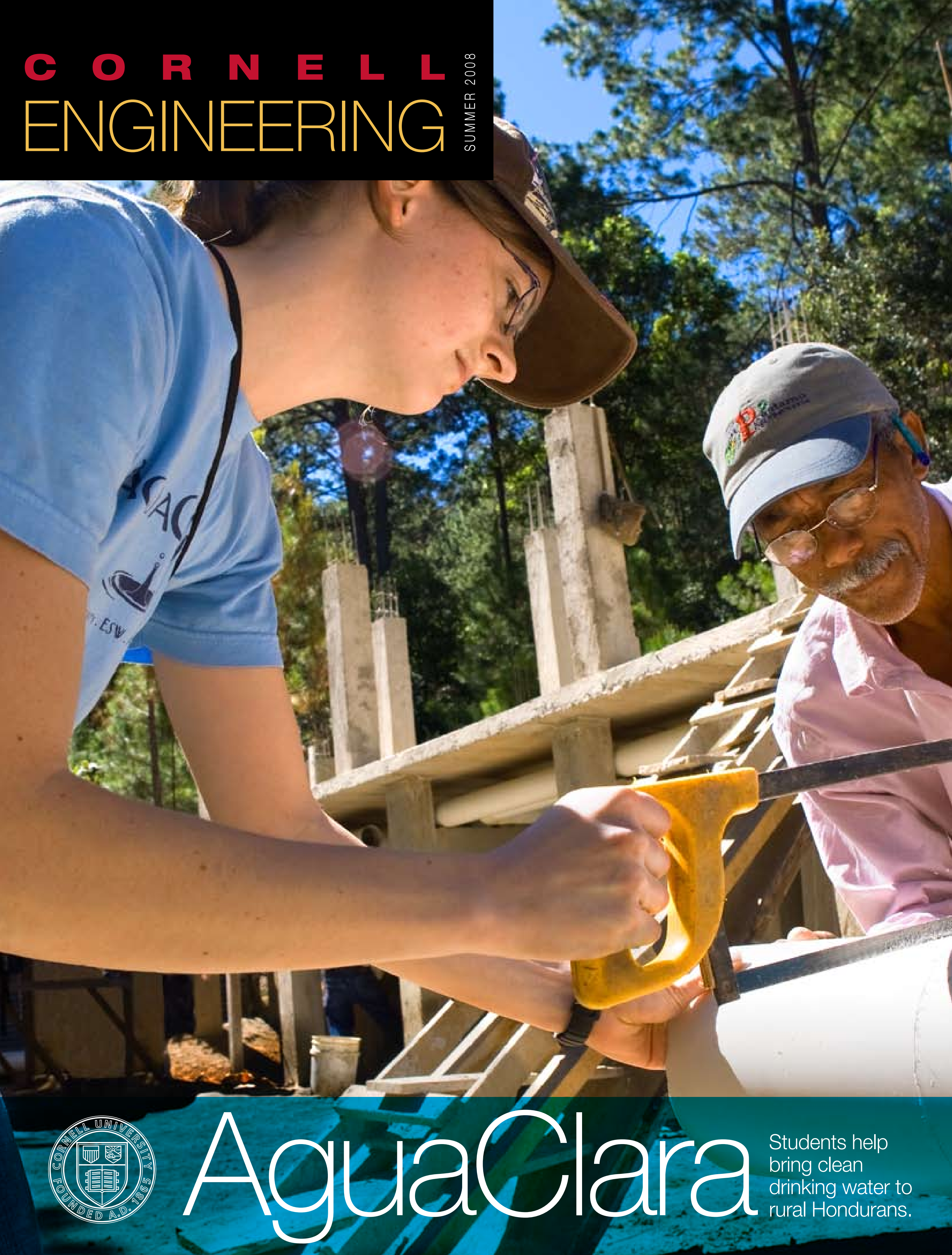
CORNELL ENGINEERING

SUMMER 2008

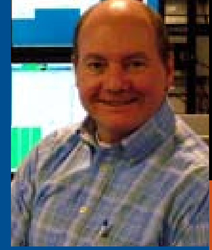


AguaClara

Students help bring clean drinking water to rural Hondurans.

Engineering Global Fellows

If you know the value of a Cornell education, consider putting a Cornell engineering student to work for you. Undergraduates who intern, co-op, volunteer, study, or conduct research abroad gain valuable international experience and are recognized as Engineering Global Fellows.



"Archelon's success depends on employing individuals capable of innovatively adapting to today's fast-paced financial world. We have interviewed at a number of top engineering and technical schools and Cornell's students consistently stand out. We like to hire Cornell interns and co-op students to introduce Archelon and the idea of working in a small firm with global reach to a limited group of talented students."

Charles Tall '78 ORE
Founder, Archelon Partners LLC

"The international internship at Archelon was actually the most rewarding experience of my college life. I was able to explore cutting-edge trading technologies while getting a broad exposure to European cultural diversity. It wasn't just the work I did that summer, but the whole experience of exploring and discovering new places and meeting different kinds of people that dramatically changed my perspective on life."

Richard Liao '07 ORE, M.Eng. '08
Former intern at Archelon, Frankfurt
(at left)

"My international co-op experience in Beijing was the most formative semester of my Cornell experience. I was challenged by a new continent, a tough language, and an intense workplace. After a few weeks of wondering what had ever compelled me to leave the comforts of the U.S., everything started to click. I found a strong social network of expats and locals, I found ways to contribute to the team at work, and—most importantly—I learned how to communicate with a totally different culture."

Matt Perkins '08 MSE
Former co-op student
GE, China

"GE depends upon great talent, and Cornell students have it. We hire more than 40 Cornellians every year for programs and direct full-time hires. We appreciate their creativity, technical rigor, and work ethic.

"Matt was really the first Cornell intern who we successfully placed in an international assignment. Frankly, it was his determination that made it happen. An obstacle was presented at nearly every turn, yet Matt was able to form creative solutions and take risks to make it happen. These are exactly the attributes which make great leaders in GE!"

Chris Schmitt '82 AgEng
Manager, Technical Operations
GE Infrastructure and Energy

Engineering Co-op & Career Services
Cornell University
201 Carpenter Hall
Ithaca, NY 14853-2201
Phone: 607 255-5006
eng-career@cornell.edu

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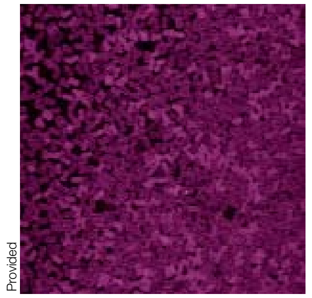
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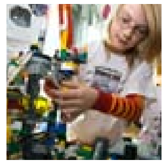



NBC Photo: Mitch Haaseth

COLOR-CODED ATOMS

David Muller, left, associate professor of applied and engineering physics, and John Silcox, David E. Burr Professor of Engineering, stand with the newest scanning transmission electron microscope in Duffield Hall University Photo

A new electron microscope installed in Cornell's Duffield Hall is enabling scientists for the first time to form images that uniquely identify individual atoms in a crystal and see how those atoms bond to one another. And in living color.

"The current generation of electron microscopes can be thought of as expensive black-and-white cameras where different atoms appear as different shades of gray," explained David Muller, associate professor of applied and engineering physics. "This microscope takes color pictures—where each colored atom represents a uniquely identified chemical species."

The instrument is a new type of scanning transmission electron microscope, built by the NION Company of Kirkland, Wash., under an instrument-development award to Cornell from the National Science Foundation. John Silcox, the David E. Burr Professor of Engineering at Cornell, and Ondrej Krivanek of NION are co-principal investigators on the project.

The microscope incorporates new aberration-correction technology designed by Krivanek that focuses a beam of electrons on a spot smaller than a single atom—more sharply and with greater intensity than previously possible. This allows information previously hidden in the background, or "noise," to be seen. It also provides up to a hundredfold increase in imaging speed.

The capabilities of the new instrument in analyzing a test sample are described in an article in the Feb. 22 issue of the journal *Science* by Muller, Silcox, Krivanek, and colleagues at Cornell and in Korea and Japan.

It allows scientists to peer inside a material or a device and see how it is put together at the atomic scale where quantum effects dominate and everyday intuition fails. One of the most important applications of the new instrument will be to conduct what Silcox calls "materials pathology" to aid researchers in their development of new materials to use in electronic circuits, computer memories, and other nanoscale devices. "We can look at structures people have built and tell them if they've built what they thought they did," Silcox explained.

The microscope shoots an electron beam through a thin-film sample and scans the beam across the sample in subatomic steps. In addition to forming an image, the new microscope can identify atoms in its path by a process called electron energy-loss spectrometry. Atoms in the path of the beam absorb energy from some of its electrons to kick their own electrons into higher orbits. The amount of energy this takes is different for each kind of atom.

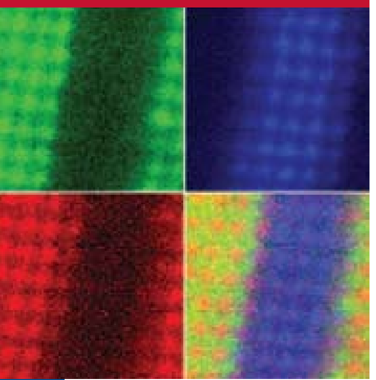
The detector collects electrons emerging from the sample and measures the energy losses, and from this the atoms in the path of the beam can be identified. The detector can simultaneously produce multiple images—one for every different species of atom in the sample, and these can be color-coded, each color representing a different electron energy signature.

The method can also show how atoms are bonded to one another in a crystal, because the bonding creates small shifts in the energy signatures. In earlier scanning transmission electron microscopes, many electrons from the beam, including those with changed energies, were scattered at wide angles by simple collisions with atoms. The new STEM includes magnetic lenses that collect emerging electrons over a wider angle. Previously, Silcox said, about 8 percent of the emerging electrons were collected, but the new detector collects about 80 percent, allowing more accurate readings of the small changes in energy levels that reveal bonding between atoms.

More complete collection and a brighter and a more sharply focused beam also allow the new microscope to scan much faster. In early tests it collected a 4,096-pixel image in about 30 seconds, 50 to 100 times faster than in conventional STEMs.

—*Bill Steele,* Cornell Chronicle

Provided/David Muller



Electron spectroscopy identifies atoms in a cross-section of an artificially layered material. Upper left shows an edge between layers of lanthanum and manganese atoms; upper right, an edge between lanthanum and titanium; lower left, a manganese-lanthanum edge; lower right, all three images combined. A line of purple shows that manganese and titanium atoms are mixing across their boundary, a problem that needs to be fixed to make the material useful.

RANGER RECORD

We're not sure what brand of batteries it was using, but the Cornell Ranger robot just kept going and going April 3 when it set an unofficial world record by walking nonstop for 45 laps—a little more than 9 kilometers or 5.6 miles—around the Barton Hall running track.

Developed by a team of students working with Andy Ruina, professor of theoretical and applied mechanics, the robot walked (and walked) until it finally stopped and fell backward, perhaps because its battery ran down. "We need to do some careful analysis to find out for sure," said Greg Stiesberg, a graduate student on the team.

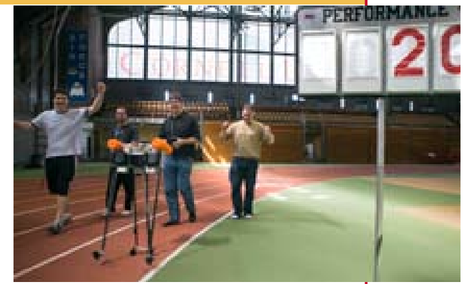
An earlier version of the same robot had already set a record by free-walking a bit over 1 kilometer, about .62 miles. (Another robot has walked 2.5 kilometers [1.55 miles] on a treadmill, Ruina noted. A six-legged robot has walked a bit more than 2 kilometers, and there's some debate over whether or not that counts.)

There are no rules for such records, Ruina admits, and the Guinness people were not involved. "There's a lot of rigmarole with that," he explained. The event, he said, was to show off the machine's energy efficiency. Unlike other walking robots that use motors to control every movement, the Ranger emulates human walking, using gravity to help swing its legs forward.

Standing still, the robot looks a bit like a tall sawhorse; walking, it suggests a human on crutches, alternately swinging forward two outside legs and then two inside ones. There are no knees, but at the ends of the legs are feet that can be tipped up and down, so that the robot pushes off with its toes, then tilts its feet upward to land on the heels as it brings its legs forward.

The goal of the research, Ruina said, is not only to advance robotics but also to learn more about the mechanics of walking. The information could be applied to rehabilitation and prosthetics for humans and even to improving athletic performance. "We've learned tons about what it takes to make walking work," he said.

—*Bill Steele,* Cornell Chronicle



Lindsay France/University Photo

The celebration begins on lap 20 (2.1 km), as the Cornell Ranger breaks the distance record for a walking robot. Accompanying the Ranger are, from left, engineering graduate students Andrey Turovsky and Greg Stiesberg; Jason Cortell, manager of the Biorobotics and Locomotion Lab; and Bram Hendriksen, a visiting graduate student from the Netherlands.

'ONE-POT' CELLS

Cornell researchers have developed a "one-pot" process to create porous films of crystalline metal oxides that could lead to more efficient fuel cells and solar cells.

In a fuel cell, a material with nanoscale pores offers more surface area over which a fuel can interact with a catalyst. Similarly in solar cells, a porous material offers more surface area over which light can be absorbed, so more of it is converted to electricity.

