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Carbon-trapping ‘sponges’ can cut greenhouse gases

I n the fight against global warming, carbon capture—chemically trapping carbon dioxide before it releases into the atmosphere—is gaining momentum, but standard methods are plagued by toxicity, corrosiveness and inefficiency. Using a bag of chemistry tricks, Cornell materials scientists have invented low-toxicity, highly effective carbon-trapping “sponges” that could lead to increased use of the technology.

The researchers have been working on a better, safer carbon-capture method since about 2008, and they have gone through several iterations. Their latest consists of a silica scaffold, an inorganic material that is the sorbent support, much like a sponge, with many nanopores scales which provide for maximum surface area. They dip the scaffold into liquid amine (the organic liquid) required to pick up the CO2, which soaks into the support and partially hardens. The finished product is a stable, dry white powder that captures carbon dioxide even in the presence of moisture. The two materials (scaffold and amine together) provide a tolerance to water in the process, which can increase capturing carbon dioxide in other methods.

For example, solid amine sorbents are used in carbon capture, Giannelis said, but the supports are usually physically impregnated with the amines. Over time some of the amine is lost, decreasing effectiveness and increasing cost.

The researchers instead grew their amine onto the sorbent surface, which causes the amine to chemically bond to the sorbents, meaning very little amine loss over time, and providing maximum capacity.

Qi said the next steps are to optimize the sorbent and to eventually demonstrate it for industry, possibly at Cornell for retrofitting its power plant. He also said the technology could be used on a smaller scale—for example, in greenhouses, where the captured carbon dioxide can be used to enhance plant growth.

KyuJung Whang, Cornell’s vice president for facilities services, heard a presentation by Giannelis on the topic at a board of trustees meeting earlier this year.

“We have made great strides in sustainability, particularly in the energy supply areas of alternative energy sources, and the demand side of energy conservation and building design standards,” Whang said. “If we are truly to achieve neutrality (a major goal at Cornell University), though, we also have to consider capturing and off-setting carbon. Emmanuel’s presentation got my attention, and I was hoping to learn more about it and explore ways we might be able to work together.”

The paper is called “Sponges with Covalently Tethered Amines for High-Efficiency Carbon Capture” and was supported by King Abdullah University of Science and Technology (KAUST) and Qatar University.

The researchers used the Cornell Center for Materials Research, funded by the National Science Foundation. They performed scaling-up experiments at the prototyping and testing facility of the KAUST-Cornell Center for Energy and Sustainability.

—Anne Ju

Tata-Cornell Initiative observes first year of research

and Nutrition Initiative (TCI) briefed faculty and students Dec. 5 on drinking-water system projects, studies on iron nutrition for women, agricultural data collection and a food fortification program.

Art and Agriculture and nutrition are top political topics in India, explains Prabhu Pingali, director of TCI and a professor in the Charles H. Dyson School of Applied Economics and Management. The initiative, in the College of Agriculture and Life Sciences (CALS), provides financial support for critical field research, as India faces a population burgeoning to

Prabhu Pingali

C elebrating its first full year of research projects in India, the Tata-Cornell Agriculture

Alexander King

1.6 billion by 2050, surpassing China’s projected population of 1.3 billion at that time. The initiative features eight Cornell doctoral students, and the program will have 16 in the near future, said Pingali. “Field work is a crucial part of what we think this program is all about.”

Cornell Engineering’s interaction with the TCI program is through our AguaClara program. Monique Weber-Shirk, director of Cornell’s AguaClara program described the pilot partnership between TCI and AguaClara in the Jharkand villages of Gufa and Ronhe. For Indian villagers, the AguaClara filtration system provides reliable operator training and potable water, safe for drinking and cooking.

One of the eight students is Indian-born Akshay King, ’15, who conducted food fortification research in Mumbai. TCI, which aims to solve problems of poverty, malnutrition and rural development in India, is funded by the Tata Trust. Ratan Tata. Tata ’59, B. Arch. ’62 is chairman emeritus of Tata Sons.

—Blaine Frittslander

Land use looms as large factor in global warming

F or the globe’s warming, don’t blame burning fossil fuels exclusively. Land use and land cover changes contribute about 40 percent to “radiative forcing,” a key metric of global warming, according to Cornell environmental scientists writing in Atmospheric Chemistry and Physics on Dec. 3, 2014.

Radiative forcing measures the change in the balance between the sun’s incoming energy and radiative thermal emissions that act to cool the Earth. Forcing can be used to predict changes in Earth’s surface temperatures. Burning fossil fuel—often considered to be responsible for about 80 percent of warming—has been found to account for about 60 percent of forcing.

“Pressure on land resources is expected to increase as global population continues to climb and the world becomes more affluent, swelling the demand for food. We need much more than a global energy policy. We need land policies, as well, to minimize future increases in radiative forcing and associated climate change,” said Dan Ward, Cornell postdoctoral researcher in earth and atmospheric sciences. Policies that encourage switching to conventional biofuels, which might spur deforestation, could also be detrimental to climate, if not correctly designed, he said.

The new research accounts for land-resource pressures and land cover change, from agriculture and deforestation to shopping malls and urban sprawl that contribute about 40 percent of all radiative forcing. For each ton of carbon dioxide emitted from burning fossil fuels, the total radiative forcing is only half that from land use, said co-author Natalie Mahowald, professor of earth and atmospheric sciences and a fellow at Cornell’s Atkinson Center for a Sustainable Future.

Mahowald explains that land use contributes to an increase in other greenhouse gases, like methane and nitrous oxide,
and reduces future sinks (a natural repository) of carbon dioxide on natural lands. In contrast, fossil fuel emissions are usually associated with aerosols, which reflect the incoming solar radiation and thus tend to cool the climate. Through examining models of global climate, the scientists say that continued deforestation at Earth’s temperate and equatorial climes will lead to historic levels of warming by the next century. By perpetuating today’s deforestation activity in the tropics, Earth could risk more than a two-fold increase in global forcing from land use. This radiative forcing in the year 2100 would be of a greater magnitude than forcing from present-day fossil fuel burning in this possible scenario, Ward said. In addition to Mahowald and Ward, Svita Klöster, former Cornell postdoctoral researcher now at the Max Planck Institute for Meteorology, was a co-author of the study. “Potential Climate Forcing of Land Use and Land Cover Change.” The National Science Foundation and the Guggenheim Foundation funded the research.

Alaine Friedlander

A 70 m deep basin formed near the summit of the Flade Isblink Ice Cap in the fall of 2012 when a lake 540 m beneath the ice surface suddenly emptied. Summer meltwater streams on the ice cap surface enter increases near the bottom of the image. Simulated 3-dimensional view from the south made using WorldView-2 Satellite imagery. Scale changes due to perspective, but the basin is about 4 km north-south and 2 km east-west. WorldView-2 Imagery (c) 2014, DigitalGlobe, Inc.

