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Letter *from the Chair*



Dear friends,

This has been an eventful year for chemical engineering at Iowa State. Our name change to the Department of Chemical and Biological Engineering is confusing to some, but the curriculum and degree name remain chemical engineering. The additional word recognizes the increasing role the biological sciences play in our discipline, especially in certain research applications, and reflects the opportunity students have to emphasize aspects of the biological sciences in their electives program, which is especially useful for those considering careers in medicine and in the food, pharmaceutical, and agricultural chemicals industries. However, the core remains chemical engineering.

New faculty hires include **Aaron Clapp**, recently a postdoc at the Naval Research Lab (see story, this issue) and **Laura Jarboe** from UCLA, who will join us in 2008 after completing her postdoc at Florida. **Surya Mallapragada** has been promoted to full professor, **Glenn Schrader** has left us to become a department head at the University of Arizona, and affiliate **Marc Porter** has gone to Arizona State, although he remains a collaborating professor with us.

Also I am pleased to announce the appointment of Professor **Kurt Hebert** as associate chair of the department. Kurt Hebert previously served as interim chair during the fall of 2004.

Some bad news: after 33 years, University College London has discontinued the summer laboratory program. Ironically, Professor **Dean Ulrichson** led the first and last programs. However, our Oviedo program continues to thrive, and there are other opportunities for our students to gain international experience, especially in student exchanges.

Some good news: for those of you who cut your transport phenomena teeth on Bird, Stewart, and Lightfoot, Iowa native **R. Byron Bird** will receive an honorary doctorate from Iowa State and be commencement speaker for the spring 2007 graduation on Saturday, May 5. Professor Bird will also visit the CBE department, so if you are in the vicinity, here is a chance for you to meet one of the giants of the profession.

Finally, I want to remind you that our commitment to producing knowledge and preparing students for successful careers as chemical engineers is still our top priority, regardless of the level of funding received from the state or from tuition. Of course, we always need your help, especially in pursuing our goals of becoming the regional school of choice for undergraduates and exceeding our previous graduate school rankings. These goals are related and have a lot to do with our ability to attract the best undergraduate and graduate students, faculty, and resources.

Please keep in touch: we'd like to hear about your accomplishments and also to receive your suggestions. If you would like us to hold an alumni event nearby or even visit during travel by our faculty, please let us know. Also, please check our Web page periodically for the latest news at www.cbe.iastate.edu.

Have a great year!

James C. Hill

On the cover:

Doctoral student Maria Torres and Professor Balaji Narasimhan analyzing vaccine delivery from polymer microparticles (story on page 16)

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CBE alumni elected to National Academy of Engineering

In February, **G. Paul Willhite** and **Lanny A. Robbins**, both alumni of the Department of Chemical and Biological Engineering, were elected to the National Academy of Engineering (NAE).



NATIONAL ACADEMY OF ENGINEERING



G. Paul Willhite

Operating under the same 1863 congressional charter as the National Academy of Sciences, the NAE is directed "whenever called upon by any department or agency of the government, to investigate, examine, experiment, and report upon any subject of science or art." Election to the academy is based upon the member's lifetime contribution to engineering and is generally considered the highest recognition the profession offers.

G. Paul Willhite earned his BS in chemical engineering from Iowa State in 1959, followed in 1962 by a PhD in chemical engineering from Northwestern University. He joined the University of Kansas faculty in 1969 and in 1974 co-founded TORP, an internationally known program for studying methods of oil recovery in old reservoirs. Willhite has received many honors and awards during his career as a professor and chemical

engineer, including the Professional Achievement Citation in Engineering from Iowa State in 1995. Willhite has also been honored as a Miller Scholar in 2002 and received the Excellence in Teaching Award from the University of Kansas in 1999. The NAE cites Willhite's election in recognition of significant "research, technology, and education outreach in tertiary oil-recovery processes."

Lanny A. Robbins received his BS in 1961, followed by an MS in 1963 and the PhD in 1966, all in chemical engineering from Iowa State. Robbins spent his entire career with Dow Chemical Company, starting in research and development in 1966 and retiring in 2003 as a Research Fellow in Dow's Engineering Sciences Lab, where he developed many separation and purification unit operations. He holds 20 patents and is the author of the liquid-liquid extraction chapters in R. H. Perry's *Chemical Engineer's Handbook* and Philip A. Schweitzer's *Handbook of Separation Techniques for Chemical Engineers*, both fundamental texts in his field. His election to the NAE recognizes his "development of novel commercial separation and purification processes for environmental control that have greatly improved the removal of trace impurities."



Lanny A. Robbins

Cochran receives Dreyfus award

CBE Assistant Professor **Eric Cochran** has been named one of twelve young scholars nationally—and one of only two chemical engineers—to receive the 2006 New Faculty Award from the Camille and Henry Dreyfus Foundation of New York.

The unrestricted cash award of \$50,000 supports the scholarly activity of especially promising new faculty in chemistry, biochemistry, or chemical engineering, and is intended to help initiate independent research programs.

Eric Cochran



Recommendations for the award are based on the nominee's potential to produce outstanding scientific scholarship and make significant contributions to education in the chemical sciences.

Cochran's research examines the equilibrium and dynamic properties of polymeric systems that undergo self-assembly at pertinent length scales ranging from nanometers to microns. He is particularly interested in identifying the guiding principles in systems that feature multiple self-assembly processes, as well as the structure and dynamics of block copolymer nanocomposites. His experimental work is complemented by a theoretical/computational program that uses field theoretic models to simulate the equilibrium/near-equilibrium phenomena of complex polymeric fluids.

Cochran is the second Iowa State CBE faculty member to receive the Dreyfus award. Associate Professor **Andrew Hillier** was recognized with the award in 1996 as a new faculty member of the University of Virginia, Charlottesville.

Support AIChE!



A reminder, once again, that all of us need to help keep AIChE strong. Don't forget to pay your 2007 AIChE dues, or to rejoin and volunteer if you've been inactive. Visit the AIChE at www.aiche.org or call 800 242-4363 today!

The AIChE Annual Meeting will be held November 12–17 this year at the San Francisco Hilton in San Francisco, California. We hope to see many of our faculty, students, and alumni there. Iowa State CBE will host a reception from 7:00 to 9:00 p.m., Tuesday, November 14, at the Hilton (Union Square rooms 15 and 16). Please drop by to renew old acquaintances, exchange ideas, and update us on your professional progress!

Atom probe microscope signals major advance for CBE, Iowa State

CBE Associate Professors **Andrew Hillier** and **Balaji Narasimhan** are half of a four-man team responsible for one of the most significant acquisitions in the history of the College of Engineering. Together with **Krishna Rajan** of materials science and engineering and **Sriram Sundararajan** of mechanical engineering, the two will take delivery in the near future of an atom probe microscope (APM), one of only three such instruments in American academic institutions.