Previously such porous materials have been made on hard templates of carbon or silica, or by using soft polymers that self-assemble into a foamy structure. Making a hard porous template and getting the metal oxides to distribute evenly through it is tedious. The polymer approach is easier and makes a good structure, but the metal oxides must be heated to high temperatures to fully crystallize, and this causes the polymer pores to collapse.

The Cornell researchers have combined what Ulrich Wiesner, Cornell professor of materials science and engineering, calls "the best of the two approaches," using a soft block copolymer, called poly(isoprene-block-ethylene oxide) or PI-b-PEO, that carbonizes when heated to high temperatures in an inert gas, providing a hard framework around which the metal oxide crystallizes. Subsequent heating in air burns away the carbon. Wiesner calls this "combined assembly by soft and hard chemistries," or CASH.

The research is described in an online paper in the journal *Nature Materials* by Wiesner; Francis DiSalvo, the J. A. Newman Professor of Chemistry and Chemical Biology; and colleagues.

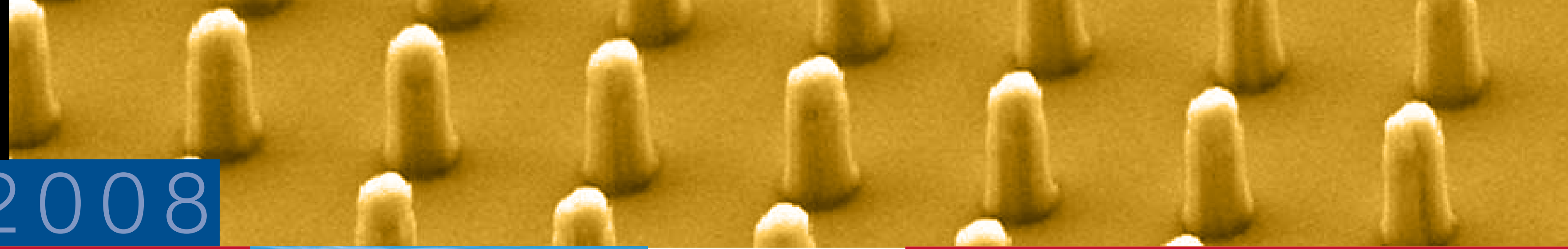
The next step, Wiesner said, is to apply the CASH process to the creation of porous metals.

Co-authors of the *Nature Materials* paper are postdoctoral researcher Jinwoo Lee and graduate research assistants M. Christopher Orilall, Scott Warren, and Marleen Kamperman.

—*Bill Steele,* Cornell Chronicle

Provided/Ulrich Wiesner

In the CASH process, a polymer forms itself into ordered rows of cylinders surrounded by a metal oxide. Heating in the absence of oxygen turns the polymer into a hard carbon framework that holds its shape while the metal oxide is heated to a higher temperature to make it form uniform crystals. Finally, heating in air burns off the carbon to leave a porous material.



GRANULITE GENESIS

Provided/Gabriela Depine

Gabriela Depine, left, and Chris Andronicos stand in a stream in the Coast Mountains of British Columbia.

A team of Cornell researchers has created a mathematical computer model of the formation of granulite, a fine-grained metamorphic rock, in the Earth's crust.

By studying what were once pockets of hot, melted rock deep in the Earth's crust 55 million years ago and calculating the period of cooling, the scientists were able to explain how granulite is formed as the molten rock migrates upward through the crust.

The research is published in the March issue of the journal *Nature* by Gabriela V. Depine, a fourth-year graduate student in earth and atmospheric sciences; Christopher L. Andronicos, an EAS associate professor; and Jason Phipps-Morgan, professor of EAS. The research is funded by Cornell and by the National Science Foundation's Continental Dynamics program.

Granulite is a major component of the continental crust. Unlike other rocks, it forms under a wide range of depths but under a narrow range of temperatures—700 to 800 degrees Celsius (1,292 to 1,472 degrees Fahrenheit). In the continental crust, temperature was usually believed to increase almost linearly with depth—that is, the deeper the crust, the hotter the rock.

The researchers mathematically re-created the formation of granulite at various depths, to see if they could come up with a method that mirrors the natural formation of the rock.

They did so by looking at plutons, or pockets of hot, melted rock that were once as much as 13 kilometers (about 8 miles) below the Earth's surface but are now exposed. (Plutons that rise to the surface and erupt can become volcanoes.) The researchers found that the melted rock deep in the Earth is buoyant and will migrate upward through the crust to form a pluton. Heat conducting downward from the hot pluton will, in turn, raise the temperature of the underlying rock to the pluton temperature. They then realized that granulite can form at various depths but at similar temperatures.

—*Anne Ju,* Cornell Chronicle

NEW BIOFUELS LAB

Linda McCandless

Construction has started on the former power and machinery lab on the east end of the Cornell campus to convert it into the Biofuels Research Laboratory. Occupancy is slated for January 2009.

A former agricultural engineering power and machinery lab at Cornell is being gutted to make way for a state-of-the art Biofuels Research Laboratory that will convert perennial grasses and woody biomass into cellulosic ethanol and other biofuels and will occupy the entire east wing of Riley Robb Hall by January 2009.

The $6-million lab is being constructed thanks to a $10-million grant awarded to Larry Walker, Cornell professor of biological and environmental engineering, from the Empire State Development Corp., and will include analytical equipment, incubators, fermenters, and other innovative biotechnology equipment.

"Biofuels is the emerging program for our department," said Mike Walter, chairman of the Department of Biological and Environmental Engineering in the College of Agriculture and Life Sciences.

The department plans to offer a master's of engineering program focused on biofuels in fall 2008 because demand for trained biofuel engineers is skyrocketing, said Walter. The new lab will be shared by faculty and students across campus. Faculty members expected to work in the laboratories include Larry Walker, Beth Ahner, Norm Scott, David Wilson, Jim Gossett, Susan Henry, Harold Craighead, and others involved in the biofuels research program at Cornell.

Five separate labs will be equipped to focus on different aspects of biofuels research, including two growth chambers for specialty plants—"biomolecular farming," as the engineers call it—that express different proteins. Researchers are working to overcome the physical, chemical, and biological barriers to liberating sugars from such alternative energy crops as switchgrass, biomass sorghum, and other perennial grasses as well as woody biomass, and to biologically convert these sugars into such biofuels as ethanol, butanol, or hydrogen.

The facility has been designed so that feed stock materials—the plants—will enter at the north end of the building to undergo pretreatment, bioconversion, and fermentation processes in an integrated and engineered framework. State-of-the-art analytical systems will allow the researchers to work at different scales, ranging from understanding fundamental molecular mechanisms at the nanoscale to larger scales with fermentation vessels up to 150 liters.

—*Linda McCandless*

LEGO EXPO

Lindsay France/University Photo

SpeidieBuilders team members Tim Cain, 10, left, and Maia Wright, 8, demonstrate their design at the Junior FIRST LEGO Expo.

Hordes of children swarmed the lobby of Duffield Hall, Jan. 26. They shot paper rocket ships into the air and launched hover-gliders off the upper-floor crosswalks, while peppy music pumped in the background. For the second year in a row, Duffield played host to the Junior FIRST LEGO League Expo.

The children, ages 6 through 9 and hailing from various towns in New York and Pennsylvania, gathered to experience aspects of engineering as both a fun and educational activity. The event was sponsored by FIRST (For Inspiration and Recognition of Science and Technology), founded by Dean Kamen, the inventor of the Segway Human Transporter.

According to Dan Woodie, lab use manager at the Cornell NanoScale Facility and the event's coordinator, the goal of the expo was to inspire children to develop teamwork, to learn to solve real-world problems, and to get as excited about science as they tend to be about sports.

All told, about 90 children on 17 teams competed in creating a LEGO model and a poster demonstrating the flow of energy to an appliance from an original source. Projects included tracking cotton from the field to a candle's wick, as well as the beeswax used to make the candle itself, how waterfalls might power televisions, and how windmills provide power for a toaster.

All of the teams received an award, such as the Crazy Bee Award, which went to the SpeidieBuilders from Binghamton for dissecting the inner workings of a candle.

Contest entries were required to demonstrate the flow of energy from its source to an appliance.

The children also played in various activity booths, sponsored by the Nanobiotechnology Center, where volunteers taught them how to make hover-gliders out of common household objects, construct 3-D shapes out of straws and paper clips, and create "plankton" out of washers, paper, string, and marbles that would float suspended at neutral buoyancy.

"Cam's mom asked us if we liked LEGOs, and we said yes, and here we are!" said third-grader Annika, from the team EAC Rocks, of the EAC Montessori School in Ithaca. Her team would later win the Flying Windmill Award for their demonstration of wind power.

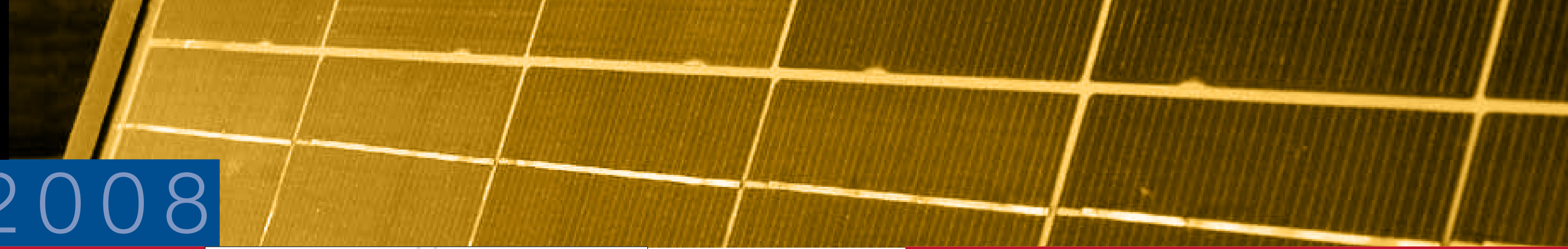
"The whole idea is really interesting," said Alex Roth '09. "I enjoyed seeing the kids so enthusiastic about LEGOs and science."

Members of the Lego-ologists—Abby Wood, 7; Amy Wood (Abby's mom); Ava Kutz, 7; Rebecca Rayne, 9; and Jennifer Rayne, 7—demonstrate their design to judge and grad student Yajaira Sierra at the Junior FIRST LEGO Expo.

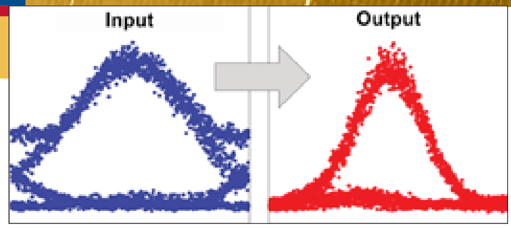
Ellie Rosenberg, team leader of the Tigers from Ithaca's Beverly J. Martin Elementary School and mother of participant Irena, said, "I found out about it in the newspaper and thought, 'What a great idea!'"

The event was co-sponsored by the Ithaca Sciencenter, the Nanobiotechnology Center, and the Cornell NanoScale Science and Technology Facility.

—*Jennifer Wholey '10 is a writer intern at the* Cornell Chronicle.



PHOTONIC PUMP



Provided/Gaeta Lab

After traveling through 20 kilometers of optical fiber a pulse of light a few picoseconds long becomes distorted. "Pumping" with a clean pulse on a photonic microchip can sharpen the signal before sending it further down the line.

More and more of our communications—from text messages to high-definition television—travel over optical fiber. At last count the United States was crisscrossed by more than 80 million miles of it, with some 225 million miles worldwide.

But there's a problem: Light is dimmed by miles of fiber, and the crisp on-and-off pulses that represent the ones and zeros of a digital signal become misshapen and fuzzy. Every 50 miles or so the signal must be reamplified, cleaned up, and relaunched.

Now Cornell researchers have demonstrated that all this can be done on a single photonic microchip, replacing bulky bundles of fiber or electronic amplifiers that slow down the signal.

The development is described in an article by Alexander Gaeta, professor of applied and engineering physics; Michal Lipson, associate professor of electrical and computer engineering; and colleagues, in the journal *Nature Photonics* and was posted in the online version of the journal in December 2007.

Previously the researchers had demonstrated a light amplifier on a silicon chip using a process called four-wave mixing, which could amplify an optical signal by "pumping" with another beam of light. In the new work they show that the same process can clean up and sharpen the pulses of fiber-optic communication. If the pumping beam consists of a series of pulses synchronized with the input signal, the process also cleans up "timing jitter," in which the pulses are not only deformed but also move slightly forward or back

The four-wave mixing approach also offers a broad bandwidth, the researchers report, so it could be used in multiplexed fiber-optic systems where several wavelengths are used simultaneously to carry multiple signals.

—*Bill Steele,* Cornell Chronicle

PHOENIX RISES

Mark Malkin

Members of the Phoenix Society ready to meet the dragon as it passes in front of Carpenter Hall.

Dragon Day. March 14. Under grim skies the phoenix, a vivid red creature with black eyes, yellow beak, and accents of gold and yellow, rises from the ashes of Cornell history. "Awesome," onlookers declare.

Armand Awad '11 and his all-freshman (except for one senior) team of designers and builders with obvious delight resuscitated engineering's response to architecture's dragon, the product of the two schools' decades-long "friendly rivalry."

"We've heard tales from the past of how great the phoenix was, and that it had existed for years and years and years," Awad said. "Long ago, engineering students decided they had had enough of the architecture students having their own holiday."

