Cornell Engineering
Magazine Summer 2014

Bright Ideas
ENTREPRENEURIALISM IS FLOURISHING AT CORNELL ENGINEERING
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CornellEngineering Magazine

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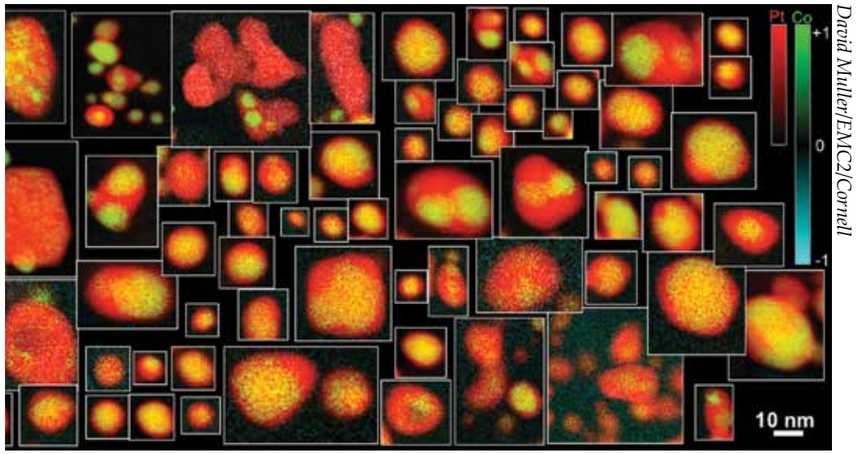


David Muller/EMC2/Cornell

Many engineers and chemists work toward better batteries at Cornell. Here, a collage of "before and after" images of catalyst particles from an automotive fuel cell shows simulated years of driving.

New battery test center adds zip to New York economy

Sustainable energy storage loves New York. Replacing the gasoline economy with better batteries may be accelerated thanks to unique battery testing capabilities at Cornell, and anchored by a new testing and prototyping center that the university helped to establish.

The New York Battery and Energy Storage Technology consortium, known as NY-BEST, and energy company DNV GL have opened the state-of-the-art BEST Test and Commercialization Center, a testing facility at the Eastman Business Park in Rochester, New York. The new center offers such services as conducting the validation and independent certification needed to introduce new energy storage technologies into the marketplace, and boost renewable and distributed energy.

"This will vault the New York battery scene onto the national and international energy landscape. Upstate New York can see an entirely new economy, which can focus on creating long-running and large-capacity storage batteries," said chemist Paul Mutolo, who directs external partnerships at Cornell's Energy Materials Center. "For batteries, it's all about safety and durability. Thanks to this new facility, we expect to see incredible strides in battery longevity and reliability."

Partnered with the new testing facility, the Center for Future Energy Systems—a partnership between Cornell and Rensselaer Polytechnic Institute—helps New York companies get access to specialized battery testing with tools unavailable elsewhere. For example, the Cornell High Energy Synchrotron Source (CHESS) can assess battery chemistry in real time inside casings during charging and discharging. Electron microscopes also can examine the chemical properties contained within battery cells. This information is critical to improving batteries for tomorrow's applications.

Startup companies have begun to take advantage of the battery business atmosphere. For example, NOHMS, founded in the laboratory of Cornell chemical engineering professor Lynden Archer, produces lithium-sulfur cells—which have the potential to rival the energy density of gasoline-powered engines and to deliver more power than today's lithium-ion batteries.

Another startup founded at Cornell, Lionano Inc., advances replacement anode material for lithium-ion batteries, which increase capacity, prolong battery durability and reduce charging time—with more safety features—for about one-fifth the cost of current materials.

Beyond transportation, Mutolo said this technology could improve electricity grid resiliency; as Superstorm Sandy displayed, there needs to be more storage battery capacity on the grid, he said. The $23 million center is funded by the New York State Energy Research Development Authority (NYSERDA), $5.9 million, Empire State Development, $1 million, and DNV GL, $16 million. DNV GL is relocating its energy storage testing facility to this center in New York from Pennsylvania.

—Blaine Friedlander

Cornell synchrotron receives up to $100M in NSF support

Arduous, year-plus-long scrutiny by the National Science Foundation (NSF) has found the Cornell High Energy Synchrotron Source (CHESS) rich in scientific discovery and exemplary in its use of government funds. CHESS has received its requested grant renewal of up to $100 million over five years, securing the national X-ray facility's near-term future.

"To be funded in the current economic climate is the best you could possibly hope for," said Joel Brock, CHESS director and professor of applied and engineering physics. "We're absolutely thrilled, and it's a real testament to the quality of the staff here—their hard work, creativity and unique capabilities."

CHESS is supported by the NSF's Division of Materials Research, and it provides synchrotron X-ray capabilities to roughly 1,200 users each year.

CHESS is one of only two high-energy synchrotron sources in the U.S. (The other is the Advanced Photon Source at Argonne National Laboratory). But what distinguishes CHESS from other national facilities, said Brock, is its culture and mission: encouraging novel, high-risk, high-reward research projects and maintaining an emphasis on science and engineering education programs at all levels.

Cornell graduates roughly 20 percent of the nation's Ph.D.s trained in accelerator science and advanced X-ray technology, and approximately 60 undergraduates participate in CHESS laboratory research every year.

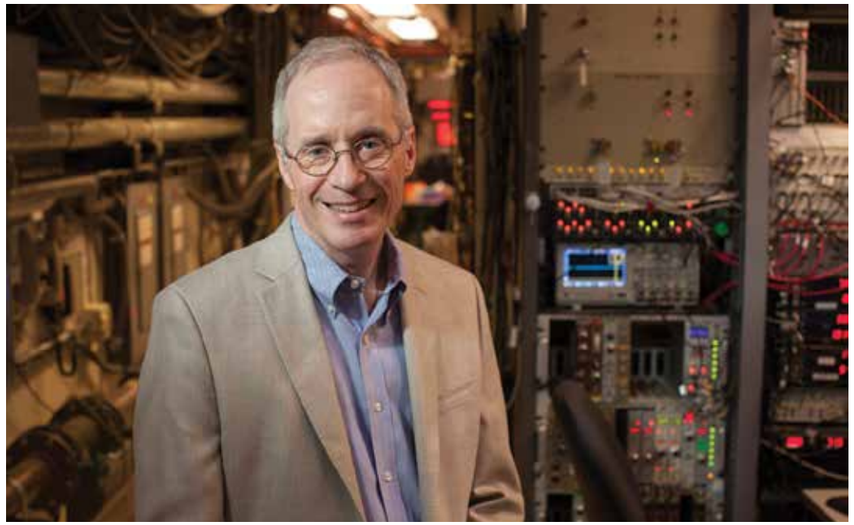
Among the advanced synchrotron radiation technologies Cornell has developed recently are photoinjectors and superconducting acceleration capabilities for the highest-current electron beams in the world, and many types of X-ray detectors, novel X-ray sources, and X-ray optical devices.

About three-quarters of CHESS's $20 million yearly budget is spent on salaries. In addition to eight graduate students and three postdoctoral associates, the CHESS award supports more than 130 Cornell employees. The remainder of the budget is spent on electricity, liquid nitrogen and equipment, according to Brock.

The funding renewal will allow CHESS to continue developing experimental techniques and technology based on high-energy X-ray beams, all aimed to best serve research on advanced materials in, for example, next-generation batteries and structural materials for aircraft engines, and on the atomic structure of viruses and other important macromolecules. CHESS officials hope that its plans to substantially enhance the performance and capabilities of this X-ray source will also come to fruition in the coming years.

In the longer term, CHESS scientists are hopeful to break ground on the Energy Recovery Linac project, a major upgrade to the CHESS beamlines and accelerator (Cornell Electron Storage Ring, or CESR) that would offer among the world's brightest and most powerful X-rays.

—Anne Ju



Joel Brock, director of CHESS.

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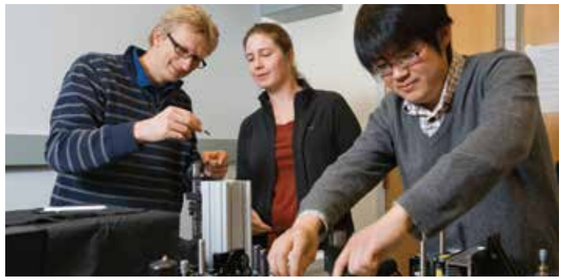


Ulrich Wiesner, left, works with graduate students Jennifer Drewes and Kai Ma to characterize the size and brightness of C dots.

See spots glow: Camera system aids cancer clinical trial

With a new, commercially available camera system using Cornell-developed nanoparticles that make cancer cells glow, the way is lit for surgeons diagnosing and removing tumors.

With researchers from Memorial Sloan Kettering Cancer Center (MSKCC), Uli Wiesner, the Spencer T. Olin Professor of Materials Science and Engineering and inventor of the fluorescent "C dots" (Cornell Dots), has integrated his lab's nanoparticle technology with an optical camera made by Quest Medical Imaging. In real time, the camera gives surgeons a clear view of cancer in the body.

The camera is called the Artemis Fluorescence Camera System. It is now being used in a second C dots clinical trial at MSKCC. Approved by the U.S. Food and Drug Administration (FDA), the trial involves melanoma patients with lesions in the head and neck region, Wiesner said.

The first trial was essentially a safety trial, in which radiologists injected C dots into melanoma patients to see whether the dots are safe and where they would go. But now, for the first time, they will use the C dots in conjunction with the Artemis system to image nodal disease in melanoma patients. MSKCC is the first U.S. hospital to bring the optical Artemis camera system into the operating room.

"This is extremely exciting, because in general it is the first time an optical inorganic nanoparticle probe will be used in a surgery room in conjunction with an optical camera to help surgeons identify nodal disease during surgery," Wiesner said. "This is what we have worked toward all these years, and it will finally happen."

For the trial, they will first inject the C dots around the primary lesion in the head and neck; using the Artemis camera, they will observe how the C dots are taken up by the lymphatic system and end up in the lymph nodes adjacent to the tumor. If those nodes contain cancer cells, the C dots should stick to them and glow. If the nodes are cancer-free, the C dots will not stick, and the fluorescence will be transient.

For several years, Wiesner has worked with collaborators at MSKCC to optimize the Artemis system toward the optical characteristics of the C dots, which Wiesner's group first published about a decade ago. Specifically he worked with radiologist Dr. Michelle Bradbury, who played a central role in getting the C dots into patients and the camera optimized for surgical use, and Dr. Snehal Patel, a surgeon who works on head and neck lesions.

