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Message from the Dean

Lawrence Larson

The Revolution of the School of Engineering at Brown

With this issue, we officially kick off our $160-million campaign for the expansion and renewal of the School of Engineering at Brown, which was announced by President Paxson on April 10. Over the next decade, we intend to add to our world-leading faculty, expand our graduate programs, create innovative new learning experiences for our undergraduates and create great new space for engineering and technology right here on College Hill. It’s an exciting time to be part of engineering at Brown, and we will need the help of everyone of our alumni to make this vision a reality.

I’m often asked why this change is necessary. What forces are driving Brown to make this investment in engineering at a time when budgets are tight and universities face challenges on many fronts?

First of all, the technological world has expanded dramatically in the last 50 years. The disciplines of biomedical engineering, computer engineering and environmental engineering (just to name a few) hardly existed when Barus and Holley and Prince Labs were first built in the early 1960s, yet we are still occupying the same space, and at roughly the same size faculty, as in that earlier time. At the same time, the engineering disciplines that were important in an earlier era (mechanical engineering, materials science, electrical engineering, and chemical engineering among others) are still incredibly vital today. The world of science and technology has expanded dramatically, and Brown must stay at the leading edge of this new world.

Many of the challenges that face the world today must be addressed through scientific and technological innovation: challenges of health care, economic development, global warming, and information.

President Paxson has written, “If our students and our faculty aren’t put in situations where they can confront issues that are facing society, if they can’t work collaboratively with others to grapple with solving those issues, then we’re not really doing our job of producing students who are going to live lives of usefulness and reputation” or living up to our full potential as a research institution.” A great University like Brown must lead the way in solving our society’s greatest challenges, and deep training and research in science and engineering are key to solving these issues.

Finally, our students need an expanded “tool set” to thrive in the world beyond College Hill. They need the best education in science and technology, in the unique liberal arts setting that Brown provides. But they also need to be able to turn their ideas into action, into new enterprises, new companies and even entirely new industries. Our PRIIME Master’s Program in Innovation and Entrepreneurship and our proposed Center for Entrepreneurial Innovation will serve as a hub and gathering place for new ideas and innovations across the entire campus.

In the months and years ahead, I’ll be giving you updates on the exciting progress we are making on the growth of the School of Engineering at Brown. Now is especially important time to get involved; you can mentor a student, help us find summer internships for our students, come back to Brown and give our students your perspective on the world, or help to provide philanthropic support for our growth. Your engagement with the School will be crucial as we take our next steps forward.

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For all School of Engineering gifts and contributions, please call Rick Marshall at 401-863-9377 or email him at richard.marshall@brown.edu.

Learn more about Brown Engineering at www.brown.edu/academics/engineering

On the cover: Brant Hoffman ’14 works on the wind turbine the Brown Building Society designed, built and installed.

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Energy and Momentum

There is a great sense of energy and momentum around the halls of Barus and Holley these days. No, it is not from our neighbor in the physics department. It’s, however, the great excitement that the start of a new campaign for engineering (see story on page 3-4) and the idea of growing our faculty and student body have brought to campus. There is a buzz in every area of engineering – new faculty are excited about joining Brown, as evidenced by our recent strong faculty recruitment (see story on page 24). Our alumni turnout at our Back to Brown Engineering event was the largest it has ever been, as more than 125 people packed the lobby of Barus and Holley – we are going to need a bigger space in the new building to accommodate all of our alumni who continue to be engaged and excited and return to Brown each year at Commencement. Our undergraduates also had the unique opportunity to have their departmental ceremony in the First Baptist Meeting House for the first time this year (see photo on back cover), a truly special privilege that future classes will also enjoy.

As you read through our latest issue, you’ll discover the School has recently launched a Corporate Advisory Board, our professors continue to produce exciting and transformational research (see story on wireless brain implant), new student groups have been created in the past year (Seize Decathlon and are having an international impact, and our alumni are continuing to lead lives of “usefulness and reputation.” Whenever you look, there’s exciting news about Brown engineers doing great things, from College Hill to Africa.

Until the next issue arrives, we hope you will continue to stay engaged with us through our website, Facebook, Twitter, YouTube, Instagram, Flick, LinkedIn, and iTunesU – whatever method works best for you. If you have some Brown engineering news that you would like to pass along, please email us at brownengineering@gmail.com.

Editor
Gordon Morton ’93

Make a Gift

For all School of Engineering gifts and contributions, please call Rick Marshall at 401-863-9377 or email him at richard.marshall@brown.edu.
New gifts totaling $44 million have launched a $160 million campaign for the School of Engineering at Brown University. The gifts will enable the University to move forward with plans to improve and expand facilities and support the growth of the School of Engineering.

The gifts, which have been formally accepted by the Brown Corporation, include lead gifts totaling $35 million from venture capitalist Theresia Gouw, a 1990 Brown graduate and a fellow of the Corporation of Brown University, and from Managing Director of Silver Lake Partners Charles H. Giancarlo, a Brown trustee and 1979 graduate, and Diane G. Giancarlo. An additional $9 million has been given by donors who wish to remain anonymous. Gouw’s gift honors Barrett Hazeltine, renowned professor of engineering mentors at Brown, who inspired Gouw while she pursued her bachelor’s degree in engineering.

“These generous donors recognize the crucial role engineering and technology leaders play in addressing global challenges,” said Brown President Christina Paxson. “On behalf of the entire Brown community, I thank them for their enormous generosity and unwavering support of the growth of engineering at Brown.”

The $160-million campaign will enable the University to move forward with plans to improve and expand facilities for the School of Engineering. Current goals of the campaign include: construction of new teaching and career development and management and entrepreneurship have long been among the most popular on campus — a prime example of the school’s emphasis on entrepreneurship as a way to bring engineering solutions out of the lab and into people’s lives.

“It’s a great honor to be recognized in Theresia’s gift,” Hazeltine said. “The spirit of entrepreneurship and social action possessed by Brown students is genuinely remarkable. My thanks to Theresia for a gift that will build on this spirit and benefit generations of future students.”

Engineering growth at Brown

“Brown is such a special place that has created wonderful opportunities for so many, including for me. I feel very fortunate to have gone from a first-generation immigrant on financial aid to being in a position to support the school that has been so significant in shaping my life and career,” said Gouw, a managing partner in the venture capital firm Accel Partners. “I am delighted to join with others to support the school’s growth and continued commitment to cultivating creative thinkers and leaders.”

“I am particularly pleased to honor Barrett Hazeltine, who has made an enduring difference in the lives of so many students he has taught, mentored, and inspired over the course of his career.”