Meanwhile, the dragon, in a stark departure from the minimalist exoskeletal 2007 version, was distinctly anthropomorphic, with an animated jaw, flapping "hands" and wings atop poles, along with undulating scales of foil and wood. Draped over a wooden frame was the dragon's skin of translucent, loose-woven cloth panels of green, gold, and russet; its chest scales, made of cut-up yellow coffee cups, accented with a color scheme reminiscent of medieval coats of arms.

The Phoenix Society, founded in the mid-1980s, has branched out into other creations that have sallied forth from the Engineering Quad on Dragon Day: a Viking longboat, a cobra, a penguin, and a knight among them.

"We have a creative side, too," said a young woman engineer before disappearing beneath the phoenix, presumably to make last-minute adjustments.

"We just want to represent the engineering school and say, 'We are here,'" asserted Awad, who with classmates has been designing the mythological bird since the fall semester. "The phoenix is traditionally not burned. It will be dismantled. We're going to try to save the head and put it up in Duffield."

During the brief but strangely intense clash of the two creatures at the Engineering Quad entrance, the dragon seemed to try to nip at, or perhaps smooch, the phoenix. The two titans parted after a few awkward moments.

Later, on the Arts Quad, torches lit the hapless dragon. And then, even as the remnants of the dragon hung in the dark sky, talk turned to packing for spring break and evacuating Ithaca.

—*George Lowery,* Cornell Chronicle

CEAA AWARDS BANQUET

University Photo

Senior Research Associate Petru Petrina received the Academic Achievement Award.

The Cornell Engineering Alumni Association recognized outstanding students and faculty at an awards banquet during its annual conference in March.

The highlight of the evening was the naming of the student team award. The Albert R. George Student Team Award honors the Cornell Formula SAE team's longtime advisor. George, the J. F. Carr Professor of Mechanical Engineering, has guided the team to nine championships in 20 years—the best record of any university. Members of the CEAA are raising an endowment to support the award so it can provide a portion of the winning team's funding. This year's recipient was Cornell Minesweeper, which is developing a low-cost, humanitarian landmine detection robot.

Carol George '78 (HumEc) and Professor Al George watch as past members of the FSAE team recount his leadership.

The Undergraduate Student Organization Award was shared by the Cornell chapters of the National Society of Black Engineers and the Institute of Biological Engineering.

The Undergraduate Research Award for the best individual research project went to Ryan Walter '09 CE, who has been researching vinyl chloride in drinking water with civil and environmental engineering Assistant Professor Ruth Richardson.

The Academic Achievement Award went to Petru Petrina, a senior research associate in theoretical and applied mechanics and civil and environmental engineering. The CEAA established this award to recognize non-tenured 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.

The CEAA awards are funded by an endowment created with lifetime membership fees when the association eliminated dues last year. CEAA President Jaclyn Spear presented certificates to recognize the contributions of those lifetime members in attendance at the banquet.

David Gries, associate dean for undergraduate programs, presents an Undergraduate Student Organization Award to Adepeju Adeniji '08 ChE and Ptah Plummer '08 ORE of NSBE.

Two student groups received special mentions: The Society of Women Engineers, for being awarded Most Outstanding Collegiate Section at the 2007 SWE National Conference; and the Society of Hispanic Professional Engineers, for being awarded the Outstanding Small Chapter of the Year at the 2007 SHPE conference.

The Tau Beta Pi Professor of the Year award was also presented at the banquet, to Chemical and Biomolecular Engineering Associate Professor T. Michael Duncan, who received the same honor in 1997. More recently, Duncan was named the 2007 New York Professor of the Year by the Carnegie Foundation and the Council for the Advancement and Support of Education.

—*Robert Emro*

David Heller '81 ME presents the Al George Award to Cornell Minesweeper members Vikas Reddy '08 ME, Hamzah Sikander '09 ECE, Andres Mack '09 Ind. Maj., and Steven Liu '11 ME.

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AguaClara

By Anne Ju
Photos by Lindsay France

Cornell Engineering students help bring clean drinking water to rural Hondurans.

Clean water is something many of us take for granted. But 18 Cornell students probably never will again.

Mostly civil and environmental engineering majors, they are members of AguaClara, Spanish for "clear water," a Cornell student engineering team, and they are making a difference for thousands of people in Honduras who live without clean drinking water.

Led by civil and environmental engineering senior lecturer Monroe Weber-Shirk, students in AguaClara design drinking water plants for rural areas of Honduras using treatment technology they study in class.

For the fifth time in as many years, Weber-Shirk accompanied a group of his students on a two-week trip into the heart of the Central American country during the end of winter break, Jan. 4–20. They toured existing municipal water systems, visited completed and ongoing AguaClara projects, and volunteered some design and construction help for a water plant in the city of Marcala.

More than anything, Weber-Shirk stresses that he brings students to Honduras so they can be immersed in the culture, people, and conditions they're working with.

"They're getting all the context that includes not only the engineering, but all the other pieces that go into making this a successful project," Weber-Shirk says.

> "They're getting all the context that includes not only the engineering, but all the other pieces that go into making this a successful project. "
>
> —Monroe Weber-Shirk, CEE senior lecturer

Central to AguaClara's efforts is a blossoming partnership with the Honduran nonprofit organization Agua Para el Pueblo, "water for the people." Founded in 1984, the local organization has technicians, engineers, and outreach coordinators who scout out potential sites for AguaClara plants, and help the students make connections with the towns. They are in charge of getting the plants built; the students lend them technical support.

During the students' recent stay in Honduras, Agua Para el Pueblo personnel met with the students several times, accompanying them on day trips and listening as the students described the treatment technology they use for the plants and their ongoing research to improve the designs.

Jacobo Nuñez, director of Agua Para el Pueblo, says he was happy about the relationship that's growing between his organization and the Cornell students.

"They have provided us with a new technology to improve the quality of water in many communities in Honduras," Nuñez says.

Others who accompanied the students on this year's trip were Weber-Shirk's wife, Juanita Weber-Shirk, as well as Chris Bordlemay, manager of the water treatment plant that serves all of Cornell.

Támara: A new chapter for Hondurans

A highlight of the trip was a four-day stay in the town of Támara, which was the focus of this year's cohort of AguaClara students. During the fall semester, a handful of Weber-Shirk's students designed a treatment plant for the town of about 3,500 residents, whose water is currently treated only with chlorine.

A group of five students worked on the Támara plant design and three of them—Rebecca Thompson '08 CE, Raúl Santiago, M.Eng. '08 CE, and Kolby Hoover '07 ME, M.Eng. '08 SE,—came on the January trip. Other students in Weber-Shirk's classes worked on technical designs and models, such as an automated design system for future plants.

Construction on the Támara plant began while this year's students were visiting Honduras. They attended a groundbreaking ceremony, along with local officials and Agua Para el Pueblo members, on the afternoon of Jan. 13.

Also present were members of two Westchester County (N.Y.) Rotary Clubs, Northeast Westchester Rotary and Somers Rotary, that have committed to raising more than $70,000 toward the water plant's construction.

Bringing clean water to Támara has been a challenge due to several factors, according to Arturo Díaz, an Agua Para el Pueblo leader. It is a growing area, in which the population has tripled since Hurricane Mitch struck in 1998. The municipality has struggled not only with water quality, but with having sufficient quantity to supply its expanding populace.

Ojojona: Celebrating a handover

It was perhaps the sweetest moment of all for the students, witnessing the ceremonial handover of a completed project in the town of Ojojona.

On Jan. 11, the students witnessed the symbolic changing of hands of that town's water plant from Agua Para el Pueblo and Cornell engineers to Ojojona's local water board. Designed by a previous generation of AguaClara students, that plant has been running since June 2007. Those students worked with Agua Para el Pueblo last year to help bring the plant from design stage to reality.

This year's students spent an afternoon at the Ojojona plant, meeting its operators and peering into the flocculation tanks and chemical feed systems that their predecessors had designed in class.

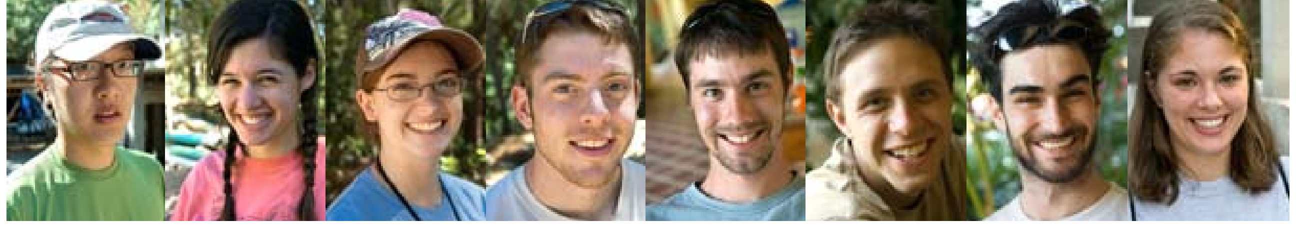
M.Eng. student Hoover, who was on the design team for

(left) Students on the AguaClara Project Team walk toward Ciudad España, a town in central Honduras. The planned community that was built following Hurricane Mitch in 1998 is visible in the background. (center) A new treatment plant will bring clean water to middle-class homes such as this in Támara, Honduras. (right) Most homes do not have running water indoors, and instead have a concrete storgage facility—called a pila—that holds municipal water for cooking, drinking, washing, and bathing.

(left) As Hondurans, Cornell students, and guests watch, Monroe Weber-Shirk, civil and environmental engineering senior lecturer, mixes cement during the groundbreaking ceremony of a student-designed water treatment plant in Támara, Jan. 13. (center) Christopher Bordlemay, Kevin Borden, and Daniel Menendez work with Hondurans to assemble the piping that will carry the treated water from the sedimentation tanks to the distribution tank. (right) Students look over imported water treatment plant modules that were donated by the Spanish government.

(left) Rachael Moxley and Tiffany McClaskey perform final design calculations for the baffle spacing for the hydraulic flocculator at Marcala. (center) Leslie Campbell, David Railsback, and Kolby Hoover drill holes for a flow meter Railsback invented to measure chemical dosages. (right) Menendez and Nicole Ceci lay out fittings for the piping that delivers the flocculated water to the bottom of the sedimentation tanks.

(left) The non-electric flow control module invented by AguaClara is used to deliver chlorine at the Ojojona water treatment plant. (center) Sarah Hiong and Hoover mark locations of baffles in the hydraulic flocculator at the Marcala water treatment plant. (right) Baffles increase the efficiency of the hydraulic flocculator at the AguaClara water treatment plant in Ojojona.



Ian Tse · Nicole Ceci · Rachael Moxley · Kolby Hoover · Scott Freyburger · Seth Luxenberg · David Railsback · Tiffany McClaskey

Ian Tse
MS ’09 CEE
The trip for me was more of a cultural immersion than an engineering/technical one. I genuinely wanted to develop a bond with the Hondurans I met in order to legitimize any claims of solidarity I would make in the future. I think that failure to engage the communities in the most respectful and sustainable way is just as disastrous as miscalculations in the engineering design.

Rachael Moxley
’09 CE
I think we have a good product and we should keep doing what we’re doing. I think the goals we set for this year are really exciting, like getting maybe five plants built, broadening the areas where the team is going to recommend plants, and actual fundraising on our part and publishing what we have. We are also trying to get everything automated, because that would facilitate our future design recommendations.

Nicole Ceci
’08 GS
Even though I knew what else needed to be done working on my part of the project, I feel like I have a better sense of it now. Not until you go and see the plant do you actually understand what physical setup you’re working with, and exactly what parameters you can and can’t play with. It sort of gives you a mental checklist of what you have to work on.

Scott Freyburger
M.Eng. ’08 CEE
I worked on the pilot plant, which is a miniature version of our flocculator. The point is to increase the efficiency of the flocculator. We are doing that by designing a tapered baffle system, which is when the baffles at the beginning are closer together than the baffles at the end. This trip has put my research into perspective. It’s hard every day to just program in front of a computer and actually realize what you’re doing. Here we’re seeing it happening and seeing the people benefit from it.

