

DEPARTMENT OF

# Chemistry News



FALL/WINTER 2010 UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN



Arctic sunset captured by Chemistry alumnus Mark Patsavas.  
Read more on page 6.

A Tradition of Innovative Thinking Since 1868

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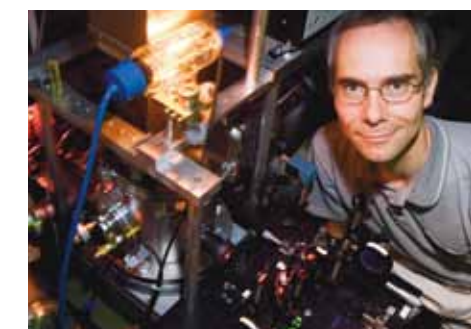
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## Letter from the Department Head



AS I THINK ABOUT THIS PAST YEAR, THE OPENING LINE OF *A TALE OF TWO CITIES* SPRINGS TO MIND: "IT WAS THE BEST OF TIMES, IT WAS THE WORST OF TIMES..." Of course, the state of Illinois budget woes helped to make it one of the most challenging times in recent memory. Staff reductions were managed entirely in our administrative office with three of five positions remaining unfilled for a good portion of the year as hiring was frozen; two of those three were permanently eliminated. As a result, correspondence with our donors and supporters was delayed, and the patience of many of our graduate students and faculty was strained with slow responses on a broad range of services. We also worked to manage a mid-year budget rescission and a cut in our teaching assistant budget.

I sincerely thank everyone who stepped up and worked extra hours under difficult circumstances to help us through this period. As always, we have some outstanding staff working in the Department of Chemistry. With their considerable extra effort and creativity, I am happy to say that for the most part we have weathered the storm. We have reorganized and retrained some of the staff, hired a Stewardship and Advancement Coordinator using non-state funds, and found new ways to deliver instruction that do not compromise the high standards our students deserve and have come to expect.

Challenges certainly remain with the state economy. And our outstanding faculty continue to be courted by other universities. But good news is abundant. As described in detail on page 12, we hired a bright young theoretician, Professor So Hirata, from the University of Florida. Our alumni and faculty continue to receive many awards, a sampling of which can be found on page 3. With their extraordinary 2007 gift toward a student support program, Dr. Robert C. and Carolyn Springborn have allowed us to attract some extraordinary graduate students to Illinois. Indeed, Bob (B.S. 1951, Marvel) and Connie made their annual trip back to campus a few weeks ago to meet the 17 remarkable students known as Springborn Graduate Fellows.

In other anticipated news, the 2010 *U.S. News and World Report* rankings, largely based on reputation, had the Department of Chemistry at Illinois rising to sixth place. Even more impressive, the National Research Council (NRC) finally released their data-driven ranking of more than 5,000 doctoral programs in 62 fields at 212 universities in the U.S. Rather than providing a single ranking, the NRC gave a range with a 90% confidence limit. Taking the mean of the range for the overall ranking, our Department is well positioned in second place, tied with Harvard University. Only UC Berkeley ranked higher. Keep an eye out for the spring newsletter, which will feature an article about the NRC rankings and what they mean for the Department of Chemistry.

Beyond educating students, research remains the central component of our enterprise, and you will read in this issue how Illinois chemists have changed our view of the Earth and the universe through pioneering research on the atmosphere, oceans, and outer space. Page 7 describes the inaugural Charles David Keeling Lecture series. Dave Keeling (B.S. 1948) made the most accurate measurements of carbon dioxide in the atmosphere, which has led to the current concern about climate change. Related work is being carried out today by Mark Patavas (B.S. 2006, Lauterbur). As part of his Ph.D. thesis he is measuring carbon dioxide in seawater in the Arctic Ocean and has sent some beautiful photographs (see page 8). Finally, page 11 offers an overview of Professor Ben McCall's pioneering work in astrochemistry.

I hope you find this newsletter both interesting and informative. As always, please share your ideas and stories with me (sczimmer@illinois.edu) and best wishes for the upcoming holiday season!

Sincerely yours,

Steve C. Zimmerman  
Head and Roger Adams Professor  
Department of Chemistry

## U.S. News & World Report Ranks Chemistry #6

THE DEPARTMENT OF CHEMISTRY AT ILLINOIS HAS RISEN FROM SEVENTH TO SIXTH PLACE IN THE 2010 *U.S. NEWS & WORLD REPORT* RANKINGS FOR GRADUATE CHEMISTRY PROGRAMS. The rankings represent a composite of a number of factors, including peer assessment, student selectivity, faculty and financial resources, graduation and retention rates, and alumni giving rates. The ranking reflects our dedication to excellence and achievement. Only UC Berkeley, Cal Tech, MIT, Harvard, and Stanford are ranked higher.

"As maligned as such rankings are," noted Department Head Steve Zimmerman, "departments live and die by them. Students and potential faculty pay attention to the rankings as do the administrators that set our budget."

The rankings reflect the considerable forward momentum Chemistry at Illinois has achieved recently. In the last year alone, the department has had 16 patents listing chemistry faculty inventors, four faculty and eight alumni elected ACS fellows, and a number of other faculty and student awards. We also welcomed Professor So Hirata, a world-renowned theoretical chemist from the University of Florida. *Read more about Dr. Hirata on page 12.*

The rise in rankings also reflects our insistence on attracting some of the best and brightest graduate and undergraduate students. On this and the broader successes of the department, Tom Rauchfuss, former director of the School of Chemical Sciences, pointed out: "Without a doubt, one can trace back the success of our department to our very loyal alumni who have impacted our programs immeasurably." This is a point quickly picked up by Zimmerman, who added, "These rankings are absolutely a direct result of the extraordinary partnership that we have built with our successful alumni."

The best-known American college and university rankings have been compiled since 1983 by the magazine *U.S. News & World Report* and are based upon data which *U.S. News* collects from each educational institution either from an annual survey sent to schools or from the institutions' websites. It is also based upon opinion surveys of university faculty and administrators who do not belong to the school.

## 2009-2010 Faculty Awards

**Martin D. Burke** will receive a 2011 **Arthur C. Cope Scholar Award from the ACS**. The award, which consists of \$5,000, a certificate, and a \$40,000 unrestricted research grant, encourages and recognizes excellence in organic chemistry. Ten Arthur C. Cope Scholars are named annually: four between the ages of 36 and 49, four age 50 or older, and two age 35 and younger. Burke will deliver an address at the 242<sup>nd</sup> ACS National Meeting in Denver in August of 2011.

**Thom H. Dunning, Jr.** has been awarded the **2011 ACS Award for Computers in Chemical and Pharmaceutical Research**. Since 1984, this award has annually recognized outstanding individual achievement for the use of computers in education, product development, or research in the chemical and biological sciences. Given annually, it recognizes outstanding contributions to the advancement of the use of computers in the chemical and biological sciences, and consists of a cash prize and certificate. The monetary award is \$5,000, plus a \$1,000 travel allowance to attend the meeting at which the award will be presented.

**Wilfred van der Donk** will accept the **2010 Jeremy Knowles Award from the Royal Society of Chemistry** for his interdisciplinary work on the discovery and development of new antibiotics, the mechanism of fatty acid oxidation by cyclooxygenase and lipoxygenases, and the development of new biocatalysts for use in the pharmaceutical industry. The award itself consists of 2,000 BP and a medal, which was presented at the award lecture on September 17 at the RSC conference "Directing Biosynthesis 2010: Discovery, Evolution, Function" in Durham, UK. As part of the award, van der Donk will also be delivering a lectureship at UK universities in March of 2011. This award is an especially fitting one because Knowles served as a visiting instructor in the Department of Chemistry in 1962 well before he joined the Harvard faculty. His extended time here as well as at Yale is cited as a major reason for his wanting to work in an American chemistry department.



Dr. Elaine Fuchs (in orange) poses with Mary Macmanus Ramsbottom, School of Chemical Sciences Head Andrew Gewirth and Chemistry Head Steven C. Zimmerman

## Commencement 2010: Chemistry Grads Look to the Future

ON MAY 16, 2010 THE DEPARTMENT OF CHEMISTRY HONORED 173 GRADUATES IN THE ANNUAL COMMENCEMENT CEREMONY. Family, friends, and faculty joined in the celebration, which took place at the Tyron Festival Theater at the Krannert Center for the Performing Arts with a reception that followed on the grounds of Noyes Laboratory.

The Aduro Brass Quintet performed at the ceremony, which included remarks by Department Head Steve Zimmerman, Associate Dean of the College of Liberal Arts and Sciences Mary Macmanus Ramsbottom, and Commencement Speaker Dr. Elaine Fuchs.

Fuchs (B.S. 1972, Hon. 2006), the Rebecca C. Lancefield Professor in Mammalian Cell Biology and Development, and a Rockefeller University and Investigator at the Howard Hughes Medical Institute, delivered an inspirational commencement address that reflected on how her own training at the Illinois in physical chemistry enabled her to ultimately study the biology of human skin. She advised students to see their education as a beginning, not an end, noting that, "Although I never took biology at the University of Illinois, I credit my education here for teaching me to pursue my passion, rather than what I was trained to do."

In addition to recognizing each individual graduate for receiving their degree, five awards were given out to undergraduates who had distinguished themselves during their tenure at Illinois:

**John C. Bailar Award for Outstanding Undergraduate Thesis**  
Carlos Concepcion

**John David Barnwell Memorial Award for Academic Achievement and personal Ethics and Scholarship**  
Paul Kornbluh

**Reynold C. Fuson Awards for Academic Excellence**  
Eric Elleby and Jason Olejniczak

**Peter C. and Gretchen Miller Markunas Scholarships for Academic Achievement**  
Megan Cisemesia and Stuart Schelkopf

**C.S. Marvel Award for Excellence in Undergraduate Thesis Research**  
Jordan Axelson

After the ceremony, the graduates, faculty, family and guests gathered on the lawn of Noyes Laboratory for a reception. A large tent pitched on the Quad next to Noyes kept everyone dry as a light drizzle soon gave way to sunshine that suited the joyful celebration.