Wiesner connected with Quest Medical Imaging during a trip to Hungary years ago when he was giving a talk on bioimaging. At the conference, he discovered that Quest researchers had a camera system and were looking for a probe, and Wiesner had the opposite problem—a probe, but no camera.

"The match was perfect," he said.

—Anne Ju

Artemis Imaging Technology:
http://youtu.be/P9Zur9kMHio

Impressive finishes for steel bridge, concrete canoe teams

The concrete canoe team prepares for their swamp test at Allan Treman park. From left: Warren Crowell '16, Tiffany Ly '15, Irene Lin '14, Eugene Ng '16, Jason Schwab '15 and Matt Calo '15.

Fourteen regional schools duked it out for top spots in the American Society of Civil Engineers (ASCE) Steel Bridge and Concrete Canoe competitions, hosted by Cornell April 24-26.

Both Cornell teams showed major improvement over last year, with the canoe team's second-place finish propelling them to the national competition in June—Cornell's first trip to nationals since 2000.

Cornell's ASCE chapter also placed second overall for the conference, which combines both the steel bridge and concrete canoe teams' performances. The overall winner of both competitions was Montreal's École de Technologie Supérieure.

Cornell's steel bridge team won first in presentations, first in display and first in construction economy. They blazed a 10:42 construction time for their 17-foot under-truss bridge, netting them a first-place finish in construction speed, too.

"We did a time that was very close to our best time," said Bruno Fong Martinez '15, one of Cornell's four builders.

The steel bridge team placed sixth overall and also received second place in the Mead paper, presented by Eric Simeonoglou '15, which requires students to answer an ethical question.

The concrete canoe team, which is fundraising for its trip to the ASCE National Concrete Canoe competition June 19-21 in Pittsburgh, earned first place for their paper describing their design, second for their oral presentation and third for the final product. After the swamp test, which they passed with flying colors, they raced in the Cayuga Inlet, where Cornell placed second in women's endurance, second in women's sprint, second in men's sprint and third in men's endurance.

After having practiced only with a wooden mold, team leader Jacqueline Maloney '14 had one word to describe paddling a concrete canoe, even one that's half as dense as industrial concrete: "Heavy."

"But it's easier to steer because it keeps straighter," she said.

—Anne Ju

ASCE Regional Conference:
http://www.cornell.edu/video/asce-steel-bridge-concrete-canoe-2014

Cracker-sized satellites launch into orbit

Zac Manchester

"Sprite" mini satellites that were in orbit.

After years of planning and several last-minute delays, about 100 Cornell-developed mini satellites demonstrating space flight at its simplest have launched into orbit and were circling Earth.

With just a laptop, antenna and a few other basics, space flight enthusiasts could listen for signals sent by the cracker-sized "sprites" that launched April 18 aboard a SpaceX Falcon 9 rocket as part of NASA's CRS-3 mission. Inside their mothership craft, the sprites were scheduled to deploy on May 4 to become the smallest free-flying spacecraft.

The project is called KickSat and has been led by Zac Manchester '09, now a graduate student in aerospace engineering, since he was an undergraduate doing research with Mason Peck, associate professor of mechanical and aerospace engineering and former NASA Chief Technologist.

Sprites are satellites stripped down to their most basic components: a microcontroller, transceiver and solar cells for power. Manchester took to Kickstarter in 2011 to see if amateur space enthusiasts would help fund the project.

More than 300 people sponsored KickSat and were allowed to transmit whatever signal they wanted from it—for example, their initials or a message to a loved one. The KickSat housing is engraved with the sponsors' names.

The sprites are housed inside a CubeSat, which is a small satellite frequently used in space research. The CubeSat is aboard a capsule that separates from the shuttle, which continues to the International Space Station.

The big event—when the sprites leave the spacecraft began transmitting signals the afternoon of May 13.

Manchester has been updating his Kickstarter blog with mission information.

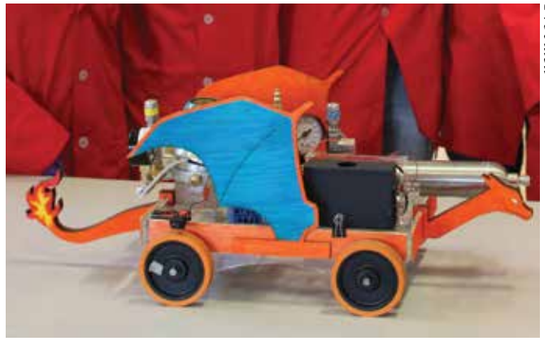
"After a beautiful launch at 3:25 this afternoon [April 18], KickSat was deployed in low Earth orbit. We at Cornell and several amateur radio operators around the world have made contact with the spacecraft, and it is alive and well.

—Anne Ju

Editors note: The sprites never deployed from their mothership, burning with it upon reentry into Earth's atmosphere around 9:30 p.m. May 13. A "hard" reset of the CubeSat's microcontroller, likely caused by radiation, caused the deployment countdown to restart without enough time to complete before the satellite's planned re-entry.

Zac Manchester

Zac Manchester '09 with the Falcon 9 rocket before its launch from Cape Canaveral, Fla.



Provided

Cornell's fuel cell car at the annual Chem-E-Car competition.

Cornell's chemically engineered cars win again

Repeating past successes, Cornell collected top prizes in the Northeast Regional Chem-E-Car competition, April 5 at the University of Connecticut. The Cornell team entered a battery-powered car that took a first prize and a hydrogen fuel-cell-powered car that came in second. The team will go on to the national competition in the fall.

The event, part of the American Institute of Chemical Engineers Northeast Regional Student Conference, challenges students to build a shoebox-sized car that is both powered and controlled entirely by chemical reactions. The car must travel a distance between 50 and 100 feet, carrying a payload of up to 500 milliliters of water, and stop as close as possible to the designated finish line without brakes, timers or any other mechanical systems. The exact distance and payload are not announced until one hour before the first car runs, so contestants must design a chemical control system they can adjust to account for the specified distance and weight.

Both Cornell cars used an "iodine clock reaction" in which a solution containing starch and an iodine compound is combined with a mix of other chemicals that temporarily prevent iodine from precipitating out and combining with the starch. When the reaction is complete the transparent solution suddenly turns dark blue. A light beam passing through the solution falls on a photosensitive receptor that controls the drive motor. When the solution turns dark and breaks the light beam the car stops. The ratio of the two mixes of chemicals controls the time of the reaction.

"We learn a lot from other teams," DeRooy said.This method enabled the battery car to travel 82 feet and stop just about 20 inches from the line, while the fuel cell car landed about 24 inches from the line. This success grew from extensive testing—mostly in Cornell hallways—to calibrate how time, distance and payload would interact, said Brianna DeRooy '14, senior team captain.

The Cornell team includes about 60 students from several fields of engineering, divided into sub-teams for various parts of the job. This includes "Potions" for the group that designs the timing reaction, and the equally important "Finance," which has obtained sponsorship from Merck, Air Products and the College of Engineering. The cars cost roughly between $300 and $2000 to build.

The students have spent most of the semester designing and building their cars in a lab space decorated by the skeletons of previous years' cars.

The team is advised by Roseanna Zia, assistant professor of chemical and biomolecular engineering.

—Bill Steele

Tiger beetle's chase highlights mechanical law

If an insect drew a line as it chased its next meal, the resulting pattern would be a tangled mess. But there's method to that mess, says Jane Wang, professor of mechanical engineering and physics, who tries to find simple physical explanations for complex, hardwired animal behaviors.

It turns out the tiger beetle, known for its speed and agility, does an optimal reorientation dance as it chases its prey at blinding speeds. Published online April 9 in the *Journal of the Royal Society Interface*, Wang and colleagues used high-speed cameras and statistical analysis to reveal a proportional control law in which the angular position of prey, relative to the beetle's body axis, drives the beetle's angular velocity with a delay of 28 milliseconds. That's about a half-stride in beetle terms.

These observations led Wang to propose a physical interpretation of the behavior: that to turn toward its prey, the beetle, on average, exerts a sideways force proportional to the prey's angular position, measured a half-stride earlier.

"The idea is to find laws that animals use to intercept their prey," Wang said. "We do it, too [interception]—when trying to catch a baseball, or when chasing someone. But since insects have a smaller number of neurons, their behaviors are more likely hardwired, which makes it possible for us to find and understand the rules they follow."

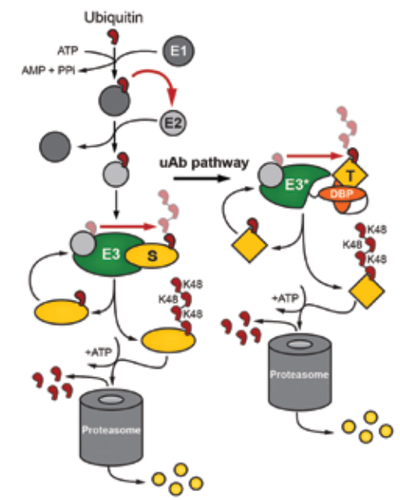
Why the tiger beetle? It's a nice model system, Wang said, which she learned after attending a talk several years ago by entomology professor Cole Gilbert, who studies neural mechanisms of behavior in arthropods and is a paper co-author. Andreas Haselsteiner, the paper's first author, was a visiting student in Wang's lab and designed the experiments.

For the experiments, a "dummy prey"—a black bead—was dangled in front of the beetle, which, mistaking the bead for a meal, would give chase. Its chasing patterns were recorded with a high-speed camera.

From their analysis emerged a macroscopic description of the animal's movements, which reveals an internal time scale that governs the beetle's sensing-to-actuation system and a close-to-optimal gain value in the control algorithm, Wang said.

—Anne Ju

Engineered molecules tag proteins for destruction



DeLisa lab

A schematic shows the natural (left) and Cornell-engineered ubiquitin-proteasome pathway.

Like little mercenaries following strict orders, Cornell-developed engineered molecules called "ubiquibodies" can mark specific proteins inside a cell for destruction, paving the way for new drug therapies or powerful research tools.

Chemical engineers led by Matthew DeLisa, the William L. Lewis Professor of Engineering, have developed a new type of antibody, called a "ubiquibody," which is an antibody fragment they have inserted into the natural process known as the ubiquitin-proteasome pathway (UPP). Their work appears in the March 16 issue of the *Journal of Biological Chemistry* and is highlighted in an analysis piece in the publication *SciBX*.

The UPP is the natural cellular pathway, or process, by which a cell gets rid of proteins it doesn't want anymore. A doomed protein gets tagged with a chain of a protein called ubiquitin, which is like a molecular sign that reads, "destroy me." The ubiquitin-tagged protein gets sent to the cell's proteasome—the cell's trash compactor—which breaks the protein into component amino acids.