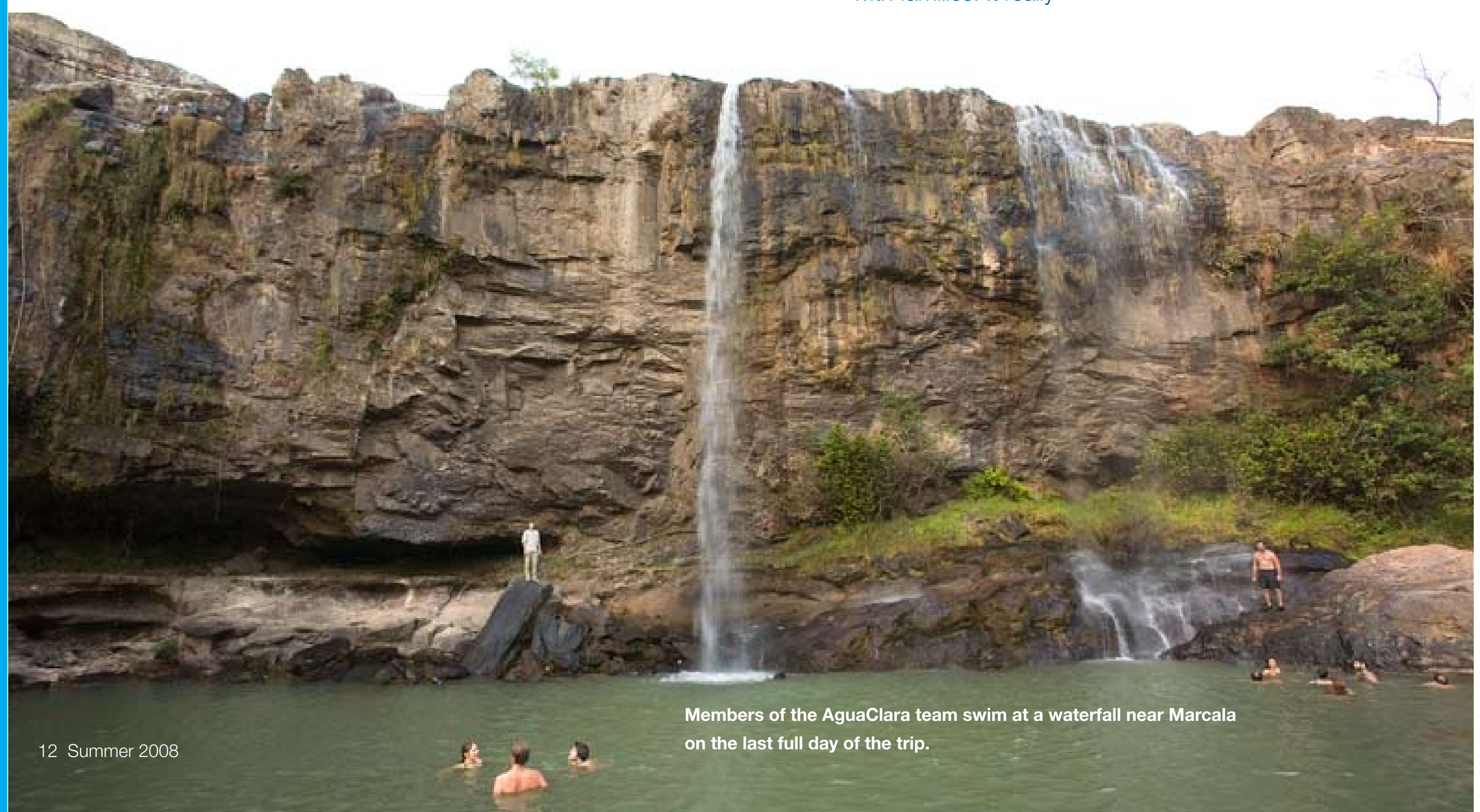
David Railsback
’08 CE
I’ve realized through this trip that so many problems in the world relate to people’s misunderstanding of water. Everything from erosion problems from Hurricane Mitch, to massive landslides, have to do with a misunderstanding of water.

It’s a great project. This will be the work I remember for a long time when I leave college.

Seth Luxenberg
’08 (HumEc)
The biggest thing that I took from this trip was the importance of public participation and working with local governments. In Honduras I saw how important public support can be, which is necessary for raising the price of water, maintaining the plant, and other things.

My favorite part of the trip was staying with families. It really allowed us to connect with the people we are working with and get an idea of what their lives are like and what problems they face.

Kolby Hoover ’07
ME, M.Eng. ’08 SE
We definitely learned firsthand how important clean water is. AguaClara is beginning to take large steps pointed directly at the many issues of water in Honduras. We saw how large of a role culture plays in infrastructure, even that as basic as water and waste systems. I think social capital is the missing ingredient in most of the hard work and valiant attempts to help from across national divides.



Members of the AguaClara team swim at a waterfall near Marcala on the last full day of the trip.

the Támara plant, explained that his team started from the Ojojona plant and designed improvements of various components. They added a new plant leveling tank and modified the plant layout to make operation and maintenance easier.

David Railsback ’08 CE, a civil engineering major who joined the AguaClara team in Honduras for the second time in two years, says he was “psyched” to see the Ojojona plant working.

He also says it was important for this year’s students to see the plant, and that there’s still more work to do there—such as lowering the turbidity, or cloudiness, of the water.

“There are things that can be improved, and things that could be placed differently,” Railsback says.

Marcala: Lending a hand

The last leg of the busy trip was a stay in the city of Marcala, with a population of about 10,000. That plant is a project of the National Rural Water Association, an organization that previous AguaClara students had worked with, to design and build a water plant for the village of La 34, back in 2005.

Fred Stottlemyer, a volunteer field coordinator for the association, is spearheading a treatment plant project along with the Honduran organization Agua y Desarrollo Comunitario, “Community Water and Development,” that will serve about 70 percent of Marcala’s population. Some of Weber-Shirk’s students worked on the design for the Marcala plant last semester.

Unlike AguaClara projects that have been new construction, the Marcala plant will be a redesign of a failed filter system that had fallen into disuse. The new plant, designed with the Cornell students, will replace the filters with a treatment plant that uses flocculation and sedimentation to clean the water.

The plant is now under construction, and the students spent several days there, lending a hand cutting PVC pipe and doing engineering calculations.

Tiffany McClaskey ’08 CE, one of the students who designed the Marcala plant, explained that her team had faced the challenge of designing treatment systems that had to fit the into the existing structure.

“I had to design around it, which was what made it hard,” she says.

Touring the countryside

During the trip, students also got to see other parts of Honduras, including the towns of Tela, Lago Yojoa, Las Vegas, Danli, and Tegucigalpa, the country’s capital.

In Danli, they visited a water plant that had been donated by the Spanish government, as well as a slow-sand filter high on a mountain. Hondurans also invited the students into their homes so the students could look at personal-use water filters, made of clay or sand.

And in Ciudad España, a planned community built after Hurricane Mitch destroyed thousands of homes in 1998, the students also helped pitch the idea of a water plant to interested local leaders. They spent a morning touring the community, looking at their water chlorination system, and explaining to members of the town water board the technology they would use to build a plant.

> “I think we are giving a huge educational uplift to engineering students, who have the opportunity to step out of their normal boxes of engineering education and design.”
>
> *—AguaClara supporter Ken Brown ’74 ME*

Though some of the chemical processes the AguaClara plants use are identical to those used in modern U.S. plants, the students face many design challenges of rural water systems. On of them is that electricity is often unavailable.

The biggest issue, explained Weber-Shirk, is that the student-designed plants use exclusively hydraulic technology—no external power sources.

“We figure out ways to do it so that the water is dissipating the energy required to do the mixing we need,” Weber-Shirk explained. “Except for one component, we do that, using supplies purchased in local hardware stores.”

One of AguaClara’s key supporters over the past few years has been the family of Ken Brown ’74 ME, who resides in South Florida. He and his wife, Elizabeth Sanjuan, have given or committed more than $500,000 to the AguaClara project. The sum has paid for such things as the construction costs for Ojojona, travel expenses and summer stipends for the students, stipends for two full-time engineering interns in Honduras, and a graduate research assistantship at Cornell dedicated to AguaClara research.

The couple has also recruited friends to donate at least $55,000 to AguaClara efforts, according to Brown.

Brown says AguaClara is a project he cares for deeply, and that he is very happy with the direction it’s going. He says he is pleased with the ability to not only help get water plants built for people who need them, but also for the educational value of giving engineering students real-world experience.

“I think we are giving a huge educational uplift to engineering students, who have the opportunity to step out of their normal boxes of engineering education and design,” Brown says.

University Photo

ORIE Assistant Professor Huseyin Topaloglu teaches Systems Engineering 520 to students in Ives Hall and in Lockheed Martin's remote classroom in Owego, N.Y.

Distance DEGREE

A new Systems Engineering program lets engineers earn an M.Eng. without quitting their day jobs.

By Dan Tuohy

Ezra Cornell, in his inauguration speech for the new university in 1868, spoke of promise and of an educational ethos with no boundaries.

"I hope we have laid the foundation of an institution which shall combine practical with liberal education, which shall fit the youth of our country for the professions, the farms, the mines, the manufactories, for the investigations of science, and for mastering all the practical questions of life with success and honor," Cornell said at the ceremony. "I believe that we have made the beginning of an institution which will prove highly beneficial to the poor young men and the poor young women of our country."

The repeated use of the word "practical" was deliberate, says Peter L. Jackson, director of the Systems Engineering Program at Cornell University. The "practical arts" have held a certain recognition since the birth of the institution.

Jackson turned to the Ezra Cornell inauguration for inspiration when he drafted a proposal for a new Master of Engineering in systems engineering as a distance-learning degree program. "To hold to those ideals and yet to prevent part-time study at the professional master's level is incongruous," he wrote. "Wealthy students from around the world will continue to come and be educated at Cornell. The question is whether working professionals in our own state will have access to a degree from the College of Engineering."

They do now.

Starting this fall, working professionals have an opportunity to earn an Ivy League master's degree without quitting their day job or relocating to Ithaca.

Pending approval from the state of New York, the university plans to matriculate the first students in the program this summer. The new distance-learning degree is in keeping with Ezra Cornell's egalitarian ideal, but it is also a response to corporate interest.

"We had GM approach us. We had Xerox approach us. We had Applied Materials approach us," Jackson said during an interview at his office in Rhodes Hall. "I conceived of a more mature audience for this program from the beginning."

In fact, Systems Engineering had approximately 200 inquiries on file a year ago.

The Systems Engineering Program has used distance learning in some form since it was established in 1998, starting with a single course and growing to include remote classrooms at Lockheed Martin Corp. in Owego and Syracuse, as well as offerings for practicing engineers across the state. But until now, distance-learning students could only earn certificates.

"We've had distance-learning courses from early on but we were nowhere near being able to offer a degree until the recent addition of several online classes," Jackson said.

Jackson said the faculty have learned much from providing distance learning over the past decade. From an administrative standpoint, the instructors coordinate the same homework and the same schedule for students, regardless of whether they are in a classroom on campus or in a classroom at a remote location. "We're very pleased with the technology," he said.

One systems engineering M.Eng. student who knew there was a good chance he might get called away from Ithaca has already made good use of the distance-learning technology. Before he was deployed last year to Iraq, U.S. Navy Lt. Matthew Zarracina, an instructor in the Cornell Reserve Officers Training Corps, arranged to continue his studies. He attends class via Web-streamed video lectures and continues to interact with professors and his adviser when he's not working in the Green Zone and around Iraq.

> "We've had distance-learning courses from early on but we were nowhere near being able to offer a degree until the recent addition of several online classes."
>
> —Peter Jackson, director of Systems Engineering

"It was important for me to find a quality graduate school program," Zarracina said in a telephone interview from Baghdad. "The distance-learning appealed to me because I knew there was an opportunity I'd be forward-deployed."

Students in the new program won't do all their learning from afar. To ensure they get some face time with faculty—and each other—it begins with a one-week summer course that gives students a chance to work together on their team projects. Another one-week summer course is taken later in the program, after students have completed the core requirements, and prepares the students for creative leadership of systems engineering projects.

The new distance-learning course accounts for the usual forces of supply and demand and it considers the unusual logistics that come with a fast-paced business world. Students, whether from Upstate or from Baghdad, have a new opportunity to master "all the practical questions of life with success and honor."

Going the Distance

Students trickle into the classroom at Ives Hall on a gray morning in February. The course is Systems Engineering 520: Systems Architecture, Behavior, and Optimization. Professor Huseyin Topaloglu, the instructor, enters and the class begins promptly at its 10:10 a.m. start time. Two large screens show another group of students, about 10 of them, scribbling in notebooks or pecking away on laptops. The students are in Owego, a remote classroom for employees at Lockheed Martin Corp. Topaloglu jumps right into the day's lesson plan for the master's level course.

He works through numerous equations on an overhead projector, stopping occasionally to ask questions of his class. Students in Owego can interact with their professor, though the video connection has about a one-second delay.

Topaloglu runs through a few samples of random variables. "I'd like to generate samples of this random variable," Topaloglu says, "How would I do so?"

It looks and sounds very much like a traditional classroom. As the class ends at 11:30 a.m., the screens showing the remote class roll silently up and students in both locations make final notations and then depart. At Ives Hall, three students approach the professor at the front of the class and ask follow-up questions. Topaloglu turns to a chalk board to demonstrate an equation.

Topaloglu said the distance-learning programming is also helpful for students traveling or away on personal or professional business. "As soon as I go back to my office, the lecture's on the Internet," he said.

The technology works very smoothly. "It's not exactly being in the classroom," Topaloglu says, "but it's pretty close."

There can be a small learning curve for professors using the technology. Mason A. Peck, assistant professor of mechanical and aerospace engineering, notes he tends to move around the classroom a lot while lecturing. When he teaches a distance-learning course, however, he has to remember to stay still so the camera can keep him in view. He says he must also remember to gesture with the mouse on the computer, rather than to wave his hands at the screen or the board behind him, so as to include the students in a remote classroom who are learning in real time.

"I make a concerted effort to look at the camera and to ask them pointed questions to encourage class participation," Peck said in an e-mail. "When an instructor gets used to it, it's not much of a burden; but there is definitely some adjustment of one's style that comes with teaching a DL class. In the case of my class, the DL students add a lot. They bring professional experience and anecdotes, which generally help confirm the principles of systems engineering that the class is studying."

Working professionals say distance learning allows them to make the most of their day job and their studies. Michael Baldwin and Jessica Scofield, who are in their third and final year in the Engineering Leadership Development Program offered at Lockheed Martin, cite convenience as a major benefit.

"It is always tough taking time out of your normal workday to attend a class, but even tougher if you have to drive to campus to do it," Scofield says, by way of e-mail. Baldwin adds that it takes 45 minutes to travel from Owego to Ithaca on a good day, and sometimes much longer in winter.

Both students said their M.Eng. studies have already helped them at work. “My role at Lockheed is a systems engineer and therefore, the concepts learned through classes taken at Cornell are directly applicable to my day-to-day work,” said Scofield, who received an undergraduate degree at Messiah College in Grantham, Pa., in 2005.

