4 Professor Paul J. A. Kenis invested as Lycan Professor
6 New ways to study brain cancer
12 BP Ultimate Field Trip winners recap trip
20 Professor Bill Hammack–The Engineer Guy: Sharing engineering with the public
Dear Alumni and Friends,

In late October, our department celebrated the 2013 Illinois homecoming with a departmental tailgate with food, drinks, memories, and fun. More than 50 of our alumni attended the homecoming event to reminisce about their time at Illinois and cheer on the Illini football team. We are so glad so many of you joined us to celebrate; we look forward to next year’s!

This fall we welcomed a record 206 freshmen and 32 transfer students, bringing our total undergraduate enrollment to 668. We are so excited to have so many undergraduates in chemical engineering! To manage that number of students, we are starting to offer many of our required undergraduate courses twice per year. Apart from being able to provide a better classroom experience to our students, this change enables freshmen entering with lots of advanced credit to start earlier with the core courses in the spring of their freshman year, then follow an accelerated schedule; students who need extra time can delay taking certain courses, and students now can pursue an internship or co-op opportunity without falling behind. This change also is welcomed by our corporate recruiters.

An ABET review that happens every six years for our undergraduate program went very well and our design across the curriculum program was noted as a strength.

This summer, I had the pleasure to visit some of our alumni such as Dr. Juh Wah Chen (Ph.D. ’59) and his wife, Mrs. Han Lin Chen. He told us stories about his time with Professors Max Peters and H. Fraser Johnstone. Jim (B.S. ’51) and Norma Bright shared stories about their time (with many other Illinois Chemical Engineering alumni!) at Monsanto, and Frank Hackman (B.S. ’67), who now works at a law firm, shared a story about his role in helping to remove curfew rules for female students during his time at the University. One of our Ph.D. alumni, Liangfang Zhang, an associate professor at the University of California, was selected to receive a 2013 TR35 Innovator Award by the MIT Technology Review to recognize his innovative research in the field of nanotechnology drug delivery. And, alumni Phil Reiss, shared his story with us about his friendship with Dr. Thomas J. Hanratty.

This has been a very productive semester for our students and faculty. Our AIChE student chapter was named an outstanding chapter for the third year in a row, Professor Hyun Joon Kong was named a Centennial Scholar, and Professor Mary Kraft received the 2014 Shaw Young Investigator Award in Lipid Research from the American Society for Biochemistry and Molecular Biology for her work on unraveling the chemical composition of cell membranes using advanced imaging and image analysis methods, which was featured in the previous newsletter. We hope you will enjoy reading about Professor Bill Hammack, known as “The Engineer Guy,” who shares his love of media and engineering with the public.

I encourage you to share your feedback, memories, photos, updates, and more with us so we can feature some of these in our newsletter. I wish you all a happy 2014!

Best Regards,

Paul J. A. Kenis
William H. and Janet G. Lycan Professor and Department Head
kenis@illinois.edu (217) 244-9214
AIChE Conference 2013
San Francisco

The American Institute of Chemical Engineers (AIChE) conducted their 2013 Annual Meeting in November in San Francisco, California. During that meeting, the Chemical and Biomolecular Engineering Department hosted an alumni reception.

The AIChE annual student conference took place in November. The Illinois AIChE student chapter received the Outstanding Student Chapter Award this year. Pictured in the front row left to right: Aimee Nugent, Allison Rogers, Lindsey Muller, Lecturer and AIChE Advisor Dr. Troy Vogel, Erica Peterson, Kevika Rustagi, Ellery Marks, and Megan Randby. Back row left to right: Nicholas Connolly, Jacob Galeski, Zain Lakhani, Lucas Tan, Scott Kieback, Maciej Kowalkowski, Ryan Becker, Alex Senak, and Patrick Sayles.

Andrew Ferguson (right), an affiliate faculty member of Chemical and Biomolecular Engineering, talks with Charles Sing, a new faculty member who will join the department in August 2014.

Department Head Paul Kenis visits with Paul Adriani, B.S. ’85, who works at Banyan Energy at the department’s AIChE reception in San Francisco.

Current and former Illinois graduates enjoy the department’s AIChE reception. (From left to right): Maryam Sayyah, Ph.D. ’13 (Suslick), Sunny Choi (current graduate student in Dr. Brendan Harley’s research group), and So Youn Kim, Ph.D. ’11 (Zukoski).

Edgar Goluch (far right), appreciates the department’s AIChE reception with his graduate students. Goluch received his B.S. in chemical engineering in 2003 and his Ph.D. in Bioengineering in 2007 from Illinois. He is an assistant professor at Northeastern University. From left to right: Thad Webster, Ashley Webster, Negar Golshan, Nil Tanidogan, Hunter Sismaet, Pegah Abadian, and Goluch.

Photo by Jonathan San

Photo by Prashun Gorai
Kenis invested as Lycan Professor

Professor and Department Head Paul J. A. Kenis of the Chemical and Biomolecular Engineering Department at the University of Illinois was invested as the William G. and Janet H. Lycan Professor in the School of Chemical Sciences during an investiture ceremony on September 25, 2013 at the Spurlock Museum.
Kenis, who has earned an international reputation for his research and scholarship in microchemical systems, leads a creative and highly interdisciplinary research program at Illinois that has led to new understanding and applications in energy and health.

His research focuses on microreactors, microfuel cells, and enabling microfluidic tools. He has become an established leader on campus as his work combines principles from engineering, chemistry, and the biological sciences to address programs that have ranged from protein crystallization to fuel cells and artificial photosynthesis.

Upon receiving the named professorship, Kenis said he reflected on his path to Illinois. He said he had an inspiring set of high school teachers in physics, biology, and chemistry that helped put him on course to pursue an undergraduate degree in Chemistry at the University of Nijmegen in 1995, which he then followed up with a Ph.D. in Chemical Engineering at Twente University in his native home of the Netherlands, in 1997. He said he was fortunate enough to be part of the early days of microfluidics while a Postdoc at Harvard, which has led him to become a leader in the field.

“At Illinois, I have been blessed to work with collaborators in many different disciplines,” he said.

The William H. and Janet G. Lycan Chemical Science Faculty Excellence Fund was established in 1990 and supplements funds for faculty positions in the School of Chemical Sciences in the College of Liberal Arts and Sciences. William H. Lycan’s career is marked by his accomplishments and dedication to the chemical sciences. He and his wife received their degrees from the University of Illinois. Past recipients of the Lycan Professorship include Chemical and Biomolecular Engineering Emeritus Professor Charles Zukoski and School of Chemical Sciences Director and Professor Jonathan Sweedler.