## 2010 Department of Chemistry Graduates

### Bachelor of Science in Chemistry

Stevia Angesty  
Jordan Cole Axelson \*#&†  
Mary Patricia Choules  
Megan Cisemesia †  
Joseph Daniel Gomez  
Ashley R. Gupta  
Charles Ho  
Ada Huang  
Gretchen S. Karcher  
Robert Y. Lee  
Thomas Joseph Mazzacano  
Anthony Mazzotti #&†  
Eugenio Mendoza  
Tripta Pradeep Mishra  
Lauren Moore  
Jason Olejniczak  
James Thomas Payne  
Robyn J. Reuter  
George Sang  
Courtney Shaner  
Phillip Taylor †  
Thomas Andrew Tiojanco  
Aaron White  
Henny Wong

### Bachelor of Science in Liberal Arts and Sciences

Favin Babu ≠†  
Sukjin Bae  
Christopher Beyer  
Alyssa C. Bradley  
Gretchen L. Bromann #†  
Jenna Lyn Cameli  
Brian Cho  
Constance Hyojin Cho  
Brian S. Choe  
Michael John Choe\*  
Carlos de la Cruz Concepcion†  
Delores Michelle Confer  
Breanne Cornwell  
Eric Christian Elleby  
Kimberlee Fiala  
Kourtney Kay Fox  
Kimberly Ann Fricke  
Yurica T. Fultz  
Emily Ganschinietz  
Matthew Ryan Gerber†≠  
Nathan L. Haas†

Jeanne Marie Hankett  
Ryan D. Harrington  
Spencer Thomas Hart≠  
John R. Holmstrom  
Steven Huang  
Christophe I. Jang  
Gregory M. Jenkins  
Jinwoo Jeong  
Julee Jung  
Jeniffer Hyunjin  
Kelly Kinder  
Younoun Koh  
Jeanne M. Knuth  
Paul G. Kornbluh  
Sarah C. Kwon\*†  
Brittney Larsen  
Hyun Min Lee  
Joong Hyo Lee  
Jung Wook Lee  
Rebecca I. Lee  
Ian Matthew Ludwig  
Jacob V. Ludwig  
Adam Marek  
Marissa Jamie Marszalek  
Oluwafemi Masha  
Brian Maynard  
Sonya Mohan  
Ji Whan Moon  
Melanie Nhu-Quynh Nguyen  
Jennifer L. Osiol≠  
Beth A. Papanek  
Jay June Park  
Krystal Monique Preston  
Anupama K. Puppala≠  
Feng Que  
Jared Reynolds  
Emilie C. Robinson≠  
James Rogers  
Abasin Safi  
Stuart Schelkopf \*&†  
Leonid A. Serebryanny≠  
Pooja Shrivastav  
Jaclyn Christine Sievers  
Stephanie J. Sterling≠  
Robert F. Stewart  
Kyle A. Sundell  
Issac Christian Tan≠  
Thomas A. Tiojanco  
Paul R. Tredrea≠  
Janelle Turner

Emily Underwood  
Ashok Venugopal  
Francis A. Villar  
Julie J. Weber  
Valerie Jean Wersching  
James Nolan Winters  
Jung Hee Woo†

### Bachelor of Science in the Teaching of Chemistry

Gerald Joseph Brady  
Michael S. Frazier  
Kimberly A. Fricke≠  
Megan Livingston&  
Jacob L. Marcotte  
Daniel Rudnick  
Mark Schadel  
Patrick Sweeney

### Master of Science in Chemistry

Rachel Kristina Campbell  
Kyle B. Ford  
Johnny Giles  
Clara H. Jeong  
Brandon S. Lange  
Aaron Lozano  
Jahed Momand  
Richard W. Pierce  
David Shellhamer  
Praveen Sundaradevan  
Christopher David Taylor  
Haylee Michelle Thomas  
Heath Cameron Timmons

### Doctor of Philosophy in Chemistry

Alaadin M. Alkilany  
Stephen Michael Anthony  
Alfred Baca  
Rachel Lynn Behrens  
John M. Boettcher  
Michael Scott Bultman  
Stefanie B. Bumpus  
Andrew Scott Campbell  
William Collins  
Scott R. Daly  
Jared H. Delcamp  
Praveen Chowdary Duggirala  
Hung Tuan Duong

Yan Fan  
Jillian Rebecca Gunther  
Daniel Heller  
Richard Helmich  
Mirth Tucker Hoyt  
Leigh Anne Furgerson Ihnken  
Philip A. Janowicz  
Travis L. King  
Richard Kohman  
Theodore E. Lapainis  
Jin-Hee Lee  
Charity Flener Lovitt  
Jack Hung-Chang Liu  
Stephen Todd Meyer  
Michael Jonathan Motala  
Christopher J. Musto  
Nandini Nagraj  
Amy L. Nicely  
Mitchell T. Ong  
Zakiah Naché Pierre  
Alexis Anne Black Pyrkosz  
Sreenivasa Rao Ramisetty  
Matthew Aaron Rigsby  
Jason D. Rodriguez  
Patrick Neal Sisco  
Lucas Benjamin Thompson  
Tu Thanh Truong  
Benjamin Joel Tucker  
Douglas Mwangi Warui  
Curtis Whaley  
John T. Whitteck  
Rebekah C. Wilson  
Fang Xie  
Min Xie  
Huabin Zhang

### Doctor of Philosophy in Chemical Physics

Jonathan Chen  
Brian Alan Tom

\*Bronze Tablet Recipient  
& Phi Beta Kappa  
# Chancellor's Scholar  
≠ Double Major/Dual Degree  
† James Scholar recipient  
• Triple Major



## Dispatches From the Arctic

By Mark Patsavas



MARK PATSAVAS (B.S. 2006, LAUTERBUR) IS CURRENTLY PURSUING HIS PH.D. IN CHEMICAL OCEANOGRAPHY AT THE UNIVERSITY OF SOUTH FLORIDA AND RECENTLY RETURNED FROM A MONTH-LONG RESEARCH TRIP IN THE ARCTIC OCEAN. Below is an account of his time on the Coast Guard Cutter Healy performing research related to carbon systems measurements—a field pioneered by Charles David Keeling.

I am writing you from the Arctic Ocean aboard the Coast Guard Cutter Healy, the U.S. Coast Guard's largest diesel powered icebreaker. My work here involves carbon system measurements (pH,  $\text{CO}_2$  fugacity of the water,  $\text{pCO}_2$  of the air, total carbon), and I am performing the world's first *in-situ* high precision measurements of carbonate ion in seawater. It's a simple method of adding lead chloride to seawater and observing the ratio of the free lead peak vs. the complexed lead carbonate peak in the ultraviolet spectrum (Byrne and Yao 2008). Our overall goal in the Arctic is to make baseline measurements of these parameters, so in the future we can observe ocean acidification (due to anthropogenic  $\text{CO}_2$  dissolution in the upper ocean). The cruise as a whole exists because Canada and the U.S. are battling for mineral rights in this area—so we have two icebreakers (one U.S., one Canadian, and a

helicopter flying in between) mapping the ocean floor and determining seismic profiles of the sediment, which will be used by the U.N. to define the mineral rights.

Perhaps it's a good idea to mention more about what observing ocean acidification in the Arctic Ocean means. The world's oceans act as a source or sink of atmospheric  $\text{CO}_2$ . Because solubility of gasses increases with decreasing temperatures, polar oceans have the tendency to store more atmospheric  $\text{CO}_2$  and act as a sink of atmospheric  $\text{CO}_2$ . The Arctic ice sheets are melting at a rapid rate, which uncovers more ocean surface area and allows for more air-sea gas exchange. Our research involves high precision spectrophotometric methods to measure parameters of the carbon system, which include: pH,  $\text{CO}_2$  fugacity, total carbon, total alkalinity, dissolved inorganic carbon, and carbonate ion concentration in seawater. We also measured partial pressure of  $\text{CO}_2$  in the atmosphere. This cruise is unique because it is possibly the first time that the carbonate ion concentration has been directly measured *in situ*. Usually, two of the parameters listed before are directly measured, and the others are calculated using thermodynamic equilibria principles of the marine carbon system. On this cruise, we were able to directly

measure carbonate, and cross check our calculations of the other parameters, so we added more confidence to our data set with internal consistency.

With this information, we can compare the difference of the partial pressure of  $\text{CO}_2$  in the atmosphere with its tendency to dissolve into the ocean (fugacity). In areas where there is no ice, the difference in pressure is smaller than areas where there is still ice cover. This makes sense because the areas of ocean without ice are approaching gas exchange equilibrium with the atmosphere. The areas of ocean covered with ice show greater potential to store more atmospheric  $\text{CO}_2$ . As the ice melts, this potential air-sea gas exchange will occur. This is good news for atmospheric carbon sequestration because the atmospheric  $\text{CO}_2$  will dissolve into the ocean, possibly reducing the greenhouse gas effect of  $\text{CO}_2$ , but this is bad news for ocean acidification. As the atmospheric  $\text{CO}_2$  dissolves into the ocean, a series of equilibrium reactions with water occurs and protons are released, lowering the pH of the seawater (the basis of ocean acidification). The exact implications of ocean acidification are not yet well understood, but most of life's reactions are pH dependent, especially the formation of calcium carbonate

shells or tests (the foundation of many organisms in the marine food web). The important idea to understand is that we humans are performing a very rapid acid titration in the earth's oceans, and we don't know when we will reach the endpoint, nor do we fully understand the possible effects of such a grand experiment.

The cruise itself was an adventure. We left out of Dutch Harbor, Alaska, where the TV show "Deadliest Catch" is filmed. Life on a ship is very different, and working in a research lab that has no windows and is constantly vibrating when the ship is breaking ice is not easy. The scenery was beautiful and ever-changing. The sun barely set every night so the coloration of the sky in the twilight was magnificent, especially against the unique ice formations. We were visited by a few polar bears, along with whales, seals, and arctic birds.