“Although my other degrees have helped me with my career, the degree I am getting in systems engineering from Cornell is very closely tied to what I do on a day-to-day basis at Lockheed,” Baldwin said in an e-mail. He received degrees in aerospace engineering and mechanical engineering from the University of Michigan in 2003, and has a master’s degree from Georgia Tech.

“I also find that I have been able to apply some of my college experiences, especially those involving group projects, to my work at Lockheed,” he says. “Another reason for getting this degree is the challenge of it. Cornell is known as a very challenging school academically for any student and I wanted to see how I would do there.”

Baldwin and Scofield cited a lack of personal interaction with professors and other students as a challenge. “That being said,” Baldwin notes, “all the Cornell professors I have answered questions over the phone and through e-mail instead of making me attend office hours.”

Degree Requirements

The Systems Engineering Distance Learning Degree Program requires 30 credit hours of instruction, with students completing the same set of core courses as on-campus students. Seven 3-credit courses are taught using distance-learning technology. Completing a project supervised by Cornell faculty earns 7 credits. And the week-long summer courses are 1 credit each.

The basic admission criteria are the same. At a minimum, students must have a baccalaureate degree in engineering, mathematics, or science, conferred by an accredited college or university. Additional selection criteria apply for enrollment in the distance-learning degree program. In particular, applicants must document at least one year of work experience in a relevant field to be eligible to enroll in the distance-learning degree program. Administrators further reserve the right to restrict enrollments based on capacity, geographical location of the student, and the technical or administrative capability of the program.

Students in the distance-learning degree program pay tuition on a per-credit hour basis and must be enrolled for a minimum of 3 credit hours per regular semester.

Students in the distance-learning degree program are charged tuition at a College of Engineering special program rate. For the 2007–08 year, that rate would have been $1,442 per credit hour.

There may also be an on-site coordinator, paid by the student’s employer, who acts as a proctor. In the event there is no site coordinator, the student is required to designate a proctor. Exams for off-campus students are scheduled to occur within 24 hours of the on-campus exam, typically during local business hours on the same day as the on-campus exam.

While the on-campus program for the master’s degree is growing steadily, Jackson anticipates small but steady growth for distance-learning students. The distance learning degree, too, will benefit from Cornell’s name and reputation.

“Cornell has a special appeal and we have a very interesting curriculum,” Jackson said. “The strongest interest we’ve seen for systems engineering is from working professionals.” ■ ■ ■

University Photo

Lockheed Martin students, shown on the large screen, can interact with the class in real time.

ATTENDING BIG RED FROM THE GREEN ZONE.

Cornell ROTC Lt. Matt Zarracina M.Eng. ’08 SE rides in a Black Hawk helicopter going to Tikrit.

Provided

While his peers walk across campus for class, Matthew Zarracina crosses the Green Zone.

Bringing new meaning to the phrase “nontraditional student,” the U.S. Navy lieutenant is continuing his Cornell University engineering studies while deployed in Iraq. When he’s not briefing American and British commanders on the state of oil refineries, he is busy participating in the distance-learning program.

“It demonstrates to a lot of people what is possible,” he said in a telephone interview from the Green Zone. “It’s definitely been challenging. For me, though, honestly, it’s been a nice distraction.”

His studies have allowed him to still feel connected to Cornell, to compartmentalize his graduate work and the challenges facing his duty in Iraq.

Better known as a Reserve Officers Training Corps teacher back in Ithaca, Zarracina travels in and around Baghdad as the country rebuilds. He usually works 14 to 16 hours a day, devoting precious spare time to reading or studying materials mailed to him by Cornell professors.

Once he gets course materials, with some work sent by e-mail, he must plan the week out ahead to carve out enough class time. The class is taped, which he watches via Web streaming.

“I just try to fit it in where I can,” he said. “It’s really hard to create a concrete schedule.”

Zarracina, 28, has had a busy life since graduating with an engineering degree from the Naval Academy in 2001. He attended flight school from 2001 to 2003. Then, while stationed in San Diego, he served two deployments in the Pacific region, including flying medevac missions as part of a multinational force to help victims of the 2004 Indian Ocean tsunami.

Zarracina said he chose Cornell University, where he became an instructor in ROTC, for the caliber of the Systems Engineering Program.

“It was important for me to find a quality graduate school program,” he said. “The distance-learning appealed to me because I knew there was an opportunity I’d be forward-deployed.”

Provided

Zarracina stands near a burning oil pipeline, between Kirkuk and Bayji, that was cut by insurgents.

He left for Iraq last year. He is scheduled to return in May or June. His goal is to graduate with a Master of Engineering degree in systems engineering, and with a business degree, by 2010. He plans to return to ROTC instruction, not to mention looking forward to enjoying weekends again.

In Iraq, he serves as an adviser and provides information to military commanders, reports that are ultimately relayed to the staff of General David Petraeus, the U.S. commander in Iraq. His work has taken him in and around Iraq, including dangerous locales. He interacts with a number of Iraqis within the ministry of oil. It is rewarding work, he says. He conducts cost-benefit analysis on projects and tracks development, production, and refinery capacity and issues.

In Iraq, he has been able to apply some optimization concepts to his work. At the time of the interview, he was studying “risk management.” “It’s very convenient and it’s cool that the technology exists,” Zarracina said.

And he keeps in regular touch with professors and his adviser. “The responsibilities with the job supersede the course work,” he said. “That’s just the way it is, but professors understand and are flexible.”

—By Dan Tuohy

Robert Barker/University Photo

Best of Both Worlds

Cornell Engineering's 2-2-1 program lets a student earn three degrees, at home and abroad.

By Melanie Bush

This spring, Ramin Farhangi will be the first to graduate with three degrees through a unique College of Engineering program.

A collaboration with École Centrale Paris, the 2-2-1 Program awards co-terminal Bachelor of Science and Master of Engineering degrees from Cornell, as well as the prestigious Diplôme d'Ingénieur from France's premier technological school. Farhangi spent his freshman and sophomore years at Cornell, the following two years at Centrale, then returned to Cornell in 2007 for his M.Eng. studies.

"I did it because I wanted a challenge," Farhangi explains over hot chocolate at Olin Library, as a late-winter snow falls on the Arts Quad. "And I knew about the prestige of Centrale. It's one of the top schools in Europe. They have a saying there: 'After Centrale you can do anything,' and it's true."

Farhangi, whose parents emigrated to France from Iran in the 1980s, was born in Paris and speaks French fluently, but it was never his intention to go to Centrale—he considered the program only after enrolling at Cornell, where he met 2-2-1 originator Michel Louge, professor of mechanical and aerospace engineering. "Actually, I always wanted to attend an American university," says Farhangi. "I saw American movies with huge, beautiful campuses."

Cornell was the natural choice: Farhangi's father graduated from Cornell in operations research in 1974, as did his brother in 2006. "I felt at home here from the minute I unpacked my bags," he continues. "I was really impressed by the university, it exceeded my highest expectations. And I

University Photo

Ramin Farhangi works on his M.Eng. studies in Duffield Hall on Cornell's Ithaca campus.

really liked the campus experience, something I couldn't have gotten in France."

Farhangi says he never felt any discomfort due to differences during his immersion in Ithaca. "I feel the U.S. has a culture that includes all cultures—it's easy to fit in here because it's already so diverse. In France or Iran it's different; they're just not as used to variety."

Studying at Cornell allowed Farhangi to experience another kind of variety—the multitude of teams, clubs, and projects in which Farhangi could participate. "I joined the piano club right away, as I've played classical piano for 10 years," he says. "Sports are also very big for me: I discovered squash here."

In his freshman and sophomore years Farhangi joined civil engineering teams that contend in the American Society of Civil Engineers Concrete Canoe Competition and the American Concrete Institute's international Egg Protection Device Competition, in which an egg is protected by a concrete arch. "I also discovered concrete," he says.

Making such discoveries is even more important for American students, says Louge. "Globalization means there is no guarantee that an engineer trained in one country will ever work in that country. For the first time, American students, as good as they are, cannot be assured they will have jobs here. Customers will not necessarily be in U.S. markets, and an engineer's first job is to understand what the customer wants. So, what are we doing, with no foreign language, no experience with other cultures?" asks Louge, a Centrale alumnus. "This is the 'English curse,' as English has been the dominant language of engineering. But English is no longer hegemonic."

His concern for students entering an increasingly global job market led Louge to plant the seed that grew into the 2-2-1 program. "Back in 2004, I recommended that Dean Fuchs appoint the international committee, in order to evaluate Cornell's relationship with foreign universities. I thought immediately about Centrale because I graduated from there in 1978—and because it's the top school in the country, " he says. "Ramin is definitely an exceptional student. He has a very strong work ethic, and can also have fun on the ride. But we see students of Ramin's quality at the top of our classes here at Cornell—those are the students who are suited for Centrale.

"I think the typical U.S. student is afraid, culturally, to go abroad," Louge continues, "even to earn a prestigious foreign degree, unless they understand the quality of the program. ÉCP is a peer institution to Cornell in every way. In fact, the recruitment of its students is even more selective. Centrale is a school for leaders; this is where modern CEOs are trained."

The two schools produce top quality graduates, but they do so in different ways. Farhangi describes the difference between the two educational systems as one of breadth versus depth. "Centrale gives you an unparalleled general education in engineering; it's focused on how to learn, on methods to build bridges between all different fields. It teaches you how to interact with specialists from any discipline, whereas at Cornell, you choose a major in your third year and focus intensely on that," he says.

Final exams at Centrale are staggered over the year-end period, not as tightly bunched as they are in the U.S. Also, students have no homework. Instead, they meet in the evening to go over what was covered in class. "The pace at Centrale is really fast. You are covering material at an astronomical pace, " says Farhangi. "But the grading structure is also very different. You only need to achieve a grade of 6 out of 20 to pass any given course, so it's understood you may get a 6 in one class and an 18 in another. I lacked motivation for some courses, but I was 29th out of 450.

"ÉCP is a really rare degree to have—companies compete for Centrale students," says Farhangi. "Boston Consulting Group [Farhangi's employer beginning this spring], for example, often recruits from Centrale. They're looking for people with powerful analytical minds. They're looking for people who can work that hard."

A shared focus on excellence is at the heart of the relationship between ÉCP and Cornell, according to Deborah Cox, assistant dean for Strategic Planning, Assessment, and New Initiatives. "The 2-2-1 is interesting because it results in three separate degrees—it's unique in that sense. Most study-abroad programs run for either one semester or one year, so this is a longer immersion in the culture," says Cox, who coordinates 2-2-1. "The purpose of any study abroad is to expand perspective and experience, and today especially, when engineers will be facing global careers, students need that international exposure."

Provided

Farhangi and friends from École Centrale in Paris.

"For an American student, coming to Centrale is a way to meet the leaders of European science and industry. The networks that come out of this, both personally and professionally, are unparalleled—and they last a lifetime."

—ÉCP Professor Christophe Laux

Cox's counterparts from Paris agree complètement. "Any type of exchange program has an academic aspect, a social aspect, and a personal aspect," says Florence Mayo-Quenette, professor of English and head of ÉCP/USA Relations. "These are an individual's prime years for personal change and development, at around age twenty. Before then, it's too early; after that, it's too late."

Mayo-Quenette visited Ithaca in February, accompanied by ÉCP professors Christophe Laux and Julie LeCardinale. The French delegation had a long discussion over lunch at Cornell's Statler Hotel with Cox, Louge, and operations research and information engineeirng Professor Les Trotter. Laux, a professor and researcher at the Molecular and Macroscopic Energy and Combustion Laboratory at Centrale, has a long perspective on U.S.–French educational relations, having spent fifteen years at Stanford.

"For an American student," says Laux, "coming to Centrale is a way to meet the leaders of European science and industry. The networks that come out of this, both personally and professionally, are unparalleled—and they last a lifetime. Today, if someone asks me to find them an internship, I can find one on any of five continents. At Centrale, we have students from all over Europe, China, India, Russia, South America. Actually, the United States is our most underrepresented country."

Mayo-Quenette jumps in to explain why. "There's a reticence on the part of American students because until recently they just didn't think it was a necessity. From the 1970s to the 1990s it was possible to remain focused on one institution, one country, but today students graduating from top institutions will be leaders globally. They can no longer have that outlook."

Cox explains that the two schools are also working on new exchange programs modeled on the one Cornell presently has with the University of Cantabria in Santander, Spain, in which a group of American and Spanish students spend a year apiece at each other's school. "This has two advantages for us. First, it neutralizes the impact on Cornell's budget; second, it creates a cohort of students who are together for two years in a row, which offsets social concerns," she says. "Cantabria has already agreed to teach the Cornell required civil engineering and electrical engineering classes in English. So, it's a discipline-focused program like Cornell's and has no language requirement."

Farhangi will return to Paris this spring to begin his job with BCG, but his education at Cornell is not over. He received a Knight Scholarship, which awarded him $40,000 to first complete his M.Eng. and then return to Cornell to pursue an MBA in the Johnson School of Management after he spends some time working in the field.

The Knight Scholarship, given to roughly 10 Cornell students each year, was created by Lester B. Knight Jr., BME '29, to encourage engineers who are interested in business. "Cornell's program is fairly unusual," explains Jeffrey Newman, director of the office of Research and Graduate Studies. "Both schools realize the synergy of the programs and have enabled the student to get both degrees in a relatively short time."

Farhangi's M.Eng. project is neatly balanced between engineering and business. A team from the School of Operations Research and Information Engineering is acting as a technical consulting team to Canadian National Railway, studying the way it allocates crews to road and yard jobs and trying to optimize the way jobs are assigned. "This," Farhangi says, "is where I get to apply the concepts I've learned."