Kenis joined the University of Illinois as an assistant professor in 2000. He was a postdoctoral fellow in the Department of Chemistry and Chemical Biology at Harvard University.

Kenis thanked the students in his research lab including undergraduates, graduates, and postdocs. “I want to thank you for your hard work,” he said. “It is a pleasure to work with you and watch you become independent and develop new ideas.”

Receiving the Lycan Professorship is an honor for Kenis who said he is grateful to the Lycans for their gift. “Illinois is a great place to work and live,” he said. “And, it is my honor to be a Lycan Professor.”

The honor was presented to Kenis by Jonathan Sweedler, Director of the School of Chemical Sciences and Professor, Ilesanmi Adesida, Provost, Brian Ross, Interim Dean of the College of Liberal Arts and Sciences, and Andrew Gewirth, Professor of Chemistry and former director of the School of Chemical Sciences.

Adesida said that “Kenis now joins the most accomplished researchers, teachers, and mentors at Illinois who are international and national leaders in their fields. Be proud of what you have accomplished so far in your career.”

Gewirth shared that sentiment saying that Kenis has expanded the field of microfluidics and has become an innovative leader. “He leads by his enthusiasm,” Gewirth said. “He is full of energy, and he is a great collaborator and department head. It has been a pleasure to be a colleague and collaborator with you.”

“Illinois is a great place to work and live. And, it is my honor to be a Lycan Professor.”
Researchers develop new approach for studying deadly brain cancer

Human glioblastoma multiforme, one of the most common, aggressive, and deadly forms of brain cancer, is notoriously difficult to study. Scientists have traditionally studied cancer cells in petri dishes, which have none of the properties of the brain tissues in which these cancers grow, or in expensive animal models.

Now a team of engineers has developed a three-dimensional hydrogel that more closely mimics conditions in the brain. In a paper in *Biomaterials*, the researchers describe the new material and their approach, which allows them to selectively tune up or down the malignancy of the cancer cells they study.

The new hydrogel is more versatile than other 3-D gels used for growing glioma (brain cancer) cells in part because it allows researchers to change individual parameters – the gel’s...
it, but there’s also a lot of the HA in the brain surrounding the tumor.”

Previous studies have used hydrogels made out of nothing but hyaluronic acid to study gliomas, Harley said. “The problem there is that HA is structurally not very strong.” It also is difficult to adjust the amount of HA that the glioma cells are exposed to if their environment is 100 percent HA, he said.

In the new study, Pedron observed how glioma cells behaved in two different hydrogels – one based on methacrylated gelatin (GelMA) and the other using a more conventional polyethylene glycol (PEG) biomaterial. These two materials vary in one important trait: GelMA is a naturally derived material that contains adhesive sites that allow cells to latch onto it; synthetic PEG does not.

Harley and Pedron found that additions of HA to glioma cells had “very similar” effects in both materials. Adding too little or too much HA led to reduced malignancy, while incorporating just enough HA led to significantly enhanced malignancy. This held true for multiple types of glioblastoma multiforme cells. This suggests that “it’s the HA itself that is likely the cause for this malignant change,” Harley said.

“If you have a material that allows you to selectively tune up or down malignancy, that will allow you to ask lots of questions about treatment methods for more malignant or less malignant forms of glioma."

Being able to adjust these traits individually will help researchers tease out important features associated with the initial growth of a tumor as well as its response to clinical therapies, said University of Illinois Chemical and Biomolecular Engineering professor Brendan Harley, who led the study with postdoctoral researcher Sara Pedron and undergraduate student Eftalda Becka. Harley is an affiliate of the Institute for Genomic Biology at Illinois.

The researchers found that they could increase or decrease the malignancy of glioma cells in their hydrogel simply by adding hyaluronic acid, a naturally occurring carbohydrate found in many tissues, especially the brain.

Hyaluronic acid (HA) is a key component of the extracellular matrix that provides structural and chemical support to cells throughout the body. HA contributes to cell proliferation and cell migration, and local changes in HA levels have been implicated in tumor growth.

“Hyaluronic acid is one of the major building blocks in the brain,” Harley said. “The structure of a newly forming brain tumor has some of this HA within it, but there’s also a lot of the HA in the brain surrounding the tumor.”

If you talk to pathologists, they’ll say a biomaterial will never allow you to grow a full brain tumor, which is probably true,” Harley said. “But it’s realistic to think that a well-designed biomaterial will allow you to study aspects of glioma growth and treatment in a way that’s much richer than simply looking in a petri dish and much more accessible than trying to study tumor development within the brain itself.”

~ Diana Yates
University of Illinois News Bureau
SMALL CHIPS,
BIG PROMISE
microfluidic platforms for protein crystallization
Membrane proteins reside in the lipid boundaries that surround cells and intracellular organelles, communicating with either side of the boundary to carry out critical processes such as signal transduction, material transport and bioenergetics.

Damage to membrane proteins is linked to diseases such as Alzheimer’s, diabetes, cystic fibrosis and hypertension. To better understand their function, and use this knowledge in rational drug design, it is essential to first determine the 3-D structure of membrane proteins.

The primary source of such 3-D data is X-ray crystallography, which requires proteins in crystalline form. The set of optimal conditions that can coax purified proteins into crystals varies from protein to protein and routinely requires testing thousands of conditions for each protein. Membrane proteins specifically pose a tremendous challenge because they yield very small amounts after purification and are very unstable in solution, thus limiting the number of conditions that can be tested. These crystals are very fragile and get damaged easily when being handled for X-ray analysis. In contrast, non-membrane proteins pose few difficulties and therefore their crystallization conditions are identified at a much higher rate.

Responding to the urgent need for a better crystallization method and funded by National Institutes of Health, researchers led by Paul Kenis, William H. and Janet G. Lycan Professor and Department Head of Chemical and Biomolecular Engineering, developed novel microfluidic platforms that can accelerate membrane protein crystallization. One such platform is published in the research article “A Microfluidic Approach for Protein Structure Determination at Room Temperature via on-chip Anomalous Diffraction” and was highlighted on the cover of the August issue of the journal Lab on a Chip.

These all-in-one chips, roughly the size of a penny, can be used in the initial search for and optimization of crystal-forming conditions, followed by on-chip X-ray data collection by viewing and targeting individually the hundreds of protein crystals grown in the chip.