DeLisa and colleagues hypothesized that this common process could be harnessed as a simple, tunable way to eliminate certain target proteins in a cell without having to mess with the genome to delete the protein using standard genetic engineering tools.

They did it by taking advantage of the modular nature of the UPP, which involves three enzymes called E1, E2 and E3. They modified a particular E3 enzyme called CHIP, giving only that part of the pathway a makeover.

They removed CHIP's natural binding domain, replacing it with an engineered binding protein—in this case an antibody fragment—that was created in the lab. The idea was to empower CHIP to put ubiquitin chains on any target, guided by the homing capabilities of the antibody fragment to seek out and bind to its specific target. They named the entire re-engineered molecule with the modified CHIP enzyme a ubiquibody.

To prove their concept, the researchers modified CHIP with a binding protein that targets the enzyme beta-galactosidase. They introduced DNA that encoded for their beta-galactosidase target into a human cell line, along with DNA that encoded their ubiquibodies with a binding protein for the beta-galactosidase enzyme. Sure enough, beta-galactosidase levels went down in the presence of the corresponding ubiquibodies.

"Our ability to redirect whatever protein you want to the proteasome is now made possible simply by swapping out different binding proteins with specificity for targets of interest to the researcher," DeLisa said.

Ubiquibodies could provide a powerful way to not only completely delete a protein from a cell to study that protein's effects, but to discover what happens if, say, only 50 percent of that protein is deleted. Current gene knockout technologies are all or nothing, DeLisa said. Ubiquibodies could fine-tune research around protein deletion or reduction.

The technology could also prove useful for future drug therapies. In a cancer cell in which a certain protein has been identified as contributing to the disease, the ubiquibody could reduce or eliminate the protein from within by targeting that specific protein only, DeLisa said.

The therapeutic potential for ubiquibodies is being explored further in DeLisa's lab, with experiments on target proteins known to be present in diseases including Alzheimer's, cancer and Parkinson's.

First author of the paper, "Ubiquibodies, Synthetic E3 Ubiquitin Ligases Endowed with Unnatural Substrate Specificity for Targeted Protein Silencing," is Alyse Portnoff, a former Cornell biomedical engineering graduate student. Other co-authors are Erin Stephens, a graduate student in the field of biochemistry, molecular and cell biology; and Jeffrey Varner, professor of chemical and biomolecular engineering.

The work was supported by the National Institutes of Health.

—Anne Ju

On theWeb

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BREAKING THE RULES to PROMOTE CORNELL ENGINEERING

By Chris Dawson

QUICK: NAME AS MANY OF THE TOP TEN U.S. UNDERGRADUATE ENGINEERING SCHOOLS AS YOU CAN.

It is a safe bet that you put Cornell Engineering on your list—maybe even fairly high up. If so, that would be understandable. Cornell's undergraduate engineering program IS consistently ranked in the top ten. And if you are reading this magazine, you probably have a strong connection to Cornell.

However, the broader population is not as familiar with Cornell Engineering. In a survey conducted last fall by market research firm Harris Interactive, 3,026 adults were given the same task. Just three percent put Cornell on the list.

But then, after learning that Cornell University has a College of Engineering, the same respondents were asked where Cornell Engineering ranks in the top twenty programs nationally. Remarkably, 77 percent put Cornell Engineering in the top ten and 31 percent put it in the top five.

Simply connecting the word "engineering" to the reputation of Cornell changes the outcome dramatically.

"This matters a lot," says Lance Collins, the Joseph Silbert Dean of Engineering. "The bottom line is, Cornell Engineering is missing out on some of the most promising young engineering students simply because they might not know about us and the amazing work we have been doing for years."

File this datum point away for a moment. Next, consider the 2011 competition launched by New York City's former Mayor Michael Bloomberg to find a university or consortium to develop and operate an applied science and engineering campus in New York. The city received seven responses from a total of seventeen world-class institutions. The competition was fierce, but in the end, Cornell and its partner institution, Technion—Israel Institute of Technology, were selected to build a $2 billion, two-million-square-foot campus on Roosevelt Island.

Dean Collins has said that the competition for the Cornell NYC Tech campus was a real eye-opener for him. "We had an incredibly strong proposal and, honestly, it should not have been that close. Some of our competitors really benefitted from greater name recognition. Our failure to effectively manage our brand nearly cost us the competition," says Collins. "This has been a real crash course for me in the importance of marketing."

Rob Kurcoba

Dawn McWilliams is Cornell Engineering's first Director of Marketing and Communications.

So, early in his tenure as dean, it became clear to Collins that Cornell Engineering had a problem. As problems go, it was not a terrible one to have: the college he was leading had world-class faculty, students, staff, and alumni working at the frontiers of their disciplines in fields as diverse as nanobiotechnology and satellite design, yet the broader public didn't know much about it. "There is a humility here at Cornell Engineering that might be called humility to a fault," says Collins. "I realized that we need to tell our story more effectively."

To address this problem, Collins hired Dawn McWilliams to be the first director of Marketing and Communications. Before her arrival, the office had been Communications and Media Relations, which Collins changed in recognition of the need to more strongly promote the college. McWilliams came from the Simon School of Business at the University of Rochester, where she had implemented a highly successful rebranding strategy. The college then undertook a yearlong, exhaustive study of itself. The lead strategist for this examination of Cornell Engineering was Claude Singer, of the brand identity consulting group Seigelvision. "My role was to talk to as many people as possible, to learn the engineering culture at Cornell, to seek out what is truly unique, and to craft a new story line and strategy," says Singer. Seigelvision's founder and CEO, Alan Seigel, graduated from Cornell's Industrial Labor Relations School in 1960 and was also deeply involved in crafting this new strategy to help Cornell Engineering tell its story to the wider world.

To find out what characteristics are at the heart of Cornell Engineering, Singer and McWilliams convened groups of current students, faculty, staff, and alumni to pick their brains and hear about their experiences. They combed through written responses of students who were admitted to Cornell Engineering but chose to go somewhere else. They also spoke with companies that hire Cornell Engineering alumni to ask them what qualities they see in graduates of the school.

After all of the listening, Singer and his colleagues went back to the office, "to look for patterns and try to forge all of our data points into a meaningful profile of Cornell Engineering." Many of the themes they identified showed promise. There was a lot of talk about both "innovation" and "collaboration." But when Singer and his team looked at the messages of other highly regarded engineering programs, they saw that every one of them focused on these same two themes. "Both of these seemed so generic—any engineering school could say these things," says Singer. "And in fact, they all were saying them. Cornell Engineering needed something that was unique and an authentic reflection of the program and its people."

"Then we looked back through our notes and saw a comment from an alumna who had been at a group session in Boston," recalls Singer. Her name is Renee Miller-Mizia '81 MSE and she said that what she learned at Cornell Engineering was "how to break the rules."

"Once this theme was identified, it was easy to go back and hear how true it was to the experience of so many Cornell Engineering alumni," says McWilliams. "We found person after person who pushed boundaries, challenged conventions, and asked the questions nobody else was asking."

Miller-Mizia, on the board of directors for the Cornell Engineering Alumni Association, says her years as an undergraduate at Cornell had an outsized influence on who she is today. "I would not be who I am but for the people here," says Miller-Mizia. "Looking at myself as a freshman, I don't know if even I would have bet on myself to make it."

Miller-Mizia was the first in her extended family to go to college. "It was very hard, but with the help of (the late) Professor Jim Mayer I made it through. He took Ezra Cornell's aspiration for Cornell—that it would be a place 'where any person can find instruction in any study'—seriously." Miller-Mizia credits Mayer with helping her see that engineering can be a creative enterprise and that "if you are willing to think beyond the rules, you can make anything happen."

Of course, using the words "break the rules" as the central theme of the new brand set off some alarms within the college and the larger university community. "Some people raised the question: Do we really want to be telling 18-year-olds to break the rules?" says McWilliams. "In the end, it was good to hear their concerns because they helped us sharpen our message. The more carefully we listened to our students and faculty and alumni, the greater focus we heard on the fact that Cornell Engineering alumni don't just break the rules for the fun of it," says McWilliams. "They break the rules to advance our understanding or to challenge conventional wisdom. It is always with the goal of making the world better."

Once the theme of "breaking the rules" was chosen, the task became to gather stories of Cornell Engineering alumni who have done just that. "It's not just some tagline," says Collins. "It's really all about the stories. We have phenomenal stories of people coming together in unconventional ways and producing great, world-changing outcomes. Once we get beyond our traditional reticence, the stories that we hear are truly inspirational. The brand gives them permission to tell the world about their work. Cornell Engineering becomes part of the national conversation."

Provided

Renee Miller-Mizia '81 coined the phrase during a focus group about the brand.

The stories are told in writing and in short videos produced by videographer Jules Hamilton and his New York production company Vanguard, Ltd. With Cornell's Integrated Web Services, McWilliams created a new brand website as a repository for the stories and videos. "The subjects of the stories, (and their departments or companies) can have access to them and use them to help us spread the word about Cornell Engineering," says McWilliams.

Along with the focus on Cornell Engineering alumni who in some way break the rules to make great things happen, the college has also created a new visual identity for itself. New York firm Opto Design has been working closely with McWilliams and her team to create a look that they hope reflects the break-the-rules spirit of Cornell Engineering. The old look had the words "Cornell University College of Engineering" along with the university seal. The new logo shrinks that down to two words: Cornell Engineering. The main engineering website is getting a new look, as are the school and department sites. The publications of the college are starting to reflect the new visual identity, as are Cornell Engineering's Facebook, LinkedIn, YouTube, and Twitter pages.

In addition to Cornell websites and publications, McWilliams is counting on the roughly 45,000 living alumni of Cornell Engineering to help tell the story. She has created a brand ambassador kit that alumni can use to host a get-together in their town to share the stories and spread the word. "Our alumni are one of our most valuable resources," says McWilliams. "What they do in their lives and their careers represents the truth behind our message."

Collins and McWilliams are planning to continue the rebranding effort for several years. "This is not the same thing as an ad campaign that runs for a few months and then disappears," says McWilliams. "This is a multi-year effort to really change the awareness and the perception of Cornell Engineering. This message will infuse everything we do."

For Collins, one the most important metrics for measuring the success of the rebranding effort will be admissions yield. "We have more than 12,000 students apply for 740 spots," says Collins. "After we have offered admission to these amazing students, the real test is, do they choose to come here or do they go somewhere else?" Collins goes on to explain, "Even more basic than that, there are still really bright kids and families out there who just don't know about Cornell Engineering. By focusing on our stories and being more assertive in getting them out there, we hope to reach those students and those families, too."

