Synthetic to Biomolecular Polymers, and Beyond: Generations of Cornell Faculty in the Lead
Gary Hamed: History of Polymers at Cornell
Producing ChemEs: Cornell Engineering Teaches Product Design and Manufacturing
The Adventures (and many talents) of Julian C. Smith

Cornell Engineering
Chemical and Biomolecular Engineering
DEAR ALUMNI & FRIENDS
OF THE DEPARTMENT,

A summer again turns to fall. I write to provide a brief update from the School of Chemical and Biomolecular Engineering (CBE) and to thank you for your engagement during the past year. It has been said that the modern chemical engineer is the universal engineer. An engineer who in addition to mastery of traditional subjects such as mathematics, physics, engineering analysis and design, also lays claim to mastery of the sciences of life—chemistry and biology. An engineer equipped with the right set of tools to tackle the key challenges of our time. I am especially happy to report that CBE and Cornell continue to play leading roles in educating chemical engineers prepared to lead in these fields and in equipping students at all levels (undergraduate, masters, and Ph.D.) with the required tools to create new knowledge at the forefront of our discipline.

Eighty-two senior engineers B.S. degrees in May. Of this number, 47% were women, which made the chemical engineering class of 2014 among the most gender diverse in the College of Engineering (COE). This year's class cases CBE's contributions to advancing knowledge in the field. This focus is timely as it comes at a time of renewed growth of the plastics industry in the United States fed by the shale-gas boom. It also comes during a period of rising interest in on-shoring of manufacturing in areas in which CBE graduates have already made significant contributions and are well prepared to contribute and lead. The cover story features my colleagues, Ferdinand Rodriguez (Rod) and Claude Cohen, who are together responsible for educating over two generations of Cornell-trained polymer scientists. Rod and Claude's masterful textbook, Principles of Polymer Systems, is widely recognized as one of a handful of key texts used worldwide for training most of the current generation of polymer scientists and engineers. On pg 10, CBE alumni Gary Hamed B.S. '72 and M.S. '73 puts this history in the broader context of the birth and growth of Chemical Engineering at Cornell. On pg 12-18 of the issue we describe ongoing work in polymers and complex fluids fields by several of my colleagues. On pg 19, we discuss how a new program in Product Design and Development is transforming the undergraduate experience in Chemical Engineering. In closing, I would like to express my personal gratitude to all alumni and friends of the School who continue to inspire our students and faculty through your loyalty and generosity in supporting the school and its programs. I will single out Billie Nelson '49 and Peter Wright '75 for their generous gifts in support of the 2EM project to modernize the Unit Operations Laboratory (UO lab). Fully funding this project over the next year remains a high priority and is also an important component in the school's effort to maintain its tradition of excellence in undergraduate education in the face of rising student enrollments and interest in chemical engineering. I would also like to publicly thank Mike Zak ORIE '75 for providing funding to endow a professorship in an emerging area, Energy Systems Engineering. With Mike's support, we are in the early stages of a search that I hope to use to attract an outstanding mid-career or junior person to the department to ensure that CBE and Cornell leads this emerging field.

I hope you enjoy the stories we have assembled and feel informed after reading this issue of the Olin Hall News. If your travels bring you to the Ithaca area, please visit Olin Hall.

Sincerely,

Lynden A. Archer
William C. Hoesey Director and Professor

FROM THE DIRECTOR

SYNTHEITIC TO BIOMOLECULAR POLYMERS, AND BEYOND:
GENERATIONS OF CORNELL FACULTY IN THE LEAD

“It has been said that over millennia, human civilization has moved from the age of stone, to bronze, to plastics. Untold numbers of scientific breakthroughs in the last century have had something to do with polymers,” says Lynden Archer, director of Cornell Engineering's School of Chemical and Biomolecular Engineering. And for 50 years, the school's faculty members have been blazing the trail.

Polymers—ubiquitous in everyday products—are very broad classes of natural and synthetic compounds characterized by small repeating units called monomers (Greek: meros = parts). Living organisms produce biopolymers in a variety of sizes and shapes. “The very DNA that stores the life code in all organisms is a polymer,” Archer explains. And designing specialty polymers—such as those that store solar energy in photovoltaics, or carry drugs in drug delivery systems—can help shape the future of our planet.

Cornell has for years been a leader in the field of plastics, rubber, and fiber. In the 1920s, for example, the school was one of the first to teach polymer science, materials science, and thermodynamics, which have influenced research and education in the polymer area worldwide. “Cornell is one of the premier places in the field of polymers, and its programs are positioned to lead,” Archer concludes. This dedication to excellence in undergraduate education in the polymer area worldwide.

For Rodriguez, there were only two prominent places in the field of polymers, Cornell being one. “And they made me a nice offer, due largely to Charles Winding who was then head of Chemical Engineering and well-known in the polymer business,” he says.

“Cornell turned out to be a great place because of the people on my committee,” he says. Along with Professor Winding there was a Nobel prize winner in physical chemistry Paul Flory and organic chemist Professor William Miller.

“When I finished my Ph.D. in 1958, I was unexpectedly offered a job as assistant professor at Cornell. This worked very well for me because I could continue to work with Winding who encouraged me to teach a course and continue research in polymers. I worked with very good grad students in the area of polymer engineering and po-

FEATURE STORY
lymerization, which was just achieving some importance then, and we expanded into other areas, such as rheology. It was a very fertile period,” Rodriguez recalls.

“Cornell was an easy place to get used to and did well at” he continues. “Engineering administration during that time went up and down but in general it was a place that welcomed new ideas. You could get close to undergrad and grad students without compromising your standing in the field."

In 1970, Rodriguez published the first edition of his seminal book, Principles of Polymer Systems, based on work he had done with Winding and with students on extrusion technology for polymer engineering. The text was among the first to combine the science of polymers with their application. In its fifth edition (2003), it has attracted co-authors over the years, including fellow Cornell faculty members Christopher Ober of the Department of Materials Science and Engineering, Lyn- den Archer, and Claude Cohen, the Fred H. Rhodes Professor of Chemical Engineering.

In the 1980s, Rodriguez developed an interest in lithography and the various processes involved in making computer chips. His team expanded to electron beams and other methods for developing a thin film of polymer or silicon and into a pattern of circuits through selective dissolution. “We also benefited from the sub-micron facility in electrical engineering,” he says.

A great friendship and professional partnership developed between Rodriguez and Cohen, now considered Rodriguez’s successor. “He too had a strong interest in polymers so it was natural that we should collaborate,” says Rodriguez. When Rodriguez left Cornell in 2001, he turned over much of his work to Cohen with whom he now still collaborates on the sixth edition of Principles of Polymer Systems. Among the many accolades Rodriguez took with him when he left Cornell in 2001 were his many teaching awards from the Cornell Society of Engineers and the Daon of Engineering; as well as the “Hispanic Engineer National Achievement in Educa- tion-Research Award.” Rodriguez is also the composer of five published songs.

In 1977 when Claude Cohen came to Cornell as an assistant professor it was still called the School of Chemical Engineering. “Biomolecular” was added some twenty-five years later—a period in which Cohen’s own work evolved through various phases, beginning with characterization of properties using dynamic laser light scattering to probing how polymer molecules move in fluids. At that time he had to build his own instrumentation to do this work. Today, these instruments are produced commercially.

Cohen held a Bachelor’s in chemistry from The American University in Cairo, Egypt, and a Ph.D. from Princeton. A postdoctoral fellowship in the Polyms Depar-tment at Weizmann Institute of Science in Israel was followed by a research associ- atehip in chemical engineering at Caltech. At Cornell, his initial research focused on the orientation of added glass fibers to polymers to enhance, or strengthen, their properties, such as how much they swell upon hydration. Cohen says, “People are very much interested in this area now but at that time not much was known about their structural properties, such as how much they swell when you change their structure.” Because many hydrogels are biocompatible, they are found in several bioengineering and biomedical applications, such as contact lenses, tissue engineering, and drug delivery. Much of Cohen’s efforts today focus on how changing the structure of elastomers—rubber bands, tires, O-rings that seal apparatus—affects their properties. (The fatal space shuttle Challenger disaster in 1986 was caused by a malfunctioning O-ring.) Here he collaborates with CBE Professor Fernando Escobedo who develops computer simulations of polymers and biological molecules. “Speaking of his co-authorship of Prin-ciples of Polymer Systems, Cohen says: “There are lots of books on polymers, in- cluding many from chemists, but few give an overall perspective—from the chemistry and physics, to the engineering processing of plastic parts. The text provides both the fundamental and practical sides.”

“We hope to do most of the work on the sixth edition this [2013] summer,” says Cohen. “And in the fall I will test some of the new ideas and assigned problems with the class I will be teaching to see how stu- dents respond. This next edition should be published by the time I teach in the fall of 2014.”

“A lot of my work is fairly fundamen-tal,” says Cohen, “with no direct commer- cial application. But it forms the basis for understanding the properties of polymers, which can be used by industry to design better elastomers and develop new appli- cations.”

“There’s lots of interest now in try- ing to make polymers not from oil or gas through fractionation and separation, but from renewable resources by combining small molecules, or monomers, to make the polymers,” Cohen points out. He cites a current two-pronged effort to produce polymers from either microorganisms, through genetic modification, or other nat- ural resources, such as orange peel and car- bon dioxide—the work of Professor Geoff Coates of Cornell’s Chemistry department.

Those new developments will be included in the next edition of the text, says Cohen. As Cohen approaches his own retire- ment, he observes that the school has done well in increasing the number of “really good faculty.” When he joined, there were fifteen faculty. At one stage that number dipped to twelve. Now the school boasts twenty one tenure-track faculty, plus three lecturers or “industrial practitioners,” who have spent most of their careers in industry. “This has been very helpful to the students and allows other faculty to spend more time on research,” he says.