Theresia Gouw ’90

Charles Giancarlo joined Silver Lake Partners in 2007 as a managing director and leads the firm’s Value Creation Team. Silver Lake Partners is the world’s largest technology-focused private equity investor. A senior executive at Cisco Systems from 1993–2007, Giancarlo most recently served as executive vice president and chief development officer of Cisco, leading the company’s overall product development and management activities. As chief development officer, Giancarlo was responsible for all of Cisco’s product divisions and business units and led Cisco’s expansion into a large number of new markets and technologies. Giancarlo currently serves on the boards of Accenture, Mercury Payment Systems, Vantage Data Centers, and Blue Jeans Networks and is the chairman of Avaya.

He was elected to the Brown Board of Trustees in 2008. Giancarlo holds a B.Sc. degree in electrical engineering from Brown, an M.S. degree in electrical engineering from the University of California–Berkeley, and an M.B.A. from Stanford University.

By Kevin Stacey
In a significant advance for brain-machine interfaces, engineers at Brown University have developed a novel wireless, broadband, rechargeable, fully implantable brain sensor that has performed well in animal models for more than a year. They describe the result in the Journal of Neural Engineering and at a conference.

A team of neuroengineers based at Brown University has developed a fully implantable and rechargeable wireless brain sensor capable of relaying real-time broadband signals from up to 100 neurons in freely moving subjects. Several copies of the novel low-power device, described in the Journal of Neural Engineering, have been performing well in animal models for more than a year, a first in the brain-computer interface field. Brain-computer interfaces could help people with severe paralysis control devices with their thoughts.

Arto Nurmikko, L. Herbert Ballou University Professor of Engineering and Physics, oversaw the device’s invention and presented it at the 2013 International Workshop on Clinical Brain-Machine Interface Systems in Houston in February.

Neuroscientists can use such a device to observe, record, and analyze the signals emitted by scores of neurons in particular parts of the animal model’s brain.

Meanwhile, wired systems using similar implantable sensing electrodes are being investigated in brain-computer interface research to assess the feasibility of people with severe paralysis moving assistive devices like robotic arms or computer cursors by thinking about moving their arms and hands.

“This wireless system addresses a major need for the next step in providing a practical brain-computer interface,” said neuroscientist John Donoghue, the Wriston Professor of Neuroscience at Brown University and director of the Brown Institute for Brain Science.

Tightly packed technology

In the device, a pill-sized chip of electrodes, the microscale individual neural sensors capable of relaying real-time broadband neural signals from up to 100 neurons in freely moving subjects, is hermetically sealed. The small volume houses an entire signal processing system: a lithium ion battery, ultra-low-power integrated circuits designed at Brown for signal processing and conversion, wireless radio and infrared transmitters, and a copper coil for recharging — a “brain radio.” All the wireless and charging signals pass through an electromagnetically transparent Sapphire window.

In all, the device looks like a miniature sarcophagus. But what the team has packed inside makes it a major advance among brain-machine interfaces, said lead author David Borton, a former Brown graduate student and postdoctoral research associate who is now at Ecole Polytechnique Federale Lausanne in Switzerland.

What makes the achievement discussed in this paper unique is how it integrated many connections into the device’s laser-welded, hermetically sealed titanium “can.” The can measures 2.2 inches (56 mm) long, 1.65 inches (42 mm) wide, and 0.35 inches (9 mm) thick. That small volume houses an entire signal processing system: a lithium ion battery, ultra-low power integrated circuits designed at Brown for signal processing and conversion, wireless radio and infrared transmitters, and a copper coil for recharging — a “brain radio.” All the wireless and charging signals pass through an electromagnetically transparent Sapphire window.

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The device transmits data at 24 Mbps via 3.2 and 3.8 Ghz microwave frequencies to an external receiver. After a two-hour charge, delivered wirelessly through the scalp via induction, it can operate for more than six hours.

“The device uses less than 100 milliwatts of power, a key figure of merit,” Nurmikko said.

Co-author Ming Yin, a Brown postdoctoral scholar and electrical engineer, said one of the major challenges that the team overcame in building the device was optimizing its performance given the requirements that the implant device be small, low-power and leak-proof, potentially for decades.

“We tried to make the best tradeoff between the critical specifications of the device, such as power consumption, noise performance, wireless bandwidth and operational range,” Yin said. “Another major challenge we encountered was to integrate and assemble all the electronics of the device into a miniature package that provides long-term hermeticity (water-proofing) and biocompatibility as well as transparency to the wireless data, power, and on-off switch signals.”

With early contributions by electrical engineer William Patterson at Brown, Yin helped design the custom chips for converting neural signals into digital data. The conversion has to be done within the device, because brain signals are not produced in the ones and zeros of computer data.

Ample applications

The team worked closely with neurosurgeons to implant the device in three pigs and three rhesus macaque monkeys. The research in these six animals has been helping scientists better observe complex neural signals for as long as 16 months so far. In the new paper, the team shows some of the rich neural signals they have been able to record in the lab. Ultimately this could translate to significant advances that can also inform human neuroscience.

Current wired systems constrain the actions of research subjects, Nurmikko said. The value of wireless transmission is that it frees subjects to move however they intend, allowing them to produce a wider variety of more realistic behaviors. If neuroscientists want to observe the brain signals produced during some running or foraging behaviors, for instance, they can’t use a cabled sensor to study how neural circuits would form those plans for action and execution or strategies in decision making.

In the experiments in the new paper, the device is connected to one array of 100 cortical electrodes, the microscale individual neural

...listening posts, but the new device design allows for multiple arrays to be connected, Nurmikko said. That would allow scientists to observe ensembles of neurons in multiple related areas of a brain network.

The new wireless device is not approved for use in humans and is not used in clinical trials of brain-computer interfaces. It was designed, however, with that translational motivation.

“This was conceived very much in concert with the larger BrainGate* team, including neurosurgeons and neurologists giving us advice as to what were appropriate strategies for eventual clinical applications,” said Nurmikko, who is also affiliated with the Brown Institute for Brain Science.

Borton is now spearheading the development of a collaboration between EFL and Brown to use a version of the device to study the role of the motor cortex in an animal model of Parkinson’s disease.

Meanwhile the Brown team is continuing work on advancing the device for even larger amounts of neural data transmission, reducing its size even further, and improving other aspects of the device’s safety and reliability so that it can someday be considered for clinical application in people with movement disabilities.

In addition to Nurmikko, Borton and Yin, the paper was also co-authored by Juan Acores, an expert in mechanical engineering.

The National Institutes of Health’s National Institute of Biomedical Imaging and Bioengineering and National Institute of Neurological Disorders and Stroke (Grant R01EB020740-01), with partial support from the National Science Foundation (Grants: 0937848 and the Defense Advanced Research Projects Agency (Contract: N66001-10-C-2010), funded the research.

*Brain-gate [*] is an investigational device. Limited by federal law to investigational use.

by David Chronicle

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A Better Way to Culture Central Nervous Cells

A protein associated with neuron damage in Alzheimer’s patients provides a superior scaffold for growing central nervous system cells in the lab. The findings could have clinical implications for producing neural implants and offers new insights on the complex link between the apoE4 apolipoprotein and Alzheimer’s disease. Results appear in the journal Biomaterials.