Purchased through a grant from the W. M. Keck Foundation of Los Angeles, California, the APM will be the centerpiece of the new W. M. Keck Laboratory for High Throughput Atom-Scale Analysis on the third floor of Sweeney Hall. The lab, which will be the primary research center of Iowa State's Institute for Combinatorial Discovery (ICD), is being supported with an additional \$3.12 million from the university.

Atom probe microscopy is the direct descendant of the field ion microscope introduced in the 1930s, the first microscope to provide direct atomic level images. But whereas the earlier instrument was limited to defining the position of atoms in space on a single axis, the APM is capable not only of rendering the atomic structure of samples in three dimensions, but also of fully characterizing all of the elements comprising the sample—atom by atom.

"The microscope can produce an image with ten million atoms in a computer-generated, three-dimensional visualization that allows you to see into a particular compound," Hillier says, "a pseudo-three-dimensional, 'rotatable' image you can turn around and upside down, look at the outside of, and take slices of and look inside of." In short, he adds, "You would have the atom's identity and the coordinate—X-Y-Z—where it is. And you would have that data set for each of those ten million atoms."

That's a lot of data to digest, which makes high-speed computation the necessary adjunct to the APM. Fortunately, Iowa State is home not only to Krishna Rajan, one of the world's foremost authorities in materials informatics, but also to one of the world's most powerful computers, an IBM BlueGene/L acquired earlier this year. Indeed, Narasimhan observes, it was just that combination of people and facilities that convinced the W. M. Keck Foundation that Iowa State would be the ideal site for an APM.

"Not only do we have the experimental capability," says Narasimhan, "but we have the data-mining capability essential for an instrument of this kind to be effective. The fact that we had the supercomputer on campus was the last piece of the puzzle: it convinced Keck that we had a unique combination of capabilities that would be beneficial for the instrument."

Ironically, another key factor working on Iowa State's behalf was a limitation of the APM. Typically, an APM requires that samples be highly conductive for the microscope's electric field, making

it generally incapable of imaging organic compounds. The Iowa State team, however, has developed methodologies to modify the instrument's tips to be used with organic compounds with no loss of resolution and at the same high level of throughput, a feat Narasimhan calls "the next big leap in materials science."

"This is the grand challenge," Narasimhan says. "When you look at organic materials, you're typically looking not at atoms but at molecules. So now we can do molecule-by-molecule imaging of organics, soft materials, and biomolecules, with the atom probe microscope eliminating the requirement for conductivity, which previous methods required."

The bottom line for science and engineering across a host of disciplines at Iowa State, the researchers feel, is an advantage and an opportunity that comes along infrequently.

"We hit at the right time with the right people," Hillier says. "With the support of the W. M. Keck Foundation and the Iowa State administration, we now have a tool the vast majority of our peer institutions do not have. In terms of so many areas, access to the right tools really gives you a leg up.

"And," he adds, "we're going to have access to one of the really unique tools."

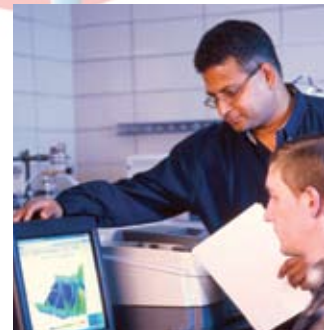


Narasimhan to lead Institute for Combinatorial Discovery

CBE Associate Professor **Balaji Narasimhan** has been named director of the Institute for Combinatorial Discovery (ICD).

Combinatorial science ("CombiSci") involves the use of massively parallel strategies for the discovery and high-throughput screening of thousands of new materials over a relatively short time span. Whereas traditional one-at-a-time methods can take many weeks or even years to analyze huge libraries of materials samples, CombiSci is capable of compressing this process to a matter of days or even hours, allowing scientists and engineers to develop novel materials to meet emerging critical needs rapidly.

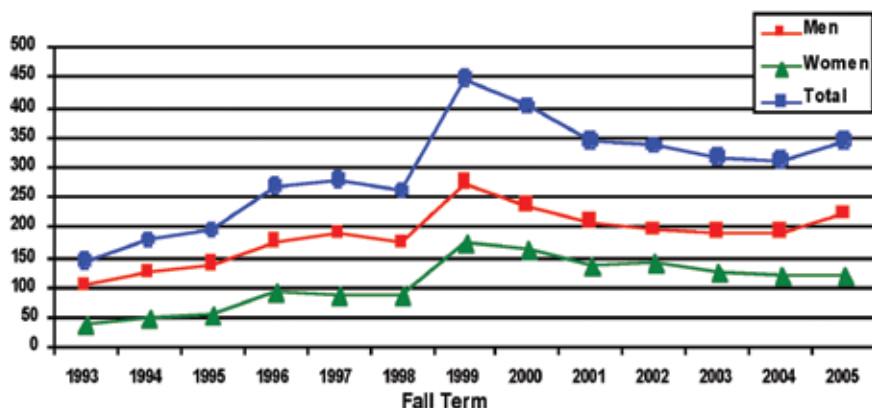
Designated as one of six flagship research initiatives at Iowa State by President **Gregory Geoffroy** in 2002, today the ICD comprises nearly three dozen researchers from 12 different departments at Iowa State. With Iowa State's acquisition of a Blue Gene/L supercomputer last January and the Keck Laboratory's atomic probe microscope (see story, this page), the ICD is poised to become one of the world's leading materials research centers.



Balaji Narasimhan with graduate student Jon Thorstenson

CBE: Where we stand today

The Department of Chemical and Biological Engineering continues to thrive in one of the most competitive regions of the nation, with top-20 chemical engineering departments in several of the states bordering Iowa. According to the National Association of Colleges and Employers (NACE), the national average starting salary for chemical engineers graduating with the BS last spring was over \$56,000, highest of all disciplines in the NACE survey. Last year, approximately three-quarters of Iowa State CBE undergraduates had secured jobs at that average salary by the time they graduated—40% of those in bio-oriented industries.



In the last two years, nearly 50 CBE undergraduates have benefited from co-ops and internships at firms as diverse as Anheuser-Busch, Chevron Phillips Chemical Company, Abbott Laboratories, and Rockwell Collins, among others. In addition, our students are increasingly reflective of the population beyond the immediate campus and Iowa generally. For example, of 317 undergraduates in the department last spring, 36% were women, and 16% of U.S. citizens enrolled were members of minority groups; another 9% were international students.

Our graduate program continues to thrive. The 2006 *U.S. News and World Report* survey of chemical engineering departments ranks Iowa State CBE in the top quartile of all graduate programs nationally. Over the past five years, the department has produced, on average, eight new PhDs per year from a pool of candidates even more diverse than our undergraduates. Of 52 graduate students enrolled last spring, 35% were women, 52% were international students, and 16% of citizens were self-identified as members of minority groups.

