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IU•CHEMISTRY

Association of Indiana University Chemists Alumni Journal

Obesity agents: Peptides and metabolism

Bogdan Dragnea's golden virus

In memoriam: Ed Bair

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Back cover: *Tao and Tucker, both age 14, live at the Exotic Feline Rescue Center, Center Point, Ind. Staff scientist Helena Soina examines the importance of the sense of smell in felines and other creatures in her piece on page 5. (Photo by Stephen McCloud)*

Obesity agents

Team discovers novel hormonal co-agonists are effective in the treatment of obesity and metabolic disorders.

by Richard DiMarchi

Obesity and its associated consequences, including adult-onset diabetes, remain a primary health and economic threat for modern societies.

Obesity is a chronic condition in which excess body fat accumulates to a degree associated with adverse health effects. It is associated with increased risk for coronary heart disease, diabetes, cancer, hypertension, stroke, depression, sleep apnea, and overall mortality. The U.S. National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC) have defined obesity as having a Body Mass Index (BMI) of 30 kg/m^2 and above. A BMI between 25 and 29.9 is considered overweight.

Obesity is also a multi-factorial condition with behavioral, environmental, and genetic components. The treatment of obesity requires dietary changes, exercise, and counseling in addition to any prescribed pharmacologic intervention. Bariatric surgery (e.g.gastric bypass or banding) is recommended for individuals classified as "morbidly obese," with a BMI of over 40.

Of medical importance is the fact that moderate weight loss of approximately 10 percent has been shown to significantly decrease many of obesity-associated diseases.

According to the CDC, obesity is at epidemic levels as it affects more than one quarter of the adult U.S. population. Approximately another third meets the clinical definition for being overweight. Data from national population surveys (NHANES) have demonstrated that, since 1960, the prevalence of obesity has more than doubled. Globally, there are more than one billion overweight adults. The total economic cost of obesity-associated diseases in the U.S. is estimated to be more than ninety billion per year.

Despite the huge number of individuals in the U.S. being classified as obese, the patient population using pharmacologic therapy is very small. While a minimal percentage of obese patients turn to pharmacological intervention, the percentage seeking some form of treatment for their obesity (e.g., behavior modification, dieting, exercise, OTC agents, and nutraceuticals) is significantly larger. Studies suggest that, at any one time, 35 to 80 percent of obese individuals are attempting to lose weight. Unquestionably, there is a high unmet need for effective and safe anti-obesity agents.

Pharmacologic treatment that is efficacious and safe has yet to emerge, but the enhanced acceptance of obesity as a chronic disease has elevated the search for a suitable novel therapy. Current treatment options are modestly efficacious, poorly tolerated, and plagued by safety concerns. Of the prescription drugs that are available in the U.S. to treat obesity, only two – Abbott's Meridia (sibutramine) and Roche's Xenical (orlistat) – are approved for long-term use.

While Meridia has the ability to control appetite, offering an average weight loss of 4.3 percent over one year, it can lead to hypertension and increased heart rate.

Xenical leads to weight reduction through the inhibition of lipase-mediated breakdown of gastrointestinal fat. Despite an average weight loss of 2.9 percent over one year, one quarter of patients taking the drug experience unpleasant gastrointestinal adversities.

Phentermine, first introduced in the 1950s, is a generic appetite suppressant still in wide use today. It remains the most widely prescribed anti-obesity agent in the U.S., leading to an average placebo adjusted weight loss of 3.5 percent over 3 to 6 months. However, patients begin to regain weight quickly after stopping treatment.

Currently the most effective drug for treatment of the metabolic syndrome activates the receptor (GLP-1R) for the gut peptide, glucagon-like peptide-1 (GLP-1). GLP-1R agonism safely improves glycemic control in adult-onset diabetics with simultaneous reduction in body weight.

Peptide research at IU

Enhancing pharmacotherapy by combining multiple peptides targeting different receptors is emerging as a viable and attractive approach to treat obesity. Identifying the most effective agents and minimizing the total number of drugs to be used simultaneously constitutes a major research challenge.

Reporting in *Nature Chemical Biology*, Richard DiMarchi and colleagues have shown that a rationally designed single peptide that targets two key pathways in glucose homeostasis might provide a novel therapeutic strategy for obesity.

In 2005, DiMarchi and colleagues founded Marcadia, considered one of Indiana's most promising biotech startups, upon other discoveries made

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Charlie Parmenter

Richard DiMarchi

Obesity agents

(*continued from page 1*)

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A rationally designed single peptide that targets two key pathways in glucose homeostasis might provide a novel therapeutic strategy for obesity.

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at the DiMarchi Indiana University laboratory. Last year, the company signed a collaborative agreement Merck & Co. to develop and commercialize its drug candidates. The work presented in the *Nature Chemical Biology* report represents one of the more advanced peptides.

The synthetic and biochemical aspects of the work were performed by Jonathan Day, PhD, as part of his graduate thesis research, in concert with other members of the DiMarchi laboratory. The *in vivo* pharmacology studies were conducted at the University of Cincinnati in the research group led by Dr. Matthias Tschoep, MD.

Acute glucagon administration reduces food intake in animals, as well as in humans, and some reports indicate that sustained glucagon receptor (GCGR) activation not only decreases food intake, but also promotes lipolysis, and weight loss. Chronic investigation of glucagon's metabolic effects are challenging since the native hormone is rapidly degraded, and possesses poor solubility and stability in physiological buffers.

Glucagon and GLP-1 have distinct receptors that are also structurally related. Despite this similarity, glucagon and GLP-1 have classically been thought to oppose each other in controlling blood glucose. Glucagon acts directly at the liver to raise blood glucose by stimulating gluconeogenesis and glycogenolysis, whereas GLP-1 acts by multiple mechanisms to lower glucose, most notably by enhancing glucose-stimulated insulin synthesis and secretion at the pancreas. Another proglucagon gene product, oxyntomodulin, also reduces food intake and body weight in rodents and humans, much like that reported for GLP-1.

DiMarchi and colleagues explored the efficacy of combined glucagon and GLP-1 agonism in a single peptide. They hypothesized that the anti-hyperglycemic property of GLP-1 agonism would minimize any diabetogenic risk of excessive glucagon agonism. The lipolytic and thermogenic properties attributed to glucagon in addition to the satiation-inducing pharmacology of GLP-1 provided a strong mechanistic rationale for the development of a synergistic co-agonist peptide.

A set of potent glucagon/GLP-1 co-agonists possessing differing activity at each receptor of interest was synthesized and biochemically characterized *in vitro*. Two specific glucagon analogs enhanced for sustained action and engineered to have activity at the GLP-1R comparable to that of native GLP-1 were studied pharmacologically in rodent obesity models.

A single subcutaneous injection of either of these compounds to diet-induced obese (DIO) mice significantly decreased food intake, causing a reduction in fat mass and therefore body weight within one week. Similarly encouraging results were seen in long-term (one month) experiments.

Once-weekly administration of one of the peptides reduced body weight by about 28 percent in DIO mice, although cumulative food intake was statistically unchanged by treatment and the effects seemed to result predominantly from increased energy expenditure. Long-term treatment also reduced circulating levels of glucose and insulin, suggesting improved glucose homeostasis and increased insulin sensitivity, as well as decreasing total cholesterol and improving lipid profiles.

In GLP1R-knockout mice, the treatment still caused some reduction in body weight and fat mass proving that glucagon agonism contributed to weight loss independent of the GLP1 pathway. Importantly, these mice demonstrated a slight increase of blood glucose in response to treatment with the co-agonist. These experiments highlight the necessity of simultaneously targeting the GLP1R to avoid the deleterious effects of GCGR activation while retaining the therapeutic benefit.

This study offers perspectives for the future by showing the possibility of selectively combining, in a single peptide, the lipolytic effects of glucagon with the glucose-regulating properties of GLP1, potentially providing a new approach to therapy for obesity and, by association, type-2 diabetes.

Original research paper Day, J. W. *et al.* A new glucagon and GLP-1 co-agonist eliminates obesity in rodents. *Nature Chem. Biol.* 13 Jul 2009 (doi:10.1038/nchembio.209)

Richard DiMarchi is the Linda & Jack Gill *Chair in Biomolecular Sciences and Professor of Chemistry at Indiana University. He is a retired Group Vice President at Eli Lilly & Company where for more than two decades he provided leadership in biotechnology, endocrine research and product development. He currently serves as a co-founder and Board Chairman of Ambrx, Inc. Professor DiMarchi is readily recognized for the discovery and development of rDNA-derived Humalog® (LisPro-human insulin). This designer insulin represents the first demonstration that structurally altered rDNA-derived biosynthetic proteins can improve pharmacological performance without increasing the risk of an abnormal immunological response. As scientist and administrator Professor DiMarchi also contributed to the commercial development of Humulin®, Humatrope®, Xigris®, rGlucagon®, Evista®, and Forteo®.*

Nanofluidics in lab-on-a-chip devices

by Stephen C. Jacobson

Microfluidics emerged in the 1980s as a field studying the behavior, control, and manipulation of fluids typically on the sub-millimeter scale (mm = 10^{-3} m). Microfluidics saw continuous growth in the 1990s and continues to do so, due to the emergence of nanoscience and nanotechnology as evolving subdisciplines.

Accordingly, nanofluidics delves into the study and application of fluids on the nanoscale (typically 1-100 nm; 1 nm = 10^{-9} m). Although not a new area of research specifically, the development of new micromachining techniques has made the study and application of nanofluidics much more accessible in recent years. Nanofluidics finds a very diverse home and impact of study in the areas of biology, chemistry, physics, and engineering.

Our work developing microfluidic systems has stimulated interest in pushing the channels to smaller dimensions in order to study fluid transport through nanoscale conduits. As our ability to fabricate features at nanometer length scales improves, we must determine which lessons from the microscale extrapolate to the nanometer regime and which are unique to the nanoscale.

Some aspects of microchannel transport are expected to transfer directly to operation of smaller nanoscale channels, but these systems can be significantly influenced by phenomena such as double-layer overlap, surface charge, diffusion, and entropic forces, which are either insignificant or absent in larger microchannels.

To develop analytical functions from these unique nanofluidic phenomena, we are using both nanochannel and nanopore systems to study fundamental fluid and material transport and apply what is learned to separation and sensing problems, e.g., creating tunable particle/molecular filters and monitoring supramolecular assembly. Graduate students **Michelle Kovarik**, **Kaimeng Zhou**, **John Perry**, **Brett Hildenbrand**, and **Zach Harms** have contributed to various aspects of this project.

In our initial work, we created in-plane channel architectures, which were confined to the nanoscale in both depth and width, to study flow transport and attoliter-scale dispensing with injection volumes as low as 40 aL (1 attoliter = 10^{-18} L).

Electrokinetic transport was achieved by applying potentials up to 10 V directly from an analog output board without amplification, producing modest electric field strengths in the nanochannels and enabling rapid dispensing and analysis. We have also worked with nanopore-based systems in which we demonstrated trapping of sub-micrometer (1 µm = 10^{-6} m) particles using an integrated nanopore/microchannel device coupled with AC electric fields. Similarly, we have applied this technique to trapping and releasing the bacterium *Caulobacter crescentus*. The high field strengths and field gradients generated in the vicinity of the conical nanopores give rise to both electrophoretic and dielectrophoretic effects.

By tuning the amplitude and frequency of the trapping waveform, the direction and relative magnitude of these two forces can be controlled to fractionate or concentrate particles based on size, charge, and polarizability.

More recently, we have used similar integrated nanopore/microchannel devices with isolated single nanopores to elucidate the mechanism of small molecule concentration at nanochannel/

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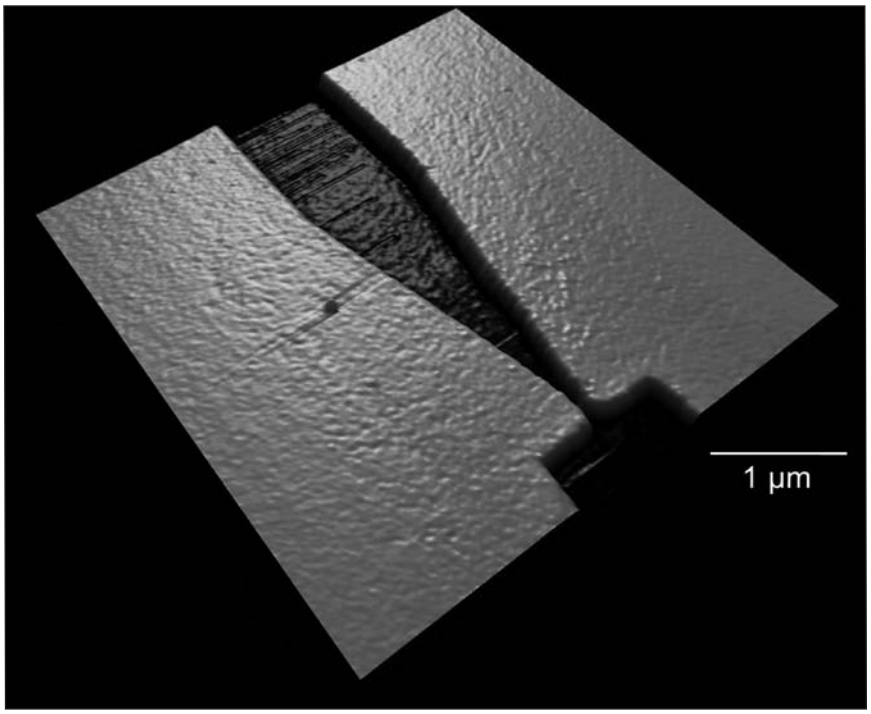


Fig. 1: *Atomic force microscope (AFM) image of a nanoscale funnel with an 80-nm wide tip and a 1–mm wide base.*

Nanofluidics (*continued from page 3*)

Charlie Parmenter

Stephen Jacobson

microchannel interfaces. Microfluidic channels are used to isolate single conical pores in a track-etched membrane, and we studied the formation of ion depletion regions in the microchannel adjacent to the single nanopore. In contrast to previous reports, electrical and optical characterization of these individual nanopores suggests double layer overlap is not required to form an ion depletion region adjacent to the nanopore in the microchannel; rather, excess surface charge in the nanopore contributes to the formation of this ion depletion region. In more recent work, we have fabricated nanoscale funnels using electron beam lithography to create a mold and have used the molds to cast nanofunnels in a polymer (see fig.1).

We are also applying the integrated nanopore/microfluidic structures to study supramolecular assembly of biological ensembles, e.g., viruses. To monitor assembly kinetics, we are constructing microfluidic devices with single nanopore sensing elements. The microfluidic channels provide fluid control and precise mixing conditions, and the nanopore is used as a Coulter counter to determine the size distribution of assembled or partially assembled complexes without the need to label the complex.

This measurement technique uses what is referred to as resistive pulse sensing where the protein complex blocks a portion of the electrical current in the nanopore. The virus subunits and buffer appropriate for capsid formation are brought together at a microfluidic mixing tee and sensed with the nanoscale conduit downstream of a microfluidic mixing tee. The flow rate and distance between the mixing tee and the nanopore determine the assembly time and can be varied.

Our goal for these experiments is to obtain kinetics for these assembly processes and their dependence on reaction conditions. This project is in collaboration with Professors **Bogdan Dragnea**, **Martin Jarrold**, **Peter Ortoleva**, and **James Reilly**.

Our efforts at the nanoscale will be further enhanced with the acquisition of a new focused ion beam (FIB) instrument, which was recently funded through the NSF Major Research Instrumentation Program.

The FIB instrument uses an ion beam to mill hard and soft materials and will allow us to machine structures and surface features, e.g., pores, channels, and electrodes, down to ~10 nm. In addition, material and biological samples can be precisely sectioned for analysis with either a scanning or transmission electron microscope.

Faculty members from the Chemistry department **Lane Baker**, **Bogdan Dragnea**, **Amar Flood**, **Dongwhan Lee**, **Sara Skrabalak**, and **Steven Tait**, along with **David Baxter** (Physics), **Suchetana Mukhopadhyay** (Biology), **Juergen Schieber** (Geological Sciences), and **David Morgan** (Director of the Cryo-Transmission Electron Microscopy Facility), participated in this successful proposal. The FIB instrument will be housed in the Nanoscale Characterization Facility in Simon Hall.

Professor Stephen Jacobson earned a BS in mathematics from Georgetown University in 1988 and a PhD in chemistry from the University of Tennessee in 1992. After graduate school, he was awarded an Alexander Hollaender Distinguished Postdoctoral Fellowship at Oak Ridge National Laboratory (ORNL). In 1995, Jacobson became a research staff member at ORNL, and during his stay at ORNL, he participated as an adjunct faculty member in the Genome Science and Technology Program at the University of Tennessee from 2000 to 2003. In 2003, he joined the faculty at Indiana University as an associate professor in the Department of Chemistry. Research in the Jacobson group focuses on developing microfabricated instrumentation and using this instrumentation to study various chemical and biochemical problems. Current projects are in the areas of microfluidic separations, nanofluidics, photolithographic mapping, and cell-based assays.

Chemical communication: a staff scientist's view

by Helena Soini

How important is your sense of smell? Just imagine not being able to smell your food, flowers in the garden, or any odors that you may associate with your environment. People suffering from anosmia, a loss of smelling capability, can suffer from depression and are often suicidal.

The sense of smell is vitally important to all other living creatures which emit and perceive odors to communicate with each other on their gender, reproductive state, their territories, etc. Some mammals, such as the common house mouse, have developed a very intricate system of chemical communication without which they would not be able to survive in their surroundings.