The project has nothing to do with concrete because the Centrale experience prompted Farhangi to change his major when he returned to Cornell. "I might never have discovered how much information technology interested me had I not encountered it there," he says. "Without exposure to all the options, how can you make the best choices?"

"I think the 2-2-1 program at École Centrale can help American students learn many things: how to work in teams with people from very different backgrounds in a non-native language, and how to be autonomous in a complex learning environment," concludes Farhangi. "And you have an enlightening experience through getting to know yourself better in terms of your goals in your education, your career, and your life."

MSE graduate student Ian Hosein prepares a column to separate colloids by size as Assistant Professor Chekesha Liddell looks on.

University Photo

The Shapes of Things to Come

Cornell materials scientist Chekesha Liddell uses an old science to create new crystals

By Kenny Berkowitz and Robert Emro

As a young girl, Chekesha Liddell often kept busy at family reunions by teaching math and writing to her younger cousins. Growing up in Tallahassee, she began assembling 3,000-piece jigsaw puzzles in middle school. Her parents decided she had the makings of an engineer, and by senior year in high school she was building robots at MIT's science camp. But Liddell didn't completely make up her mind until her first year in the five-year, dual degree program offered by Spelman College and the Georgia Institute of Technology.

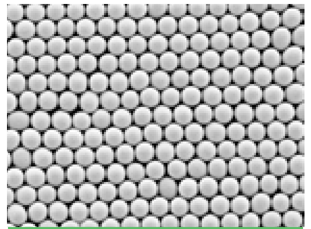
"I loved chemistry from the first class that I took at Spelman," says Liddell, now an assistant professor in materials science and engineering at Cornell. "So when I went to Georgia Tech, I started reading through the course catalog, looking for a discipline where I'd be able to do the kind of analytical investigations that excite me, and I found materials science, which is really a mixture of chemistry, physics, and engineering. I could see exactly how to apply the chemistry that I had learned, so I took my first materials class, and I just loved it. From then on, I knew it was exactly what I wanted to do."

It's a cold January morning, with a dusting of snow on the Engineering Quad, and in the white-cinderblock quiet of her Bard Hall office, Liddell pages through her laptop, explaining the pleasures of self-assembly. Still jet-lagged, she's recently returned from a conference to promote nanoscience collaborations between India and the United States. Before that, she was in Japan for the National Academy of Sciences Frontiers of Science Symposium, and before that, at the White House, where she was honored as one of 20 winners of a Presidential Early Career Award for Scientists and Engineers from the National Science Foundation. (Cornell's Brian Kirby, assistant professor of mechanical and aerospace engineering, received the same award from the Department of Energy.)

It's the latest in a series of honors that began in high school with a National Achievement Scholarship and continued in college with a NASA Women in Science and Engineering Scholarship. There, at NASA's Kennedy Space Center, two summers spent as an intern in the microchemical analysis laboratories helped point her toward nanoscience.

"That's really where I got excited about understanding materials at small scales and being able to solve problems with that understanding," says Liddell. "We actually investigated some space shuttle tiles, which were a very big issue at the time, in the wake of the *Challenger* disaster. It was like being in an episode of *CSI*, where we were assigned to figure out why these tiles hadn't stayed bonded. We were detectives, discovering how engineering could mean the difference between life and death."

Ten years later, Liddell keeps a piece of that tile in a drawer behind her desk. After graduating summa cum laude in 1999 with two bachelor's degrees—one in chemistry and one in materials science engineering—she stayed at Georgia Tech to earn her doctorate in 2003. Faced with a choice between academia and industry, she accepted an assistant professorship at Cornell, arriving in November 2003 and quickly going to work.



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—Chekesha Liddell

"I was really, really impressed with Cornell when I came for my visit, and particularly drawn with the presentation by the department here," says Liddell. "I saw a lot of interdisciplinary work going on, a lot of collaboration, and the people I met were very enthusiastic. There seemed to be a healthy balance between the research goals and teaching goals of the university. I felt strongly that it would provide the resources I needed, and it seemed like a good place for the creation of new knowledge."

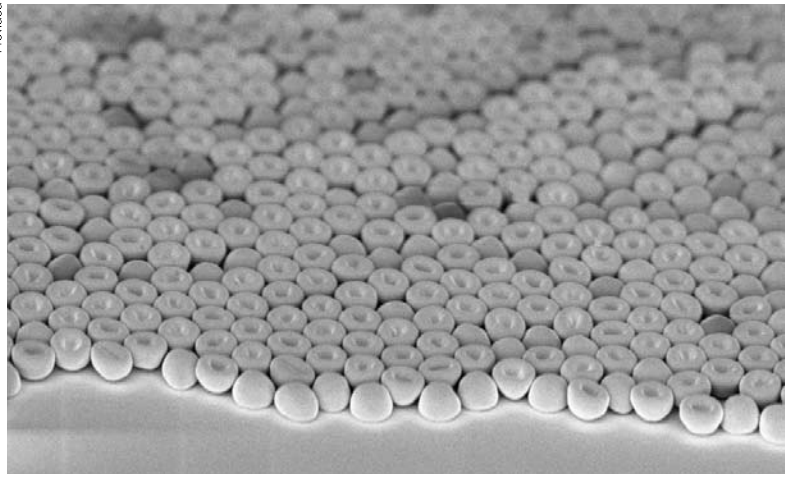
In her dissertation work at Georgia Tech, Liddell made colloids of non-spherical particles with the idea that they could be processed into photonic crystals. Because of their highly ordered microstructure, these crystals interact with light in ways that give them useful properties. Opal is a naturally occurring example, consisting of roughly spherical particles. Synthetic photonic crystals can be created with complex nanofabrication machinery, or more simply with colloids, the science of which was already established when Cornell was founded in 1868.

Colloids appear to be solutions but are actually mixtures of suspended particles. Smoke, milk, and paint are all familiar examples. By evaporating the liquid that holds the particles, materials scientists have long used colloids to synthesize self-assembled crystals from spherical shapes, which pack together like billiard balls. When the structure is near perfect, these crystals have useful photonic properties, but if just a small fraction of particles are out of place, or if they differ in size, the crystal is not able to control light. Achieving this level of perfection is difficult, which is why Liddell turned her attention to particles shaped like peanuts, pears, mushrooms, and eggs.

In theory, researchers should be able to create photonic structures from these non-spherical shapes as well. Computer modeling shows that the additional complexity of the non-spherical building blocks should give the material the desired photonic properties even if its structure is not quite perfect. And the different shapes give rise to new packing patterns which affect the ways the new materials interact with light. In practice, however, preparing uniform non-spherical particles and drying the liquid slowly enough to allow them to self-assemble into highly ordered structures has been challenging. For the past five years, that's what Liddell has been trying to do.

Liddell holds up a small vial with the thin film that remains after the liquid has been evaporated from one of her colloids. It shines with the iridescence of mother of pearl. "My central interest is in understanding the role of symmetry and crystal structure in the interaction between light and colloidal materials," says Liddell. "I'm interested in expanding understanding from the opal-type structures through a range of structures with new geometries."

Provided



Colloidal crystal self-assembled by controlled drying (convective assembly) of a suspension of "mushroom-cap" shaped polystyrene particles. The particle size is 1.2 micrometers in outer diameter and 890 nanometers in height.

The goal is to create low-cost packings over large areas that control light far better than anything that currently exists in the photonic crystal field, and if the theory is right, the applications for these photonic structures are numerous. Using titanium dioxide, these new geometries could conceivably power the next generation of solar cells. In medicine and biotechnology, photonic crystals of metals like silver could greatly increase the sensitivity of tests designed to detect the presence of proteins, DNA, or pesticides. And crystals made with germanium and silicon could ultimately advance optical communications, leading to a new world of photonic computers.

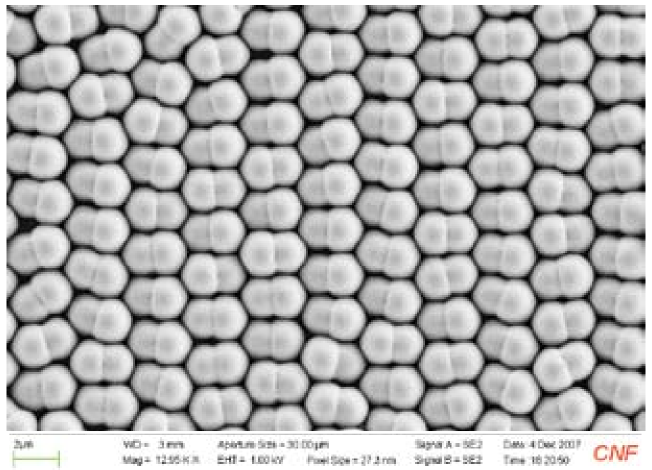
"The implications are enormous," says graduate student Ian Hosein, a member of Liddell's research group. "People are already familiar with semiconductor technology and the fact that so many of our devices, like cell phones and computers, work on semiconductors that control electrical current and transform it into a form of electronic information. We're trying to do a similar thing with light: to make a semiconductor that can channel light into optical information. So in the same way that we have electronic switches and electronic memory storage, we can envision optical switches and optical storage."

Though it's too early to know the full impact of their efforts, Liddell and her group have been working steadily, producing eight papers and 43 presentations in the last four years. In the cover story of the October 2007 issue of *Langmuir*, Liddell's group showed how they created two-dimensional packings predicted to respond strongly to light from asymmetric, peanut-shaped particles.

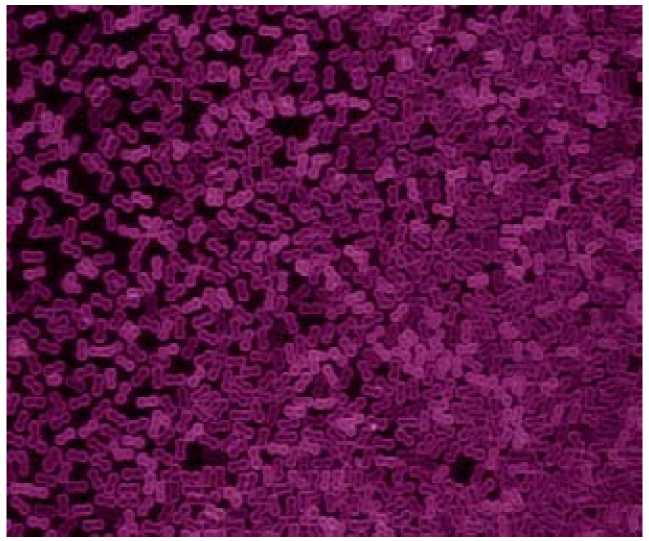
Colleagues are taking notice. "She has a single-minded focus toward attacking this problem," says Emmanuel Giannelis, director of materials science and engineering and Walter R. Read Professor of Engineering. "Early on, I tried to suggest that assembling some of these structures might be very difficult. But she was convinced she could make a contribution, and she has no fear. She's very methodical. She's persevered, which has led to some very exciting results, and proven to be right."

"When you are just starting your career, it's all too easy to focus on a specific problem and miss the big picture,"

Provided



Asymmetric dimers in an assembly.



Confocal microscope image of fluorescent hollow-silica shell, peanut-shaped particles.

University Photo

Hosein, Liddell, and MSE graduate student Stephanie Lee evaluate the first batch of particles collected from the column.

says collaborator Fernando Escobedo, associate professor of chemical and biomolecular engineering. "I am very impressed that Chekesha has a vision of what she wants to do and a good balance of the scientific and technological understanding she needs. She has great potential, and you can see the ability she has to ask the right questions and integrate that new knowledge. She's very humble, very nice, very polite—and also very, very busy."

Liddell teaches two courses a year, an undergraduate class in the atomic and molecular structure of matter and an upper-level seminar in colloid assembly that culminates in each student writing an NSF-styled grant proposal for funding new work in colloid research. "I try to really engage students in their own learning, instead of having them just tacitly listening to a lecture," she says. "That's the fun part for me, the creative part. It leads to a much stronger interaction with the material, and really draws students into the process."

For the students around her, the underlying lessons are clear. "Sometimes people don't try things because they think, 'Well, that will never work,'" says graduate student Stephanie Lee, a member of the Liddell group. "But Professor Liddell is not that kind of person. She thinks, 'I don't see why it shouldn't work.' So even though people said we couldn't make assemblies with non-spherical particles, we aggressively pursued different processing strategies until we found something that worked. She just goes after what she thinks is right. She's not intimidated by the hard things."

"Sometimes people don't try things because they think, 'Well, that will never work,'. . . but Prof. Liddell is not that kind of person, She thinks, 'I don't see why it shouldn't work.'"

—Stephanie Lee, MSE graduate student

As the daughter of a college administrator and a social worker, Liddell takes her responsibilities as a mentor very seriously. "That was one of the big draws of this job, that I'd be helping people prepare for the future," she continues. "So I try to spend time emphasizing communication skills, sending students to conferences early on, and talking with them often about professional issues. When I think about this career, I ask myself, 'What do I want to do with my life? How do I want to contribute to the world?' Developing people is a very worthwhile goal—that's what drew me to education."

Liddell is enormously grateful for the help she herself received as a teenager, spending her summers in a long series of science camps, and as a young woman trying to lay the foundations for her career. "Education was really emphasized in my family, and for as long as I can remember, people have invested in me and expected good things from me," says Liddell. "My parents made sure I had opportunities to explore different career options. At each step along the way, I had people helping me understand how to navigate the next stage, and now when I mentor students, I want to understand their life goals."