Atmospheric warming heats the bottom of ice sheets, as well as the top

A team of scientists led by Cornell University Earth and Atmospheric Sciences researcher Michael Willis, has published a new paper showing for the first time how water from the surface of an ice cap in northeastern Greenland can make its way beneath the ice and become trapped, refilling a subglacial lake. This meltwater provides heat to the bottom of the ice sheet. These groundbreaking findings provide new information about atmospheric warming and its affect on the critical zone at the base of the ice. The warmth provided by the water could make the ice sheet move faster and alter how it responds to the changing climate. The research is detailed in a new paper published online by the journal Nature on Jan. 21, 2015. The paper was written by Willis, who is also an adjunct faculty member in the geological sciences department at UNC-Chapel Hill’s College of Arts and Sciences, along with co-authors Bradley Harrky, Polari Geospatial Centre, University of Minnesota; Michael Bevis, School of Earth Sciences at Ohio State University and Robin Bell, Lamont Doherty Earth Observatory at Columbia University. “We’re seeing surface meltwater make its way to the base of the ice where it can get trapped and stored at the boundary between the bedrock beneath the ice sheet and the ice itself. As the lake beneath the ice fills with surface meltwater, the heat released by this trapped meltwater can soften surrounding ice, which may eventually cause an increase in ice flow,” said Willis. The direct link between the surface meltwater and the filling of the lake at the base of the ice has never been seen before. Over the last few years the number of lakes on the surface of the Greenland ice sheet has greatly increased. Surface lakes are also occurring much farther inland at higher altitudes than in the past. If this mechanism of transferring water and warmth from the surface lakes to the bottom of the ice sheet is common then the Greenland Ice Sheet is likely to respond more rapidly to climate change than is currently predicted. The Greenland Ice Sheet comprises about 80 percent of the land mass of Greenland and previous studies have documented that the ice sheet is melting at a faster rate due to climate change. The meltwater beneath the ice sheet, from the interior to the ocean, is the topic of ongoing investigations as it can control the speed at which the ice sheet moves. This is the first study to document that surface water can penetrate to the bottom of an ice cap and be trapped in place. Researchers say this process could also occur at other large bodies of ice. The study was sparked in 2012 when Willis was mapping ice changes around the edge of the Greenland Ice Sheet as part of a study funded by U.S. National Science Foundation (NSF) to understand how much of the accelerating ice loss in Greenland is caused by melting and how much is caused by the increase of ice moving into the ocean. During his research, Willis spotted a 70-meter-deep hole (the equivalent of a 20-story building) that had formed when a subglacial lake, far beneath the ice surface, emptied in the late fall of 2011. Subglacial lakes are rare in Greenland, and the presence of such a lake in the far northeast came as a surprise. The ice in this region is much too slow, too cold and too thin to allow melting beneath the ice cap, which is how a subglacial lake usually forms. Between 2012 and 2014, Willis watched as summer meltwater fed into and warmed the ice made its way down cracks around the hole and refilled the lake that was 540 meters beneath the base of the ice cap. When water was flowing on the surface, the subglacial lake filled. When water stopped flowing on the surface, the subglacial lake stopped refilling. “Each summer scientists see bright blue streams form on the surface of Greenland as warm air melts the ice sheet. What happens to this water when it disappears into cracks in the ice has remained a mystery.” Willis and the researchers were able to pinpoint when the subglacial lake refilled using data collected from high-resolution satellite images from the University of Minnesota’s Polar Geospatial Center, as well as data from NASA’s operation IceBridge for calibration and verification.

The Cornell-led team calculated that the lake beneath the ice has filled about half way since its 2011 blowout that originally drove water from the lake at a volume of 215 cubic meters per second (nearly 57,000 gallons—close to the volume of a 30-foot-by-50-foot backyard swimming pool every second). As the lake refills, the surface meltwater carries heat stored, called latent heat, along with it from the relatively warm atmosphere to the icy depths. This latent heat reduces the stiffness of the surrounding ice and makes the ice more likely to flow out to sea. Even though researchers have long known of the existence of subglacial lakes, never before have they witnessed any refilling from the surface. The refilling signals to researchers that Greenland’s ice loss has likely reached a milestone.

—Eileen James Mhuye

Roller coaster fans form a club and win a prize

Some career counselors say that what you do for fun might be the thing you ought to do for a living. So it shouldn’t be a surprise that a group of students have formed a club dedicated to the engineering side of roller coasters and other amusement rides. The Cornell Theme Park Engineering Group, formed early this semester, got off to a good start by winning a prize in the first annual Ryerson T.H.R.I.L.L. Invitational Design Competition, Oct. 30-Nov. 1 at Ryerson University in Toronto. Members are not all engineers, according to club president Ronnie Forster, M.E. 17. There are also students in urban studies and applied economics. And not all are dedicated riders of roller coasters and other amusement park rides, he said, and some are considering careers in the industry. Forster himself is planning to do a co-op program with Premier Rides, a major roller coaster builder. In the Ryerson competition, sponsored by the Ryerson Thrill Club and judged by industry experts, student groups from Cornell, Drexel University, Philadelphia and the Universities of Guelph and Waterloo in Ontario competed in three categories. The first was to design a coaster inspired by the KAF Spitfire fighter plane; the Cornellians designed a coaster whose cars are mounted as “wings” spreading beyond the track so passengers ride with nothing beneath them.

The second challenge was to create a modification to the classic carousel. The Cornell proposal was a ride that preserves and greatly increases the up and down and around motion, but with “spaceship” cars instead of horses, and outer space lighting effects. Cornell took third place in the third category, the Academic Curriculum Challenge, which asked students to demonstrate the connections they perceive between what they learn in the classroom and what they’ve experienced in the amusement world. They created a hypothetical curriculum for a college major in theme park engineering, combining existing Cornell courses and new courses they invented. The plan offered concentrations in park management, ride design, design analysis, structural engineering and systems engineering, giving students a solid grounding in engineering that could be applied in many other fields.

The win was a bonus, because the group had little time to prepare. They had only learned about the event a week before it happened, Forster said. They ended up presenting their entries virtually, via Skype. Meanwhile, the students volunteer with EYES (Encouraging Young Engineers and Scientists), a program of the Cornell Public Service Center, to present lessons on roller coaster physics in Ithaca elementary schools.

—Bill Steele
Cornell Engineering Diversity Programs Wins Awards

Cornell Engineering has been awarded a $300,000 grant from the Henry Luce Foundation to establish a Claire Boothe Luce Professorship. Since it was founded in 1999, the Claire Boothe Luce program has become the largest source of private support for women in science, mathematics, and engineering in the United States. Cornell will use the grant to support the recruitment and success of an outstanding woman faculty member in the area of bioengineering. Cornell Engineering has been a leader in addressing the nationwide gender gap in engineering. Last year, the number of women freshmen in the College of Engineering is 43% female, compared to the national average of less than 20%. Women represent one-third of the new tenure-track hires at Cornell Engineering in the past ten years.

Alan Zehnder, Associate Dean for Diversity & Faculty Development, said "We are honored that the Luce Foundation has chosen us for this award. It is a recognition of the College of Engineering’s diversity efforts as a whole as well as the efforts of women engineering faculty who have persistently advocated for greater inclusion and equity." Diversity Programs in Engineering also won an ABET 2008 Diversity Programs in Engineering (DPE) Awards Banquet.

Award. The Accreditation Board for Engineering and Technology (ABET) announced the 2014 winners of its prestigious Claire L. Felbinger Awards for Diversity: • Cornell Diversity Programs in Engineering, • Purdue Women in Engineering Program, and • Eugene M. DeLoatch, Ph.D. The awards were conferred at the ABET Annual Awards Banquet in Baltimore, on October 31, 2014. The organization’s diversity award is named for the late Dr. Claire L. Felbinger, a Public Member on the ABET Board of Directors and a leader in promoting diversity initiatives for technical fields. Cornell Diversity Programs in Engineering was recognized for the following achievements: • Cornell Diversity Programs in Engineering in Engineering "in recognition of sustained success in deploying integrated programs for faculty, pre-college, undergraduate, and graduate students to increase the diversity and success of populations underrepresented in engineering."

Engineers Got Talent!

Who says engineers don’t know how to have fun? More than 30 Cornell Engineers shared their non-engineering skills and talents at the First Annual Engineers Got Talent extravaganza held Saturday, November 22 in the Statler Auditorium. The show, which was the brainchild of mechanical engineering students Mark Flame ’16, Emma Luongo ’16, and Ruben Gihjen ’16, and electrical engineering student Richard Quan ’15, drew 260 audience members and was a great success. "It was really exciting to see how many people showed up," said Luongo. Richard Quan added, "We knew from Facebook that about 150 people said they were coming. So we figured we’d really have about 100. But then we got way more. It was great."

All four of the organizers are part of the Engineering Leadership Certification Program at Cornell and the talent show grew out of a weekend retreat the group took back in the spring semester of 2014. "We each had to identify an extracurricular project we wanted to create and complete in the coming year," said Flame. "All four of our proposed projects had the theme of ‘school spirit.’ So we formed a group and started thinking about what we could do to bring some fun to campus."