We had to ship our instrumentation and personal gear to Seward, Alaska, in April, even though the cruise started August 1<sup>st</sup>. Because of this I sent most of my old clothing in advance, so everything I am wearing on the research cruise says ILLINOIS on it, and subsequently all of the pictures taken demonstrate my true Illini spirit. ■



Dr. Cicerone (center) with Eric Keeling and Emily Keeling Takahashi, children of the late Charles David Keeling

## Ralph Cicerone Delivers Inaugural Charles David Keeling Lecture

ON SEPTEMBER 13, 2010, NATIONAL ACADEMY OF SCIENCES PRESIDENT, CHAIR OF THE NATIONAL RESEARCH COUNCIL, AND ILLINOIS ALUMNUS DR. RALPH J. CICERONE DELIVERED THE INAUGURAL CHARLES DAVID KEELING LECTURE. In his lecture, entitled “CO<sub>2</sub>, Energy, and Climate: Then and Now,” Cicerone spoke of Keeling’s life and groundbreaking research, how scientists today are adapting and expanding the subject, possible implications of the data, and the role of scientists in the global discourse on carbon dioxide emissions and climate change. The lecture, which was the brainchild of Professor Benjamin McCall, was attended by two of Keeling’s children, Eric Keeling and Emily Keeling Takahashi, and was co-sponsored by the Department of Atmospheric Sciences.

Throughout his speech Cicerone traced many facets of the global climate change conversation back to Keeling and his highly detailed data sets. “The world only needed one Dave Keeling,” joked Cicerone, who told anecdotes of Keeling’s extreme attention to detail and preparations, including measuring gas levels in parts per million, something that was cutting edge for the time and made for a highly valuable data set. It is because of his precision and accuracy, which Cicerone referred to as “really good chemistry... beyond question,” that Keeling’s data is so important today.

Keeling inspired many to take up the cause of carbon cycle data collection and understand its implications in the world today. Cicerone displayed a number of graphs with data either begun or inspired by Keeling, noting that former Vice President Al Gore carried around a copy of the “Keeling Curve” and, at least for a time, it was rumored that the chart was the only scientific graph in the White House.

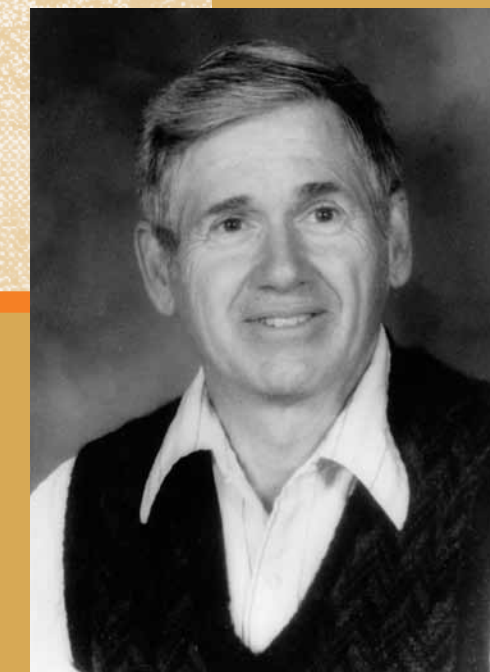
Cicerone closed his speech by noting the implications of Keeling and his successors’ data and the role of scientists in the public discussion on climate change. Keeling saw himself as a scientist, not a politician, and actually resisted the label of “climate change” until the late 1990s when he felt that the data made it “crystal clear.” Cicerone himself expressed hesitation over scientists’ involvement in setting energy standards, saying, “I’m not sure that scientists should decide what’s dangerous... that might be for the public to decide.” However, he did stress that no matter what is gleaned from the data, smart energy decisions are necessary and that energy policy and technology must take into consideration security, costs, and climate change data.

Cicerone’s own research has focused on atmospheric chemistry, the radiative forcing of climate change due to trace gases, and the sources of atmospheric methane, nitrous oxide and methyl halide gases. He has served as founding chair of the Department of Earth System Science at University of California, Irvine, and the president of the American Geophysical Union. For his outstanding research contributions to the understanding of Earth’s atmospheric processes, biogeochemical cycles, and other key elements of the climate system, Cicerone has won numerous awards, including the Albert Einstein World Award in Science, the Bower Award and Prize for Achievement in Science, and the Roger Revelle Medal.

In addition to the National Academy of Sciences, he is a member of the American Academy of Arts and Sciences, the American Philosophical Society, the *Accademia Nazionale dei Lincei*, the Russian Academy of Sciences, and the Korean Academy of Science and Technology. ■

## Alumni Profile: Charles David Keeling

THE DEPARTMENT OF CHEMISTRY IS ASSOCIATED WITH SOME OF THE GREATEST DISCOVERIES AND SCIENTISTS OF THE LAST CENTURY, BUT FEW ARE AS GLOBALLY PROMINENT AS CHARLES DAVID KEELING, whose research at the Mauna Loa Observatory in Hawaii directly contributed to today’s worldwide discussion of the effect of carbon dioxide on the Earth’s environment.



A 1948 alumnus of the University of Illinois Department of Chemistry, Keeling was born in Scranton, Pennsylvania, and earned a Ph.D. in chemistry from Northwestern University in 1954. He served as a postdoctoral fellow in geochemistry at the California Institute of Technology until he was recruited by preeminent oceanographer Roger Revelle to the Scripps Institution of Oceanography in 1956, where stayed throughout his career and where his son Ralph currently serves as a professor.

It was at Cal Tech that Keeling developed the first instrument to measure carbon dioxide in atmospheric samples. A lifelong outdoorsman, he camped at Big Sur, where he first used his new device to measure the level of carbon dioxide and found that it had risen since the 19<sup>th</sup> century.

In 1958, Keeling started collecting carbon dioxide samples at the International Geophysical Year (IGY) base in Mauna Loa, two miles above sea level. Within two years, he had collected data to establish strong seasonal variations in CO<sub>2</sub> levels that peaked in the late northern hemisphere each winter, with a reduction in carbon dioxide that followed during spring and early summer as plant growth increased in the land-rich northern hemisphere. In 1961, Keeling produced data showing that carbon dioxide levels were rising steadily. The plot of his data, painstakingly collected with incomparable accuracy, is now widely known as the “Keeling Curve.”

The data collection started by Keeling and continued at Mauna Loa is the longest continuous record of atmospheric carbon dioxide  
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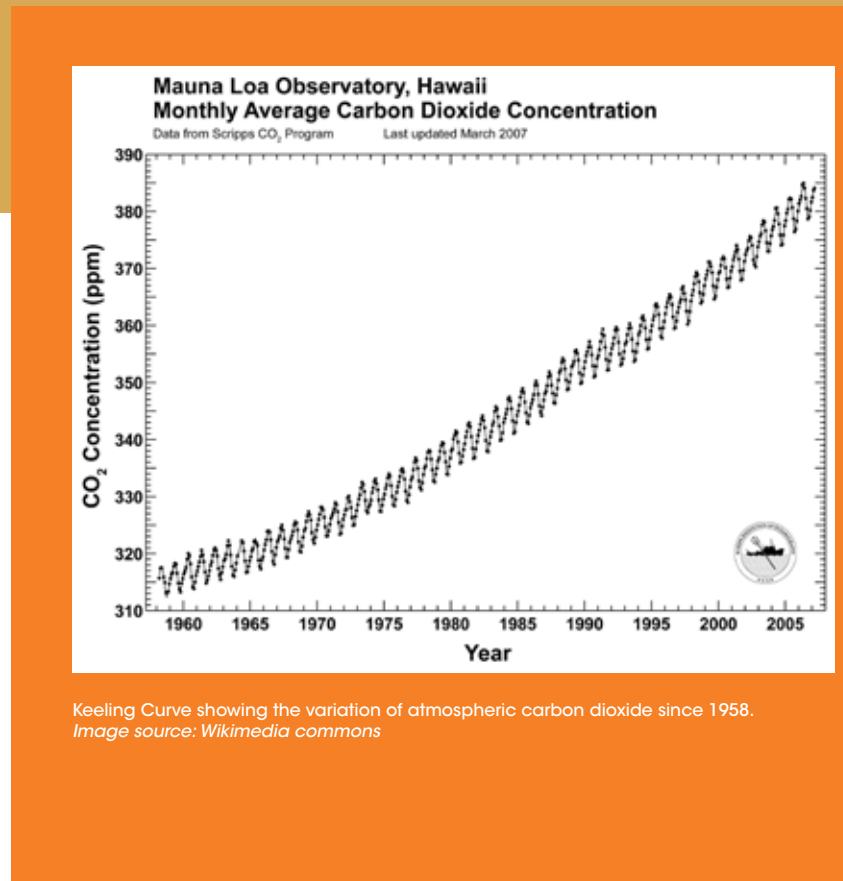
## Alumni Profile: Charles David Keeling

*continued from previous page*

in the world and is considered a reliable indicator of the global trend in the mid-level troposphere. Keeling's research shows that the atmospheric concentration of carbon dioxide has grown from 315 parts per million (ppm) in 1958 to 380 ppm in 2005—which correlates with an increase in fossil fuel emissions.

"Dave Keeling showed that atmospheric carbon dioxide amounts have grown worldwide. His measurements were done with great accuracy, from 1957 until now," said Ralph Cicerone, President of the National Academy of Sciences and the inaugural lecturer for the Department of Chemistry's Charles David Keeling Lecture. "The extremely high quality of his research was traceable to the amount of thought, integrity, and care that he invested in it. His results were well known, used, and respected around the world. During the early 1990s it was said that the only scientific data on display in the White House was one of his graphs; I think that story was true."

Keeling won many awards during his career, including the Second Half Century Award of the American Meteorological Society (1981), the Maurice Ewing Medal of the American Geophysical Union (1991), the Blue Planet Prize from the Science Council of Japan and the Asahi Foundation (1993), the National Medal of Science—the highest U.S.