Liddell would like to introduce more young people to engineering, using home science kits to produce materials like the irridescent film in the vial and jigsaw puzzles with enlarged images of her photonic crystals to teach the basics of materials science. "We want to take these images and use them as tools to talk about the differences between self-assembly and directed assembly or microfabrication," says Liddell. " We're working on colloidal materials that children can make at home, by adding water and then letting it dry out. Then, with a laser pointer, they could see the diffraction patterns and recognize how the light is scattered into different patterns by different structures."

Writing her proposal for the Presidential Early Career Award helped focus her thinking about outreach, and now that she's won it, with the opportunity to publicly recognize some of her most important mentors at the ceremony, Liddell has found herself doubly committed to making a contribution to the world. "These structures we're building and the principles behind them could be fundamental for many different research areas," she says. "There are always going to be new questions, new problems that people haven't thought of before, and my goal is to develop the fundamental understandings that can be passed down to the next generation of researchers. Tools change, so just as we can go back to contributions people made twenty years ago, we can pass on our new ideas to the next generation of researchers—who knows the exciting places they will lead?"

CORNELL GLADIATOR

NBC Photo: Mitch Haaseth

Structural engineer Jamie Reed Kovac '01 was "Fury" on NBC's *American Gladiators.*

As girls, Jamie Reed Kovac '01 CE, M.Eng. '02 and her three sisters would turn their backyard into NBC's hit show *American Gladiator*, where regular folks competed against muscular, cocky, warrior men and women in an arena, cheered by crowds.

Kovac would step up, flex, and glare at her challengers—she was a gladiator, maybe Lace, described by the announcer as feminine yet tough and strong. Her sisters would be challengers, trying not to be eliminated, aiming for the championship. The girls would pummel each other, wrestle, joust with brooms, turn the monkey bars of their jungle gym into "Hang Tough," where combatants attacked with their legs while hanging from rings.

Jump to January 2008. On the TV screen now, Kovac tosses back her brown hair, squares her shoulders and washboard stomach, places hands on hips and stares haughtily. Gray letters settle beneath her image: Fury.

Kovac was a gladiator for real last winter, on NBC's new *American Gladiators,* where now the goal was to keep ordinary folks from winning $100,000. Some might call it destiny. In the senior yearbook, her high school classmates in Newport, Ore. had deemed her "Most Likely to Be an American Gladiator."

Kovac is also a structural engineer, a project manager, and designer for Weidlinger Associates in Manhattan, designing buildings. She competes in figure, a sort of body-building, although she aims more toward the modeling side. She's a wife, married to Frank Kovac '00, former Cornell hockey player, now a trader for Deutsche Bank.

This balance of careers is nothing new. The Kovacs work hard and play hard: tennis, windsurfing, mountain biking, skiing, snowboarding. A few of her civil engineering professors told Jamie to quit sports and grow up, as she recalls it, but she didn't.

She did quit the Cornell softball team but took up pole vaulting instead, because her younger sister Niki (now an Olympic hopeful) was doing it and the event's blend of speed, power, and daring looked like fun. Jamie competed for two seasons and set school records indoors and out.

Track coach Nathan Taylor still marvels that she learned a new sport at the Division I level.

"There was a huge learning curve but Jamie had the basic criteria: fast, powerful, nearly fearless," Taylor says. "She was very dedicated. She did in one year what should take five years."

Kovac's star turn was cut short by a knee injury in the seventh episode, the semifinals. But not before she was able to relive her girlhood.

She heard about the new *American Gladiators*—a bigger and wilder version of the old show, which ran from 1989 to 1996 and starred another Cornellian, Lee Reherman '88, as Hawk—but missed the tryout in Brooklyn. Then she found herself in Las Vegas for a figure photo shoot and had another chance. Kovac went through the tryout, then sent in an audition tape and waited.

The tape in itself is a gladiator story. She was carrying the tape in a purse while waiting for a train when a man grabbed it. Kovac chased the thief for blocks, yelling, and he dropped it. "[Pursuing him] was really stupid," she says, "but I didn't think about it. All I thought was, 'My God, he's got my stuff.' "

NBC summoned Kovac to Culver City, Calif., for seven weeks, and Weidlinger gave her time off. She trained, did photo shoots, and taped an advertisement, then the show's eight episodes were taped over three weeks.

The show's massive set—the apparatus set above a giant water tank, surrounded by crowds, with spotlights lighting up everything—gave Kovac a taste of life as a pro athlete. Two of her favorite events were "Earthquake" (wrestling on a tilting platform) and "Hang Tough" (preventing contestants from crossing over a pool via hanging rings).

At one point, a producer urged her to toy with a contestant, to make good TV. "She's bigger than me," Kovac says, "and she's hungry, she wants $100,000. Toy with her?"

Kovac tore major ligaments in her right knee while competing at "Power Ball"—stopping contestants from carrying balls to vertical pods. Her feet stuck on the stage floor as she turned. She finished the game but the damage was severe.

After surgery in January, she attacked her rehab regimen for two hours per day, aiming for a spot on Season 2 of the show. She was walking in a month. She had no desire to sit still.

Life, after all, is balance.

—*Scott Conroe*

CAREER AWARDS

Four engineering faculty members have received National Science Foundation Faculty Early CAREER Awards. CAREER funding represents NSF's most prestigious award in support of the early career-development activities of teacher-scholars who "most effectively integrate research and education within the context of the mission of their organization." About 350 such five-year grants are given annually to faculty throughout the United States.

Rafael Pass, of the Department of Computer Science, received a $450,000 award for a project called "Computation and Collaboration in the Era of the Internet." His research could make Internet business exchanges more secure and lead to more reliable voting systems and online auctions. Currently, Pass explains, encrypted data traveling over a network are only as secure as the initial setup. If two parties try to exchange encrypted data without a trusted setup, a third party could slip in between them and make the person on each end use the intruder's encryption key, thinking it was the key for the other communicator. Pass proposes to attack the problem through game theory, which deals with how individuals collaborate or compete when none of them has complete information about what the others are doing or planning, to create new kinds of secure communication that also preserve privacy.

Paat Rusmevichientong, of the School of Operations Research and Information Engineering, received a $400,000 award for his project, "Real-Time Stochastic Optimization with Large Structured Strategy Sets and High-Volume Data." His research is aimed at decision-makers who must select, in real time, from among a large number of alternatives. The difficulty of the optimization problem for these decision-makers is compounded by underlying uncertainty and by the high volume of data needed to characterize the operational situation. Rusmevichientong proposes to develop a suite of methodologies and algorithms that can be customized to exploit the special structure of each decision-maker's problem. To accomplish this he will create a unifying framework for studying and analyzing this class of problems.

Abe Stroock, of the School of Chemical and Biomolecular Engineering, received a $400,000 award for his project, "Fundamental Studies to Advance the Science and Engineering of Water at Negative Pressures." Stroock's group is pursuing research designed to push the knowledge and practical use of liquid water into a physical regime that has been only sparsely explored experimentally and nearly entirely unexploited technologically: the thermodynamically metastable state of liquid water at negative pressure. The team will build on their recent development of a plant-mimetic method to drive liquid water deep into the negative pressure regime. This research has the potential to open a new regime of operation for water management technologies for heat transfer, soil remediation, microfluidic lab-on-a-chip systems for separations and purifications, and electrodes for low temperature fuel cells.

G. Edward Suh, of the School of Electrical and Computer Engineering, received a $425,000 award for his project, "Flexible Multi-Core Substrate for Trustworthy Computing Systems." The project aims to realize the full potential of large-scale multi-core processors as a secure and trustworthy computing substrate by investigating strong isolation techniques and building a flexible framework for dynamic inspection of various correctness properties. The research is intended to deliver the benefits of hardware support in security and verification without requiring dedicated resources for a single fixed mechanism.

University Photo

Rafael Pass

University Photo

Paat Rusmevichientong

University Photo

Abe Stroock

University Photo

G. Edward Suh

C-ENG.PEOPLE

SUMMER 2008

NEW NAE MEMBERS

Jason Koski/University Photo

Jon Kleinberg '93 CS

Cornell professor of computer science Jon Kleinberg '93 is one of 65 new members of the National Academy of Engineering this year. He was elected "for contributions to the understanding of the structure and behavior of the World Wide Web and other complex networks."

Election to the academy is among the highest professional distinctions for an engineer. Academy membership honors those who have made outstanding contributions to "engineering research, practice or education," according to the academy's Web site.

Also elected this year were four other Cornell alumni: Howard J. Bruschi B.E.E. '62, M.Eng. '64; Cynthia Dwork, M.Sc. '81 CS, Ph.D. '83; Barbara J. Grosz '69; and James A. Miller, M.Eng. '70 AE, Ph.D. '74.

Kleinberg studies how Web sites link to one another and the way people link to one another on the Web. His insights were partly responsible for the Google search engine's strategy of ranking Web pages based on the number of pages that link to them.

Besides his Web expertise, Kleinberg has collaborated with biologists on problems in protein folding and databasing of biological molecules. Currently he is working with behavioral scientists to study the sociology of the Web and how it has changed over time.

—*Anne Ju,* Cornell Chronicle

DARPA YOUNG FACULTY AWARDS

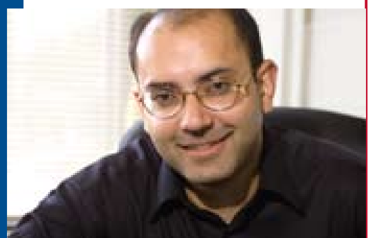
University Photo

Sunil Bhave

University Photo

Ehsan Afshari

University Photo



Farhan Rana

Three assistant professors of electrical and computer engineering, Ehsan Afshari, Sunil Bhave, and Farhan Rana, have been chosen by the Defense Advanced Research Projects Agency to receive DARPA 2008 Young Faculty Awards. The awards consist of grants of about $150,000 each to advance "innovative, speculative, and high-risk research ideas."

Afshari works in a field he has nicknamed "optotronics," which applies the principles of optics to manipulating electrical signals in a silicon chip. He modifies the geometry of circuits to create the electrical equivalent of lenses, prisms, and other optical devices on silicon. His DARPA grant will help support a project to create an electrical lens that carries out a Fourier transform at very high speed with extremely low power consumption. Fourier transform is a process that separates out the individual frequencies of a complex signal.

Bhave will develop a silicon opto-acoustic oscillator using silicon-based microresonators that will combine mechanical and optical resonance to generate a very pure, frequency-stable, radio-frequency signal. Vibrations in the mechanical resonator distort the shape of the device and, therefore, its optical resonant frequency, which in turn varies the intensity of light passing through the cavity. The light is fed back repeatedly through a loop to intensify the signal at the resonant frequency.

Rana is developing nanoscale devices that operate in the terahertz frequency range (over 1,000 gigahertz). Devices operating at terahertz frequencies make possible ultrahigh-speed electronics and ultrawide band communications. Terahertz radiation penetrates living tissue without the damage associated with such ionizing radiation as X-rays and can be used for chemical and biological sensing, medical imaging, and security screening. The trouble is, current electronic devices like transistors can't reach these frequencies. Rana plans to generate terahertz signals in graphene, which is a single atomic layer of carbon atoms, by creating and amplifying waves of electrons by a process similar to the way photons are created and amplified in a laser. He calls these devices "lasers for circuits."

DARPA's Microsystems Technology Office sponsors the Young Faculty Award program, designed to seek out ideas from nontenured faculty and identify the next generation of researchers working in microsystems technology. DARPA made awards this year to 39 of these "rising stars in university microsystems research."

—*Bill Steele,* Cornell Chronicle

NY PROFESSOR OF THE YEAR

Robert Barker/University Photo

T. Michael Duncan

Students of T. Michael Duncan, associate professor of chemical and biomolecular engineering, can claim their teacher as the best in the state, according to the Carnegie Foundation for the Advancement of Teaching and the Council for Advancement and Support of Education.

Duncan was named New York state's Professor of the Year through a Carnegie and CASE program that salutes the most outstanding undergraduate instructors in the country who "positively influence the lives and careers of students," according to the program Web site.

Duncan, who serves as associate director of undergraduate programs for the School of Chemical and Biomolecular Engineering, received the honor along with teachers from 39 other states and the District of Columbia. Winners of the award, whose names were submitted by nomination, were announced Nov. 15 in Washington, D.C.

CASE launched the teacher awards program in 1981. That same year, the Carnegie Foundation for the Advancement of Teaching began hosting the final round of judging, and in 1982 it became the primary sponsor.

Since joining Cornell in 1990 after 10 years at AT&T Bell Labs, Duncan has taught 12 different courses to a total of more than 2,600 students. He is also the co-author of an introductory textbook on engineering design and analysis, published in three languages and used on five continents.

—*Anne Ju,* Cornell Chronicle

WEISS FELLOW

University Photo

Al George

Albert R. George, the J. F. Carr Professor of Mechanical and Aerospace Engineering and adviser to the Cornell FSAE race-car team, was among three Cornell faculty members awarded 2007 Stephen H. Weiss Presidential Fellowships for excellence in teaching and advising undergraduate students and outstanding efforts to improve instruction on campus.

The other recipients were Ross Brann, the Milton R. Konvitz Professor of Judeo-Islamic Studies and dean of the Alice H. Cook House, and David Winkler, professor of ecology and evolutionary biology and the faculty curator of birds.

The awards—$5,000 a year for five years for each faculty member—are named for Stephen H. Weiss '57, emeritus chair of the Cornell Board of Trustees, who endowed the program. The awards honor excellence in teaching, advising, and outstanding contributions to undergraduate education. To date, 46 faculty members have been named Weiss fellows, including 13 engineering faculty members.