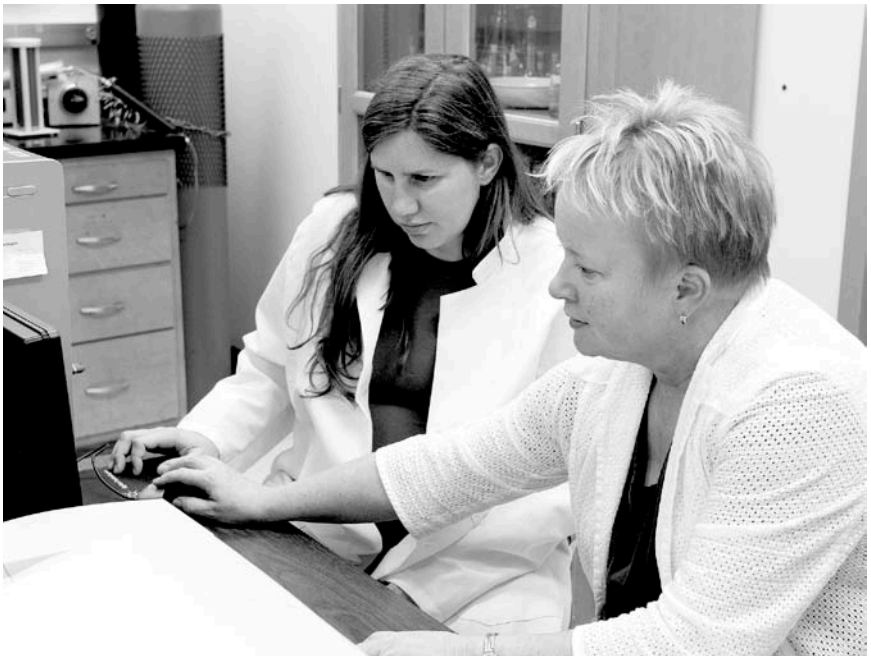
The chemical substances called "pheromones" or "chemosignals" have received ample attention in biological and behavioral scientific literature, yet very little is known about their precise molecular nature and the mechanisms of their perception. Now, there are an increasing number of dedicated scientists who want to change this situation.

Dr. **Helena Soini** is a senior scientist at the IU Institute for Pheromone Research, which was established in 1999 by Distinguished Professor **Milos Novotny**. Novotny has collaborated for a number of years with biologists and behavioral scientists, leading to several important discoveries in the field, among them the structural identification, chemical synthesis and testing of the first definite mammalian pheromones — 2-*sec*-butyl-dihydrothiazole and dehydro-*exo*-brevicomin (see fig. 1 on page 6).

Since joining the Institute in 2001, Soini has seen her share of "exotic" samples of animal urines, skin glands and glandular secretions.

Using cutting-edge analytical methodologies and instrumentation based on mass spectrometry, she has carried out investigations on South African molerats, mound-building monogamous mice, Siberian dwarf hamsters, canids and felines, and even humans.

About 5 percent of genes in mammals are dedicated to olfaction, emphasizing the general importance of chemical communication. Most recently, it has been noted that olfaction is very important even in birds. A recent 2008 genetic study in Germany and New Zealand supports the fact that songbirds may have as good a sense of smell as mammals, countering the previous beliefs that birds communicate merely through vision and audible cues. A collaborative bird study, with the IU Biology Distinguished Professor **Ellen Ketterson** and **Danielle Whittaker**, is leading the Institute's chemical communication research once again to vastly uncharted areas.



Charlie Parmenter

Above: Amanda Posto and Helena Soini work in the Novotny laboratory.

Practical applications

Some of the practical applications for the studies may include rodent population control. For example, Novotny patented farnesene (see fig. 1 on page 6), the dominant male mouse pheromone, as a mouse repellant. A large research area has been in the investigations of prey-predator interactions.

Canids, such as wolves and foxes, seem to rely strongly on the sulfur-containing compounds in their territorial markings. One of the current projects involving canids, is a large suburban red fox study in collaboration with scientists at the University of Bristol, UK.

Cats are elegant and somewhat mysterious animals. They are also extremely skillful predators. The cat-scent investigations have led Soini and Novotny to an international collaboration with researchers from Germany and Australia as well as Professor **William Timberlake** at the IU Department of Psychology. Rats "freeze" in fear for long periods of time when they pick up a scent from a collar worn by a domestic cat. Could there be some

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Pheromones (*continued from page 5*)

practical applications when we find out the chemical nature of this chemosignal?

Another aspect of the cat-scent studies is communication among individual cats. **Dr. Susan U. Linville,** formerly from the IU Department of Biology and IU Center for Integrated Study of Animal Behavior (CISAB), has conducted behavioral studies with tigers, lions, cougars, and leopards in the nonprofit *Exotic Feline Rescue Center* (EFRC) in Center Point, Ind.

Large felines greet each other by brushing their foreheads together. Correspondingly, Soini and her assistants **Craig Hollars** and **Amanda Posto** have now been analyzing volatile compounds from the feline foreheads and cheeks. Preliminary findings point to a unique scent map on cat foreheads. **Don Wiesler,** the institute's emeritus scientist, has identified almost 400 compounds in these samples. Harry G. Day Professor of Chemistry **David Williams** has been assisting this effort through the preparation of synthetic analogs to verify identifications and providing materials for behavioral tests.

During a two-year study, Soini and Novotny were also involved in a large human odor study in collaboration with Austrian, German and British scientists. This study has led to identification of a set of 375 compounds distinguishing families and genders.

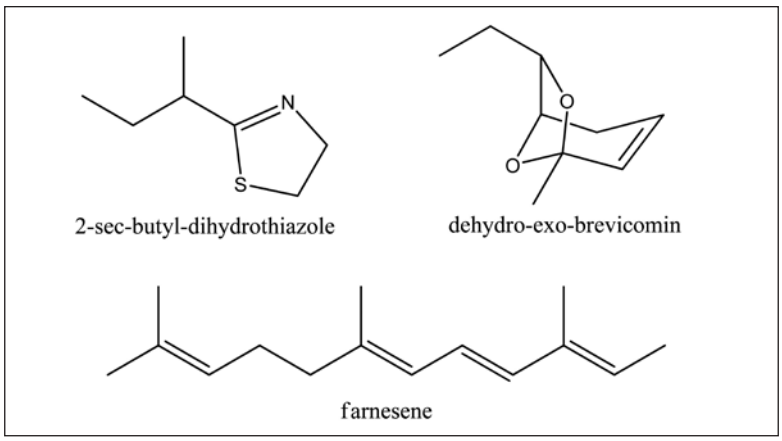


Fig. 1: Structures of the first definite mammalian pheromones, 2-sec-butyl-dihydrothiazole and dehydro-exo-brevicomin. These two synthetic compounds act synergistically, and they provoke fighting that is quantitatively and qualitatively comparable to that elicited by intact male urine. Later discovered, a dominant male mouse pheromone, farnesese, which has led to a patented mouse repellant.

Helena Soini joined IU in 2001 as an associate scientist in the Institute for Pheromone Research. In 2008, she was promoted to senior scientist. She coordinates all pheromone identification studies and maintains all analytical expertise for the institute. Soini has 14 years of research experience in industrial bioanalytical laboratories and earned her master's degree from University of Oulu and a PhD from the University of Helsinki, both in Finland. The Institute for Pheromone Research is housed in the Department of Chemistry's Novotny laboratory, and is highly equipped with instrumentation necessary for the isolation, analysis and characterization of pheromones and their receptor and transporter proteins. Since its opening in June 2000, the interdisciplinary institute has continued to develop its research on the structural elucidation of mammalian pheromones and the molecular mechanisms of their reception at target tissues.

FACULTY AWARDS

Since our last alumni journal, our faculty members have continued to receive university and national recognition. See more news from our faculty in the Around IU Chemistry section, on page 11 of this magazine.

Lane Baker was selected as a recipient of the National Science Foundation (NSF) Early Career Award. The NSF honors outstanding junior faculty members in science and engineering nationwide with the Faculty Early Career Development (CAREER) awards. The CAREER award is NSF's most prestigious honor for junior faculty members. It recognizes faculty members most likely to become the academic leaders of the 21st Century.

David Clemmer was the recipient of the 2009 Tracy M. Sonneborn Lecture Award sponsored by Indiana University. This award is given to faculty members who have achieved local, national, and international distinction in both teaching and research.

Daniel Mindiola earned the 2009 National Fresenius Award. This award, a joint honor of Phi Lambda Upsilon and the American Chemical Society (ACS), is made annually to an outstanding scientist under 35 in recognition of excellence in early-career achievements. He'll receive the award at the spring 2010 American Chemical Society (ACS) Awards Banquet.

Mindiola also received the Friedrich Wilhelm Bessel Research Award from the Alexander von Humboldt Foundation in Germany. The Bessel award recognizes internationally renowned scientists and scholars who are expected to continue producing cutting-edge achievements which will have influence on their discipline beyond their immediate field of work.

Ronald Hites was selected to the 2009 class of Fellows of the American Chemical Society (ACS). This honor was presented at a special ceremony during the ACS National Meeting in Washington, D.C., August 17, 2009.

Krishnan Raghavachari was selected as a recipient of the 2009 Davisson-Germer Prize in Surface or Atomic Physics sponsored by AT&T Bell Laboratories. The Prize was established to recognize and encourage outstanding work in atomic physics or surface physics and was presented at the March 2009 American Physical Society meeting in Pittsburgh during a special Ceremonial Session.

William Carroll Jr., PhD'78, is the recipient of a prestigious Distinguished Alumni Service Award (DASA). This award was established in 1953 to recognize outstanding achievements by Indiana University alumni in their careers and in service to the university, their communities, the state and the nation. The honor was bestowed upon Carroll during the annual IU Alumni Association Cream and Crimson weekend in June 2009. Carroll is an adjunct professor in the Chemistry Department and has taught polymer chemistry.

Last spring **Kenneth Caulton**, **Romualdo de Souza** and **Kate Reck** were recipients of Trustees Teaching Awards. These awards were established by the IU Board of Trustees to recognize excellence in classroom instruction. Courses taught, course enrollments, and student evaluations provided the basis for their selection.

CHAIR'S LETTER

Building infrasctructure despite setbacks

One of our most exciting (and time-consuming) activities involves faculty hiring. Each subdiscipline considers the possibility of adding new colleagues who will complement its current expertise and range of interests and help to redefine future goals.

By this measure, it has been a relatively quiet year for the Chemistry Department. It should not surprise anyone to hear that Indiana University has experienced the impact of our country's economic woes. Following a year of considerable expansion, when five new assistant professors joined us, we did not have the opportunity to hire any new faculty members in 2008–2009, and the upcoming year may be similar.

Nevertheless, in times of uncertainty, fewer people seek transition in their lives. The number of retirements from IU dropped precipitously this year and from our department no faculty members retired or transferred. Thus, we find ourselves in an equilibrium state with 35 research faculty members.

However, we have been fortunate to maintain, and even build upon, our excellent departmental infrastructure.

For example, we now have a 200 MHz NMR in the undergraduate organic chemistry lab, along with working 300, 400, 500, 600 and 800 MHz research spectrometers. The Mass Spectrometry Facility obtained a new high resolution MALDI-TOF instrument that is capable of spatial imaging and a multiple ion source LC quadrupole spectrometer that is currently set up for walk-up use by graduate students and postdocs.

In the biggest coup of the year, **Steve Jacobson** spearheaded an effort by members of the Nanomaterials Characterization Center to obtain a $2 million, multiuser research instrumentation grant from the National Science Foundation for a focused ion beam (FIB) instrument. A number of research groups will use this to manufacture infinitesimally small devices that will probe phenomena in the microscopic world. Our faculty is active in submitting group proposals to federal agencies for various other types of spectrometers and diffractometers that will enhance the research capabilities available in the department.

Our graduate-student recruiting program was highly successful. We recently welcomed 51 new students; most are just beginning to think about their first-year (C500) research projects.

Despite this good news, characterizing the overall financial climate at IU as "challenging" would be euphemistic at best. The university has instituted a new policy and is cutting the number of professional staff. (People are not being laid off; however, most departing staff are simply not being replaced).

Along similar lines, our departmental travel budget has been drastically cut. The latter normally covers the expenses of our invited research seminar speakers and visiting prospective graduate students. University administrators are also considering a threefold increase in the tuition that chemistry faculty pay for their out-of-state graduate student research assistants.

Charlie Parmenter

Jim Reilly

To prevent these financial setbacks from having an inordinate impact on the livelihood of our department, we are appealing to our alumni. Over the years we have received contributions from many. For this, we are profoundly grateful. I know that you recognize the value of having strong, high-quality undergraduate and graduate chemistry programs at IU. Therefore, we welcome and appreciate any assistance you can offer that might help us to sustain these programs through this critical time. For your convenience, an envelope has been inserted in this brochure.

Thank you in advance for your unwavering support and loyalty. Our success is largely due to your generosity and past efforts. We are humbly indebted. Please plan to stop by the chairman's office the next time you are in Bloomington. I would love to thank you personally.
— *Jim Reilly*

Awards Named for Faculty Members

The **Ronald A. Hites Award for an Outstanding Research Publication** in the Journal American Society for Mass Spectrometry was announced late last year by the president of ASMS. Given that JASMS is the leading journal in the field, it seems appropriate that the society awards the quality of papers published. Ronald Hites was president of ASMS when the journal was conceived and is the person most responsible for its existence. Because Hites's vision in establishing the society journal was so important, the current ASMS Board of Directors felt it fitting to name the award for him. For more details, visit: https://www.asms.org.

The Special Libraries Association Chemistry Division has honored Gary Wiggins, BA'66, former head of IU's Chemistry Library. The **Wiggins-Roth Award for Outstanding Service i**s named in honor of Gary Wiggins and Dana Roth, who are each well-known and highly regarded for tremendous contributions to the field of chemical information and for their enthusiasm about sharing their expertise with others.

Bogdan Dragnea's *golden* virus

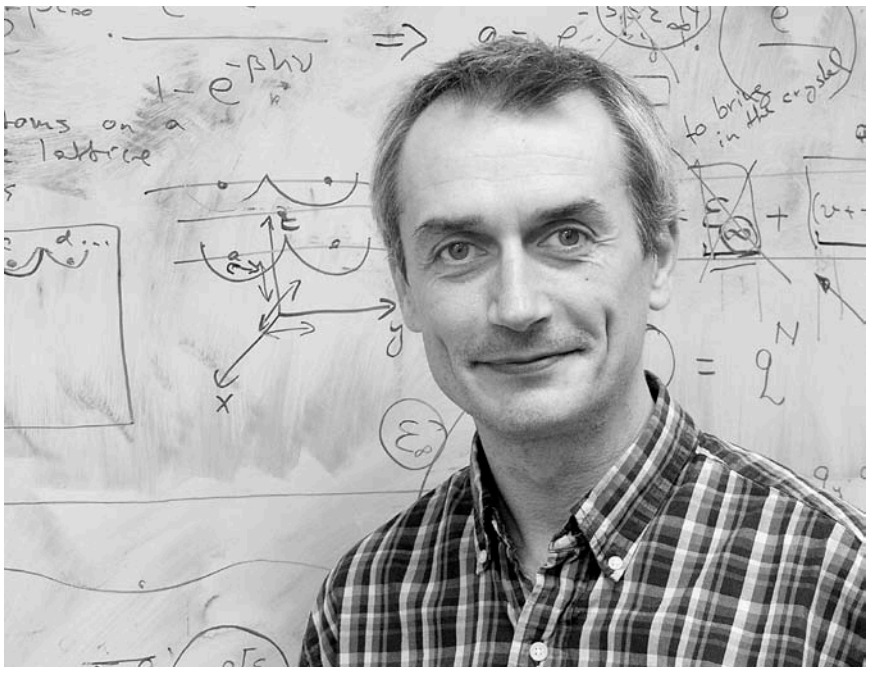
A commentary and interview by Charlie Parmenter

IU•Chemistry: *You are now in the midst of research that has attracted much attention. Even to us who know about science, your achievements seem quite fantastic. You have taken a gold nanoparticle, that is to say a gold sphere about 10 nm in diameter, and have encouraged it to wrap itself in a nicely tailored coat made from the native proteins of a disassembled virus. From the outside, your little creations look like viruses, but the organized protein coat hides a completely inert core. They even have their own acronym, VLP, for virus like particles.*

Your VLPs occupy a special niche in the hot field of molecular self-assembly. VLPs certainly have promise as tools for explorations in the bio world, and they have already served as models for revealing the rules governing virus capsid construction.

An obvious question arises. How did you conceive of this far out line of research?

Bogdan Dragnea: For us, the initial inspiration came from biology. When I first came to IU, I wanted to build upon my experience with optics and lasers to study how biological systems work. I wanted to have an autonomous optical probe that could travel inconspicuously inside a cell and report on its local environment, using the least intrusive vehicle — light.



Charlie Parmenter

Bogdan Dragnea

I imagined it like building the Voyager all over again, but instead of vacuum and eons of nothingness, we had to send our explorer into the crowded microscopic universe of a living cell. Instead of a thermal and UV shield we had to use a molecular coat. Because of the wide variety of intermolecular interactions (the average distance between two proteins in there is 2 nm) we needed a fine-tuned chemistry. The broader goal was to learn enough about cellular transport to create synthetic systems that work with similar precision and efficiency. We needed something much smaller than a cell, something that would act as a beacon, that would be responsive to chemical clues and, at the same time, be disguised so that it could not be recognized as an intruder by cellular defense mechanisms.

Hints at how these characteristics might be achieved were not lacking: the most abundant life form on Earth actually includes most of them, and conveniently pre-packaged! At the border of living matter, viruses represent a class of biological supramolecular entities, much smaller than a cell, with no metabolism of their own, but apt at subverting the cellular machinery for their own replication. In their most basic form, viruses consist of a segment of nucleic acid packaged inside a protein cage (the capsid).

The main issue was then whether the virus' ability of adapting and responding to a variety of chemical environments in order to target and gain access to a host's interior could be preserved while creating a new class of bio-inspired architecture for non-genomic materials packaging and transport. We assumed that such complexes could find their way into biomedical applications, for instance in high-contrast functional imaging or as oncolytic virus-like agents.