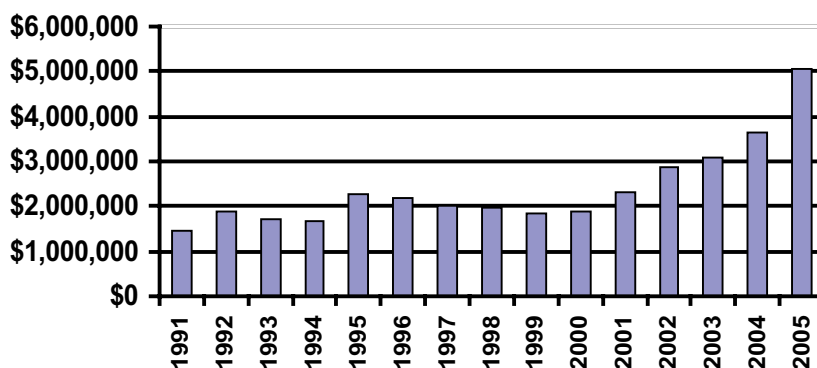
A significant factor in driving enrollments at all levels, of course, is the quality of scholarship produced by a department's faculty. Not only do CBE faculty members serve on external editorial panels for leading publications in their fields, they are also responsible for a high volume of the scholarship appearing in these media. Last year, CBE faculty published six books or book chapters and papers in 93 peer-reviewed journals. They also gave 62 invited presentations, as well as contributing another 140 presentations at seminars and academic conferences.

This scholarship reflects the financial support faculty have won for their research. The department's research expenditures have been increasing steadily as shown in the figure below. This figure excludes research expenditures of joint appointees in the College of Engineering.

Goals for the future include increased focus on attracting greater financial support for the department, both in sponsored funding for research and to strengthen the endowments that support fellowships for graduate study and named chairs and professorships to attract and retain the best faculty.

CBE is strong both at Iowa State and among its peer departments across the nation. With the continued support of our alumni, friends, and industrial allies, we look forward to even greater accomplishments in the years to come.

CBE Research Expenditures



Mallapragada takes new direction at Ames Lab

While the work of CBE Professor **Surya Mallapragada** in neural tissue engineering and drug delivery proceeds apace, her appointment in 2004 as program director of the Materials Chemistry and Biomolecular Materials program at the U.S. Department of Energy Ames Laboratory opened up a promising new research path for the young chemical engineer.

Taking a cue from nature, Mallapragada and her Ames Lab colleagues are looking to synthesize uniform magnetic nanocrystals that demonstrate the same types of properties as those found in magnetotactic bacteria—"bugs" with tiny magnets inside them that orient a given bacterium to the Earth's magnetic field. Exhibiting superparamagnetic properties, magnetite nanocrystals are typically used as contrast agents in magnetic resonance imaging technologies. The Ames Lab team, which also includes CBE's **Balaji Narasimhan** and **Monica Lamm**, as well as several Iowa State physicists and microbiologists, seeks to incorporate the crystals within a polymer matrix for use in advanced sensors and other applications.

"There are some proteins inside the bacteria that are thought to be responsible for forming these crystals," Mallapragada says. "The neat thing is that the crystals are very uniform and arranged in a chain-like structure. So the question is, how does a 'bug' do it? And can we do it outside the bacterium in a test tube?"

The project is part of a DOE Basic Energy Sciences program that funds research in bio-inspired strategies for the development of new materials. Rather than the lithographic techniques currently used to make nanomaterials or microscale structures—a "top down" technique that essentially drills features into bulk materials—project scientists seek instead to emulate nature's "bottom up" approach to building novel nano- and microstructures through a series of self-assembling building blocks, in this case the magnetotactic bacteria.

Although they are only in the first year of the project, the team has already isolated the protein and used it to synthesize nanocrystals outside of the protein's original bacterial host. The next challenge for the group, Mallapragada says, is to develop a technique for introducing the proteins into a polymer matrix in which the team can control both the uniform formation of the magnetite crystals and their orientation within the matrix through the application of a magnetic field.

"Because we have these magnetite nanocrystals in an organic polymer matrix," says Mallapragada, "these are essentially organic-inorganic hybrids. By applying a magnetic field, we think we can change the shape and other properties of the polymer."

The properties of magnetotactic bacteria and organic-inorganic hybrids might seem exotic to some, but Mallapragada is quick to point out that this new direction is not a radical departure from her previous work.

"Smart polymers and self-assembly are something we've been working on for a few years now," Mallapragada says. "We've looked at the application of these polymers for drug delivery, for instance, mixing them with drugs and injecting them subcutaneously, where they form solids inside the body that slowly dissolve and release the drugs."

In addition to novel drug delivery systems, Mallapragada's ongoing work includes gene delivery for cancer therapies using the same family of polymers. Currently, she and the University of Nebraska Medical Center in Omaha are exploring opportunities for collaborative research efforts through UNMC's Eppley Cancer Center.



Surya Mallapragada

Early success brings honors

Only ten years out of the PhD, Surya Mallapragada continues to receive honors typically reserved for more senior scholars. In May she became one of the youngest persons ever promoted to full professor in the College of Engineering. March saw her induction as a fellow of the American Institute of Medical and Biological Engineering. And in August she was appointed to the Biomaterials and Biointerfaces Study Section (BMBI) of the National Institutes of Health's Center for Scientific Review. The BMBI reviews grant applications in materials science and the closely allied field of materials surfaces and their interactions with basic biological systems.

Shanks 'rationally exuberant' on biofuels

On April 26, **Robert C. Brown**, director of Iowa State's Office of Biorenewables Programs, testified before the U.S. Senate Committee on Agriculture, Nutrition and Forestry. Invoking the "tech bubble" of the 1990s, Brown noted that "the original investors of the Internet...are among the largest investors in the renewable fuels industry today.

"With a growth rate averaging 22 percent in the last four years and a doubling expected in the next five years, it is hard not to be excited," Brown continued.

"However, we must realize that decisions made today will determine whether this industry meets expectations or whether it falls victim to irrational exuberance."

Associate Professor **Brent Shanks**, Brown's CBE colleague, has experienced firsthand the new "irrational exuberance." A month before Brown's testimony, Iowa State had issued a news release on Shanks' work in ethanol optimization, which in turn generated a feature article in the *Des Moines Register*.

"Two venture capitalists from California contacted me the morning after that news release came out," Shanks recalls. "Two years ago, I would not have been contacted by venture capital firms within 24 hours of a release.



Brent Shanks

"We don't have anything ready to commercialize," Shanks adds. "Energy is an enormous issue; that's why government also has an important role to play. It's not like setting up some mom-and-pop Internet company." Shanks' current work is part of a larger project involving a consortium of schools to get more value out of distiller's dry grain, a byproduct of the corn milling process. As an alternative to enzymatic catalysts, Shanks and his team are investigating chemical catalysts that could aid in extracting an additional 7 to 8% ethanol from corn.