Research scientist and co-author Ash Pawate commented on the significance of publishing the research. “The work done in the current publication establishes the strength of our technology as a single platform to carry out the complete set of experiments” Pawate said. “We are working on making our chips available to any researchers who are interested.”

Sudipto Guha, a co-author on the paper, highlighted the cost-effective nature of the method. “Our platform will bring high-throughput protein crystallization and on-chip structure determination capabilities to labs at a fraction of the cost of expensive robotic systems that are otherwise needed,” Guha said.

Co-author Sarah Perry said these microfluidic chips can be very powerful tools for future experiments involving the study of membrane proteins. “The ability to enhance the available knowledge of challenging proteins, such as those responsible for diseases, disease transmission, or those which could be potential targets for pharmaceutical intervention have tremendous potential to enhance not only our biochemical understanding of the science behind the disease and treatment, but also to improve the quality of life for people around the world,” Perry said.

~ Ashtamurthy Pawate, Sarah Perry, and Sudipto Guha, Kenis Research Group Chemical and Biomolecular Engineering
Two faculty members from the Department of Chemical and Biomolecular Engineering and affiliated with the Institute for Genomic Biology (IGB) at the University of Illinois have been awarded a $2 million grant by the Roy J. Carver Charitable Trust.

Under the leadership of Principal Investigator Dr. Huimin Zhao and co-Principal Investigator Dr. Christopher Rao, the grant will be disbursed over two years to provide instrumentation and core facilities for a new research theme devoted to the new scientific subdiscipline of synthetic biology.

“I’m hugely excited by the potential of synthetic biology at the IGB,” said Zhao. “We’re doing something different, I think, from other synthetic biology centers in the world by focusing on higher eukaryotes. We will develop foundational synthetic biology technologies and computational platforms for the genetic modification of plants and animals to address grand challenges in human health and environmental sustainability. This grant will provide powerful research tools to assist us in that.”

The new research theme, Biosystems Design, led by Zhao, Centennial Chair Professor of the Department of Chemical and Biomolecular Engineering, currently counts 12 University of Illinois faculty members among its own, from seven different departments. It is partly this interdisciplinary nature, says Zhao, which will allow the new theme to produce important results.

“Most synthetic biology centers work with bacterial cells, like E. coli,” said Zhao. “We will be one of the first to develop new synthetic biology tools for plant and mammalian cells. This has the possibility to create huge scientific advances, like plants with better photosynthetic capacities, or gene therapy for diseases like sickle cell anemia and inherited cancers.”

To do this, the researchers will have to create new technologies able to efficiently and cost-effectively construct large DNA molecules such as pathways and vectors and alter the expression of multiple genes simultaneously within the cells of plants and animals—technologies that do not yet exist. This is where much of the grant money will be directed, said Zhao.

“These tools have the potential to vastly improve everything from crop yields to quality of life. I think this new theme will be doing important work.”

The Biosystems Design research theme focuses on the development and application of synthetic biology tools for the design of improved or novel biological systems to produce better crops, new methods of drug production, novel medical treatments, or other biotechnological innovations.

Roy Carver was an industrialist and philanthropist, famous for his tire manufacturing company Bandag Inc., as well as a University of Illinois graduate (class of ’34). The Roy J. Carver Charitable Trust was established after his death to further biomedical and scientific research, as well as children’s education and recreation.

“These tools have the potential to vastly improve everything from crop yields to quality of life.”
Professor Mary Kraft earns the 2014 Walter A. Shaw Young Investigator Award in Lipid Research

Assistant Professor Mary Kraft in the Department of Chemical and Biomolecular Engineering is the recipient of the 2014 Walter A. Shaw Young Investigator Award in Lipid Research from the American Society for Biochemistry and Molecular Biology.

The award recognizes outstanding research contributions in the area of lipids by young investigators.

Kraft said she is honored to receive the award for her research in which she and her researchers have "pioneered the application of a new high-resolution imaging mass spectrometry technique to identify how cholesterol and sphingolipids are organized in cell membranes, which addresses a key dispute in cell biology."

She says the award is a great honor because it "demonstrates that the biochemistry and cell biology community recognizes the importance of my research."

"The award helps to disseminate my findings to scientists outside of Chemical and Biomolecular Engineering, namely to biochemists and molecular and cellular biologists," Kraft said.

In her research, Kraft has made important discoveries related to the sphingolipid and cholesterol organization in cell membranes that have major implications for our understanding of plasma membrane organization.

Kraft received her undergraduate degree from the University of Illinois in Chicago, her Ph.D. in Chemistry from the University of Illinois, followed by a postdoctoral fellowship at Stanford University. She joined the faculty at the University of Illinois in 2007.

Schroeder wins Camille Dreyfus Teacher-Scholar Award

Charles Schroeder, assistant professor of Chemical and Biomolecular Engineering, was one of 13 faculty members from across the country selected for the 2013 Camille Dreyfus Teacher-Scholar Award, presented by the Camille and Henry Dreyfus Foundation.

The award program supports and recognizes the research and teaching careers of talented young faculty in the chemical sciences. Schroeder was nominated for the award by Huimin Zhao, Centennial Chair professor, Chemical and Biomolecular Engineering.

"I am truly honored to be recognized as a scholar in the chemical sciences," Schroeder says.

Working with and mentoring students at the University of Illinois has helped Schroeder to be successful in his teaching and research career. In the past five years, he has mentored 12 undergraduates as research assistants in his lab.

"I firmly believe that first-hand research experience for undergraduates is paramount for their future success in the chemical engineering discipline," he said. "In my research group, we train undergraduate students to think creatively and independently on open-ended projects, while relying on the fundamental skills and concepts learned in the core curriculum. Several of the undergraduates have appeared as co-authors on peer-reviewed publications from my lab:"

Schroeder, who joined the faculty at Illinois in 2008, says the award will help to fund research in molecular engineering and biomaterials, specifically by developing new routes to synthesize sequence-defined polymers.

Schroeder also was recognized with a 2013 NSF Faculty Early Career Development Award and the 2012 Arthur B. Metzner Early Career Award from the Society of Rheology.

Kong named College of LAS Centennial Scholar

Associate Professor Hyunjoo Kong has been named a Centennial Scholar by the College of Liberal Arts and Sciences.

Kong, who joined the faculty at the Department of Chemical and Biomolecular Engineering in 2007, joins nine other College of LAS faculty who have been named Centennial Scholars. The scholars were named in honor of the 100th anniversary of the creation of the College of Liberal Arts and Sciences at the University of Illinois.