The group named themselves the Cornell Engineering Student Activities Committee and worked through several ideas during the spring and summer. "We really hit a talent show on Engineers Got Talent. They received funding from the Cornell Student Assembly Finance Commission and the CU Tonight Commission, which found their “pitch” both highly entertaining and persuasive. With $300 of funding in place, they reserved the Statler Auditorium, ordered food from Chipotle, printed flyers and other publicity materials, and ordered a large trophy for the winner.

Luengo contacted a friend in the Skits-O-Phrenics sketch comedy group and arranged for them to be the opening act to warm up the audience. The Statler provided a sound-and-light technician to make things feel more professional. But the real highlight of the night was the sheer diversity of talent on display by the eleven acts that performed.

There were singers, dancers, guitarists, a “friendly neighborhood juggler,” and freestyle rappers/beathawks. And there was Asher Novick. Novick does not sing, dance, beatbox, rap, or play a musical instrument. Novick balance things on his chin. Things like an umbrella, a golf club, a ski, a chair, and a ten-foot long table. Oh, and also a first place trophy. While each of the performers, (who were just about all engineering students,) received loud, sincere, and enthusiastic applause, Novick was the clear fan favorite and he walked away with the trophy as winner of the first annual Engineers Got Talent contest. "I decided to be in the show because I seem to have a number of unique talents that are only ever relevant in the context of a talent show," says Novick. "So why not show off one of them?" When asked if this event will become a yearly thing, Flame, Luongo, and Quan all make it clear that they would very much like for that to happen. “As people were leaving the show that night they were already asking about next year’s show,” said Flamme. "We really hope to be able to make that happen. As we were getting this show ready we kept half jokingly calling it the ‘first annual,’ but now we all hope it really is. We just need someone to step forward and take it on.”

—Chris Drason

Cornell engineers join $2M DARPA Robotics Challenge

Cornell engineers are adding their expertise in robot autonomy to the DARPA Robotics Challenge (DRC), a multi-year, international prize competition sponsored by the U.S. Defense Advanced Research Projects Agency (DARPA). Radu Biagioni, assistant professor of mechanical and aerospace engineering; graduate student Spyros Maniatisopoulos; and Roberto Villalba ’15 have joined Team VGIR (Virginia-Germany Interdisciplinary Robotics) to compete for the top prize of $2 million. VGIR made the top 10 teams following a December 2013 trial, earning a spot in the challenge finals in June 2015. Cornell joined the team in August.

The DRC follows on the Grand Challenge (2005) and Urban Challenge (2007), which featured a Cornell team. Its goal is to develop advanced ground robots capable of complex tasks during natural or man-made disasters, such as the Fukushima Daiichi nuclear power plant disaster in Japan. It’s not quite at the level of RoboCop running into burning buildings, but the DRC teams are trying to develop robots capable of assisting humans in responding to such disasters, Maniatisopoulos said.

“What we want is to create autonomy for the robot by making provably correct robot controllers,” Maniatisopoulos said. The Cornell team led by Kress-Gazit is contributing research in bringing full or partial autonomy to the robotic platform, reducing the need for human input to accomplish tasks. Robots that can make decisions and automate tasks without help at every turn could prove invaluable in disaster situations and countless other applications. “Our research is about synthesizing controllers from high-level behavior specifications, to reduce operator overload, and to provide guarantees,” Kress-Gazit said. That includes guarantees of safe behavior and self-monitoring ability of all the robot’s systems, even in the event of human error. Team VGIR’s principal investigator is David Conner, a senior research scientist at DARPA, Robotics, a Virginia Tech startup. Team VGIR, which initially included researchers from Virginia Tech Center for Human-Computer Interaction and Germany’s Technical University in Darmstadt, competed in a context of a DARPA Virtual Robotics Challenge in June 2013. Based on their sixth place finish, they were awarded
Hackathon showcases smart content search engine

At the Big Red // Hacks event Sept. 26-28, 2014—billed as the first student-run, large-scale hackathon at Cornell University—participants had access to a semantic intelligence application program interface API, the core technology for a new startup, Speare. Speare founder and CEO Rahul Shah '16 (a Computer Science major) said his passion for understanding information, coupled with the need for at least some autonomy for the robot. The competition was purposefully designed to be difficult, the DRC website says, to spur innovation and shed light on the most difficult problems in robotics.

“Back when I was in high school I was interested in how computers understand the meaning of content and information,” Shah said. “I started by looking at and working with music, by trying to extract characteristics of songs—e.g., tempo, key, etc.—and to use that data to recommend new music to users.”

[At Cornell] I started working with a team of people to develop technology that can understand the meaning behind textual data. I had developed some innovative core technology; I was looking for a business problem to solve.”

While participating in eLab, the Speare team decided to focus on the publishing industry because it is underserved by effective analytics, and the potential for using Speare technology to connect more effectively with audiences is great. “Media helps ‘hold the world together’ by providing audiences with notices and commentary about political change, technology advancements, social movements, etc.,” Shah said.

According to Shah, media has changed significantly in one generation. Audience segmentation has increased and the reach of individual media channels is continually in flux. All of this places a significant strain on the ability of any single publisher to generate new audiences and increase revenue. “Engaging an audience is the key to success in the media space,” Shah said.

By providing newsrooms with a smarter content discovery engine and an analytics portal that allows editors and journalists to make decisions based on insights gleaned from data, Speare’s mission is to take news and media websites to a new level of personalization for their readers. “Current solutions are unable to fully engage readers because they don’t understand why the recommendations were chosen. Speare is the first personalized engine to fix this,” Shah said.

Following Big Red // Hacks, development teams will be granted six months free use of Speare technologies. In return, the Speare engine will become “smarter,” enabling publishers to make better data-driven decisions about the content they provide.

A ‘STAR’ is born: Engineers devise genetic “on” switch

All life processes depend on genes turning on and off. Cornell scientists have created a new “on” switch to control gene expression—a breakthrough that could revolutionize genetic engineering.

Synthetic biologists led by Julius Lukas, assistant professor of chemical and biomolecular engineering, have created a new genetic control mechanism made exclusively of ribonucleic acids (RNA). They call their engineered RNAs STARS—described online in Nature Chemical Biology, Feb. 2, 2015.

“We’ve created a whole new toolset of regulation,” said Lukas, who describes RNA as “the most engineerable molecule on the planet.”

RNA is a single-stranded version of its close cousin, DNA, which makes up the double-stranded genome of all living organisms. While DNA acts as nature’s hard drive, storing the genes that make up our genome, RNA is part of the cellular computer that activates the hard drive by helping the cell tune the expression of specific genes, Lukas says. While RNA is known to do this in many ways, one thing it can’t do in nature is start the process by turning on, or activating, transcription—the first step in gene expression, and the core of many cellular programs.

In the lab, Lukas and colleagues have assigned RNA this new role. They’ve engineered an RNA system that acts like a genetic switch, in which RNA tells the cell to activate the transcription of a specific gene. The STAR system involves placing a special RNA sequence upstream of a target gene that acts as a blockade and prevents the cell from transcribing that gene. When the STAR is present, it removes this blockade, turning on the downstream gene by allowing transcription to take place. The effect is like a lock-and-key system for turning genes on, with STARS acting as a set of genetic keys for unlocking cellular genetic programs.

“RNA is like a molecular puzzle, a crazy Rubik’s cube that has to be unlocked in order to do different things,” Lukas said. “We’ve figured out how to design another RNA that unlocks part of that puzzle. The STAR is the key to that lock.”

RNA is Lukas’ favorite molecule because it’s “much, much simpler—much smaller than a protein—and its function can be engineered by designing its structure. In fact, new experimental and computational technologies, some developed by Lukas’ lab, are now giving quick access to their structures and functions, enabling a new era of biomolecular design that is much more difficult to do with proteins,” Lukas envisions RNA-only, LEGO-like genetic circuits that can act as cellular computers. RNA-engineered gene networks could also offer diagnostic capabilities, as similar RNA circuits have been shown to act as genetic only if, for example, a certain virus is present.

“This is going to open up a whole set of possibilities for us, because RNA molecules make decisions and compute information really well, and they detect things really well,” Lukas said.