Half of new faculty members were hired in the last fifteen years and reflect exciting diversity, says Archer, naming As- sociate Professor Yong Joo, and Assistant Professor and James C. and Rebecca Q. Morgan Sesquicentennial Faculty Fellow Rosanna N. Zia. Archer believes that the new types of research and courses that Joo and Zia bring to the department will have the same lasting impact as their predeces- sors Rodriguez and Cohen.

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His work with Rodriguez, with whom he shared students, was one of those fruit- ful collaborations. They worked together on hydrogels, which are essentially cross- linked polymers that host a large amount of water. Says Cohen, “People are very much interested in this area now but at that time not much was known about their structural properties, such as how much they swell when you change their structure.” Because many hydrogels are biocompatible, they are found in several bioengineering and biomedical applications, such as contact lenses, tissue engineering, and drug delivery.

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THE ADVENTURES (AND MANY TALENTS) OF JULIAN C. SMITH

The entertainer

“How old are you again?” “Ninety-five,” replied Professor Emeritus Julian Smith. “Can’t you tell?” he asked, making a comically pitiful face, hunching his shoulders up to his chin so that his neck disappeared, and affecting a feeble wobble. He then straightened up and chuckled.

The next night found Smith onstage in the Statler Auditorium in black tie and singing before a packed house of alumni attending Reunion 2014. Accompanied by fellow Savage Club member Bill Cowdery on the grand piano, Smith sang “Have Some Madeira, M’Dear,” a 1959 song about a lecherous old man trying to ply a young girl. "Have some Viagra, my dear…” at the song “Have Some Madeira, M’Dear” -- "Have some Viagra, my dear …" at the Savage Club’s concert in Statler Auditorium -- "Have some Viagra, my dear …" at the Savage Club’s concert in Statler Auditorium.

Smith accepted a job offer from Du Pont, where he worked for several years (including on the Manhattan Project, making fluorine and distilling uranium hexafluoride), before returning to Cornell as an assistant professor in 1946. He retired in 1986 after 40 years of service on the faculty, including serving as director of the School of Chemical Engineering from 1975-83 and director of continuing education for the College of Engineering from 1965-73.

He also co-authored (with Warren McCabe) a textbook, “Unit Operations of Chemical Engineering,” which is still in print today and has sold over a half a million copies.

Mike Shuler, the Samuel Eckert Professor of Chemical Engineering and a member of the Cornell faculty since 1974, explains Smith’s considerable legacy in the college: “He assumed the role [of department chair] in a particularly turbulent time in the department, as it was evolving into a modern department of chemical engineering. He guided the school toward the future -- where research and graduate education played an increasingly important role -- while still maintaining the school’s traditional dedication to undergraduate instruction. Many of the older faculty members were uncomfortable with the change.”

Julian Smith in 1951 as an assistant professor at Cornell. Photo: provided.

“Julian could walk the narrow line to do what needed to be done while maintaining the best of the former culture. He had the trust of all the faculty.”

Shuler also remembers Smith having “a remarkable sense of humor -- often slightly understated -- but used with great skill to make key points.”

Another colleague, Claude Cohen, the Fred H. Rhodes Professor of Chemical Engineering, was the first non-chemical engineer hired into the faculty, by Smith, in 1977. “Such a hiring was not the norm,” Cohen reflects, “because he was recognized (based on his textbook … and his consultant activities) as ‘Mr. Chemical Engineer,’ and he had the trust of the faculty. We now have four more faculty members with non-ChemE degrees expanding the frontiers of the field and a very vibrant department.”

Smith sings a new verse to the song “Have Some Madeira, M’Dear" -- “Have some Viagra, my dear …” at the Savage Club’s concert in Statler Auditorium. Julian Smith in 1951 as an assistant professor at Cornell. Photo: provided.

A man of many talents

Off campus, Smith lived a life full of service and activity. He and his wife, Joan (who died in 2003), raised their three children in the Firth family’s large house on Lake Memphremagog, near Magog. His family employed cooks and chauffeurs and nurses. He went to the best schools, discovered a talent for math and science and English, had ambition to be or near the top of his class, earned very high marks, graduated from high school with the highest exam scores in his province, and was given every opportunity to pursue his various interests (stamp collecting, golf, chemistry).

“‘In the workshop in the basement of our house,” recalls Smith in his memoir, “my father had encouraged me to set up chemical experiments, buying me acids, bases and some more exotic chemicals like solid iodine that were available at drug stores in the 1930s. I also had a Bunsen burner and a gas-fired rack on which beakers and dishes could be heated. One Saturday afternoon Tom Harris and I were mixing and heating various chemicals in a porcelain dish ‘to see what would happen.’ We had lots of curiosity and daring, and very little sense. After one mixture showed no interesting activity, I grabbed the bottle of acetone and said, ‘I wonder what this will do,’ and poured acetone into the dish.”

The resulting fire was extinguished in the nick of time by the family butler, Darby

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A Cornell education, and career

There was never any question that Smith would attend Cornell. Both his parents were Cornellians, as well as a great uncle and a few cousins, and his older brother: Boyce was an upperclassman, president of his fraternity and captain of the ski team by the time Smith arrived in Ithaca as a freshman in 1936.

Julian Smith in 1951 as an assistant professor at Cornell. Photo: provided.

“Julian could walk the narrow line to do what needed to be done while maintaining the best of the former culture. He had the trust of all the faculty.”

During his first week at Cornell, Smith attended a freshman event at the president’s house, where President Edmund Ezra Day pointed out that Julian Smith was a freshman of sorts, since it was his first year in the role. Smith auditioned for the Glee Club and was made assistant accompanist.

He did very well academically, graduating second in his class and subsequently earning a master’s degree in chemical engineering from Cornell the next year.

Smith accepted a job offer from Du Pont, where he worked for several years (including on the Manhattan Project, making fluorine and distilling uranium hexafluoride), before returning to Cornell as an assistant professor in 1946. He retired in 1986 after 40 years of service on the faculty, including serving as director of the School of Chemical Engineering from 1975-83 and director of continuing education for the College of Engineering from 1965-73.

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Julian Smith as the director of the School of Chemical Engineering in 1981. Photo: Jon Rels Photography.

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Julian Smith sings a new verse to the song “Have Some Madeira, M’Dear" -- “Have some Viagra, my dear …” at the Savage Club’s concert in Statler Auditorium. Julian Smith in 1951 as an assistant professor at Cornell. Photo: provided.

Still standing, still singing

Smith, who says he will perform at next year’s Reunion “if I can still walk and stand and sing,” credits his longevity to a series of things: “My parents could afford top medical care. I was not badly hurt when I totaled my car at age 19. I played a lot of golf, and no extreme or contact sports. I’ve always accepted the inevitable without too much fuss. I never smoked -- well, maybe a few cigarettes. But I think mostly,” he concludes, “it has been a matter of good fortune.”

This story first appeared in the June 2014 edition of Cornell’s Ezra Update. Written by Emily Sanders-Hopkins.

A man of many talents

Off campus, Smith lived a life full of service and activity. He and his wife, Joan (who died in 2003), raised their three children in the Firth family’s large house on Lake Memphremagog, near Magog. His family employed cooks and chauffeurs and nurses. He went to the best schools, discovered a talent for math and science and English, had ambition to be or near the top of his class, earned very high marks, graduated from high school with the highest exam scores in his province, and was given every opportunity to pursue his various interests (stamp collecting, golf, chemistry).
In a recent communication with Olin Hall Herslow wrote, “The biggest business lesson I have learned is that to be very successful as an entrepreneur one must always focus on niche markets. If you take something ordinary like a credit card and elevate it by changing its material composition and aesthetic, you create a completely unique experience for the cardholder. They feel special at the point of sale when they hand their card to the cashier, creating loyalty to the card issuer. At 73 I am still at work for 12 hours a day and enjoy working closely with Michele developing new products to meet even the most outrageous customers wants and needs. One of our new employees is a Cornell PhD who I introduce as my replacement. He and the rest of the team are doing such a good job I will probably never retire.”

Robert S. Langer

Ebert S. Langer ’70 ChemE, the David H. Koch Institute Professor at Massachusetts Institute of Technology, has won the $500,000 Kyoto Prize in Advanced Technology from Japan’s Inamori Foundation. He is among three recipients of the 2014 Kyoto Prize, which honors significant contributions to the betterment of society.

“I’m thrilled,” Langer says of winning the award. “I look at the people who have won this prize before, and for me to be lucky enough to be in that company, it’s a thrill and an honor.” Langer is best known for his pioneering contributions to tissue engineering, where he applies biodegradable polymer technologies to construct scaffolds for cell growth, and for developing drug delivery systems for the controlled release of proteins, nucleic acids, and other bioactive molecules.

The other two recipients of this year’s Kyoto Prize are mathematician Edward Witten, who won the Kyoto Prize in Basic Sciences, and artist Fukumi Shimura, who won the Kyoto Prize in Arts & Philosophy. The awards will be presented on Nov. 10 in Kyoto, Japan.

Steve Rosen earned his Bachelor of Science degree from Cornell’s School of Chemical Engineering in 1960. He went on to earn an M.S.E. in plastics engineering from Princeton University and a Ph.D. from Cornell in 1984. Even today, 50 years after leaving Cornell Engineering, Rosen has lasting memories of his years in Olin Hall. “I elected the polymer course as an undergraduate,” said Rosen. “It was taught by a new, young faculty member, Ferdinand Rodriguez. He lit a fire under what had been an uninspired (and uninspiring) student.” Shortly after receiving his B.S., Rosen returned to Cornell to work with “Rod” on his Ph.D. Rosen’s doctoral work formed the basis of his 39-year career in academics, as well as serving as the inspiration for his successful textbook, Fundamental Principles of Polymeric Materials. Rosen started as an assistant professor of chemical engineering at Carnegie Tech (now Carnegie Mellon) in Pittsburgh in January, 1964. He rose through the ranks and then left Carnegie Mellon in 1981 to become department chair at the University of Toledo.