Keeling Curve showing the variation of atmospheric carbon dioxide since 1958.  
Image source: Wikimedia commons

award for scientific research lifetime achievement (2002), and the Tyler Prize for Environmental Achievement, considered to be the world's most distinguished award in environmental science (2005).

In addition to his numerous awards, Keeling was a fellow of the American Academy of Arts and Sciences, the American Geophysical Union, and the American Association for the Advancement of Science, and a member of the National Academy of Sciences. He served as a member of the Commission on Global Pollution of the International Association of Meteorology, and as scientific director of the Central CO<sub>2</sub> Calibration Laboratory of the World Meteorological Organisation. He was also the author of nearly 100 research articles. ■



BACK ROW: Kathryn Filson, Joel Johnson, Alexandra Rutz, Clare Kane  
FRONT ROW: Caryn Doner, Stephanie Lucas, Arabella Lazar  
NOT PICTURED: Stephanie Lucas, Rebecca Weiner, Madeline Michael, Emily Allen, Sarah Kwon

## Giesecking Scholarship Provides Valuable Research Experience

EACH YEAR, GIFT FUNDS ALLOW THE DEPARTMENT OF CHEMISTRY TO PROVIDE UNIQUE LEARNING OPPORTUNITIES AS WELL AS GENERAL SUPPORT FOR STUDENTS. In addition to private and industrial fellowships for graduate students, the department offers a variety of undergraduate scholarship opportunities for students. This summer, the John E. Giesecking Scholarship provided research opportunities for 11 undergraduate students.

Created seven years ago to provide aid to undergraduate chemistry majors, the Giesecking Scholarship stands as a testament to John E. Giesecking's legacy and dedication to the University of Illinois and the Department of Chemistry. The former Illinois professor, who passed away in 2003, was a crop scientist and consulting chemist who recognized the need to support undergraduate students in pursuing their academic interests.

Research opportunities for undergrads are often transformative, leading many students to explore career paths in chemistry. Clare Kane, 2010 Giesecking recipient, said of the experience, "The scholarship is important not just because it looks good on a resume, but it provides an opportunity to explore areas of chemistry that might otherwise not be available. Doing research this past summer has taught me an enormous amount of chemistry that I would have never learned in any lecture. A hands-on approach is really key to understanding a complex subject such as chemistry."

The Giesecking scholarship also gave students direct experience with unscripted laboratory work, which employers and graduate schools seek. By preparing students for the public presentations and collaborative work that are standard in the field, they are far more confident and effective scientists. Giesecking recipient Arabella Lazar said of the experience, "Receiving the Giesecking scholarship was important because it gave me a chance to experience what grad school would be like. It gave me a better understanding of the research I am doing and how to articulate that to others."

As a part of the scholarship, each student was an integral member of a research group, performing a variety of tasks and assisting graduate students. This summer's projects included: developing grafted polymers for cell surface display, detecting RNA splicing using a biarsenical tetracysteine system, developing analytical applications of gold nanoparticles, and using hematoxylin and eosin staining to identify cancerous tissues.

Receiving the Giesecking scholarship allowed students to stay on campus for the summer and devote time to research and their studies, rather than returning home or taking a less career-focused job. "A scholarship is an honor," said Alexandra Rutz, a 2010 Giesecking recipient, "but also a monetary award that allows the recipient to do the work. The scholarship is important because otherwise, a student may have to return home for the summer and take an ordinary job. The scholarship provides the means to cover the expenses of living away from home, thus facilitating an outstanding work experience."

### 2010 Giesecking Scholarship Recipients and Faculty Sponsors

**Emily Allen** (Scott Silverman)

**Caryn Doner** (Catherine Murphy)

**Kathryn Filson** (Kenneth Suslick)

**Joel Johnson** (Steven C. Zimmerman)

**Clare Kane** (Alexander Scheeline)

**Sarah Kwon** (Scott Silverman)

**Arabella Lazar** (Paul Hergenrother)

**Stephanie Lucas** (Anne Baranger)

**Madeline Michael** (Ryan Bailey)

**Alexandra Rutz** (Steven C. Zimmerman)

**Rebecca Weiner** (Catherine Murphy)

# McCall Research Group Brings Astrochemistry to Illinois

The Milky Way galaxy contains roughly  $10^{66}$  molecules; some 16 orders of magnitude more than are present on Earth. Simple diatomic molecules such as CH and CN were detected in interstellar clouds in the late 1930s, but now the known chemical inventory of these clouds includes roughly 150 species identified by high-resolution spectroscopy. Chemical models suggest there are hundreds, if not thousands, more species that must be present but have not yet been detected. There are also hundreds of molecular transitions (e.g., the Diffuse Interstellar Bands, or DIBs) that have been observed but not yet assigned to individual molecules. This rich chemical inventory is not just a curiosity—these molecules play key roles in the process of star formation, in seeding young planets such as Earth with water and other pre-biotic compounds, and as powerful indirect probes of the temperatures, densities, radiation fields, and velocities of interstellar clouds.

Understanding how these molecules are formed and destroyed in such hostile environments is truly a grand challenge for the chemical sciences. Although the young field of “astrochemistry” has made impressive progress, there is a great deal left to be understood. As illustrated in the figure below, the major areas of investigation that feed into astrochemistry can be broadly classified into four topics: molecular structure and spectroscopy; chemical reaction kinetics and dynamics; astronomical spectroscopy; and astrochemical and astrophysical modeling.

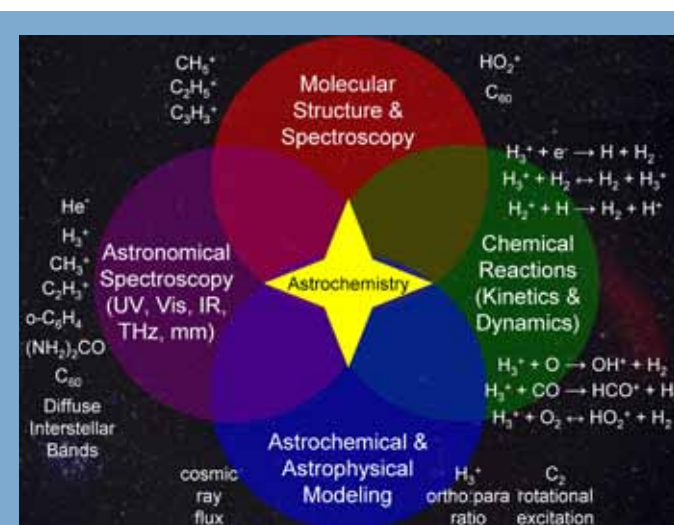
At Illinois, Professor Ben McCall leads a team of chemists, physicists, and astronomers with expertise in all four of these areas. In terms of molecular structure and spectroscopy, his group is building innovative laser spectrometers to acquire the high-resolution, gas-phase spectra of astrophysically important molecular ions (including  $\text{CH}_3^+$ ,  $\text{C}_2\text{H}_5^+$ ,  $\text{C}_3\text{H}_3^+$ ,  $\text{C}_6\text{H}_7^+$ , etc.) as well as the large, highly stable neutral molecule  $\text{C}_{60}$ . He also actively collaborates with theorists to perform state-of-the-art calculations of these and other molecules to guide his group’s laboratory and astronomical work. His group is also active in measuring (and, with collaborators, calculating) the rates and branching ratios of key chemical reactions, especially those involving  $\text{H}_3^+$ , the centerpiece of interstellar chemistry.

Most of McCall’s spectroscopic targets are also of great fundamental interest, in that they exhibit non-classical bonding and fluxional dynamics (e.g.,  $\text{CH}_5^+$ ,  $\text{C}_2\text{H}_5^+$ ) or possess very high symmetry ( $\text{C}_{60}$ ). Some are also prototypical reactive intermediates in organic chemical reactions, such as electrophilic aromatic substi-

tution ( $\text{C}_6\text{H}_7^+$ ). The detailed understanding of the structure and intramolecular dynamics (e.g., tunneling motions) of these ions may ultimately lead to new insights into organic reactivity from a quantum mechanical perspective.

On the astronomical side, McCall is actively engaged in astronomical observations as well as analytical modeling. His group is best known for its work on interstellar  $\text{H}_3^+$ , and using its abundance to infer the flux of interstellar cosmic rays. He is also involved in millimeter-wave searches for more complex molecules, such as urea, and in the study of the DIBs in the optical. The close synergy of laboratory, observational, and theoretical work makes his group rather unique.

McCall is also committed to educating the next generation of astrochemists. He has developed an entirely new undergraduate lecture and laboratory course. The latter has made use of the University of Illinois campus observatory. Steve Zimmerman, Head of the Department of Chemistry, fittingly noted, “Ben is a rising superstar who is pioneering this new and exciting area of chemistry. He is a gifted lecturer and a sought-after research advisor. We are delighted to have him here at Illinois.” ■



## New Faces: Professor So Hirata



THE DEPARTMENT OF CHEMISTRY IS EXCITED TO WELCOME PROFESSOR SO HIRATA TO THE UNIVERSITY OF ILLINOIS. Hirata received his B.S and M.S. from the University of Tokyo and his Ph.D. from the Graduate University for Advanced Studies (Institute for Molecular Science) in Japan. After completing his graduate work, he served as a visiting scholar at University of California, Berkeley and a postdoctoral research associate at University of Florida. He was a senior research scientist from 2001 to 2004 at Pacific Northwest National Laboratory prior to serving as assistant professor at University of Florida, where he was promoted to associate professor in 2009. Hirata joined the Illinois faculty in August 2010 as full professor and alumni research scholar as well as a faculty member of the Institute for Advanced Computing Applications and Technologies (IACAT).

Chemistry first attracted Hirata during his undergraduate studies. “As an undergraduate student at the University of Tokyo, I was given two years to decide on a major,” said Hirata. “Of the various subjects I studied during the first two years, I was most deeply impressed by the exquisite beauty of quantum mechanics and statistical thermodynamics as applied to chemistry—namely, by how properties and transformations of molecules as individuals or as innumerable sums can be infallibly described by these mathematical theories.”