The hemicellulose in distiller's grain, Shanks notes, is made up of linked xylose, arabinose, and glucose, sugars that must be separated in order to ferment them into ethanol or other products. Because enzymes are highly specific—a xylose-arabinose bond is very different from a xylose-xylose bond—it takes about seven different enzymes operating at

room temperature to attack that structure. By contrast, a chemical catalyst operating at 150 to 175 C can break down these elements at reaction rates several times faster than enzymatic catalysts.

"But we're not as selective as biocatalysts," Shanks acknowledges. "So can we engineer a catalyst and find reaction conditions where we get this hydrolysis? Can we break hemicellulose down without degrading those sugars to other products? That's our challenge."

This and other approaches the consortium is tackling, Shanks says, have long-term implications for cellulosic conversion in general—think switchgrass and corn stover. However, the key language in all this for our energy future is long term: the "irrationally exuberant" are likely to be disappointed if they're looking to the work of Shanks or anyone else for a silver bullet to solve the world's energy woes.

"There is no single source of energy that's going to completely replace fossil fuels," Shanks stresses. "And when people talk about hydrogen or electric cars, the infrastructure changes associated with those are immense. We have to transition into these alternatives so we don't have this massive disruption in our economy.

"In my view," Shanks concludes, "that's what ethanol from seed corn or biofuel from soybeans does: helps us create an infrastructure to transition into alternatives."

Cargill, Minneapolis, announced a \$600,000 gift this summer to help prepare Iowa State students for the biorenewables industry. The funds will support four new components of Iowa State's Bioeconomy Initiative, including both freshman and international experiences in biorenewables, as well as course work and a common laboratory in biobased technologies.

"Considering that both Cargill and Iowa State are squarely at the intersection of agriculture and energy, Cargill's investment makes sense," said Cargill Vice Chairman David Raisbeck (BSIAd'71). "Not only is Cargill a leading producer of food products, providing energy to humans, plants, and animals, we're also a leading biofuels producer in Europe and the United States."



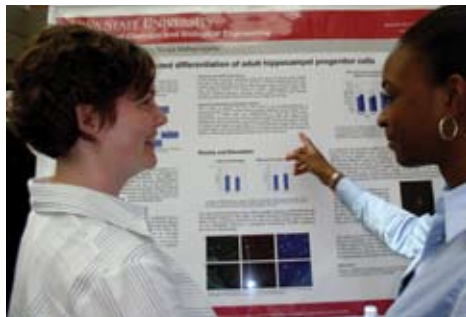
Faculty and staff news

Lamm honored for teaching

CBE Assistant Professor **Monica Lamm** was presented with the 2006 ISU Foundation Award for Early Achievement in Teaching at the university-wide fall convocation held in the Memorial Union on September 11. The award, accompanied by a \$1,000 prize, recognizes a tenured or tenure-track faculty member who has demonstrated outstanding teaching performance unusually early in his or her professional career.

"Monica is one of those instructors who, by dint of clear explanations, a mix of teaching approaches, openness to out-of-class questions, and a supportive environment is able to make students believe they can succeed," observed CBE Professor and former department chair **Charles Glatz**, who nominated

Lamm for the award. "I went away from my meetings with her inspired to try her ideas and approaches in my own classes. It's a worthy recipient who can inspire both their students and their colleagues."



Monica Lamm discusses research with Stanford University undergraduate Lily Ayo Roberts at this summer's REU poster presentation

Danielson doubles up on staff honors

2006 has seen CBE administrative specialist **Jody Danielson** score a rare double recognition for her service to the department, college, and university. In April, Danielson received a 2006 CYtation Award from the university-wide Professional and Scientific Awards Committee. The award was granted in recognition of Danielson's "extraordinary help and counsel during the transition between old and new department chairs" in 2005.

Danielson's willingness (and ability) to go the extra mile for CBE was again recognized in September, when at fall convocation she was awarded the Dean's Staff Excellence Award for her superior service to the College of Engineering. According to CBE Professor and Chair **James Hill**, Danielson "has created an environment that is the best, most collegial, and most effective that the department has seen in over 30 years."



Jody Danielson accepts a plaque recognizing her with the Dean's Staff Excellence Award from Associate Dean Ted Okiishi

A tip of the (red) hat to CBE's Don Schlager

CBE computer support specialist **Donald Schlager** has been designated a Red Hat Certified Engineer (RHCE) by Red Hat, the global leader in Linux open source software technology. He is one of four College of Engineering IT professionals to take—and pass—the

RHCE exam this year, which typically has a success rate of only 40%.

Schlager, who has been with CBE for 10 years, oversees all aspects of the department's Windows and Macintosh operating systems, in addition to building, maintaining, and managing three Windows-based computer labs. He also manages one Linux lab and two Linux servers for CBE—one for student and departmental data and the other for the Institute for Combinatorial Discovery.

Besides his work for CBE, Schlager has also been recognized for his collaboration on projects associated with the "Seamless IT Initiative" announced by Dean **Mark J. Kushner** in 2005. Called the "crown jewel of Linux certifications," the RHCE documents an individual's ability to configure networking services and security on servers running a Red Hat operating system, thus contributing significantly to this important collegewide effort.



Clapp joins CBE faculty

The Department of Chemical and Biological Engineering is pleased to announce the appointment of **Aaron R. Clapp** as assistant professor, effective fall 2006.

Clapp had been a National Research Council postdoctoral fellow with the Optical Sciences Division of the Naval Research Laboratory in Washington, D.C., since 2002. He was previously a postdoctoral research associate at the University of Florida in Gainesville, where he earned his PhD in chemical engineering in 2001. Clapp also holds

an MS in biomedical engineering from Florida, as well as a BS in chemical engineering from the University of Minnesota.

Clapp's research focuses on interfacial phenomena, particularly colloidal phenomena in biological systems in which surface area effects begin to dominate the behavior of materials. His primary interests in this area include synthesis, characterization, and application of biocompatible nanoparticles (e.g., luminescent quantum dots) and the development of optical microscopy-based techniques for observing nanoscale interactions and processes.

Clapp is also interested in the application of engineered nanomaterials for investigating biological processes, nanocrystal synthesis and applications, optical spectroscopy, energy transfer in molecular systems, and biosensor development. He is the author of 15 refereed journal articles and has given 20 presentations at various conferences and symposia.