Throughout his career as a teacher, Rosen continued to draw inspiration from many of his professors at Cornell. “I recollected many of Ray Thorpe’s homework problems whenever I taught the intro course in those 39 years,” said Rosen. “And I often used Julian Smith’s text when I taught unit ops.” Another professor who affected Rosen’s teaching years after leaving Cornell was C.W. Mason. “I tried to hide behind the microscope in his microscopy course,” remembered Rosen, “but in his materials science course I learned how to formulate exam questions that required thought and synthesis rather than rote memory. For example: How would you test the crispiness of corn flakes?” Rosen singled out Peter Harriott’s emphasis on technical communication in the unit ops lab at Cornell as especially invaluable. “I still cringe at split infinitives,” said Rosen. “I tried to follow his example whenever I taught unit ops lab.”

In 1990, Rosen joined the University of Missouri-Rolla (now Missouri University of Science and Technology), where he was department chair for five years. He retired in December 2002 as professor emeritus. “Since then, I’ve been enjoying a quiet retirement in Rolla, a nice college town in the Ozark boondocks,” reported Rosen.
A SHORT HISTORY OF POLYMERS IN CBE AT CORNELL

In 1938, Dr. Fred Hoffman (“Dusty”) Rhodes founded the School of Chemical Engineering (located in Baker Hall) and appointed Dr. Charles Calvert (“C.C.”) Winding as an assistant professor. Although Dusty was not involved in polymers, C.C. co-authored two books on this subject: “Plastics: Theory and Practice” (with R.L. Hasche in 1947) and “Polymeric Materials” (with G.D. Hill in 1961). These books were written for chemical engineers and published at a time when the growth of commercial polymers was quite rapid.

In 1940, Franklin Walter Olin, president of Olin Industries (and a major league baseball player for two seasons!), donated monies funding the construction of Olin Hall. In September 1942, the School of Chemical Engineering moved from Baker into Olin Hall and finally had its own space. The Geer Laboratory of Plastics and Rubber was established in Olin Hall in 1953 using monies donated by Dr. William C. Geer. Dr. Geer was a graduate of the Cornell class of 1905 and vice-president of research at BF Goodrich. He held 40 patents related to inflatable rubber-fabric wing designs. These were credited with preventing numerous airplane crashes.

During World War II, C.C. was a consultant to the Rubber Research Board on the vital synthetic rubber manufacturing effort. He became the Herbert Fisk Johnson Professor of Industrial Chemistry and director of the School of Chemical Engineering in 1957 and wrote Olin Hall News for nearly twenty years. The Charles C. Winding Scholarship Fund was established in 1973 from donations in his honor. He retired in 1974 and died in 1986. In 1957, C.C. hired Dr. Ferdinand R. Geer. Dr. Geer was a graduate of the Cornell class of 1905 and vice-president of research at BF Goodrich. He held 40 patents related to inflatable rubber-fabric wing designs. These were credited with preventing numerous airplane crashes.

The course on polymers that I took from Rod used his 1970 first edition of “Principles of Polymer Systems” (now in its fifth edition with co-authors). In this course, two tests of equal weight were given. Each test had two problems. A right answer was worth 50 points; a wrong answer received 0 points—no partial credit. I made two silly errors on the first test and received a zero—total devastation! But, I received 100 on the second test and Rod gave me an A+ for the course!

I will close with a bit of remarkable history regarding C.C., Rod, and polymers. Rod was my graduate advisor; C.C. was Rod’s graduate advisor; Dr. Ralph E. Montonna was C.C.’s graduate advisor. Following this progression back six more generations, and it is found that Jakob Berzelius appears! Thus, Berzelius was C.C.’s great-great-great-great-great “grand-advisor.” Of course, Berzelius was one of the foremost chemists of the nineteenth century—responsible for the law of definite proportions, the letter notation for the elements, isolator and discoverer of several elements, among many other seminal contributions. In addition, in 1833, Berzelius coined the term “polymer” to describe organic compounds that shared identical empirical formulas, but differed in overall molecular weight—larger compounds were “polymers” of the smallest. For example, glucose ([C₆H₁₂O₆]) was viewed as a polymer of formalddehyde ([CH₂O]).

Written by Professor Gary R. Hamed, The University of Akron.

Robert J. Fritz, B.S.ChemE, 1943
Otis D. Purdie, B.S.ChemE, 1943; B.ChemE, 1947
William N. Taylor, B.ChemE, 1944
John M. Cole, B.ChemE, 1944
Paul T. Attwood, B.S.ChemE, 1945; B.ChemE, 1947
John P. Fraser, Ph.D., B.S.ChemE, 1945; M.S.ChemE, 1947; Ph.D.ChemE, 1949
Stoddard Henry Knowles, B.S.ChemE, 1945; B.ChemE, 1947; MBA GradMgmt, 1949
Charles M. Winchester III, B.ChemE, 1948
Richard B. Sainburg, B.ChemE, 1948
John E. Watson, B.ChemE, 1950
Kenneth E. Wattman, B.ChemE, 1950
Roger Sands Chamberlin, B.ChemE, 1950
Eric W. Kjellmark Jr., B.ChemE, 1950
William M. Marcusson, B.ChemE, 1950
Don E. Skoog, B.ChemE, 1950
David George Bowen, B.ChemE, 1951
Kenneth R. Ross, B.ChemE, 1951
James F. Ackerman Jr., B.ChemE, 1953
Irwin B. Margloff, B.ChemE, 1953
George H. Tidman, B.ChemE, 1954
John B. DeVries, B.ChemE, 1957
Theodore P. Oft, B.S.ChemE, 1958
George J. Zachmann Jr., B.ChemE, 1958
Jack Weaver, Ph.D., B.ChemE, 1959
Jonathan E. Johnson II, B.ChemE, 1959; MBA GradMgmt, 1960
Caleb F. Davis IV, B.ChemE, 1961
Ivan G. Szanto, M.S.ChemE, 1961
Roy A. Kyndberg, B.ChemE, 1964
Donald I. Townsend, B.ChemE, 1965
Craig F. Stead, B.S.ChemE, 1965; M.Eng.ChemE, 1966
Dennis C. Dakin, B.S. ENGR, 1972
Thomas E. McMillan, B.S. ENGR, 1980
Eric Joseph Young, B.S. ENGR, 2010

3/1/13 Pembroke, NH
3/20/14 Fayetteville, NC
11/21/13 Williamsport, PA
5/15/14 Basking Ridge, NJ
11/26/13 Guadalupe, CD
2/25/13 Houston, TX
9/6/13 Frederick, MD
11/24/13 Landerberg, PA
4/26/13 New Canaan, CT
12/4/13 Riverside, CA
2/7/14 Chadds Ford, PA
5/16/14 Johnstown, NY
11/4/13 Ft. Lauderdale, FL
5/29/14 Arcadia, CA
5/15/13 Wilmington, DE
8/20/13 East Stroudsburg, PA
10/11/13 Dublin, GA
8/10/13 Litchfield, CT
7/25/14 Duarte, CA
1/15/14 Norwich, VT
3/10/14 Lafayette Hill, PA
6/9/13 Davenport, IA
6/24/14 Coopersburg, PA
12/11/13 Meadowbrook, PA
12/7/13 Los Angeles, CA
12/18/13 Houston, TX
7/1/13 Wilmington, DE
5/8/14 Saint Paul, MN
3/10/13 Midland, MI
2/15/13 Putney, VT
7/1/13 Lincoln University, PA
1/17/14 Hockinson, DE
6/3/14 Webster, NY
FACULTY RESEARCH

POLYMERS & COMPLEX FLUIDS RESEARCH

LYNDEN ARCHER: PASSIONATE ABOUT NOHMs

Lynden Archer has always been scientifically inquisitive, although his first experiment was quite different from the work he does today. As a ten-year-old boy in Guyana, Archer was an avid reader of chemistry books. He had read a story about the wonders of brewer’s yeast as a dietary supplement and had a hunch—what if he fed some of his mother’s chickens a diet re-inforced with brewer’s yeast? His mother, perhaps seeing the spark of scientific genius in her son, let him experiment away.

“The experiment actually turned out pretty well,” said Archer. “My mother commented that, relative to the control group, the birds whose diets were supplement-ed with brewer’s yeast were healthier and tasted better, and that little bit of a compliment, for a kid, goes a long way. So that was the first concrete science lesson I had as a youngster.”

Much has changed for Archer since those early days. Today, he serves as director of the School of Chemical and Biomolecular Engineering at Cornell Engineering and co-director of the KAUST-Cornell Center for Energy and Sustainability. He is the Samuel Roberts Noble Professor and co-director of the KAUST-Cornell Center for Molecular Engineering at Cornell Engineering, for a kid, goes a long way. So that was the first concrete science lesson I had as a youngster.”

Although the batteries field has provided fertile ground for innovations on the basic NOHMs design, I do not consider myself an electrochemist or battery jock, I’m in fact more passionate about the nanoparticle-tethered polymers that make it all work,” said Archer.

But a series of very able graduate stu-dents (David Lou, Zhichao Yang, Jenefer Schaefer, Yingying Liu) and post doctoral scientists (Surya Moganty and Jay Nava-needhalakshman) in his lab helped him un-derstand the promise of NOHMs for en-abling batteries that offer three to ten times the energy storage capacity of today’s state-of-the-art lithium-ion batteries. “Archiver is very inspiring,” said Yang. “He comes up with many ideas quickly and finds ways to overcome problems and ar-rive at answers quickly.”

