsorbate-substrate interactions and how these impact structure and function. During the past year, studies in our ultra-high vacuum systems have focused on highly stable self-assembled ionic lattices, one-dimensional metal-organic chains, and a collaboration to study chemical modification of graphene. We have also installed and commenced experiments with a new scanning tunneling microscopy system for studies at the liquid-solid interface. On that system we study the use of dynamic libraries for the development of complex surface architectures and have begun a collaboration with the **Flood** Group to study attachment and ordering of foldamer molecules at surfaces. We are also building up a new experimental system to study novel catalyst systems consisting of metal-organic complexes at surfaces.

CONFERENCES, SPECIAL LECTURES AND SYMPOSIA

IU Chemistry has had over 150 seminar speakers present novel research in our department over the last calendar year. These speakers represented many levels of experience from fifth-semester graduate students, to defending Ph.D. students, existing IU faculty and faculty visiting IU from around the world. Two named lectures of note are below.

November 3, 2010
V. J. Shiner Jr. Lecture in Organic Chemistry was presented by Professor Dr. Ben Feringa, Department of Organic Chemistry, Stratingh Institute for Chemistry, Center for Systems Chemistry & Zernike Institute for Advanced Materials, University of Groningen, Netherlands, "The Art of Building Small: From Molecular Switches to Molecular Motors."

April 13, 2011
Raymond Siedle Distinguished Lecture was delivered by Ian Manners, Professor and Marie Curie Chair of Inorganic, Macromolecular and Materials Chemistry, Department of Chemistry, University of Bristol, UK. "Strained Metallorings and Functional Metallopolymers."

IU's NMR Facility and the "Dynamic" Functions Within

by Kate Reck

High-resolution NMR (nuclear magnetic resonance) is undoubtedly the most used spectroscopic method in chemistry. Richard R. Ernst (ETH in Zürich) was awarded the Nobel Prize for Chemistry in 1991 for "the development of the methodology of high resolution nuclear magnetic resonance (NMR) spectroscopy."

The new 800 MHz NMR is a beast of an instrument. (Photo: Jocelyn Bowie)

The layman may be more familiar with NMR through the medical technique magnetic resonance imaging (MRI) which is a medical imaging technique used to visualize detailed internal structures of the body. MRI makes use of the concepts of NMR to image nuclei of atoms inside the body. This extension of NMR led to Paul Lauterbur (University of Illinois at Urbana-Champaign) and Sir Peter Mansfield (University of Nottingham) being awarded the 2003 Nobel Prize in Physiology or Medicine for their "discoveries concerning magnetic resonance imaging."

NMR has developed into an extremely powerful research tool capable of characterizing at atomic resolution the three-dimensional structure and dynamics of small organic molecules, and the solution structures of larger molecules such as proteins, DNAs and bimolecular complexes. Although most often utilized daily by the organic chemist, our most recent acquisitions of a 600 and 800 MHz instruments have allowed it to become a more commonplace tool for IU's biochemists as they explore folding pathways and binding kinetics and thermodynamics of biomolecules.

Currently, the NMR facility has instruments in two locations, the Chemistry Building NMR Facility (C237) and Simon Hall BioNMR Facility (SI037), and has seven fully operational systems used by both graduate and undergraduates:

- Varian 800 MHz (14.1 Tesla) NMR System with Pumped AS800 Magnex Magnet and Salt Tolerant HCN Cold Probe
- Varian 600 MHz (14.1 Tesla) NMR System with Oxford Shielded Magnet and Salt Tolerant HCN Cold Probe
- Varian Inova 500 MHz (11.7 Tesla) NMR System. 3-4 Channel with PFG Dual, PFG HCX, PFG HCN and Broadband Probes, Waveform Generators and Gradient 2H Shimming
- Varian Inova 400 MHz (9.4 Tesla) NMR System. 3 Channel with 4 Nuc PFG, Indirect Detection PFG and Broadband Probes and Gradient 2H Shimming
- Second Varian Inova 400 MHz (9.4 Tesla) NMR System. 2 Channel with Indirect Detection PFG and Broadband Probes and Gradient 2H Shimming
- Varian Gemini 2000 300 MHz NMR System with 4 Nuclei Probe
- Varian Mercury 200 MHz NMR System with PFG 4 Nuc Probe and Gradient 2H Shimming
- Bruker EMX X-band EPR Spectrometer, Low Temp. to 4 K

IU's facility is an ideally suited environment for carrying out experiments toward elucidating organic, inorganic, biochemical and materials research. Our facility is run by only three staff members: **Doug Brown**, **Frank Gao** and the most recent addition, **Dejian Ma**. (By comparison, Purdue University's NMR facility is overseen by nine staff personnel!) Our staff work incredibly hard to bring our researchers the best possible service and they live by the motto "providing more with less." All three work together to execute the functions of the facility to support our department through maintenance (filling the liquid nitrogen and helium), user training (meeting with new users), grant writing, and spectroscopic services (meeting with users with unique experiments or problems).

Dr. **Doug Brown** is a Senior Scientist and Director of the NMR Facility. He joined the department in 2007 after a career at Eastman Kodak (Rochester, New York) for over a decade. Doug earned a B.S. in physics, but while in college he took organic chemistry in summer school which set him straight on what career path he wished to follow. After graduation, he pursed a Ph.D. in inorganic chemistry with Professor Chris Allen at the University of Vermont where he studied small molecule synthesis and polymers.

It seemed as if Doug was destined to work in NMR from the beginning. While in graduate school, he acquired a great deal of experience in NMR. He built his own probe (^{19}F decoupled to ^{31}P), a project most graduate students are not confident enough to pursue. Furthermore, he was the first person to run 2-D experiment in the state of Vermont.

Assistant Scientist **Frank Gao** has worked in chemistry the longest among all three staff members in the NMR facility and has helped execute many of the facility's recent improvements. Frank earned a B.S. in Electronics from Peking University. Before going to graduate school, he worked as a Research Associate at Changchun Institute of Applied Chemistry in Changchun, China for ten years. He became the Manager of the NMR Application Department at Bruker Instruments Ltd., in Beijing, China for almost three years.

Frank earned his PhD in chemistry from University of Missouri-Columbia in 2004. Frank's dissertation focused on the structure and interaction of several neuro-peptides in membrane mimics by NMR spectroscopy and molecular dynamics simulation; hence, Frank has a varied background and experience that he brings to our department. Frank came to IU in 2000 as a Chemical Informatics

Specialist. This position allowed him to split his time between the NMR facility and the Molecular Visualization Facility. Frank became full-time in the NMR Facility in summer 2008 and in this capacity has helped the facility become the facility it is today.

Dr. **Dejian Ma** joined IU in 2010 and was hired to run the BioNMR Facility due to his extensive bio-NMR knowledge. Dejian earned a PhD in Bioinorganic Chemistry from Nanjung University studying 1-D and 2-D studies of cytochrome-c. Prior to coming to IU, Dejian spent three years at University of California-Davis as a visiting scholar studying the NMR of hemoproteins. From 2002-2009, Dejian was a Research Associate at University of Pittsburgh pursuing structural studies of transmembrane proteins.

Dejian's expertise helps to enhance the biochemistry research groups. Since arriving, he has developed online templates for users with all the parameters pre-set for running biological samples. He helps students run 2-D and 3-D biological samples in water, while suppressing the water signal. The challenge of biological NMR is to employ several sets of such experiments to tease out properties unique to each atom in the sample. Often with Dejian's help, the graduate student or scientist can get a rough idea of the protein's overall shape and can see possible arrangements of groups in its different parts. Each new set of experiments further refines these possible structures or arrangements. Finally, the researcher carefully selects the solutions that best represent their experimental data and present the average of these solutions as their final structure.

The facility has acquired two new instruments: a 600 and 800 MHz NMR that were installed in Simon Hall in 2008. These were purchased via an NIH ($1M) and the Lilly Foundation ($2M) grants, respectively. Two instruments had their consoles replaced with "gently used" consoles and their Linux operating software was updated to reflect the most current software.

Over the past several years, older instruments have been updated to work beyond the manufacturer's default specifications and get the most out of our equipment. Perhaps the most important software improvement has been to implement "pulse field gradient" automatic shimming. Pulsed-field gradients allow analytically accurate, automated adjustments of shims which allow the user the instant ability to perform 1-D and 2-D experiments with reliable shimming with 98% accuracy. Finally, the facilities website has been updated with new tutorials and training guides so that users could learn on their own.

All three staff members are highly receptive and supportive of the development of new methods to enhance and facilitate NMR-based biomolecular, chemical, and analytical applications. If you have a new experiment you want to run or need training, all three are available for consultation to help you. Research would come to a standstill without Doug, Frank and Dijian who all bring their unique talents to making our NMR Facility run smoothly. ■

STAFF NEWS

Misty Boteler was hired as the Administrative Secretary to Dr. Hieftje (replacing Selena Williams). Misty transferred from the Marketing Department of the Kelley School of Business where she worked as a Secretary for almost three years. Prior to coming to IU Misty was the Rental Coordinator for Professional Golfcar Corporation, and she served as the Head Softball Coach at Bloomington High School North.