A protein associated with neuron damage in people with Alzheimer’s disease is surprisingly useful in promoting neuron growth in the lab, according to a study by engineering researchers at Brown University. The findings, in press at the journal Biomaterials, suggest a better method of growing neurons outside the body that might then be implanted to treat people with neurodegenerative diseases.

The research compared the effects of two proteins that can be used as an artificial scaffold for growing neurons (nerve cells) from the central nervous system. The study found that central nervous system neurons from rats cultured in apolipoprotein E-4 (apoE4) grew better than neurons cultured in laminin, which had been considered the gold standard for growing mammalian neurons in the lab.

“Most scientists assumed that laminin was the best protein for growing CNS (central nervous system) neurons,” said Kwang-Min Kim, a biomedical engineering graduate student at Brown University. Kim performed the research under the direction of Tayhas Palmore, professor of engineering and medical science and Kim’s Ph.D. adviser. Also involved in the project was Jan-ice Vicenty, an undergraduate from the University of Puerto Rico, who was working in the Palmore lab as a summer research fellow through the Leadership Alliance.

The results are surprising partly because of the association of apoE4 with Alzheimer’s. Apolipoproteins are responsible for distributing and depositing cholesterol and other lipids in the brain. They come in three varieties: apoE2, apoE3 and apoE4. People with the gene that produces apoE4 are at higher risk for amyloid plaques and neurofibrillary tangles, the hallmarks of Alzheimer’s. But exactly how the protein itself contributes to Alzheimer’s is not known.

This study suggests that outside the body, where the protein can be separated from the cholesterol it normally carries, apoE4 is actually beneficial in promoting neuron growth.

Growing new neurons

In the body, neurons grow in what’s called an extracellular matrix (ECM), a protein-rich scaffold that provides cells with nutrients and a molecular structure in which to grow. To grow neurons in the lab, scientists try to mimic the ECM present in the body. Laminin is a common protein in the body’s ECM, and studies have shown that laminin aids the growth of neurons from the peripheral nervous system (nerve cells that grow outside the brain and spinal cord).

It was largely assumed, Kim said, that because laminin was good for growing peripheral nerve cells, it would also be good for growing central nerve cells. That turns out not to be the case.

Kim was inspired to test the effects of apoE4 by a previous study that found that a mixture of apoE4 and laminin promoted CNS cell growth better than laminin alone. “The previous work hadn’t tested the effects apoE4 by itself,” Kim said. “So we started working on a side-by-side comparison of apoE4 and laminin.”

Kim and his colleagues cultured rat hippocampal cells — a model for mammalian CNS neurons — in four different treatments: laminin, laminin and apoE4 mixed, apoE4 alone, and bare glass. They found that cells cultured in apoE4 alone performed substantially better than any other treatment. The apoE4 cells were more likely to adhere to the protein scaffold, which is necessary for proper growth. They also showed more robust growth of axons and dendrites, the wire-like appendages that enable neurons to send and receive nerve signals.

Laminin doesn’t seem to be of much benefit at all for culturing CNS cells, according to the study. Cells cultured on laminin alone did not perform any better than cells cultured on bare glass.

That was another big surprise, Kim said, because laminin is so widely used in all kinds of neuron cultures.

A second part of the research looked at the chemical pathways through which proteins may enhance neuron growth. Previous work had found two receptor signals, the gateways through which neurons interact with the outside world, that play a role in how external proteins trigger cell growth. However, when Kim blocked these two receptors, known as integrin and HSPG, he found that apoE4 still enhanced neuron growth. That finding suggests that neurons use an as yet unknown pathway to interact with apoE4.

“This discovery opens up a new target for researchers who are interested in identifying receptors that are important for spurring neural growth,” Palmore said.

Application to neural prosthetics

Unlike other cells in the body, nerve cells tend not to regenerate after being damaged by disease or trauma. So researchers hope that they can eventually implant lab-grown cells in the body to treat trauma or neurodegenerative diseases like Alzheimer’s.

“People are looking at all these different proteins to see if we can make a material — a scaffold — that to a neuron, looks and feels like their natural environment,” said Palmore. “The finding that apoE4 is a better protein to add to neural scaffolds is a good breakthrough because most people have been using laminin for the central nervous system models, which turns out to be less than optimal.”

The research was supported by the National Science Foundation (HRD-0548311) and the National Institutes of Health.

By Kevin Stacey

A more dependable scaffold for neural cell culture (above) flat central nervous system cells cultured in the apoE4 protein (right) fare better, with more axons and dendrites than cells cultured in laminin (left). Ironically, apoE4 is associated with the neural deficits of Alzheimer’s disease in the body.

Credit: Mike Cohea/Brown University

One size doesn’t fit all (below) Tayhas Palmore and Kwang Min Kim showed that laminin, the preferred scaffold for peripheral nerve cells, is not the best choice for culturing cells from the central nervous system. The protein apoE4 works much better.

Credit: Mike Cohea/Brown University
Two wrongs don’t make a right, they say, but here’s how one tangle can straighten out another.

Diane Hoffman-Kim, associate professor of medicine in the Department of Molecular Pharmacology, Physiology, and Biotechnology, is an affiliate of both Brown’s Center for Biomedical Engineering and the Brown Institute for Brain Science. Every thread of expertise woven through those multidisciplinary titles mattered in the Hoffman-Kim lab’s most recent paper, led by graduate student Cristina Lopez-Fagundo.

In research published online in Acta Biomaterialia, Hoffman-Kim and Lopez-Fagundo employed their neurophysiological knowledge and technological ingenuity to unravel a tangle of branching, tendinous nerve cells, or neurons.

The scientist-engineers helped explain how neurons grow in new tissues in response to physical guidance cues, called Schwann cells. Their paper also provided medical device makers with an overt demonstration of how to craft the best artificial Schwann cell imitations in silicone to make neurons grow as natural as possible in a desired direction.

“If you’ve got an injury in your arm or your leg then you’d like to have proper reconnection for your body to function,” Hoffman-Kim said. “Sometimes when I give lectures I say, ‘Bio-medical engineers are control freaks, and we use the long axis of the soma to guide themselves.’

“It was only when they had both roads (processes) and rest stops (ellipses or soma) where they could get their bearings.

And thus the neurons made their way along the artificially optimized straight and narrow. To the researchers, who also included co-authors Jennifer Mitchel, Talisha Ramchal, and Yu-Ting Dingle, the experiments were a triumph of how the meticulous analytical control afforded by engineering can demystify a complex biological phenomenon.

“Sometimes when I give lectures I say, ‘Bio-medical engineers are control freaks, and we consider that a compliment,’” Hoffman-Kim said. By David Orenstein

Silicone Schwanns

Hoffman-Kim and Lopez-Fagundo did not invent the idea of creating an implant to direct neural growth through repaired or reattached tissues. Their clinical goal is to make that technology the best it can be by systematically studying neural growth on Schwann-like substrates. As a matter of basic science, they wanted to learn how neural growth proceeds.