Lynden Archer in the lab with graduate students Praveen Agarwal (left) and Laura Olenick (right).

Archer recalled his first meeting with Giannelis—before deciding to come to Cornell—with a smile. “Emmanuel had just published an important paper on clay-based nanocomposites, (composites made up of inorganic clay mineral particles physically mixed with polymers), and had an interesting theory for the properties of the materials that explained many aspects of what we knew about nanocomposites, but one of the key assumptions was inconsis-tent with my intuition based on knowledge of how polymer molecules move near rigid surfaces. I wanted to know whether this in-tuition was right and what factors might be at work in its failure to describe clay-based polymer nanocomposite materials. I came up with a physical model system of hairy nanoparticles to test my hypothesis; that’s where the gnomes of the materials platform that ultimately became NOHMs started.”

Archer and his first Cornell Ph.D. stu-dent, Qiang Zhang, began experimenting with nanocomposites created by attaching organic polymers to spherical inorganic nanoparticle cores—like spokes from the hub of a wheel, or rays from a star. They reasoned that by making the molecular structure rheology and ion transport properties of the particles to a high-molecular weight polymer corona to inorganic nanoparticle cores—like spokes from the hub of a wheel, or rays from a star. They reasoned that by making the molecular spokes dense enough it should be possible to simul-taneously limit particle-particle contacts and prevent physical adsorption of polymer molecules on the nanoparticle surfaces, allowing two of the major deter-minants of a nanocomposite material’s properties to be isolated and studied.

“We quickly discovered that unlike physical mixtures of nanoparticles and polymers, which spontaneously segregate into coarse particle-rich and particle-de-pleted phases, the hairy particles exhibited remarkable colloidal stability in their poly-meric hosts for extended periods of time,” said Archer.

A consequence is that upon addition of the particles to a high-molecular weight polymer to create a nanocomposite, none of the typical enhancements in mechanical properties reported in physical mixtures of clays and polymers are observed.

“This told us that contrary to conven-tional wisdom at the time, the forces com- municated through particle-particle con-tacts and sustained by the slow motions of adsorbed polymers confined between the particles that mediate these contacts, play the crucial role in setting the properties of a nanocomposite material,” said Archer.

The realization that the hairy particles at the heart of their studies were fundamen-tally interesting came a few years later; after a postdoctoral scientist in the Giannelis group made the discovery that similar par-ticles created by ionically linking molecules, and short polymers to inorganic structures exhibited fluidity in the absence of a sol-vent.

“A flurry of collaborative studies prompted by this finding showed that the Zhang particles created by covalent attach-ment of polymers had the same ability to exist as self-suspended suspensions, lead-ing to current understanding that the be-havior is a characteristic of any sufficiently-well grafted nanoparticle. It means that whether the linkage between the organic and inorganic phases is ionic or covalent, every nanoparticle making up the sus-pension is itself a nanocomposite.”

Archer’s current approach for build-ing macroscopic nanoscale organic hybrid materials one nanoparticle building block at a time was thus born. This simple con-ceptual breakthrough lead to various in-car-nations of the materials, including ionically conductive NOHMs based on ionic liquids tethered to nanoparticles, which remark-ably show no melting transition, nanopar-ticle salts that stabilize electrodeposition of metals in high-energy batteries, and cross-linked NOHMs networks that exhibit un-usual shape-memory properties.

“The power of NOHMs is that one can now conceive and easily assemble novel organic-inorganic hybrid materials with es-sentially any desired set of physical proper-ties by taking advantage of the vast library of inorganic nanoparticle core chemistries, sizes, and shapes that already exist and the vast set of organic ligands, (polymers, ionic liquids, surfactants, and mixtures of any of these materials), that can be tethered to the nanoparticle cores to create nano-composite building blocks appropriate for meeting a particular need,” said Archer.

Commercializing NOHMs

The Archer group has experimented with a wide range of different core and corona materials for NOHMs. These com-binations led to Archer’s personal favor-ite application—batteries. He found that NOHMs’ coronas can interneur with each other—creating porous interstitial channels that allow material to travel to the core of the particle.

“I realized that I could do chemistry on the surface of the core particle that would become internalized into the pores between nanoparticles once the NOHMs form,” said Archer. “Thus, if we use the materials as electrolytes in a battery, it is possible to regulate the rate at which ions flow from the anode to the cathode by the chemistry done on the outside of the particles.”

But a series of very able graduate stu-dents (David Lou, Zhichao Yang, Jenefer Schaefer, Yingying Liu) and post doctoral scientists (Surya Moganty and Jay Nava-needhalakshman) in his lab helped him un-derstand the promise of NOHMs for en-abling batteries that offer three to ten times the energy storage capacity of today’s state-of-the-art lithium-ion batteries. “Archiver is very inspiring,” said Yang. “He comes up with many ideas quickly and finds ways to overcome problems and ar-rive at answers quickly.”
With Archer’s scientific guidance, NOHMs Technology opted to tackle lithium-sulfur batteries (Li-S) for cell phones and other uses. They selected this material because sulfur is sourced from coal.

“If one could make a battery, which is a clean, green technology—that diverts a “dirty” source material from a less beneficial contemporary use [combustion]—that would be a really cool thing to do. That was the genesis of that thought,” Archer said.

It also helped that the material is cheap and abundant in the U.S. Archer and his team also brought original ideas from their polymer physics tool set that helped overcome fundamental limitations with Li-S battery technology, which has led to a core set of intellectual property. NOHMs had a design in place, but it worked, and the work continued.

**Long-term goals of research**

Archer’s goals for his ongoing research are pretty basic, “I want to understand NOHMs, period,” he said. “I want to understand why. But I want to understand where they belong. When I say the word ‘polymers,’ every person without a detailed understanding of what polymers are generally understand what a transformational role polymers have played in enabling modern technology: NOHMs have a long way to go to achieve comparable impact,” said Archer. “But because they combine features of two exceptional classes of materials (inorganic ceramics and organic polymers), the journey should be faster and perhaps more interesting. The Archer lab in CBE is pursuing basic science of NOHMs structure, dynamics and transport properties with the goal of advancing understanding to position NOHMs alongside other technological giants such as polymers and colloids that dominate today’s materials landscape.”

**STABILITY OF LIQUIDS AND GASES**

Paul H. Steen: *Dynamical Stability of Liquids and Gases*

Paul Steen’s expertise is in the dynamical stability of liquids and gases, especially the sudden shape change of liquid surfaces. “I’m interested in interfaces, liquid-gas interfaces, liquid-liquid interfaces, interfaces where surface tension is important, so droplets, bubbles, liquid bridges, and rivulets are subjects,” he said.

Together they study the dynamics of water drops on vibrating surfaces. Just like the string of a violin that resonates and creates distinct sounds when it is plucked, droplets on vibrating surfaces also resonate creating unique droplet shapes. What is different here is that the droplet is constrained on a two-dimensional surface, in contrast to the violin string that is only constrained at its ends.

The Steen group focuses on the theoretical analysis and prediction aspect of their joint studies. Working with the Steen theoretical analysis and prediction aspect of NOHMs structure, dynamics and transport properties with the goal of advancing understanding to position NOHMs alongside other technological giants such as polymers and colloids that dominate today’s materials landscape.”

Ultimately, Daniel aims to understand fundamentally how surfaces are wet by fluids and how to harness surface chemistry and liquid shape to actuate droplets on a surface for engineering applications. Daniel said she especially appreciates the opportunity to work with people like Steen and bright students who are passionate about the subject. “There is no doubt that the Daniel group will continue to propel this field forward scientifically and through novel engineering applications,” she said.

Together they study the dynamics of water drops on vibrating surfaces. Just like the string of a violin that resonates and creates distinct sounds when it is plucked, droplets on vibrating surfaces also resonate creating unique droplet shapes. What is different here is that the droplet is constrained on a two-dimensional surface, in contrast to the violin string that is only constrained at its ends.

The Steen group focuses on the theoretical analysis and prediction aspect of their joint studies. Working with the Steen theoretical analysis and prediction aspect of NOHMs structure, dynamics and transport properties with the goal of advancing understanding to position NOHMs alongside other technological giants such as polymers and colloids that dominate today’s materials landscape.”

**SURFACE SCIENCE**

Susan Daniel: *Surface Science*

A ssociate Professor Susan Daniel became interested in surface science while doing undergraduate research at Lehigh University. Continuing on as a graduate student at Lehigh, Daniel pioneered a technique to manipulate liquid droplets on surfaces by controlling interfacial properties.

During her research, she discovered that inducing shape fluctuations in the droplets could be used to control their motions. Since joining Cornell in 2007, the Daniel’s group has continued to study the dynamics of droplets that undergo shape fluctuations.

Daniel comments the availability of resources and opportunities for collaboration with other groups at Cornell’s School of Chemical and Biomolecular Engineering. “We have a very exciting collaboration with the Steen group,” she said.
YONG L. JOO: INSTABILITIES IN THE PROCESSING OF COMPLEX FLUIDS AND NANOFIBER FORMATION

By working to understand the instabilities in the processing of complex fluids and nanofiber formation, Associate Professor Yong L. Joo is making the world a better place.

Elke and Joseph, as well as several other faculty and researchers based on his nanofiber work are about to be used in a breakthrough lithium-ion battery that delivers much higher energy density than conventional technologies and can be successfully scaled to be cost competitive. But Joo is just as excited at unlocking the fundamental secrets behind the creation of these materials.