He first visited campus as a seminar speaker and was drawn to Illinois for a variety of reasons. “I liked every aspect of the University,” he said, “from its unmatched record of excellence to how the campus looked... I knew that joining the department would be the best thing that could happen to my career.”

Hirata is a computational chemist who seeks to quantitatively interpret and even predict the properties and transformations of molecules, polymers, and solids. He and his coworkers develop new mathematical methods and algorithms to make the fundamental equations of motion of chemistry, which are high-dimensional partial differential equations, tractable for numerical solutions. They make the resulting computer software available for application

by the entire chemistry community. Today, they are increasingly focusing their efforts on accurate methods for understanding solids, potentially leading to new and advanced materials. The Hirata Research Group will benefit from Illinois’ commitment to cutting-edge computer technology and development. Hirata said, “Illinois offers literally the best computing resources and the brightest minds among colleagues in chemistry, physics, materials science, and computer science for this type of research.”

In searching for a leading theoretician, the Department of Chemistry consulted with the top practitioners throughout the world,” noted Steve Zimmerman. “The consensus was that So Hirata was the leading figure in his age group, an incomparable scholar whose creativity, breadth, and depth were simply outstanding. Naturally, we are delighted he chose to join our community of scholars.”

The recipient of numerous awards, including Camille Dreyfus Teacher-Scholar (2009-14), National Science Foundation CAREER Award (2009-14), Hewlett-Packard Outstanding Junior Faculty Award (2008), and the Japan Society for the Promotion of Science Fellowship for Young Scientists (1996-99), Hirata considers the Medal of the International Academy of Quantum Molecular Sciences as his most honored prize. In 2008, he won for his work on theory and algorithm developments in electron correlated methods for molecules and extended systems. The award, presented to a young member of the scientific community who has distinguished themselves by a pioneering and important contribution, was also bestowed upon Professor Nancy Makri in 1995.

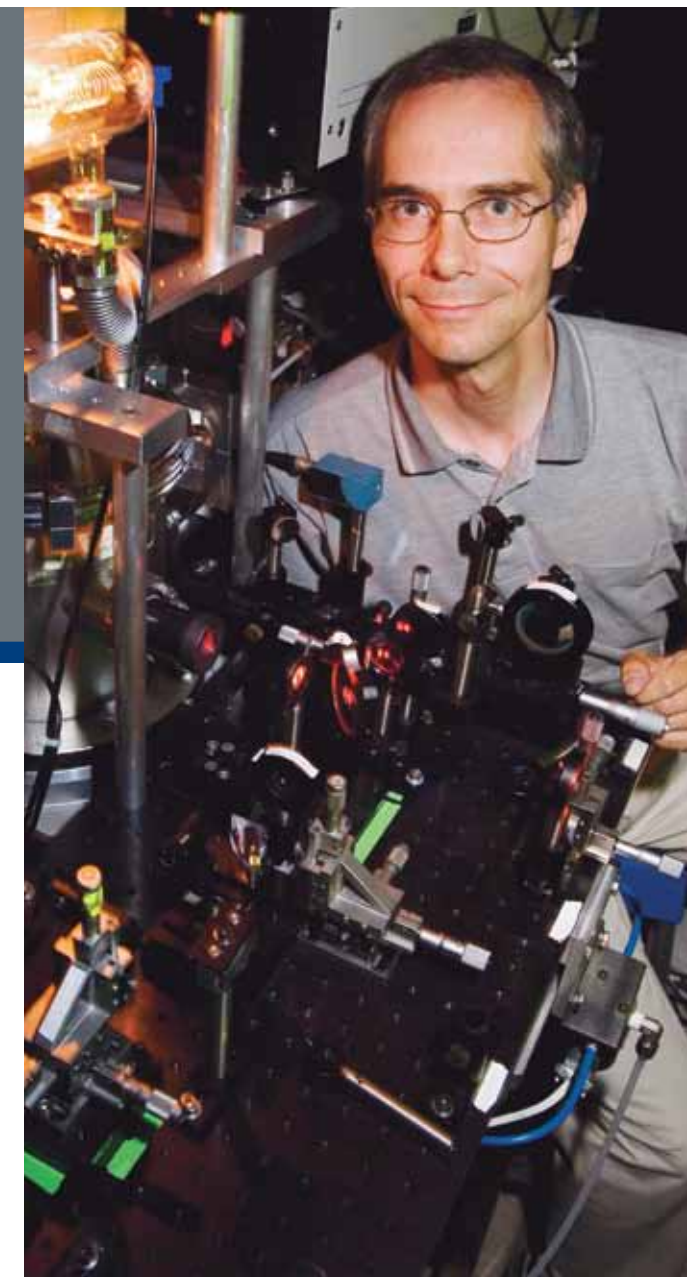
### The Department of Chemistry also welcomes...

**Martha Awles**, Career Counseling and Placement Services Secretary  
**Kristin Lang**, Stewardship and Advancement Coordinator  
**Nicholas Llewellyn**, Lecturer  
**Todd Spinner**, Undergraduate Advisor (School of Chemical Sciences)  
**Alex Ibarra**, Instructional Technology Specialist





## A Moment with Martin Gruebele



Dr. Martin Gruebele, the James R. Eiszner Endowed Chair in Chemistry, has been with the Department of Chemistry since 1992 and over the last 18 years has garnered a number of prestigious awards for his innovative research, including a recent selection as a fellow of the American Academy of Arts and Sciences.

The Gruebele Group is engaged in experiments and computational modeling to study a broad range of fundamental problems in chemical and biological physics. A common theme in these experiments is the implementation of state-of-the-art laser techniques to interrogate and manipulate complex molecular systems, coupled with quantum or classical simulations. The results of these efforts are contributing to a deeper understanding of the way that proteins fold into functional 3-dimensional molecules, the details of how chemical bonds are broken by vibrational motion and how this can be controlled, and the switching of energy flow in large molecular structures on surfaces.

We caught up with Gruebele to discuss his latest research and how his family and childhood led to his career as a chemist.

### How did you decide to pursue an education and career in chemistry?

In the 1970s in Austria, it was rather easy for children to buy chemicals and glassware, at least if you sounded like you knew what you were talking about. So I had a fully stocked lab at home. My parents wanted something more 'practical' than chemistry, but after a pre-med semester as a biochemistry major, I switched over to chemistry, synthesizing co-crystallization agents for Ken Sauer at the Melvin Calvin Lab, and later doing gas phase spectroscopy on ions of interest in interstellar chemistry with Rich Saykally (at University of California, Berkeley).

### Is there anyone in particular that inspires you as a chemist?

My academic great-great grandfather Linus Pauling, who I was lucky enough to still know in person, and his great-grandfather Justus von Liebig. Von Liebig was one of the first biological chemists, and the first to realize (before Woehler's famous synthesis of urea) that organic and inorganic matter are fundamentally made from the same elements, and organic matter can be synthesized. At the same time, he was very practical, inventing everything from the basic laboratory condenser to the cubes of meat extract still used to flavor soups today. Pauling is perhaps the most brilliant physical chemist ever. He introduced quantum mechanics into chemistry and frankly, his general chemistry text is still better than anything around today. He worked on everything and anything, from protein secondary structure to quasi-crystals, to hybrid orbitals, to transition state theory of enzymes.

### In April, you were named a fellow of the American Academy of Arts and Sciences. How does it feel to join such a prestigious group?

It's great! I hope Francis Ford Coppola shows up (also elected this year), so I can meet the creator of "Godfather," "Apocalypse Now," and "Patton" in the flesh and blood. It is an Academy of ARTS and Sciences!

### Your groundbreaking research on protein folding within cells has the potential to revolutionize the study of biological processes in diseases such as Alzheimer's and Huntington's. What drew you to this area of study?

Frustration. We had been trying to study proteins in artificial crowded environments in the test tube. Although we were slowly getting results, it was very difficult because proteins would aggregate under these conditions [speaking of Alzheimer's and Huntington's, which are aggregation-related diseases]. At one point I thought, "It can't be any harder to just do this in a real cell!"

Graduate student Apratim Dhar started to set up a microscope that could "jump" cells to induce a protein in them to fold or unfold, and he was soon joined by Simon Ebbinghaus, who I was lucky to get as a postdoc from Germany. Professor MacDonald provided his microscope and came up with some crafty optical tricks, and voila: proteins folded and unfolded in cells without aggregating. In hindsight, cells have a few billion years of evolution behind them to make sure proteins don't aggregate inside of them under crowded conditions. We have yet to figure out in detail how crowding within cells is physically different from the simplified crowding models in test tubes.

### You attended UC Berkeley for your undergraduate and graduate coursework and worked at the California Institute of Technology as a postdoctoral fellow. What made you decide to move to the Midwest and pursue a career at Illinois?

Our group is very heavy on new instrumentation design. The School of Chemical Sciences simply has the best shops and facilities in the U.S. Period. The only serious competition was a C4 position I had been offered in Germany. It also didn't do any harm that my then-girlfriend Nancy Makri had just gotten a job here. So I said good-bye to the tenured professor offer in Germany, and went to Illinois instead.

### What is your favorite aspect of working at Illinois?

The students. I think this would be true anywhere. Students and postdocs are like a great amplifier that makes possible what a single person could never come close to doing. Over the last 10 years we have seen an even further extension of this to interdisciplinary collaboration creating very large 'effective group sizes.' Interdisciplinary interactions are easy and many on campus, and I've co-authored papers with many other faculty. The interdisciplin-

ary system has its pitfalls (committee-ism), but also, as 'Big Physics' discovered over 70 years ago, its advantages.

### If you could give advice to a student interested in pursuing a career in chemistry, what would it be?

Find out where your greatest strengths are, and pursue them. Do the rest as a hobby.