Lopez-Fagundo, whom Hoffman-Kim recruited for her lab in 2008 when she applied to Brown after graduating from the University of Puerto Rico, started the research with rigorous measurements of Schwann cells in cell cultures of rat neural tissue — the cell size, their elliptical shape, and the average distance between any two, as well as the length and width of the “processes” or wispy extensions that connect them.

“We were able to deconstruct the topography of Schwann cells,” said Lopez-Fagundo. “We were then able to manipulate it into different designs to better understand the influence this topography has.”

They came up with six archetypal designs. One of them mimicked the somewhat messy real-world layout of Schwann cells but the other five were arranged in neat horizontal rows. In one the elliptical Schwann cell bodies were few and far between. In another they were densely packed and in another their spacing was the exact average of Lopez-Fagundo’s measurements. Another design had no “processes” to connect the elliptes and another had only processes but no ellipses.

Using Brown’s microfabrication facility, Lopez-Fagundo patterned their designs on silicon wafers like those used to make computer chips and then transferred them to silicone sheets to replicate the Schwann squares about a centimeter on a side so that the ellipses and processes were in raised relief on the silicone. They then put each pattern in a cell culture of rat neurons and watched them as the neurons grew across each pattern of artificial Schwann cells. As a control for their experiment, they also cultured cells on unpatterned silicone squares.

All of the patterns encouraged some directed neuron growth compared to the random growth of neurons on the unpatterned squares, but clearly some patterns did better than others.

After 17 hours, the two best patterns were the ones with only processes and the one with average ellipse spacing. The natural replica pattern and the one with only ellipses fared the worst.

But by day five, new winners emerged: the patterns where the ellipses were farther than average and nearer than average. Hoffman-Kim said she was surprised that the nerve cells didn’t remain content to follow the straight-forward pattern of plain horizontal tracks formed by the process-only pattern. Meanwhile, to some extent, the neurons grew the proper way even without a continuous track at all, for instance in the ellipse-only pattern.

Lopez-Fagundo puzzlement over the question of why the ellipses, also called “soma,” matter even as the neurons clearly also grow along the processes.

“I asked myself that question a lot and it wasn’t until I sat at the computer and looked at the [time lapse] videos over and over,” Lopez-Fagundo said. “They use the soma as anchor points. They jump from soma to soma and use the long axis of the soma to guide themselves.”

And thus the neurons navigated most effectively when they had both roads (processes) and rest stops (ellipses or soma) where they could get their bearings.

To the researchers, who also included co-authors Jennifer Mitchel, Talisha Ramchal, and Yu-Ting Dingle, the experiments were a triumph of how the meticulous analytical control afforded by engineering can demystify a complex biological phenomenon.

“Sometimes when I give lectures I say, ‘Bio-medical engineers are control freaks, and we consider that a compliment,’” Hoffman-Kim said.

By David Orenstein

Nervous growth

Brown scientists created patterns in silicone to guide the growth of nerves: regular (top left) and a more natural pattern (bottom left). The resulting nerve growth (red) was much straighter and directed with the regular pattern than the natural.

Credit: Cristina Lopez-Fagundo and Diane Hoffman-Kim/Brown University
Robert Rome Named Associate Dean

Robert Rome has been named to the newly created position of associate dean for organizational development and planning at the School of Engineering at Brown University. Rome is responsible for development of expanded master’s programs, growth of industry connections, planning for space growth of the School, communications, and diversity initiatives.

Rome comes to College Hill from the University of California San Diego, where he was the chief operations officer of the Department of Electrical and Computer Engineering. He brings a wealth of experience in student affairs, graduate program development, and financial management.

Rome holds a bachelor’s degree in psychology from American University and a master’s degree in education from the University of Pennsylvania.

Rod Clifton to Receive Sigma Xi Monie A. Ferst Award

Rod Clifton, Rush C. Hawkins University Professor Emeritus and Professor (Research) at the School of Engineering at Brown University, has been selected as the winner of the 2013 Sigma Xi Monie A. Ferst Award. The award is given annually to an educator in engineering or science who has made “notable contributions to the motivation and encouragement of research through education.” Its purpose is to “recognize significant contributions to scientific research by an educator in engineering or science.”

The award is presented annually to an educator who has inspired his or her former students and colleagues to significant scientific achievements. Clifton will receive a medal, a monetary award, and a day-long symposium held at Georgia Tech in his honor with several of his former students making presentations at the symposium.

Clifton has been a member of Brown’s engineering faculty since 1965 and served three separate terms as the dean of engineering from 1974 to 1979, 1998 to 2003, and most recently as interim dean from 2008–2011. Under his guidance, the School of Engineering was established in July of 2010.

Described by a former graduate student as “a towering giant in the field of experimental solid mechanics,” Clifton is a member of the National Academy of Engineering (1989) and the American Academy of Arts and Sciences (2005), and a fellow of the American Society of Mechanical Engineers (1999). In 2000, he was awarded the latter society’s top award in applied mechanics, the Timoshenko Medal.

Clifton’s primary research is on the shearing resistance of materials at high rates of deformation, such as those that occur during high-speed impact. He introduced, with his graduate students, an experimental tool that revolutionized the field by allowing measurements at the highest speeds and temperatures. The innovation contributed to the study of materials such as metals, ceramics, and fluids, and to a better understanding of high-speed machining, armor penetration, and other processes. A computational method he developed is well known in the gas and oil industry. Currently he is working on the measurement of the viscoelastic properties of soft biological tissues at high frequency, such as the mechanical properties of vocal folds at phonation frequencies.

A native of Nebraska, Clifton received his B.S. in 1959 from the University of Nebraska and his M.S. (1961) and Ph.D. (1964) from the Carnegie Institute of Technology, all in civil engineering. He has served as a visiting professor at Stanford University and a visiting scientist at MIT. From 1992 through 1997 he was a member of the board of governors of the NSF’s Institute for Mechanics and Materials.

Shreyas Mandre wins HFSP Grant for Bipedalism Studies

Shreyas Mandre, assistant professor of engineering, is part of an international research team awarded a Young Investigator Grant by the Human Frontier Science Program. The team will receive $350,000 in each of three years to study the mechanics of the human foot.

“Understanding the fundamental mechanics of the foot informs the fields of biotechnology, robotics and human evolutionary biology,” Mandre said. “Our research in this field considers the interaction of the foot with uneven ground to investigate how humans maintain a stable running gait. The interdisciplinary and international nature of this research falls squarely within HFSP purview.”

The research is led by Madhusudhan Venkadesan, a biomechanician from the National Center for Biological Sciences in India, and in collaboration with Mahesh Bandi, a physicist at Japan’s Okinawa Institute of Science and Technology. The researchers hope to shed light on evolution of bipedalism, a task possible only by combining the capabilities of the three team members.