Kong said he was flattered to be selected as a Centennial Scholar and was nominated by Centennial Chair Professor Huimin Zhao.

"I am honored to be selected for my scholarly productivity and contributions to the educational mission of the College of LAS," he said.

The Centennial Scholars were nominated for the appointment, and a committee submitted recommendations to the dean of the college. Each scholar will hold his or her appointment for three years and receive $10,000 for research during each of those years.

"These scholars represent the best of the liberal arts and sciences at the University of Illinois," says Brian Ross, interim dean of the College of LAS. "We are thrilled to have them on campus as the college reaches this symbolic milestone."
BP Ultimate FIELD TRIP

winners make memorable trip to Europe

From England to Norway to Scotland, three undergraduates in Chemical and Biomolecular Engineering at Illinois took part in a two-week field trip that focused on the BP operational hubs for North Sea oil and gas exploration and production as well as some sightseeing of those countries.

The trip was part of the prize for winning this year’s BP Ultimate Field Trip, which is BP’s flagship competition that asks teams of undergraduates to solve real world energy problems. Sophomores Nicholas Connolly and Michael Richards and senior Akash Moradia won that competition, beating out other finalist teams from MIT, University of California-Berkeley, and the Georgia Institute of Technology.

This year’s participants were asked to address the growing demand for energy by developing a single technical innovation, which has previously not been demonstrated, to significantly reduce the cost of MPG per capita in their country by 2030. The Illinois team came up with a modular fueling system called the “UniPump” that could be efficiently implemented across American retail gas stations.

In early July, Connolly, Richards, and Moradia joined the winning teams from the United Kingdom and Trinidad & Tobago for the field trip at the BP operational hubs for North Sea oil and gas exploration and production in Norway and the Shetland Islands, north of Scotland.

“The BP Ultimate Field Trip was simply amazing,” Moradia said. “Not only was it a great experience meeting all of the different teams, but it was a lot of fun becoming friends with them all, and enjoying the different sites we visited.”

During the first two days of the trip, the teams worked together in an Exploration and Production Executive (EPEX) Asset Management Course, something primarily given to upper level management with BP. The team worked together to simulate five years of running an oil company looking at investing in technology, health, safety, and the environment to bidding for licenses and producing oil.

(From left to right) Nicholas Connolly, Michael Richards, and Akash Moradia aboard a ferry heading from Stavanger, Norway to Lysefjord, Norway during the BP Ultimate Field Trip.
“Through this course and dinner time discussions, all of the winners became very close friends,” Richards said.

The group then traveled to Stavanger, Norway where the main BP office in Norway is located. They toured BP’s main offices and learned about their offshore operations in the North Sea and Norway’s oil reserves. They also visited the Norwegian Petroleum Museum.

“Seeing BP’s North Sea operations was phenomenal,” Connolly said. “I have a much better understanding of upstream oil, from license bidding and seismic data to processing the oil and getting it onto a tanker.”

“We hiked up Pulpit Rock (Preikestolen), which is a famous cliff overlooking Lysefjord, one of Norway’s most spectacular fjords and went kayaking in the sea,” Moradia said.

“It was a great time where we were able to learn a lot, while having a good time seeing the city and countryside and becoming better friends with the other teams.”

They spent three days in the Shetland Islands, Scotland to visit the BP Sullom Voe oil terminal that processes about one million barrels per day of oil and gas from North Sea fields of various oil companies. The teams also toured where tankers drop off and receive oil from the terminal.

The last part of the trip was spent at BP’s Aberdeen, England office as well as dinner and visiting some London sites including Piccadilly Square and a ride on the London Eye.

Connolly says his favorite activity was hiking to Pulpit Rock. “Looking off of Pulpit Rock at the water below was something I will never forget,” he said. “I also got to take a quick swim in a small pool near the top of the fjord, which was icing on the cake.”

The Illinois team said they were honored to go on the BP field trip and enjoyed an experience of a lifetime.

“I loved being able to interact so closely with employees from all over BP’s global operations and talk to them about their experiences and roles at BP,” Richards said. “This trip was also fantastic because we had the opportunity to tour global BP operations, something that not many people get to do.”
High school girls extracted DNA from strawberries, determined the best way to get grass stains out of strips of cotton T-shirts, explored nanoparticles, and more during this year’s Chemical and Biomolecular Engineering GAMES camp.

GAMES or Girls Adventures in Mathematics, Engineering, and Science is an annual week-long camp that takes place in July and is designed to give academically talented high school aged girls an opportunity to explore engineering and scientific fields through demonstrations, classroom presentations, hands-on activities, and contacts with women in these technical fields. Camps range in topics from chemical engineering, bioengineering, computer science, aerospace engineering, and others. This year 167 high school girls attended these camps.

During the chemical and biomolecular engineering camp that took place in July, the girls interact with college students, science and engineering faculty, and professionals. Exciting laboratory projects and research presentations encourage the attendees to pursue careers in engineering and technical fields.

The camp was led by department lab assistant Ricky Greer as well as department lecturers Dr. Jerrod Henderson and Dr. Troy Vogel.

Throughout the week, campers learned how to be better problem solvers, to consider what could be “bottlenecks” in the engineering process, and discussed the variety of careers for a chemical engineer. The Chemical Engineering camp began in 2007 in conjunction with Bioengineering. At that time, former lecturer Dr. Marina Miletic was instrumental in developing the program for Chemical Engineering. In 2012 the two departments each created their own camps.

“Our program continually sells out and is popular because we demonstrate real-world applications of chemical and biomolecular engineering and highlight the fact that chemical engineering is all around us and impacts every aspect of their lives,” Henderson said.

Faculty members Dr. Mary Kraft, Dr. Deborah Leckband, and Dr. David Flaherty each made research presentations to the campers as well as laboratory tours.

“Presentations led by our faculty and hands-on activities led by faculty and students makes our program popular,” Henderson said. “Parents and students are happy to know that our faculty take time out of their schedules to present.”

Attendees also toured the LyondellBasell plant in Tuscola where they walked through the control rooms, felt the heat from the reactors, and learned about the chemical processes at the plant.

Helping to mentor students and sharing her knowledge of science and chemical engineering, Renee Nathaniel served as a GAMES lab assistant. She is a chemical engineering undergraduate who plans to graduate in May 2015.

She said she became a lab assistant because she is passionate about introducing science and engineering to more females.