### Is there anything else you would like to add?

I've been here for well over a decade. I look forward to the next! ■

## Faculty and Alumni Elected Fellows of the American Chemical Society



FOUR PROFESSORS AND EIGHT ALUMNI OF THE DEPARTMENT OF CHEMISTRY WERE AMONG THE 192 DISTINGUISHED SCIENTISTS ELECTED 2010 FELLOWS OF THE AMERICAN CHEMICAL SOCIETY (ACS) at the Fall National Meeting in Boston. Unlike other ACS national awards, this honor is bestowed upon scientists who have made outstanding contributions to both chemistry and the ACS. The group includes scientists from a wide range of disciplines and geographic locations, including 33 technical divisions and 79 local sections. The 2010 class also includes distinguished scientists and engineers from industry, academia, and government.

**Professor Peter Beak**, the James R. Eiszner Endowed Emeritus Chair in Chemistry—a leader in physical organic chemistry—has advanced the characterization and understanding of organic reactions. He has made significant contributions to stereochemistry through his study of reaction geometry at nonstereogenic atoms. He also is a member of the National Academy of Sciences and a fellow of the American Academy of Arts and Sciences.

**Professor Theodore Brown**, an emeritus professor of chemistry, was the founding director of the Beckman Institute for Advanced Science and Technology at Illinois. He has been an active leader and adviser within the scientific community, including service on the ACS Governing Board for publishing and co-chairing a National Academy committee on interdisciplinary research. He is a pioneer in the area of organometallic chemistry. He has written books on philosophical, social, and cognitive aspects of science and co-wrote a best-selling general chemistry text.

**Professor Jeffrey Moore**, the Murchison-Mallory Professor of Chemistry, is an alumnus of Illinois who returned to join the faculty. His research focuses on large organic molecules and polymers in three main areas: macromolecule construction, self-healing polymers, and materials for energy storage. He has a joint appointment in the Department of Materials Science and Engineering, is a member of the Beckman Institute for Advanced Science and Technology, and is a fellow of the American Academy of Arts and Sciences.

**Professor Kenneth Suslick**, the Marvin T. Schmidt Professor of Chemistry, has pioneered the study of the chemical effects of ultrasound and its applications to nano-materials synthesis and sonoluminescence, as well as exploring plasma formation in imploding bubbles. His team also is at the forefront of chemical sensing, and developed an artificial “nose” capable of molecular recognition. He holds a joint appointment in the Department of Materials Science and Engineering and is a member of the Beckman Institute for Advanced Science and Technology.

**Chris Cramer** (Ph.D. 1988, Denmark) is currently the Distinguished McKnight and University Teaching Professor and holds the Elmore H. Northey Chair in the Chemistry Department at the University of Minnesota, where he began his academic career in 1988. He also served as an active duty officer in the United States Army. His research interests encompass the development and application of models that include condensed-phase effects on structure and reactivity, the characterization of the electronic structures of organic and inorganic systems having frontier-orbital near degeneracies, and the application of computational methods for both catalyst and materials design, with special interest in water splitting and oxygen activation. He is the recipient of numerous professional awards and serves as the editor of *Theoretical Chemistry Accounts* and as the North American editor for the *Journal of Physical Organic Chemistry*.

**George Inglett** (B.S. 1949), who worked as an undergraduate for Professor G. Frederick Smith, has traveled to and lectured in about 60 countries in his career. He has published more than 300 articles, books, chapters and patents and made about 270 presentations. He has worked in private industry as well as the public sector, including 40 years at the USDA-ARS National Center for Agricultural Utilization Research, where he created TRIM TECHNOLOGIES. Inglett has been recognized many times for his expertise in the field of food science, including the prestigious Lincoln Award, the highest award for achievement by the state of Illinois, in 2005. Said Inglett, “I have contributed to many scientific discoveries and seen most of the world since my undergrad days, but those Illinois days will never be forgotten.”

**Leonard Interrante** (Ph.D. 1964, Bailer) is currently professor of chemistry and chemical biology at the Rensselaer Polytechnic Institute. Interrante was an NSF Postdoctoral Fellow in London at University College. His first teaching assignment came as an assistant professor at the University of California, Berkeley, where he continued for four years. Before coming to Rensselaer in 1985, Interrante spent 17 years at the General Electric Research and Development Center in Schenectady. He is the founding and current editor-in-chief of the ACS journal *Chemistry of Materials*.

**Paul Jones** (Ph.D. 1956, Fuson) is currently a visiting scholar at the University of Michigan and professor emeritus of chemistry at the University of New Hampshire, where he has been a faculty member since completing his Ph.D. in 1956. In addition to his academic positions, Jones has been the recipient of numerous research and faculty fellow positions, including two Fulbright fellowships. He is active in the American Chemical Society, serving as ACS Councilor, Huron Valley Section from 2003-2009 and as a member of the ACS Publications Committee from 2006-2010.

**C. Gordon McCarty** (Ph.D. 1963, Curtin) is currently adjunct professor at University of South Carolina Beaufort. He had previously worked for Bayer Corporation in Pittsburg. In addition to his industrial and academic careers, McCarty has been dedicated to the ACS, serving on its board of directors.

**Tim Minton** (B.S. 1980) traces his scientific career back to his year working with Professor Willis Flygare. After receiving his Ph.D. from the University of California, Berkeley, Minton returned to Illinois to do post-doctoral research with Doug McDonald. After five years at the Jet Propulsion Laboratory, Minton left to pursue an academic career in the Chemistry and Biochemistry Department at Montana State University, where he has worked for 15 years. His research focuses on reaction dynamics, with special emphasis on hyperthermal gas-phase and gas-surface reactions and their relevance to environmental effects on space vehicles in low Earth orbit.

**John Verkade** (B.S. 1956, Ph.D. 1960, Piper) is active in research and teaching at Iowa State University, where he began immediately after graduating from Illinois as Stan Piper's first Ph.D. student. Over his half-century at Iowa State, his research in organophosphorus chemistry has resulted in more than 400 publications, eight books, and 20 patents. His service to the ACS has included posts as chair of the Society Committee on Publications, the C&EN Editorial Board and the Chemical Abstracts Services Committee as well as Region V Director on the ACS Board of Directors. Piper inspired Verkade to pursue an academic career by encouraging him to conduct his research on the coordination chemistry of a new cage-like organophosphite ligand. Verkade also said that he has Elias (E.J.) Corey and Reynold Fuson to thank for teaching him the elegance of organic chemistry.

**Christopher Welch** (B.S. 1982, Ph.D. 1992, Pirkle) is a Distinguished Senior Investigator at Merck Research Laboratories, where he has been employed for 11 years. He worked with Professor Pirkle during his undergraduate and graduate tenure at Illinois and noted that his undergraduate research experience solidified his decision to become a working chemist. Since receiving his Ph.D., he published more than 175 articles and is now viewed as an expert in the field of chiral chromatography. Welch said, “At Illinois we were always reminded that in addition to pursuing personal research objectives, it was also important to support the infrastructure of chemistry. I have tried to follow that guidance, and have been an active member of the ACS, where I currently serve as a Councilor for the Division of Organic Chemistry (ORGN). I'm thrilled to be one of the nine U of I graduates inducted in the 2010 class of ACS fellows!”

Inaugurated in 2009, the fellows program recognizes a select group among the 161,000 ACS members who have made exceptional achievements in both science and society. The ACS is the world's largest professional society and we are delighted that so many Illinois alumni have been selected as fellows. ■

Reprinted in part from an article by the University of Illinois News Bureau.

## Alumni Notes

**Tony Barnes** (Ph.D. 1984, *Nieman*) is currently Senior Vice President of Clinical Diagnostics at Rules Based Medicine in Austin, Texas, as well as a Special Professor at the University of Nottingham and a fellow at the Institute for Advancing Medical Innovation at Kansas University. Previous to his position at Rules Based Medicine, Barnes started a company with Professor John Robertson of Nottingham University with the goal of using the early detection of autoantibodies to cancer specific antigens to save cancer patients. The company raised more than \$45 million in support and developed a product which has recently been shown to detect lung cancer early and with good reproducibility.

**Theodore W. Gray** (B.S. 1986) one of the founders of Wolfram Research and currently Wolfram's Director of User Interface Technology, has received the James T. Grady-James H. Stack Award for Interpreting Chemistry for the Public sponsored by the American Chemical Society. The purpose of the award is to recognize, encourage, and stimulate outstanding reporting directly to the public, increasing the public's knowledge and understanding of chemistry, chemical engineering, and related fields.

**Philip Horwitz** (M.S. 1955, Ph.D. 1957, *Moeller*) a Senior Scientist for NorthStar Engineering Technologies, was part of a team that recently won a 2010 R&D Award. The awards, widely recognized as the "Oscars of Innovation," identify and celebrate the top high technology products of the

year. The R&D 100 Awards spans industry, academia, and government sponsored research: sophisticated testing equipment, innovative new materials, chemistry breakthroughs, biomedical products, consumer items, and high-energy physics. Horowitz is also the holder of countless technology patents on the subject of chemical separations and the winner of numerous awards, including the 1984 Glenn T. Seaborg Actinide Separations Award, the 2000 American Chemical Society Award in Separation Science and Technology, and in 2004, the prestigious Becquerel Medal Award presented by the Royal Society of Chemistry in London.

**Steven Thorn** (M.S. 2000) is the founder of Thorn & Associates LLC. His practice covers all aspects of federal and state environmental law. Prior to founding the firm, Thorn was an Associate Regional Counsel at U.S. EPA, Region 5 (handling matters in Illinois, Indiana, Ohio, Minnesota, Wisconsin and Michigan) and an environmental attorney at a large Chicago-based law firm. During this time, he was involved in several hundred enforcement matters that spanned the spectrum of environmental statutes. In addition to winning numerous awards for his work, he was designated a Leadership in Energy and Environmental Design Accredited Professional (LEED® AP) by the United States Green Building Council.

**To submit an alumni update and receive the most current and news, check out the alumni page on the Department of Chemistry website:** [chemistry.illinois.edu/alumni](http://chemistry.illinois.edu/alumni)

## Chemistry at Illinois' Oldest Alumnus: Charles "Hap" Fisher

THE DEPARTMENT OF CHEMISTRY IS DELIGHTED TO SEND BIRTHDAY WISHES TO CHARLES "HAP" FISHER, our oldest known living alumnus, who celebrated his 104<sup>th</sup> birthday on November 20, 2010.