“The goal of my lab is to develop simple but quantitatively accurate descriptions of phenomena with applications to energy, environment and biology,” Mandre said.

“The interdisciplinary and international nature of this research overlaps perfectly with the research mission of the School of Engineering and Brown University,” said Larry Larson, dean of the School of Engineering.

Based in Strasbourg, France, the Human Frontier Science Program aims to promote basic research in the life sciences by funding researchers all over the world. This year, the organization awarded $34 million to 33 research teams that include scientists from 26 countries.

Nitin Padture Honored by IIT Bombay

Nitin Padture, professor of engineering and director of the Center for Advanced Materials Research at Brown University, received a Distinguished Service Award from his undergraduate alma mater, the Indian Institute of Technology in Bombay. Since 1999 the awards have been given to IIT Bombay alumni who have contributed in a notable and sustained manner to the progress of the Institute.

Padture was honored as the co-leader of the Class of 1985 Legacy Projects, which include promoting entrepreneurship, supporting recruitment of top junior faculty at IITB, and supporting a Faculty Wellness Fund to benefit retired IITB faculty members and their families lacking medical coverage. Padture received the award at IITB’s alumni day.

Padture’s research and teaching interests are in the broad areas of synthesis/processing and properties of advanced materials used in applications ranging from jet engines to solar cells to computer chips, impacting transportation, energy, and information technology sectors. He has published 125 journal papers, which have been cited over 5,000 times, is co-inventor of four patents, and he has delivered over 150 invited/keynote/plenary talks in the U.S. and abroad. Padture is the recipient of several awards and is Fellow of the American Ceramic Society and Fellow of the American Association for the Advancement of Science. He is editor of a prominent international journal, Scripta Materia.
Whitehouse, Langevin Tour Brain Science Labs

To learn more about some of the basic and translational research going on at Brown in different areas of brain science, U.S. Sen. Sheldon Whitehouse and U.S. Rep. Jim Langevin toured labs in Barus and Holley and in Metcalf Laboratory on Friday, June 7, 2013.

At Barus and Holley they visited with Arto Nurmikko, professor of engineering, who explained his lab’s recent work to develop a rechargeable wireless implantable brain sensor. The sensor can transmit neural signals directly from a subject’s cortex without the subject having to be connected to any cables that might limit freedom of movement. The device, should it receive approval for use in humans, could become the next generation device for brain-computer interfaces, such as the investigational BrainGate system.

From Nurmikko’s lab, the members of Congress headed a few blocks west to Metcalf Laboratory, home of the Virtual Environment Navigation Lab. There Whitehouse and Langevin each put on the lab’s virtual reality helmet to navigate through a simulated hedge maze and other environments.

Researchers led by William Warren, professor of cognitive, linguistic, and psychological sciences, perform such experiments in the VEN lab to study how people use visual information as they move through an environment and how people interact among crowds. They also conduct studies using motion capture markers to precisely measure gait in patients who have undergone surgical repair of the ACL in their knees.

In all, Brain Science at Brown and its affiliated hospitals involves more than 100 researchers who cover a gamut of interests ranging from basic studies of biology and behavior to the development and delivery of clinical therapies for conditions such as Alzheimer’s disease and depression.

Professor Leigh Hochberg Honored for BrainGate Work

Dr. Leigh Hochberg, associate professor of engineering, researcher at the Providence VA Medical Center, a neurologist at Massachusetts General Hospital and Harvard, has been honored by the Clinical Research Forum for a Nature paper last year describing how the investigational BrainGate system allowed two patients with tetraplegia to reach for and grasp objects using robotic arms controlled directly by their brain activity.

The CRF named the research, co-directed by John Donoghue, one of its Top 10 Clinical Research Achievements of 2012 and awarded it the Herbert Parades Clinical Research Excellence Award as the most outstanding project nominated for this year’s Top 10 Awards.

Other authors on the Nature paper, in addition to Hochberg and Donoghue, were Daniel Bacher, Beata Jarosiewicz, Nicolas Masse, John Simeral, Joern Vogel, Sami Haddadin, Jie Liu, Sydney Cash, and Patrick van der Smagt.

Brown School of Engineering to Host 2013 Joint SES 50th Annual Technical Meeting and ASME-AMD Annual Meeting

The School of Engineering at Brown University will host the 2013 Joint Society of Engineering Science (SES) 50th Annual Technical Meeting and American Society of Mechanical Engineers (ASME) - Applied Mechanics Division (AMD) annual meeting from July 28-31, 2013, in Providence. Pradeep Guduru, James R. Rice Associate Professor, and Allan Bower, Royce Family Professor of Teaching Excellence and Professor of Engineering, are the conference co-chairs.


The Society of Engineering Science (SES) Technical Meeting is held annually to foster and promote the exchange of ideas and information among the various disciplines of engineering and the fields of physics, chemistry, mathematics, bioengineering, and related scientific and engineering fields. The ASME Applied Mechanics Division summer conferences are intended to foster an intimate exchange of ideas on all aspects of mechanics in a relaxed atmosphere.

This SES Technical Meeting aims to convene a diverse and interdisciplinary group of leading researchers in all engineering, mathematics and science disciplines. Topics of interest include, but are not limited to, mechanics of structural materials; dynamic behavior of materials; mechanics of thin films, soft and composite materials; nanotechnologies and microelectronic materials; energy storage and energy harvesting; geomechanics and geological materials; computational methods in solid and fluid mechanics; materials design; mechanics of biological materials at tissue, cell and molecular levels; microfluidics; rheology; animal, cell and bacterial mobility; and mechanics education at K-12, undergraduate, and graduate levels.

Honoring Rod Clifton

There will be a symposium in honor of Rod Clifton on the occasion of his 75th birthday. Clifton has been a member of Brown’s engineering faculty since 1965 and served three separate terms as the dean of engineering from 1974 to 1978, 1998 to 2003, and most recently as interim dean from 2008 – 2011. Under his guidance, the School of Engineering was established in July of 2010. He is a member of the National Academy of Engineering (1989) and the American Academy of Arts and Sciences (2005), and a fellow of the American Society of Mechanical Engineers (1999). In 2000, he was awarded the latter society’s top award in applied mechanics, the Timoshenko Medal. This symposium celebrates his contributions over the last five decades to various aspects of solid and structural mechanics and mechanics of materials. Topics of interest to the symposium are dynamic deformation and failure of materials and recent advances in multiscale mechanics and physics of solids.
Jon Peha ’85 Receives Brown Engineering Alumni Medal

For his outstanding contributions to tele-communications policy and research in network modeling, flow control, and access protocols, Jon Peha ’85 was recognized at the Brown Engineering Awards Dinner on May 25 with the Brown Engineering Alumni Medal.

Peha is a magna cum laude graduate of Brown with an Sc.B. in electrical engineering and an A.B. in computer science. He went on to receive his master’s degree and Ph.D. in electrical engineering from Stanford.