“My favorite part about being a lab assistant with GAMES is leading the girls through group projects and experiments,” she said. “Being a GAMES lab assistant helps develop my teaching and communication skills related to the chemical engineering field. Participation in the camp intensified my interest in a future career in chemical engineering.”

During the week-long summer camp, high school girls from across the country conducted laboratory experiments, made presentations, and gathered together to learn about chemical engineering as shown in the photos.
167 high school girls attended
### 2013 Graduate Fellowships

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Twelfth Annual Graduate Research Symposium

The Department of Chemical and Biomolecular Engineering graduate students and members of the Graduate Student Advisory Council organized the 12th annual graduate research symposium that took place October 25.

During the symposium there were eight poster presentations and 10 oral presentations given by students. Those presentations were judged by three chemical engineering alumni who returned to their alma mater. Those judges were Professor Josh D. Ramsey, Ph.D. ’06 (Pack), from Oklahoma State University, Professor Subramanian Ramakrishnan, Ph.D. ’01, (Zukoski) from Florida A&M University/Florida State University, and Dr. Tim Drews, Ph.D. ’04, (Alkire), from OSIsoft, LLC.

This year’s winners of the 12th annual Graduate Symposium are:

**Poster Presentations**

**First Place (tie):** Todd Freestone
*Advisor:* Professor Huimin Zhao
*Metabolic Engineering for increased production of the anti-malarial FR900098*

**First Place (tie):** Danielle Mai
*Advisor:* Assistant Professor Charles Schroeder
*Flexible Branched Polymers for Single Molecule Rheology*

**Third Place:** Eitan Barlaz
*Advisor:* Professor Edmund Seebauer
*Challenges in Defect Engineering of Undoped Titanium Dioxide*

**Oral Presentations**

**First place:** Cartney Smith
*Advisor:* Associate Professor Hyunjoon Kong
*A Bio-inspired Assembly Strategy for Formulation of Enhanced MRI Diagnostic Probes*

**Second place:** Utsav Agrawal
*Advisor:* Assistant Professor Charles Schroeder
*Super-resolution Imaging of the Bacterial Chemotaxis System in Bacillus subtilis*

**Third place:** Vahid Mirshafiee
*Advisor:* Assistant Professor Mary Kraft
*Protein Corona Significantly Reduces Active Targeting Yield*

Other graduate students who participated in this year’s symposium:

**Poster Presentations:** Nicholas Clay, Prashun Gorai, Jacquelyn Pence, Daniel Reilly, and Tong Si.  
**Oral Presentations:** Laura Mozdzen, Matt Byrne, Mei-Hsiu Lai, Dawn Eriksen, Mayank Behl, Enes Oruc, and Tong Si.

Bill Grier, a chemical engineering graduate student with Assistant Professor Brendan Harley’s research group, helped to organize this year’s symposium.

“‘The symposium offered a great opportunity for some of our students to showcase a portion of all of the exciting work that is under way in the department,’” he said. “‘All three of our alumni judges enjoyed the opportunity to come back and interact with both faculty and students while also getting a chance to see the current state of the department where they spent so much time when they were graduate students.’”
Graduate student researches in the lab, coaches rowing on the shore

Finding ways to better treat orthopedic injuries is the goal for an Illinois chemical and biomolecular engineering post doctorate. Being able to serve as a volunteer coach for the university’s rowing team is a bonus.

Bill Grier, a Ph.D. student in Assistant Professor Brendan Harley’s group, focuses his research on the development of a spatially-graded collagen scaffold for the regeneration of orthopedic interfaces like the tendon-to-bone junction in the rotator cuff.

“Current surgical procedures do little to reform the natural tissue and are subject to high rates of recurring injury,” Grier said. “As someone who has always been physically active and remains involved with athletic teams here at the university, orthopedic injuries are relevant in what I do.”

Grier says being a part of Dr. Harley’s group is a natural fit. “It allows me to work with biomaterials while actively pursuing solutions to problems that are very relevant to me,” he said.

“Finding ways to better treat these injuries and to help the body recover to its natural state are very important to me.”

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~ Bill Grier

had great experiences in my first year of coaching,” he said.

As a coach, Grier would prefer to ride in a motorized boat next to the athletes while they practice. Since nearby Homer Lake offers the best rowing conditions the team practices there but cannot use engines on the water. He says coaches stand on the shore relaying information by megaphone or radio to the coxswain (the person who steers the boat). Even though the team is new they are working to perform well at national championships and Grier is developing a year-long training plan to maximize each athlete’s physical potential.

Grier is drawn to rowing because the sport is all-encompassing and popular with engineers. “The rowing stroke is technically complex and physically exhausting; yet, in order to move a boat well, it is a feat that must be performed almost perfectly time after time in unison with seven other rowers in the boat.”

Grier says he chose Illinois because he could perform research in a biomaterial-related field. “The fact that Illinois is a top school for chemical engineering, and that I was able to stay in the Midwest and become a rowing coach were icing on the cake.”

Graduate students earn honors at AIChE

Two graduate students from Chemical and Biomolecular Engineering were honored during the American Institute of Chemical Engineers (AIChE) 2013 annual meeting that took place in November at San Francisco, California.

The focus of this year’s meeting was “Global Challenges for Engineering a Sustainable Future.” Chemical engineers from across the world addressed the latest research in energy, water, sustainability, pharmaceuticals and health care in more than 750 sessions.

Folarin Latinwo and Danielle Mai, both graduate students in Assistant Professor Charles Schroeder’s research group, placed in the Fluid Mechanics graduate student poster session at the AIChE annual meeting.

Latinwo was awarded first place for his poster “Nonequilibrium Work Relations for Dilute Polymer Solutions.” He and Schroeder were authors on the poster.

Mai received second place for her poster “Flexible Branched Polymers for Single Molecule Rheology.” Authors on the poster were Mai, Schroeder, Amanda B. Marciel, and Christopher Brockman.
Bill Hammack enjoys a challenge. Whether he wants to explain how to take apart an LCD monitor, rip up a hard drive, disassemble a cell phone, show how engineers make a light bulb filament, or look at why the Betamax failed and VHS thrived, Hammack is ready to help the public understand engineering. For the past 14 years, Hammack has shared engineering and technology to the public, becoming one of the first engineering professors to be tenured and promoted to full professor for this kind of outreach work.

“I enjoy the challenge of explaining something in a clear way,” says Hammack, a professor at the Department of Chemical and Biomolecular Engineering at Illinois. “I’m drawn to this type of work.”