"Individuals usually focus on just the applications of the materials," Joo said. "But as a chemical engineer, a lot of understanding is needed in the processes—both in studying the process and developing the process." Joo said partnering with other Cornell faculty like Uli Wiesner in Materials and Chemical Engineering, and Margaret Frey in Fiber Science produces a synergy that advances everyone's research. "Collaboration is easy at Cornell, which helps in terms of accommodating others' work and integrating that into our work," he said. "That makes it simpler to obtain new materials, and their materials go through the scalable nanomanufacturing processes I work with. Having such a large and involved faculty and student body helps me work towards a better future." Joo Park, graduate student, and Yong Joo work on a multi-nozzle, gas-assisted electrospinning setup to develop ceramic and metallic nanofibers.

To create ceramic, metal, and hybrid nanofibers, Joo is using water-based electrospinning. "This process is also solvent-free, resolving the issue of working with toxic solvents," he said.

In collaboration with DuPont, Joo recently laid a new foundation for experimental and theoretical studies on advanced, scalable manufacturing processes based on flow instability, such as in needleless centrifugal spinning, in which a polymer solution or melt is placed on a rotating plate and spreads out and forms "fingers." The "unstable nature helps stretch the polymer liquid to form thin fibers," he said. "This process does not require a needle, just a polymer film, unlike conventional spinning processes."

High loading of inorganic precursors into water-soluble polymers in scalable processes such as gas-assisted electrospinning and needleless centrifugal spinning gave rise to cost-effective, simple production of metallic and ceramic nanofibers. The newly developed, continuous Taylor-Couette reactor, which also utilizes unstable but controlled vortex flow, offers fundamental studies on the effect of flow structures on crystallization, absorption, extraction, and chemical reactions.

Joo’s aim is to understand the process behind the creation of the fibers, instead of relying on trial and error. He utilizes modeling and theoretical analysis to give him an edge in attempting to improve the processes. Comprehensive mesoscopic modeling and simulation studies on the dynamics of confined assembly of block copolymer/nanofiber scale systems lead to ceramic and metallic nanofibers with tailored nanostructures such as ordered mesopores which are being used in reaction studies in various catalysts and energy storage devices.

A 1999 graduate of Seoul National University, Joo earned his Ph.D. in chemical engineering from Stanford in 1993 and completed a two-year postdoc at the Massachusetts Institute of Technology before joining Cornell in 2001. ROSEANNA N. ZIA: EINSTEIN’S MICROSCOPE, REVISITED

The importance of rheology—the study of the deformation and flow of soft matter—in the analysis of natural and engineered complex fluids has a long and rich history, tracing its roots to the work of the botanist Robert Brown in the early nineteenth century. Brown’s observation of microscopic pollen grains dancing about in water was initially thought to reveal some sort of “fundamental life force.” However, upon further investigation, it turned out the motion depended only on the microscopically small size of the particles. The mysterious phenomenon went unexplained until the turn of the next century when Einstein and Perrin utilized this “Brownian motion” to prove the atomic nature of matter and to derive Avagadro’s number. In addition to this profound result, the foundation of modern-day rheology had been laid. Einstein combined the theory of diffusion with Stokes’ solutions for creeping flow to yield the Stokes-Einstein relation connecting measurable particle motion—diffusion—to material properties: the viscosity. Perrin’s experiments confirming the theory earned him the 1926 Nobel Prize, illustrating the broad importance of such theory across science. But Einstein’s arguments and the Stokes-Einstein relation rely on the existence of equilibrium and other narrow criteria.

New approaches, including several predictive theoretical models developed by the research group of Assistant Professor Roseanna N. Zia, have extended the idea of tracking the motion of a Brownian particle to understand material properties far beyond this limited model. These advancements are critical to the study a remarkable range of systems—from blood to biofilms; from paint to injectable pharmaceuticals; from petroleum products to artificial tissue scaffolds—which conduct much of their function in far from equilibrium.

Important macroscopic properties such as viscosity, diffusivity, and osmotic pressure in complex fluids are profoundly influenced by the presence and arrangement of particles suspended in the fluid, and display rich non-Newtonian behaviors when driven from equilibrium. The Zia group studies the behavior of such soft matter systems from a micromechanical perspective, combining continuum mechanics to describe the fluid phase with non-equilibrium statistical mechanics that dictate the distribution of particles. A combination of first-principles, phenomenological, and constitutive models is then utilized to translate this microscopic detail into predictive theory for macroscopic system behavior.

An emergent focus on mechanical transport in confined, crowded, watery particulate systems shows the unique role played by rheology in understanding microscale biological systems in particular, providing new insights into the role played by mechanical intracellular transport in the function of eukaryotic cells. Interestingly, Brown’s initial hypothesis was in some sense not too far off the mark: rather than being driven by life, Brownian motion plays the role of the invisible hand that drives many of the processes required for life to proceed, and indeed may have played a role in the very origin of the life process.

The departures from equilibrium that give rise to complex macroscopic behaviors need not result from flow. Indeed, in so-called “arrested” systems, microscopic particles in suspensions exert attractive forces...
on one another, leading to the formation of a networked gel. Their non-equilibrium arrangement in the fluid is frozen, or arrested, into the structure by particle bonding. The weakly bonded network structure allows the gel to support its own weight under gravity but flow like a liquid under injection or spreading—and recover a solid shape immediately when external forces are removed. Such gels present an important class of materials that can be delivered as liquids but, in situ, act as elastic solids. A central focus of the Zia group is the design and manufacturing of high valued-added chemical products. To be successful in this role, Cornell chemical engineering students learn not just how to how to manufacture chemical products; they also learn which products to make in the first place and how to transition products from initial concept to manufacturing.

"Working with everything from disposable diapers, to drug delivery agents, to lab-on-a-chip diagnostics, successful chemical engineers must be skilled in initial concept design—what to make, product development, and ultimately manufacturing," said Director Lynden Archer, who has made teaching Product Design and Development a priority. "Our students learn to innovate and lead discovery, design, development, and manufacturing of new products in industries of all types, from small startups to larger manufacturing companies—right out of school."

A defining strength of the chemical engineering mindset in process and product design alike is the robust understanding and control over physical, chemical, and biological processes spanning many length- and timescales. As illustrated in the figure, these concepts apply to the microscopic lab-on-a-chip as well as to the production of ammonia at multi-million tons per year. In the case of chemical structure products like foods, cosmetics, or paints, the performance of these products depends on the formulation and microstructure.

"Robust product design starts with understanding the equilibria and kinetics at the molecular level and controlling factors like rheology and encapsulation at the microscale," said Associate Professor Tobias Hanrath, who leads the Product Design and Development initiative with Senior Lecturer Alan Feitelberg. "To manufacture these products, the chemical engineer must understand processing/performance relationships of unit operations for product assembly and processing. Ultimately, understanding and optimizing supply-chain and recycling aspects at global length scales and understanding of intellectual property and copyright laws. The diversity of skills is reflected in the background of the product design team. As a successful leader and integral partner of the team, the chemical engineer must have a solid working understanding of the various technical and non-technical facets of product design."

In the spring of 2012, the school launched ChemE 430 Product Design as a pilot senior design course. Building on
“TO CAPTURE THE STUDENTS’ IMAGINATION AS INNOVATORS, WE CHALLENGED THEM TO PROPOSE THEIR OWN DESIGN PROJECTS. AFTER REVIEWING HISTORIC EXAMPLES OF SUCCESSFUL AND, IMPORTANTLY, FAILED CHEMICAL PRODUCTS, THE TEAMS PROPOSED A NEW CONCEPT AND THEN ANALYZED FEASIBILITY AND CREATED AN INITIAL DESIGN”
– Tobias Hanrath

the traditional senior plant design course (ChemE 4620), this course integrates technological innovation, intellectual property, practical engineering and entrepreneurship, and communication of results in the framework of a fictional start-up company. “A hallmark feature of both plant and product design course is the effective incorporation of team-centered, problem-based learning and communication of results,” said Hanrath. “The teams work closely with faculty on various aspects of a feasibility study including economics, engineering, safety and environmental impact.”

The product design course presented unique opportunities to integrate the latest research into the teaching curriculum, making product design an attractive option for seniors planning to pursue graduate studies or employment in the chemical product segment. “An important educational objective on the impact and feasibility of their projects pre-defined by the instructor,” he said. “The most important lessons were: (1) Students take intellectual ownership, pride, and an additional level of engagement in advancing their own project/product, (2) Projects aligned with cutting-edge research at Cornell opens new opportunities to engage faculty in the senior design course, and (3) Relying on the student teams to conceive projects/products that take advantage of technical expertise and ongoing research activities at Cornell.”

“TO CAPTURE THE STUDENTS’ IMAGINATION AS INNOVATORS, WE CHALLENGED THEM TO PROPOSE THEIR OWN DESIGN PROJECTS. AFTER REVIEWING HISTORIC EXAMPLES OF SUCCESSFUL AND, IMPORTANTLY, FAILED CHEMICAL PRODUCTS, THE TEAMS PROPOSED A NEW CONCEPT AND THEN ANALYZED FEASIBILITY AND CREATED AN INITIAL DESIGN”
– Tobias Hanrath

To determine the optimum balance between pre-defined and student-initiated projects, product design topics in 2013 focused on distributed hydrogen generation. In this project, the students were challenged to design a hydrogen generation system capable of supplying H2 fuel to a proposed fuel cell powered bus fleet on Cornell’s Ithaca campus. This approach defined the boundary conditions of the project (e.g., required amount, purity and pressure of H2 at the refueling station, safety and size constraints for unattended operation), while at the same time giving the students the opportunity to pursue individual designs (e.g., electrolysis, steam reforming, algae bioreactor).

I feel it is the only chemical engineering course that goes over what one will actually do if they go into consumer products and other product industry,” wrote one student evaluator that year. “This class should actually be a requirement.”

“I liked the breadth of the course,” wrote another student. “I feel as though I got a good overview of how to design a chemical product. The projects and homework were educational.”

“Our experience with teaching product design as a capstone design course pointed to the need to introduce product design concepts as a toolbox earlier in the curriculum,” said Hanrath.