Through a mix of academia, industry, gov-ernment, and work with developing coun-tries, he has sought to advance new com-munications technologies, and to establish public policies that help society benefit from what technology can do.

In academia, Peha is a professor at Carnegie Mellon University in the Department of Electrical and Computer Engineering and the Department of Engineering and Public Policy, where he leads a research program on technical and policy issues of telecom networks. This includes technologies from broadband Internet to cellular to Wi-Fi, and policy issues from network neutrality to on-line dissemination of copyrighted material to Internet privacy and cybersecurity.

Within government, he has served in the Federal Communications Commission (FCC) as Chief Technologist, in the White House as Assistant Director of the Office of Science & Tech-nology Policy, on legislative staff of the House Energy & Commerce Committee, and at the US Agency for International Development, where he helped launch and lead a new program to assist developing countries on information infrastructure.

He has been Chief Technical Officer of three high-tech start-ups. The most recent first used new technology to offer a secure ser-vice to transfer money on the Internet, and then used this technology to create cost-effective financial services for the eight per-cent of American households that do not have bank accounts. This included conven-ient and inexpensive ways to shop online, obtain small loans, transfer money to family, and cash their paychecks. Early in his career, Peha also worked for Microsoft and AT&T Bell Labs.

Peha has worked with developing countries around the world, seeking ways to make In-ternet, phones, and computers accessible to everyone. He helped the government of Ken-ya establish a competitive cellular industry that now serves 77% of its population (over 30 million people), and expanded Internet-in-schools programs in Thailand.

The tragic events of 9/11 showed how inadequate communications systems for emergency responders such as firefighters, police, and paramedics can cost many lives. Since then, improving these systems has been one of his goals. After assisting local public safety agencies in Pennsylvania and launching a research program on the topic at Carnegie Mellon, in 2004 he began proposing the idea of creating a nationwide broadband wireless network for emergency responders. While CEO of the FCC, Peha helped develop the 2010 U.S. plan for a nationwide public safety network. In 2012, Congress put $7 billion into creating this net-work. Peha received the FCC’s “Excellence in Engineering Award” for this work.

Another one of Peha’s interests is spectrum. Lack of available spectrum is expected to be a serious barrier to the growth of wireless devices and services, and all the benefits they bring. For years, Peha has been seeking ways to fundamentally rethink the way we have been managing spectrum for over 80 years, in part through spectrum sharing. Peha has written many research papers as a professor, served as CEO of a company developing technology for shared spectrum, worked on reforming spectrum regulations from within the FCC, and established an interagency task force to advance spectrum technology when he worked at the White House. The Institute of Electrical and Electronics Engineers (IEEE) gave him the 2011 publication award for career contributions in this area.

Peha has also been honored as an IEEE Fellow and as an American Association for the Ad- vancement of Science (AAAS) Fellow.
Entrepreneur and Engineer Kyle Schutter ‘10 Powers Takamoto Biogas Forward

As Kyle Schutter ‘10 and his roommate were riding back to Providence on the train from Boston one day during their senior year, they did what they often did during their discussions. “We’d just throw these crazy ideas at each other,” Schutter says. The crazy idea this time was biogas. “Have you even heard of it?” his roommate asked. Schutter hadn’t. “You just take anything that can rot and turn it into fuel.”

After this, Schutter, a biomedical engineer major, couldn’t get biogas out of his head. For a class, he drew up a plan for a biogas construction company in Ghana. It didn’t work out. Schutter didn’t like his boss, and he was being given only menial tasks to do. After five days, he quit and went on his own to Uganda, Rwanda, and, finally, Kenya, which he decided “was a great place to live and start a business.” The country has a reliable cell phone network, he says, and an educated, business-oriented population. Farmers in rural areas—his target customers—have access to banking services. And finally, well ahead of the United States, Kenya has developed a mobile money system in which phones can be used to purchase goods. This makes handling cash unnecessary, which Schutter says reduces “the chances of theft and increases transparency.”

He opened Takamoto Biogas in Nairobi in 2011. He used a biogas system developed by a nonprofit company, taking cow dung, vegetable scraps, cooking grease, and even human feces—pretty much anything organic—mixing in water, and placing it in an oxygen-free container. Bacteria digest the waste, generating natural gas that can be captured and used to fuel anything from a milking machine to a propane cooking range. Over a six-month period, Schutter sold twelve biogas systems, each one costing $1,000.

Schutter turned to friends and family for additional capital, and during the next year and a half he sold twenty more units. If the cost of research and growth are excluded, Schutter says, “this idea will be spread worldwide.”

Right now we are in a good place,” Schutter says. “We could grow faster if we had more cash, but we have to keep enough cash on hand “because one of the biggest threats to an enterprise is stress and burnout.”

Government corruption can also be a hindrance. A Kenyan official once asked him for a $200 bribe in exchange for a permit. Schutter said he would sell the bureaucrat a biogas system at a reduced price: $1,000. The official didn’t know that what Schutter was charging him was the regular retail price for the system. The bluff worked, and no laws were broken.

For now, Schutter plans to concentrate on Kenya, but he eventually hopes to distribute his biogas systems throughout the developing world. Already, he’s received inquiries from officials in Cameroon, Somalia, and Uganda. “Whether it’s me or someone else,” he says, “this idea will be spread worldwide.”

Brown/RISD/Erfurt Team Selected to Compete in 2014 Solar Decathlon Europe

Team Inside Out, composed of students from Brown University, Rhode Island School of Design and University of Applied Sciences of Erfurt (Germany), has been selected to compete in the Solar Decathlon Europe 2014 competition. The Brown/RISD/Erfurt team is one of only 20 teams from 16 countries selected to participate in the international competition which will be held in Versailles, France, in June-July 2014.

These 20 teams now have to work on the design, production and implementation of their respective projects, to be assembled and presented in Versailles. The teams will have to meet the challenge of fully designing and constructing an energy independent solar house.

The Solar Decathlon team brings together a diverse group of participants from Brown, RISD and Erfurt. Its evolution goes can be traced to Jonathan Knowles, professor of architecture at RISD, who led the RISD Solar Decathlon team in the 2005 edition of the competition. His positive experience in 2005 inspired him to start building the current team. The University of Applied Sciences of Erfurt was a natural partner for several reasons, including Prof. Knowles’ longstanding collaboration with Prof. Rolf Gunder, Erfurt’s expertise in passive architecture, and Erfurt’s proximity to the 2014 Solar Decathlon competition site in Versailles.

“Brown University offers talented students and strength in science and engineering that will help develop the project’s technical innovations that are an important component of the competition,” said Derek Stein, assistant professor of physics and the faculty liaison for the team.

The Solar Decathlon core team members from Brown include engineering students Matt Breuer ’14, Montana Feiger ’14, Isby Lurin ’16, Beverly Xu ’14, and Gareth Rose ’16 in addition to Howard Carter ’16, Jonah Fay ’12.5, Sage Green ’14, and Haily Tran ’16.