Meetings and events have been held on campus over the past six months to solicit input from faculty and staff and to share the work that has been done thus far. Groups of engineering alumni have also had a hand in shaping the look and the message being created by McWilliams and her team. "Feedback has been overwhelmingly positive so far," says McWilliams.

Collins agrees, "I have met with the faculty of several of the engineering departments to talk about the brand and people are very excited about this. It's as if they have been given permission to share their excitement about their work."

As Collins discusses the rebranding effort, he grows more and more animated and it is clear he has learned the importance of managing the Cornell Engineering brand. "The genie is out of the bottle," says Collins. "We are encouraging our faculty, students, alumni, and staff to tell the world about the incredible work Cornellians do. Now that the genie is out of the bottle, Cornell Engineering will never be the same."

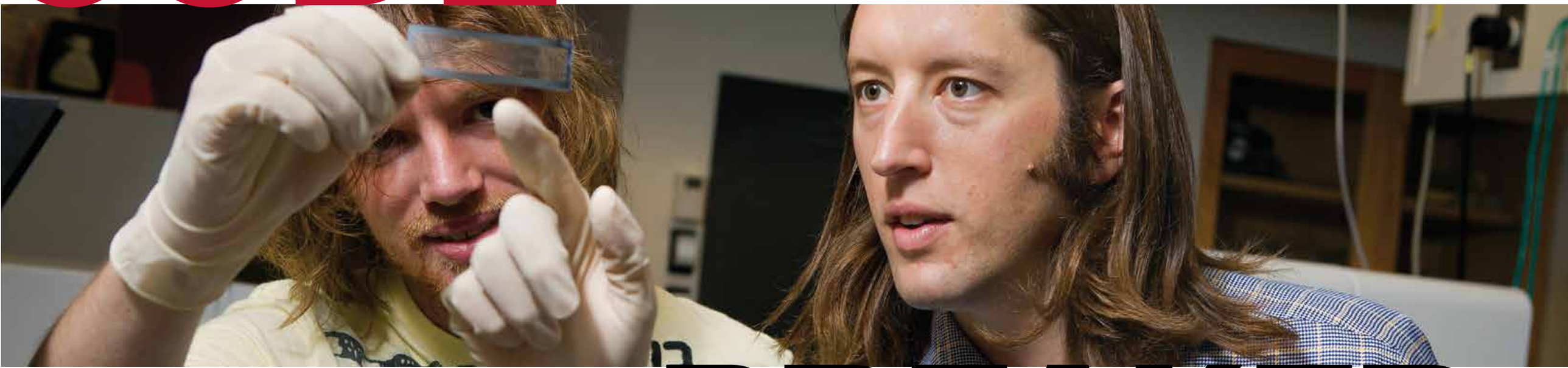
A banner created for Cornell Cup displays the college's new branding.

CODE BREAKER

JULIUS LUCKS (PICTURED RIGHT) UNLOCKS THE SECRETS OF RNA

By Lauren Cahoon

Julius Lucks is on to something. The professor of chemical and biomolecular engineering is making discoveries that have garnered attention; in the last two years alone, Lucks has received the 2012 DARPA young faculty award; a 2012 Gates Grand Challenge Exploration Grant; the 2013 Office of Naval Research Young Investigator Award; the NIH Director's New Innovator Award; and was named a 2013 Sloan Research Fellow. At the same time, his lab group has doubled in size, he's founded a seminal course on synthetic biology at Cold Spring Harbor Laboratory, and has just recently published some key discoveries in the journal *ACS Synthetic Biology*.



This wasn't always the case. In graduate school, Lucks found himself disheartened and doubting, and, were it not for the seasoned advice of a mentor, would likely have quit. The advice?

"This is all just a 'choose your own adventure' detective story," Lucks says. "Just see where this leads."

It's a good thing Lucks decided to take that advice, as his chosen adventure has led to key discoveries about one of biology's most important, yet frequently overlooked, molecules. While DNA typically gets the spotlight for holding the secrets of life, Lucks believes that it's time to introduce a new star.

"RNA does it all—it stores information, it propagates that information, it's the master molecule of life," he says.

By applying engineering principles to molecular biology, Lucks is uncovering not only new truths about what RNA does and what it impacts, but also potential shortcuts to engineering tailor-made biological pathways that could advance discoveries in human health and medicine.

Scientific Serendipity

"Addicted to learning new things," Lucks studied chemistry as an undergrad at the University of North Carolina, following that with a masters in theoretical chemistry at Cambridge University. At that point, he took an interest in quantum physics, "so I figured I would go learn quantum physics from the people who discovered it," and threw himself into a masters and Ph.D. program in physics and a Ph.D. at Harvard University. After that, Lucks' thirst for knowledge led him to biology and a fascination with RNA, a path that seemed, at Luck's reflection, almost cosmically laid out for him. At Cambridge University, Lucks drank pints of ale at the very same pub where Watson and Crick first sketched out the physical structure of DNA—RNA's more famous cousin. While strolling along Cornell's oak-lined Tower Road, Lucks happened to spot a small plaque dedicated to Robert W. Holley, who won the Nobel Prize for his discovery of the structure of transfer RNA and linked DNA to protein synthesis. And last year Lucks developed a summer course at Cold Spring Harbor Laboratory, taught in a room down the hall from who else but—James Watson himself. "We don't tell the students that he's there," says Lucks. "It's a lot of fun once they realize that the elderly scientist in the office next door is the guy who discovered the structure DNA."

Whether it was destiny that led him to this field of study or pure happenstance, Lucks is making significant headway. Traditional biological models of RNA portray the molecule as a static, single-strand entity that transcribes the code from DNA into proteins. "Textbooks represent it as DNA going to a wavy line [representing RNA], which goes to protein," says Lucks. "But RNA is anything but a simple wavy line." Instead, Lucks explains that the molecule is more like a 'very long, sticky rope' that

"SOMETHING IS HAPPENING," SAYS LUCKS. "THINGS ARE STARTING TO CLICK."

tends to ball up and fold in on itself. He uses an analogy of an old film reel projector, spitting out film that tends to snarl into tangles as it comes out. Those snarls, or folds, turn out to be instrumental in RNA function as well as overall gene expression. "Every RNA that's being made has an opportunity to fold in a particular way," says Lucks. "We want to 'make a movie' for every RNA molecule as it's getting spit out of that reel projector—that's our mission…if we can do that, we will definitely discover new things about biology."

Layers of Code

DNA-to-protein code is not the only code involved in gene expression. Research has already uncovered epigenetics, in which certain genes in the DNA code are turned off or on by functional changes such as methylation or histone modification—but there is even more complexity to genetic expression, thanks to RNA. Lucks explains that the physical structure of RNA provides "another layer of code" for gene expression, selectively turning genes off and on. "New biology asks what this code is, and that's what we're trying to figure out," says Lucks.

One thrust of his quest to decipher this code involves a technique known as SHAPE-Seq, in which Lucks and his team chemically alter RNA molecules according to their shape, and then sequence the RNA to ultimately measure its structure. With every known structural tweak they make, Lucks and his group uncover an additional piece of the code that lies beneath the RNA structure.

Lucks is attacking the mystery from another angle as well; building an RNA-only genetic system from 'scratch'—one that is oversimplified and easy to control. Lucks hopes to someday be able to tackle biological issues via engineered, RNA-only genetic systems that he can 'program' to do exactly as he wants. "We're on a beautiful quest to create something that will act like a computer," says Lucks. "We're far off from doing that now, but we will do it."

Molecular Legos

By putting together these systems themselves, Lucks and his team are creating oversimplified versions of biology's genetic designs. "What we're doing with RNA does not exist in nature—but then again nature isn't an engineer. As engineers we want things that are simple, that fit together neatly like Legos."

Once these 'Lego-like' systems are available, a wide range of possibilities open up. The applications could include, in the near term, metabolic engineering—"making cells make things that we like and care about," as Lucks puts it. While there are E. coli bacteria that now produce insulin and yeast cells making crucial components for malaria drugs, Lucks believes that his engineered RNA systems could push these boundaries even further. By controlling engineered RNA systems, Lucks says that scientists will be able to balance metabolic pathways that previously would have been insurmountable roadblocks to certain processes—

Provided

Rapidly characterizing the fast dynamics of RNA...

such as trying to make a mammalian protein in a bacterial cell.

In the long term, Lucks is planning to build a 'truly universal genetic circuitry'—an RNA system with a genetic passport to any type of cell, be it plant, mammal, yeast or bacterial—allowing much more efficient genetic engineering and design. He also hopes to utilize these universal RNA circuits to control cell differentiation. "Using this technique, you could grow tissues in the lab way easier," Lucks says. "By having a universal set of core building blocks, you could take a group of cells and make them turn into blood vessels or muscles."

Cold Spring Harbor Crash Course

In the meantime, Lucks and his group have made promising steps toward designer-made RNA systems. This past summer, Lucks and NSF Graduate Fellow Melissa Takahashi collaborated to help create the first Cold Spring Harbor Laboratory summer course on synthetic biology. The lab is renowned for summer courses and seminars that have sparked formative scientific discoveries in the field of molecular biology and have hosted Nobel Prize-winning scientists. Lucks' two-week course hosted sixteen select students as they conducted real synthetic biology research and experiments—most of whom were unfamiliar with RNA or molecular biology. "It was our dream in creating this course where students could do real research on a topic they've never heard about before," says Lucks. His dream was realized. During the two-week course, the group proved one of Lucks' long-held theories—that RNA-only genetic circuits are faster compared to protein circuits. Using a cell-free transcription-translation system ("it's literally crushed up cells in a tube—a goop of cellular machinery that allows the RNA to do its thing so we can test its function,"), the group was able to prove that RNA circuits relay information faster. Specifically, at roughly five minutes per step—much faster than the protein circuits that naturally operate on hour time scales in cells. Lucks says this has exciting implications for things like stem-cell research, which requires weeks for differentiation to occur—but with an RNA-only circuit system would take only days. "It was hugely inspirational that we were able to pull this off," says Lucks. "Hopefully it sets the tone for even greater things to come." It is this work, Lucks believes, that has attracted the recent deluge of awards. "A lot of these awards recognize high risk, high reward research," he says.

An Open Door Policy

When he's in the lab doing research, Lucks is fairly easy to spot, according to his students—thanks to his 'iconic' red sweatband he wears when he's in the thick of running experiments. "It's hilarious because it's so ridiculous," graduate student Kyle Watters says. "I've never seen him not wear it when doing anything in the lab." It's clear that Lucks has established camaraderie within his research group that seems to lead to scientific success.