The paper is called “Creating Small Transcription Activating RNAs,” and its co-authors are postdoctoral associate James Chappell and graduate student Melissa Takahashi. Supporters include the National Science Foundation, the Defense Advanced Research Projects Agency and the Office of Naval Research.

Anne Ju
GLOBAL REACH

By Chris Dawson

Ithaca is a truly beautiful place. Spring is glorious, summer spectacular, and autumn stupendous. The light on a crisp, clear winter morning would inspire Renaissance masters. At the same time, it must be acknowledged that there are times in an Ithaca winter when the world can feel like it has shrunk down to just the small snowy segment visible as you cross the Pew Engineering Quad with your head down, eyes narrowed, muscles tensed against the windy cold, making your way to a 9 a.m. final exam. At times like these, Cornell can seem isolated up on its hill overlooking Ithaca and the southern end of Cayuga Lake, barely visible through the squall.

But this isolation is an illusion. You can’t see them through the blinding snow, but there are tendrils radiating out from the Quad and connecting Cornell Engineering with people and places all over the world. Some of those links head off to China, others to Spain or Germany or Tanzania. Still others rise up into low-Earth orbit, and beyond. Cornell engineers come from everywhere and they go everywhere.

Long before there even was a College of Engineering at Cornell, students and professors were leaving their native countries to come to Ithaca. In 1868 in the very first undergraduate class at the newly formed Cornell University was one unknown student of “engineering and mechanical arts” who listed his home address as “Italy.” These days, Cornell keeps much better records. More than 2,500 students from countries outside of the United States applied for admission to the class of 2018 and the current undergraduate engineering population has students from 32 foreign countries. At the graduate level, the number of countries represented is even greater. In fact, more than half of the 2,000 graduate students pursuing engineering degrees come from outside of the United States. These 1,042 foreign-born students represent an astounding 67 countries from six continents. (So far, no Antarcticans have registered at Cornell.)

By far, the largest contingent of foreign students comes to Cornell from China. Approximately 80 undergraduates and 550 graduate students from China study at Cornell Engineering. Though they might not know it, there is a long tradition of talented Chinese students coming to Cornell. The tradition dates back to 1901, when Alfred Sao-ke Sue travelled to Ithaca from China and enrolled as a freshman. His brother, S.C. Thomas Sze, followed a year or two later and became the first Chinese student to earn an engineering degree from Cornell.

Thomas Sze then returned to China with his newly-awarded degree in mechanical engineering and began his career with the Peking Mukden Railway. He went on to be a driving force in the development of China’s national railway system, as well as playing a key role in the development of China’s banking system and electrical distribution network. Today, the director’s position in Cornell’s Sibley School of Mechanical and Aerospace Engineering is named for S.C. Thomas Sze.
Students from Cornell and other universities spend July in the Andes of Argentina, completing a course in field mapping and geology. Cornell's Department of Earth and Atmospheric Sciences partners with the University of Buenos Aires to offer an Andes Field Camp experience.

"with Melissa and then took the initiative to find a program. It wasn't that hard to make it happen," says Giannelis. "I met faculty advisors, submitting the required paperwork, and helping students who want to study abroad plan every step along the way. "One thing that was holding some people back from going abroad was this perception that you can't do it as an engineering student," says Bazley. "And now they are seeing that this is just not true."

Paul Giannelis '16 AE/EE spent his sophomore spring semester at the Technische Universität Dresden in Germany. "It wasn't that hard to make it happen," says Giannelis. "I met with Melissa and then took the initiative to find a program. The one I found was run in conjunction with Boston University and it focused on mechanical engineering. The credits all transferred and it was a great experience."

Caroline Caglioni '15 EnE/E echoes Giannelis. "I think Cornell Engineering students underestimate the likelihood of finding a program that will work within their major," says Caglioni. "I went through the Cornell-Cantabria Exchange Program in Santander, Spain and it was easy to arrange."

Professor Todd Coven of Cornell’s School of Civil and Environmental Engineering designed the University of Cantabria program especially for Cornell Engineering students. “Back in 2001 I had developed a working relationship with Professor Iñigo Losada at Cantabria,” says Coven. “I saw how students in the university systems in Europe had real mobility to spend time at other universities. I started to think about how to get U.S. students into European schools. So, we started an exchange program.” The Cornell-Cantabria Exchange Program is piloting a track for chemical engineering majors and seven chemical engineering juniors will be joining seven civil, environmental, and mechanical engineering majors already at Cantabria this spring.

Chemical engineering majors can also choose a five-week summer session at Imperial College. The program, started in the summer of 2014, is taught by a Cornell faculty member in cooperation with the teaching assistants at the state-of-the-art ChemEng Discovery Space at Imperial College, (which was recently rated as the sixth-best university in the world).

Undergraduate chemical engineering students can earn six credits and live in London for a summer. A separate program for M.Eng. students is designed specifically for those whose undergraduate degree is in something other than chemical engineering. Students dive into a four-week crash course that will get them up to speed as they start their M.Eng. program back at Cornell in September.

Coven, Caglioni, and Giannelis all agree on the value of studying abroad. “The education you get in the classroom is just a small percentage of a total education,” says Coven. “Having international experience shows you there are many ways to put together a society. If you want to have broad impact as an engineer, you need to understand more than just one culture.”

Caglioni adds, “It’s all about challenging yourself and putting yourself in a new context/environment. It makes you grow.” Giannelis agrees. “I would do it again in a heartbeat. My time in Germany changed me in profound ways—I understand myself better.”

The value of studying in a foreign country goes far beyond the technical education students receive. In fact, Cornell places such a high value on study abroad that the university has adopted a goal of increasing the portion of undergraduates who participate in an international experience to 50 percent by the year 2020. Fredrik Logevall, vice provost for International Affairs, says, “This great university aspires to be one of the top ten research universities in the world. To succeed, we must infuse an international perspective into our curriculum, our culture, and all that we do. We need to produce global citizens, and enabling our students to have an educational experience abroad is an excellent way to do that.”

Les Trotter, associate dean of Cornell Engineering and a member of Cornell’s Internationalization Council, can attest personally to the value of working or studying in another country. “I can look at intellectual corners I have turned and new paths of research I have taken and I can trace these directly to time I spent abroad,” he says. “When you are in a new environment, the mind turns on its ‘learning’ button. These sorts of experiences—just being in a new country—you learn from it. You can’t help but learn from it.”

Besides Cantabria University in Spain, Cornell Engineering has formal study abroad exchange programs with the Hong Kong University of Science and Technology, and the Technion-Israel Institute of Technology. Cornell has also approved transfer of technical credits from a long list of institutions, including Ecole Centrale Paris, the Danish Institute for Study Abroad, Queen Mary College in London, the University of Edinburgh in Scotland, and the University of Queensland in Australia.

Back from her year in Spain, Caglioni is more convinced than ever of the value of engineering students studying abroad. “Before I even came to Cornell I knew I wanted to spend a semester in another country,” says Caglioni. “So much learning happens when you are on your feet out in the world. Part of going abroad is opening of the mind. But another part of it is just learning really valuable life skills, particularly in another language. I had to figure out how to open a bank account and..."
“IT’S ALL ABOUT CHALLENGING YOURSELF AND PUTTING YOURSELF IN A NEW ENVIRONMENT. IT MAKES YOU GROW.”

how to find an apartment and how to get around Europe when we traveled. I grew up so much in so many ways.”

For students who would like an international experience without committing to an entire semester or year abroad, there are other options for spending time overseas. The AguaClara team travels to Honduras each January to work on water treatment plants that provide safe drinking water for more than 30,000 people. AguaClara also has new project sites in India. The Engineers For a Sustainable World team travels to Sabana Grande, Nicaragua to work with two local groups, Las Mujeres Nativas and Grupo Fenix, on issues of alternative energy and sustainability. The Engineers Without Borders team has begun a collaboration with a non-profit group called Engineers in Action Solares and Grupo Fenix, on issues of alternative energy and sustainability. The Engineers Without Borders team has begun a collaboration with a non-profit group called Engineers in Action.