The students have already developed the project’s concept of a “woven” house, whose reconfigurable walls will be made of textiles, and whose various uses will be intertwined with the needs of the community. The team is rethinking what materials can go into energy and cost-efficient housing, as well as what designs will promote efficient interactions between people and their environment.

“We are designing the house to have impacts beyond its walls; users will interact with elements of the house playfully, and we will design positive feedbacks to teach users about sustainability best practices,” said Breuer. “As part of this, we are weaving the systems that are traditionally kept in the background into the foreground - users will be aware of the presence of electrical, heating, and water systems and how their behavior impacts their resource consumption. We hope this will strengthen the relationship that users have with their living space and will promote a responsible and environmentally friendly lifestyle.”

About Solar Decathlon

The Solar Decathlon is an international competition organized every other year by the Department of Energy (DOE) in the United States. Since 2010, a Solar Decathlon has been organized in Europe in the alternating years between the American competitions. The first two European competitions were held in Madrid. The next competition, to be held in June/July 2014, is being organized by France and will take place in Versailles. A competition will also be held in 2013 in the United States and China.
Custom Designed Wind Turbine Raised by Brown Building Society

On May 4th, we watched as a wind turbine began spinning in the light afternoon breeze in Seekonk, Massachusetts. Standing more than 30 ft tall, the wind turbine represented the culmination of two years of intensive work by over thirty members of the Brown Building Society (BBS). Every aspect of the turbine had been designed and built by Brown students.

We founded BBS in 2010 as an engineering student group dedicated to undertaking collaborative extracurricular building projects. BBS was established to provide opportunities for students to expand learning beyond the classroom and gain valuable hands-on experience in applying engineering theory to conceptualize, design, and build from the ground up. BBS’s first project was the construction of a trebuchet, a type of medieval catapult, which soon began flinging watermelons on ballistic trajectories. Beginning in the fall of 2011, we began working on a new project, a wind turbine.

An initial plan to build a small simple wind turbine out of commonly available materials soon morphed into a plan to build a more sophisticated turbine intended to fully utilize our engineering education and the manufacturing capabilities available to us. We started with a blank page and after re-searching wind turbine technology and existing wind turbines, we began to develop a set of requirements and the broad outline of our design. We aimed to build a turbine that would act as a demonstration of an inexpensive power-generating horizontal-axis wind energy system that would serve as an instrumented test-bed for experimenting with varying blade designs and other technologies. A decision was made early in the design process to scratch build as many of the wind turbine components as possible, even in cases where doing so would increase costs or result in lesser performance. We did so in order to maximize both the challenge and educational benefits of the project. As a result of this decision, virtually all of the wind turbine, including the blades, alternator, and tower, was designed and built from scratch by BBS members.

The turbine features a 3-blade 16 ft diameter fiberglass rotor turning a permanent-magnet axial flux alternator. Over a thousand hours of labor was required to model the blades, produce the necessary molds, lay-up the fiberglass components, assemble, and paint the blades. The blades spin two discs of neodymium magnets located on opposing sides of a fixed array of copper coils, generating power. The alternator assembly is attached to a welded steel rotation assembly which allows the turbine to pivot in the wind. The rotation assembly incorporates a series of graphite brushes and slip rings which transmit the alternator power output and instrumentation signals through a rotating joint and down the tower. Both the alternator and rotation assembly are enclosed by a streamlined fiberglass nacelle. A fiberglass tail with a lightweight foam core serves to direct the turbine into the wind, but is designed to protect the turbine in high winds by automatically rotating the turbine out of the wind. The turbine is mounted on 22 ft, guy wire supported, steel monopole tower. A lumber frame located at the base of the tower supports an electric winch system which is used to raise and lower the tower. A digital control system regulates the speed of the turbine and dissipates the power output while logging a variety of performance metrics.

We began the project with little exposure to wind energy technology and by the end we were able to watch as our two years of work coalesced into a fully functional wind turbine. Through designing the wind turbine, we were able to apply and build upon skills learned in a wide array of classes ranging from fluid dynamics to structural analysis to electromagnetism. Fabricating the turbine provided us with practical experience in a variety of techniques including machining, composites manufacture, and carpentry. Throughout the course of the project, we honed our project management skills, weathered the inevitable trials and tribulations, and gained lifelong friends. The wind turbine project has been an exceptionally rewarding undertaking and, for many of us, the culmination of our time at Brown.

Many other individuals and companies contributed to allow us to complete the wind turbine. The wind turbine project was made possible by the generous support of the Brown School of Engineering, Innovative Products and Equipment, Andrew Jencks, DPR Construction, Stanley Black & Decker, AMT Assembly & Manufacturing Technologies, and Dassault Systems SolidWorks. In addition, the invaluable advice and assistance of Professors Kenneth Breuer, Brian Burke, Joseph Fontaine, and David Odeh as well as the staff of the Joint Engineering Physics Integrated Shop greatly aided our efforts. In particular, we could not have completed the project without the patience and guidance of BBS’s faculty advisor, Christopher Bull.

We are continuing to test and evaluate the performance of the wind turbine. BBS has also begun a new project that will be the organization’s focus during the coming school year: the design and construction of a manned hovercraft.

by Nathaniel Gilbert ’13
Chris Bull, who has been the team’s faculty advisor since 2004, said it operates on its own, adding that he is on hand to “make things run smoothly,” purchasing supplies, working with Brown’s administration, and offering advice.

Bull said he watched the car team evolve since it “began kind of organically with a few students” in 1986. Initial competition “disasters,” he said, but “you learn an incredible amount just by going and seeing what other people are doing.” He recalled that one student transferred to Cornell, “because they had a better car team than we did.”

The competition requires that teams build entirely new cars each year. Gottesman said that Brown’s team has “a habit of going in two-year cycles,” where one year they will significantly redesign the car, and the next they will refine what has already been done.

Redesigns aim to improve performance, reduce cost, or adapt to an evolving rulebook. But the process can be complicated. For example, three years ago, the team switched to a lighter and more powerful engine, but the engine’s lubrication system contained a six-inch-tall pan that sat below it to collect the oil pumped through the engine’s moving parts. In a small race car, that space is valuable. To adjust, the team designed a new lubrication system that displaced the

pan to elsewhere in the car, which lowered the car’s center of gravity, and improved its stability.

Bull said the car team is a valuable experience for the students. But as a self-described “bicycle person” whose research and classes focus on sustainability, he called the competition’s carbon footprint “a little bit unsettling.” He also said that the car team consumes significant financial resources from the school. Brown allots $40,000 to the team each year, although they depend on sponsors as well.

Well-funded teams have a competitive edge. According to Thronc Morris, who specializes in the car’s structure, some teams build their cars’ frames entirely out of carbon fiber, a material five times stronger than steel and two thirds lighter—but much more expensive and requiring specialized equipment to mold. “There are certainly teams who spend a quarter of a million dollars on their cars,” he said.