"He is relentlessly enthusiastic about the research that we are doing," says postdoc James Chappell. "I can honestly say it's an absolute pleasure working for him. His door is always open, and he is always there to deal with challenges, push the work forward, and to celebrate the successes." Graduate student Melissa Takahashi agrees. "When you walk out of a meeting with him, you leave pretty excited about your work."

Lucks' enthusiasm for the work his group is doing is clearly genuine. "It's taken me a long time to connect all these different dots and begin to put the pieces of the puzzle together," he says, "but now, we are really creating the core pillars of this mission, and it's starting to click. We're going to have our moment in a few years when we show the world what we've discovered."

At the end of the day, Lucks has chosen an adventure with a big payout in the end—one that may be game-changing for everyone.

Andrew Vaslas '15 CS finds time to serve as CTO of Student Startup Sunn on top of his engineering course load.

BRIGHT IDEAS

ENTREPRENEURIALISM IS FLOURISHING AT CORNELL ENGINEERING

By Robert Emro

More faculty innovations are finding their way to market, invigorating local economies in the process. Cornell Tech's new graduate programs match students with organizations—and mentors—and then give them the option of starting their own company. And for entrepreneurial-minded undergraduates, Cornell now offers a host of resources—from the Engineering Management minor to startup incubators—to help them launch a company as part of their Cornell experience.

Provided

Worthy Jerky is made entirely from scratch using no artificial ingredients.

WORTHY JERKY

Alex Krakoski '16 ChemE came to Cornell with a budding jerky business born in his dorm room at the Leysin American School in Switzerland, where he went for his final two years of high school. Demand was high in the ski resort town for healthy, portable snacks and Krakoski asked his mom to send him a big batch of her beef jerky.

"When I was little—I hated it at the time, but I understand now it was best for me—she didn't want me to have a lot of the processed snacks," he says. "My mom said, 'No. I'm going to make snacks,' and one of those is the jerky that I am selling now."

The jerky was a hit, helping Krakoski finance his travel to and from his home in Florida. Once at Cornell, Krakoski gathered a team of seven food science, nutrition, and business majors (Ben Pham, Camille Kapaun, Brenda Margolies, Justin Siegel, A.J. Schonenberg, Laura Stargala and Daniel Yoon including Krakoski's high school friend, who helps with accounting from the University of Florida) and Worthy Jerky applied to the competitive eLab, an incubator dedicated to accelerating top student Cornell startups. Established in 2008 by the nonprofit Student Agencies Foundation, in collaboration with Entrepreneurship@Cornell, eLab has worked with hundreds of students in turning concepts into real businesses.

"The professors in the program have been very good with identifying product market fit and what the problems are that customers may or may not perceive," says Krakoski. "The main challenge is communicating that it's a healthy snack because there is this already preconceived notion that it's junk food."

Independent testing has shown Worthy Jerky rivals or exceeds other healthy snacks, according to Krakoski. "It's a healthy durable snack people can take with them without feeling guilty about doing it," he says.

Worthy Jerky is made entirely from scratch, using no artificial ingredients. "Most of the jerky that is out there is made with mystery meats and a lot of artificial ingredients," says Krakoski. "We're using top sirloin cuts from Omaha Steaks and we're using fruit- and vegetable-based marinades and not the cocktail of a lot of very bad chemicals that other brands are using."

The trade off is in shelf life. Even so, in testing, Krakoski says Worthy Jerky stored at room temperature is good for at least four or five months and can keep as long as a year. "If you start with a lean cut of meat, you can extend the shelf life," he says. "Also because we're using fruits and vegetables in the marinades, those tend to be a little more acidic than other marinades, so we get a little bit of curing effect similar to ceviche."

Scaling recipes up for a contract manufacturer has been one unexpected challenge. "The recipes that work on the kitchen-size level do not use the same proportions when you scale up to larger batches on the order of 100 pounds," says Krakoski. "The flavor profile doesn't match what we would expect, the pepper is too weak and the raspberry flavor is too weak whereas some of the other flavors are stronger than we'd like."

With help from Alexander Schonenberg '16 ChemE, Worthy Jerky has been working with the manufacturer to tweak ingredient amounts and has just about finalized the recipes for its four flavors: Spicy Citrus Barbecue, Citrus Barbecue, Raspberry Chipotle—the company's best seller, and Pineapple Teriyaki. The students rely on their taste buds to tell them when they have it right. "You can do all the chemical analysis you want," says Krakosi, "but at the end it's the people eating it that will really make the decision."

At its annual Demo Days competition held on April 10, Entrepreneurship@Cornell selected Worthy Steak Jerky as the winner of the Student Business of the Year, awarding the company $5,000 with which Krakoski plans to make more jerky. So far Krakoski has financed everything from his personal savings. None of his student employees are drawing a salary, but lawyers provided by eLab are drawing up stock option plans for them.

Until recently, the only way to buy Worthy Jerky was directly from one of the other students involved—Krakoski keeps a supply in his backpack—but the company recently started online sales and is in talks with Cornell Dining and local grocer P&C Fresh to carry their product. The company is also exploring opportunities to sell Worthy Jerky at sporting events.

"We have a lot of opportunities to move into specialty markets where there is almost zero competition from other jerky brands," says Krakoski, "because what they're selling is almost equivalent to junk food whereas the people we're selling to are looking for a healthier, portable snack."

Alex Krakoski presenting at Cornell Demo Day

Provided

Sunn

eLAB also encourages students to earn class credit for developing and growing a startup. Students can receive 5.5 credits over the school year, a real help for students already juggling the hectic engineering curriculum. Andrew Vaslas '15 CS was concerned about the time commitment when he took over as CTO for Sunn, an LED lighting company founded by Jeremy Blum '12 ECE, M.Eng. '13.

"The school year was starting, it was my junior year—the so-called busiest year. But to me it was almost a no brainer because I was so passionate and so excited about this project," says Vaslas. "One of the most important things is to not underestimate your ability to incorporate your outside work into your coursework."

Sunn, another eLab startup, grew out of a Cornell University Sustainable Design project that used fiber optics to bring natural sunlight into a room, supplemented by energy-efficient LEDs that mimicked natural light. The system worked, but was impractical due to the high cost of fiber optic cable, according Vaslas. But Blum saw potential in an LED that could shine like the sun. "We did a lot of research into the lighting industry and thought, 'We could really build something

Andrew Vaslas '15, a student in computer science (COMS), with an LED light.

that people would want,' says Vaslas. "All of us just said, 'Whatever you're doing over the summer, put it aside, we're working on this.'"

The students secured a provisional patent for an LED light with help from the Cornell Center for Technology Enterprise and Commercialization, but with the advent of several commercially available wireless LEDs, have temporarily pivoted away from hardware to the software.

"Smart lighting is just the future, that's almost guaranteed," says Vaslas. You can save money, get more pleasant light, and control your light with your phone or any device. It's an amazing time to get into the market early and establish ourselves as the major player in lighting controls."

Sunn is about to release its first app for the Phillips Hue LED light. "It's going to mimic what the lighting conditions would be if it was an ideal sunny day at your current location and time," says Vaslas, describing the app's default mode. "We claim this is the healthiest and most natural light possible on the basis that we, as humans, evolved under this type of light for 99 percent of our existence."

Sunn's health claims are based on research showing that a photoreceptor in the eye tied to melatonin production is tuned to particular wavelengths. When the receptor senses blue wavelengths like those found in sunlight, production of melatonin, a hormone that causes sleepiness, is curtailed. While some conventional bulbs can reproduce this wavelength, the light is not dynamic, changing intensity over the course of the day as the sun does.

"When you're getting sunlight your body is naturally being told stay awake, stay alert," explains Vaslas. "When you're experiencing light bulbs that have Sunn software running on them you will essentially be experiencing sunlight in terms of the color and quality and it's pretty widely accepted that natural sunlight has these benefits."

At night, Sunn controlled bulbs will replicate the wavelengths in candlelight to allow melatonin production, at least in default mode. "This is where our app is awesome; it allows you to customize everything," says Vaslas. "If you are a shift worker and you're working late at night, you can change the time of day. Not everybody lives on the same schedule."

Vaslas says Sunn has raised about $100,000 in angel investment, which has financed travel for the team which is currently spread out between Ithaca, Chicago, Los Angeles, and Denmark. "One of the most important things is to every once in a while get together and see each other's faces," he says. "We also have a lot of anticipated costs in terms of hosting software."

Sunn makes use of the PopShop in Collegetown. Opened in 2012, it's a new space for Cornell students and Ithaca residents to engage in scheduled programs and chance encounters, to discuss their entrepreneurial ideas, organize meetings for their startups, and receive guidance and support from experienced entrepreneurs on campus. "Whenever I have a team meeting, or whatever, that's generally the go-to place," says Vaslas. "There are so many people there who are similarly entrepreneurial minded. It's such a great environment to work in."

Vaslas also credits Cornell Engineering's Kessler Fellows Program with allowing him to pursue his entrepreneurial dreams while earning his degree. The five-year-old program offers select junior engineering students a unique year-long experience that combines learning and exposure to the startup culture through a summer placement in a company or other entrepreneurial environment. While most fellows are placed with someone else's startup, Vaslas got to work for a company he helped launch.

"Its been a fantastic experience being a Kessler fellow," says Vaslas. "I think the program is really great."

Ahmed Elsamadisi '14 ME, in the robotics lab where he does undergraduate research.

Not every student business idea pans out, but they can all enhance an engineering education.

Ahmed Elsamadisi '14 ME, first became interested in entrepreneurship as a high school student. He has taken several ideas through the proof of concept stage at Cornell Engineering.

Elsamadisi, who is originally from Egypt by way of New York City, dove right in, taking the entrepreneurship class taught by John Callister, the Harvey Kinzelberg Director of Entrepreneurship in Engineering, his first year. He came up with an idea for a phone charging case that uses coils to harvest energy from walking. He called it ActiveCase. On his own time, he built a prototype.

"I was super excited about it," he says. "But I started working with the prototype and it didn't work. I went back to the math and found out I converted a percent to a number without multiplying by 100. Well that estimate of 1,000 steps required ended up becoming 100,000 steps."

Undaunted, Elsamadisi explored five more product ideas while at Cornell, including reinflatable bubble wrap called ReWrap and an exoskeleton called Sleeve that can double the wearer's arm strength. "I have all these things ready and when the time comes I'll make them all go big," he says.

As his senior year drew to a close, Elsamadisi set his sites on launching his latest product, called Simpoll. "It's a mobile app that allows you to poll large groups of people through text messaging. It would be a new way to make asking for advice a lot easier and more fun and a lot quicker," he says.

But by the time he was featured as one of Business Insider's "19 Incredibly Impressive Students at Cornell" in March, Elsamadisi had shifted gears and was planning to work for WeWork, the startup he was placed with as a Kessler Fellow.