Steve Corenflos was hired as a Technology Support Specialist (full-time professional) for Dr. Peter Ortoleva's group. Steve received a Bachelor of Arts in 2007 (Major: Cognitive Science, Psychology; Minor: Information Technology, Computer Science). He began working hourly for Dr. Ortoleva in August 2007 as a Systems Administrator/ Software Developer.

Thomas Smith was hired as a Research Machinist III in the Chemistry Department (replacing John Cramer). Tom is from Mitchell, Indiana. He is a journeyman toolmaker with over 30 years of experience. His work experience includes E & M Machines (Bedford, IN), B.F. Goodrich (Bloomington, IN), Visteon Systems (Bedford, IN), and Research Machinist III (IU Cyclotron).

Devon Underwood was hired as a Supplies Coordinator in the Chemistry Scientific Storeroom. Devon has been working hourly in the Storeroom since October 2009. His work experience includes Royal (sales and leasing consultant) and Underwood Construction.

Service Recognition

10 years – Angie Monts, Richard Moore, and Becky Wilson
30 years – Jackie Drake, Don Garvin, and Cheryl Johnson
35 years – Rick Hackler

2010 Staff Award Recipients (right)

Dalane Anderson, Graduate Office
Toni Lady, Graduate Office
Amy Van Pelt, Director of Business

IU-Chemistry participated in the Hoosiers Outrun Cancer 5K Walk/Run on September 24, 2011. In total 40 people (not all pictured here since some did the 5K run) either in or affiliated with IU-Chemistry participated in this annual community event. We plan on making this an annual chemistry function, so we hope you join us next year so that we can make our group larger.

Leaving the department

Richard Moore, Mechanical Instrument Service

Retirements

Sarah Collins leaves the Chemistry Department after 29 years of service to IU. Sarah was hired as a clerk-typist in the Chemistry Department in October 1964, then as a secretary in June 1967. She provided secretarial assistance to Drs. Kaslow, Cordes, and Carmack. After leaving the university for several years to care for her children, she returned to Chemistry in August 1985 as a secretary in the department. Many remember Sarah in her capacity as the payroll contact for the department which she took on full-time when Lloyd Hudson retired from the department in December 1992. Sarah and her husband, Jim, are looking forward to spending more time with their four grandchildren and relaxing on their front porch in Greene County.

Mary Swarthout leaves the chemistry department after 36 years of service to IU. Mary began her employment at Indiana University as a secretary in microbiology (1967-1970). She returned to Indiana University in August 1978 to work as a secretary in the Department of Chemistry for Drs. Hieftje and Hayes. In May 1989, Mary was hired as Administrative Assistant in the Chemistry Chair's Office, replacing Barbara Pogoni. Mary has two adult children and is looking forward to spending more time with her three grandchildren.

GRADUATE NEWS

During the 2010-2011 school year, Professor **Caroline C. Jarrold**, was the Director of Graduate Studies. Serving with her on the Standards Committee were professors **Richard DiMarchi**, **Srinivasan Iyengar**, **Amar Flood**, **Dennis Peters**, **Michael Van Nieuwenhze**, and **Dongwhan Lee**.

Daniel Mindiola chaired the Graduate Admissions Committee. Evaluating the hundreds of dossiers submitted to the department were professors **Lane Baker**, **Erin Carlson**, **Charles Dann III**, **Sarah Skrabalak**, **Steven Tait**, **Silas Cook**, and **Zachary Aron**.

Fellowship Award Winners for 2010-2011

Amanda Mann was awarded the Chester Davis Inorganic Fellowship. Amanda joined the lab of Dr. Sara Skrabalak in the fall 2007.

Akshay Shah was awarded the Chester Davis Organic Fellowship. Akshay joined the lab of Dr. David Williams in the fall 2008.

Raghu Ramabhadran was awarded the Richard Slagle Fellowship. Raghu joined the lab of Dr. Krishnan Raghavachari in the fall 2008.

Yuran Hua was awarded the Raymond Siedle Materials Fellowship. Huran joined the lab of Dr. Amar Flood in the fall 2005.

Matthew Lauber was awarded the E.M. Kratz Fellowship. Matt joined the lab of Dr. James Reilly in the fall 2007.

Wenjun Liu was awarded the Raymond Siedle Inorganic Fellowship. Wenjun joined the lab of Dr. Dongwhan Lee in the fall of 2007.

Darci Trader was awarded the Marvin Carmack Fellowship. Darci joined the lab of Dr. Erin Carlson in the fall of 2008

Jeremy Felton was awarded the Kraft Fellowship. Jeremy joined the lab of Dr. Gary Hieftje in the fall of 2008.

Kevin McDonald was awarded the Paget Organic Fellowship. Kevin joined the lab of Dr. Amar Flood in the fall of 2008.

Robert Hansen was awarded the Dissertation Fellowship through the College of Arts and Sciences. Rob joined the lab of Dr. Philip Stevens in the fall 2006.

Women In Science Fellowship recipients were, **Meghan Mulcrone** and **Joan Walker**.

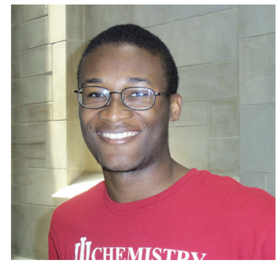
Other Fellowship recipients were:

Jeremy Felton, Deans Allocation Fellowship & Graduate Scholars Fellowship
Alicia Friedman, Deans Allocation Fellowship
Justin Luebke, Deans Allocation Fellowship
Fese Mokube, Deans Allocation Fellowship & NIH-Pre-doctoral Fellowship
Ashley Sidebottom, Deans Allocation Fellowship
Michelle Hoffman, Arts & Sciences Travel Fellowship & WIS/OWA Travel Fellowship
Yuran Hua, Arts & Sciences Travel Fellowship
Angela Carrillo, Charles Paget Organic Travel Fellowship
John Lisher, QCB Training Grant Fellowship
Kaelyn Wilke, QCB Training Grant Fellowship
Jonathan Dilger, Crane Fellowship
Mallory Mueller, William Carroll Fellowship
Sarah Waller, Eli Lilly Recruiting Fellowship In Organic Chemistry
Abhishek Singha-Roy, McCormick Science Fellowship
Rachel Lecker, Paget Organic Fellowship & Baxter Fellowship
Brittany Witherspoon, Mays Fellowship
Felicia Konopka, Wentworth Fellowship
Douglas Crandell, Lanterman Fellowship


Amanda Mann

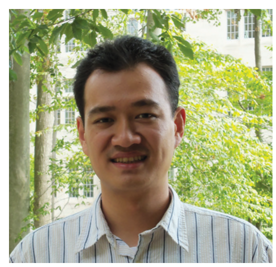

Darci Trader


Akshay Shah


Jeremy Felton


Raghu Ramabhadran

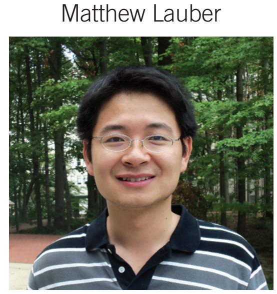

Kevin McDonald


Yuran Hua

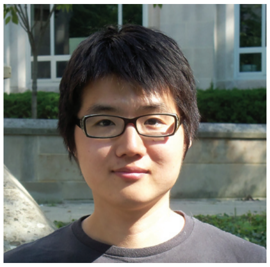

Robert Hansen


Matthew Lauber


Ashley Sidebottom


Wenjun Liu


Mallory Mueller


Semin Lee


Katie Leslie


Soumya Ghosh


Sarah Lindahl


Alexander Graham


Erick Pasciak


James Patterson


Paul Gladen


Michael Ewing

Annual Chemistry Department Award Winners

At the Chemistry Honors Banquet in April 2011, the following students were honored:

E. Campaigne C500 Award: **Semin Lee** and **Mallory Mueller**

Jack K. Crandall Award: **Kevin McDonald**

Wendell P. Metzner Memorial Award: **Akshay Shah**

William H. Nebergall Memorial Award: **Soumya Ghosh**

Felix Haurowitz Award: **Alexander Graham**

Henry R. Mahler Award: **James Patterson**

David A Rothrock Award: **Darci Trader**

John & Dorothy McKenzie Award: **Paul Gladen**

Associate Instructor Awards: **Michael Ewing**, **Katie Leslie**, **Sarah Lindahl**, **Erick Pasciak**, **Ashley Sidebottom**

Congratulations to recent graduates!