In the Fall 2013 semester, the school introduced ChemE 4610 to train students to successfully: (1) ‘house-of-quality approach’ to prioritize customer requirements and relate requirements to engineering characteristics; (2) to perform brainstorming and innovative problem solving using TRIZ; (3) use Taguchi methods to improve product quality in the design stage; and (4) complete a failure modes and effects analysis, as well as a risk assessment, on a product.

“This course also introduced students to the concepts of multigenerational product plans, intellectual property, product life cycle analysis, DFM, DFA, entrepreneurship, and new business development,” said Feitelberg.

Looking forward, the school has considered several models to coherently structure synergies and work-flow between the three design courses. “To provide the student teams with a better industrial perspective on the impact and feasibility of their products, we have reached out to external industrial partners,” said Hanrath. The value of these external connections was exemplified in the successful collaboration between one of the 2012 design teams and Glycobia, a startup founded by Professor Matt DeLisa.

“It was very fulfilling to be involved with the senior design team. Their vision for applying and commercializing a novel technology was original and creative,” said Glycobia chief science officer and director of R&D Adam Fisher. “It is my hope that student-driven design projects will lead to viable startups in the very near future. They could be a good source of fuel for the entrepreneurial ecosystem. New chemical engineers tend to have a broad skill set and practical thinking, which places them among the best suited to bring new innovations to the global marketplace.”

“With our contacts in industry, we see compelling opportunities for future design teams to collaborate in strategic product areas ranging from consumer products to advanced materials, renewable energy technology, and biotechnology,” said Hanrath.
Christopher Alabi  

Professor Christopher Alabi was named a Nancy and Peter Meirig Family Investigator in the Life Sciences, in honor of the generous endowment created by Nancy ’62 and Peter ’61 Meirig to support the recruitment and retention of outstanding faculty in the life sciences. Research in the Alabi group is geared towards development and translation of nanoparticle therapeutics by elucidating the underlying principles that dictate macromolecular interactions and transport of nanostructures in complex biological environments. Alabi’s multidisciplinary research program integrates biophysical science, chemical synthesis, and engineering principles to solve problems beneficial to human health and provides important strength at the interface between chemical and biomolecular engineering and biomedical engineering at Cornell.

Lynden Archer  

Professor Lynden Archer, the William C. Hossey Director and Professor of Chemical and Biomolecular Engineering, was recognized with multiple awards. In fall 2013 his work on polymer nanoparticle composites was recognized with the National Science Foundation (NSF) award for Special Creativity from the Division of Materials Research (DMR). In spring 2014 he was named Merrill Presidential Scholar Dennis Chua as the member of the Cornell faculty who had the greatest influence on his development and by Thompson Reuters as one of the world’s most influential scientific minds in the area of materials science. Archer was the only Cornellian to receive the latter recognition in 2014. Finally, this summer, Archer was selected as the recipient of the 2014 Nanoscience and Engineering Forum (NSF) award from the American Institute of Chemical Engineers (AIChE). The AIChE NSF Award was established in 2005 and recognizes individuals who have made outstanding contributions to the advancement of nanoscience and engineering in the field of chemical engineering.

Susan Daniel  

Professor Susan Daniel was promoted to the rank of Associate Professor with indefinable tenure. Daniel’s research focuses on the biological physics of supported lipid bilayers and on their applications as models of biological membranes for: (a) sorting, extracting, and compartmentalizing membrane species; (b) establishing protein structure-function relationships; and (c) characterizing lipid-protein interactions. Her work is primarily experimental and makes use of an inverted microscope-based Total Internal Reflection Fluorescence system she developed at Cornell.

Matthew DeLisa  

Professor Matthew DeLisa, the William L. Lewis Professor of Engineering, has been elected by peers to the American Institute for Medical and Biological Engineering (AIMBE) College of Fellows. The College of Fellows is the most accomplished and distinguished leaders in the fields of medical and biological engineering in academia, industry and government. These leaders in the field have distinguished themselves through their contributions in research, industrial practice and/or education. Fellows are nominated each year by their peers and represent the top 2% of the medical and biological engineering community. They are considered the life-blood of AIMBE and work towards realizing AIMBE’s vision to provide medical and biological engineering innovation for the benefit of humanity. DeLisa’s induction will be held at the National Academy of Sciences during AIMBE’s Annual Meeting on March 24, 2014.

Julius Lucks  

Professor Julius Lucks has been named a New Innovator by the Director of the National Institutes of Health, Dr. Francis Collins. The goal of the NIH Director’s New Innovator Award Program is to support exceptionally creative new investigators who propose highly innovative projects that have the potential for unusually high impact. The New Innovator Program is one of the four programs in the NIH High Risk-High Reward Program, which is part of the NIH Common Fund. Lucks is the fifth Cornell faculty member to receive this award since its inception in 2007. Lucks’ laboratory focuses on elucidating and engineering the sequence-structure-function relationship of noncoding RNAs - a class of molecules now known to play central roles in maintaining, regulating and defending the genomes of all organisms. As an NIH New Innovator, Lucks and his group will develop an ‘omics’ technology to determine how RNAs fold inside the cell. This technology development will provide a new tool, which they will use in their overall mission to truly understand, engineer, and correct RNA function in biological systems and prevent disease. Lucks and Lucks’ lab NSF Graduate Fellow Melisa Takahashi have helped create the first Cold Spring Harbor Laboratory (CSHL) summer course on synthetic biology. Cold Spring Harbor Laboratory has hosted summer courses and conferences on important topics of biology for over 65 years. Notable past courses include Mac Delbrück’s original phage course, which helped crystallize the field of molecular biology, and led to several Nobel Prizes for key discoveries in that area. The laboratory is also known for hosting the work of notable biologists including Cornell’s own Barbara McClintock.

Paul Steen  

Professor Paul Steen was elected a fellow of the American Institute of Chemical Engineers (AIChE). This award recognizes Steen’s long record of excellence in “service to the profession” and “his significant professional accomplishments” were cited by the AIChE in recognizing him with this honor. Steen’s professional accomplishments bridge fundamental and applied research in chemical engineering. His scholarship is on the side of fundamentals and his innovation on the side of practice. Over his career, Paul Steen has made major contributions to the fields of interfacial instability and nonlinear dynamics, both pure and applied. He is equally comfortable communicating to chemical and mechanical engineers, to materials scientists,
Choosing Among Options (MIT Press, 1st edition 2007, 2nd edition 2012) -- of which Tester is the lead author. Motivated by student interest in a course that provided a broader introduction to energy systems engineering, Tester re-engineered ChemE 6660 in a modular format that has proven successful with students as well as the COE faculty who he has skillfully recruited to co-teach.

**Roseanna Zia**

Professor Roseanna Zia is the recipient of both the 2014 Office of Naval Research (ONR) Young Investigator Program (YIP) award and the 2013 National Science Foundation (NSF) early career award. The ONR YIP program identifies academic scientists and engineers who show exceptional promise for doing creative research. Zia is one of only 24 ONR Young Investigators selected nationwide this year, and brings to the number of CBE faculty who have won this prestigious award. As an ONR Young Investigator, she will develop new models for kinetically arrested states of microstructured soft matter that will elucidate correlations and collective behavior via universal phase mapping. The NSF CAREER award is designed to support the development of junior faculty of exceptional promise who demonstrate creativity in research, and is also designed to recognize junior members of the faculty who show early promise in integrating their research and education goals within the context of the mission of the Universi- ty. Zia’s CAREER proposal is to develop a predictive theory for gel stability by discerning and elucidating the underlying mech- anisms of the sudden collapse of colloidal gels, with a view toward the rational design of soft biomimetic drug delivery platforms and transplantable tissue scaffolds. Such theory is potentially transformative because it would establish qualitative understanding of gel collapse.

**Jefferson Tester**

Professor Jefferson Tester was awarded a 2013 Mr. & Mrs. Richard F. Tucker Excel- llence in Teaching Award from the Col- lege of Engineering. Tester’s award rec- ognizes his work in conceiving and teach- ing CBE’s Analysis of Sustainable Ener- gy Systems course (ChemE 6660) to increasing numbers of seniors and MEng students interested in learning about energy systems engineering. The prototype for this course was a one-semes- ter energy analysis class co-taught with Professor Brad Anton in 2009. Tester had developed a similar course with colleagues at MIT that resulted in the publication of a unique textbook—Sustainable Energy—tent in a modular format that has proven successful with students as well as the COE faculty who he has skillfully recruited to co-teach.

The 2013 Raymond G. Thorpe Lecture took place on Friday, November 1st in Olin Hall. Distinguished lecturers, Robert (Bob) Beadle and Stephen (Steve) Kirk, both from the class of 1971, kept the crowd of students, faculty and friends entertained as they presented, “From the Director’s Hot Seat to the Catbird’s Seat and What We Learned Along the Way.”

Both Beadle and Kirk shared stories of their careers and explained how Cornell and chemical engineering helped to shape their futures. Kirk explained that following his retirement from Lubrizol in December 2011, he joined Cleveland State University (CSU) as Executive in Residence. Bob Beadle ’71 ’70 M.Eng.

Headquarters in London, England. Kirk was elected Vice President of Lubrizol in 1993, and had leadership roles in Market- ing, Sales, and Business Unit Management. Having enjoyed a 40-year career at Lu- brizol, a $6 billion Fortune 500 Company; he was elected Chief Operating Officer in 2008, prior to that, he served as President of Lubrizol Additives and Senior Vice Pres- ident of the Corporation. Kirk served on the Board of Directors of Robbins & Myers (NYSE) from 2006 un- til its sale to National Oilwell Varco (NOV) in 2013. Kirk is currently on the Board of ICM Products, Inc. He was on the Board of Directors of the National Petrochemical & Refiners Association and is past Chairman of the American Chemistry Council Petro- leum Additives Panel. Kirk is currently a director and Vice Chair of Vocational Guid- ance Service, a Cleveland agency which “helps prepare people with barriers to em- ployment for a brighter future.”