Hammack moved from Carnegie Mellon University to Illinois when his alma mater created a role for outreach. It was here that he began to pursue a new form of teaching and outreach. From 1999 to 2005, he produced 300 weekly public radio shows that were distributed by Illinois Public Radio and appeared on the public radio program Marketplace. In 2005 and 2006 he served as a diplomat in the U.S. Department of State working as a science advisor on the Six-Party Talks to denuclearize North Korea and as a member of the Bureau of International Security and Non-proliferation helping to secure highly-enriched nuclear material across the world.

Professor Bill Hammack and his team are producing a series of five videos that reveal the mysteries of the Fourier Methods, featuring this machine built in 1903 that implements this mathematic technique. Photos by Steve Kranz
Upon his return to Illinois in 2006, he was promoted from Associate Professor to Professor and decided to pioneer in a new medium: videos. This led to the creation of the EngineerGuy video series. These videos, shown on YouTube, explain the engineering underlying everyday objects from hard disc drives to cell phones.

With the help of undergraduate and graduate students, he now has four series of these videos which have been viewed millions of times. As a companion to the fourth series, he co-authored his most recent book in 2012 with chemical and biomolecular engineering undergraduate students Patrick Ryan and Nick Ziech called *Eight Amazing Engineering Stories: Using the Elements to Create Extraordinary Technologies*. The book shows the innovation and engineering of digital camera imagers, atomic clocks, batteries, microwave ovens, and lasers.

Hammack says he is always looking for the next challenge and another way to demonstrate engineering to the public. And that has brought him to his latest projects.

Hammack, Don DeCoste, a Professor in Chemistry, and School of Chemical Sciences student Alex Black have filmed the famous Michael Faraday lectures, *The Chemical History of a Candle*, a series of six lectures on the chemistry and physics of flames given by Faraday in 1860.

Hammack wanted to bring Faraday’s lectures to life. He is doing that in a series of five lectures filmed on campus.

> “Nothing,” says Hammack, “is more important to keep our country competitive in the world marketplace than engineers—and the only way to create those new engineers is to show them what engineers really do.”

Hammack says that soon for the first time he and his students are moving outside the studio to film the infrastructure of Champaign-Urbana. The film will answer questions such as “Where does the gas come from when you light your stove?” and “Where does your power come from?” Hammack says, “This series opens up a hidden world to the viewer and highlights the impact engineers have on our world.”

To watch Hammack’s videos, listen to past radio programs, purchase his books, and to stay up-to-date on his new videos, visit www.engineerguy.com

*Make* called Hammack a “brilliant science-and-technology documentarian,” whose “videos should be held up as models of how to present complex technical information visually.”

*Wired* said the videos are “dazzling.”

*Scientific American’s* blog stated that Hammack is a “smart, easygoing everyman with a firm understanding of the science.”
A reunion to celebrate 55 years of association and friendship between Professor Thomas J. Hanratty and his Ph.D. student Dr. L. Philip Reiss

Editor’s Note: Dr. L. Philip Reiss, a Chemical Engineering alum, wrote the following story and shared his memories of Dr. Thomas J. Hanratty. He said the Remember When photos led him to write this story and share it with Mass Transfer readers. Do you have a story to share about your experiences with a faculty member or want to share a story about your career after your education at Chemical and Biomolecular Engineering at Illinois? Please submit your stories to us: chemeng@illinois.edu

Phil Reiss and his wife, Sally, traveled from their home in Columbia, California to Urbana, Illinois, to visit with Dr. Thomas Hanratty on June 18, 2013. This meeting marked nearly 55 years since the couple first came to the University of Illinois two and a half weeks after they were married in August 1958, for Reiss to enter graduate school in Chemical Engineering.

In September 1958, Reiss had meetings to discuss the research interests of each of the faculty. In his meeting with Professor Hanratty, Reiss remembers saying, “Well I am here just to do a master’s degree so I can keep out of the military with my 2-S student deferment. I am not sure that I can handle the foreign language requirement for a Ph.D.” Reiss says Hanratty replied, “If you are here at Illinois, your goal is a Ph.D. You will be able to do the language requirement.”

The more Dr. Hanratty spoke about his research, the more intrigued Reiss became, as it appeared there would be a lot of electronic equipment used in the experimental fluid mechanics research. At the end of this first meeting, Hanratty had Reiss refocus on obtaining a Ph.D. rather than avoiding the draft and accepted Reiss as a Ph.D. candidate. Reiss said he remembers this first meeting with Hanratty in his office as a major life altering event. As Reiss and his wife, Sally, sat with Hanratty in the same office 55 years later, this first meeting was still prominent in Reiss’ mind.

Hanratty and Reiss began to evolve Hanratty’s idea of using diffusion controlled electrochemical reactions to measure average mass transfer rates in a flowing pipe. Reiss set up his lab in 211 East Chemistry and began to experiment with electrodes and electrolytes. A three-eighths inch diameter Lucite tube flow system was set up with electrodes comprising various lengths of the pipe wall and a few small circular wires inserted perpendicularly through the plastic pipe wall to be small point source electrodes. Reiss obtained average mass transfer rates by measuring the electrical current in the electrochemical circuit, and wrote about them for his master’s thesis. But the intriguing, unexpected observation that the small point source electrodes produced not only an average current, but an easily measured fluctuating current, gave rise to the idea that the structure of turbulence next to a pipe wall might be measured with this electrochemical technique.

Reiss also set up a larger one-inch diameter Lucite flow loop in his lab and the test section was comprised of different diameter point source electrodes spaced longitudinally along, and circumferentially around the pipe. Dual electrochemical circuits were set up with low frequency DC amplifiers to amplify and measure the fluctuating current in both circuits simultaneously. This allowed correlation coefficients of the turbulence to be measured both longitudinally and circumferentially. State of the art vacuum tube electronic equipment was used to analyze the electrical signals in real time from the experiment.

After two years of taking data, Sally typed Reiss’ entire Ph.D. thesis while caring for an 18 month toddler, Betsy, and she was also three months pregnant! Final thesis defense was held, the thesis approved, and the beer drinking celebration at Charlie Farwell’s across California Street was complete. Reiss, Sally, and Betsy piled into their 10 year old Chevy, with their total cash assets of only $200, and headed for the San Francisco Bay Area and a job with Shell Oil Company, Research Division.

During the ensuing years, Reiss became involved with administration of chemical manufacturing in Shell’s Agricultural and Industrial Chemical Divisions. He then took an early retirement from his position of Process Development Manager in Shell’s Ag Chemical Division when it was sold to the DuPont Company.