Ph.D. Degree Recipients

William Alley Jr. (Analytical, Novotny, August 2010) Postdoc, Indiana University, Chemistry

Brian Bohrer (Analytical, Clemmer, June 2011) Chemist, Valspar Corporation

Rui Chen (Chemical Biology, Tolbert, August 2010) Scientist, P & G, Beijing, China

David Dye (Inorganic, Zaleski, May 2010) Crane Naval Base

Peng Du (Analytical, Peters, August 2010)

Pablo Garcia-Reynaga (Organic, Van Nieuwenhze, December 2010) Postdoc, University of California, Berkeley

Nancy Goicochea (Physical, Dragnea, August 2010) Postdoc, Transgenex Nano-biotechnology

Xinlei Huang (Physical, Dragnea, August 2010) Postdoc, University of Chicago Medical School

Xiaohu Li (Chemical Physics, Iyengar, October 2010) Postdoc, Northwestern University

Nicholas Mayhall (Physical, Raghavachari, June 2011)

Joshua Maze (Physical, M. Jarrold, August 2010) Senior Scientist, Thermo Fisher Scientific

Alan McIntosh (Physical, de Souza, July 2010) Postdoc, Texas A & M, Cyclotron Institute

Kevin Olivier (Organic, Van Nieuwenhze, December 2010)

Manolo Plasencia (Analytical, Clemmer, November 2010) Postdoc, Washington Univ, St. Louis

Beili Quan (Chemical Biology, DiMarchi, December 2010)

William Running (Analytical, Reilly, December 2010) Postdoc, Indiana University, Chemistry

Gregory Schilling (Analytical, Hieftje, August 2009) Chemist, LECO Corporation

Jacob Shelley (Analytical, Hieftje, June 2011) Purdue University

Zexi Zhuang (Analytical, Jacobson, August 2010)

M.S. Degree Recipients

Julienne Green (Organic, Williams, March 2011) Legal Counsel, MiaSole Solar Panel Company

Brigitte Spencer (Analytical, Zaleski, January 2011) Franklin College

M.A.T. Degree Recipients

Joshua Albus (licensure in chemistry) High School Teacher

Timmy Global Health — Providing Volunteer Opportunities Abroad

by Lauren Santiesteban

Over the last four years at Indiana University, none of my wonderful experiences compare to the volunteering I did through the IU Chapter of Timmy Global Health (http://www.timmyglobalhealth.org/). Timmy Global Health, centered out of Indianapolis, helps to empower students to impact change through organizing and executing short-term medical brigades in developing countries.

I was fortunate enough to travel on two separate occasions to Quetzaltenango in Guatemala in 2010 and 2011. I was especially excited for the spring break trip in March, 2011 because my father was coming along for the ride, in the role as an expert translator and physical therapist. We traveled with 20 students, along with health professionals including nurses, pharmacists, physicians, and other volunteers. In one week, we visited four barrios outside the city to bring medical aid to underrepresented communities.

"These trips and working with IU-Timmy Global Health have definitely solidified my interest and excitement for volunteer medical work, both locally and internationally."

From this one week of experience, I was able to gain insight into the daily responsibilities of various health professionals. I also acted as a translator for the health professionals and students. Not only was translating a great way to conquer the Spanish language, but I was also able to learn about another culture that is very different from my own through directly communicating with the patients and the people throughout the various communities.

One of the most memorable patients was an older gentleman who had a number of health problems. I was discussing the patient's health with his wife because she spoke Spanish, while her husband spoke a dialect of Mayan known as Quiché. She said that her husband was suffering from what she called "sickness of the blood," or as it's more commonly known, leukemia. He also had an enlarged spleen or "bazo" in Spanish. Lastly, he had an inguinal hernia, which had been plaguing him for over 20 years.

After hearing this list of health issues, the physician asked, "What would you like us to help you with specifically?" He asked this question because the patient was already being treated for the leukemia and the enlarged spleen was most likely a symptom of this disease. I later asked the physician why he would not suggest surgery for the inguinal hernia, and he told me it was because the man had been living with this problem for such a long period of time and the patient did not complain of pain due to the hernia.

The next step was to physically examine the patient's symptoms. Since I would be attending medical school in the fall, the physician allowed me to palpate the patient's abdomen so I could get first-hand experience comparing an enlarged spleen to a normal abdomen like my own.

There are many reasons why this patient could be considered more memorable than the hundreds of other patients over two trips. He was one of the most extreme patients I had observed, and this patient's condition shed light on the great need of medical care in a country like Guatemala. Throughout the entire examination, the patient did not complain once of pain or discomfort. He really just wanted to provide some relief more for his wife by getting his symptoms checked by a physician.

Although volunteering with IU-Timmy Global Health has been one of the most challenging and eye-opening experiences I have had throughout college, I also consider it one of most frustrating experiences. It is frustrating to know that one week of volunteering will not drastically alter the future of the patients that we saw. There are so many more issues in Guatemala that need to be modified in order to really impact the lives of the people in those communities. Still, these trips and working with IU-Timmy Global Health have definitely solidified my interest and excitement for volunteer medical work, both locally and internationally. I will be attending medical school this fall, and I hope to continue working with underrepresented medical communities throughout medical school and as a physician in my future. ■

Lauren Santiesteban is from Zionsville, Indiana, and graduated in May 2011 with BS degrees in biochemistry and anthropology and minors in Spanish and biology. Her involvements at Indiana University included the IU Chapter of Timmy Global Health, mentor for freshman students and tutor through the Hudson and Holland Scholars Program, Student Ambassador, Home Health and Hospice Volunteer through Bloomington Hospital, COAS Student Advisory Board, Phi Beta Kappa, and a member of the Hutton Honors College. She will attend the New York University School of Medicine in fall 2011 in pursuit of an M.D. in medicine.

UNDERGRADUATE NEWS

We are pleased to add 101 new alumni to the department after December 2010 and May 2011 commencements, as 13 chemistry BS degrees, 20 biochemistry BS degrees, 46 chemistry BA degrees, and 22 biochemistry BA degrees were awarded to our students. As some of our graduates continue to be employed in the industrial positions, most continue their education through graduate programs which include research or the health professions.

This year, students saw some changes in course offerings and degree requirements. In spring 2011, we offered a new biochemistry course, CHEM-B 486 – *Gene Expression and Physiology*, which focused on biosynthesis of macromolecules, control of gene expression, and advanced topics in biochemistry. Our biochemistry majors were very excited about this new course which may be counted toward elective hours required for their degree. Benefits to this change are primarily two fold. Students have added flexibility in upper level electives while it allows students to learn the fundamentals of biochemistry in a three semester sequence rather than a two-semester sequence. Students who elect to take the complete C484-C485-B486 sequence will find that they will be afforded good mastery of the fundamental biochemistry topics necessary for the successful student today.

All students who matriculated as of summer 2011 or later will be required to complete the new General Education curriculum which has been incorporated into every degree program within the Bloomington campus of Indiana University. These new requirements are meant to give each student a similar solid foundation for learning, and they will not affect departmental courses required for the major. General Education will prepare students for modern opportunities and challenges by guiding them to become self-aware, responsible citizens in their own communities as well as the communities at large through the skills of communication, critical thinking, and quantitative analysis.

A strong part of our undergraduate program continues to be our research experiences with faculty through *C409: Chemical Research*. Students value their research experiences because they are afforded the opportunity to acquire knowledge in an academic field that transcends classroom study. Students who pursue research often reflect that this is the most challenging, yet rewarding, part of their undergraduate degree program. Employers and professional and graduate schools value independent research experiences by students as it greatly enhances critical skills in communication, independent thinking, creativity and problem-solving. Although not all research experiences culminate in a publication, they often help clarify an individual's academic and career interests and goals; oftentimes this is the most valuable part of the experience. During fall, spring, and summer semesters, 61 students received academic credit for C409 research.

After at least two semesters of research, students may elect to take *G410: Chemical Research Capstone* (2 cr.) to help fulfill their graduation requirement of an upper level lab elective. Pursuing G410 for credit requires writing a senior thesis and presenting an oral presentation at a morning long symposium before their peers and faculty colleagues.

In fall 2010, four students presented at the G410 Senior Symposium: **Jordan Merz** (Peters Laboratory), **Christi Perkins** (Ortoleva Laboratory), **Joseph Rheinhardt** (Peters Laboratory), and **George Venious** (Van Nieuwenhze Laboratory). In spring 2011, we had nine presenters at the G410 Senior Symposium: **Angie Budgin** (Bronstein Laboratory) **Brian Fisher** (Flood Laboratory), **Katie Geiger** (Giedroc Laboratory), **Greg Lackner** (Van Nieuwenhze Laboratory), **Bryan Lanning** (Carlson Laboratory), **Alexandra Mims** (Oakley Laboratory), **Julie Neel** (Van Nieuwenhze Laboratory), **Sonja Skljarevski** (Peters Laboratory), **Joseph Thomas** (Flood Laboratory). Each symposium culminated with a lunch at Malibu Grill for presenters, advisors and parents.

We are excited to announce the accomplishments of two of our students: **Kent Griffith** and **Esther Uduehi**. Kent Griffith was one of two IU recipients of the Barry M. Goldwater Scholarship given to students planning careers in science, mathematics, or engineering. The scholarship provides funding for tuition, fees, books, and room and board. Griffith is pursuing majors in chemistry and geological sciences. He plans to pursue a Ph.D. and eventually teach at the university level. Esther Uduehi is one of only 32 Americans who has been named a 2011 Rhodes Scholar. This scholarship provides all expenses for two or three years of study at the University of Oxford in England. Uduehi graduated in the spring with degrees in chemistry and mathematics, and she left for the University of Oxford in fall 2011.

Of course, we continue to have many strong students in our department: 14 students completed honors theses this year, 32 were inducted into Phi Beta Kappa, and 123 were on the honor roll. We look forward to continued accomplishments in the 2011-2012 school year.

Chemistry Honor Roll

The following chemistry and biochemistry majors attained an overall and in-major grade point average of 3.75 or better through the fall 2010 semester.