"I feel like when I'm ready to incorporate and put my life into a company, I want to put my whole life on the line for it," says Elsamadisi. "Right now, I'm not ready to dedicate my whole life to one thing because I'm still so young."

WeWork, a "Community for Creators," provides business spaces for budding startups in several major cities around the country. "That environment of me meeting a lot of people and building products every single day was great for me," says Elsamadisi. "I was going be working on turning their building into a robot that learns."

Then, Elsamdisi said he realized he wasn't ready. "I don't know enough to make products that will make a big impact. I need a couple more years learning," he says. "Then I can take everything to the next level."

So he started applying with employers that could help him advance his education, including Raytheon, where he will be working in Integrated Defense Systems. "I was very, very interested because that will give me a lot of rigorous mathematical and engineering skills," he says of working for the defense contractor. "Once I've had just a couple more years of learning I'm going to go off into the startup world and see what I can do there. I have so many ideas that I want to bring to life."

FOLLETT INNOVATION MANUFACTURES SUCCESS

By Kenny Berkowitz

ICEMEN

When Bethlehem Steel filed for bankruptcy in 2001, it felt like the end of an era. At its peak, the company had 300,000 employees, making it the second largest steel producer in the United States, and when it closed, people started asking whether American manufacturing would survive the new century. But just down the road from the plant's old blast furnaces, there's a much smaller factory that might have the answer.

"YOU CAN DIFFERENTIATE WITH PRODUCTS, AND YOU CAN DIFFERENTIATE WITH SERVICES—BUT YOU CAN ALSO DIFFERENTIATE WITH CULTURE, WHICH IS WHY OUR CORE VALUES ARE SO IMPORTANT TO US. THAT'S ONE OF THE BIGGEST LESSONS I LEARNED FROM MY FATHER."

It's called Follett Ice, and for the past 20 years, it's been run by Steve Follett '78, who took over the business in 1994 from his father, Don Follett '52, who inherited it from his father, Roy Follett, back in 1954. With 320 workers at the facility outside Easton, Pennsylvania, the company is never going to rival the old Bethlehem Steel, and it's not supposed to. It's a family business, privately held by the Folletts and their employees, run with a motto that promises "innovative solutions inspired by ice," a strong sense of core values, and an impressive record of growth.

"Over the last four years, the business has doubled its revenue, and more than doubled its profits," says Steve, CEO and chairman, who majored in operations research and industrial engineering. "Last year, our revenue broke the hundred million dollar barrier for the first time ever, broke it by a fair amount. In each of the past four years, we developed a growth plan that was pretty aggressive, and succeeded in meeting our goals. This year we're looking at double-digit growth, and we're going to keep being lean, scrappy, and innovative."

In the years since Steve arrived, Follett Ice has greatly expanded its line, which began in 1948 with a single product: storage bins for York ice machines. Roy Follett was an optimist, a natural entrepreneur, and after coming back from World War II, he wanted to start a company of his own. He opted to go with the latest technology, automatic ice, which was introduced in 1945 as an alternative to the iceman and the delivery truck.

To concentrate on sales, Roy subcontracted the manufacturing to some sheet metal shops in New York City, and within two years, he was doing well enough to buy out his partners. But his health hadn't been good since landing with the Navy at Okinawa, and in 1954, Roy died suddenly, leaving the business to his only child.

"My father and I were very close, but we had very different personalities, and we could not have worked together," says Don, who'd graduated two years earlier with a bachelor's in mechanical and industrial engineering . "We knew that, so it wasn't even a question in our minds. Still, a lot of my father rubbed off on me. I knew I wanted my own business some day, that much was clear. I was working for Reliance Electric, and things were going along quite well, but here was an opportunity to operate independently. I found that rather exciting."

Provided

Follett headquarters in Easton, Pennsylvania.

For the next two years, Don kept up the sales business, but what he really wanted was to make the leap into manufacturing. So he called Bob Conti '52, who'd been a friend since their fifth-year engineering project, when they built an electromagnetic fluid metal pump to cool nuclear power plants. ("The faculty members were really, really impressed we were tackling this project," says Don. "We were getting all kinds of notoriety, and we did a beautiful report, built the pump, and both got A's. Well, guess what? The pump didn't work.")

Conti signed on, and after several false starts, they opened a 20,000 square-foot factory in Phillipsburg, New Jersey, and started producing the ice bins themselves. Innovations followed, and ten years later, they moved to a space three times larger in Easton, where they diversified into other products to complement the York line. There was a freestanding ice and water dispenser, vending machines, and a countertop beverage dispenser, and when York decided to exit the ice market, Don and Bob bought the rights to the company's diced ice technology.

There was nothing else like it on the market, a machine that could make ice nuggets in a continuous process, then transport them to a dispenser in another room—usually office kitchens or fast-food restaurants, which were rapidly becoming a nationwide phenomenon. But there was one problem: The technology didn't always work.

"It was a very, very interesting concept, but the machines themselves were very unreliable," says Steve, who joined Follett Ice in 1987, ten years after the company began manufacturing its own version of the York machine. "The machines worked, but not well, which meant the service aspect of our business got really good, because it needed to. Over a number of years, there was a lot of redesign on the ice machine, with some new product development and pretty radical changes to the designs. And that's when the growth really started happening."

Like his father, in all his time at Cornell, Steve had never planned to run the company. After receiving his bachelor's, Steve spent two years at The Trane Company, one of the world's largest makers of air-conditioning systems, then went back to school for an MBA at Northwestern University. Next, he worked five years at IBM, where he was involved with project management to launch new hard disk drives and a new product line of mid range computers before deciding he'd prefer the challenge of expanding Follett Ice.

"We talked about it, and I gave him all the reasons why I didn't think it was a good idea," says Don, who has remained a member of the board of directors. "He said, 'Now, wait a minute. You had a chance at this. Why shouldn't I get a chance?' Well, the timing was right, because Bob Conti had just gotten his Ph.D. and was getting ready to go into teaching. And Steve had the intellectual tools and experience to understudy for Bob, who was the operations person, while I did the sales and marketing. I realized it was the perfect spot for Steve to step in and take over."

For the next seven years, until Don retired as CEO in 1994, Steve took charge of sales, marketing, and financial planning, taking what he calls "a $10 million company with great potential" and building it into an industry leader. Under Steve's leadership, Follett Ice opened a manufacturing plant in Gdansk, Poland, which caters to growing markets in Europe, and the Middle East, and made significant inroads in Australia, Canada, Hong Kong, Latin America, Mexico, and Singapore. It expanded its market leading position in healthcare markets for ice and water dispensers by launching a line of medical-grade refrigerators and freezers that account for much of the company's recent revenue growth, and it's continually re-envisioned its food service equipment, which now covers ice machines, ice dispensers, and ice transport systems.

To make it possible, Steve has expanded the Easton plant to 175,000 square feet, increased the number of engineers on staff, placed a new emphasis on modular design, and dramatically reduced inventory costs. Most important of all, he continues to install many aspects of the Toyota production system, which emphasizes continual improvement and lean manufacturing, while strengthening a culture of service to customers, teamwork, personal accountability, and respect for others.

FOLLETT®

Innovative solutions, inspired by ice

"The Toyota system permits Follett Ice to keep costs competitive with offshore manufacturing and maintain a high level of quality and a superiority in product design," says Peter Jackson, Cornell professor and director of graduate studies, who visits the factory each year with his ORIE 5100 class. "Their product development cycle, the engineering that goes into their products, and the process they go through in bringing new products to the marketplace are all important parts of their success. Their designs are fundamentally different from those of their competitors, and they have a unique ability to understand customer needs, design new products to fit those needs, and deliver them with high added value."

To Steve, that added value is the key to keeping the company competitive with overseas producers, and one of the main reasons why he remains optimistic about the future of American manufacturing. "Here in the U.S., none of us manufacturers will ever be low-cost producers," he says. "So we work very hard to be high-value producers, which means we have to be innovative, both in our products and in our services. Our best opportunity to succeed is when we have innovation infused throughout every piece of the system, from design to manufacture to ordering to delivery to service. There's been some really positive news about manufacturing in the U.S., with a trend toward leanness and taking the waste out of operations, and we're proud to be part of it."

Provided

Steve Follett and Don Follett

According to the Department of Commerce, manufacturers contributed $2.14 trillion in value-added output during the fourth quarter of 2013, rising 3.1 percent over the year before. That's a long way from $1.69 trillion in the second quarter of 2009, when the Great Recession touched bottom, and that's good news for both Steve and Don, who describes the current state of American manufacturing as "strong and competitive." Now retired, he divides his year between Pennsylvania and Florida, spends as much as he can with his grandchildren, and remains deeply connected to Cornell, serving as a life member on the University Council along with his wife, Mibs Martin Follett '51.

Looking back, father and son credit the college—and each other—for their company's success. "We both agree that the Cornell education we received was absolutely the best anyone could have received for doing what we did," says Don. "We can truthfully say that we used all of it in starting and building a manufacturing business from scratch."

"When I came on board, the business was small, but it had a culture of customer service that is still very, very evident today," says Steve, who currently serves on the board of the Society for Hospitality and Foodservice Management and is a former president of the North American Association of Food Equipment Manufacturers. "There was a strong emphasis on service, and as we've grown, we've worked very hard to maintain that piece. You can differentiate with products, and you can differentiate with services—but you can also differentiate with culture, which is why our core values are so important to us. That's one of the biggest lessons I learned from my father."

Follett Ice's Core Values and Beliefs

We will build an enduring company that:

- *Conducts all business relationships with honesty, integrity and respect;*
- *Enthusiastically serves our customers and strives for total customer satisfaction;*
- *Continually improves our products, processes, and skills, and celebrates successes along the way;*
- *Creates a team-oriented workplace that values both team and personal accountability, innovation, commitment, and fulfillment; and*
- *Supports our community as a responsible corporate citizen.*

PEOPLE

Kent Fuchs

Fuchs, Greene, Feeney elected to arts and sciences academy

Provost Kent Fuchs; Harry Greene, professor of ecology and evolutionary biology; and alumnus Chuck Feeney '56, have been elected to the American Academy of Arts and Sciences.

One of the nation's most prestigious honorary societies, the academy is a leading center for independent policy research. Members contribute to academy publications and studies of science and technology policy, energy and global security, social policy and American institutions, and the humanities, arts and education. The current membership includes more than 250 Nobel laureates and more than 60 Pulitzer Prize winners.

"It is a privilege to honor these men and women for their extraordinary individual accomplishments," said Don Randel, chair of the academy's Board of Directors and former Cornell provost. "The knowledge and expertise of our members give the academy a unique capacity—and responsibility—to provide practical policy solutions to the pressing challenges of the day. We look forward to engaging our new members in this work."