La Bahía de Santander (the Santander Bay), as well as part of the city of Santander, Spain itself. Santander is home to the University of Cantabria, which hosts engineering exchange students from Cornell every year.

in CalIFA, Bolivia to improve water quality there. Cornell University Sustainable Design has designed an early childhood education center in Johannesburg, South Africa. Students majoring in Science of Earth Systems have had the chance to attend a summer field course run jointly by EAS professor Suzanne M. Kay and the Universidad de Buenos Aires in the Argentinian Andes.

For engineering undergraduate students, the partial list above makes it clear that the possibilities for having an international experience while at Cornell are wide open. In his 2012 white paper on “internationalizing” Cornell, President David Skorton wrote: “If we are to educate students for global citizenship, we must offer them language study, an understanding of history and of cultures beyond their own, and meaningful international experiences. We must equip them to live and work in a world whose chief problems transcend national boundaries.”

Trotter argues that engineering students, who are developing the technical skills to have direct and immediate impact on some of the most pressing global problems, are the very students who should be studying abroad and gaining international experience while still in school. “One thing about engineering as a general field is that it is so useful,” says Trotter. “Engineers can have a real impact on real problems right away—even as students. This is why engineering students need to get out in the world as undergrads.”

In order to both recognize and encourage engineering undergraduate students to have international experiences, the college started its Global Fellows program in 2008. Students who are named as Engineering Global Fellows receive a certificate from the dean, have their name and picture displayed in Carpenter Hall, and have the chance to share their experiences with other interested students. The first group of Global Fellows in 2008 numbered 58. In 2013 there were 80 Global Fellows recognized by Lance Collins, the Joseph Silbert Dean of Cornell Engineering.

Another hugely important aspect of Cornell Engineering’s global reach is the faculty. Many of the more than 250 full-time faculty of the college are from outside of the United States. Just as in the student body, six continents are represented any time the full faculty gathers. Whether from India or Indiana, England or New England, professors are often drawn to Cornell Engineering by the quality of students and faculty, the extensive modern facilities, and the reputation for collaboration across disciplines.

Cornell Engineering has a well-earned and long-held reputation as an institution actively involved in research projects and collaborations around the world. Whether it is a windfarm off the coast of Denmark, a telescope in Chile’s Atacama Desert, a rural health clinic in Kenya, or the Biliu River Basin in China, there are Cornell Engineering professors on-site, doing research that will have a real impact on how people live and interact with the world. Today’s Cornell Engineering faculty members are following in the footsteps of earlier generations of Cornell researchers, including the group of professors who led one of the first full-scale scientific expeditions to the Brazilian Amazon in the 1870s, and Jack Oliver and Bryan Isacks of the Department of Geological Sciences (now Earth and Atmospheric Sciences), whose use of earthquake seismology in the South Pacific helped bring the theory of plate tectonics into wide acceptance in 1968.

Professor Derek Warner of the School of Civil and Environmental Engineering points out one value of international collaborations: “For our research group to be at the forefront of our field, we must collaborate with others to...
“THE EARTH IS COMPLEX AND HETEROGENEOUS, TO UNDERSTAND IT, WE HAVE TO WORK IN DIVERSE AREAS WITH DIFFERENT ROCKS, DIFFERENT PROCESSES, AND DIFFERENT ENVIRONMENTS. SIMPLY PUT, THE ROCKS WON’T COME TO US—WE HAVE TO GO TO THEM AND UNDERSTAND THEM IN PLACE.”

human activities. “There are lots of reasons to be involved in international scientific collaborations,” says Pritchard. “When doing fieldwork in another country, having local knowledge is key for scientific understanding and working together in the cultural and logistical context. For my projects studying volcanism at the regional or global scale, having international collaborations makes the science better by bringing together research teams with the necessary expertise.”

According to a study published recently in the online journal PLOS ONE, international collaboration between researchers doesn’t just lead to better science, it can also be a good career move. The authors found that international collaboration leads to publication in more highly esteemed journals and a greater number of citations. Matthew Smith of the University of Chicago and his collaborators found that “as the number of countries represented in the author list increases, articles are more likely to be published in journals with higher impact factors and accrue more citations than peer publications which have fewer countries represented.”

While faculty members from all of the schools and departments within Cornell Engineering either do research overseas or collaborate with researchers from other countries, faculty from Earth and Atmospheric Sciences and the School of Civil and Environmental Engineering have the most obvious reasons to leave Ithaca for their work. “The Earth is complex and heterogeneous,” says John Thompson, the Wold Family Professor in Environmental Balance for Human Sustainability in Earth and Atmospheric Sciences. “To understand it, we have to work in diverse areas with different rocks, different processes, and different environments. Simply put, the rocks won’t come to us—we have to go to them and understand them in place.”

Rick Allmendinger says, “Climate change, hazards, and human activities. “There are lots of reasons to be involved in international scientific collaborations,” says Pritchard. “When doing fieldwork in another country, having local knowledge is key for scientific understanding and working together in the cultural and logistical context. For my projects studying volcanism at the regional or global scale, having international collaborations makes the science better by bringing together research teams with the necessary expertise.”

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Rick Allmendinger says, “Climate change, hazards, and resources don’t recognize human borders so we go to the best place on Earth to study the phenomena or resources in which we are interested.”

Cornell engineers—faculty, students, and alumni—have been “going to where the rocks are” for many generations. Each year, more and more students study abroad or travel with student project teams. Faculty members understand that for Cornell to be a world-class research institution, they need to be out in the world, collaborating with leading scientists and researchers wherever they are. Peter Frazier, assistant professor of operations research and information engineering at Cornell, sums it up nicely when he says, “By opening yourself up to the whole world, rather than just the United States, you allow yourself to work on a greater range of interesting problems.”

Dean Collins is proud of the international reach of Cornell Engineering. “Cornell Engineering has a rich history of successful and important scientific collaborations with researchers all over the world. But to remain a true global leader in engineering education and research, we need to do even better,” says Collins. The problems of the 21st century are global. Knowledge and innovation do not respect national boundaries. “More of our students need to spend time abroad. Our professors need to continue active collaborations with researchers all over the world. And our graduates need to be out in the world, making a difference.”

If you have spent a winter at Cornell, then you have probably also been on campus for spring, summer, and fall. If so, you know how gloriously beautiful this part of the world can be when the sun is shining and the hills are a million shades of green and the lake is sparkling off in the distance. On days like these, you can almost see those filaments spreading out to all the places Cornell engineers live and work and learn. From its perch above Cayuga, Cornell Engineering continues to be a truly international institution.

Field work in the Argentine Andes with Argentine colleagues. From left to right Greg Hoke (former Cornell EAS Ph.D. student), Florencia Bechis, Professor Rick Allmendinger (Chair of EAS), Jordan Garreauy (Cornell EAS undergraduate student), Phoebe Judge (Cornell EAS Ph.D. student), and Laura Gambagi.
warms of excited children ran through the Sciencenter, a hands-on science museum in Ithaca, one cold November Saturday afternoon. Along with the usual hands-on exhibits, they and their parents massed around stations stocked with cool new gadgets.

At one table, a mother and son tossed a wiggling ball back and forth, laughing. At another, a brother and sister built a mini-blanket fort with a hinged quilt. Girls tried out a projector that beamed their drawings on the ceiling; boys oohed and ahhed over an interactive gaming system that encourages competitive play using two bicycles and radio signals, and a dad in a baseball cap tried out an electronic kitchen handle with a spatula attachment.

Were these the latest holiday season must-haves from the shelves of a big box retailer? Not quite yet. Each product was a prototype, stemming from an original idea and created from scratch by a team of Cornell Engineering students in “Innovative Product Design via Digital Manufacturing,” a popular upper-level class taught by Rob Shepherd, assistant professor of mechanical and aerospace engineering, and Sirietta Simoncini, a lecturer in systems engineering.

Shepherd, who joined Cornell in 2013, created the course to teach a modern manufacturing process that combines mechanical engineering with design thinking. He and Simoncini call their theory “design and systems thinking.” Before teaching at Cornell, Shepherd completed a post-doc at Harvard University and started his own company, drawing on his M.B.A. and Ph.D. in materials science. Simoncini is an architect from Italy who, in addition to teaching at Cornell, has taught as a design thinking coach at many universities, including Stanford’s world-renowned Hasso Plattner Institute of Design, better known as the d.school.