Additional faculty and staff news

- Associate Professor **Andrew Hillier** received the Engineering Student Council Leadership Award.
- Professor **Surya Mallapragada** was given an Inventor Incentive Award from Ames Laboratory.
- Professor **Rodney Fox**, who continues his tenure as the Stiles Professor of Chemical Engineering, has been appointed to the Board of Consulting Editors of the *AIChE Journal* for three years.
- Professor **Charles Glatz** is on sabbatical this year at the University of Canterbury in New Zealand, Carnegie Mellon University, and Rensselaer Polytechnic Institute.
- Professor Emeritus **Dean Ulrichson** accompanied ISU students to the summer laboratory course at University College London.
- University Professor Emeritus **Tom Wheelock** continues his research program devoted to the production of hydrogen from coal or biomass.
- Distinguished Professor Emeritus **Dick Seagrave** is president of ABET, which oversees accreditation of all engineering programs in the U.S.
- Emeritus Distinguished Professor **George Burnet** is still active and chairs the department development committee.
- Student Services secretary **Wendy Ortmann** was recognized as the "Most Helpful CBE Staff Member" by the Iowa State AIChE Student Chapter.
- Associate Professor **Dennis Vigil** recently served as associate chair of the department and is currently serving as the department's ABET coordinator.
- Lecturer **Stephanie Loveland** was named Outstanding Faculty Mentor by the College of Engineering student marshal **Andy Whipkey** at summer commencement.
- Professor **Peter Reilly** and his graduate students had illustrations of enzymes they are working on published on the covers of two more journals, bringing the total to five over the past eight years.
- Professor **Jacqueline Shanks** continues in her role serving on the Editorial Advisory Board of *Biotechnology Progress*.
- Professor Kurt Hebert is serving as the North American regional editor of the *Journal of Applied Electrochemistry*.

Breen funds equipment gift

When CBE alumnus **Bernard Breen** (PhD'64) made a major gift to the department a few years back, his only request was that the funds should support research in the energy sector. Former department chair **Chuck Glatz** asked CBE Associate Professor **Brent Shanks** and Professor Emeritus **Tom Wheelock** to draft a proposal for the gift. Late last year, the department unveiled a new Micromeritics ASAP 2020 surface area and porosimetry analyzer.

According to Shanks, the \$52,000 device will permit CBE researchers to analyze and characterize surface area and porosity in order to better achieve a balance between these two critical aspects of catalysts. Introducing discrete amounts of nitrogen to catalysts, the ASAP 2020 can measure changes in pressure after equilibration, revealing precisely how much nitrogen is adsorbed and, in the process, the catalyst's surface area. And by filling the sample surface's pores with increasing amounts of nitrogen, investigators can characterize porosity by backing off pressure and monitoring the release of the adsorbed nitrogen.



Brent Shanks conducts research with equipment enabled by the Breen gift to CBE

Fully automated with the capacity to run two samples simultaneously, the ASAP 2020 represents a major upgrade over equipment the department had been using courtesy of Ames Laboratory.

Chemical and Biological Engineering Faculty Roster

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Robert C. Brown

Bergles Professor
(joint with Mechanical Engineering)
Combustion;
gasification; fluidized
beds; biomass energy
systems



Eric W. Cochran

Assistant Professor
Thermodynamics
of side-chain liquid
crystalline block
copolymers; structure
and dynamics of
block copolymer
nanocomposites;
theory and simulation
of equilibrium/near-
equilibrium phenomena
of complex polymeric
fluids



Rodney O. Fox

Stiles Professor
Chemical reaction
engineering;
computational fluid
dynamics



Kurt R. Hebert

Professor
Corrosion;
electrochemistry



Laura R. Jarboe

Assistant Professor
(2008)
Systems biology;
identification and
simulation of regulatory
networks in *Escherichia*
coli bacteria



Aaron R. Clapp

Assistant Professor
Colloidal behavior and
interfacial phenomena
in biological systems;
nanocrystal synthesis
and applications; energy
transfer in molecular
systems; optical
microscopy techniques



L. K. Doraiswamy

Distinguished Professor
Emeritus
Theoretical and
experimental studies
in catalytic reactions
and reactors; modeling
gas-solid (noncatalytic)
reactions; chemical
reaction engineering
approach to
crystallization



Charles E. Glatz

Professor
Biochemical
separations; protein
purification from plant
and microbial hosts;
membrane processing;
protein extraction;
fermentation



James C. Hill

University Professor and
Chair
Fluid mechanics;
turbulence; transport
phenomena; reacting
flows; computational
fluid dynamics



Kenneth R. Jolls

Professor
Thermodynamics,
stability, phase
equilibrium; analog
computation and
simulation; computer
visualization;
applied electronics
and chemical
instrumentation



Larry F. Hanneman

Adjunct Professor and
Director, Engineering
Career Services
Supercritical fluid
processing of
polymeric materials;
trace analysis for
environmental
compliance;
exploratory data
analysis



Andrew C. Hillier

Associate Professor
Interfacial engineering;
materials synthesis
and characterization;
electrochemistry;
combinatorial
discovery; fuel cells



James R. Katzer

Affiliate Professor
Energy technologies,
catalysis, and chemical
reaction engineering



Mark J. Kushner
Melsa Professor and
Dean
Partially ionized gases
(plasmas)



Surya K. Mallapragada
Professor
Smart polymers
and neural tissue
engineering; designing
polymeric biomaterials
with tailored micro/
nanostructures to
precisely control
function and properties
at the molecular and
cellular levels



Peter J. Reilly
Distinguished Professor
Biochemical
engineering;
enzyme technology;
carbohydrate
chromatography;
computational biology;
utilization of agricultural
residues



Richard C. Seagrave
Distinguished Professor
Emeritus
Application of principles
of thermodynamics and
transport phenomena to
living systems



Cory K. Stiehl
Lecturer
Process systems



Monica H. Lamm
Assistant Professor
Molecular simulation;
polymeric materials;
nanostructured
materials; solid-fluid
phase equilibria



Balaji Narasimhan
Associate Professor
Nanoscale manipulation
of polymer surfaces/
interfaces; engineered
biomaterials; controlled
drug/protein delivery;
combinatorial design of
materials



Derrick K. Rollins
Associate Professor
Predictive modeling
and control of chemical
processes; data
reconciliation/gross
error detection; powder
mixtures



Brent H. Shanks
Associate Professor
Heterogeneous
catalysis; catalytic
conversion of
biorenewable
feedstocks;
mesoporous metal
oxides; novel coupling
of reactor/catalyst
combinations



R. Dennis Vigil
Associate Professor
Multiphase flow;
reaction engineering;
adsorption; particulate
processes



Stephanie D. Loveland
Lecturer
Process control and its
applications



Marc D. Porter
Professor (Collaborator)
Analytical surface
chemistry; spectro
electrochemistry;
miniaturized analytical
instrumentation;
combinatorial chemistry



Glenn L. Schrader
Professor Emeritus
Catalysis; kinetics;
thin film materials;
biocatalysis; natural
product chemistry



Jacqueline V. Shanks
Professor
Biochemical
engineering; plant
metabolic engineering;
NMR tools for
metabolic evaluation;
phytoremediation



Thomas D. Wheelock
University Professor
Emeritus
Coal cleaning; hot
gas desulfurization;
calcium-based sorbent;
methane reforming;
carbon/fly ash
separation

'BIOMAP' directs students to summer research

Research Experiences for Undergraduates (REU), a three-year National Science Foundation program, brought 16 students to Ames for 10 weeks this summer to focus on biological materials and processes—or 'BioMaP.' An international program jointly administered with Mexico's Tecnológico de Monterrey/ITESM, this year's cohort included three students from Monterrey and two who split their time between Ames and the Mexican campus on projects jointly supervised by Iowa State and Monterrey faculty.