That answers the first part of the question, but how did you have hope that you could build this ersatz virus with its golden heart? I recall that you were working with gold nanoparticles in your early years of optics and photonics at IU, but the concept of incor-

(*continued on page 9*)

porating them in an assembly that mimics a virus seemed a stretch. Also, you must have started with a wealthy patron in mind since funding for such an adventurous idea is unlikely to be forthcoming from the conservative coffers of our hard pressed funding agencies

Here is how to build a Trojan horse. We first need some materials: gold, polymers, and proteins. Then we needed to know that in 1955, Fraenkel-Conrat and Williams demonstrated how an active tobacco mosaic virus could be reconstituted in-vitro by mixing together its inactive molecular constituents: nucleic acids and proteins.

When put together in the right environment, an amazing thing happens: they spontaneously organize into a functional machinery able to protect its blueprint (the genetic code), travel through a hostile environment, and subvert the synthetic machinery of the cell to follow its own genetic instructions. This form of spontaneous molecular organization, ubiquitous among living systems, is a particular example of molecular self-assembly, a research area of significant growth in recent years.

Thus, animated by the feeling of something that appeared as a job half done, encouraged by collaborators, and unaware of any of the obstacles that were ahead, we set compass towards encapsulating, by selfassembly, a gold nanoparticle in the virus coat of a quasi-spherical virus instead of its native genomic material. The gold nanoparticle was chosen because it can be coated by ligand monolayers that are covalently attached to the surface through a thiol bond. In addition, gold nanoparticles have a specific, size-dependent, collective free-electron oscillation that can be resonantly excited with optical wavelengths. This makes them easy to locate by optical means, and the resonance is sensitive to local changes in the dielectric constant of the nanoparticle environment.

Three years of testing off-the-shelf anionic ligand candidates to find one that emulates the RNA met with limited success despite the current dogma that the interaction between RNA and the protein capsid was non-specific. Very few nanoparticles would get encapsulated – encouraging, but still a far cry from the 100-percent efficiency of encapsulation boasted by the native RNA. We came to realize that most ligands, although interacting electrostatically with the N-terminal of the cage protein as required, would denaturate the protein. Something that would bind water strongly enough to prevent hydrophobic interactions between the protein and the nanoparticle core was necessary. Vince Rotello, an organic chemist at University of Massachusetts (Amherst) synthesized for us a library of short carboxyl terminated

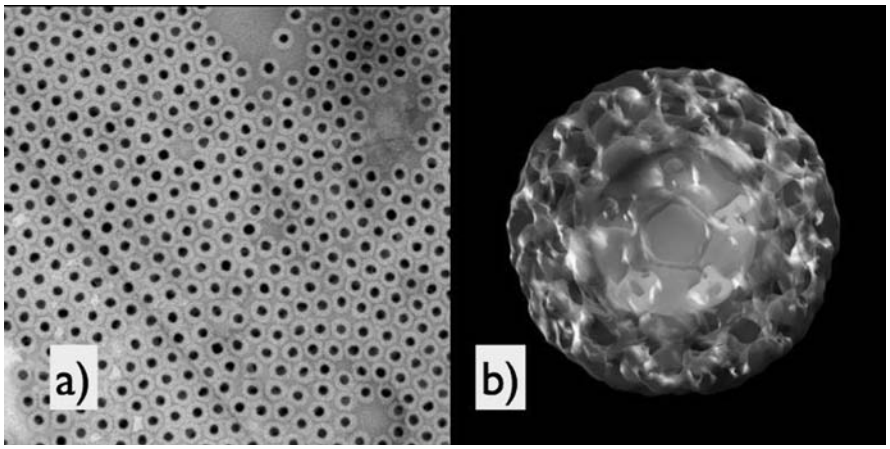


Fig. 1: (a) Transmission electron micrograph showing gold nanoparticles, 12 nm diameter, encapsulated in a virus coat. (b) Image reconstruction from the data in (a) revealing the cosahedral symmetry of the shell and the number of proteins (180) that formed it.

polyethylene glycols. Coating our nanoparticles with this ligand lead to 90% incorporation efficiency, Fig. 1 (a) and allowed us to reconstruct the three-dimensional structure of the virus-like particle, which had icosahedral symmetry and a multiple number of 60 proteins depending on the core size, Fig. 1 (b).

Soon after the publication of the initial results, the initial skepticism of the reviewers toned down and first funding (from the National Science Foundation) arrived.

Bogdan joined our department after a post-doc at JILA in Boulder, Colo. That might seem to be a fairly typical route to the academic world, but Bogdan's path has actually been one of successive transformations, both geographical and intellectual.

Born in Romania, he completed his undergraduate degree in physics and physical optics at the University of Bucharest. He then pulled up stakes and moved to France to become a graduate student in the famous Laboratoire de Photophysique Moleculaire of the University of Paris-Sud at Orsay studying solid surfaces with special nonlinear laser techniques. Equipped with his new physics PhD, he journeyed with his wife and daughter to the world of chemical physics in Boulder where much of his work concerned novel optical approaches to chemical problems.

At IU, his transformations continue. If one tries to place labels on Bogdan, he is a physical chemist, an analytical chemist, a materials chemist, a physicist, and, as revealed by his work described above, he is now very much a biochemist. Since the concept of transformation appears to recur constantly in your career, could you comment on this aspect of your science?

(*continued on page 10*)

Golden virus (*continued from page 9*)

"Here is how to build a *Trojan horse*. We first need some materials: gold, polymers, and proteins."

I believe fascination with chemistry comes for most of us from its transformative character. It has been so since the times of the philosopher's stone and it remains today the main rejuvenating principle of chemistry. What brings about chemical transformation, the links forming between basic constituents of matter and giving birth to new substances is a territory traditionally divided among the kingdoms of covalent, ionic, and metallic interactions.

A question arises naturally: What happens with transformation once atoms have been locked into molecules? Is the main chemical principle banned from going beyond redistributions of atoms? Could there be a different hierarchy where molecules or even entities of higher architectural hierarchy take the place of atoms as fundamental constituents and organize into structures that, again, go farther from being merely a sum of their parts?

There are already a few hints of where explorations of that new hierarchy could lead. We could think of the host-guest compounds pioneered by Jean-Marie Lehn (he won the Nobel Prize for supramolecular chemistry in 1987), a deeper understanding of sub-cellular biological structures (flagella, membranes, ribosome's — the basic machinery of life), and, most recently, the intriguing concept of metamaterials.

Granted, as these explorations lead us past the boundaries of individual atoms and molecules, we are crossing into the realms of cellular and molecular biology or that of soft condensed matter physics. This cross-disciplinary aspect has both its rewards and challenges, for students and researchers alike. Should we take on these challenges and should we allow chemistry to transform itself in order to keep in line with its leading principle? It remains to be seen, but current trends seem to suggest that this is the case. The Materials Chemistry Division — the newest addition to our IU academic organization — has rapidly grown to impressive levels of young talent in both faculty and students. A few of them are tackling problems that involve chemistry beyond molecules.

The next question is obvious. Now that you have solved the riddle of how to build this special VLP, where do you go from here?

Today, focus has shifted in the group from proof-of-principle experiments to applications and also on the fundamental principles of assembly. The lab has now 12 members who work on four main directions: experimental models to elucidate the physical principles of self-assembly, virus-like vectors for therapeutic delivery and diagnostic, development of microscopy instrumentation for tracking single particles, and bio-enabled optical metamaterials. In February 2009, Professor **Adam Zlotnick** (now in IU Biochemistry) and I organized the first Gordon Research Conference on Physical Virology. At least 130 participants of disciplines ranging from mathematics to clinical medicine shared a genuine enthusiasm for being together. It was hard to say where all this would bring us, but it did feel like change was in the air.

One may sense that Bogdan tends to live dangerously. For example, he certainly did so by embarking on such a risky course of science so early in his academic career.

Outside of chemistry, his life also seems filled with perilous moments. Witness the cover of this issue. Bogdan is high off the ground climbing an ice wall to nowhere in the Colorado mountains. More locally, some of us would say that his most threatening adventures occurred daily as he bicycled to Chemistry from his home on a winding, hilly, narrow, and busy Nashville, Ind., road.

On winter vacations when the rest of us go south or travel to manicured ski slopes, Bogdan seeks the mountain wilderness. He never met a glacier that he didn't love. He adopts them as prime solo campsites with complete isolation, not even e-mail. In a recent winter, a plane dropped him high on an Alaskan glacier field, so he might spend some days being watchful for crevasses.

Bogdan has returned with beautiful images from these isolated worlds. His only complaints about the harsh conditions concerned his camera, immobilized by the cold. I advised that he should get a Leica and he said, "It was a Leica." Perhaps Bogdan should develop a nano-camera wrapped in a protein coat to be impervious to the abuses of his wilderness adventures.

If we actually suggested that, he would point out that his VLPs may in fact be proto-cameras. When tickled with a laser, they may image, in their way, the harsh environment inside the biological cell.

Around IU • Chemistry

FACULTY NEWS

Erin Carlson joined our faculty in 2008. Her research program focuses on the development and application of advanced chemical biology and systems biology technologies to define the mechanisms of bacterial development and identify potential therapeutic agents. Her group is pursuing the development of technologies for natural product discovery including innovative methods for compound isolation and screening. They are currently writing up their first manuscript on this work and look forward to having their first publication in the near future. They are also utilizing state of the art metabolomic and proteomic methods to map the biochemical pathways associated with bacterial development in collaboration with Professors Carl Bauer and Yves Brun from IU biochemistry and biology, respectively. Carlson was invited to speak about this work in a special Young Investigators session at the national Pittcon meeting next spring.

Ken Caulton lectured at the European Chemistry and Molecular Sciences Congress in Turin, Italy, and at the Universities of Toronto and Montreal. He is active on the Canadian Chemistry scene since his appointment to the Canadian National Science and Engineering Research Council, the government grant funding agency for all their academic science. This involves a grueling weeklong debate on the merits of proposals, following an even more grueling reading of many proposals; nevertheless, it broadens Caulton's awareness of the rich chemistry done north of our border. (That border, incidentally, is increasingly difficult to cross!). The "Competition Week" occurs in brutally cold Ottawa, Calif., in February. Caulton also spent a March week lecturing at a "Winterschule" for high-level young European researchers, held in Heidelberg, Germany. The talent pool there is impressive, but even postdoctorate students of that quality currently fear for their futures in the depressed job market.

Silas Cook joined the Chemistry Department in January 2009, after completing his postdoctoral studies at Harvard University with Professor Eric Jacobsen. Silas and his research group investigate novel chemical reactivity to produce the next generation of "green" catalysts to be used in organic chemistry. Additionally, the group develops new synthetic strategies for difficult synthetic applications, ranging from the construction of

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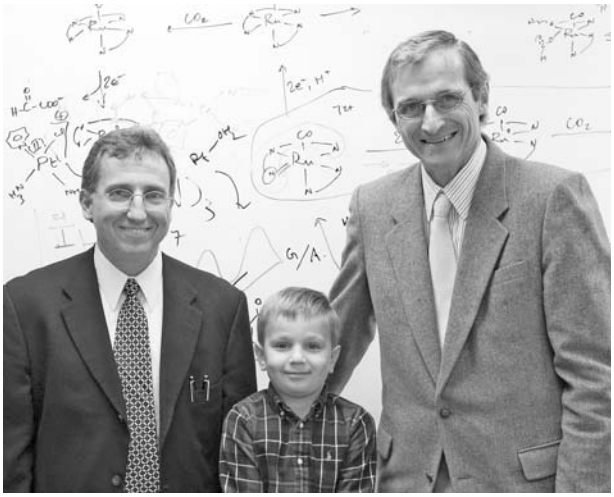
CONFERENCES, SPECIAL LECTURES, & SYMPOSIA

Every year, the department hosts over 100 unique seminars, from all divisions, delivered by invited speakers, internal faculty, and graduate students. Among these, there are a few endowed seminar series that are hosted most every year. These annual events are highlighted below.

The 18th *Annual Inorganic Alumni Symposium* took place on Oct. 3, 2008. Speakers included **Eyal H. Barash**, BS'91, of Aptuit Inc. (West Lafayette, Ind.), on "Solid-State Chemistry in the Pharmaceutical Industry: From Science to Patents;" **Lori Watson**, PhD'04, of Earlham College (Richmond, Ind.), on "Being a Scientist at a Small Liberal Arts College;" **Scott Thomas Haubrich**, PhD'95, Cabot Security Materials research and development manager (Albuquerque, N.M.), on "Security Materials"; and **Eduardo M. Libby**, PhD'90, of the Universidad of Costa Rica, on "Spin Equilibria of Iron Nitrosyl Complexes." The symposium concluded with the customary dinner at Le Petit Café on Friday night and a well-attended picnic on Saturday at Brown County State Park for the entire inorganic division.

F.G. Keyes Professor of Chemistry **Richard Royce Schrock** of MIT (Cambridge, Mass.) delivered the Raymond Siedle Lecture to a full house on Oct. 8, 2008. Schrock presented on, "The Olefin Metathesis Reaction: A Nobel Prize, What We Know, and What's New." Professor Schrock is perhaps best known as the discoverer of hydrogen abstraction reactions in high oxidation state metal alkyl complexes that yield high oxidation state "carbene" (alkylidene) and "carbyne" (alkylidyne) complexes. High oxidation state alkylidene complexes ("Schrock carbenes") are the active catalysts for olefin metathesis reactions, and much effort has been expended in learning how to design, synthesize, and control the activity of olefin metathesis catalysts. His seminar highlighted these reactions and new directions his lab was taking.



Charlie Parmenter

Jeffrey Zaleski and Ethan Zaleski pose with Raymond Siedle Lecturer Richard Royce Schrock, who spoke Oct. 8, 2008.

On Nov. 13, 2008, 65 analytical chemists from Midwest colleges, universities, and companies descended upon the Indiana Memorial Union for the 52nd annual Midwest Universities Analytical Chemistry Conference (MUACC). MUACC is unique. Big picture ideas and problems are presented with the hope of soliciting collegial suggestions and approaches to solving these problems.

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FACULTY NEWS

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biologically active natural products to the synthesis of fuel-cell polymers. Current synthetic targets being pursued by the group include anti-cervical cancer, anti-renal cancer, and anti-malarial natural products.

The department recently appointed Professor **Christie G. Enke** as an adjunct professor. Enke, who is professor emeritus at both Michigan State University and the University of New Mexico, is a distinguished researcher who has been active in electrochemistry, scientific instrumentation, and mass spectrometry. He is particularly well known as the inventor of the triple-quadrupole mass spectrometer, which is still the most commonly used form of tandem mass spectrometry. Enke is working with the Hieftje group at IU to develop a new concept in mass analysis, termed distance-of-flight mass spectrometry.

In 2009, **Amar Flood** was the recipient of an National Science Foundation Early Career Award in Chemistry and his group secured funding from the Department of Energy. Both awards will help extend discoveries made over the year on how C–H groups can engage in stronger then expected hydrogen bonds to anions within macrocyclic receptors. The NSF studies will focus on understanding the fundamental factors that control anion binding in such receptors as well as extending the synthetic procedure towards a one-pot preparation. The DOE proposal supports basic research to understand how to use light-driven conformational switches in the form of azobenzene to release oxyanions after they have been bound and transported to another physical location. Progress is being made to both of these goals with talented graduate and undergraduate students involved in research over the past year. We are also looking forward to publishing a proof-of-principle application of the triazolophane receptors in ion-selective electrodes with collaborator Leonidas Bachas, of the University of Kentucky. In other works, the mechanistic studies of how molecular switches move molecular subunits around after being triggered, using electrochemical stimulation has been published and is seeding new creative investigations. Lastly, our research on coupling analyte-receptor binding with the ultra sensitive technique of surface-enhanced Raman scattering was well received at the fall ACS Meeting, and we look forward to more discoveries in this area.

Professor **Gary Hieftje**'s group has become active in the new field of ambient ionization mass spectrometry with the introduction of a new ion source, termed the "Flowing Atmospheric-Pressure Afterglow" (FAPA). The FAPA source can desorb and ionize molecules directly from solid, liquid, or gaseous samples, and produces remarkably simple mass spectra. The source has been patented and licensed to two firms, Prosolia in Indianapolis, which has ties to Purdue University, and to Leco Corp. of St. Joseph, Mich. Prosolia intends to market the source for application to solid samples while Leco is interested in vapor-phase applications. Hieftje received the Maurice F. Hasler Award at the 2009 meeting of the Pittsburgh Conference and Exposition, the largest gathering of chemists in the United States. He is only the third person ever to have won all three of the major awards presented at that conference. At the annual meeting of the Federation of Analytical Chemistry and Spectroscopy Societies (FACSS), held in October 2008 in Reno, Nev., Hieftje was recognized as a "FACSS Distinguished Lecturer" to honor his 40 years of contributions to atomic spectroscopy and analytical chemistry. A special symposium was organized to celebrate his work.

Jacob T. Shelley, a graduate student in the laboratory of Gary Hieftje, has received a fellowship from the Center for Analytical Instrument Development at Purdue University. The fellowship will enable Shelley to perform collaborative studies with the research group of Professor R. Graham Cooks at Purdue University in the area of ambient ionization mass spectrometry. As part of the fellowship, Shelley spent approximately half of fall 2009 semester at Purdue.

Professors Gary Hieftje and **Jeffrey Zaleski** have accepted invitations to join the advisory and editorial boards, respectively, of the new journal *Metallomics*, introduced this year by the Royal Society of Chemistry. The new journal is oriented toward the new science of the same name, involving the role and function of metals and metalloids in biological systems. Zaleski and Hieftje also participated in the Second International Symposium on Metallomics, held in June 2009 in Cincinnati. Hieftje served as program chair for that meeting and Zaleski presented an invited lecture.

Professor **Ronald Hites** was elected to be a fellow of the ACS in the inaugural class of these fellows. The ACS board of directors created the ACS Fellows Program in December 2008, "to recognize members of the American Chemical Society for outstanding achievements in and contributions to science, the profession, and the Society." Unlike ACS national awards, the distinguished honor of a fellows designation will go to those who have distinguished themselves in multiple areas, including promoting the science, the profession, and service to the American Chemical Society. Ultimately, the body of fellows is intended to reach up to 2 percent of ACS membership.