When it was Beadle’s turn to speak, he explained that he retired as a corporate SVP from Valero Energy Corporation in 2006 af- ter a 30 year career at Valero and succes- sor companies. He earned a bachelor’s and master’s degree in chemical engineering from Cor- nell University. “sandwiching” the two degrees around a four year tour in the United States Navy. Upon completion of his mas- ter’s degree he joined Diamond Shamrock Corporation in 1976, serving in various sales, marketing, and business manage- ment as well as strategic planning and de- velopment positions.

In 1986 he was elected Corporate Vice President of Diamond Shamrock and held various executive responsibilities in it and successor companies. Valero Energy pur- chased Ultramar Diamond Shamrock in 2002.

Some of Beadle’s community service activities have included stints on the North San Antonio College Foundation, Executive Council of Alamo Area Council, US Savings Bonds, South Texas (chair); Board of Directors, Boysville, Inc.; Boerne Edu- cative Council, and San Antonio Spurs Foundation.

Beadle resides in Boerne, Texas and Bagnala, Italy, and has been married for 38 years to the former Serenella B. Paladino of Rome, Italy. They have three children, Mi- chelle, Barbara, and Robert, Jr.
forces set the material’s microstructure and determine its macroscopic properties. He also discussed his recent work on chemical swimmers and on the origin of a new source for stress that is responsible for self-assembly and pattern formation in active matter.

Dr. Brady is the Chevron Professor of Chemical Engineering and Professor of Mechanical Engineering at the California Institute of Technology. He earned his BS in chemical engineering from the University of Pennsylvania in 1975, which was followed by a year at Cambridge University as a Churchill Scholar. He earned both an MS and PhD in chemical engineering from Stanford University, the latter in 1981. Following a postdoctoral year in Paris at ESPCI, he joined the Chemical Engineering department at MIT. Dr. Brady moved to Caltech in 1985.

Dr. Brady has been recognized for his work by several awards, including a Presidential Young Investigator Award, the Professional Progress Award of the American Institute of Chemical Engineers, the Bingham Medal of the Society of Rheology and the Fluid Dynamics Prize of the American Institute of Physics. Dr. Brady served as an associate editor of the Journal of Fluid Mechanics and editor of the Journal of Rheology. He is a fellow of the American Physical Society and member of the National Academy of Engineering.

### Austin Hooey Graduate Research Excellence Recognition Award

The Austin Hooey Graduate Research Excellence Recognition Award is the highest award given to a graduate student by the School of Chemical and Biomolecular Engineering. It recognizes outstanding contributions to scholarship and research towards a Ph.D. degree. Each student is presented with a $500 check and the opportunity to present their research to the department. The School of Chemical and Biomolecular Engineering would like to recognize the following winners:

#### Fall 2013:
- Samanvaya Srivastava and Jay Park
  - Jay Park presented, Controlling the Placement of Inorganic Nanofillers within Electropun Nanofibers Using Flow and Self-Assembly.

#### Spring 2013:
- Deirdre Costello and Jennifer Schaefer

#### Spring 2014:
- Beth Savoy and Brian Koo
  - Beth Savoy presented, A modeling study of local surface heterogeneities and their impact on wetting and adhesion behavior in dry and humid environments.
  - Brian Koo presented, Computationally predicted ordered heterojunction architectures based on fullerene adsorption in phthalocyanine covalent organic frameworks.

### CBE Graduate Women’s Group

CBE Graduate Women’s Group focuses on the professional development of graduate students in addition to providing resources for women to help them succeed in the career of their choice. This year we collaborated with several other organizations on campus (CHEUSA, GPWomen, Grad School, Career Services) to make professional development workshops, seminars and activities more accessible to graduate students in Olin Hall. Subsequently, the events saw increased attendance and participation from students in all years. The fifth edition of our annual event W.O.M.E.N. (Women’s Outreach in Materials, Energy and Nanobiotechnology) for Parent Buddy Event high school sophomore girls and parents held on March 22nd was an incredible success this year and the participants rated our event higher than ever before. (See photo page 28.) Recently, CBE Women was invited to submit an article demonstrating the successes of the W.O.M.E.N. event by ACM-W, a group that supports, celebrates and advocates internationally for the full engagement of women in computing.

“WORKING WITH THEIR DAUGHTERS IN THE BUDDY LAB AND GETTING EXPOSURE TO THE SCIENCES THEIR DAUGHTERS ARE LEARNING”

“CONVERSING WITH GUIDES ON THE TOUR”

“SEEING THE DORMS AND THE DINING HALL”

“GETTING AN OVERVIEW OF THE LABS”

“THAT PROGRAM WAS DIRECTED TOWARDS GIRLS”

STAFF NEWS

Years of Service

We recognize and sincerely appreciate the dedicated staff in CBE and at Cornell. Our Finance Lead, Sally Carland, has been at Cornell 30 years, our Finance Office Administrative Assistant, Barbara Warner, has been at Cornell 25, and our Manager of Graduate Student Services, Shelby Clark-Shevalier, has been at Cornell 15 years. Sally and Shelby have been dedicated to CBE for most of their Cornell careers. Barb was dedicated to the Graduate School for over two decades before coming to CBE where she supported CBE’s graduate students centrally prior to joining us in Olin Hall.

2013 William C. Hooey Outstanding Staff Award

Olivia Cully

Olivia Cully received the 2013 William C. Hooey Outstanding Staff Award. The award was established in 2011 by the School of Chemical and Biomolecular Engineering (CBE) to recognize a member of the staff who goes “above and beyond” their job responsibilities in helping the School and its faculty execute all aspects of CBE’s mission. We congratulate her, as well as her husband Tom on his Doctorate in Veterinary Medicine (May 2014) and wish Olivia, Tom and Ruthie the best in their new life in Wisconsin.

Congratulations

We thank our Cornell student colleagues for their contributions to CBE and congratulate four that supported CBE and graduated in May 2014, Andrew Ryan Cosachov, Rishika Ghosh (ChemE ’14), John Kosley, and Amrita Mookerjee.

Welcome

Allison Dobish

Allison Dobish was hired into the departmental Administrative Assistant position on June 25, 2014 after ably filling it in a temporary capacity for approximately eight months. Allison previously worked at Memorial Sloan Kettering Cancer Center in New York City, has her Bachelor’s degree from the University of Rhode Island, and had her own retail business while in college.

Celia Szczepura-McLean

On November 1, 2013 Celia Szczepura-McLean became the new Director of Administration for CBE. She comes to the department with 14 years of administrative experience at Cornell, in the Johnson School, the department of Crop and Soil Sciences, and most recently the KAUST-Cornell Center for Energy and Sustainability. Her B.S. is in Finance from Canisius College and MBA from SUNY Buffalo led to 15 years in banking prior to transitioning to managing MBA recruiting operations at Cornell and subsequent unit and research administrative positions.

Celia is supporting the School, the Director Lynden A. Archer, and the College in current endeavors including addressing space and infrastructure needs, rising enrollments in graduate and undergraduate programs, and expanding and changing research initiatives.

Barbara Warner

Barbara Warner started January 21, 2014 as an Administrative Assistant in the CBE Finance Office. Barb worked for the Graduate School for 25 years and was most recently a Graduate Student Services Representative. Her skills and Cornell experience are a good fit for this position. Adapting to, and assisting with, the implementation of many changes in the Graduate School over the years will serve her well as we work towards aligning tasks and matching needs to resources. We are excited to have her as part of our team.

Tommy Wildenstein

We are pleased to announce that Tommy Wildenstein transitioned from 50% to full-time Research Administrative support of CBE faculty efforts toward sponsored research proposals.

Paul Pelletier and Patrick Smith

Paul Pelletier and Patrick Smith (College of Engineering) provide facilities and IT support, respectively, to CBE in Olin and Snee Halls. We are grateful for their dedicated efforts and are happy to have them as our new colleagues.
Dennis Chua

Dennis Chua is the epitome of successful work-life balance in chemical engineering. In addition to academically gifted and ranked first in the Class of 2014 Chemical Engineering, he has accrued a wide variety of awards and honors, including Cornell University’s prestigious Merrill Presidential Scholarship for his outstanding scholastic accomplishments and community engagement.

Dennis is a Hunter R. Rawling’s III Presidential Research Scholar, a Tau Beta Pi Scholar and a John G. Karrer Scholar. He is president of the Cornell Chapter of Tau Beta Pi Engineering Honor Society; president of Cornell’s BASE Productions dance group; a member of Phi Sigma Pi national honor fraternity; and was the chairperson for many, many late nights in the Olin Hall senior lounge. His personal favorite Olin Hall memory is getting his picture taken and added to the “ChemE Class of 2014” wall. It did not mean much at the time, but looking back, he thinks of it as the first step of the development of class unity. For Thomas, knowing that he and his classmates would spend the next four years working together made a greater impression on him during his time at Cornell.

As a sophomore, he organized and led a team of engineering students to represent Cornell in the International Mathematical Contest for Modeling. Of the approximately 360 teams from Universities world-wide that participated in the competition, Dennis’ team emerged as the top U.S. group and was awarded the Mathematical Association of America Award at MathFest 2012. That same year, he led a team of Cornell engineering students in the IBM Watson Two World Case Competition. His team proposed a new concept for Watson, which they dubbed Hello Watson, which applied the super-computer Watson’s capabilities for technical support for consumer electronics. The team’s entry earned it 1st place in the competition. He worked with the Archer Lab in the Chemical Engineering Department on lithium-ion batteries, modeling dendritic growth inside a half-cell, and the Lammerding Lab in the Weill Institute for Cell and Molecular Biology on the effects of gene mutation on the mechanical strength of muscle cells. Outside of Cornell, Dennis has always been very involved in service, both locally and internationally. His volunteer work while at Cornell spans South Africa, Peru, Greece, Singapore, Malaysia, and the United States. He was awarded the Gold Level President’s Volunteer Service Award as recognition for his commitment to service, which represents the highest level of commitment to service.