Undergraduates participating in the REU came from schools as diverse as Stanford, Manhattan College, the University of Oklahoma, Northwestern, the South Dakota School of Mines, and Penn State, among others. And while many of the students were aspiring chemical engineers, the cohort also included biomedical and biological engineers, as well as several pre-med students.

"The REU exposes undergraduates to the excitement of research and discovery through independent work," says **Balaji Narasimhan**, CBE associate professor. "But it also provides a cohort experience where you bring together 16 people for 10 weeks and thrust them into this invigorating research environment where they're all working on these open-ended new problems—in our case, the biological engineering area."

Students already know projects and advisers they want to work with and provide a list of their top three preferences as part of their applications. Once selected, they work in teams with other REU students, grad students, postdocs, and their primary mentors. In addition to lab work, the students take short courses on ethics and safety, as well as technical writing and

communications. On August 4, the student researchers presented their findings during a poster session held in the atrium of the Molecular Biology Building.

Skipping the mountains and the ocean for a summer of research in Iowa may have been a somewhat easier choice for **Ryan Erickson** and **Lily Ayo Roberts**, two students who worked on projects supervised by



Ryan Erickson of the University of Colorado makes a point about adult stem cells to CBE Professor and Department Chair Jim Hill

CBE Professor **Surya Mallapragada**: Erickson is a junior chemical engineering major at the University of Colorado at Boulder, while Roberts has plenty of opportunities (if not time) for a day at the beach as a junior major in biomechanical engineering at Stanford University in California.

Both Erickson and Roberts grounded their research in Mallapragada's studies of the differentiation of adult stem cells to encourage regeneration of the neuronal pathways critical for restoring function to damaged peripheral nervous systems. Through the use of extracellular matrices and nano-patterned substrates, the researchers hope to encourage the development of the AHPCs into neurons.

The integration of undergraduate research into the mainline projects of some of the top people in their fields is what makes the REU both valuable and appealing for students such as Erickson and Roberts. Indeed, Narasimhan notes, more than a merely "academic" exercise, the NSF evaluates the success of individual REU programs on the publications generated with undergraduate involvement, as well as the number of REU students who proceed to graduate or medical school.

And, Narasimhan acknowledges, the program has other benefits as well: "It's a wonderful recruiting tool for Iowa State."

Balaji Narasimhan and undergraduate student Katie Pfeiffer working together on drug delivery systems



CBE, chemistry students experience diversity through NOBCChE

Of 316 domestic undergraduates declaring chemical engineering majors at Iowa State last year, 40 were minorities. Of those, only eight were African Americans.

As the CBE department's sole African American faculty member, Associate Professor **Derrick Rollins** knows the challenge: not only are fewer Americans enrolling

in science and engineering programs generally, but Iowa is still one of the least ethnically diverse states in the nation. To attract and retain minority students to Ames, then, Rollins and his colleagues need every possible tool at their disposal.

The National Organization for the Professional Advancement of Black Chemists and Chemical Engineers—or NOBCChE (pronounced “NO-buh-shay”)—is one such tool. Founded in Atlanta in 1972, the organization boasts

several dozen chapters at universities across the nation, including both the University of Iowa and Iowa State.

Rollins had been personally involved with NOBCChE since joining the professoriate in 1990 but launched a local chapter only in the last three years.

“I had envisioned establishing an Iowa State chapter, but the numbers weren’t there,” Rollins says. “But I became inspired a few years ago when I taught a statistics course and five out of 35 students were African American—which surprised me. That was a large percentage.”



Derrick Rollins with students Andy Whipkey and Yin Yani; Whipkey was the student marshal for the College of Engineering summer commencement ceremony

Despite those numbers, NOBCChE at Iowa State depends on students from a variety of ethnic backgrounds for numbers sufficient to maintain chapter status. While about half the members are African American, others include Hispanic, Asian, and native African students. In fact, there are no racial or ethnic litmus tests for membership—just a commitment to academic excellence and diversity in the profession.

NOBCChE members participate in a number of service activities throughout the year, including sharing their experiences with prospective minority students visiting the Iowa State campus. Many serve as mentors to younger students and participate in weekly study tables facilitated by Rollins and co-adviser **Malika Jeffries**, an assistant professor in the Department of Chemistry.

The study tables, Rollins points out, are as much for social as academic reinforcement. “We have some really bright students in NOBCChE, so it’s not exactly as if they’re in a position of struggling to succeed,” he says. “A lot of these students have very strong GPAs and are involved in the Carver Honors program.”

One such student is CBE junior **Amber Strohbehn**. Not your “typical” minority student—her father is German American, her mother Chinese American—Strohbehn came to Iowa State from a high school that, in her words, was virtually “all Caucasian—not well integrated at all.”

That experience motivated Strohbehn to embrace the opportunity for a more diverse educational experience at Iowa State. And, for her, the fact that the Iowa State chapter of NOBCChE didn’t necessarily match the national model made membership all the more attractive.

“Nationally, NOBCChE is largely African American,” Strohbehn notes. “But Iowa State is a little different. NOBCChE has had tons of benefits for me, allowing me to be a leader in a great organization that’s nationally known and helps Iowa State.”

Cargill, CBE partner in Spain program

Cargill, Inc., has signed on as a sponsor of the “ISU-Cargill Summer Laboratory Course in Spain.” Offered in conjunction with Spain’s University of Oviedo since 2001 and taught in English, the intensive, five-week laboratory and report-writing course provides undergraduates seven credits toward their Iowa State CBE degrees.

Professor **Kenneth Jolls**, who has worked with the Oviedo program since 2002, is quick to point out that the Spanish experience was hardly a tourist

picnic for the students. “The thing that put the damper on that was a lot of work,” he says. “We hit the ground running, and it was go, go, go for five weeks.”

In that short period, the students conducted 10 experiments and wrote 10 reports, including an oral presentation on the final day of the program. Still, there were abundant opportunities for students and staff to enjoy the beauty and culture of Spain, and even share a little American culture with their hosts. Last year, for example, Jolls invited local musicians to join in as he jammed on his trademark vibraphone for the session’s closing banquet.

“I think the instrument I played came back over with Columbus,” Jolls laughs.

'ChemE Car' carries team to San Francisco—and beyond

Dan Hanson's "ChemE Car" doesn't get quite the same reaction from people as Iowa State's solar and formula SAE racecars. But that's OK: Hanson's team is glad to provide the "reaction" themselves—after all, that's what powers their car.

Hanson and his fellow undergraduates are revving their engines for CBE's third year of ChemE Car competition, a program of the American Institute of Chemical Engineers (AIChE). But unlike the SAE formula racer, their engine makes little noise; and unlike either of their better-known counterparts, nobody gets to drive the ChemE Car.