Professor **Milos Novotny** has lectured extensively during the last year, presenting 24 lectures, which included presentations at conferences in Washington, D.C., Philadelphia, San Diego, Brazil, Japan, Mexico, and Sweden. In March 2009, he was chosen to give the annual public address to the Czech Academy of Sciences, which attracted considerable interest of the news media. Novotny presented a series of lectures on

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Faculty news

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the recent advances in bioanalytical chemistry at the Charles University (Prague). He was also a Robert A. Welch Distinguished Lecturer, giving presentations at three universities in Texas. At IU, he continues to lead the Institute for Pheromone Research (featured in this issue) and the NIH-supported National Center for Glycomics and Glycoproteomics. He also interacts extensively with the international organizations in the fields of glycobiology and cancer biomarker research.

Research in the group of Distinguished Professor **Peter J. Ortoleva** has focused on modeling nanosystems and the computer-aided design of vaccines and therapeutic intervention strategies. The laws of chemical physics are being used to develop strategies for addressing challenges in the pure and applied life sciences. Antiviral vaccines are being designed based on statistical mechanical techniques resulting in a computer-aided workflow. Our approach has wide applicability to addressing pandemic viruses and viruses that induce cancers. In the latter regard, we are developing a cervical cancer vaccine with more broad-spectrum and thermal stability characteristics as part of our initiative to address challenges in world health. A methodology based on chemical kinetics and information theory is being developed for the reconstruction of the network of processes regulating the genome and proteome of a human cell. This methodology is being used to identify abnormalities associated with the onset and progression of cancer. Novel methods in theoretical nanoscience are being developed and applied to the design of nanocapsules for the targeted delivery of therapeutic agents to diseased cells. These projects are being carried out in collaboration with research teams from IUB, the IU School of Medicine, other universities, and industry under funding from the NSF, DOE and NIH. In the past 12 months, students graduating from the Ortoleva group have taken teaching and research positions at Oakridge National Labs, City of Hope Research Hospital, Harvard School of Medicine and Lawrence Livermore National Laboratory, University of Texas at Arlington, as well as a high administrative position at the NSF.

Dennis Peters and some of his students are continuing their research dealing with the electrochemical reduction of halogenated environmental pollutants. **Sonja Skljarevski**, a junior undergraduate, is investigating the catalytic dechlorination of a freon (1,1,2-trichloro-1,2,2-trifluoroethane) with electrogenerated cobalt(I) salen in the presence of carbon dioxide; the latter species enters the coordination sphere of the cobalt(I) complex, making it a highly effective catalyst. **Jordan Merz**, a junior undergraduate, has found that nearly total dechlorination of lindane (1, 2, 3, 4, 5, 6-hexachlorocyclohexane), used to treat head lice and scabies, can be accomplished by direct electroreduction. **Angela Peverly**, a second-year graduate student, is working on the electrochemical determination of trihalomethanes at the nanomolar level in drinking water.

Kate Reck continues to teach, serve as the director of undergraduate studies, and provide guidance as the faculty advisor for several students groups on campus: the Timmy Foundation, IU Women's Soccer Club, and a new student group on campus, the Minority Association for Premedical Students (MAPS). MAPS worked with the local NOBCChE chapter to host a Research

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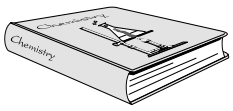
LIBRARY  NEWS

Chemistry Library reorganizes, reacts to economy

Tiea Julian continues as branch coordinator while Assistant Librarian **Brian Winterman**, and I continue to split our time between the Chemistry Library and the Life Sciences Library. The Indiana University Bloomington libraries reorganized recently, and Winterman will spend more of his time in the coming year on training our users.

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 graduate assistant is Lisa Shelling. Starting in September 2009, we will also welcome **Yuening Zhang** for the 2009–2010 school year. Zhang has had extensive course work in chemistry at Michigan State and IU. **Jacquelyn 'Jakki' Petzold** was our SLIS GA for 2007–2008. She took a position as chemistry and biology librarian at the University of Nebraska. **Quia Hu**, who served us for the fall 2008 semester took a position as the chemistry and physical sciences librarian at Rutgers.

The economic downturn has affected the libraries, too. We expect the materials budget that funds our journals, books, and databases to be flat in the 2010 fiscal year. In order to balance our budget, I trimmed approximately five percent of our subscription costs, under the advice of the Chemistry Library Committee. One major perturbation to our budget juggling includes a $10,000 increase in the cost of the ACS journal package and a Web replacement of the *CrossFire* (*Beilstein* and *Gmelin*) database.

CrossFire is owned by Elsevier and is being repackaged into a web-based product, *Reaxys*, that adds a patent component but with a significant price increase. *CrossFire* only runs on PCs so a web-based interface will make the database more accessible to Mac users.

The trend to move away from retrieval software that is loaded on a user's PC to Web-based systems slowly continues. The Cambridge Structural Database and the Inorganic Crystal Structure Database are offering Web-based versions this year. These Web interfaces should allow easier incorporation of these important databases into the undergraduate curriculum.
— *Roger Beckman*

Report on the American Peptide Society Conference

All enjoyed 'Breaking Away' in Bloomington during the 21st Annual APS meeting

The 21st Symposium of the American Peptide Society was held on the Indiana University Bloomington campus June 7-12, 2009. This meeting occurs every two years and typically is hosted in a prominent North American city, the last three meetings were in Montreal (2007), San Diego (2005) and Boston (2003). The IU-based meeting theme was "Breaking Away," embracing the spirit of the scientific and social program. The university setting was reminiscent of symposia from earlier years in the formative period of the Peptide Society.

Charlie Parmenter

Richard Di Marchi

What was unique about this 2009 meeting was the level of commercial participation from pharmaceutical and biotechnology companies that complemented the traditional academic excellence. The unprecedented interest in the use of peptides as drugs separates this period from any other in the history of the APS, and it is a direct result of the advances in core peptide chemistry and biology that have been achieved in recent years.

The meeting opened with a Sunday social gathering at the center of the IU campus. Monday consisted of a full day focused on advances in chemical biology and receptor signaling. The day concluded with the Merrifield lecture given by Professor Stephen Kent (University of Chicago) and two associated lectures that extended the scope of advances in chemical synthesis. Tuesday lectures focused predominately on advances in rational design, analysis and material aspects of peptide chemistry. It concluded with a first ever session co-sponsored by the American Association of Pharmaceutical Sciences pertaining to technology directed at accelerating the transition of peptides from the lab to the clinic. Wednesday was highlighted by the presentation of the Makineni Lecture by Professor William DeGrado (University of Pennsylvania), the first Goodman award lecture by Professor Charles Deber (University of Toronto), and a set of lectures pertaining to advances in biosynthesis with non-native amino acids.

Courtesy photo

Henry Mosberg

The Symposium program moved to peptide biology and pharmacology in the last two days of the meeting. A particular emphasis was placed on capturing the unprecedented success currently being experienced in peptide-based therapeutics. Thursday represented an array of several therapeutic areas, most notably neuroscience, infectious diseases and cancer. Metabolic diseases with a particular emphasis on obesity and the related disorders in glucose and lipids were the focus of the last day. At the end of each of the first four days were poster sessions that stimulated communication among all participants and highlighted the importance of young investigator participation.

The social program was abundant and diverse. Whether the primary interest was the arts, athletics, or outdoor activities, there was something to meet all needs. The campus and the Bloomington community with its easily accessible open spaces and attractive architecture provided a stimulating social environment for multiple activities. An item of particular note was the Wednesday night social event at the Musical Arts Center, where the renowned Jacobs School of Music staged a performance exclusively for symposium guests. Additionally, the Thursday night social banquet themed, *Mix, Mingle, & Move, an evening of Martinis, Moonshine, and Music*, is destined to be one to that will be remembered as unlike anything previously experienced at an APS meeting

It was a pleasure to co-host with Professor Henry Mosberg (University of Michigan) this late spring week of science and entertainment. The total attendance was in excess of 800 participants with representatives from more than three dozen countries. We are deeply grateful to all of the individuals who helped in the assembly, funding and operations associated with this event. The dedicated university-based conference staff, numerous volunteers, and especially conference director Mary Morgan made seminal contributions to the success of this meeting.

Richard DiMarchi, Indiana University, APS co-host

Henry Mosberg, University of Michigan, APS co-host

CONFERENCES, SPECIAL LECTURES, & SYMPOSIA

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To facilitate interactions, traditional "chalk talks" are given, which encourage presenters to describe ideas clearly and succinctly without the distraction of details. Significance of ideas can be clearly articulated along with associated hurdles so the audience can publicly or privately offer encouragement and advice. This leads to spirited and engaging discussions, and the 2008 meeting at IU was no exception. Presentations ranged from conceptual ideas to more developed research programs to educational activities related to analytical chemistry. A banquet was held in the Tudor Room of the IMU; it was followed by a poster session presented by IU students. The 2008 conference was generously supported by funds from GFS Chemicals, Agilent, Lilly, Varian, and the Department of Chemistry. Michigan State hosts the 2009 meeting.

The *PINDU* (Purdue-Indiana-Notre Dame Universities) *Inorganic Chemistry Conference* was hosted at Indiana University on Nov. 15, 2008. This one-day conference rotates between all three universities every three years and provides graduate students the opportunity to present a poster or oral presentation in a more informal setting, while developing collegial relationships among their colleagues within Indiana. Our inorganic students presented three oral presentations and 21 posters. IU won awards overall for participation and oral presentation.

The *Frank C. Mathers Lectures Symposium* occurred on April 24, 2009. The invited speakers included: **James W. Jorgensen**, W. R. Kenan Jr. Professor of Chemistry, on "Exploring the Limits of Resolution in Liquid Chromatography and Capillary Electrophoresis;" **J. Michael Ramsey**, Minnie N. Goldby Distinguished Professor of Chemistry, on "Micro- and Nano-fluidic Devices for Acquiring Biochemical Information;" and **R. Mark Wightman**, W.R. Kenan Jr. Professor of Chemistry, on "Monitoring Dopamine in the Brain during Behavior." All speakers came from the University of North Carolina at Chapel Hill Department of Chemistry.

The 2009 *Frank T. Gucker Lecture* was presented on Sept. 16, by Professor **Geraldine Richmond**, the Richard M. & Patricia H. Noyes Professor of Chemistry at the University of Oregon. Richmond's seminar was titled,"At the Water's Edge: Understanding Environmentally Important Processes at Liquid Surfaces." Her research using laser spectroscopy and computational methods focuses on understanding the chemistry and physics that occurs at complex surfaces and interfaces between water and organic phases in addition to small molecules involved in atmospheric chemistry.

John Huffman

John Huffman

At top: Friends and colleagues or all ages enjoy a picnic during the 18th Annual Inorganic Chemistry Alumni Symposium. Below: Inorganic Alumni Symposium speakers Eyal H. Barash, Lori Watson, Eduardo M. Libby, and Scott Haubrich.

Charlie Parmenter

Krishnan Raghavachari and Frank T. Gucker Lecturer Geraldine Richmond

Faculty news

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Symposium on campus in April 2009 where 27 students (both undergraduates and graduates) exhibited research posters. Over spring break, she chaperoned 22 students on a medical brigade to administer health care to over 1,100 patients in Ecuador. During summer, Professor of Biology **Thomas Donahue,** Professor of Psychology **Dale Sengelaub,** and Reck ran a very successful *Initiative for Maximizing Student Diversity Summer Scholars Program* for several new and returning students who pursued undergraduate research. She is developing two new classes for liberal arts majors: Global Sustainability and War and Peace, both classes that hope to entice more non-majors to be attracted to chemistry in a new way. She has also been asked to teach a LAMP class on science policy in spring 2011. She has been shooting and posting videos to demonstrate the lab techniques to help students be more prepared before coming to organic chemistry laboratory (now if she can only get students to watch them before they come to lab!). Happily, she saw four MAT students graduate in May 2009, **Michelle Borden-Page**, **David Burgan**, **Anna Kinsella**, and **Andrew Turner**.

Jill Robinson serves as outreach coordinator for the Nanoscience Center and has organized several projects aimed at bringing an understanding of this emerging field and cutting-edge research at IU to the general public. One notable event was the Nanodays Celebration at the Louisville Science Center on April 4. IU faculty and students held programs in which visitors were able to make stained glass art with gold and silver nanoparticles and perform lithography using the process of micro-contact printing. Exhibits showing uses of nanotechnology in consumer products and medicine were also presented. In the upcoming year, she will be working with New Technology High Schools in Bloomington and Columbus, Ind., to develop nanoscience problem-based learning projects. These projects are funded by the ISTEME initiative, which seeks to increase IU's involvement in the education of Indiana's students in STEM related areas. On campus, a grant obtained through the IU Writing Center enabled her to implement a series of new assignments designed to help students improve their scientific writing skills in analytical chemistry laboratory.

Horizons in Chemistry Seminar Series

The Horizons in Chemistry seminars provide a great opportunity for alumni to share research and career experience with students and faculty. The series also provides an opportunity to appreciate the tremendous investments that have been made in the Chemistry Department in recent years or to spot talented research candidates for roles in your organization. Dr. **Ken Miller**, PhD'78, (now of SABIC Innovative Plastics) created the Horizons in Chemistry concept in corroboration with Professor **Kenneth Caulton**. A long career in chemistry is not required to be a valuable contributor to this program. To get involved, please communicate your interest to Ken Miller at ken1.miller@sabic-ip.com or to **Bill Carroll** at william_f_ carroll@oxy.com.

The Horizons in Chemistry Seminar Series would like to extend a special thanks to Dr. Miller for his continued sponsorship of the IU Chemistry Department and to Professor Caulton for his support within the department, and not least of all to Jeannette Silvers for her seamless and gracious administration of seminar schedules.

2008–2009 Horizons speakers

Speakers hosted roundtable discussions for graduate students following the presentation.

• Oct. 21, 2008: **Joel I. Shulman**, adjunct professor of chemistry at the University of Cincinnati and retired manager of doctoral recruiting and university relations with Proctor & Gamble, presented on "Life After Graduate School: Some Tips on Obtaining the Job You Want."

• Nov. 18, 2008: **Robert B. Wilson Jr.**, who is director of chemical science and technology with SRI International Physical Sciences Division, traveled from Menlo Park, Calif., to present on "Two topics in Polyolefins and an Introduction to SRI International."

• Dec. 4, 2008: **Thomas J. Wenzel**, Charles A. Dana Professor of Chemistry at Bates College in Lewiston, Maine, presented on "Succeeding as a Faculty Member at a Primarily Undergraduate Institution."

Southern Indiana Section of the American Chemical Society Summary

The local ACS section remains an outlet for collegial gatherings and education for both our undergraduates and the community. The group has sustained the activities that continue to work and stimulated some new ideas this year. We host the departmental ice cream socials at the beginning of every fall semester and the culmination of every spring semester. After several blustery years, this September's event was finally greeted with partly cloudy, slightly breezy weather, complete with sunshine.

Local ACS members continue to volunteer with the local Science Olympiad, science nights at the local elementary and high schools, and Big Brothers/ Big Sisters. Our section helps IU undergraduates by supporting one free tutor, one night a week, for three hours, in the Chemistry Resource Center. We interacted further with the community by doing more demonstrations for high school groups and for the public in People's Park (which is located downtown at the corner of Kirkwood and Indiana Ave.).

We provided six travel grants for students (three graduate and three undergraduates) to travel to the national ACS meetings in both spring and fall. And the group initiated a new seminar series, called the Student Seminar Series, where the speaker is chosen solely by graduate student vote. The inaugural speaker for this series will be Professor Philip S. Baran from The Scripps Research Institute and he will speak on campus in spring 2010.

Every year, the department celebrates a National Chemistry Week. This year's NCW program, celebrated Oct. 18 to 24, was organized and by Coordinator of Labs and Outreach Coordinator **James Clark**. Daily events included: donuts and cider, a Movie Night, a games competition in front of the chemistry building including a pie throwing competition, and a community demonstration, culminating in a well-attended, four-hour open house on Oct. 24. The open house sought to enhance the public's awareness of the wonderful contributions of chemistry. This year's theme was the "It's Elemental", highlighting the periodic table and how the different elements impact our lives. Due to the event's proximity to Halloween, students hosted a very successful Haunted Laboratory, as well as several hands-on activities. In addition to the usual series of activities, the day concluded with the customary "Demonstration Extravaganza," presented by **James Clark**, **Erick Pasciak**, and several students from the local Alpha Chi Sigma chapter.

For the calendar year 2009, **Zach Aron** was the chairman, **Erin Carlson** served as chair-elect, **Kate Reck** remained as secretary, and **Andrea Pellerito** continued to serve as treasurer. **Kenneth Caulton** loyally serves as our local section councilor, with **Daniel Mindiola** as alternate councilor. — *Kate Reck*

STAFF NEWS

Tricia Miles was hired as an administrative secretary for professors De Souza, Dragnea, Novotny, and Reilly (replacing **Diana McGovern** and **Jessica Homan**). Miles is originally from Monroe, Mich. She came to Bloomington in 1991 to attend Indiana University and now lives in Bloomington with her husband and three children. For the past 10 years, she has worked at the Department of Geological Sciences as a department secretary and a grant monitoring specialist. Prior to that position, she worked at the Jacobs School of Music as the interim director of marketing and publicity and as senior publicity assistant.

Amanda Posto joined Dr. Milos Novotny's laboratory as a lab technician, replacing Craig Hollars. Posto resides in Stinesville, Ind., and earned her MA in evolution, ecology and behavior from Indiana University in 2009. Posto has 10 years laboratory experience, most recently in biology with Dr. Leonie Moyle.