Class of 2011 (Senior) Honor Roll: Sukriti Bansal, Bryant Lee Barrett, Lani Beams, Edwin Leo Becher III, Stephanie J Beidelman, Kyle Wayne Brown, Kirk Edward Cahill, Kevin Victor Chaung, Arefin Chowdhury, Ryan Patrick Clodfelter, Larry Dean Davis Jr., Xiqiao Ding, Lauren Elizabeth Evenson, Brian Francis Fisher, Christopher M Gast, Kathryn R Geiger, Julie Marie Ghekas, Zachary F Hallberg, Daniel M Hostrander, Jacquelin K Kammeyer, Samuel Alex Kasmark, Neil Keshvani, Alexei A Krainev, Mohineesh Kumar, Greg Lawrence

Continued from page 24

Lackner, Bryan Robert Lanning, Shona Marie Lee, Grant Lin, Christopher D Mattson, Nicholas J McColley, Anne Noelle McLaren, Alexandra J Mims, Priyanka Parekh, Christi D Perkins, Zachary J Plummer, Adam Thomas Ramey, Jeffrey Remster, Madeline Ruth Riffle, Lauren G Santiesteban, Katherine Elizabeth Seat, Jeong Ho Seo, Sung Hyun Seo, Anja Skljarevski, Sonja Skljarevski, Eric Allen Skorupa, Isaiah S Steffen, Aaron Christopher Sue, Theodore Allen Timothy, Esther Oluchukwu Uduehi, Juan E Velez-Valencia, Matthew Ryan Watson, Mackenzie Marie Weaver, Tommy John Wilson, Anastasia Marie Yesnik, Ryan William Zipper, Omid Zolali-Meybodi, Mary Kala Zorn

Class of 2012 (Junior) Honor Roll: Aleksander Alavanja, William C E Berry, Matthew Mark Bower, Adam Coey, Matthew Ryan Colin, Trevor Donald Crafts, Omar Elsheikh, Rachel Marie Frantz, Kent Joseph Griffith, Logan William Guckien, Nicolas Alberto Hidalgo, Hailey Brooke Holland, Ryan Wayne Kessens, Joseph William King, Kyle Jonathon Kleist, Kelsey Jean Lawrence, Adam James Richter, Rebecca Reed Schwab, Eric Daniel Scripture, Supriya S Shah, Joseph Brown Thomas, William George Tilbury, Yilun Wang, Yueren Wang, Lionel Shiwei Zhao

Class of 2013 (Sophomore) Honor Roll: Arooj Imtiaz Ahmad, Stacy Lynn Blank, Wenjing Cai, Lauren Nicole Cardinal, Divya Chauhan, Katherine Prue Cline, Hannah Christine Cook, Holly Epple, Brian Timothy Gabet, Liron Ganel, Adriana Amalia Giuliani, Shannon Rae Harvey, Joseph Robert Hedinger, An Vinh Huynh, Sangeeth Arun Jeevan, Ryan A Kabir, Hannah Marie Kenninger, Taylor Lane LaCross, Alex Lazar, Paige Marie Matthews, Terra Mauer, Haley Ann Meyer, Zachary Moon, Adam Joshua Nichols, Stephen Fogarty Overcash, Jheel Patel, Andrea Marie Patterson, Derek A Price, Alexa Jade Proctor, Jonathan Philippe Rasio, Adam Michael Schafer, Jonathan Paul Schmidt, Amy Katherine Schulze, Keith Scott, Adam Zoltan Spitz, Emily Anne Tisma, Jordan Matthew Venderley, Audrey Welklin, Brynn Louise Whalen, Evan Alexander Yanni, Michael David Zimmerman

Class of 2014 (Freshman) Honor Roll: Caleb Alan Cooper, Evan Dominquez, Stephanie Iden, Tara Shea Wills

Chemistry Honors Program

The following students are BS majors in chemistry or biochemistry, have maintained a minimum grade point average of 3.3, and have completed a research project and thesis.

Brian Fisher, Kathryn Geiger, Greg Lackner, Bryan Lanning, Jordan Merz, Alexandra Mims, Julie Neel, Christi Perkins, Joseph Rheinhardt, Sonja Skljarevski, George Venious

Phi Beta Kappa Fall and Spring Inductees

Bryant Barrett, Nielson Baxter, Kirk Cahill, Larry Davis Jr., Lauren Evenson, Brian Fisher, Daniel Hostrander, Jacquelin Kammeyer, Alexei Krainev, Greg Lackner, Bryan Lanning, Shona Lee, Grant Lin, Anne McLaren, Alexandra Mims, Shaily Patel, Christi Perkins, Zachary Plummer, Adam Raney, Jeffrey Remster, Madeline Riffle, Lauren Santiesteban, Katherine Seat, Jeong Seo, Sonja Skljarevski, Eric Skorupa, Theodore Timothy, Juan Velez-Valencia, Mackenzie Weaver, Anastasia Yesnik, Ryan Zipper, Mary Kala Zorn

Departmental Scholarships and Awards

C117 Award: Shaina Banchik

S117 Awards: John DeBrota, Sidney Fletcher

Organic Chemistry Course Award: Rebecca Schwab

American Chemical Society Awards: Esther Uduehi, Laura Wetzel, Anastasia Yesnik, Mary Kala Zorn

Keith Ault Scholarship: Neil Keshvani

William H. Bell Awards: Grant Lin, Zachary Hallberg, Christina Romer

John H. Billman Summer Scholarship: Rachel Al-Saadon

Harry G. Day Summer Scholarships: Ryan Clodfelter, John DeBrota, Alexander Doran, Danielle Henckel

LeRoy Dugan Scholarship: Rebecca Schwab

Dr. & Mrs. Harlan English Scholarships: Nathan Spahn, Tyler Stanage

Courson Greeves Scholarship: Quinn Easter

R. J. Grim Memorial Scholarships: Ryan Clodfelter, Kent Griffith, Jonathan Hourmozdi, Stephen Overcash, Priyanka Parekh, Adam Richter

Russel Leo & Trula Sidwell Hardy Scholarship: Joseph Brown Thomas

Hutton Honors College Summer Research Grants: Clark Baumberger, Ryan Clodfelter, Priyanka Parekh, Megan Weisenberger

Hypercube Scholar Award: Christi Perkins

Ira E. Lee Memorial Fund in Chemistry: Clark Baumberger, Kyle Brown

Eli Lilly Summer Undergraduate Research Scholarship in Organic Chemistry: Hannah Kenninger

Andrew Loh Scholarship for Analytical Chemistry: Clark Baumberger

Frank Mathers Undergraduate Summer Research Scholarships: Priyanka Parekh, Emily Renzi

Merck Index Awards: Eric Skorupa, Alexandra Mims

Dennis G. Peters Scholarships: Aleksander Alavanja, Christopher Mattson, Logan Norrell

William G. Roessler Scholarship: Will Berry

Joseph B. Schwartzkopf Award: Kirk Cahill

Raymond Siedle Scholarships: Rebecca Schwab, Megan Weisenberger

Earl G. Sturdevant Summer Research Scholarship: Alexander Kovach

Enola Rentschler Van Valer Trafford Scholarship Awards: Sukriti Bansal, Jacquelin Kammeyer

Viola Scholarship in Nuclear Chemistry: Kyle Brown

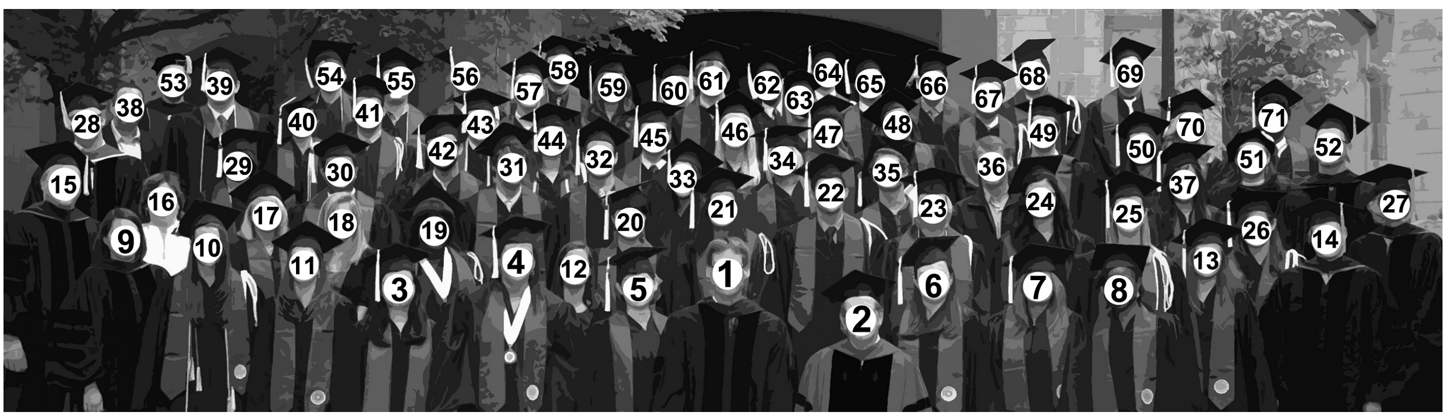
Forrest L. Warner Scholarships: Adam Coey, Emily Tisma