“I felt it was important for the College of Engineering to have an open design class,” says Shepherd, “so that instead of being told exactly what they are supposed to build and how to build it, the students are encouraged instead to come up with their own idea, build it, and sharpen it into a realistic product.” The course is part of a larger trend at the college and in engineering education in general, led by faculty who are excited about the vast disruptive potential that design thinking and additive manufacturing processes, such as 3D printers, can offer.

In ‘Empathy 101: New Course Integrates Design Thinking with Engineering’ by Bridget Meeds, the students are encouraged to come up with their own idea, build it, and sharpen it into a realistic product.

Rob Shepherd

Visual indicator of gameplay for competitive bicycle racing product from Team Left to Right. They created the L2R Bike System, an interactive gaming system designed to promote outdoor physical activity and actually decrease screen time, promoting a healthier lifestyle.

“The students are encouraged to come up with their own idea, build it, and sharpen it into a realistic product.”

—Rob Shepherd
observed a blended family (each partner bringing children to the relationship from a previous marriage) and noted that their biggest need was to find shared activities that could be used to create bonds.

“My team looked to leverage differences, overcome barriers, and foster closeness,” said Phillips. With those goals in mind, they decided to focus on making cooking an exciting activity for everyone in the family.

“The Cook-E is going to make it easier to get kids into the kitchen. It will have some cool functionalities which we’re still exploring,” she explains. “The handle will have different attachments, such as a spatula, and the spatula might have a temperature sensor that changes color to help children understand when food is cooked to the correct temperature.”

Coming from a business background, Phillips is excited about the market longevity of the Smart Handle, as the manufacturer could keep producing new attachments for it. More importantly, she is grateful to have learned so much about this design method. “The whole purpose of what we learned is to develop products built around the needs of the person,” she notes.

“Engineers, most of the time they are given a problem to solve, and they start solving the problem,” says Simoncini. “But it is not always clear if that was the right question to answer. We teach them how to start with a completely fresh mind without knowing what the solution is, and then define the problem.”

“This course has been the most demanding of all my graduate courses,” says Harolyn, citing the intense time commitment required for the observation and brainstorming portions of the process. “But as I look to advance into program management at Boeing, it probably has been the most relevant.”

Walsh, who will use these techniques again in a spring course focusing on traffic issues, found that the course resonates strongly with his values. “Design thinking matters,” he says. “You can go through a development phase for a product to make it as good as you possibly can but if you don’t do it with the right intention and enough market and design research, you could create an absolutely amazing product that no one will want. This process very efficiently helps you refine and strive towards a product that everyone is going to need and want.”

As the day at the Sciencenter wound down, tired children put on their warm coats and went home for their sippers while the students packed up their prototypes. They also brought home the myriad observations and conversations they had had with children and parents, ready to analyze. They had a few more weeks to work on these projects before the semester ended—products which could eventually end in a patent, commercial licensing, or a Kickstarter campaign—but that was not the final goal for Shepherd and Simoncini.

“What matters,” says Shepherd, “is the process they are learning. They are performing it really well. Next year, we are going to have students work on assisted living devices. I am looking forward to a new set of students with a new set of ideas!”

(From OCCAM) with their Cook-E product. From left to right, Daniel Escobar, Abhishek Sriramam, Jenna Witzleben, Paul Weston, and Paul Chang.
t was a moment any student team dreads.
Cornell Racing had spent months designing, building, testing and retesting its formula-style racecar in preparation for the Toronto Shootout. But during its timed trial, Cornell’s car stopped dead in its tracks.

Team leader Nina Buchakjian ’15 MAE, engine subteam leader TeAnn Nguyen ’15 MAE, and electrical subteam leader Sarah Behringer ’16 ECE remember that day. “The engine problems that had plagued us earlier that week had followed us to Canada. When we saw the car completely stopped on the track, the three of us, with several other members of the team, rushed out there to figure out what had happened,” says Buchakjian. “Unfortunately, the failure was beyond what we could fix at that moment.”

There as they took this disappointing moment in stride. Rebecca Macdonald, Cornell Engineering’s Swanson Director of Engineering Student Project Teams, couldn’t help but notice something different about the members of Cornell’s team. “As I watched our students fix the car I was struck by the image of three female leaders for the Cornell Racing team working together in the pits,” Macdonald says. “In fact, while we were at the Toronto Shootout I noticed that many of the other racing teams were predominantly male. It was a moment that made us take notice and realize that Cornell Engineering is doing something special.”

Historically, engineering has been a male-dominated profession. According to the latest figures from the National Science Foundation, male students comprise 81.4 percent of all
but they all share a passion for engineering, problem solving, represent a vibrant mix of backgrounds and experience levels, to 40 percent of its student body is female. Of the nearly 1,100 nationwide.

first-year undergrad students enrolled in engineering programs nationwide. But Cornell Engineering shelters the national trend. Close to 40 percent of its student body is female. Of the nearly 1,100 students on teams, 37 percent are women. Nearly every single Cornell Engineering student team has female leaders. “The teams are a reflection of our student body,” Macdonald says. “It is exciting to see Cornell ahead of the trend and being a trailblazer in producing engineering leaders from all backgrounds and genders.”

Overall, the female student leaders for these teams represent a vibrant mix of backgrounds and experience levels, but they all share a passion for engineering, problem solving, and creating smart, innovative design. But in the larger engineering world where women are still a smaller minority, there are moments when being a young female engineer means that they stand out from the crowd. For some, it can be a light-hearted moment. “Sometimes we make jokes that we should go out for girls’ night. Once we even received a silly award at a competition for having the most girls on the team,” says Tiffany Ly ’15 MSE, team leader for Cornell Engineering’s Concrete Canoe team, which is split evenly among male and female students. But for some, standing out from the crowd also means having to confront the biases. “There are moments where I notice that someone sees me as being different because I am a woman or young. What I’ve learned is that I can’t let it bother me and ultimately, I know if I work hard, the results will show for themselves and people will respect that,” says Corinne Lippe ’16 MAE, leader of the Mars Rover’s drive systems subteam. “I do take it as a challenge when someone judges me. I want to prove them wrong.”

Likewise, Brecken Blackburn ’15 ECE, subteam leader for the Engineering World Health team, says that she has noticed the surprised reactions when someone learns she is an engineering student. “The reactions are never hurtful, but it is obvious that I battle their expectations of what an engineer should look like,” Blackburn says. Many female students interviewed for this article spoke of the disbelief they have encountered when people learn they are engineering majors. Like Blackburn reported, it is never harmful but the reactions illustrate that there are still people who consider engineering the domain of men.

Lance Collins, the Joseph Silbert Dean of Engineering, says that attracting an equal representation of the genders is an important goal for Cornell Engineering and for the entire scientific and research community. “Engineering needs to be open and inclusive in order to support a culture of discovery and creativity. It is well known that diverse teams yield a wider range of ideas that ultimately lead to better outcomes,” Collins says. “Role models are a critical component to helping girls and young women consider engineering careers. Role models help break down the stereotypes of engineering and showcase the real-life possibilities within the field.”

Inshera Abedin ’15 CEE, the co-leader of the Steel Bridge team says that seeing other women in positions of leadership had a tremendous impact on her. “I am grateful for the confident women who have taken on these roles and paved the way for me. The past female leaders for the Steel Bridge have always been role models for me,” Abedin says. “It is inspiring to see women taking on these roles and paving the way for the rest of us.”

Cornell Racing saw the power of role models almost immediately. Buchakjian says that since more women have joined the team, there has been a noticeable increase in the number of female prospects. “We’re guessing that it has probably doubled from past years,” she says. “I can only assume why this has happened but I believe that having more women leaders on our team seems more approachable and more girls are willing to talk to us and learn about the team.”