Jacqueline Vasseur transferred to Milos Novotny's laboratory to work as a lab technician. For the past year Jackie worked as a Laboratory Demonstration Technician in the undergraduate laboratories. Vasseur is from Minneapolis, and earned a BS in genetics, cell biology, and development from the University of Minnesota in 2006. She has three years laboratory experience as a QA laboratory assistant at Fraser in Blaine, Minn., and two years experience as a clinical laboratory technician at Medtox Laboratories in Burnsville, Minn. — *Cheryl Johnson*

Staff awards and honors

Our staff banquet was hosted at the Indiana Memorial Union Tudor Room on April 30, 2008, at which time the staff awards and service recognitions announcements are announced.

Service Recognition

10 years – **Tricia Miles**

15 years – **Paul Ludlow**

25 years – **Doug Garvin**

Staff Award Recipients

Bruce Frye, Mechanical Instrument Service

Scott Harrington, Information Technology Group

Erin McLaughlin, Administrative Secretary

Angie Monts, Administrative Secretary

Robin Nordstrom, Duplicating

STAFF PROFILE:

Mass Spectrometry Facility

Instrumental work

by Kate Reck

The mass spectrometry facility is a pivotal part of how the department executes its research for the last several decades. However, the mass spectrometry lab received a facelift in 2004 in many ways: new personnel, a new philosophy, and new equipment have made it a hopping destination.

Charlie Parmenter

Jonathon Karty, Mass Spectrometry Facility director

The Department of Chemistry hired one of its own graduates, **Jon Karty**, PhD'04, to run the facility in 2004. Since then much has changed. Our mass spectrometry facility is now run by Karty and **Angela Hansen**, BS'91, and it's a full-time job keeping up with maintaining the instrumentation and new directions in research projects.

Karty earned a BS in chemistry from Purdue University, where he originally intended to pursue chemical engineering until he hit calculus. Analytical chemistry was the closest field to engineering that still allowed him to do some chemistry, not merely scale up peoples' research. He did undergraduate research in NMR with M. Dan Raftery, but it was the mass spectrometry section of R. Graham Cooks' class that really turned him on to the field of analytical chemistry. Hence, Karty decided to pursue a PhD at Indiana University in analytical chemistry, joining the group of Professor **James Reilly** where he found a good fit in the lab. Karty valued the one-on-one time with Professor Reilly, where he was taught to develop his scientific caution, and tone down a natural enthusiasm to rush ahead.

During his PhD work, Karty appreciated the experiences he gained learning about instrumentation, taking apart instruments and putting them back together again. He became the maintenance guy in the lab and this experience has paid off well in his new position.

One of the best parts of graduate school was that Karty met his future wife, Jackie Vorhauer, a fellow graduate student who worked in the lab of Professor **Ronald Hites**. He and Jackie met in 1996 and were married in 1999. Jackie earned her MS and took her first position at Naval Surface Warfare Center Crane Division, and later she moved to Baxter BioPharma Solutions. She liked her position in Bloomington, so the desire to stay in the area was strong. Karty was hired in the mass spec lab in 2004 while he was still writing his thesis and he defended within two months.

Hansen grew up in Tipton, Ind., where her high school chemistry teacher instilled in her a strong interest in chemistry. She came to IU with her mind set on studying chemistry, and she graduated from IU with a BS in Biochemistry in 1991. After graduation, she took a position as a technician at the University of Kentucky working second shift, looking at therapeutic drug screenings where she honed her skills at HPLC and GC-MS. She left this job she loved for all the wrong reasons, to follow a boyfriend, to take a position in Richmond, Va., at Wella Manufacturing, where she worked as a quality control technician. Nine months were as many as she could take before returning to Indiana to work at Seradyn Inc., conducting monospot tests, which are used to diagnose infectious mononucleosis.

Finally, when a position opened up at IU in the mass spec lab she was happy to apply; Hansen was hired in March 1997. When she started, the lab was equipped with only one high resolution instrument and a GC-MS. A MALDI-TOF and new magnetic sector were added in 2000 and 2003, respectively.

Since 2004 and Karty's hiring, the lab has seen almost an explosion in technology: a new GC-MS, new MALDI-TOF, two high resolution ESI-TOF's (electrospray ionization; one for peptides and one for organics), and a walk-up HPLC-MS. The space has expanded down the hall to accommodate the new equipment, and Hansen was finally given an office on her birthday in July 2009 (Karty waited purposefully to tell her about her new office digs so that it came as a birthday present).

Since the implementation of new instrumentation and Karty's overseeing the lab, the philosophy of the facility has also changed. Long gone is the idea of Hansen serving solely a technician where people drop off samples and wait for the spectra to arrive in their mailboxes. Both see their jobs as helping educate graduate students in how to run

(*continued on page 20*)

GRADUATE NOTES

During the 2008-2009 school year, Professor **Charles Parmenter**, was the director of graduate studies. Serving with him on the Standards Committee were professors **Richard DiMarchi**, **Caroline Jarrold**, **Dennis Peters**, **Michael VanNieuwenhze**, and **Dongwhan Lee**.

Stephen Jacobson chaired the Graduate Admissions Committee. Evaluating the hundreds of dossiers submitted to the department were professors **Mu-Hyun Baik**, **Dongwhan Lee**, **Lane Baker, Erin Carlson, Charles Dann III**, **Sarah Skrabalak**, **Steven Tait**, **Srinivasan Iyengar**, **Silas Cook,** and **Michael Van Nieuwenhze**.

Fellowship Award Winners

Byung Gyu Park was awarded the Chester Davis Inorganic Fellowship. Park joined the lab of Dongwhan Lee in fall 2006.

Mario Vieweger was awarded the Richard Slagle Fellowship. Vieweger joined the lab of Bogdan Dragnea in fall 2006.

Pucheng Ke was awarded the Chester Davis Organic Fellowship. Ke joined the lab of David Williams in the fall 2006.

Nicholas Mayhall was awarded the Kratz Fellowship. Mayhall joined the lab of Krishnan Raghavachari in fall 2006.

Pablo Garcia-Reynaga was awarded the Lilly Organic Fellowship. Garcia-Reynaga joined the lab of Michael Van Nieuwenhze in the fall 2006.

Richard Lord was awarded the Siedle Fellowship. Lord joined the lab of Mu-Hyun Baik in the fall 2005.

Women in Science Fellowship recipients were **Margaret Donoghue**, **Michelle Kovarik**, **Meghan Mulcrone, Anne Starace**, and **Joan Walker.**

Other fellowship recipients were **Brian Finan,** Linda & Jack Gill Fellowship; **Kasha Casey**, Mays Fellowship; **Vincent Cavaliere**, Rupert Wentworth Fellowship; **Alison Fout**, Arts & Sciences Dissertation Fellowship; **Jeremy Felton**, **Paul Gladen**, **Akshay Shah**, and **Fese Mokube**, Deans Allocation Fellowship; **James Klein**, Lilly Organic Fellowship.

Research and University Graduate School Fellowships were awarded to: **Sam Barnes**, **David Burgan**, **Jonathan Butensky-Bartlett**, **Nathan Contino**, **Scott Dietrick, Zachary Gosser**, **Alexander Graham**, **Robert Hansen**, **Jennifer Hass**, **Tao He**, **Brett Hildenbrand**, **Michelle Hoffman**, **Johnathan Hutt**, **Gopala Jarugumilli**, **Oscar Judd**, **Anna Kinsella**, **Matthew Lauber**, **Sunyoung Lee**, **Seth Madren**, **Benjamin Mann**, **Nicholas Mayhall**, **Megan McCormick**, **Kevin McDonald**, **Daniel Meyers**, **Celeste Morris**, **Meghan Mulcrone**, **Nancy Ortiz**, **Raghunath Ramabhadran**, **Kevin Pfeuffer**, **Angela Peverly**, **Nicholas Pierson, Michael Rudolph**, **Johnathan Smith**, **John Tipping**, **Darci Trader**, **Haitao Tu**, **Andrew Turner**, **Joan Walker**, and **Benjamin Wicker**.

— Toni Lady

Annual department award winners

At the Chemistry Honors Banquet in April 2009, the following students were honored:

E. Campaigne C500 Award: **Ba Tran**

Eli Lilly Analytical Award: **Benjamin Mann**

Wendell P. Metzner Memorial Award: **Pucheng Ke**

William H. Nebergall Memorial Award: **Debashis Adhikari****

Felix Haurowitz Award: **Mario Vieweger**, **Nicholas Mayhall**

Jack Crandall Award: **Pablo Garcia-Reynaga**

Henry R. Mahler Award: **Nancy Goichochea**

David A Rothrock Award: **Christopher DuFort****

John H. & Dorothy McKenzie Award: **Isaiah Sumner**

Instructor Awards: **Alex Graham**, **Brian Finan**, **Justin Orlando**, **Lynette Prophyl**,****** and **Jacob Shelley**

******No picture available

Benjamin Mann

Nicholas Mayhall

Mario Vieweger

Ba Tran

Nancy Goichochea

Isaiah Summer

Pucheng Ke

Alex Graham

Brian Finan

Pablo Garcia-Reynaga

Justin Orlando

Jacob Shelley

Congratulations recent graduates!

PhD

Emily Barter (Biological, Stone, May 2009) Curriculum Writer/Science Adventures Knowledge Learning Corp.

Chao Chen (Physical, Dragnea, August 2008) Postdoc, IU Biology Department

Ujjal Das (Physical, Raghavachari, December 2008) Postdoc, MIT, Boston

Alison Fout (Inorganic, Mindiola, February 2009) Postdoc, MIT, Boston

Xuan Jiang (Inorganic, Lee, December 2008) Postdoc, University of Pennsylvania

Pilsoo Kang (Analytical, Novotny, February 2009) Postdoc, MIT, Boston

Uriah Kilgore (Inorganic, Mindiola, April 2009) Postdoc, Pacific Northwest National Lab, Richland, Wash.

James Cullen Klein (Organic, Williams, May 2009)

Ruwan Kurulugama (Analytical, Clemmer, February 2009)

Michael Lawler (Organic, Evans, August 2008) Postdoc, Wyeth Pharmaceuticals, Pearl River, N.Y.

Taewoo Lee (Biological, Feig, September 2008)

Yinyin Li (Biological, Oakley, December 2008)

Xiaoyun Liu (Analytical, Clemmer, January 2009) Postdoc, Yale University School of Medicine, New Haven, Conn.

Jayasree Srinivasan (Organic, Johnston, December 2008)

Wei Wang (Organic, Montgomery, August 2008) Postdoc, Albert Einstein College of Medicine, Bronx, N.Y.

Christopher Weitzel (Biological, Oakley, May 2009) Postdoc, Bandeis University, Waltham, Mass.

Zhiyin Xun (Analytical, Clemmer, December 2008) Postdoc, University of California, Davis, Calif.

Xiaofan Yang (Inorganic, Baik/Caulton, December 2008)

Lloyd Zilch (Analytical, M Jarrold, December 2008)

MS

Drew Buschhorn (Inorganic, Caulton, August 2008)

Benjamin Fullmer (Inorganic, Caulton, March 2009)

Ann Marie Staub-Carrick (Biological, Stone, May 2009) Academic Advisor, University of Alabama

Timothy Tatge (Biological, Zhang, December 2008) Research Position, 3M Corporation, St. Paul, Minn.

MAT

Michelle Borden-Page (licensure in chemistry and biology) Instructor, Kennesaw State University

David Burgan (licensure in chemistry and physics) Teacher, Elmhurst High School, Fort Wayne, Ind.

Anna Kinsella (licensure in chemistry) Teacher, Columbus Signature Academy, Columbus, Ind.

Andrew Turner (licensure in chemistry) Teacher, North Miami High School, Denver, Ind.

Staff profile

(*continued from page 18*)

the instruments and be self-sufficient in recording spectra. The focus is much more on education. The more instrumentation the students know how to run, the better prepared they'll be when applying to the workforce. After being checked out on the low resolution instruments, graduate students can run samples on their own 24/7, while high resolution samples are still run by Hansen or Karty.

Karty works closely with many of the undergraduate classes (A316/C315), making them more practical and applicable to real-life diagnostic techniques. He has written several laboratories for the analytical graduate course C613 Mass Spectrometry & Stable Isotopes. Karty's future plans include completing a laboratory-based mass spectrometry textbook. He is a strong proponent that all graduate classes need to have a laboratory component in order for students to understand and integrate their new knowledge.

Over the past few years, the mass spec lab has been a vehicle for undergraduates to work and learn as well. These student employees include:

William Barker III, BS'08, graduate school at University of Vermont; **Jenna Birne**, BS'07, MS in Health Administration from Michigan; **LaDasa Jones**, BS'09, industry, Indianapolis; **Jarred Lampert**, BA'08, Butler University Physician Assistant Program; **Jeffrey Mayfield**, BS'07, graduate school, University of Notre Dame; **Elizabeth Siegel**, class of 2010 biochemistry major, graduate school bound; **Claire Shewmaker**, BA'06, IU School of Dentistry; and **Derek Zipkin**, class of 2010 chemistry major, medical school bound.

Although the position started out rather lonely for Hansen, it has turned into a position where every day brings in new people and new challenges in elucidation. She enjoys working with the students and teaching them new information and working on interesting projects.

Both Karty and Hansen can equally comment that the job is never boring and there is always plenty to do. Every day brings something new and intriguing to solve. Most recently, the lab has been working most markedly with the DiMarchi, Flood, Li, and VanNieuwenhze groups, in addition to the routine organic confirmations for the Williams' group.

Outside of chemistry, our mass spec lab provides ongoing quality control of scintillation fluid for the Department of Physics on the NOvA Project (a $280 million project funded by DOE). This project is a national collaboration which entails Fermilab scientists generating and sending a beam of neutrinos under Wisconsin to big detectors 800 miles away in northern Minnesota. What they are after is how neutrinos either change into matter or antimatter and how this can lead to understanding how processes occurred when the universe formed. Larger, on-going projects like these are a testament to the skills that they lab provides to the greater community at IU.

When not at work, both Karty and Hansen enjoy a mutual love of huskies, and they each have two and three dogs, respectively. Karty is a member of Trinity Episcopal Church and a former member of the vestry. They both love to travel with their spouses and hope to continue to do more of it in the future. For more, check out: http://msf.chem.indiana.edu.

UNDERGRADUATE NOTES

It is usually during the troughs of the business cycle that essays are penned touting the benefits of a liberal arts and humanities education over mathematics and the sciences.

This summer was apparently no exception, as several such articles appeared in journals, newspapers, and blogs throughout the past several months. A June 15, 2009 op-ed essay in the *Bloomington Herald-Times*, for example, decried the fact that the United States has become a nation of "workers and producers rather than poets and philosophers" and argued that "calculus and chemistry" could not develop "the sort of creative independence and intellectual rigor in students that is imperative for statesmen, philosophers and other agents of political and social transformation."

We wholeheartedly disagree. Courses in the sciences and mathematics engage students at a very focused, analytical level and force them to understand and internalize abstract concepts. As such, the sciences are crucial to developing a thorough understanding of both the physical universe and humanity's place within it. Furthermore, editorials like this propagate the false idea, unfortunately all too prevalent in American culture, that there is a sharp either/or division between "poets and philosophers" and scientists. This simply is not the case.

The belief that the artistic and scientific components of the human intellect were mutually exclusive is a very recent phenomenon. Ancient Greek philosophers, medieval scholastics, Renaissance scholars, and the intellectuals of the Enlightenment had no difficulty combining interests in the liberal arts and the sciences. Only in the Romantic era did a sharp distinction between "artist" and "scientist" develop. Throughout the 19th and 20th centuries, however, there have still been numerous examples of individuals who have comfortably bridged the supposed gap between the liberal arts and the sciences.

In addition to writing *Faust* and *The Sorrows of Young Werther*, the famous German poet Goethe made important contributions to botany and anatomy. *Lolita* author Vladimir Nabokov was a noted lepidopterist. Within the field of chemistry, the Russian composer Alexander Borodin, who in his spare time composed two symphonies, two string quartets, and the opera *Prince Igor*, was an accomplished researcher noted for his work on aldehydes. Clearly, the belief that a scholar must be either a poet-artist or a scientist is a false dichotomy.

As the undergraduate academic advisor for the Department of Chemistry, I meet with students every day who enjoy and excel in both the liberal arts and the sciences. We have numerous majors who are skilled musicians, as well as one young composer whose works have been performed in New York and Washington, D.C.

Charlie Parmenter

Graduation day, and everyone has gathered in Chemistry C122 for the ceremony.

Several others are brilliant actors, combining their majors in chemistry and biochemistry with second majors in theatre and drama. Still others are receiving second majors or minors in the fields of history, religious studies, philosophy, comparative literature, and foreign languages. Despite carrying heavy courseloads of math, physics, biology, and chemistry, our chemistry and biochemistry majors have no difficulties pursuing interests outside of the sciences. I would even be so bold as to claim that our majors are some of the most diverse and interesting young men and women at IU.

The truth is that our undergraduate program in the Department of Chemistry is not just turning out "workers and producers." Although we are developing the next generation of scientists and researchers, we are also cultivating our students' diverse interests in all fields of intellectual endeavor. Our students leave Indiana University as well-rounded, engaged citizens, as comfortable in the lab as in the most bohemian coffeehouse. Chemistry and biochemistry majors do not have to choose between being artists or scientists, poets or doctors, philosophers or researchers. We each contain multitudes, and our students will never need to decide between their interests in the liberal arts and their interests in the hard sciences. Artist or scientist? Be both.— *Shawn Adrian*

❖

Artist or scientist? Be both.