"Your car has to fit in a shoebox, essentially," says Hanson, a sophomore from Grinnell, Iowa. "Basically, your constraints are that it has to be either powered or stopped by a chemical reaction." Moreover, he adds, the chemical reaction must be calibrated to either drive or stop the car at an arbitrary distance between 50 and 100 feet—not set by ChemE Car officials until the day of the competition.

While competitors can adapt existing vehicles (think of a Tonka dump truck, says Hanson), the ISU team decided instead to build their car from the ground up. And they didn't let pride stand in their way: "We even got a piece of carbon fiber for our chassis from the solar car team," Hanson acknowledges.

To power their vehicle, the team uses a standard electric motor driven by a fuel cell, with a photo resistor as a switch. In turn, the photo resistor is operated by a light-emitting diode (LED). Between the photo resistor and the LED is a clear vessel into which the team deposits an (initially) clear mixture of a starch solution, sodium metasilicate, and potassium iodate, diluted by water.

This "clock reaction" causes the solution to darken and block light from the LED after a predetermined time, thereby switching off the photo resistor and shutting off the car's power. The rate of reaction depends on the ratio of water to the chemical solution: more water equals a longer reaction time equals a greater distance traveled; less water makes for a quicker reaction and a shorter ride.

It may sound like an inexact science, but this approach was good enough to come within three feet of their 68-foot target in the regional competition last April in Stillwater, Oklahoma (host Oklahoma State took first, coming within six inches). And that earned the team a trip to the nationals, underwritten by General Mills at the AIChE Annual Meeting in San Francisco in November.

Hanson is optimistic they can do even better this fall—they've come within six inches themselves in practice. But win, place, or show, he and his teammates are already winners.

"The competition is geared mostly toward problem solving and novel thinking," Hanson stresses. And while those skills might be no substitute for raw horsepower on the NASCAR circuit, they'll take a chemical engineer places no stock car can hope to travel.



CBE takes lead in engineering leadership

With support from the Minnesota-based 3M Corporation, the College of Engineering launched its new Engineering Leadership Program (ELP) last spring. Designed to encourage engineers to assume leadership roles beyond the profession, by 2009 the program will sponsor up to 60 3M Scholars who will be given special training and opportunities over the course of their undergraduate careers at Iowa State.

CBE senior **Aaron Seitz** of Council Bluffs, Iowa, was among 11 3M Scholars selected for the first ELP cohort last spring. He'll be joined this fall by four incoming CBE students, including **Michael Kalkhoff**, a freshman

from Spirit Lake, Iowa; **Meredith Ritter**, a freshman from Urbandale, Iowa; **Elif Miskioglu**, a freshman from Houghton, Michigan; and **Carol Faulhaber**, a junior from Sedalia, Missouri.

For more information about Iowa State's Engineering Leadership Program, see the feature "College Launches Leadership Program" in the fall issue of *Innovate*, the College of Engineering research magazine.



Student Awards — April 2006

Michael Alexander Lois and Manley Hoppe
 Jorge Almodovar-Montanez Cargill Oviedo
 Michael Ancil Ralph S. Millhone
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 Leigh Cumpston College of Engineering
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 Diana Douglas Maurice and Ruth Larson
 Judd Eder College of Engineering
 Michael Fritz A. Douglas and Helen Steffenson
 Lois and Manley Hoppe
 Roderick Seward, Flossie Ratcliffe and
 Helen M. Galloway
 Krystal Garringer Jerrold S. and Mary R. Feroe
 Roderick Seward, Flossie Ratcliffe and
 Helen M. Galloway
 Cargill Oviedo
 Katherine Gidlewski College of Engineering
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 Cargill Oviedo
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 Melanie Goering College of Engineering
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 Tonielle Greenlee Maurice and Ruth Larson
 Jack Guidarelli Skogen-Hagenson
 Jason Haase Harry Oakley Price
 Meisam Hajimorad Lawrence E. Burkhart
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 Andrea Lowe Maurice and Ruth Larson
 Chi-Kuen Ma Skogen-Hagenson

Ecoterina Mariano . . . Roderick Seward, Flossie Ratcliffe
 and Helen M. Galloway
 Ryan McClatchey College of Engineering
 Emily Meierotto Kenneth and Mary Heilman
 Dylan Murray Ralph S. Millhone
 National Merit Finalist
 Anh Nguyen Roderick Seward, Flossie Ratcliffe and
 Helen M. Galloway
 Daniel Olson Engineers Week
 Daniel Orr Robert O. and Marie E. Dierks
 Shannon Parker Lawrence E. Burkhart Outstanding
 Senior Award
 Nadya Pecharsky Frederick Martinson
 Angela Peet College of Engineering
 Latrisha Petersen Clifford A. Shillinglaw
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 National Merit Finalist
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 Ann Staudt Robert O. and Marie E. Dierks
 Katherine Steffensmeier Lois and Manley Hoppe
 Amber Strohbehn . . . Roderick Seward, Flossie Ratcliffe
 and Helen M. Galloway
 Bennett Swiniarski Ralph S. Millhone
 National Merit Finalist
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 Samantha Ulrich College of Engineering
 Brandon Vonk Engineers Week
 Kyle Wagenbach Roderick Seward, Flossie Ratcliffe
 and Helen M. Galloway
 Christine Westgate Robert Fields
 Nathan Wieseler College of Engineering
 Lynn Wolf Don Delahunt
 Adam Wright College of Engineering
 National Merit Finalist
 Anthony Young Frederick Martinson

Torres an ambassador for CBE

As an undergraduate at the University of Puerto Rico, Mayaguez (UPRM), **Maria Torres** wanted to be attractive to industrial recruiters, so she added a chemical engineering major to her major in chemistry. In the process, she made herself attractive to recruiters from the chemical engineering graduate program at Iowa State as well.

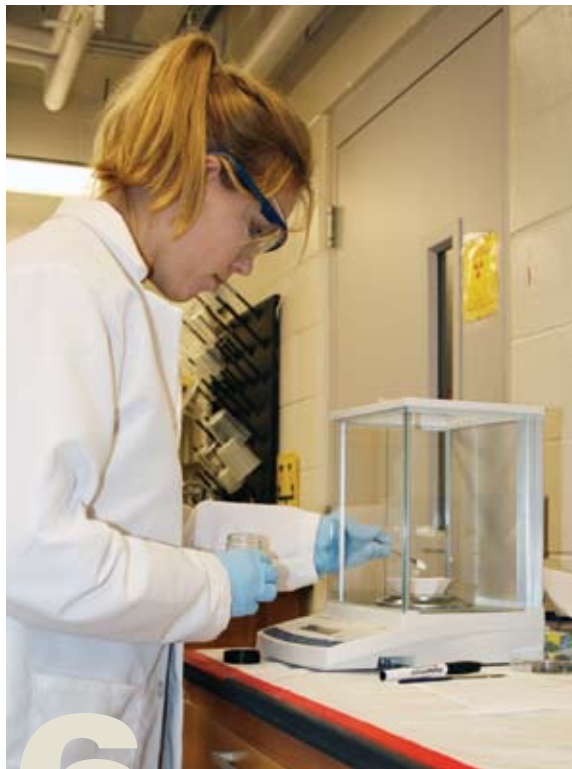
By this time next year Torres will be the first Puerto Rican to graduate with a PhD in chemical engineering from Iowa State. But she won't be the last: besides Torres, CBE now has three graduate students from UPRM, one in the master's and two in the PhD program.