Professor Hanratty had a distinguished career with the Chemical Engineering Department at Illinois, both in teaching and research, advising nearly 80 Ph.D. students prior to becoming an emeritus professor. He received awards from the American Institute of Chemical Engineers, and is a member of the National Academy of Engineering and the American Academy of Arts and Science.
Schematic of a “nanosponge” capable of safely removing a broad class of dangerous toxins from the bloodstream, including toxins produced by E. Coli, poisonous snakes, and bees. The nanospomges are made of a biocompatible polymer core wrapped in a natural red blood cell membrane. Images by Liangfang Zhang

Reiss collaborated with several of Dr. Hanratty’s graduate students to establish the Thomas J. Hanratty Professional Development Fund. The earnings from the fund are used to support travel expenses for Illinois Chemical Engineering graduate students to attend professional society meetings. The fund was presented to Hanratty at a reunion of more than half of his graduate students in 1998 on the Illinois campus.

This fund continues today and is a fitting tribute to Hanratty’s professional career. Each year funds are awarded to an average of 16 graduate students who use these for professional development. To make a donation to the Thomas J. Hanratty Professional Development Fund, use the enclosed envelope in this newsletter, by phone (217) 333-7108, or visit chbe.illinois.edu/alumni-and-friends/giving.

Alum Liangfang Zhang named a top young innovator by MIT Technology Review

Liangfang Zhang, ’06 Ph.D., who now is an associate professor of nanengineering at the University of California, San Diego, was named one of the top 35 young innovators of 2013 by MIT Technology Review.

Professor Zhang was recognized for his innovative research in the field of nanotechnology and biomaterials, a field that he first explored during his time at the University of Illinois. Zhang received his Ph.D. in Chemical Engineering from the University of Illinois at Urbana-Champaign in 2006 with Professor Steve Granick as his advisor.

Zhang says he is honored to receive the award. “I believe honor always belongs to the past, but this award gives me and my research team an extra boost of motivation to pursue innovative technologies for improving human health care,” he said.

In his research, Zhang and his team have invented a novel technology for cloaking nanoparticles in natural red blood cell membranes that can evade the body’s immune system. This allows for targeted delivery of drugs to diseased cells or tissues for enhanced therapeutic effectiveness and reduced toxicity. The nanoparticles also serve as a nanosponge to soak up toxic proteins produced by infectious bacteria or introduced by snake or insect venom. If the particles flood the bloodstream, they will divert most of the toxin away from actual cells.

“Using the body’s own red blood cells marks a significant shift in focus and a major breakthrough in the field of drug delivery research,” Zhang said. “Being recognized as an award-winning technology certainly boosts our confidence to move it forward for clinical trials. This award may also facilitate the translation process by attracting more investors’ interests and thus bringing in needed resources more quickly.”

He says his time during Illinois shaped the foundation of his career.

“I really appreciate the excellent education that I received at Urbana, which forms the solid base of my current and future professional career,” he said.

Being accepted into the doctorate program at Chemical and Biomolecular Engineering at Illinois changed Zhang’s professional career path.

After earning his B.E. and M.S. degrees in chemical engineering from Tsinghua University in China, Zhang says he “could have opened a factory to produce exceptionally tough rubber materials.” But he says he knew that if he started a factory at that time, other people would develop a better technology that he could not compete with.

That’s when he decided to pursue an advanced graduate degree in engineering in the United States. After coming to the University of Illinois, Zhang met Professor Steve Granick and began a new research journey.

“His diverse, open, and dynamic research interests, along with his friendly and considerate personality deeply influenced me and brought me into academia and during the middle of my time at Illinois I decided to pursue a career in academia,” he said.

One of Zhang’s fondest memories of his time at Illinois is working at the Materials Research Lab (MRL) in the early morning hours. “I had to come out of the MRL building at 2 a.m. to move my car,” he said. “This happened to not only me but also to many other graduate students and postdocs who like to work late at night.”
Ray Mentzer:
Giving Back to Undergraduate Education

Supporting undergraduate education is one way that Ray and Beverly Mentzer are helping students move their education forward.

The Mentzers, who are both chemical engineers, from The Woodlands, Texas, decided several years ago to set up undergraduate scholarships in chemical engineering at four universities where their family has roots. The Chemical and Biomolecular Engineering Department at the University of Illinois was one of those places. It’s where Mentzer received his undergraduate degree in 1974; he later attended graduate school at Purdue University where he received his Master’s and Ph.D., both in chemical engineering.

At Illinois, Mentzer created the Dr. Ray A. Mentzer Scholarship Fund for undergraduate students. “We’ve been very fortunate and feel it appropriate to share for the benefit of others,” he said. “With continued shrinking of state support for higher education nationwide, there is clearly a growing gap and burden placed on students and their families to fund a college education. Funding undergraduate education enables us to assist in helping well deserving students pursue their dreams and keep America strong.”

Upon retirement from ExxonMobil in 2008, Mentzer joined the field of academia as a part-time lecturer in the Chemical Engineering Department at Texas A&M University. There he teaches one course each semester and works with six graduate students focusing on process safety research, including modeling and prevention of major incidents such as the Texas fertilizer plant explosion. And, in the summer he has taught chemical engineering at Tianjin University in China as part of a study abroad program, which he says “is very enriching, enabling me to go beyond being a tourist in another culture.”

Mentzer, who on his days off enjoys playing golf, said he believes a sound engineering education has been fundamental to him and his wife’s careers. He said he encourages his students to go beyond the classroom and pursue internships to understand how classes are applied in industry, and to assess the work and cultures of various companies.

“I encourage students to be open-minded with their careers,” he said. “Today, business is very international, so consider having a study abroad opportunity while an undergraduate, and perhaps an overseas assignment during one’s career, as part of career development. This can lead to a very rewarding and fulfilling career.”

Looking back on his time at Illinois, Mentzer says he has fond memories of the solitude of studying in the Chemistry Library at Noyes Laboratory. He also remembers his senior year Fluid Mechanics course taught by Professor Thomas Hanratty that took place before and after the lunch hour. He says he and classmates would go to Dooley’s on Fridays for 10 cent hotdogs and 25 cent beers for lunch. “I think Professor Hanratty figured out that our smiling faces post lunch were not solely due to our love for laminar and turbulent flow,” Mentzer remembers, laughing.