Prior to his appointment as provost, Fuchs was the Joseph Silbert Dean of the College of Engineering (2002-08). His research interests include dependable computing and failure diagnosis of integrated circuits.

He is a member of Tau Beta Pi Engineering Honorary Society and Eta Kappa Nu Electrical Engineering Honorary Society and a fellow of the IEEE, the Association for Computing Machinery, and the American Association for the Advancement of Science. Awards he has received include the Distinguished Alumnus Award from the Duke University Pratt School of Engineering and the Distinguished Alumni Award from the University of Illinois Department of Electrical and Computer Engineering.

Peck receives NASA Distinguished Public Service Medal

NASA administrator Charles Bolden presented Mason Peck, with the NASA Distinguished Service Medal during a March 7 ceremony at NASA headquarters in Washington. Peck was recognized by the space agency for his outstanding service and leadership during his tenure as NASA chief technologist.

Mason Peck, associate professor of mechanical and aerospace engineering, served as NASA's chief technologist from January 2012 to December 2013.

"This is an extraordinary honor, and I'm humbled to be in the company of past recipients," Peck said. "NASA is where we can dream big.

NASA / Tom Tschida

NASA Dryden engineer and project manager Jerry Budd shows off the recently completed 1/3-scale Twin Ventus glider center section that would be used to flight validate the aerodynamics of his Towed Glider Air-Launch concept to NASA chief technologist Mason Peck and deputy chief technologist Jim Adams as Dryden's technology chief David Voracek looks on.

Serving at the agency in this capacity was a once-in-a-lifetime opportunity to contribute to the kinds of technologies, exploration and science that define who we are and what we can achieve if we put our minds to it."

Peck, who researches spacecraft systems at Cornell and leads several high-profile satellite research programs including CUSat and Violet, was the agency's principal adviser and advocate on matters of technology policy and programs.

His accomplishments at NASA included creating NASA's Asteroid Grand Challenge, which asks the nation to work together to find all asteroid threats to human populations and know what to do about them. He developed NASA's first agency-wide space technology investment plan in decades and oversaw the establishment of the new Space Technology Mission Directorate. His has helped build bridges from NASA to thousands of do-it-yourself spacecraft engineers in the U.S. and around the world, the so-called "maker community."

Another of his responsibilities was communicating how NASA technologies benefit space missions and the day-to-day lives of Americans.

The Distinguished Public Service Medal is NASA's highest recognition to any nongovernment individual. The award honors an individual "whose distinguished service, ability or vision has personally contributed to NASA's advancement of the United States' interests. The individual's achievement or contribution must demonstrate a level of excellence that has made a profound or indelible impact to NASA mission success."

Past recipients of the award include Carl Sagan, Neil DeGrasse Tyson, Robert Heinlein, and Gene Roddenberry.

—*Anne Ju*

Four faculty receive NSF CAREER awards

Four Cornell faculty members have received National Science Foundation Faculty Early Career Development Awards, which support research activities of teacher-scholars. Along with their research, awardees also engage in education and outreach activities as part of their grant fulfillment.

Olivier Desjardins, assistant professor of mechanical and aerospace engineering, received $400,000 over five years for his work in computational and theoretical fluid dynamics. His goal is to develop a comprehensive, mechanistic and statistical theory of turbulence-interface interactions in liquid-gas flows. This could have impacts on the way scientists and engineers understand turbulent multiphase flows, leading to the development of new predictive models to enable simulations of engineering devices such as fuel injection systems and natural processes. His proposal includes a new massive open online course (MOOC) on multiphase flows and an iPad multiphase flow simulator to inspire students and the public.

David Steurer, assistant professor of computer science, received $600,000 over five years for his research addressing fundamental questions about approximation algorithms, which provide computational efficiency by offering approximate solutions to optimization problems that lie at the core of all of computer science and its applications. Steurer uses strong relaxations, especially the sum-of-squares method, in shedding light on such questions. An integral part

Olivier Desjardins

of his research is resolving if this method refutes the Unique Games Conjecture, an accomplishment that would likely lead to major improvements of approximation algorithms for a wide range of problems.

Ross Tate, assistant professor of computer science, received $575,000 over five years for his work in types, which are structures imposed upon computer programming languages. They can cause problems when programs written in different languages interact. His research involves a principled form of gradual typing that is compatible with the methods of industry developers. In addition to improving the language resources to develop Web technologies, his project's broader impacts include a plan for an entirely online interactive program-development environment for building interactive Web pages. The intent is to make programming accessible to people who only have access to a modern Web browser.

Roseanna N. Zia, assistant professor of chemical and biomolecular engineering, received $410,000 over five years for her research investigating the structure and macroscopic properties of colloidal gels. Her goal is to develop a predictive theory for gel stability by discovering and elucidating the underlying mechanisms of the sudden collapse of colloidal gels, with a view toward the design of soft biomaterials such as injectable drug delivery platforms and transplantable tissue scaffolds. Injectable gels have emerged in the past decade as a powerful tool in tissue engineering and drug delivery due to their biocompatibility, tunability and minimal invasiveness. However, such gels are susceptible to sudden failure. This study will yield a phase map that, for the first time, predicts the collapse and the characteristic length scale, age, attraction and underlying forces that lead to collapse.

—*Anne Ju*

First cohort of International Faculty Fellows chosen

Cornell's first cohort of International Faculty Fellows with the Mario Einaudi Center for International Studies was announced in May.

Andrea Bachner, comparative literature (Arts and Sciences); Victoria Beard, city and regional planning (Architecture, Art and Planning); Saurabh Mehta, nutritional sciences (Human Ecology); and Daniel Selva, mechanical and aerospace engineering (Engineering), will start three-year terms as International Faculty Fellows this summer. As such, they will be expected to contribute to the intellectual life of the Mario Einaudi Center for International Studies by hosting workshops in their fields, interacting with various international programs housed within the center and working across disciplines to foster cross-college connections.

Nominated by the deans of their respective colleges/schools and chosen by a

The 2014 internationalization fellows at the Spring Reception at the Einaudi Center for International Studies (ECIS). L-R: Saurabh Mehta (DNS), Andrea Bachner (COML), Daniel Selva (MAE), and Victoria Beard (CRP).

faculty committee chaired by Vice Provost for International Affairs and Einaudi Center Director Fredrik Logevall, fellows are selected on the basis of their internationally focused research and teaching and scholarly achievements.

"This new initiative is a centerpiece of our new Call to Action: Advancing Cornell's International Dimension," says Logevall. "It is meant to foster new collaborations among the colleges and the Einaudi Center, to enhance the connectivity of internationalization across campus, and to assist Cornell's colleges and schools with recruitment and retention of superb faculty whose research and teaching have an international focus."

Selva, assistant professor, who holds advanced-level degrees from world-class institutions in Spain, France and Boston and has professional experience in French Guiana, says that he has made international diversity a guiding principle in his personal and professional life. His research focuses on developing a CubeSat (a very small satellite) for remote sensing of agriculture with Spanish and Russian partners; it will have an educational component that will foster collaboration between Cornell students and Spanish and Russian students.

—*Susan Lang*

Lehman Fund makes seven awards for China study

K. Max Zhang, associate professor of mechanical and aerospace engineering was among seven scholars (four faculty members, one faculty-graduate student team and two graduate students) to receive awards from the Jeffrey S. Lehman Fund for Scholarly Exchange with China. The fund provides grants to initiate research projects, sponsor research-related conferences or workshops, host visitors from China or support faculty travel to China to work with colleagues on collaborative research projects. Zhang's project is titled "Planning Workshops for Establishing a U.S.-China Research Center on Air Pollution Control."

Roseanna N. Zia wins young investigator award

Roseanna N. Zia, assistant professor of chemical and biomolecular engineering, is among this year's Office of Naval Research (ONR) Young Investigator Program award winners.

Zia received $568,000 over three years for her project titled "Structure, Dynamics, and Nonlinear Mechanical Response of Kinetically Arrested Particle Suspensions." She will work to define the structure of colloidal fluids and learn to predict their behavior. The project may lead to cutting-edge materials that can change their physical properties to match their surroundings—for example, injectable solids for damage repair or injectable nanosensors that can flow into a system to diagnose problems and then fix them with a simple fluid change.

—*Anne Ju*

Roseanna N. Zia

Student projects that feed poor, instill pride, earn awards

Charles Sharkey '15 ChemE was among three Cornell students to win Robinson Appel Humanitarian Awards April 25. The programs are administered by the Cornell Public Service Center.

Sharkey's project is called Making the Most of Your Healthcare, a program focused on empowering elderly Ithaca patients to be effective advocates of their own health via a program and individual counseling at Lifelong, a community organization focused on enhancing the lives of older adults in Tompkins County. The program will detail strategies and methods to help patients better understand their health and maximize the health care they receive.

Gerald Robinson '54, Margot Robinson '55, Robert Appel '53 and Helen Appel '55 established the awards to recognize students who have given significant community service through their projects. The awards include a grant of $1,500 to further service project ideas or programs.

Charles Sharkey

Students presented to Leonardo Vargas-Mendez, executive director of the Cornell Public Service Center, and a panel of alumni.

CEAA Awards honor students, staff

The Cornell Engineering Alumni Association held its annual awards banquet April 10.

Walker M. White M.S. '98, Ph.D. '00, a lecturer in computer science, received the Tau Beta Pi Professor of the Year award. The award recognizes a tenure-track professor as one of the college's most outstanding teachers. Tau Beta Pi selects faculty nominated by students.

David Schneider M.S. '06, Ph.D. '07, a lecturer in systems engineering, received the Academic Achievement Award. The award recognizes non-tenure-track staff and lecturers who go well beyond their job duties for advising, teaching, and general help to students and who enhance undergraduate education outside of the classroom. Directors and chairs of the college's schools and departments nominate individuals for this award, and the final selection is made by the office of the associate dean for Engineering Undergraduate Programs.

Tim Abbot '15 ChemE won the Undergraduate Research Award for his work in Julius Lucks' lab, helping to create new technology that can characterize RNA structures inside cells.

Cornell University Genetically Engineering Machines received the Albert R. George Student Team Award, given in honor of Al George, the John F. Carr Professor of Mechanical Engineering, who has been an active member of the engineering community, particularly with the Cornell Formula SAE team, for over 23 years.

The Student Organization Award was shared by Cornell chapters of the American Institute of Aeronautics and Astronautics and Tau Beta Pi. Student and student group award recipients are recommended by the college's faculty and staff, and the final selection is made by the office of the associate dean for Engineering Undergraduate Programs.