❖

Chemistry Honor Roll

The following students are chemistry and biochemistry majors who maintained both in-major and an overall cumulative GPA of 3.75 or higher:

Jessie Atkinson, **Cassandra Baker**, **Thomas Balestri**, **Bryant Barrett**, **Edwin Becher**, **Stefanie Beidelman**, **Emilia Blaser**, **Vincent Bottomley**, **Anthony Bowen**, **Kyle Brown**, **Samuel Corey**, **Larry Davis**, **Jenna Devare**, **Graham Erwin**, **Matthew Eskew**, **Lauren Evenson**, **Nathan Farlow**, **Megan Farrell**, **Stephen Fischer**, **Brian Fisher**, **Kathleen Gifford**, **Kate**

(*continued on page 22*)

Undergraduate notes

(*continued from page 21*)

Goeller, **Lindsey Grabek**, **Travis Graham**, **Zachary Hallberg**, **Leslie Harman**, **David Hocker**, **Daniel Hostrander**, **Eric Hutson**, **Asha Jamzadeh**, **Tyler Keena**, **Alexander Kukreja**, **Matthew Laird**, **Tony Ljuldjuraj**, **Jonathan Lynch**, **Joseph Meisel**, **Alexandra Mims**, **Nicholas Molby**, **Michael Mooney**, **Kevin Parikh**, **Christi Perkins**, **Brian Pike**, **Chris Rohe**, **Joseph Rumer**, **Lauren Santiesteban**, **Katherine Seat**, **Elizabeth Siegel**, **Madhavi Singhal**, **Sonja Skljarevski**, **Eric Skorupa**, **Ethan Sperry**, **Jacob Spitznagle**, **Isaiah Steffen**, **Charlene Steiner**, **Aaron Sue**, **Jill Threewits**, **Theodore Timothy**, **Esther Uduehi**, **Juan Velez-Valencia**, **Chad Ward**, **Megan Weisenberger**, **Laura Wetzel**, **Tommy Wilson**, **Livia Wilz**, **Jay Wolverton**, **Teela Wyman**, **Anastasia Yesnik**, **Yun William Yu**, **Ryan Zipper**, **Mary Zorn**

Chemistry Honors Program

The following BS majors in chemistry or biochemistry have maintained a minimum GPA of 3.3 and participate in undergraduate research.

Jessie Atkinson, **Jonathan Bell**, **Anthony Berger**, **Vincent Bottomley**, **Kyle Brown**, **Thomas Cervone**, **Jenna Devare**, **Amy Dreischerf**, **Jason Dyke**, **Graham Erwin**, **Kathryn Geiger**, **Randi George**, **Kathleen Gifford**, **Brandon Govindarajoo**, **Travis Graham**, **Sara Hall**, **Zachary Henson**, **David Hocker**, **Andrew Hollenbeck**, **Satbyul Kang**, **Eun Koh**, **Tony Ljuldjuraj**, **Pavan Maddamsetti**, **William McConnell**, **Joseph Meisel**, **Jordan Merz**, **Andrew Miller**, **Lauren Misch**, **Julie Neel**, **Elena-Silvia Patrulescu**, **Sonja Skljarevski**, **Brian Snow**, **Esther Uduehi**, **George Venious**, **Susan Wetzel**, **Livia Wilz**, **Derek Zipkin**

Departmental Awards

C117 Awards: **Kirk Cahill**, **Abigail Snyder**

S117 Awards: **Eric Anderson**, **Kevin Parikh**

C341 Award: **Garrett Blumberg**

John H. Billman Summer Research Scholarship: **Christopher Than**

Harry G. Day Summer Research Scholarships: **Jacob Hercamp**, **Jordan Merz**, **Christi Perkins**, **Kristen Reeder**, **Ethan Sperry**, **Laura Wetzel**

Hutton Honors College Research Grants: **Jessie Atkinson**, **Satbyul Kang**, **Stephen Mendenhall**, **Jordan Merz**, **Christi Perkins**, **Sonja Skljarevski**, **Anastasia Yesnik**, **Derek Zipkin**

Ira E. Lee Summer Research Scholarships: **Travis Graham**, **Amit Pithadia**

Frank Mathers Summer Research Scholarships: **Jonathan Bell**, **Satbyul Kang**, **Joseph Rheinhardt**, **Anastasia Yesnik**

Earl G. Sturdevant Summer Research Scholarship: **Kyuwon Kim**

Verling and Elizabeth Votaw Undergraduate Summer Research Scholarship: **Stephen Mendenhall**

Chadon Photographers

American Chemical Society Awards: **Zachary Henson**, **Elizabeth Siegel**, **Virginia Teige**, **Susan Wetzel**

Keith Ault Scholarship: **Jenna Devare**

William H. Bell Awards: **Kathleen Gifford**, **Asha Jamzadeh**, **Madhavi Singhal**

Harlan English Scholarship: **Susan Wetzel**

Courson Greeves Scholarship: **Brian Pike**

R.J. Grim Memorial Scholarships: **Graham Erwin**, **Kate Goeller**, **David Hocker**, **Joseph Meisel**, **Christi Perkins**, **Sonja Skljarevski**

Russel Leo and Trula Sidwell Hardy Scholarship: **Esther Uduehi**

Hypercube Scholar Award: **Virginia "Jill" Teige**

Andrew Loh Scholarship for Analytical Chemistry: **Joseph Rheinhardt**

Merck Index Awards: **Jason Dyke**, **Lauren Misch**

Dennis G. Peters Scholarships: **Tommy Wilson**, **Teela Wyman**

William G. Roessler Scholarship: **Anastasia Marie Yesnik**

Joseph B. Schwartzkopf Award: **Tony Ljuldjuraj**

Enola Rentschler Van Valer Trafford Scholarships: **Emilia Blaser**, **Mary Koors**

Viola Scholarship in Nuclear Chemistry: **Brice Floyd**

Francis and Mildred (Eckerty) Whitacre Scholarships: **Anthony Bowen**, **Andrew Miller**

James C. White Award: **Yun William Yu**

Mary Frechtling White Award: **Livia Wilz**

Malcolm A. Kochert Scholarships: **Amy Dreischerf**, **Graham Erwin**, **Lauren Reckley**, **Derek Zipkin**

Owens Memorial Scholarship: **Amy Dreischerf**

Marshall Scholarship: **Yun William Yu**

Phi Beta Kappa: **Rachael Burchfield**, **Maureen Crispin**, **Jenna Devare**, **Jason Dyke**, **Nathan Farlow**, **Lindsey Grabek**, **Asha Jamzadeh**, **Tyler Keena**, **Mary Koors**, **Alexander Kukreja**, **Matthew Laird**, **Jonathan Lynch**, **Joseph Meisel**, **Michael Mooney**, **Chris Rohe**, **Jill Threewits**, **Chad Ward**, **Susan Wetzel**, **Allison Wildin**, **Livia Wilz**, **Jay Wolverton**, **Teela Wyman**

New graduates

This year 76 students earned degrees in the four areas our department offers — 31 with a BA in chemistry, three with BA biochemistry, 10 with a BS in chemistry, and 32 with a BS in biochemistry. On May 9, 2009, 51 students and their families attended our internal graduation ceremony, which included a hot breakfast, a ceremony where each student was introduced individually with his or her degree(s) and accomplishments highlighted, concluding with a graduation photo shown on page 22.

Graduation 2009: *1) Professor Norman Dean, 2) Professor Andrea Pellerito, 3) Professor Todd Stone, 4) Professor Jill Robinson, 5) Professor Kate Reck, 6) Professor Michael Edwards, 7) Professor Dennis Peters, 8) Professor James Reilly, 9) Professor Steven Tait, 10) Professor Lyudmila Bronstein, 11) Professor Kenneth Caulton, 12) Brian Pike, 13)Amanda Hosier, 14) Andrew Miller, 15) Jenna Devare, 16) Livia Wilz, 17) Dannielle Reeley, 18) Elizabeth Hathaway, 19) Cristal Cabrera, 20) Ceazón Edwards, 21) Kajal Rajpura, 22) Youna Huh (a.k.a. Sarah Renner), 23) David Hocker, 24) Celestial Jones-Paris, 25) Lauren Misch, 26) Zachary Henson, 27) Kristina Mrozinski, 28) Susan Wetzel, 29) Yun William Yu, 30) Jonathan Lynch, 31) Sara Pappas, 32) Chad Ward, 33) Julie Panzica, 34) Jason Dyke, 35) Brandon Govindarajoo, 36) Ryan Memmer, 37) Harjot Singh, 38) Adam Alexander, 39) Rebecca Liu, 40) Sara Hall, 41) LaDasa Jones, 42) Delores James, 43) Andrew Hollenbeck, 44) Tony Ljuldjuraj, 45) Heather Muston, 46) Mary Koors, 47) JulieAnne Roper, 48) Megan Furbee, 49) Erin Jeffries, 50) Nathan Farlow, 51) Maureen Crispin, 52) Chris Rohe, 53) Jose Leyton, 54) Katie Morris, 55) Zachary Kleiman, 56) Virginia (Jill) Teige, 57) Joseph Meisel, 58) Tommy Cervone, 59) Jay Wolverton. Attended, but not pictured: Drew Frazier, William McConnell, and Kerry Weber.*

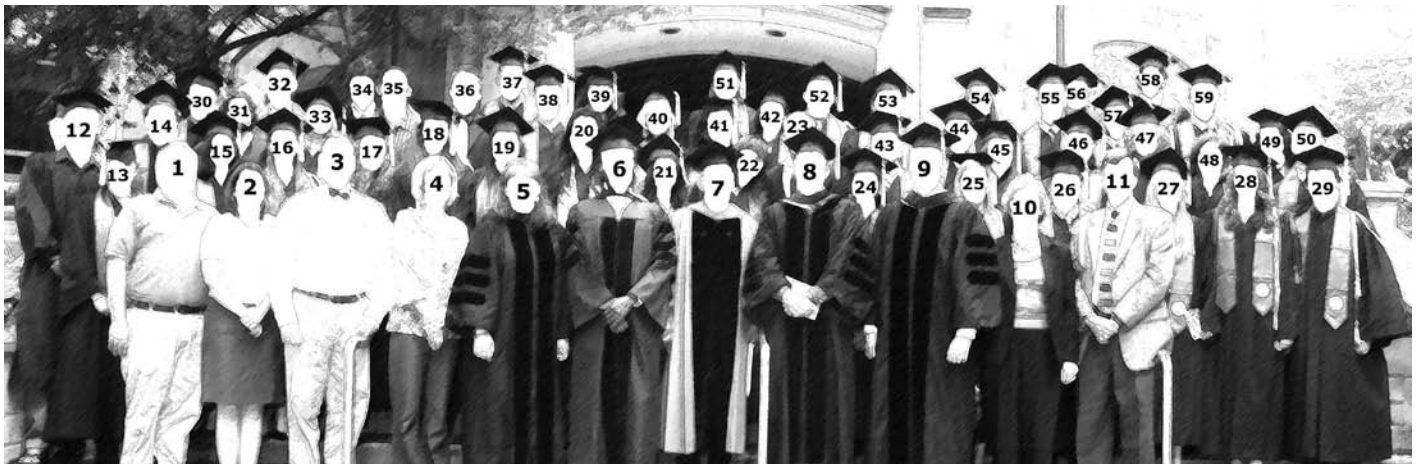

Illustration by William Unrue

In memoriam

Edward Bair

1922–2008

Indiana University Professor Emeritus of Chemistry Edward J. Bair passed away after a short illness on Nov. 10, 2008. Dorothy Bair, his wife and partner of more than 50 years, provided the following memoriam.

Charlie Parmenter

Ed Bair with a plane at Kisters Air Field (in Indiana) in 1967. He was a pilot, a hobby he shared with friends.

His was a life well lived. A third generation Coloradoan born June 30, 1922, Edward Bair never ceased to appreciate the beauty of the great outdoors. Summers spent with prospectors on his uncle's gold mining properties formed a basis for independent thinking.

A contract to cut timber at 10,500 feet for a water diversion project in a rain forest financed his first year of college. And his undergraduate studies at Colorado State University led to a variety of jobs that financed his continued education.

Upon graduation in 1943, Bair joined the Manhattan Project in Oak Ridge, Tenn., with a BS in chemistry in time to help set up facilities that purified ^{235}U for the first atomic bomb. After World War II, he earned a PhD in physical chemistry from Brown University followed by a post-doctoral appointment at the University of Washington in Seattle.

In 1954, his academic career moved him to Indiana University, where he taught until his retirement in 1989. During his tenure at IU Bloomington, he also made brief excursions as visiting research scientist to Cambridge University, the University of California, and The National Research Council in Ottawa, Ontario. As professor emeritus, he kept an office at IU and was a visiting lecturer as recently as Spring 2008.

More than 50 of his professional papers were selected for publication, and he served for 15 years as a member of the editorial board for the *Journal of Photochemistry*. His career was devoted to photochemistry of systems of atmospheric significance, and he built a laboratory to study fast processes and energy distributions in the photochemistry of molecules such as ozone. Upon retirement, Bair applied his insatiable curiosity to the investigation of the future of electric power, with a particular interest in space solar power, resulting in the publication of his book, *Connecting the Dots to Future Electric Power*.

Remembering a colleague & friend

by George Ewing, Gary Hieftje, and Charlie Parmenter

One of Ed's lasting impacts is the impressive capability of our machine shop, formally known as Mechanical Instrument Services. However, his impact on some of his faculty colleagues was great. Three colleagues offer personal remembrances.

Energy-rich molecules, a long green tube, & many fond memories

On my IU arrival in 1964, my new (and empty) lab was close to Ed's so that I came under his wing in short order. Fortunately, some of our interactions tickled the "engineer gene" in Ed. He liked to exercise his engineering talents for designing sophisticated experimental apparatus. Some of his results emerged in my lab and opened the path to a long line of novel experiments.

The first concerned the mysterious triplet state lifetime of benzene. While on the order of seconds in condensed phase, it was unknown for the gas phase but suspected to be orders of magnitude less. I had devised a speculative energy transfer scheme to produce a measurement, but it needed a bright microsecond flash discharge (100 Joules … stand back) to bring it off. Ed knew about these from his own work, and with his usual laboratory virtuosity, I was soon provided with a superb (and safe!) system that put us in business. The scheme worked, and experiments at IU and later elsewhere led to instructive stories about triplet states in isolated aromatic molecules.

"With his warm smile, he told me one day, 'I can still put out about 100 watts.' That is among my favorite memories of Ed."

Ed's biggest impact on my science involved a large-diameter, two-meter long iron tube on cement supports that lived in my labs for forty years. This great green thing was in fact a scanning spectrometer combining high resolution and high light sensitivity in a unique sealed Ed Bair design that forever kept the optics as clean as the day they were installed. The optical mounts and grating drive system were high precision devices, and Ed used the spectrometer construction as part of his strategy to improve the capabilities of the machine shop. But Ed also understood my needs, and the spectrometer was so well suited to the low intensity conditions of isolated molecules that it prevailed into work with supersonic beams, crossed molecular beams and highly dilute molecular clusters in those beams. It was truly the experimental centerpiece of our lab despite all the lasers, computers and high tech electronics that joined the research. His design has been since emulated on two other continents.

Ed took me flying several times in my early IU years. It was my first adventure in a small plane, and I was impressed with how confidant I felt with Ed as the pilot. Seeing Bloomington from above (but not too far above) was a great experience. I even had the chance to fly cross-country with Ed on our return from a visit to the Canadian National Research Council in Ottawa. All went well until weather closed the trip down in upstate New York, only half way home. It was the Uncertainty Principle at work.

Ed's engineering interests were still in full bloom during his retirement years when he turned to issues of solar power in the context of global electric power. He became interested in schemes such as turbines for electricity conversion in outer space and even had a small lab for supporting experimental work. But his maximum effort resulted in a book that provides an account of concepts needed for discussion of global electric power. Big energy units are introduced, i.e., a petawatt; one PW = 10^{15} watts. Not surprisingly, he argues that solar power will ultimately be the final choice remaining to mankind for our energy demands. Access to this power will involve photovoltaic devices in earth orbit. He closes with a comment aimed at the skeptics. "Daunting as space solar power may be, there is no reason to assume that … alternatives are any less difficult. … Any talk of them being a part of the solution to future electric power … should be supported by some arithmetic."

Ed was in remarkably vigorous physical condition until almost the end. At 85, he was proud to climb routinely the steps in the annex from the first to the fifth floors. Energy was on his mind, and he calculated

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In memoriam: Ed Bair

(continued from page 25)

the power he was putting out during the climb. With his warm smile, he told me one day, "I can still put out about 100 watts." That is among my favorite memories of Ed. And I can even quote the number in PW. — *Charlie Parmenter*

"I never knew anyone who expressed so much joy while working in the lab ... He whistled — fine clean notes, in perfect delivery, complete with trill."

A tutor in life

I never knew anyone who expressed so much joy while working in the laboratory as Ed Bair. He whistled — fine clean notes, in perfect delivery, complete with trill. I asked him how he had learned to whistle and he told me about embouchure and other techniques he borrowed from the days he played another wind instrument — a clarinet.

Ed was a storehouse of information on how to put together a laboratory. Before I came to Indiana (in 1963), I knew his book *Chemical Instrumentation*. In addition, as I was setting up my laboratory I went to him on advice on optics and vacuum lines. He gave Charlie and me, perched on stools in front of a blackboard and who did not know much of anything, tutorials on electronics. Over the years, I would send my graduate students to Ed so they could experience his wisdom, first hand, on how to pull off a difficult experiment.

And there was flying. In my first spring, Ed flew my wife Dorothy and me to Indianapolis to have dinner at the airport. The late afternoon sun lit up, and like white puffs, dogwood trees with their new blossoms scattered in the forest below. After the meal (not memorable), the small plane skimmed over the dark forest, then the lights of Martinsville, Ind., and on to the small Bloomington airport. — *George Ewing*

Flying high

Ed Bair's influence on me began even before I came to IU. While still a graduate student at the University of Illinois, I became aware of Ed's classic text *Introduction to Chemical Instrumentation* (McGraw-Hill, 1962). Like all truly great textbooks, his is timeless in its value because of the philosophy that underpins it. In particular, Ed treated instrumentation in a modular fashion, and viewed all instruments as "chemical signal sources." I still direct all students in my research group to examine the first two chapters of that text to gain a bit of that philosophy.

I first came to know Ed Bair personally during my interview for a faculty position at IU in 1969. Immediately adjacent to Ed's office on the fifth floor of the "new" Chemistry Building (finished 1965) was a small shop that contained machine tools and a small electronics laboratory. Ed proudly gave me a tour not only of that shop (which he had equipped from personal funds) but also of the departmental machine shop, which he — more than anyone else — fostered and brought to its current level of excellence. It was clear to me that not only had I discovered a kindred spirit in the field of chemical instrumentation but also a place where that field was valued and encouraged. It was an important consideration in my decision to join the IU faculty.