Francis & Mildred (Eckerty) Whitacre Scholarships: Max Breitinger, Clayton Brown

James C. White Award: Jacob Spitznagle

Mary Frechtling White Award: Sonja Skljarevski

GRADUATION 2011



1) Professor David Giedroc, 2) Professor Dennis Peters, 3) Eunice Kahng, 4) Mary Kala Zorn, 5) Jessica Zmierski, 6) Katherine Moore, 7) Hilary Conrad, 8) Vida Laudarji, 9) Professor Andrea Pellerito, 10) Christi Perkins, 11) Julie Neel, 12) Lauren Evenson, 13) Caitlin Dunn, 14) Professor Erin Carlson, 15) Professor Todd Stone, 16) Professor Martha Oakley, 17) Cassey Crowell, 18) Jessie Atkinson, 19) Esther Uduehi, 20) Ye-Geun Song, 21) Laura Wetzel, 22) Juan E Velez-Valencia, 23) Anastasia Yesnik, 24) Anna Bogun, 25) Anne McLaren, 26) Alexandra Mims, 27) Professor Jill Robinson, 28) Professor Amar Flood, 29) Brian Fisher, 30) Joseph Thomas, 31) Taylor Abram, 32) Adam Haber, 33) Mackenzie Weaver, 34) Christina Dean, 35) Matthew Johnson, 36) Timothy McBride, 37) Satbyul Kang, 38) Professor Daniel Mindiola, 39) Jordan Merz, 40) Sonja Skljarevski, 41) Kirk Cahill, 42) Sohaib Sajjad, 43) Jeffrey Remster, 44) Madeline Riffle, 45) Jacob Spitznagle, 46) Allie Larsen, 47) Neil Keshvani, 48) Jeef Bonhomme, 49) Alexander Weber, 50) Lauren Santiesteban, 51) Professor Kate Reck, 52) Professor Charles Dann III, 53) Professor Norman Dean, 54) Bryan Lanning, 55) Joseph Rheinhardt, 56) Greg Lackner, 57) Daniel Hostrander, 58) Samuel Gage, 59) Jordyn Stuart, 60) Katherine Seat, 61) Cody Weaver, 62) Rohit Patel, 63) Joseph Saffa, 64) Matthew Watson, 65) Kyle McWilliams, 66) Griffin Fuller, 67) Alexei Krainev, 68) Theodore Allen Timothy, 69) Joseph Apisdorf, 70) Kathryn Geiger, 71) Jay Patel.
Not pictured but attended: Yu Lun Tu and Tommy Wilson.

SISACS Summary 2011:

Education and Outreach

by Sara Skrabatak

The Southern Indiana Section of the American Chemical Society (**SISACS**) is working to enhance the educational experiences of the graduate and undergraduate populations at Indiana University and perform outreach activities to inform the greater Indiana community about chemistry. You can find out more information about our past and future activities at our website: http://sis.sites.acs.org/. For the calendar year 2011, **Dr. Sara Skrabalak** was the Chair, **Dr. Erin Carlson** was the Chair-Elect, **Dr. Kate Reck** was the Secretary, and **Dr. Andrea Pellerito** remained as Treasurer. **Dr. Kenneth Caulton** was our local section Councilor with **Dr. Zachary Aron** as our Alternate Councilor.

One of the cornerstones of our educational efforts is a "Chemistry of Everyday Life" Seminar Series, which was initiated in 2010. This series provides a forum to invite speakers in less "traditional" areas of chemistry to present topics of interest to students, faculty, and staff of the greater IU community, as well as the Bloomington city community. These presentations are recorded and posted on the Internet for viewing by all interested people. SISACS received an ACS Innovative Project Grant to launch this outreach-focused seminar series. The second speaker in this series, **Dr. Charles Bamforth**, visited campus on April 21, 2011. Dr. Bamforth is a Professor of Food Science and Technology at University of California, Davis and spoke on "Tapping into the Chemistry of Beer and Brewing" to an audience of ~200. The local Upland Brewery co-sponsored a thematic reception following the seminar, which was attended by many SISACS members as well as Bloomington's home brewing community. SISACS Student Organizers are finalizing the speakers for 2012.

The SISACS initiated "Student Selected Seminar Series" also continued in 2011. This series is unique in that it provides the graduate student populations of the Departments of Chemistry and Molecular and Cellular Biochemistry with the opportunity to select a prominent speaker and present their research to this scientist during their visit to campus. Student-selected seminar invites are regarded as extremely prestigious, enabling this series to attract a number of very well-known scientists to the IU campus. On April 6, 2011 **Dr. Benjamin Cravatt**, from The Scripps Research Institute, visited the department. **Dr. Michael Summer**, from the Howard Hughes Medical Institute at the University of Maryland, will visit the department on October 12, 2011. **Dr. Fred McLafferty**, the pioneer of top-down proteomics, will visit the department in 2012.

In addition to these seminar series, SISACS is committed to providing career development activities for its members. On May 9-10, 2011, a 2-day workshop entitled, "Preparing for Life after Graduate School Workshop" was held on campus, with ~40 graduate students participating. This career development workshop is offered through the ACS Office of Graduate Education and is designed to inform chemistry graduate students and postdoctoral scholars about their career options after graduate school and how to prepare for them. **Dr. Richard Bretz** from Miami University facilitated the workshop and even added a special session to address dual-career options.

Our Student Affiliates Chapter received an Honorable Mention Chapter Award for its 2010-2011 activities. The 2010-11 award-winning chapters will be recognized in the November/December issue of "in Chemistry" magazine and at the ACS Student Chapter Award Ceremony that will be held at the 243rd ACS National Meeting in San Diego, CA.

The ACS is committed to recognizing the accomplishments of undergraduates at IU. Four students received ACS awards for "Outstanding Undergraduate in Chemistry" during the Chemistry Department's honors banquet ceremony in April, 2010: **Esther Uduehi** ('11), **Laura Wetzel** ('11), **Anastasia Yesnik** ('11) and **Mary Kala Zorn** ('11). Esther is a Rhodes Scholar and pursuing a Ph.D. in organic chemistry at the University of Oxford starting in the fall 2011. Laura is working as a research associate in the Hu lab (IU-Biology department) and is planning to go to graduate school next year. Ana is studying Medicine at West Virginia School of Osteopathic Medicine starting in fall 2011. Kala is attending medical school at IU School of Medicine starting in fall 2011.

With the ACS regional meeting being held in Indianapolis this year, many SISACS members organized symposia and travelled to give presentations and hear about the exciting research and educational activities going on in the region. SISACS sponsored grants to assist its undergraduate and high school members with travel to this conference. Recipients of these ACS Travel Awards include **Christina Romer** (Mindiola Laboratory), **Jason Thrap** (Flood Laboratory/Bloomington South High School), **Andrew Rusch** (Baker Laboratory, ACS Student Affiliate), **Rebecca Schwab** (ACS Student Affiliate), **Shivani Patel** (ACS Student Affiliate), **Kent Griffith** (Peters Laboratory/ACS Student Affiliate), **Yueren (Lily) Wang** (ACS Student Affiliate), and **Faiz Kidwai** (Bronstein Laboratory).

Finally, chemistry colleagues are encouraged to get to know one another through informal gatherings hosted by SISACS. Recent events included our annual Ice Cream Social and a Friday evening Happy Hour at Nick's English Hut.

LIBRARY NEWS

by Roger Beckman

Tiea Julian continues as our branch coordinator and takes care of the day to day operations. I split my time between the Chemistry Library and the Life Sciences Library. I recently added responsibility for collection development and some reference for the IU Optometry Library.

The Chemistry Library has an "apprenticeship" program that helps train students enrolled in the School of Library and Information Science (SLIS) in the finer points of chemical librarianship. Our current SLIS GA is **Elsa Alvaro** who started with us in January 2011. She has her PhD in chemistry and worked with John Hartwig at Illinois. Elsa is off to a good start. Elsa was awarded the 2011 Lucille Wert Award from the CINF Division of ACS. This scholarship is designed to help persons with an interest in the field of chemical information. Our previous intern, **Yuening Zhang**, was the 2010 awardee. Both of these students were also awarded the IU Davis/Davis Fellowship that assists graduate students in the School of Library and Information Science in the study of scientific information.

Elsa started a blog for the Chemistry Library and it can be seen at https://blogs.libraries.iub.edu/libchem/. One of Elsa's interests is investigating chemistry information using mobile devices. Therefore, she was very pleased to receive an invitation to attend a week-long program sponsored by the ACS Publications Division in DC to focus on the future of scholarly communication. She got an iPad to practice on too.

Yuening Zhang worked with us about a year and a half, until the end of the 2010 fall semester. Thanks in large part to her knowledge of chemical information she obtained a position as Science Librarian at the Kelvin Smith Library at Case Western Reserve University and started in July, 2011. Yuening and I published a paper about a user survey we conducted of faculty, staff, and graduate students in the Chemistry Department and Biology Department to determine how well our library users like electronic books. You can read our article at http://www.istl.org/11-spring/article2.html.