All student team members leave Cornell Engineering with valuable real-world experience on their resumes. Today, the opportunities in engineering make it one of the most attractive fields for economic and job security. Economic forecasts show that some of the greatest job growth and best compensation will occur in engineering and advanced technology-related fields, according to the Society of Women Engineers. When students participate in these teams they are acquiring an enhanced skill set that will serve them well in jobs after graduation. The students are not just graduating with fantastic degrees but they know how to motivate team members, resolve conflict, and interact with colleagues with a variety of skill levels,” says Macdonald. “When I see these teams, I know I’m looking at the future leaders of engineering.”

Today, students participate in these teams to support a culture of discovery and creativity. It is well known the entire scientific and research community. “If you don’t feel confident, you might not open your mouth or speak up and give your opinion. But while work-

Rhodes Hall, Fall 2014.

2015 Cornell Racing engineering student project team outside of Rhodes Hall, Fall 2014.

From left, Caitlin Murphy, Michelle Szeto, and Eugene Ng watching an ergometer demonstration by Terry Kent, Cornell’s team rowing coach, on how to practice paddling.

Cornell’s 2014 FSAE car.
Lance Collins, professor of mechanical and aerospace engineering, has been reappointed to a second five-year term as the Joseph Silbert Dean of Engineering. Cornell Provost Kent Fuchs announced Oct. 17. The Cornell Board of Trustees approved the reappointment.

Collins was instrumental in creating, developing and implementing Cornell’s winning bid for Cornell Tech in New York City and remains part of the executive team that oversees programming offered at the new graduate campus and facilitates strong ties between the campuses.

During his first term as dean, he has focused his efforts on faculty retention at Cornell Engineering and its research in the school’s areas of focus: advanced materials; bioengineering; complex systems, network science and computation; and energy. He further developed the college’s undergraduate program through curriculum development while also enhancing experiential learning, and launched several new programs, including ones focusing on entrepreneurship, while boosting the college’s commitment to and support of its renowned student-project teams. Collins also played an active role in the college’s brand communication platform to inform external audiences of faculty and student work and the school’s impact.

In his second term, Collins will push Cornell Engineering to become more engaged with the world and nurture the continued growth of Cornell Tech and its relationship with the college. He will focus on industry ties and connections and keep Cornell engineering working as an active member of the local economies in Ithaca and New York City through its entrepreneurship programming.

— Jo Wilden

Christopher Alabi, assistant professor of chemical and biomolecular engineering and a Nancy and Peter Meinig Family Investigator in the Life Sciences, has been awarded a Research Starter Grant in Pharmacuetics by the Pharmaceutical Research and Manufacturers of America Foundation (PhRMA). The grant supports scientists who are establishing their academic research careers as independent investigators in biopharmaceutics and pharmaceutical technology.

Alabi received the 2015 Faculty Early Career Development Award from the National Science Foundation. The award is the most prestigious recognition by the foundation to teacher-scholars early in their academic careers. It supports the development of junior faculty members of “exceptional promise” who demonstrate creativity in research, teaching, and outreach. Alabi’s proposal “Uncovering Quantitative Design Principles of RNA Regulators for Synthetic Biology” aims to pioneer quantitative, multi-level design principles for RNA structure/function relationships. He proposes to use this knowledge to create new types of RNA-mediated genetic controls and new RNA genetic networks for tailoring gene expression logic and dynamics. The work builds upon recent efforts in his group that lead to the creation of a new RNA-based genetic regulatory mechanism called STARS, which can be used to selectively activate gene expression.

In November, Luckas was selected to be the U.S. Chair of the Synthetic Biology Working Group that is part of the EU-U.S. Task Force on Biotechnology Research. Founded in 1990 by the European Commission and the White House Office of Science and Technology Policy, the EU-US Task Force on Biotechnology Research aims to coordinate efforts to promote research on biotechnology and its applications for the benefit of society. Through strategic planning and working groups, the Task Force has played a key role in establishing emerging scientific fields including bioinformatics, nanobioengineering, systems biology and synthetic biology.

Lucks

Lucks granted Early Career Development Award

Julius Lucks, assistant professor of chemical and biomolecular engineering and a James C. and Rebecca Q. Morgan Sesquicentennial Faculty Fellow, has received a 2015 Faculty Early Career Development Award from the National Science Foundation. The award is the most prestigious recognition by the foundation to teacher-scholars early in their academic careers. It supports the development of junior faculty members of “exceptional promise” who demonstrate creativity in research, teaching, and outreach. Lucks’ proposal “Uncovering Quantitative Design Principles of RNA Regulators for Synthetic Biology” aims to pioneer quantitative, multi-level design principles for RNA structure/function relationships. He proposes to use this knowledge to create new types of RNA-mediated genetic controls and new RNA genetic networks for tailoring gene expression logic and dynamics. The work builds upon recent efforts in his group that lead to the creation of a new RNA-based genetic regulatory mechanism called STARS, which can be used to selectively activate gene expression.

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Hernández

Hernández to lead Grad School diversity efforts

Sara Xayarath Hernández, MPP ’07, director of Diversity Programs in Engineering at Cornell Engineering since 2009, has been named associate dean for inclusion and student engagement in the Graduate School. Hernández will lead the Office of Inclusion and Student Engagement, with a central role in Graduate School efforts to recruit, retain and support a diverse community of graduate and professional students and postdoctoral scholars. As one of five University Diversity Officers, she also will help steer Toward New Destinations diversity initiatives in colleges and the Graduate School.

We are very proud of Sara’s accomplishments as director of Diversity Programs in Engineering and as a passionate and effective advocate for the Graduate School of Engineering for greater inclusion and diversity,” said Alan Zehnder, Associate Dean for Diversity & Faculty Development. “Although she will be closely missed in engineering we are very happy to see that her talents will be applied for the benefit of our students, the larger graduate community. We look forward to working with her in her new role.”

— Daniel Aloi
contributions to data mining and data stream query processing. His research deals with tremendously large datasets such as those used in e-commerce, and data privacy problems raised by these technologies.

Joachims is cited for his contributions to the theory and practice of machine learning and information retrieval. He focuses on algorithms that can learn from unlabeled examples and then identify and classify new data, with applications in data mining and robotics.

Joachims was also named a fellow of the Association for the Advancement of Artificial Intelligence. The Fellows Program honors a small percentage of the group’s members as having unusual distinction in the profession over several years.

Langer is a Cornell Entrepreneur of the Year.

Tardos
go to the National Academy of Sciences.

van der Meulen wins ORS Women’s Leadership Award

Four Cornell Engineering faculty members have been elected fellows of the American Association for the Advancement of Science, the world’s largest general scientific society. AAAS elected 401 new fellows for 2014, honoring them for contributions to innovation, education and scientific leadership. Their accomplishments will be celebrated at the 2015 AAAS Annual Meeting. Each fellow will receive a certificate and rosette pin on Feb. 14 during the AAAS Fellows Forum.

Four Cornell Engineering AAAS fellows are

Langer is a Cornel Entrepreneur of the Year.

The Cornell Entrepreneur of the Year award is given annually by Entrepreneurship @ Cornell to a Cornellian who exemplifies entrepreneurial achievement, community service and high ethical standards.

Kathy Havis

Tardos honored as ICIAM lecturer

The International Council for Industrial and Applied Mathematics (ICIAM) has selected Eva Tardos, Cornell’s Jacob Gould Schurman Professor of Computer Science and faculty named AAAS fellows

Tardos was chosen for her numerous and deep contributions to the fields of combinatorial optimization, discrete algorithms and algorithmic game theory, and her ability to convey the basic ideas and inspire others to pursue them.

— Bill Steele

Four Cornell Engineering faculty named AAAS fellows

Four Cornell Engineering faculty members have been elected fellows of the American Association for the Advancement of Science, the world’s largest general scientific society.
Kourkoutis wins Packard Fellowship

Lena Kourkoutis, assistant professor of applied and engineering physics, has received a Packard Fellowship for Science and Engineering from the David and Lucile Packard Foundation. The five-year, $875,000 award has gone to 18 of the nation’s most innovative early-career scientists and engineers, according to the foundation. Established in 1988, the fellowships provide early-career scientists with flexible funding and freedom to take risks and explore new frontiers in their fields.