“Funding undergraduate education enables us to assist in helping well deserving students pursue their dreams and keep America strong.”
Class Notes

**Jeff MacMillan**, B.S. ’00, and his wife Nisha welcomed baby Sana Mira MacMillan into the world on March 25, 2013. Jeff completed his MBA at Duke University in 2007 and is currently working as a Senior Manager on the Business Models and Pricing team at Autodesk in San Francisco, California.

**Tanya A. Griffin**, B.S. ’87, is a Strategic HR Consultant at DeVry Education Group in Downers Grove, Illinois.

**David S. Hacker**, B.S. ’49, retired in 1995 from Amoco Chemical in Naperville, Illinois. He now resides in Highland Park, Illinois and is a lecturer on energy systems and robotics at Northshore senior centers. He did a thesis with Thomas Baron and H.F. Johnston on dispersion.

**Eleni Vasiliadou**, M.S. ’83, Ph.D. ’85 (Hanratty), is the new chair of the Natural Gas Public Company (DEFA) in Cyprus, Greece. She was appointed to that post in May 2013. She has 25 years of overseas experience in the oil and gas industry, eventually serving as development director at Shell International Gas Limited in London.

**Michael Encarnacion Vianzon**, B.S. ’02, from Schaumburg, Illinois is a senior project manager of project execution department of Fuel Tech in Warrenville, Illinois, where he manages large capital projects for coal fire utilities and pollution control technology.

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You can make a gift to the department online, by phone, or using the enclosed envelope in this newsletter. Your funds may be used toward specific areas and programs within the department including professorships, graduate fellowships, scholarships, and upgrades to teaching and research facilities. Your gift continues to support the department’s education, teaching and excellence.

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Contact

Lauren E.B. Dodge
Assistant Director of Development
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(217) 766-6168 (cell)
lodge@illinois.edu
In Memoriam

Alumni

Antonia (Cangellaris) Nikolaides, Ph.D. ’85, passed away on August 7, 2013 after a long battle with breast cancer. She is survived by her husband Christos Nikolaides, Ph.D. ’84, sons Daniel and Constantine Nikolaides, and brother Andreas Cangellaris, Dean of College of Engineering at the University of Illinois at Urbana-Champaign.

Ronald V. Skold, B.S. ’49, age 85, died May 28, 2013. He was born April 22, 1928, in Chicago. He spent most of his working years at The Dow Chemical Co. in Midland, Michigan in Product Liability and Business Management. After retiring from Dow, he and his wife moved to their cottage on Platte Lake. For several years he owned and managed The Sport Shop of Beulah. He is survived by his wife, Marilyn; three children, 17 grandchildren, and five great-grandchildren.

Clifford Norman Mitchell, B.S. ’47, age 92, passed away on April 24, 2013 in Naples, Florida. Mitchell was born November 20, 1920 in Peoria, Illinois. He attended school in Illinois, then volunteered for the U.S. Army Air Corps where he piloted B-17 and B-29 planes during World War II. Mitchell married Elizabeth, his wife of 68 years, on December 31, 1943 in Montgomery, Alabama. He started his own company, Industrial Combustion Engineers, which designed industrial furnaces. He was preceded in death by his wife, Elizabeth, and is survived by three children, eight grandchildren, and five great-grandchildren.

John Robert Pownall, B.S. ’40, age 97, passed away April 5, 2013. He was born and raised in Rochester, New York, where he met his future wife, Billie. He discovered his love of chemistry while working in Rochester at Eastman Kodak, and pursued his passion at the University of Illinois at Urbana-Champaign. With a chemical engineering degree, he worked for the Union Oil Company of California. At Union Oil, Pownall developed a successful and safe shale oil refining process for the Department of Defense. He also was responsible for building a refinery outside of Chicago. He is survived by his wife, two children, four grandchildren, and one great-grandchild.

Paul D. Blackburn, B.S. ’78, age 56, of Beijing, China, and Edwards, Illinois, is presumed dead after he went missing at sea during a sailing and snorkeling excursion on June 11, 2013, while vacationing with his family in Hawaii. He was born on Sept. 27, 1956. He married Nancy Miller on July 7, 1984; he has two children. Blackburn worked for Caterpillar Inc. for 37 years. He held a number of senior leadership positions for Caterpillar in China and Japan since he moved to Asia in 2000; prior to that, he worked for the company in positions in England, Mexico, and the United States.

Hilary Grabowski, B.S. ’42, passed away July 4, 2013. During World War II, as an officer in the U.S. Navy, he fought in the Pacific, including the conflict at Iwo Jima. He was born June 22, 1919. Prior to enlisting in the U.S. Navy in 1943, he graduated from the University of Illinois with a degree in chemical engineering. Following the war, he married his wife, Loretta, and began his career with Combustion Engineering as the head of their research and development department. He traveled across the world to assist other countries in their development of clean and efficient power plants. He authored a number of professional books and articles, and received awards and citations honoring his many achievements. However, he considered the nurturing and mentoring of young talent in the engineering field to be one of his greatest accomplishments.

Kenneth E. Meiners, B.S. ’63, passed away on October 7, 2013. He was born on May 14, 1941. He worked as a ceramic and metallurgical engineer at Battelle Memorial Institute for 22 years and after his early retirement, began his own consulting business in 1986. He is survived by his wife, Linda, of 51 years and two children.

Faculty

Roger A. Schmitz, B.S. ’59, age 78, died on October 11, 2013. Diagnosed with ALS in March 2013, he battled this disease with courage and dignity. He married Ruth Kuhl on August 31, 1957. He was a professor at the University of Illinois from 1962 to 1979. He joined the University of Notre Dame faculty in 1979 as Keating-Crawford Professor where he served in various administrative roles until 2013. Elected to membership in the prestigious National Academy of Engineering in 1984, Schmitz was internationally known for his research on instabilities in chemically reacting systems. He is survived by his wife, Ruth, three daughters, and seven grandchildren.

Roger A. Schmitz
Chemical Engineering at Illinois

Background: David L. Bondurant, M.S. ’68, Ph.D. ’70, (Westwater), a graduate student when the photo was taken, is conducting an experiment with Freon to determine the sizes and shapes of fins which will improve the heat transfer from metal tubes to boiling liquids.

Left: This IBM 1800 computer, owned by the Department of Chemistry and Chemical Engineering, is being used by Philip M. Gresho, ’61 M.S., ’69 Ph.D., (Sani), then a graduate student, aided by Linda Davis, a programmer, to solve problems in hydrodynamic instability. The computer was located in one building but monitored and controlled experiments in three buildings.

Photos circa 1960s
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