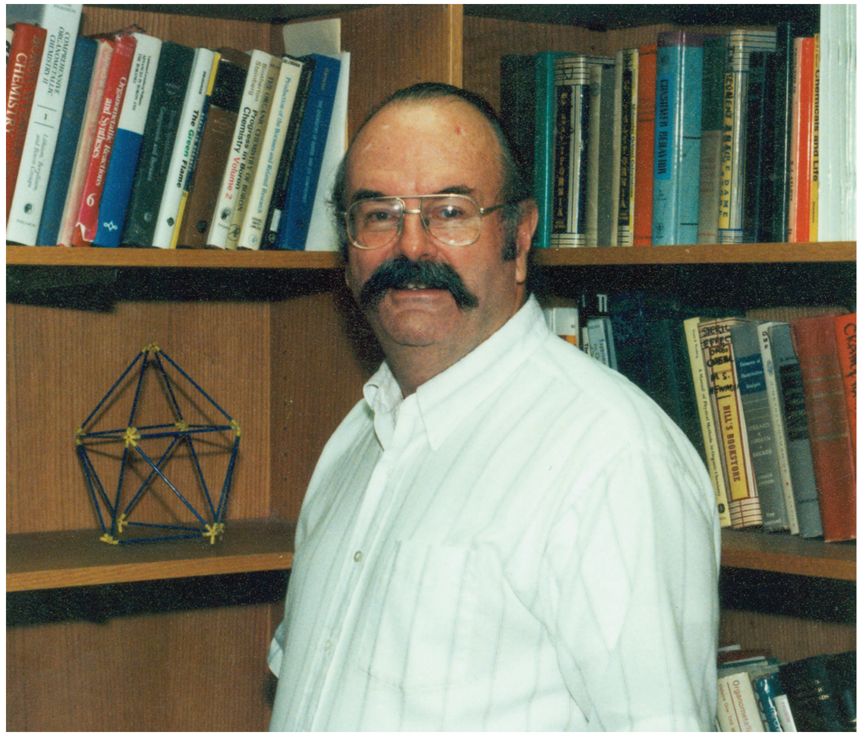
Although budgets are tight we were able to add some useful resources to the library this year. We added two new electronic reference sets: Handbook of Porphyrin Science (World Scientific, 2010) and Comprehensive Natural Products II (Elsevier, 2010). To avoid the annual "rental" fee we purchased the ACS Legacy Archives that includes all the ACS articles published from 1879 to 1995. The ACS Symposium Series titles from 1974-2008 were included in this purchase. The remaining Nature back files, 1869 to 1986, were added this spring giving us access to the whole run of this important title. Buying more e-books continues our move away from paper to electronic-only access. The IUB libraries have access to Springer e-books from 2005 to 2013, Wiley e-books from 2007 to 2010, Elsevier titles from 2008 to 2012, and RSC e-books from 1968-2011. No acceptable agreement could be reached with Wiley for 2011.

Buying more e-books continues our move away from paper to electronic-only access.

We just signed an agreement to move to the SciFinder Campus-Wide Access program which will offer unlimited seats for whole Indiana University system. Previously only 10 people at one time could use the Chemical Abstracts database. This opens up the possibility of encouraging more undergraduates and researchers in other scientific departments to use this special resource. Reaxys and SciFinder are now web-only programs and the days of loading a client software program on one's personal computer to search Chemical Abstracts, Beilstein or Gmelin are over. Library administrators are beginning to plan for the time when electronic access to journals lessens the need for each library to keep a paper copy of a journal. An initial first step happened this spring when all the Elsevier, Springer and Wiley titles that are available electronically were moved from the Chemistry Library to our remote storage facility, ALF. This is called the CIC's Shared Print Repository and IU has agreed to preserve these titles for at least 25 years so other libraries are free to withdraw their titles if shelf space is needed for other uses. ■

Lee J. Todd

by Kenneth Caulton



We are saddened to report the passing of Prof. **Lee J. Todd**, long time faculty member in the department, whose PhD was earned with former IU department chair, **Riley Schaeffer**. Lee was exceptionally involved with all the individuals who entered into his realm, either as research workers or in his classes.

Lee was truly passionate about boron chemistry, early on for the unusual characteristics of compounds of the boron nuclei contained there, but later in compounds where unusual cage borane anions were attached to transition metal ions, forming compounds where the metal was in an unusually high formal oxidations state. Finally, Lee was active in using boron compounds to attempt to sequester and precipitate radioactive cesium from nuclear reactor wastes, to immobilize them so that they would be rendered “fixed” for long term nuclear waste disposal.

“Lee Todd and professors like him made an astounding impact on thousands of people. Few people can stay in a place for so long and make such an impact.”

Lee was also very interested, later in his career, with exploiting the high capacity of boron nuclei to capture neutrons for the application in boron neutron capture cancer therapy, where the job of the researcher was to identify boron compounds which would localize in tumors to enable focused radiation therapy on the boron enriched tumor tissue; for example incorporating boron atoms into amino acid analogs was intended to improve the effectiveness of boron neutron capture therapy.

Lee was involved in collaborations with Czech boron chemists, and attended international boron chemistry conferences around the world, long ago in Moscow and most recently in Spain, to follow his love of that area of chemistry. Lee was a tireless mentor of undergraduate and graduate students, attending to their needs toward developing skills as boron chemists, but also attending to their own life choices and decisions.

This was additionally evident from email received upon learning of Lee’s death:

— “I spent a lot of time in those smelly boron labs working my heart out.”
— “I owe quite a bit to I.U. and Dr. Todd for helping me get back on my feet and on the right track.”
— “(He).. made a big difference in my life, and I recall those days with some level of fondness.”
— “Dr. Todd and his colleagues in the Inorganic Division at I.U. gave me just enough to climb out of a pretty deep hole. I am certain that my path in life would have been very different without their guidance and leadership.
— “He had a passion for his research and a love of teaching. Lee was an intellectual with the formal pedigree, but a regular guy who loved his Indiana farm and his boots.”
— “Lee Todd and professors like him have made an astounding impact on thousands of people. Few people can stay in a place for so long and make such an impact.”
— “I count myself as fortunate to have spent long hours in the lab learning the craft of chemistry from Dr. Todd. He probably spent more time training me than my major professor at Wisconsin. I loved working for him, and he’ll be missed.”

Former department chair Prof. **Paul Grieco** writes: “… Lee and I collaborated for several years on using weakly coordinating anions derived from boron compounds (e.g. lithium cobalt-bis-dicarbollide) to catalyze organic reactions. We published a few papers together. We often had lunch, at least once a week, at the Cafe Pizzaria, …where we discussed chemistry and our other common interest, COWS. …He was a very kind individual."

Lee was at Indiana during the birthing days of Fourier transform NMR spectroscopy here, which made accessible nuclei of great chemical importance, e.g. carbon, and certainly also boron, which were inaccessible previously. He showed chemically significant examples to demonstrate the power of natural abundance (1.1%) carbon NMR in metal complex chemistry, as well as mechanistic studies using ^{17}O oxygen NMR.

Following his retirement, Lee amazed us all in the chemistry department by building up a self-contained laboratory on his farm here in southern Indiana and running a small company which supplied decaborane to researchers around the world to use as a reagent for their own research. Lee had what is almost certainly the only combined boron chemical company and beef cattle farm in the world!

A memorial ceremony was held at the Bloomington Quaker Meeting House May 28 and was well attended by those who had something to say about Lee. Lee's stepson Vernon related that Lee was slow to show his emotions, but that he nevertheless took the son to farm auctions. One auction, Vernon looked longingly at a purple 10-speed bike which he knew was unobtainable: not even worth bringing to Lee's attention. Unknown to Vernon, Lee observed all of this, and, when the bidding on the bike was nearly finished, Lee swooped in and made the high bid and captured the bike for Vernon. Equally touching was a comment made about Lee's humility: "Texans say about someone who makes exaggerated claims about the size of his ranch that 'his hat is bigger than his ranch.' One friend of Lee's said that, in contrast, "Lee's ranch was much bigger than his hat!" ■

In honor of his wishes, the family has established the Lee J. Todd Chemistry Memorial Scholarship for students who pursue a chemistry degree at Indiana University. Donations may be made in his memory to the Indiana University Foundation.

Please reference account number
37-AS06-47-8 and mail to:
Indiana University Foundation
PO Box 2298
Bloomington, IN 47402

Emeritus Professor **Terry Jenkins** passed away on November 7, 2010 in Arizona. He received his Ph.D. ('57) from MIT and then spent several years as an Assistant Professor at the University of California, Berkeley. Dr. Jenkins started at Indiana university, Department of Chemistry in 1966 where he joined both the Biochemistry group in Chemistry and the Medical Science Program.

During his time in the department, he taught biochemistry courses in Chemistry and in the Medical Science Program. He also served as graduate and undergraduate advisor for several years. After his retirement in 1996, he and his wife moved to Phoenix, Arizona.

Please look for a more extensive memoriam article in next year's issue of the magazine.

NECROLOGY 2010–2011

We remember all those in the IU Chemistry family who have passed away. Included here are deaths of which we learned this year.