—*Robert Emro*

Hakim Weatherspoon, assistant professor of computer science (COMS), leads a Sonic Summer Workshop.

DPE recognizes diversity efforts

With its annual Commitment to Diversity Awards, Diversity Programs in Engineering recognizes students and faculty members for their commitment to diversity issues, as well as participation in DPE programs.

Civil and Environmental Engineering Undergraduate Program Coordinator Nadine Porter received the inaugural 2014 Richard Allmendinger Commitment to Diversity Award for outstanding staff involvement in diversity issues. This award recognizes her long-term commitment to CEE students and to the broader diversity efforts of Cornell Engineering.

Chemical and Biomolecular Engineering Associate Professor Susan Daniel and Computer Science Assistant Professor Hakim Weatherspoon received the 2014 Zellman Warhaft Commitment to Diversity Award for outstanding faculty involvement in diversity issues. Daniel's award recognizes her stewardship of the Graduate Women's Group in Chemical Engineering. Weatherspoon's award recognizes his creation of the SoNIC research workshop designed to increase the participation of underrepresented minorities at the Ph.D. level in computer science.

The 2014 Zellman Warhaft Commitment to Diversity Undergraduate Student Award went to Jamal Cherry '14 CEE in recognition of his work to foster communication between students and the college leadership.

The 2014 Zellman Warhaft Commitment to Diversity Graduate Student Award award went to Olufunmilayo (Funmi) Adebayo and Emily Farrar, both in biomedical engineering, in recognition of their work in programs supporting the retention of undergraduate students.

These honors were presented during the DPE Annual Awards Banquet Friday, May 9.

—*Robert Emro*

King is AACC Outstanding Speaker

The American Association of Clinical Chemistry has honored Biomedical Engineering Professor Michael King with its Outstanding Speaker Award for 2013. This award recognizes his achievement in earning a speaker evaluation rating of 4.5 or higher during a 2013 continuing education activity accredited by AACC. King earned this distinction for his presentation at the Upstate New York AACC Annual Spring Meeting, held May 9–10, 2013 at ACM Laboratories in Rochester, New York, in the opening talk entitled "Rolling in the deep: Tumor cell adhesion and treatment in the bloodstream."

Michael King

O'Rourke named ASCE Distinguished Member

Thomas O'Rourke, the Thomas R. Briggs Professor in Engineering at Cornell's School of Civil and Environmental Engineering, has been named a Distinguished Member of the American Society of Civil Engineers. The ASCE says a

Distinguished Member "is a person who has attained acknowledged eminence in some branch of engineering or in the arts and sciences related thereto, including the fields of engineering education and construction."

In the official commendation, O'Rourke is recognized for his leadership and contributions in the "safety and security of critical infrastructure through earthquake protection of water supply, gas, liquid fuel, and transportation systems; improved design and construction of deep excavations, pipelines and pipeline networks; and extraordinary contributions educating the next generation of civil engineers."

The ASCE inducts ten to twelve Distinguished Members each year. There have been fewer than 700 engineers honored with this title in the 162-year history of the ASCE.

Grad students to D.C.

ECE Ph.D. student Stephanie Santoso interned with the Technology and Innovation Division of the White House Office of Science and Technology Policy (OSTP) in Washington, D.C. through the end of April. In this capacity, her research on emerging technologies will help her with several projects related to the "Maker" movement and the current development of makerspaces across the U.S.

Stephanie Santoso

Dipayan Ghosh

Dipayan Ghosh, a Ph.D. student in the School of Electrical and Computer Engineering took his research expertise to Washington, D.C. last spring, interning with the National Economic Council (NEC) in the Executive Office of the President at the White House.

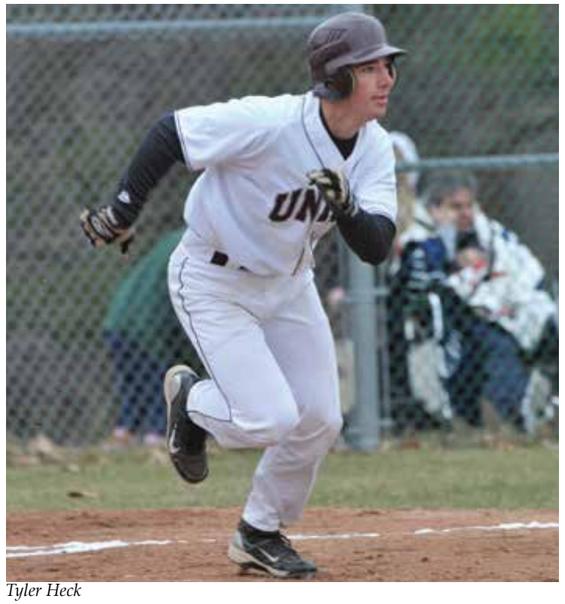
Dipayan's Ph.D. research has focused on the economics of privacy, particularly at the intersection of technology and policy. During this internship, he assisted NEC staff as they coordinate the policy-making process for domestic and international economic issues. The National Economic Council provides advice to the President, conducts research on his behalf, ensures that his decisions are in line with his objectives, and monitors and coordinates his ongoing policies.

Tyler Heck, a first-year Ph.D. student in Biomedical Engineering, has been signed to play in an independent professional baseball league, the Pecos League, this summer. He will be playing for the Alpine Cowboys, a team based out of west Texas, and will compete against teams in New Mexico, Arizona, and Colorado. He was picked up at a tryout this past December by Cowboys head coach and Ithaca College assistant coach, Ryan Stevens.

Tyler is interested in biomechanics, specifically relating to bone and cartilage, and is a member of Marjolein van der Meulen's lab of the Mechanical and Aerospace Engineering Department. Before coming to Cornell, he studied Mechanical Engineering at Union College in Schenectady, NY, where he maintained a 3.92 GPA. He helped lead the baseball team in his senior year to their best season yet where they posted a record of 26-11, won the Liberty League Regular Season title, and lost in the conference championships.

At the conclusion of the 2013 season, Heck was named to the Academic All-American 1st Team for Division III Baseball, the Liberty League Player of the Year, and Union's Student-Athlete of the Year. In all of Division III baseball, he was ranked fourth in steals and third in steals per game.

Heck is excited for his future at Cornell in the coming years and grateful for not only this opportunity, but for the support he has received from both his advisor, Dr. van der Meulen, and the Director of Graduate Studies for BME, Dr. Chris Schaffer.



Tyler Heck

HOMETOWN HERO

SERIAL ENTREPRENEUR: GREG GALVIN

When he gets a chance to talk to students interested in starting their own company, Greg Galvin M.S. '82, Ph.D. '84 MSE, MBA '93, advises them, "Don't do it!

"Then I tell them, 'Entrepreneurs don't listen to anyone's advice anyway,'" says Cornell's 2014 Entrepreneur of the Year. "The major thing is this balance between absolute belief in what you are trying to do, which has to underlie an entrepreneur because you're struggling against the odds, with the realism that it's not easy."

As the businesses he shepherded grew or were sold off, Galvin has had to relocate his office within the Cornell Business and Technology Park five times. He estimates his companies have created more than 300 jobs for the local economy. Today he actively manages three companies: Rheonix, developer of microfluidic-based molecular diagnostic systems with applications in research, health care, and public safety; Mesmeriz, an early stage micro-electro-mechanical systems company in the image recognition and projection markets; and Incodema3D, which does 3D prototyping and production of parts for aerospace and other industries. He is also an active board member in a fourth, BinOptics. "Though of late, it seems to be it's the not-for-profit sector that's occupying most of my time," he says.

Galvin is a member of the Cornell Board of Trustees, the Engineering College Council, the Department of Materials Science and Engineering Advisory Board, the Entrepreneurship@Cornell Advisory Council, the Boyce-Thompson Institute Board of Directors, the Ithaca Sciencecenter Board of Trustees, and the Tompkins County Area Development Board of Directors.

Galvin says he's involved in so many nonprofits for the same reason he leads so many companies. "Failure to say no," he says. "There are finite resources around here to lead organizations and I keep getting asked to do more."

In 1982, the freshly minted materials science Ph.D. didn't have any dreams of starting his own company, but he knew what he didn't want to do. "I got the typical set of job offers at corporate research labs and I realized the idea of continuing to do research and publish papers was not that interesting to me," he says. "I was more interested in the business side of science."

"ENTREPRENEURS DON'T LISTEN TO ANYONE'S ADVICE ANYWAY"

Galvin fed that interest by hiring on as deputy director of what is now the Cornell NanoScale Science and Technology Facility. "That was my first business experience," he says. "A lot of it was marketing the facility to industry."

Five years later, Galvin became Cornell's director of corporate research relations. When the university had trouble licensing a micro-electro-mechanical systems technology platform developed by Electrical and Computer Engineering Professor Noel MacDonald, they turned to Galvin, who was familiar with the technology from his work at CNF, for advice. "Eventually, we said, 'Maybe we should start a company around this technology.'"

Kionix was launched in 1993. "I recruited my friend Tim Davis who was just finishing up his Ph.D., so the management team had zero track record," he says. "In classes when I guest lecture I say, "Here's how not to start a business. We had no product, no customers, no market."

But Kionix was in the right place at the right time. Motion awareness in mobile devices was just taking off and Kionix developed a smaller, better, less expensive sensor. "We succeeded by perseverance and overcoming long odds, and, of course, a lot of luck along the way," says Galvin. "It was an emotional rollercoaster. There were many times we were looking at how to make payroll. It's never ending."

Galvin sold part of Kionix to Calient Networks in 2000, retaining its consumer electronics, automotive, and microfluidic technologies. In 2009, he sold the second incarnation of Kionix to Rohm Co. Ltd. "I had mixed emotions," says Galvin. "It's the outcome you're striving for and it's very satisfying, but you're also giving up something you've spent years building."

Recently, Galvin has been judging undergraduate business competitions and he said a lot has changed since he started his first company. "It's phenomenal what the kids are doing," he says. "Now is a perfect confluence with the state launching a number of initiatives to help promote job creation and entrepreneurial activity. Cornell has really jumped into promoting entrepreneurship. And then we have Tompkins County Area Development and their efforts. It's a very exciting time."

Cornell Cup

Melissa Satria M.Eng. '14 BME showcases I-3PO, a walking, "talking," autograph-signing droid developed by Cornell students at the third annual Cornell Cup USA presented by Intel held in May at the Walt Disney World Resort in Lake Buena Vista, Fla. I-3PO opened the competition with his counterpart R2-I2. The embedded design competition was created to empower student teams to become the inventors of the newest innovative applications of embedded technology.

Neal Wang

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ICEMEN

Family business shows how U.S. manufacturing can thrive in the new century. 22