Dennis served in the Singaporean army prior to entering Cornell University in Fall 2011. Dennis always had a knack for math, physics, and chemistry, and ChemE seemed to encompass all of them so it was naturally an ideal choice of major. He got a little ambitious and decided to take the infamous Chem 3980, Physical Chemistry, on top of several other ChemE classes his first semester. Dennis was blown away by the level of difficulty and rigor, but he was more impressed that all the ChemE’s in the class were determined, dedicated, and brilliant enough to take on whatever quantum mechanics was thrown their way. Dennis was inspired by the hardworking and talented chemical engineering students, and was excited to take on one of the most rigorous and challenging majors at Cornell.

Dennis discovered that the ChemE major is not only a hard science; it is an ideal choice of major. He got the opportunity to work in the research group of Professor Duncan, who became his mentor and the best ChemE professor he has ever had. He has shared countless memories with his Class of 2014 classmates, ranging from Professor Duncan’s colored chalk to the many, many late nights in the Olin Hall senior lounge. His personal favorite Olin Hall memory was when Carol Casler was giving out free donuts and coffee one day, when he was starving and rushing to class (probably with no sleep from the night before), and Carol saved the day, as usual - Carol is the true ChemE hero. During his past 3 years at Cornell, Dennis discovered that the ChemE major at Cornell not only teaches you how to be a chemical engineer, but also how to be a persevering, driven and successful person in life. Dennis’ last thoughts on his time at Cornell are, “Time flies when you’re in college! My past 3 years here seemed to have passed in 3 weeks. Sometimes I wish I was a freshman again.”

Leah Ferrara

Leah Ferrara is in the top 5% of engineering students academically, and was an active member of Cornell University’s varsity Cross Country and Track & Field teams throughout her four years at Cornell. She is also a four-time member of the 400 Club, which honors student-athletes who achieved a perfect 4.0 grade point average. Most of her (limited) time outside Olin Hall is consumed by daily practices and weekend meets. She is also an athletic tutor.

She decided to major in chemical engineering because of the interest he acquired in the chemical engineering industry. After graduation, Thomas plans to work for ACS (Automation and Control Specialists), an engineering specialist company that consults for many pharmaceutical companies. Its process control focus will greatly incorporate both the knowledge and interest he has acquired at Cornell.

Entering Cornell as a freshman, Thomas initially decided to major in chemical engineering because of the interest he acquired in high school for chemistry. He cites his high school chemistry teacher’s enthusiastic dedication to his AP Chemistry class to be his inspiration. He decided to remain in chemical engineering due to both its wide variety of applications to his fields of interests, and the friends he made in the tight-knit major.

His favorite Olin Hall memory is getting his picture taken and added to the “ChemE Class of 2014” wall. It did not mean much at the time, but looking back, he thinks of it as the first step of the development of class unity. For Thomas, knowing that he and his classmates would spend the next four years working together made a greater impression on him during his time at Cornell.

Class of 2014 was determined, dedicated, and successful persons in life. Thomas’ dedication to rowing led him to spend two years as a rowing coach at West Side Rowing Club in Buffalo, New York, which allowed him to both train for the upcoming season, and pass on his extensive knowledge of the sport to the next generation of rowers. His post-graduation pursuits, however, are primarily focused on entering the chemical engineering industry. After graduation, Thomas plans to work for ACS (Automation and Control Specialists), an engineering specialist company that consults for many pharmaceutical companies. Its process control focus will greatly incorporate both the knowledge and interest he has acquired at Cornell.

Entering Cornell as a freshman, Thomas initially decided to major in chemical engineering because of the interest he acquired in high school for chemistry. He cites his high school chemistry teacher’s enthusiastic dedication to his AP Chemistry class to be his inspiration. He decided to remain in chemical engineering due to both its wide variety of applications to his fields of interests, and the friends he made in the tight-knit major.

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American Institute of Chemical Engineers Otther Sophomore Academic Excellence Award

Joseph Chmielewski '14
This award recognizes outstanding scholarship and leadership in campus, community and professional activities.

Chemical Engineering Outstanding Scholar Award

Michael Alexander '14

Khalid Al Kaabi '14
This award recognizes a demonstrated record of ability, indication of leadership, and professional promise.

Genentech and George Scheele Outstanding Junior Award

Eric Burkholder '14
This award is sponsored by Genentech in memory of Professor George F. Schoele, former associate director of the school, to recognize academic excellence, and achievement in campus and professional activities.

American Chemical Society Scholarship

Renée Warrow '14

TAU Beta Pi Scholarship

Dennis Chua '14
Frank and Rosa Rhodes Scholarship

Philip Berard '14
This award recognizes outstanding achievements in academics and in the professional community. Sponsored by the Xerox Foundation.

Quill & Dagger Honor Society

Michael Alexander '14 and Benjamin Williams '14
Established by the company to recognize undergraduate technical presentation skills.

Merrill Presidential Scholar

Dennis Chua '14
This Cornell program honors outstanding seniors and their academic mentors who most inspired their scholastic development from high school, Raffles Institution, Chee Keong Lee and a Cornell faculty member who most significantly contributed to their college experience, Professor Lynden Archer.

Merck Engineering and Technology Fellowship

James Mathew '14
This fellowship was established by the company to recognize undergraduate scholastic and technical excellence.

Procter and Gamble Technical Excellence Award

Elizabeth Parcher '14
Established by the company to recognize undergraduate technical presentation skills.

Ferdinand Rodriguez Outstanding Student Award in Polymers and Electronic Materials

Philip Berard '14
Honoring Professor Rodriguez and recognizing outstanding achievements in academics and in the professional community.

Outstanding Undergraduate Teaching Assistant of the Year Award

Franklin Lee '14
The recipient of this award for outstanding teaching in CHEME 3230 Fluid Mechanics, CHEME 3240 Heat & Mass Transfer and CHEME 3900 Chemical Kinetics & Reactor Design by an undergraduate assistant is chosen by the faculty.

Award for Outstanding Service to the School

Emily Polk '14
This award recognizes outstanding service to the professional and social culture of the School.

2014 Tau Beta Pi Laureates

Bingxuan Dennis Chua '14

Outstanding Graduate Teaching Assistant of the Year Award

Sushmit Goyal
The recipient of this award for outstanding teaching by a graduate assistant is chosen by the faculty.
GIVING OPPORTUNITIES

MODERNIZING OLIN HALL INFRASTRUCTURE FOR RESEARCH & EDUCATION

Creation of a Cornell Institute for Biological Design and Manufacturing

Chemical engineers at Cornell are using the principles of biological and engineering design to harness living organisms for manufacturing chemical products. The Institute for Biological Design and Manufacturing will capitalize on this trend to catalyze progress toward a new “biomanufacturing economy”, in which engineers develop biological systems to manufacture new products – materials, therapeutic drugs, and fuels – that address some of the world’s most pressing problems.

Gifts to support the institute will allow the school to reno-vate and upgrade space in Olin Hall that will house the institute. Your support of the institute will also provide annual support for research and education programs in support of the institute’s mission.

Modernize and Upgrade the Unit Operations Laboratory

The Unit Operations laboratory is a capstone course taken by all chemical and biomolecular engineering (CBE) students in the senior year. CBE alumni credit UO lab for honing technical writing, teamwork, and leadership skills important to their career success in diverse fields. Key to the success of the UO lab experience is a good selection of experiments that produce reliable data.

Our efforts to modernize the laboratory are a high priority for sustaining the school’s reputation for excellence in educating students. Gifts in support of the UO lab modernization project can be earmarked to either of the following two funds: A current-use fund, which will support immediate upgrades of key experiments; and an endowment, which will support continuous improvement of the laboratory infrastructure.

We are grateful to the many alumni and friends of the department for their generous support of the school and its programs. Your continued generosity allows us to sustain and enhance the quality of the school’s programs and its reputation for educating engineers at the top of the field. Please review the list of giving opportunities below and consider a gift that will help the school accomplish one of the following objectives.

RESEARCH & EDUCATION

ENDOW A NAMED CHAIR IN BIOLOGICAL DESIGN AND MANUFACTURING

We are pleased to announce a new named chair in the Institute for Biological Design and Manufacturing. Gifts to support this endowed chair will provide substantial support for the institute. For more information, contact jml235@cornell.edu.

Weaknesses

Weaknesses in traditional academic laboratory curricula can present an insurmountable barrier to many talented applicants. The high cost of matriculating in the program grounds for careers in public policy, engineering management, and consulting. The high cost of matriculating in the program presents an insurmountable barrier to many talented applicants. Gifts will be used to provide named, competitive fellowships for select students pursuing the EEE Masters of Engineering concentration.

ACTIONS ACADEMIA

ENDOW A NAMED CHAIR IN ENERGIES AND ENGINEERING

Supporting our Energy Economics and Engineering Masters of Engineering (EEE) graduates in research and education programs will be supported by endowed funds. Gifts in support of these fellowships will be used to continuously support the EEE Masters of Engineering program.

ENHANCE THE GRADUATE EXPERIENCE

Graduate Fellowships

For more information on these or any other giving opportunities, contact June Losurdo, Director of Development jml235@cornell.edu • 607-254-1643

For more information on these or any other giving opportunities, contact June Losurdo, Director of Development jml235@cornell.edu • 607-254-1643

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