Kenneth P. Broshears, BA '41, October 29, 2010
Laurence W. Brown, BA '65, November 17, 2005
Thurl C. Burr, BA '43, MD '50, February 7, 2010
Richard T. Cady, MA '48, PhD '52, January 17, 1999
Libin T. Cheng, PhD '34, July 29, 2010
William J. Cron, BA '51, March 24, 2011
John F. Dellinger, BA '35
Howard M. Dess, BS '51, June 6, 2010
Merrill T. Eaton, BA '41, MD '44, February 19, 2011
Charles M. Fair, BS '37, January 3, 2007
Henry L. Feffer, BA '39, MD '42, May 9, 2011
Ernest G. Flint, MA '59, April 12, 2011
James F. Gale, BA '41, June 25, 2010
Robert C. Hains, BA '50, June 10, 2010
Edgar A. Hawk, BA '39, MD '42, August 3, 2010
George R. Horton, BA '39, MD '42, June 3, 2009
Leland G. Howard, BS '50, March 31, 2011
Lloyd G. Hyndman, BA '55, MD '59, January 13, 2011
Floyd L. Kauffman, MA '39, PhD '39, October 12, 1999
Lyle H. Kaufman, BA '40
Robert P. Kraft, BA '71, October 7, 2010
Richard S. Kubiak, BA '49, April 16, 2011
Michael S. Matta, PhD '66, January 3, 2011
Ralph W. McCullough, BA '48, MS '49, February 14, 2011
Guenter F. Meier, PhD '64, June 6, 2010
Fernando L. Mendez, BA '42, March 27, 2009
J. Weir Mitchell, BA '43, DDS '45, April 20, 2011
Rodney D. Moss, PhD '51, April 13, 2011
Charles E. Mumaw, BS '43, August 22, 2010
Frances Ford Murray, BS '45, May 7, 2011
Stanley S. Murzyn, BA '50, March 17, 2011
Sydney J. Nix, PhD '51, October 1, 2010
John D. Pera, PhD '60, March 29, 2011
William J. Schenck, BS '54, January 3, 2011
Chris Sue Schleicher, BA '92, October 18, 2010
Maurice E. Selzer, BA '36, March 21, 2011
Ralph L. Silverman, BA '47, August 15, 2010
Marcia Ver Steeg Snow, MA '48, September 8, 2010
Jo Ann Whipple Spencer, BA '46, January 4, 2011
Chester A. Stayton, BA '41, MD '43, September 9, 2010
Thomas M. Terpinas, BA '44, DDS '50, August 11, 2010
Lee J. Todd, PhD '64, March 22, 2011
James F. Vasil, BS '48, April 11, 2011
Robert H. Walsh, PhD '54, January 25, 2011
Thelma Scraper Walters, BA '37, July 18, 2010
Alan E. Warrender, BS '59, June 5, 2010

George Ewing

by Charlie Parmenter

Who could want a better friend than George?

"Hi George,""Good-bye George." For forty years off and on, these were my daily words to George who had the neighboring office. The habit is one I still enjoy from time-to-time even though now I am talking to myself.

George Ewing, ca. 1991, taken by Sasha Ewing on the Pembrokeshire Coast Trail in South West Wales.

George Ewing died at home with his family on 23 August 2011 after enduring the encroaching effects of cancer for about a year.

Since my 1964 arrival in Bloomington, we had adjacent offices even after a move from the fifth to the second floor. Our labs were close together. The offices of our graduate students and postdocs were intermingled. We shared the same secretary during the pre-PC years when it was common for one or two professors to keep a single secretary busy. With all this togetherness, it is fortunate that our very different personalities allowed us to become close friends. And who could want a better friend than George?

On 15 December 2010, George sent an email with just a single-word subject: CANCER. Its text was three words: "The plot thickens." During that fall while working on his book about ice, he lamented repeatedly that his energy was much diminished. In fact, it was such a problem that he cancelled his book contract with Yale University Press. Obviously something serious was wrong. George was ultimately diagnosed with a soft tissue sarcoma.

There was a small irony to this. About five years earlier, he appeared at my office door and out of the blue announced, "I'm not going to doctors any more. I want my death to be a surprise." I didn't take this seriously, nor did George. He was just enjoying being provocative. It was his trademark. We all enjoyed George being provocative.

George arrived at IU in 1963 with a BS from Yale and a PhD from Berkeley working with George Pimentel. When asked about his education, he would often say only that his education came from his friends, family, parents and teachers. Side stepping mention of his elite schools was a manifestation of George's vigorous allergy to pretention. In this spirit, he often commented with disdain about seminar notices that enumerated the heroic credentials of a visiting speaker but said not a word about the forthcoming science.

George was one of the last to be stuck with the IU tradition of beginning a tenure-track appointment as an Instructor. In only eight years, he became a Full Professor. George retired in 1998 as a Chancellor's Professor of Chemistry and a Professor of Public and Environmental Affairs.

George's academic career was a tight integration of teaching and research. He excelled at both. A formal recognition of George's innovative teaching is given by his Chancellor's Professorship. Formal recognition of his research is found in his election as a Fellow of the American Physical Society, his Guggenheim Fellowship and his visiting sabbatical appointments at top research institutions world wide: Bell Telephone Labs, Ecole Polytechnique (France), Oxford University (England), Cambridge University (England) and The Technion (Israel). His last sabbatical was as the Chapman Lecturer at the University of Alaska in pursuit of his research interest on ice.

George directed more than thirty PhD students and almost an equal number of postdocs. They organized a Fest for George at the time of his retirement and returned to Bloomington from as far as Europe.

His teaching spanned courses ranging from our most elementary offering for first year non-science majors to graduate quantum mechanics and spectroscopy. The former occupied George more times than he cared to remember, but it became his most well known course. He designed it around the theme of molecular architecture. It succeeded admirably in acquainting detached students with the beauty of our science. This innovative course was chosen as an IU "TOPICS" offering.

The nomination of George for a Chancellor's Professorship uncovered some rather delectable morsels concerning his teaching. For example, his "TOPICS" syllabus contained a poem written by a student in response to a class discussion about an IU lecture from a celebrated biologist that came across as peppered with sexist language. The poet has written "Although I graduated with a BA in English, Dr. Ewing's introductory chem class nearly stole me away from the English Department for good."

Another student, this time from his junior-senior physical chemistry course, wrote "We called him the

P-Chem Guru based on the rather wild look of his hair after he walked into the classroom and pulled his sweater off over his head. He would generally have his notes rolled up in a pocket. He would remove them from the pocket and never look at them. On one particularly memorable occasion, after introducing his main ideas of the wavefunction and quantum theory to us, he turned to the class and said 'And now there will be an embarrassing silence until some one asks a question.' And he waited for the question — something not many professors were inclined to do. My decision to pursue physical chemistry as a career was cemented in his class."

The accomplishments of his lab, the "quantum garage,"were as familiar to those overseas as in the US. One can trace the evolution of his research through at least five areas. He would first choose a topic little studied by others (thus he didn't have to read the literature, so he said), and when it became crowded, he moved on.

His initial IU work involved weakly bound complexes, so-called van der Waals molecules, such as the dimer formed from two ordinary oxygen molecules. He started when there was skepticism even about their existence. With a unique cryogenic apparatus (-200°C) created to maximize the small concentration expected of such fragile complexes, he published in 1971 the first IR study of the oxygen dimer, confirming not only its existence but reporting its bond strength and geometry.

Soon this field became hot, and he moved to the different world of energy transfer in liquids. At the time, a central issue was the time scale for vibrational energy loss from a molecule such as molecular nitrogen that was undergoing a trillion collisions per second in its liquid nitrogen environment. The time scale for loss of a vibrational quantum in this collisional mayhem was commonly thought to be on the order of a billionth of a second. Using state-of-the art laser technology in 1975, he discovered the time scale to be a little longer. It was about one second! George's paper revised concepts of liquid state energy transfer.

George revisited van der Waals complexes as a theorist. The issue was again one of time scales, but now the process was the breaking of the weak bond after one of the chemically bound molecules became vibrationally energized. He developed in 1979 "the momentum gap" methodology for prediction of the time scales that still remains in common use for certain energy transfer processes.

His developments next took George to predictions concerning molecules weakly bound to surfaces. The surface of the NaCl crystal, an insulator, was a useful model. Once again, this was a nearly virgin field since little attention had been paid to insulator surfaces. The work eventually produced another of George's papers now considered a classic.

This experience led George to studies of small atmospheric particles, mostly sea salt suspended in air. He developed a method to gain access to these aerosols via IR spectroscopy that has been adopted by others for diverse atmospheric researches. The experience led to George's service on The Indiana Air Pollution Control Board. It also stimulated George's interest in the thin films of water that cover most surfaces under ambient conditions and his fascination with properties of ice that he pursued during a winter sabbatical in Fairbanks, Alaska.

Most recently George became deeply involved with Professor **Martin Jarrold** concerning the mechanism of electric charge build up in the atmosphere. That problem has been with us for a long time, say several hundred years, so that it violates George's propensity to go after problems with a minimal literature. Still, significant issues remain unresolved.

Occasionally he came straight from his volunteer job as a cook for a community hunger relief program; the "sous chef" as George called himself.

Obviously, George was intellectually restless. But he was physically restless as well. He was a walker, and his passion took him not only to the corners of Bloomington, but especially to trails in Yellowwood Forest and the Hoosier National Forest that he dearly loved and often visited. To stay in touch, George arranged regular lunches with a few of his fortunate chemistry colleagues. In recent years, he became a dedicated yoga practitioner and demonstrated for me tortuous contortions that he had mastered. They induce pain in the observer.

George used his chemistry office primarily for meetings with students plus a few required duties. It was pretty bare. There were few books and not many of the paper piles so often found in academic offices. He was not a pack rat. Often his office did not even contain George. He would disappear to write and work in the quiet sanctuaries of the many Bloomington libraries and coffee shops. George was hard to find.