George, who has been on the Cornell faculty for 42 years, is best known on campus "for his pioneering work in developing a course on automotive engineering design that is based on learning by experience." Each year up to 30 students work on designing, building, and testing a Formula SAE racing car for international competition. His work, the Weiss committee noted, has brought "international fame to Cornell and resulted in attractive job opportunities to students who participate in the program."

His "experiential learning" teaching style, which he actively shares with other faculty members, gives students skills that allow them to apply theories to practical problems. Students also gain managerial and organizational skills by working in teams under high pressure to meet deadlines.

George has received six outstanding teaching awards just in the past decade. "His dedication to teaching and his patience and kindness in work with students are attested to by letters from many current and former students," wrote the Weiss committee. "The repeated success of Cornell students in the annual FSAE contest is remarkable."

The three faculty members were honored at an awards dinner in the spring.

—*Susan Lang,* Cornell Chronicle

SLOAN FELLOWS

University Photo

Robert Kleinberg '97

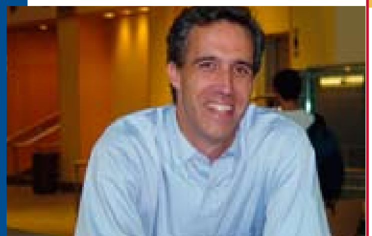
Robert Kleinberg '97 assistant professor of computer science, was among two Cornell faculty members awarded fellowships from the Alfred P. Sloan Foundation. Matthias Liepe, assistant professor also received the award.

Kleinberg received his Ph.D. at the Massachusetts Institute of Technology in 2005 and joined the Cornell faculty in 2006. He studies the mathematical foundations of algorithm design, especially questions regarding what can or can't be computed given limited access to information about a problem. He will apply the Sloan Fellowship to study how computers can learn from experience. This particularly applies to network routing where computers often must make decisions about how to route traffic without knowing the condition of the entire network.

Sloan fellowships are awarded to scientists who show outstanding promise early in their careers of making fundamental contributions to new knowledge, and consist of $50,000 distributed over two years. More than 600 nominations each year are reviewed to arrive at a final selection of 118 fellows.

ACM FELLOW

Provided



Dan Huttenlocher

Daniel Huttenlocher, the John P. and Rilla Neafsey Professor of Computing, Information Science and Business and a Stephen H. Weiss fellow at Cornell, has been named one of 38 fellows of the Association for Computing Machinery

ACM fellows are chosen from the world's leading universities, industries, and research labs "for their contributions to computing technology that have brought advances in the way people live and work throughout the world."

Huttenlocher was named for his contributions to computer vision. His research has included object tracking and identification in video surveillance, such as distinguishing trucks (which could represent a hazard) from passenger vehicles and identifying and tracking human beings, as well as the use of computer vision to guide robots around obstacles and toward specific landmarks. Huttenlocher was one of the advisers of the Cornell DARPA Urban Challenge team, which built a robot car that can drive itself through city streets.

Huttenlocher also works on social networks in cyberspace, interactive document systems, electronic trading systems, and software development methodologies. He teaches courses on computer vision, the strategic role of information technology, and the management of technology-driven businesses.

WANG AWARD

University Photo

Matthew DeLisa

Assistant Professor Matthew DeLisa has been named as the 2008 and inaugural winner of the Daniel I. C. Wang Award sponsored by John Wiley & Sons, Inc. and by the journal *Biotechnology and Bioengineering*. This award honors an accomplished younger member of the bioengineering academic community for commitment to the journal and the community it serves. The award will be presented immediately before the Gaden Award Lecture at a BIOT Division session of the 2008 Annual ACS Meeting to be held in Philadelphia, August 17-21.

DeLisa was also selected to attend the 2008 Transatlantic Frontiers of Chemistry Conference, July 31 to Aug. 3, in Cheshire, U.K. The conference is a joint meeting with the American Chemical Society, Royal Society of Chemistry, and German Chemical Society. In each country, participants were chosen by the conference committee as rising stars in the chemical sciences.

FIRST CROLL PROFESSOR

Jefferson W. Tester '66 ChE, M.S. '67, will hold the first Croll Professorship of Sustainable Energy Systems in the College of Engineering, pending approval by the Cornell University Board of Trustees.

"The overall breadth and high quality of Cornell's academic programs and the university's commitment to sustainability on campus are most compelling and are the main impetus behind my desire to return to Cornell to be part of this exciting, challenging, and vitally important new adventure," said Tester.

Tester is currently the H. P. Meissner Professor of Chemical Engineering at the Massachusetts Institute of Technology, and co-chair of an institute-wide task force on energy education. He served as director of MIT's Energy Laboratory from 1989 to 2001, program director of MIT's School of Chemical Engineering Practice from 1980 to 1989 and a group leader in the Geothermal Engineering Group at Los Alamos National Laboratory from 1974 to 1980.

Tester's appointment begins later this year, but he was on campus March 28–29 for the 25th Annual College of Engineering Alumni Association Conference, where he gave a presentation on geothermal energy and its potential for becoming a major supplier of electrical power in the United States.

As the Croll Professor, Tester is expected to play a leadership role in the Cornell Center for a Sustainable Future, which is bringing together experts in education and research from across campus to work toward common sustainability goals. On March 29, he joined CCSF Director Francis DiSalvo, the John A. Newman Professor of Physical Science, in Statler Hall to present an update on the center. A discussion of Cornell's evolving opportunities in sustainable energy research and education led by Tester followed.

Tester earned his Ph.D. from MIT in 1971. His research interests include renewable and geothermal energy systems, advanced drilling, hydrothermal reforming, upgrading of biomass and

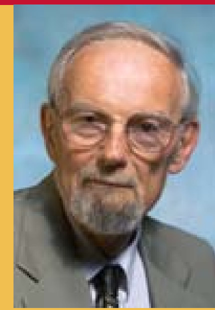
Jefferson W. Tester

Provided

fossil fuels, clean chemical processing in supercritical fluids, and environmental remediation and control technology. He has published extensively, having co-authored over 200 research papers and 10 books.

"Jeff Tester has been a leader in energy research and education for three decades," said Kent Fuchs, the Joseph Silbert Dean of Engineering. "His addition to the Cornell faculty will enable us to establish preeminent excellence in sustainable energy systems."

—Robert Emro



FRANKLIN MEDAL

The Franklin Institute awarded the 2008 Benjamin Franklin Medal in Electrical Engineering to James S. Thorp B.E.E. '59, M.S. '61, Ph.D. '62 and Arun G. Phadke, a professor emeritus of electrical engineering at Virginia Polytechnic and State University.

A former director of the School of Electrical and Computer Engineering at Cornell, where he worked for 42 years, Thorp joined Phadke in 2004 at Virginia Tech, where Thorp is the Hugh P. and Ethel C. Kelley Professor and head of the Department of Electrical and Computer Engineering.

The longtime collaborators received the award for their "pioneering contributions to the development and application of microprocessor controllers in electric power systems." These devices make synchronized measurements to monitor and protect components throughout the power grid, playing a key role in diminishing the frequency and impact of blackouts.

Phadke and Thorp helped develop hardware and software that led to widespread industry use of a new kind of protective relay. Until the early 1980s, protective relays had limited abilities. Phadke and Thorp recognized that, by using a computer in place of the electro-mechanical heart of the original relay, the new device could do more than just monitor and record. Computer-based relays scattered around the grid could act as individual intelligent units to diagnose problems, communicate them to a central hub, and adapt. Phadke and Thorp also tied these relays to a GPS clock—the subsequent precise synchronization helps provide a wide-area snapshot of the grid, a key tool to protect against blackouts when the power grid is under stress.

For 182 years, the Franklin Institute has presented awards to individuals whose great innovation has benefited humanity, advanced science, launched new fields of inquiry, and deepened the understanding of the universe.

TECHNIZZEL

HOMETOWN HERO

BRIGHT IDEA

Tech Sizzle: Student Hypes Hot Technology on Science Blog


Lindsay France/University Photo

Most college students use Web sites to hang out with friends and talk about their favorite musicians. But a Cornell engineering student who grew up playing on the floor of his father's factory and whose favorite magazine is MIT's *Technology Review* is using the Web to turn a new generation on to science and engineering. With technizzel.com, Ben Jabbawy '08 ORE has given engineering students a place to rave about the hippest new technology and science. And high school students all over the world, bored with out-of-date textbooks and curious about subjects like iPhones, Nintendo Wii, and wind farms, are reading the stories avidly.

"What we're trying to do is excite American high school students about engineering, science, and math," says Jabbawy, an articulate speaker and broad thinker who majored in Operations Research and Engineering. While at Cornell, he also played intramural soccer and was recruitment chair for his fraternity, Tau Epsilon Phi.

Technizzel, which joins a growing network of science blogs, is emblematic of a new wave of science communication being designed by young people for young readers. They don't have the patience to wait for results to be published in traditional journals. Instead, they're creating their own quick and dirty way to share information about rapidly evolving technology. (Cell phones with digital cameras make it easy to include snazzy images.) Jabbawy's on the crest of a new media for a new generation.

"A lot of people involved in technology are also entrepreneurs, so having these webzines as outlets allows people to find great ideas, to connect to other people all over the world, and to continue with the innovation process," says Jabbawy.

Technizzel is a project that Jabbawy created in his spare time. It's an outlet for his entrepreneurial spirit, one that he discovered not in classes, but in a series of internships he has held. "It's crucial for an engineer to test out different career paths," he says. "In school, it's all about engineering courses. My internships really provided a place for me to see how people run a business."

In high school, Jabbawy spent a summer working for Nantero Inc. in Woburn, Mass., where he used a scanning electron microscope to examine computer chips and etch off misaligned carbon nanotubes. "It was just about the coolest thing I could have done in high school!" says Jabbawy.

While at Cornell, he researched potential investments at Lux Research in New York, a nanotechnology market research firm owned by College of Arts and Life Sciences alumnus Joshua Wolfe '99. Other internships included one in the wealth management division of UBS in New York, developing a computer program to predict changes in the short-term market; and most recently a summer spent working on business development for an alternative energy start-up company, GreatPoint Energy Inc. of Cambridge, Mass., which creates natural gas from coal. That internship led to his first job—after graduation, he'll join the venture capital firm, GreatPoint Ventures, as a venture associate, where he will scope out emerging technologies and advise investors on which hot ideas they should support.

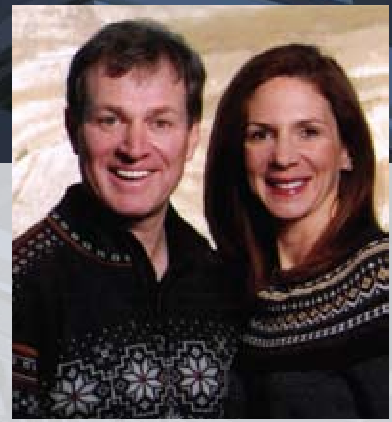
Engineering and entrepreneurship run in Jabbawy's family: his father, Samuel, is an engineer who owns NES Technologies Inc., a contract manufacturing firm. And his mother, Carole, has a doctorate in education and owns Internship Connection, a company that helps high school and college students find internships. Both his older brothers are also Cornell alumni with the business bug; Nat '02 owns an interactive Web design and advertising firm, NeueTuesday, and Michael '04 is a corporate lawyer.

The family mix of engineering, education, and entrepreneurship has very naturally led Jabbawy to Technizzel, a project he hopes to continue while he moves into the work world. Technizzel currently gets more than 5,000 hits per month and is written by student volunteers. Jabbawy hopes to expand both the topics explored and also the recruiting possibilities, both for the schools whose projects are featured on the webzine and for the writers, who can direct potential employers to their articles.

"It sounds kind of cheesy," says Jabbawy, "but I really would like Technizzel to make a difference. I had direct exposure to engineering. But for students in high school who don't necessarily know anyone who is an engineer, the concept of engineering is a foreign thing. The goal of Technizzel is to show these students how cool engineering is."

—*Bridget Meeds*

GIVING BACK



Cornell's School of Applied and Engineering Physics gave Brian Kushner '78 M.S. '80, Ph.D. '84, the foundation for a successful career. After graduation, he rose to head the advanced technology and high-risk systems division of a major defense systems and information technology company, helped lead a turnaround of an advanced computer R&D consortium, and, with his wife Wendi (Blum) '82, an English major, founded a computer remanufacturing company. Nearly ten years ago he started an interim management and advisory services firm that specializes in restructuring struggling companies. Today, the successor company, CXO LLC, works with private equity firms, hedge funds, and money center banks on four continents.

Now that Kushner is able to give back to the College of Engineering, he has chosen to support AEP. Not only did he give money for the school's director to use for expenses like innovative graduate courses, student travel, and hosting conferences, he and his wife have also given a substantial gift to the Physical Sciences Building, where AEP faculty will enjoy enhanced research and teaching space. This new space is critically important for both recruiting and retaining faculty.

"Applied and Engineering Physics really taught me how to think—to analyze problems, identify different solutions, and come up with one that maybe had not been seen by others. I have found that enormously useful in every aspect of my career since graduating," says Kushner. "I've been fortunate that life has been very good to me monetarily and I'm very pleased to be able to give back. Wendi and I have given money for scholarships, but helping students is not enough. You also need world-class facilities to attract top-notch faculty in order to make the university truly great."

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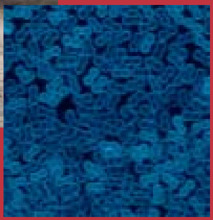

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