As Charlie Parmenter has already indicated, Ed was a pilot, and a very good one. On one occasion, Ed flew me to Champaign, Ill., so that I could collect my two sons, who then were thrilled with the flight back to Bloomington. Flying with Ed was one of the important factors that urged me to pursue my own flying license. Regrettably, unlike Ed, I never finished the course!

Ed's philosophy about instrumentation led him to revamp our general chemistry laboratory curriculum — a monumental task. Each laboratory exercise was self-paced, with students entering data they obtained into computers that were placed conveniently within the lab. Students then received immediate computer feedback about their results. And this was in the 1970s, when computers were expensive and inconvenient to program! The overall goal was to teach the students the importance of careful measurements and how to evaluate answers they acquired. I was privileged to co-teach the course with Ed for two semesters.

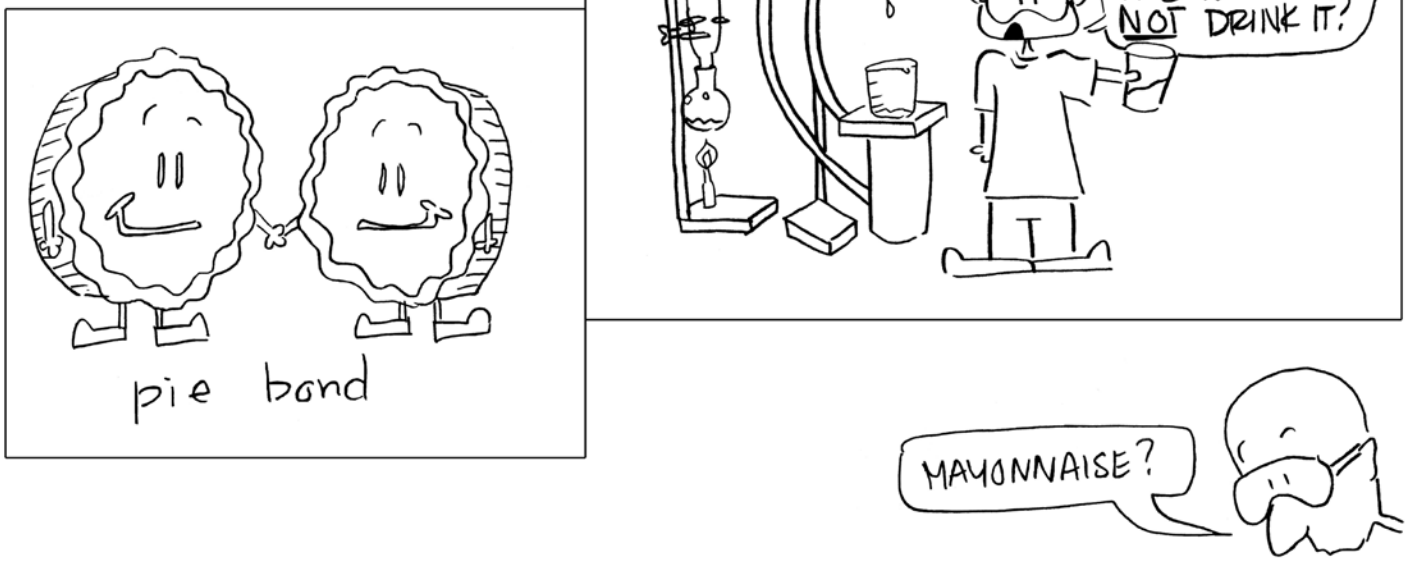
The course philosophy proved entirely correct, and students did indeed learn the value and importance of proper measurements. However, difficulties arose because of the unreliability and limited capability of computers that were then available. As usual, Ed was well ahead of the curve in education; it would be a good idea for some of our new faculty to pursue the same goal, but with modern computing equipment.

Of course, Ed's meticulous approach to instrumentation and experimental design carried over into his research. At one time, he had the highest resolution optical spectrometer on campus. In fact, the system was so delicate that Ed had installed it in the basement of Wiley Hall, otherwise a rather dreary place, in order to take advantage of a seismograph table, anchored in local bedrock, on which the spectrometer was placed.

My last memories of Ed involve his study of electrical power generation, which Charlie Parmenter also already mentioned. Whether at Starbucks, where Ed often read, or in my office, where we discussed his findings and suggestions, he retained the same enthusiasm and attention to detail that he always exhibited. Those encounters were usually preceded by the sound of Ed's whistling to himself, a sound I sorely miss. — *Gary Hieftje*

Chemistry comic relief

Illustrations by Drew Frazier

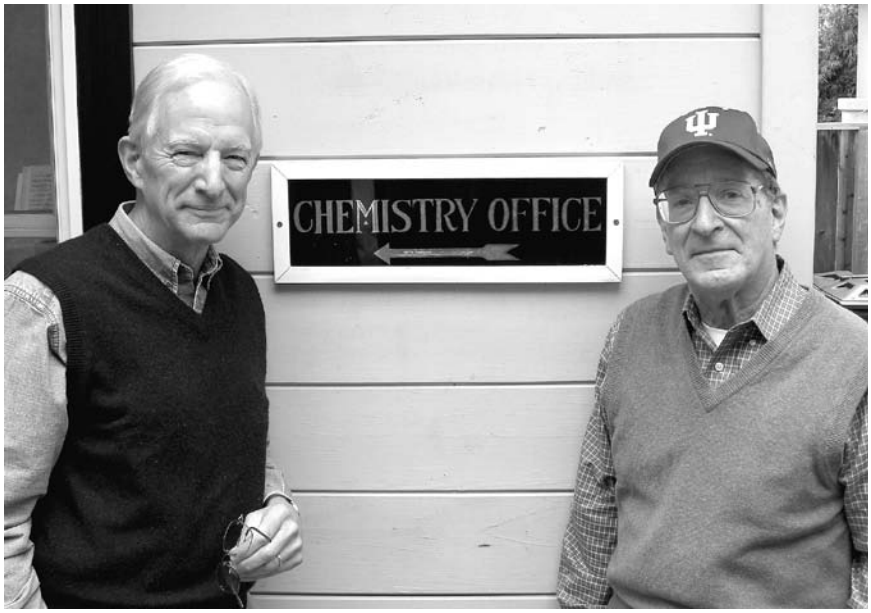


Reminiscences

A well-traveled sign

by John Hayes

I arrived in Bloomington in 1970, fresh from a postdoctoral appointment in Bristol, England. I joined the faculty as a mass spectroscopist and analytical chemist, but my post-doctoral work had been in organic geochemistry, and much of my interest in chemistry developed from my parallel interests in earth science. The central problem in organic geochemistry is to understand the history of the molecules that can be extracted from sediments.



Janice Hayes

This photograph of John Hayes and Dennis Peters (the latter attending a meeting in San Francisco) was taken in May 2009 outside Hayes's office at his home in Berkeley, Calif. Until the 1984 addition to the Chemistry Building began, followed by remodeling of the 1930 and 1964 sections of the building, the sign between them in the photograph hung in the old building in Bloomington.

What organisms produced the molecules? What do they tell us about the ancient environment? What has happened to them since their burial?

Dealing with those questions takes a lot of analytical chemistry. In my research, I hoped to develop techniques focused on the problems of organic geochemistry.

Years earlier, my biochemistry teacher had stressed isotopic tracing experiments as a means of dissecting metabolic pathways. In physical organic chemistry, I had heard about isotope effects in which the rate of a reaction or position of an equilibrium is affected by isotopic substitution. When I asked whether such phenomena could produce misleading results in tracing experiments, I was told, perfectly accurately, "The isotope effects can't be avoided but the isotopic separations that they produce are much smaller than the variations imposed by the tracers."

I kept thinking about that. The isotope effects associated with metabolic reactions *would* produce very subtle patterns of isotopic abundance in the products. Since natural carbon is comprised of 99 percent ^{12}C and 1% ^{13}C, some positions in a natural product would be slightly enriched in ^{13}C and others would be depleted. My students and I set out to measure those patterns. The plan was simple. First, learn what isotopic patterns are characteristic of primary biosynthetic products. Second, study sedimentary organic chemistry by examining the extent to which those patterns are preserved in the carbon skeletons of molecules extracted from rocks.

We found clear patterns of "intramolecular isotopic order" in fatty acids synthesized by bacteria and other unicellular organisms. At the same time, we developed new mass spectroscopic techniques that allowed us to determine the abundance of ^{13}C to within 0.0003 atom% in nanogram quantities of an organic compound. Together, these developments opened the door to measuring and understanding a host of isotopic signals in sedimentary organic molecules.

For geochemistry, this was a breakthrough, but I don't think the work could have been done in a department of geology. The chemistry was too intricate.

With that foundation laid, I began to be pulled strongly into the geosciences. I was given a half-time appointment in geology and we moved our labs to the IU Geology Building in 1984, being encouraged to do so because space was so tight in chemistry, in part due to a major remodeling project.

One day, as I was walking the hall on the main floor of the old Chemistry Building, I noticed that the construction crew had unceremoniously taken down and discarded the sign pointing to the departmental office. I pulled it out of the trash bin and have had it ever since. For some years it hung in our basement in Bloomington, pointing to my home office and defining my scientific roots.

By the 1990s, "isotopic biogeochemistry" (as I had taken to calling it) began to develop some real

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Hayes

(*continued from page 28*)

traction. We had a new tool and there was a lot of low-hanging fruit. Informative results kept appearing. The origins of most of the signals we were finding and interpreting were in the oceanic water column (where the producer organisms grew) and in ocean sediments (where a microbial community chewed on organic materials prior to their ultimate burial).

In conversations with prospective graduate students, I used to tell them "I could die happy if, when a molecule of CO_2 dissolved in seawater was assimilated by an alga and used to produce organic matter, I could predict whether that carbon would be reoxidized or instead buried in the seafloor." We were getting close. I worked often with oceanographers and was a frequent visitor at Woods Hole Oceanographic Institution (WHOI) on Cape Cod, Mass.

In the ocean sciences, WHOI is a key center. It's a private research institution. The total head count, including double crews for three ships and a support staff for *Alvin* and other deep-diving submersibles, is about 900.

The resident scientific staff includes 120 individuals organized into five departments. A doctoral program is shared with MIT. Remarkably, the whole thing runs on "soft money," with members of the staff writing proposals furiously to cover not only all the usual research expenses but also 100 percent of annual salaries. You would think that wouldn't make the work very attractive but, by providing a truly excellent research environment, the institution maintains a strong staff. Combined, they mount a broad and incisive attack on problems like the carbon cycle and its role in climate change.

And, in late 1995, they called Bloomington to ask whether I might join them.

By then, I had become more of a natural scientist than physical scientist. In field studies, in particular, I had frequently encountered dramatic evidence of past global change. I was deeply convinced (and still am!) that our unchecked combustion of fossil fuels, and the resulting increases in concentrations of CO_2 in the atmosphere, were certain to have dire effects. As a result, I didn't hesitate and, in the summer of 1996, moved to Woods Hole.

The "Chemistry Office" sign moved to our home on Cape Cod, continuing to serve as a reminder of my ever-more-cherished roots. The importance of the work we had done at IU Bloomington was increasingly recognized and honored. Unfortunately, as a result of my move, the celebrations were in Woods Hole.

There, I found my work becoming more and more biological. Inspired by the intensively collaborative environment, we used our techniques to dissect the processes occurring in microbial communities, thus contributing to knowledge of processes occurring deep in seafloor sediments. It was, I have to say, enormous fun.

The constant search for funding was indeed a grind. As my 66th birthday approached, I decided that I could afford to retire, and that I would enjoy it.

A year later, we moved to Berkeley, Calif. Our goals were to escape New England winters and to get closer to the center of our family.

Of course, Berkeley is also the home of a fine university. The phone rang quite promptly, and I wound up assisting in studies of the mechanisms by which bacteria assimilate inorganic nitrogen. In connection with that, I find myself appointed as a visiting scholar at UC Berkeley in the Department of Integrative Biology.

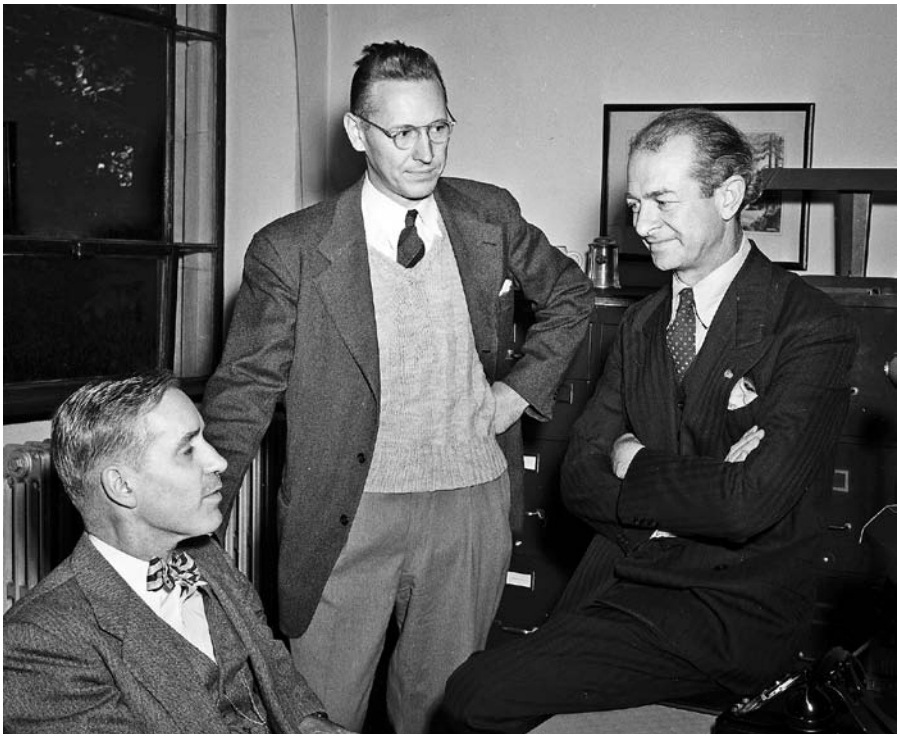
After a lifetime of multiple prefixes, I've now actually held appointments in departments of chemistry, geology, and biology. But the sign keeps reminding me of my roots and especially of the marvelous colleagues and support that I enjoyed in Bloomington.

John Hayes joined the faculty in chemistry at Bloomington in January 1970. In July of 1996, he took up a new appointment as senior scientist in the Department of Geology and Geophysics at Woods Hole Oceanographic Institution (on Cape Cod, in Massachusetts). During that appointment, he served simultaneously as director of the National Ocean Sciences Accelerator Mass Spectrometry Facility and professor of the practice of biogeochemistry at Harvard University. He was elected to membership in the National Academy of Sciences in 1998 and became a fellow of the American Academy of Microbiology in 2009.

Leslie J. Abrams, Cert/BS'07, is a graduate student in the IU School of Medicine. She lives in Indianapolis.

Sara Wakefield Brown, BA'95, OD'99, is an optometrist who lives in Katy, Texas. She and her husband, Keith, have two children — Owen and Andrew.

Donald W. Buck II, BS'02, and his wife, **Jennifer (Lazarus)**, BA'02, welcomed their first child, Benjamin Leo in January. The couple lives in Chicago.



Indiana University Archives

Professor and Past Chemistry Chair Frank Gucker, Professor Ernest Campaigne and Linus Pauling. Pauling visited IU Chemistry circa 1959. He is well known for having been awarded two Nobel Prizes in two different fields, for chemistry in 1954, and the Nobel Peace Prize in 1962. He is the only person to have been awarded each of his prizes without sharing it with another recipient.

Larry C. Crawley, MS'69, PhD'73, has retired after 33 years with E. I. DuPont de Nemours. At the time of his retirement he was the technology director for the DuPont Automotive Products Division. Crawley and his wife, Joyce, MAT'73, have relocated to Byron Center, Mich., spending time there and in Vail, Colo., where they enjoy downhill skiing and hiking.

John O. Dudley, BA'78, MBA'84, is retired. He spent 26 years with Verizon Communications and, at the time of leaving, was president of the company's Great Lakes regional office. Dudley subsequently took a position as chief development officer with the American Red Cross in Charlotte, N.C., for one year. He enjoys golf and is involved in masters swimming. Dudley is married and has three grandchildren and a dog named "Dudley." He lives in Waxhaw, a suburb of Charlotte.

Jonathan S. Fried, BA'81, MD'85, is an attending physician in the emergency department of Clarian Arnett Hospital in Lafayette, Ind. He lives in Zionsville, Ind.

Alison A. Havens, BA'07, is attending the University of Louisville (Ky.) School of Medicine, where she plans to graduate with a doctorate in medicine in 2012. When she is not in class, she works as a laboratory research assistant at the University of Louisville's Liver Research Center. Havens, a member of Mensa, lives in Jeffersonville, Ind.

In April, **R. Danny Huntington**, BS'72, joined the Washington, D.C.-based law firm Rothwell, Figg, Ernst & Manbeck. He has been recognized by leading organizations and publications for his expertise in biotechnology law and intellectual property law. Huntington is president of the Fédération Internationale des Conseils en Propriété Industrielle, a worldwide organization of intellectual-property attorneys in private practice. He lives in Potomac, Md.

Stephen E. Jacobs, BA'73, MD'77, works for Kaiser Permanente in Modesto, Calif. In July 2008, California Gov. Arnold Schwarzenegger appointed his wife, Nan Cohan Jacobs, BA'73, JD'77, to a judgeship in the Stanislaus County Superior Court. Previously, Jacobs served as a partner for the law firm Crabtree, Schmidt & Jacobs in Modesto, where she practiced family law. The couple lives in of Modesto.