Kourkoutis, a Rebecca Q. and James C. Morgan Sesquicentennial Faculty Fellow, studies new functionalities that emerge at the interfaces of materials. Her electron microscopy group develops techniques to understand such phenomena in complex oxides, a class of materials that exhibits a rich variety of properties that are unattainable in conventional semiconductors.
—Annie Ju

Fuchs named president of University of Florida

Cornell Provost W. Kent Fuchs has been named the 12th president of the University of Florida, the UF board of trustees announced Oct. 15. He began his new position Jan. 1.

Fuchs, who was appointed Cornell’s chief academic officer in 2009, came to Cornell in 2002 as the Joseph Silbert Dean of the College of Engineering. In a statement, Cornell President David Skorton said Fuchs leaves behind a legacy that “will be felt by all Cornellians, and by colleagues at other top research universities, for decades to come.”

Known for his knowledge of Cornell, clarity of purpose, and vision for the future, Fuchs became provost at the onset of the economic recession and helped the university find creative ways to hire and retain diverse, outstanding faculty, develop its new budget model and strategic plan, and establish the Cornell Tech campus on Roosevelt Island, which, Skorton said, may be “Kent’s greatest legacy as provost.”

“Kent will bring to his new position a deep understanding of the issues, constituencies, and avenues for collaborative action that are central to the life of a university,” he said. “We will greatly miss his leadership, intellect, and thoughtful, principled actions.”

“Personally,” Skorton continued, “I am excited for Kent and look forward to our continuing partnership as we each continue to contribute to the advancement of education and research at a national level.”

“I am grateful to have had the opportunity to serve Cornell for the past 12 years,” said Fuchs. “Cornell is a wonderful university with a marvellous history and glorious future.”

Skorton announced an interim provost, ILR Dean Harry Katz who started his position Nov. 14.
—Nancy DeLeite

Xu at White House BRAIN conference

Chris Xu, professor of applied and engineering physics, joined other academics and industry leaders at the White House Sept. 30 for a conference celebrating progress on the BRAIN (Brain Research through Advancing Innovative Neurotechnologies) Initiative, a sweeping federal effort to understand everything about the human brain. Xu is among 38 researchers receiving a share of $46 million in National Institutes of Health funding under the $100 million BRAIN Initiative. The NIH announced this first wave of investments for BRAIN on Sept. 30.

The three-year, $1.73 million grant to Cornell will support Xu’s work in three-photon microscopy, a noninvasive, deep-tissue imaging technique that produces high-resolution, 3D images of living tissue by harnessing the fluorescence of cells. So far, Xu and collaborators’ three-photon microscope can penetrate a live mouse brain’s hippocampus about 1 millimeter below its surface. Previous work had allowed them to image neurons; now they’re working on imaging neural functioning, Xu said. This optimization has involved an improved femtosecond laser; the use of longer light wavelengths to reduce tissue scattering and expression of new fluorescent protein probes. In particular, they have been using a sensor based on green fluorescent proteins—the subject of the 2008 Nobel Prize in chemistry—as targets for their microscope.

Three-photon microscopy can monitor neural activity in the mouse brain. Every time a neuron fires, an action potential opens a membrane channel that lets calcium ions rush in, and the green fluorescence activity of this function can be detected. By monitoring fluorescence intensity, the researchers can tell whether the neuron is active, Xu said.

The BRAIN Initiative has been compared to the Human Genome Project, which united thousands of scientists in the common goal of sequencing the complete human genetic blueprint.
—Annie Ju
ART AND NANOTECH CONVERGE ON CORNELL CAMPUS

Art and nanotech converge on Cornell campus

BIENNIAL’S ART AND SCIENCE COLLABORATIONS EARN ACCLAIM

“Art:21 [producers of the PBS series ‘Art in the 21st Century’] came to campus with an interest in Kimsooja’s project as an innovative collaboration and a new direction for the artist,” said CCA Director, Stephanie Owens. “They’re producing a documentary on the project and the nano fabrication process used to make the iridescent polymer on its surface for PBS.” A screening on campus may happen in the spring,” she said.

Materials science and engineering professor Uli Wiesner, artist Kimsooja, CCA Director Stephanie Owens and architect Jaeho Chong with Kimsooja’s “A Needle Woman” sculpture.

As artist-in-residence, Korean artist Kimsooja, wanted to explore a “shape and perspective that reveals the invisible as visible, physical as immaterial, and vice versa.” for the Cornell Council for the Arts (CCA) 2014 Biennial, she has realized that objective with “A Needle Woman: Galaxy was a Memory, Earth is a Souvenir,” which was installed in September 2014.

Kimsooja’s 46-foot-tall structure features an iridescent polymer film developed at Cornell, reflecting light with structural colors similar to those in a butterfly’s wings. Creating it involved some diligent problem-solving by materials scientists in the lab of Uli Wiesner, the Spencer T. Olin Professor of Engineering.

The group, including chemistry Ph.D. student Ferdinand Kohle and postdoctoral researcher Hiroaki Sai, worked out how to create a polymer producing the desired optical effect and how to adhere it to Plexiglas panels on Kimsooja’s structure. Architecture students assisted with materials and fabrication.

“I really love how world-class science has been incorporated in world-class art,” Juan Hinestroza said of the Kimsooja-Wiesner project. “The fundamental science behind the coatings developed by the Wiesner group, the chemistry developed by Hiro, as well as the methods pioneered to coat the films with such nanoscale precision by Ferdinand, are indeed revolutionary – and the use of these materials to assemble a large structure like Kimsooja’s needle is simply breathtaking.”
Malika Grayson has also remained dedicated to her love of community leadership and volunteering. She is currently the co-director of the Graduate Society of Women Engineers and on the board of the National Society of Black Engineers. She joined GradSWE to help other women in engineering feel supported. “So many times, you’re the only girl in the lab,” says Grayson, adding that while there are many helpful male colleagues and mentors in the engineering field, subtle issues can still arise for a woman in a male-dominated profession. “Many of us suffer from imposter syndrome,” she says. “When you’re surrounded by men, you may find yourself thinking you can’t do as much as them.”

Other minorities face the same issues in engineering. Having a minority faculty mentor for all new graduate students during their first year would go a long way to help them acclimate, Grayson explains. “I didn’t have that when I came in, and it took me a year to get comfortable at Cornell. Finally a female colleague convinced me to join NSBE, and I was able to get that support.”

Grayson is committed to ensuring that new students get more immediate support as they begin their graduate experience in engineering. “I think faculty support can make a big difference in how a student views their school, how they follow through with a life path, and how they choose to continue,” she says. As NSBE’s community service chair, Grayson has made a point of reaching beyond Cornell. She joined Professors Ephrahim Garcia’s group, studying the optimization of buildings and structures to better harness wind energy. Tragically, Garcia died in September 2014, a loss that left Grayson shaken emotionally and academically. “It’s been really hard, but I’m pushing through—I know the last thing he would want is for his students to give up. So, I dedicate my Ph.D. to him.”

Grayson has also come to Cornell by the warmth of the people in the Sibley School of Mechanical and Aerospace Engineering. There, she has made a food drive and donated a thousand dollars each to twenty different needy households. Grayson says she was drawn to Cornell by the diversity and the opportunity to be mentored by Cornell students in a relaxed, no-strings-attached atmosphere. She also rekindled the NSBE Jr. Program, where NSBE members mentor kids every week. Finally, Grayson conceived of and hosted an engineering day at the Beverly J. Martin elementary school, with tables of activities and demonstrations for the elementary students to investigate.

The mentorship program is going strong. Through NSBE Jr. we are able to help them prepare for finals, write a resume, prepare for the SATs,” says Grayson. She says that, despite the effort it takes to organize, recruit and manage outreach programs like this, seeing the enthusiasm and interest from those she’s helping makes it all worth it. “I just wanted to create something where the kids feel that we care...I grew up with so many people who acted as mentors, I know how important it is to have someone to look up to. I also want the community to not think that Cornellians just come for a few years and then leave without getting involved or taking an interest. It’s important to show we care enough to get involved.”

—Lauren Callston Roberts
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