After George's retirement, it was a good day in my office when he would appear at the door. Occasionally he came straight from his volunteer job as a cook for a community hunger relief program. The "sous chef" as George called himself. With the fragrance of the morning's efforts still with him, I could tell as he sat recovering that it was hard work.

During the first half of 2011 as George was feeling the increasing effects of his cancer, my phone at home would often ring and present his bright voice. "Hey! Can I come over?" Soon he walked the three blocks to our home, and my wife and I were enjoying another hour or so of George. There was a regular spot that he liked in our living room near big leafy plants. In defiance of an illness called cancer, he frequently wore a cap with a Marlboro cigarette logo. These were our times to treasure.

Who could want a better friend than George? ■

After graduating from IU, **Cody M. Biggs**, BA'08, entered the U.S. Army in October 2009. Upon completing basic combat training at Fort Leonard Wood, Mo., in January 2010, he attended officer candidate school at Fort Benning, Ga. Biggs was commissioned in April 2010 as a second lieutenant in the Air Defense Artillery. He is stationed at Fort Sill, Okla., where he is a Battery Executive Officer assisting in the activation and readiness of troops preparing for deployment.

Erick B. Frey, BA'96, is an investment manager for Notre Dame Federal Credit Union in Notre Dame, Ind. His wife, Heather (Mooney), MPA'04, is director of annual giving at St. Mary's College in Notre Dame. The couple welcomed their first child, Annaliese Quinn, in December 2009. The family lives in South Bend, Ind.

Erin L. Hubert, BS'09, is a student at the University of Missouri-Columbia College of Veterinary Medicine. She lives in Chesterfield, Mo. [Minor in Chemistry]

Tony E. Hugli, PhD'68, was a research scientist at the Scripps Research Institute for 28 years and is now an adjunct member of the Torrey Pines Institute for Molecular Studies in La Jolla, Calif. In 2004 he became CEO of HealthAide Inc., a company that develops skin-care products. Hugli writes, "After a career in research for over 35 years and 250 publications, I started this company as a hobby and it has become quite successful. This proves that chemistry can be fun!" Hugli lives in San Diego.

"Since my retirement as a professor of chemistry in 1985," writes **Hugh W. Johnston**, PhD'48, "I have been involved in a most unusual volunteer position for which my training in the PhD program at IU stood me in good stead. I process countless documents (sort, organize, and inventory) for Whitworth University and for the Museum of Arts and Culture. Where else could researchers and students learn about the Ponzi schemes that damaged many illustrious colleges and universities? I've seen it all!" Johnston lives in Spokane, Wash.

George P. Lahm, PhD'80, has been designated a Distinguished Scientist by DuPont, where he is a fellow in crop protection. Created in 1992, the DuPont Distinguished Scientist recognition is reserved for those scientists who have contributed significantly to DuPont's advancement and global reputation in a scientific discipline. Lahm, who has spent his career helping farmers around the world improve their crop yields to better their lives and nourish their communities, is only the sixth scientist to be so honored. A world-renowned agrochemical expert in the field of insecticides, his 30-year career with DuPont has been marked by the highest levels of creativity, productivity, leadership, and accomplishment, and has led to numerous inventions and breakthroughs in the area of crop development. Lahm is the recipient of many awards in his field, including the American Chemical Society Team Innovation Award, the Kenneth A. Spencer Award, and the 2010 National Inventor of the Year Award. He holds 49 U.S. and world patents and has published extensively at scientific meetings and in peer reviewed journals. Lahm lives in Wilmington, Del.

A veteran of World War II, **Theodore Largman**, PhD'52, was stationed in New Guinea and the Philippines where he was decorated many times during his service. After the war — and a Ph.D. in chemistry from IU — a job offer from Allied Chemical brought him to Morristown, N.J., where he was a senior research scientist. During his 39-year tenure, Largman was awarded over 35 patents. He developed fireproof nylon, novel polymers, new agrichemicals, improved amino acid synthesis and an array of new synthetic fibers for use in carpets, textiles, and fibers. After his retirement, Largman sought to apply his creative talents to areas outside the field of science. Enrolling in numerous classes at local colleges and universities, he explored photography, oil painting, woodcarving and clay. Sculpture classes introduced him to a unique medium, which he scientifically calls "Boxology". Through his sculptures, Largman (whose nom de plume is TEleazer) tells stories that challenge our way of thinking with juxtapositions of ancient and modern facts, often with a humorous twist. He lives in Morristown, N.J., and is extensively involved in his community. Recent accomplishments include his appointment as chair of the Morris Township Environmental Commission and his successful launch of the Renaissance Group, a social and educational organization for elders, which has been replicated in 33 locations across the country.

"I am still hanging on at 92. My pacemaker keeps me going," writes **Joseph R. Leal**, PhD'53. He lives in South Hadley, Mass.

In October 2010, the Indiana Department of Education named **Stacy A. McCormack**, BS'99, of Mishawaka, as 2011 Indiana Teacher of the Year. Eight of the 10 finalists in the 2011 Indiana Teacher of the Year program studied at IU. McCormack, who becomes the state's representative for National Teacher of the Year, is a physics teacher at Penn High School in Mishawaka, Ind.

Philip O. Nubel, BS'79, is an adjunct instructor of chemistry at Waubonsee Community College in Sugar Grove, Ill., near Chicago. He is also a senior research chemist in the petrochemicals division of BP Amoco Chemical Co. in Naperville, Ill. Nubel's wife, Jennifer (Yeaple), BME'81, is a church organist, piano teacher, and president of their condominium association. The couple lives in Naperville.

Raju R. Raval, BA/BS'01, is currently completing a residency in radiation oncology at Johns Hopkins Hospital in Baltimore, Md. His wife, Sheetal, is completing a residency in radiology at Hahnemann/Drexel University Hospital in Philadelphia. Raval was a Rhodes scholar as a student at IU. The couple lives in Wilmington, Del.

Alfred F. Sherer Jr., BA'70, MPA'94, is a retired laboratory purchasing coordinator for the IU School of Medicine's Department of Pathology and Laboratory Medicine. He writes, "My main occupation is the care of my children, grandchildren, and great-grandchildren. I am very interested in trees and health matters and somewhat interested in politics, history, and geography." Sherer lives in Indianapolis.

Mary Tolson Springer, BA'62, writes, "I am proud of my son Matthew Springer, Disability Services Coordinator for IU Southeast, on being selected 2010 winner of the Chancellor's Diversity Award in September." Mary Springer is the owner of Bluegrass Documentation. She lives and works in Henderson, Ky.

Richard C. Stewart, MA'55, a retired corrosion engineer with Shell Oil Co., fondly remembers the trailer park that used to house married students at IU after World War II. He writes, "The trailers were six feet wide and about 23–26 feet long. They had no running water or sewer connections. We received water from a hand pump at a central location and carried it in a bucket to our 'home.' Where we emptied the bucket escapes me. Probably a good thing! Our heat in the winter came from a kerosene heater. We had no stove or oven and used a hot plated for cooking. With the hot plate and the iron [on], additional electricity use could be critical to the good health of a fuse. We were nearly all newlyweds living in our first home. It was an adventure!" Stewart lives in Houston.

Gregory P. Sutton, BS'70, is director of gynecologic oncology at St. Vincent Indianapolis Hospital. He lives in Indianapolis.

Keegan T. Wilson, BA'08, is a quality control analyst for CSL Behring, a global leader in the plasma protein bio-therapeutics industry that researches, develops, manufactures and markets biotherapies that are used to treat serious and rare conditions. He lives in Bourbonnais, Ill., and works in Kankakee, Ill. [Minor in Chemistry]

Michael R. Wolff, BA'79, MD'83, of Burlington, N.C., performed his surgical internship and surgical residency at the University of Tennessee Medical Center in Memphis. He also performed his urology residency there and was chief urology resident from 1987–1988. Wolff currently holds hospital staff appointments at Alamance Regional Medical Center in Burlington, and is a partner at Burlington Urological Associates.

"After teaching high school chemistry and oceanography for 36 plus years, with the last 33 years at Grand Blanc (Mich.) High School, I semi-retired in June 2000," writes **Dale F. Wolfgram**, MAT'69. He adds, "Since then I've taught at Mott Community College [in Flint, Mich.] every semester unless I was traveling. I still love to learn and teaching is a good way to be an active learner. My students have taught me so much over my 47-year career. Their questions always stimulate me to search for answers. I still remember my college chemistry professor walking into class one day and telling us the 'inert gases' were no longer inert. Dr. Neil Bartlett of the University of Vancouver had reacted two of them with some unique reagents. That was in the early '60s. To this day, I am careful to call something 'true.' Most the time what we know is the best for that time. I was able to stay in touch with Dr .**Harry Day** until he passed. I believe Dr. **Dennis Peters** is the only prof I know these days." Wolfgram lives in Grand Blanc, Mich.

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The IU Chemistry Department is now is charged with maintaining records for all IU alumni. Please print as much of the following information as you wish. Updates are used as class notes and help keep IU's alumni records accurate and up to date. Attach additional pages if necessary. Mail to the IU Chemistry Department or update online by visiting **http://whatsnewwithyou.chem.indiana.edu**.

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