Fisher was Professor R.C. Fuson's first U.S. graduate student, receiving his M.S. and Ph.D. in 1929 and 1932. After completing his doctoral work during the Great Depression, he received a three-year teaching appointment at Harvard University. Fisher has said his goal in life was to "make people's lives better through science," and he had a successful and prolific career after leaving Harvard to work for the U.S. government in several research capacities, with the bulk of his time spent at the Southern Regional Research Center (SRRC) in New Orleans, Louisiana. During his tenure at SRRC, Fisher appeared as inventor or co-inventor on 72 patents, including popular products such as flame resistant cotton, frozen orange juice, wash-wear and durable press cottons. In addition to the numerous products he worked on, he also authored more than 200 scientific articles.

He later returned to academia after his retirement from government work, teaching chemistry at Roanoke College, his undergraduate alma mater. Despite his retirement, Fisher actively taught and was instrumental in growing the chemistry department, suggesting programs such as guest speaker seminars and student research initiatives. It wasn't until his 100<sup>th</sup> birthday that he retired, again. Today, the Organic Chemistry Lab at Roanoke College bears his name to recognize his efforts and contributions.

Fisher and his work have garnered numerous awards and recognition throughout his career, including the Presidential Citation of Merit from the American Institute of Chemists and being named a "Chemical Pioneer," a program that he was instrumental in initiating.

Happy 104<sup>th</sup>, Hap!

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## Buhrke's Research in X-ray Florescence Garners Birks Award

THE DEPARTMENT OF CHEMISTRY IS DELIGHTED TO ANNOUNCE THAT DR. VICTOR BUHRKE (B.S. 1950, M.S. 1952, PH.D. 1954) HAS RECEIVED THE PRESTIGIOUS BIRKS AWARD for his work in X-ray fluorescence (XRF). The award was presented in August at the Denver X-ray Conference, a meeting that attracts approximately 500 scientists from around the world. The award was established in 1986 to recognize outstanding contributions to the field of X-ray spectrometry, and was named in honor of L.S. (Verne) Birks for his many contributions to the X-ray analysis field.

The Birks Award is Buhrke's second award from the Denver X-ray Conference. In 2005, he received the Jenkins Award for lifetime achievement in the advancement of the use of X-rays for materials analysis.

Receiving both awards is an extraordinary accomplishment, an honor shared only by Buhrke and his friend Dr. John Gilfrich. These awards stand as a testament to Buhrke's five-decade long career and his outstanding contributions to the field, including writing the seminal text on specimen preparation, which has enabled scientists worldwide to increase the accuracy of their XRF and X-ray diffraction (XRD) analysis.

About the honor, Buhrke said, "Receiving the Birks Award is a very exciting event in my life. Birks and Jenkins are both deceased. They were very dear friends of mine and I hope they are both looking down to see me smiling."

Throughout his career, Buhrke has remained involved in the activities of Illinois and the Department of Chemistry. In 2007, a generous bequest from Buhrke and his wife Janet led to the renovation and dedication of 100 Noyes as "G.L. Clark Hall," named in honor of their friend and mentor Professor G.L. Clark., an expert and innovator in X-ray applications, and who mentored Gene Bertin, another recipient of the Birks Award and friend of Buhrke and the Department.



## Remembering Richard Heckert

RICHARD E. HECKERT, ILLINOIS ALUMNUS, SUPPORTER, AND FORMER CEO OF DUPONT, PASSED AWAY JANUARY 3, 2010, AT HIS HOME IN PENNSYLVANIA AT THE AGE OF 85. He will be remembered for his kindness, generosity, and dedication to Illinois chemistry, its students, and its mission.

Heckert was born on January 13, 1924, in Oxford, Ohio. He graduated in 1944 from Miami University in Oxford with a B.A. in chemistry. From 1944 to 1946, he served in the United States Army, working on the top-secret Manhattan Project at the Oak Ridge, TN, atomic energy facility. Following his discharge, he received an M.A. (1947) and a Ph.D. (1949) in organic chemistry from Illinois under Harold Snyder.

Beginning in 1949, Heckert spent his entire career at the DuPont Company, holding a number of positions and eventually rising to CEO in 1986. Described by *Fortune* magazine as “gregarious, relaxed and unflappable... a 6-foot-3, friendly bear of a boss,” Heckert was committed to research and safety. He lobbied extensively for fair treatment of the chemical industry in Washington, DC, while working hard to ensure that DuPont plants and products were safe for employees and their environs. He engineered the withdrawal of DuPont from the Savannah River Plant, a nuclear facility DuPont managed for the government. When it was determined that chlorofluorocarbons were detrimental to the ozone layer, he acted quickly to phase out CFCs by the end of the century.

In addition to his work at DuPont, Heckert was also an advisory director of Marsh & McLennan Companies, Inc., as well as a director of Remington Arms Company, Inc. and RACI Holding, Inc. He was chairman of both the National Association of Manufacturers and of the Society of Chemical Industry as well as a member of the American Chemical Society and National Board for Professional Teaching Standards.

Throughout his career, Heckert remained dedicated to the University of Illinois and Department of Chemistry, receiving an Alumni Achievement Award in 2004. His commitment to excellence at Illinois and his generosity allowed for the creation of both the Snyder Graduate Fellowship, named in honor of his mentor at Illinois, and the Richard E. Heckert Endowed Chair in Chemistry, currently held by Professor Wilfred A. van der Donk.

“It is a truly great honor to occupy the Heckert chair,” said van der Donk. “Although I only had the pleasure to get to know him during a period of about two years, I always tremendously enjoyed my conversations with Dick. He had very diverse interests and such an open and inquisitive mind. It was fun to talk about his days at Illinois and how much things had changed. But at the same time, his recollections illustrated how in many ways Illinois chemistry has remained the same: a highly interactive and collegial environment. And obviously, he had fantastic stories from his illustrious career. I was particularly pleased and honored that Dick was here for the investiture of the chair and that my students got to meet him and hear him speak about chemistry at Illinois and about his career.”

Always modest and unpretentious, at first Heckert did not wish to have the Chair named after himself, but instead merely wished to provide the funding to allow a Chair in chemistry to be created. Only at the request of the department and the University of Illinois Foundation would Heckert agree to allow the Richard E. Heckert Chair to be named as it was. Now, it provides prestige and support to its holders and stands as a tribute to one of chemistry’s distinguished alumni.

Richard is survived by his wife, Joanna, and two children from his first marriage, Alex Y. Heckert and Andra Heckert Rudershausen. An avid outdoorsman, Heckert served the environment by chairing The Nature Conservancy from 1989 to 1995. He enjoyed fly-fishing, ocean fishing, hunting, as well as shooting trap and skeet. A six-handicap golfer in his prime, he had memberships at Pine Valley and Augusta National golf clubs. Heckert also served as president of the Bear River Club near Brigham City, Utah, from 2001-2009. He was an avid vegetable gardener, growing a truck-size garden at his home in Pennsylvania, and also enjoyed the challenge of managing the shorter growing season in his Wyoming garden.

“What an extraordinary person and amazing life,” noted Steve Zimmerman. “Dick will be greatly missed here at Illinois. His humility in attributing his success to Illinois and particularly Harold Snyder was inspirational. I will always remember how when we walked through Roger Adams Laboratory he would greet each student we passed with a commanding, yet gregarious, *Hello, how is it going?* He clearly felt a part of our family and we are fortunate to be able to count him as one of Illinois’ greats.” ■



## Remembering Stanley Smith

STANLEY G. SMITH, BELOVED PROFESSOR, INNOVATOR, AND FRIEND OF THE DEPARTMENT OF CHEMISTRY, PASSED AWAY ON JUNE 1, 2010, FOLLOWING A THREE-YEAR BATTLE WITH CANCER.

Smith joined the faculty at Illinois in 1960 after receiving his B.S. from the University of California, Berkeley and his M.S. and Ph.D. from UCLA. Within three years he had published three single authored papers including his first on what would become a seminal study on the mechanism of Grignard, organolithium, and lithium aluminum hydride addition to carbonyl compounds. This was made possible by his development of a scanning, infrared, stopped-flow spectrometer. He and his group subsequently carried out some of the earliest mechanistic studies on the addition of copper reagents to unsaturated ketones. Smith was widely regarded as one of the brightest young practitioners in the area of physical organic chemistry, and his studies included mechanistic work on solvolyses, alkylation, photochemical, rearrangement, and elimination reactions.

In 1968 Smith began researching the use of computers in chemical education, and in 1970 published in the *Journal of Chemical Education* a groundbreaking paper entitled, “Use of Computers in the Teaching of Organic Chemistry.” This began a 40-year period where his leadership led to the widespread integration of computer-based technologies into instruction in general and organic chemistry. Milestones during that period included extending the PLATO-based instructional programs to microcomputers in 1979, incorporating videodisc technology in 1984, which enabled the integration of videos into learning programs, and preparation of one of the first instructional CDs.

Smith applied his research on computer-based chemical education in the creation of the Chemistry Learning Center in 1972 as a way to teach basic chemistry concepts through drill-based tutorials. Cutting-edge in technology and philosophy, Smith’s vision was to allow students to work through tutorials at their own pace and order of choosing. In addition, he created a suite of tutorials in a broad range of topics in chemistry. He was widely acknowledged as a leader in computer-assisted learning in chemistry, with his programs widely adopted by universities, colleges, and secondary schools.

Today, the Chemistry Learning Center continues Smith’s vision of providing technology and a high level of support to chemistry students. Open six days a week and evenings to accommodate students’ busy schedules, the CLC provides a variety of tutoring options, 70 computer workstations, and study space. Smith had said of the space, “The barriers to learning become lower. With the software it’s easier now to imagine chemical structures, you can balance equations visually, not rely solely on your imagination. Learning chemistry becomes conceptually easier.”