Hugh W. Johnston, PhD'48, is retired. He volunteers as an archival processor at Whitworth University and at the Museum of Arts and Culture in Spokane, Wash., where he lives. He writes, "Both volunteer services take advantage of the training received while earning the PhD degree at Indiana University."

Jay D. Kissel, PhD'07, is an associate scientific communications consultant for Eli Lilly and Co. in Indianapolis. He and his wife, Elizabeth (Keck), BS'03, an assistant director for the National Institute for Fitness and Sport in Indianapolis, live in Carmel, Ind.

Kevin S. Kolack, PhD'97, writes, "I grew up outside of Atlanta in a town with no traffic lights. After getting a BS in Chemistry and Buddhism from the University of Virginia, I moved to Bloomington to earn a PhD in Chemistry as well

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as certification as a master firefighter and EMT. While at Indiana, I began acting in earnest, traveling to Chicago weekly and New York City several times a year for classes and seminars. I moved to NYC in January 1998 to act full time. I have been everything from a movie theatre manager robbed at gunpoint, to a florist, to a helicopter pilot, and NYC taxi driver in real life, and just as wide a variety on stage and on screen. I have been seen in more than three dozen independent films and have appeared in standup comedy clubs around New York City." Kolack lives in Woodside, NY.

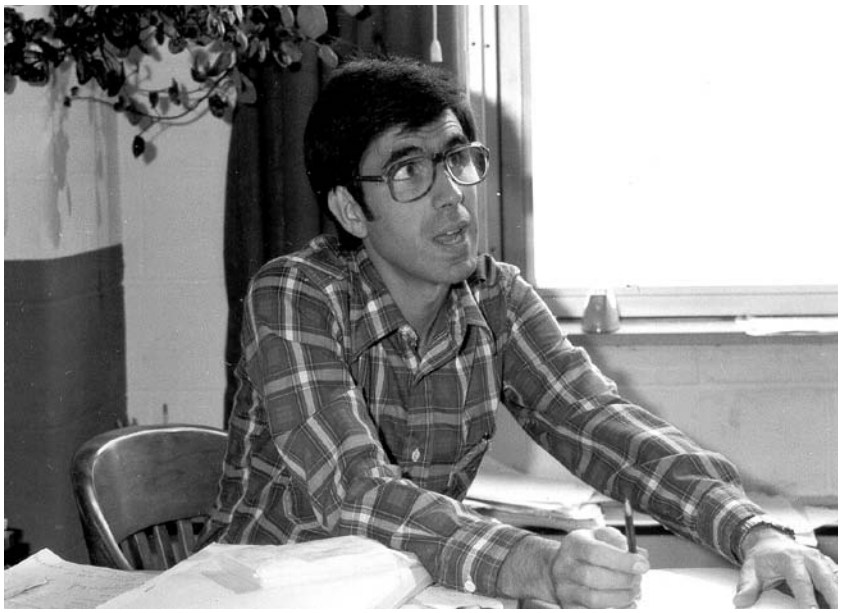
Matthew A. Lynn, MS'97, received a PhD in inorganic chemistry from the University of Arizona, where he worked as a staff scientist in computational chemistry from 2000 to 2007. He writes, "While I was in Tucson, I also took classes in American Sign Language, which led me to the position I have today: assistant professor of chemistry at the National Technical Institute for the Deaf, one of the colleges of the Rochester (N.Y.) Institute of Technology. I am responsible for teaching and tutoring all areas of chemistry to deaf and hard-of-hearing undergraduate and graduate students. I do so in American Sign Language and voice, usually both at the same time." Lynn lives in Rochester.

In April, IUPUI and its schools paid homage to supporters of the campus who have "propelled [IUPUI] forward in key mission areas." The 2009 Spirit of Philanthropy honorees included **William G. Mays**, BA'70, MBA'73, ScD'00, of Indianapolis, president and chief executive officer of Mays Chemical Co., and his wife, **Rose (Cole)**, MS'74, a professor and associate dean of the IU School of Nursing in Indianapolis, for their long-term philanthropy and support for the School of Nursing.

Graeme E. McFarland, BS'07, has begun his 3rd year of studies at the University of Alabama at Birmingham School of Medicine. An I-Man in football, he lives in Birmingham.

Floyd W. McWilliams Jr., BA'66, MBA'67, writes, "I am currently teaching in an associate's degree program in state and federal prisons in the state of Indiana. I am [also] a certified bridge teacher and a bronze life master." McWilliams lives in Paris, Ill.

In September 2008, Adrian [Mich.] College presented **Maher Mualla**, MS'84, with its Academic Services' ExcelLENT Professor of the Year award. The award, which is student-generated, was established in 1995 and is sponsored by the college's EXCEL program, a five-year grant program funded in part by the U.S. Department of Education. Mualla specializes in organic and environmental chemistry and has received numerous teaching awards throughout his career. He lives in Adrian.



Indiana University Archives

Ken Caulton: Now or Then? The only evidence we have of the era (ca. 1971) is the fact we can see the surface of Ken's desk.

John Olesik, post-doctoral studies, '84, was the 2009 recipient of the ACS Spectrochemistry Award. Olesik is presently on the faculty at Ohio State.

Todd D. Pankey, BS'90, was recently named vice president of supply chain management for Motor Coach Industries International of Schaumburg, Ill. He lives in Winnetka, Ill.

Daniel R. Plant, BA'06, MBA'08, recently completed an MBA degree at IPFW. His wife, Andrea L. Zimny, BS'06, is pursuing an elementary education teaching degree at IPFW. The couple lives in Huntertown, Ind.

Trevy A. Ramos, BA'07, completed a master's degree in biology at IUPUI in 2008. She is currently enrolled at the West Virginia School of Osteopathic Medicine in Lewisburg, W.Va.

Gina S. Rogers, BA'01, graduated from Purdue University School of Veterinary Medicine in May 2008. She earned bachelor of arts degrees in both anthropology and chemistry from IU in the same year. Rogers, who has a 3-year-old son, lives in Nashville, Ind.

Mark E. Schneider, BA'96, of Evansville, Ind., has been an assistant U.S. attorney with the U.S. Department of Justice since 2004. He currently serves as the Deputy Rule of Law Coordinator at the U.S. Embassy in Baghdad, Iraq, where he helps to oversee U.S. efforts to improve the capacity and performance of the Iraqi justice system.

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Alumni news

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Merlyn D. Schuh, PhD'71, Martin Professor Emeritus of Chemistry at Davidson (N.C.) College, has been named the Council on Undergraduate Research Volunteer of the Year for 2008. He serves on the council's board of directors as chairman of the Chemistry Division. The CUR is a national organization that promotes undergraduate research in the natural and social sciences. Schuh's wife, Judy (Swigart), MAT'70, has taught high-school and middle-school French for over thirty years. She will retire from North Mecklenburg High School in Huntersville, N.C., after the present academic year. The Schuhs lives in Davidson.

E. Paul Smith, BA'51, a chartered life underwriter, was employed as a special agent for sales and service by the Prudential Life Insurance Company of America for 32 years. He lives at the Indiana Veterans' Home in West Lafayette, Ind.

Jinkyo Suh, PhD'07, is a postdoctoral fellow in the Department of Biological Science at Simon Fraser University in Burnaby, British Columbia, Canada. He lives in Coquitlam, B.C.

Alexandra Lipps Sylvia, BA'93, JD'96, has been selected for inclusion in the 2009 edition of *Indiana Super Lawyers* magazine. She has also been named as an *Indiana Super Lawyers* Rising Star, a new designation for up-and-coming lawyers. Sylvia is a partner with the Indianapolis law firm Plews Shadley Racher & Braun. She lives in Indianapolis.

Martin S. Tamler, BA'84, MD'88, is co-author of *100 Questions & Answers About Fibromyalgia*, published by Jones and Bartlett, an independent publisher in Sudbury, Mass. The book provides authoritative and practical answers to common questions about the disorder. Tamler practices as a rehabilitation doctor at LMT Rehabilitation Associates in Royal Oak, Mich. He lives in Birmingham, Mich.

In May, **Rachel E. Tate**, BA'05, graduated with special recognition from Des Moines (Iowa) University College of Osteopathic Medicine. She has undertaken an internal medicine residency program at Des Peres Hospital in St. Louis, where she lives.

James W. Terman, BA'61, MA'63, MD'65, has retired from the Gundersen Clinic in La Crosse, Wis., after 36 years as a member of the internal medicine department and infectious diseases section. He is a clinical assistant professor of medicine at the Univer-

(*continued on page 33*)

Necrology

We received notices of the following deaths of alumni since the fall 2008 issue of *IU•Chemistry*.

William E. Adams, BS'49, Dec. 3, 2008
Richard M. Anderson, BS'47, Oct. 5, 1997
Glenn A. Berchtold, PhD'59, June 9, 2008
John W. Berry, BA'37, March 2, 2007
Robert S. Beiner, BA'48, July 22, 2003
William L. Blalock, BA'35, April 23, 2007
Herman Blond, BA'35, March 20, 2003
Pierson G. Boermans, PhD'43, Aug. 30, 2008
Lloyd H. Brown, BA'41, MA'41, May 13, 2004
Irma Wilson Brown, BA'47, Dec. 24, 2008
Charles L. Brown, BA'56, Aug. 3, 2003
Ernest F. Bundy, BA'45, Jan. 14, 2007
Sean J. Cairns, BS'96, Jan. 8, 2001
Alexander F. Craig, BA'39, MD'42, Feb. 19, 2008
Richard C. Datzman, BA'42, MD'44, May 9, 2008
Ralph A. Davis, MA '42, June 19, 2005
Phillip R. Dawkins, BA'69, MD'72, Nov. 8, 2008
Constantine Douketis, PhD'89, Aug. 26, 2008
Ernest G. Flint, MA '59, Feb. 21, 1998
Robert E. Gaidos, BS'82, Aug. 19, 2006
Roger G. Garst, MA '49, Jan. 3, 2007
James F. Grutsch, BS'51, MA'52, Jan. 15, 2004
Maurice H. Hanes, PhD'62, Aug. 12, 2008
John H. Harvey, BA'56, MAT'63, Oct. 7, 2007
Henry M. Hellman, BS'43, Nov. 3, 2005
Arthur E. Hicks, BS'42, Aug. 1, 2008
Anne Harriott Hubbard, BA'42, May 30, 1995
Ancil O. Kays, BS'47, Dec. 28, 2004
Ralph F. Koontz, BS'42, Feb. 15, 2008
Gary S. Kozak, BS'60, June 19, 2003
Alice Rosenthall Kulasavage, BA'39, July 11, 2002
Edith Schroeder Lessor, PhD'55, April 11, 1999
Katherine Barron Lett, BA'43, July 8, 2005
Alfred S. Levinson, PhD'63, Dec. 10, 2008
Frank C. McDonald, BA'38, MD'42, Aug. 5, 2005
Robert G. Meeks, BS'69, March 25, 2008
Belvey W. Mundy, MA '41, PhD'48, Nov. 14, 2006
Elaine W. Ng, PhD'72, May 25, 2008
James G. Overpeck, BA'51, Dec. 23, 2008
John F. Pain, BA'50, Oct. 6, 2008
James R. Peterson, BS'56, MAT '60, Feb. 27, 2007
Joseph P. Savage, BA'65, Oct. 15, 2005
Arthur W. Schappell, BA'38, MD'41, Aug. 24, 2006
Ann Thomas Schindler, MS'57, Nov. 18, 2008
Robert L. Schmidgall, PhD'69, April 27, 2007
Gordon H. Schrotenboer, MA'44, PhD'47, Oct. 22, 1999
Jack C. Shrader, BA'36, MD'40, June 21, 2004
Robert W. Stelzner, PhD'63, Jan. 20, 2007
James O. Stewart, BS'54, Dec. 19, 2008
Wataru Takahashi, MA'59, Sept. 24, 2003
Roy H. Thompson, BA'39, March 21, 2008
Elaine H. Waiss, BS'63, MD'68, Oct. 21, 2006
Charles W. Weber, PhD'53, April 17, 2008
Fred W. Welter, BA'65, April 9, 2007
Gilbert M. Wilhelmus, BA'42, Nov. 13, 2008
Ellis T. Woolridge, BA'27, MA'29, June 3, 1999
Robert B. Wrege, BS'38, JD'40, Sept. 20, 2008

sity of Wisconsin School of Medicine and Public Health. He and his wife Nancy (Simonson), BS'61, live in La Crosse. The couple has three children and four grandchildren.

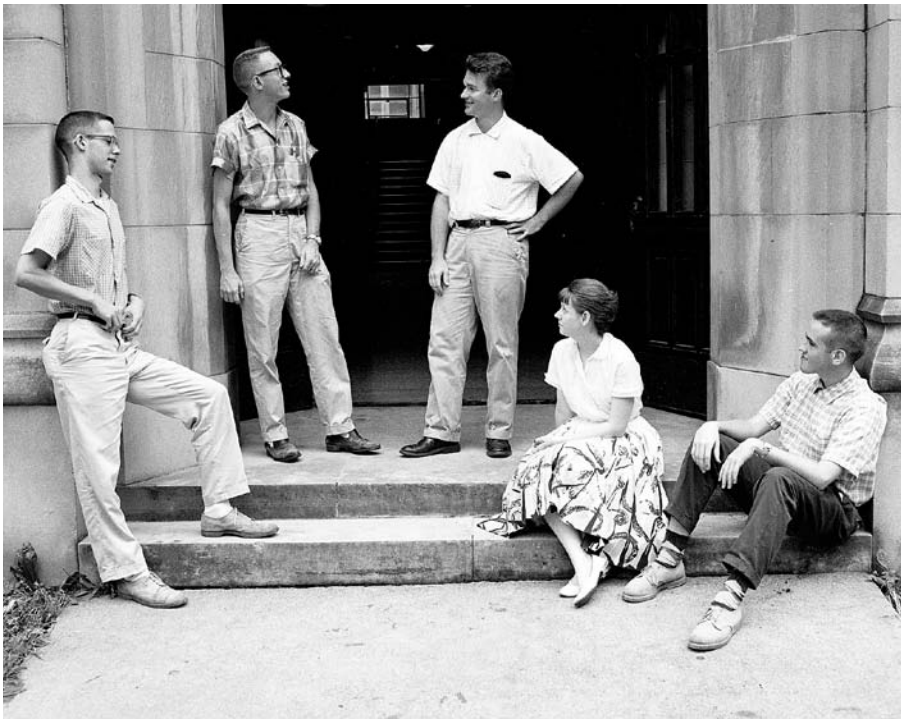
William T. Thanholt, BA'49, writes, "I retired as chairman of the Department of Applied Science at Olive Harvey College, City Colleges of Chicago, at the end of the spring term in 1990. After the death of my beloved Terese in 1998, I continued to live by myself with my Shelties until it was no longer feasible [to do so]. I am now enjoying life to the fullest at St. Anthony [an assisted-living community in Crown Point, Ind.], enjoying acceptable good health, reading, and passing on my opinion whether anyone is interested or not — mostly not. Life is good!"

"[I am] back home again in Indiana," writes **Samuel S. Wakim**, BA'86. After practicing dentistry in California for 17 years, he purchased Aspen Dental in Mishawaka, Ind., and relocated his family to Granger, Ind., in December 2007. "Since then," he adds, "my wife, Hannah, has given birth to a new baby boy. Luke Samuel (IU Class of 2031) was born in South Bend, Ind., on June 18 and was greeted by his brothers, David and Michael, and his sister, Rita."

Last fall, **Erica A. Weyer**, BA'08, and Isabel L. Estevez, BA'08, traveled to San Gerardo, a village in Ecuador, to help start a small business that teaches women how to produce artisan crafts. The cooperative, Las Flores, helps women in the community augment their incomes and provides them with a sense of empowerment. The two alumnae also played an instrumental role in other aspects of life in San Gerardo, helping a group of men start their own business, putting the community in contact with a health-food company in Ecuador, and helping the community formalize its banking system.

Steven G. Williams, BA'80, MS'85, is a senior software engineer with FileOne Inc. in Cary, N.C., where he lives. He writes, "I still enjoy the creativity and endless learning opportunities that programming allows me. My son, Jonathan, is in college (unfortunately not IU!) and my daughter, Lauren, is in high school. They both show dogs in their spare time. In junior handling two years ago they ranked 8th and 23rd in the nation, respectively. I do miss all my friends at IU. Please keep in touch!" Williams can be reached at stevewilliams17@hotmail.com.

Troy D. Wood, BS'89, an associate professor of chemistry at the State University of New York at Buffalo, has received the State University of New York Chancellor's Award for Excellence in Teaching. Wood and his wife, **Marie (Moy)**, BS'89, recently celebrated their 20th wedding anniversary. They live in Buffalo.



Indiana University Archives

Chemistry undergraduates (1959) doing the same thing that undergraduates do today: hanging out, but without cell phones or laptops.

At age 109, **Ji Zheng**, PhD'34, is the oldest alumnus of the College of Arts and Sciences at IU Bloomington and possibly the oldest professor in the world. A biochemist and renowned researcher in aging and nutrition, Zheng maintains a vigorous daily schedule of activities. At his 109th birthday celebration in May, he received mementos of IU from Hai Yan, a scientist at the California biotechnology company Amgen and a friend of Zheng's. Yan writes that Zheng "recalled his study and research in the Chemistry Building and said that he was always proud of being a graduate of the university." Zheng lives in Nanjing, China.

CHEM-MYSTERY

What do the following elements have in common?

Neon	*Molybdenum*
Aluminum	*Indium*
Argon	*Lanthanum*
Calcium	*Neodymium*
Scandium	*Protactinium*
Manganese	*Mendelevium*
Cobalt	*Meitnerium*

Find the answer on the inside back cover of this magazine!

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(*continued from previous page*)

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CHEM-MYSTERY *(from page 33)*

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Calcium	*Neodymium*
Scandium	*Protactinium*
Manganese	*Mendelevium*
Cobalt	*Meitnerium*

Answer: All of the chemical symbols for these elements are also two-letter state abbreviations (the list could be expanded to include New Brunswick and Puerto Rico as well).

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