"I wasn't even sure I wanted to go to grad school, but my professors encouraged me," recalls Torres. "So I applied to Georgia Tech and other universities where Puerto Ricans go. Iowa State wasn't one of those."

That would change, due to the tenacity of **Nancy Knight**, the college's director of diversity and graduate student affairs, and then-CBE Director of Graduate Education **Surya Mallapragada**. After a whirlwind courtship, Torres soon found herself working under both Mallapragada and Associate Professor **Balaji Narasimhan**, conducting research on novel amphiphilic polyanhydrides for vaccine delivery.

"The first semester I came here was the most difficult," Torres recalls. "I wish I could have had another student from Puerto Rico to tell me more

Senja Lopac weighs out biodegradable polymers for preparing microparticles



about the program. But I guess somebody has to be the first!"

That's a role Torres herself fills these days. In fact, she has accompanied both Knight and Narasimhan to Mayaguez to promote graduate study at Iowa State to her fellow Puerto Ricans. And through her efforts, not only has CBE been able to bring more diversity to its graduate student body, it has also pursued other teaching and research collaborations that have benefited both Iowa State and UPRM.



Surya Mallapragada and Balaji Narasimhan flank their graduate student, Maria Torres

"Maria's been a wonderful ambassador for us," says Mallapragada.



University of Puerto Rico, Mayaguez

Torres' hometown of Ponce

Lopac named Larson Fellow

The Maurice A. Larson Fellowship in Chemical Engineering for 2006 (both spring and fall) has been awarded to **Senja Lopac**. A resident of Champlin, Minnesota, Lopac received her BS in chemical engineering from the University of Minnesota, Duluth, and enrolled at Iowa State in spring 2006.

She is working with CBE Associate Professor **Balaji Narasimhan** on immune system activation mechanisms for vaccine delivery.

The fellowship is named in honor of the late Maurice A. Larson, an Anson Marston Distinguished Professor and longtime member of the Iowa State chemical engineering faculty. Last year the Larson Fellowship endowment received a substantial contribution from **Frank Stermole** (BSCHE'57, MSChE'61, PhDChE'63) and his wife, Darlene, an Iowa State alumna in home economics. Larson had served as Stermole's PhD adviser.

CBE graduate picnic (August 31, 2006)



Please stay in touch at 515 294-7642 or jgd@iastate.edu.

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Alumni news

Alums Schroeder and Paskach honored by college

CBE alumni **Will Schroeder** (PhDChE'01) and **T. J. Paskach** (BSChE'90, PhDChE'02) were honored last spring at the College of Engineering's annual awards and patents dinner with the Professional Progress in Engineering Award (PPEA) for their success in developing a new process for freezing ice cream.

Schroeder and Paskach are the founders of Blue Sky Creamery, a premium ice cream label that uses a patented technology employing liquid nitrogen instead of electricity to flash freeze ice cream. "The faster you freeze something, the less likely you are to have ice crystals, which create a grainy texture," Schroeder explained in 2001. "In our tubes, an ice cream pre-mix goes from liquid to solid in less than a second."



Besides their flagship retail outlet in Ankeny, Iowa, today the two men's firm, Nitro Ice Cream, LLC, has several restaurants in Iowa and Minnesota and is developing franchise opportunities for investors across the Midwest. The product is also available in ten Midwestern supermarket chains and other retail outlets.

Established in 1989, the PPEA recognizes outstanding professional progress and personal development in a field of engineering specialization and distinguished community service by alums under the age of 46 and is the college's highest honor for young alumni.

CBE alumni news briefs

Sydney Pounds-Leach (BSChE'98) was inducted into the Iowa girls' track and field Hall of Fame at the state coed track meet in Des Moines last May. Pounds won six state track titles at Gilbert High School. She was Iowa State's first Big 12 track champion, winning the 5,000-meter-run indoor title as a senior. Pounds is in the final year of her residence in emergency medicine in Royal Oak, Michigan, but still competes in marathons and local 5K races.

David P. VanderWiel (BSChE'93, PhDChE'98) is currently a NorPro Research Engineer for Catalytic Products of Saint-Gobain C.R.E.E. in Cavaillon, France.

William J. Amend (BSChE'27) died on June 27, 2006. A lifelong employee of DuPont, he was part of a group that pioneered processes for the commercial production of nylon intermediates and in 1940 headed an engineering technical assistance group at the first nylon plant in Seaford, Delaware. Responsible for many nylon and Dacron facilities, he finished his career at DuPont's Dacron plant in North Carolina before his retirement in 1970.

Alan P. Crowther (MSChE'79), MD, went to work with the Celanese Chemical Company in Bishop, Texas, in 1979 after studying at Iowa State under Chuck Glatz. He received his MD from Baylor in Houston in 1984 and set up a primary care medical practice in Three Rivers, Texas, in 1987.

John "Jack" N. Starr (BSChE'87) recently co-authored the "Lactic Acid" entry for the 2006 release of Ullmann's *Encyclopedia of Industrial Chemistry*. He is currently director of process technology for NatureWorks LLC, a Cargill subsidiary in Minnetonka, Minnesota, where he has worked for nine years.

David J. Haberkorn (BSChE'91) received an MBA from the University of Iowa in 1999 and became a certified project management professional for Commonwealth Edison, which merged with Exelon to form one of the largest utilities in the country. He is married with three children.

Former advisory council member **Carol A. Johnson** (BSChE'80) is a customer business analyst with Intel's Americas Sales and Marketing Organization (ASMO) in northern California.

**Department of Chemical and
Biological Engineering**

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Iowa State University
Ames, IA 50011-2230

Former chair King named Ball State provost

Former CBE professor and department chair **Terry King** has been appointed provost and vice president for academic affairs at Ball State University in Muncie, Indiana. King earned a BS in chemical engineering from Iowa State in 1975 and a PhD in chemical engineering from the Massachusetts Institute of Technology in 1979. He began his professional career as a research engineer at Exxon Chemical Company in 1979. King joined the Iowa State chemical engineering faculty in 1982 and was named a full professor by 1990, when he also assumed the chair of the department.

In 1997 King left Iowa State to become dean of the College of Engineering at Kansas State University, a position he filled until leaving for Ball State this year. King's research centers upon fundamental catalysis and surface science, including the application of solid-state nuclear magnetic resonance to catalysis, surface thermodynamics, and reaction engineering. While at Iowa State, he attracted \$4.7 million in research funding, primarily from the U.S. Department of Energy and the National Science Foundation.