Over the years, he was widely recognized for his work with numerous awards, including the EDUCOM/ENCRIPTAL Best Tutorial Software Award and Best Chemistry Software Award (1987), the Chemical Manufacturing Association Catalyst Award (1987), the Best Integrated and Best Chemistry Software in 1989, the IBM/EDUCOM Robinson Award for Instructional Computing in 1992, and the George C. Pimentel Award from the American Chemical Society in 1998. He was a fellow of the Association for the Development of Computer-Based Instruction and the Sloan Foundation. In 1990 Smith was appointed Jubilee Professor in the College of Liberal Arts and Sciences and in 1995 was appointed as the first Murchison-Mallory Chair in Chemistry, a title he held for more than a decade.

In addition to his innovation in computer-assisted learning and his prestigious research career, Smith will be remembered as a great colleague, advisor and friend. “Stan was an unfailing source of support and encouragement,” said Bob McMahon (B.S. 1980). “I relied upon his wise counsel and dispassionate advice throughout my professional career.”

Professor Peter Beak noted that Smith was instrumental in starting the service facilities, now a vital resource provided by the School of Chemical Sciences. He wrote, “Stan was a truly remarkable colleague. Much of my early work was forged by discussions with him. In that, as well as in our later research, he was always willing to go out of his way to provide ideas, analysis, and helpful criticism.” ■

## In Memoriam

**William Banick, Jr.** (Ph.D. 1957) passed away November 11, 2009. He was born in Dunmore, PA, and received his undergraduate degree from Kings College before receiving his Ph.D. from the University of Illinois. He worked for American Cyanamid for 40 years before retiring in 1997, and was a member of the American Chemical Society. Banick is survived by his wife of 53 years, Elizabeth, two daughters, a son, and siblings, as well as many grandchildren, nieces, and nephews.

**Homer J. Birch** (M.S. 1949, Ph.D. 1952) born June 1, 1918, passed away April 18, 2010. After working as a chemist and supervisor during World War II, Birch completed his M.S. and Ph.D. at Illinois while working as a teaching assistant and a research chemist doing instrumental work for other students. He also assisted in the early development of carbonless copy paper for National Cash Register. He returned to the Belle Works of DuPont where he performed advanced analyses in polymer development and catalyst research. Birch has been a resident of the township of Marshall since 1957. He came to Pennsylvania in 1956 to work at Callery Chemical Company in Evans City as a chemical laboratory supervisor in the development of high-energy fuels for the U.S. Department of the Navy. In 1959, he worked at

the Applied Research Laboratory at U.S. Steel as an associate research consultant, where he performed analytical work in the development of plated steels, cements, and various polymers. Birch is survived by his wife of 66 years, Edith Mielow, and his children Norman James Birch (Aileen), and Emily Kristine Birch (Barbara Jones), his brother Paul Birch of Struthers, OH, and numerous cousins, nieces, and nephews. He was preceded in death by his brother Clifford and his sister Mary Louise.

**Fred Easterday Boettner** (Ph.D. 1947) passed away February 3, 2010. Born in Murphysboro, IL, Boettner received his undergraduate degree from Carthage College and his master's degree from Tulane University before attending the University of Illinois. His career spanned five decades, and he was well known in the chemical field, accumulating more than 25 U.S. patents and 228 foreign patents. His work with the National Cancer Institute was especially acclaimed due to his participation in the development of Taxol, an anti-cancer drug. Boettner was a member of the American Chemical Society for more than fifty years. An accomplished woodcarver, he is survived by three children, his grandchildren, and a great granddaughter.

**Paul L. Cook** (M.S. 1952, Ph.D. 1954) passed away February 2, 2010. He was born March 2, 1925 in Holland, MI, to Peter and Adriana (Breen) Cook. He graduated from Holland Christian High School in 1943, then served his country in the U.S. Army during World War II in the 102nd Infantry from June 1943-September 1945, stationed in France, Belgium, Holland, and Germany. Cook received the Bronze Star for Bravery. He graduated from Hope College in 1950 and received a master's degree and Ph.D. degree in organic chemistry from the University of Illinois. After graduate school he began his teaching career at Albion College. He taught chemistry for 36 years, served on many faculty committees, and passed on his love for chemistry and education to students who went on to graduate school or medical school. He was a member of the American Chemical Society, Sigma Xi, The University of Illinois Alumni Association, Albion Exchange Club, and the Lansing American Legion. In addition to his wife, Alice, of 58 years, he is survived by four daughters, ten grandchildren, and one brother. He was preceded in death by his parents, a sister, and brother-in-law.

**Philip Nickerson James** (Ph.D. 1957) born August 15, 1932, died peacefully of natural causes in Sun City, AZ, on June 28, 2010. James was a graduate of MIT and held a Ph.D. in organic chemistry from the University of Illinois. He married the love of his life, Barbara Fagan James, in 1954. After working as an executive leader in academia, industry, and government for more than 40 years, James and his wife retired and toured America in their motor home. He is survived by his sons, Greg and Larry, and his grandchildren, Chris and Jill.

**Edwin G. Krebs** (B.S. 1940, Hon. 1995) born in Lansing, IA, on June 6, 1918, passed away December 21, 2009, in Seattle. Krebs was a member of the National Academy of Sciences and received a number of major prizes, most notably a shared 1992 Nobel Prize for discovering a crucial bodily process that helps govern the movement of muscles, the shape and division of cells, and even learning and memory. The process he discovered in the 1950s with Edmond H. Fischer, a colleague at the University of Washington, activates proteins that can change the entire character of cell functions, thus regulating them. Among other actions, the process can trigger the release of hormones that govern bodily functions. Krebs, who continued his teaching and research after

receiving the Nobel Prize at age 74, taught for much of his career at the University of Washington, including returning from UC Irvine in 1977 as chair of the Department of Pharmacology. He was also an investigator for the Howard Hughes Medical Institute. Krebs is survived by his wife of 64 years, Virginia "Deedy"; three children, Sally Herman, Robert Krebs, and Martha Abrego, and their spouses, Dan Herman and Phil Abrego; four grandchildren; and six great-grandchildren.

**Harriet Neville "MiMi" Limper** (B.S. 1944) of Baton Rouge, LA, and formerly of Millstadt, IL, was born November 28, 1924, and passed July 15, 2010, at her home. Limper graduated from the University of Illinois with a degree in chemistry. She was a retired technical writer for Ethyl Corp and an avid reader who loved to sew and do crossword puzzles. She was preceded in death by her husband, Arthur F. Limper; parents, Harry C. and Florence Neville nee Devere; a brother, Howard Neville; and a sister, Genevieve Saupe. She is survived by her son, Arthur (Terri) Limper Jr.; daughter, Anne Limper Burke; sister, Charlotte Crowe; brother, Donald Neville; son-in-law, Stephen Burke; seven grandchildren, Travis Limper, Laure Limper, Megan Pettit, Brandee Hart, Ryan Burke, Mackenzie Burke, and Caitlin Burke; four great-grandchildren, Forrest Moore, Trey Simms, Zeke Limper, and Arabella Limper.

**Dr. Pierre J Marteney** (Ph.D. 1961) of Manchester, CT, died January 18, 2010, at Hartford Hospital of a massive stroke. Born on New Year's Day, 1932, in Ridley Park, PA, he was the older son of Reverend (Col.) C. Walton Marteney and Lorene Rathje Marteney. He met his wife, Judith Carolyn Gates, at the University of Illinois while earning a Ph.D. in physical chemistry. He spent his career as a research scientist at the United Aircraft Research Laboratories (now the United Technology Research Center) where he specialized in catalytic combustion and fuel. Marteney was author and co-author of many scientific papers and reports, and a member of the American Chemical Society. In addition to his career as a research scientist, Pierre had a lifelong love of music and stage, and was honored to be the recipient of the Third Annual Hall of Fame Awards for Arts in Manchester. Marteney is survived by his wife, Judith Gates Marteney; his daughter, Susan Marteney, and her daughter Lydia Marteney; Martha Marteney and her husband, Robert Nelson; his sister-in-law Arline Franquiz Marteney; and one aunt, Annabelle Marteney Cruise of Huntington, WV, several nieces, nephews, and cousins.

**John Thomas (Jack) Marvel** (A.B. 1959) born September 14, 1938, in Champaign, IL, died on February 27, 2010, in Tucson, AZ. The son of Carl "Speed" Marvel, he earned his Ph.D. in chemistry from Massachusetts Institute of Technology in 1964, and was an assistant professor of chemistry and biochemistry at the University of Arizona until 1968. He left academia for the corporate world joining Monsanto's Agricultural Products Company, attended the Stanford Executive Program in the Graduate School of Business in 1977, and from 1985 to 1987 was Monsanto's General Manager of Science and Technology Europe/Africa, headquartered in Brussels, Belgium. In 1988 he joined Ethyl Corp. in Baton Rouge, LA, as Corporate Vice President for Research and Development until taking early retirement and moving to Tucson in 1995. Marvel served on the Secretary of Agriculture's User Advisory Board, Advent Europe Technical Advisory Board, EEC's Biotechnology Group, as well as consulting for corporations and working with the American Chemical Society,

**Paula S. Moffett** (M.S. 1977) died May 10, 2010, along with her companion Mark Yellen in Tuscaloosa, AL. Moffett was an anesthesiologist for Medical Anesthesia Group. Previously, she was the director of the Division of Pulmonary and Critical Care Medicine and the Intensive Care Unit at St. Jude Children's Research Hospital. She was a proponent of the arts, serving on the board of the contemporary art venue, Power House. Moffett was an avid traveler and participated in a number of medical mission trips to Peru organized by Dr. Coyle Shea. She is survived by her daughter, Lesley Bozeman (Morgan Martin) of Tuscaloosa, AL, son, Daniel Bozeman of Memphis, her father and mother, Dan and Judy Moffett of Memphis, her sister, Dana Moffett (Chris Durban) of Washington, D.C., and her brother, Pat Moffett (Sue) of Atlanta.

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