But though Brown’s budget is small by comparison, “we engineer a really good car,” said Morris. “We are, in terms of the design competition, usually one joint away from semi-final.”

Bull said that around half of the teams do not finish the racing events because of mechanical failures. Brown’s team has finished out of 15 competitions it has attended.

Overall, Bull said the team is “pretty competitive for our size,” and that big state schools tend to be the most successful because of their resources. Last year’s winner was Oregon State University, while Brown placed 36th out of 120 teams.

Each year at the beginning of May, Brown’s Formula Society of Automotive Engineers team goes to the original competition, held in Michigan, although there are others held across the United States and around the world. The team packs a rental truck with the race car, last year’s car for emergency spare parts, and nearly everything that can be moved from the workshop. Bull drives the truck, while the rest of the team piles into rented SUVs and vans.

There are three types of events at the competition: static and dynamic events. In the static events, the teams present their race cars, and the judges analyze cost and design. The dynamic events test the performances of the cars—and their drivers—in races that evaluate acceleration, maneuverability, and endurance. But before a team can race, its car must pass technical inspection, where judges scrutinize the cars and test their functionality, assuring they meet the standards of the rulebook and are safe to drive. Three years ago, Brown’s team spectacularly failed its first technical inspection.

“My freshman year,” said Morris, “we had an engine that blew up.” The team was performing a noise test on the car—proving that the engine was quieter than 110 decibels while running at 11,000 revolutions per minute—when a failing lubrication system caused a piston to burst out the side of the engine, and the car caught on fire. Morgan Walti, the student in the driver’s seat, said the people around him “had never seen someone escape the car faster.”

This challenge is exactly what engineers are prepared to handle. “It was one more all-nighter,” said Bull, “but they swapped engines and put the car back together. By the next morning, the car was ready to go again.”

The races themselves are thrilling for the drivers. Stephen Weinroth, who designs the car’s brakes, described competing in the autocross event, where drivers race against the clock in a single loop around the track. “You average somewhere around 40 mph,” he said in an email. “It sounds slow. But rounding tight corners while sitting two inches off the ground, that’s fast as hell.” All of my energy is coming from adrenaline,” he said. “Driving that car is like nothing else.”

The most highly anticipated event of the competition is a 22-kilometer-long endurance race held on the last day, called the Enduro. In 2009, Brown astonished the crowd in this event.

Halfway through the race, the cars stop, and the teams switch drivers. Bull said, “The first driver finished, and got out of the car, took off the helmet, and shook her hair out. And everybody was shocked that it was a woman.” Caitlin Ashley-Rollman, the team’s captain at the time, was one of the first women to race in the Enduro. “People’s jaws dropped,” said Bull.

“It was amazing,” Ashley-Rollman said in an email. “A number of course workers and photographers congratulated me.” One female photographer told her that “she had taken a number of photos that she was going to share with her daughter in hopes of inspiring her,” she said, “I suppose that was my fifteen seconds of fame!”

People tend to joke that Brown was the team with “girls,” said Lee. “There really isn’t a big gender focus on our team,” she said, “It’s not even a subconscious thing.” After Brown, the car team has a way of staying with its former students. “I can think of a handful of people who have ended up in sort of automotive engineering,” said Bull, “because of their experience with the car team.”

He said that a few alumni from the car team are currently working at General Motors.

“We had a career fair last year,” said Bull, “It was surprising the number who came back who had been involved in the car team, and how that was one of their high points in terms of their time at Brown.”

Lee said she has met some of the alumni who have returned to support the team at competitions. “I’ve heard so much about their stories, so much about what they’ve done for the team,” she said, “and it makes me feel really connected to them.”

“Love being part of something that I know will last beyond Brown,” she said.

By Robert Rozansky ’14
On April 17, 2013, the Brown School of Engineering Corporate Affiliates Board (CAB) held its inaugural meeting. Representatives from thirteen companies participated in events that took place on College Hill and at Barus & Holley — learning about the long-term objectives of the School and the ways members can participate, and interacting with its students. The Board represents a wide range of industries and company sizes and is geographically disbursed.

School of Engineering Dean Larry Larson highlighted ways in which member-companies can help grow the School:

- advertising engineering-oriented internships for both undergraduate and graduate students
- employment opportunities
- participating in seminars, job talks, and the School’s annual career fair
- sponsoring student organization programming
- collaborating with faculty on mutually beneficial, high impact research projects

Critically, CAB members are expected to give feedback on the preparation of the School’s graduates, curriculum development, and future areas of growth in engineering education. Roughly half of the CAB members are Brown alumni, which allows the group a solid foundation for discussions regarding the undergraduate experience both at Brown and at the other institutions from which members graduated.

After this extremely productive first meeting, the CAB has developed working groups to address specific ways in which the School and member-companies can grow together. The CAB will play an integral role in creating opportunity for Brown School of Engineering students and faculty and guiding the School’s evolution in the future. The CAB will reconvene in the fall.

Corporate Affiliates Board:

The School of Engineering’s Corporate Affiliates Board (CAB) has been developed to ensure that the growth and evolution of the School aligns with industry needs, and that the School will be guided and supported by robust industry involvement.

A main purpose of the CAB is to mutually benefit industry partners and the School. This is accomplished by developing relationships that enhance both student internship and employment opportunities, and explore ways for faculty to partner with industry in performing high-impact research. The CAB will provide the Dean with guidance on the School’s educational programs — its quality and relevance to state-of-the-art engineering challenges, together with the preparedness of its graduates.

Corporate Affiliates Board Members:

H. B. Siegel ’83
Chief Technology Officer
Weka, Seattle, WA

Dan Leibholz ’86 Sc.M.’88
VP, Embedded Systems Products and Tech Group
Analog Devices, Inc.
Norwood, MA

Tom Shannon ’85
Partner
Bain & Company
Chicago, IL

Darrell Huntley ’81
VP, Satellite Development Center
Boeing
Arlington, VA

Axel Z. Luey, Ph.D. ’81
Chief Engineer (dual fuel engines)
Cummins
Columbus, IN

Joyce Mullin ’84 P.13 ’13
VP,GMM, OEM Sales Solutions (CAB Chair, 2013-2016)
Dell
Round Rock, TX

Stephan Koltz, Ph.D.
Director of Education
Draper Laboratory
Cambridge, MA

Paul Bechta ’87 Sc.M. ’88
Senior Director, Global Services
EMC
Hopkinton, MA

Lou Hector, Jr., Ph.D.
Technical Fellow, Research and Development
General Motors
Warren, MI

Ryan Ross
Distinguished Engineer
Juniper Networks
Westford, MA

Tim Denison, Ph.D.
Director of Core Technology, Neuromodulation
Medtronic
Minneapolis, MN

Colin Mercer, Ph.D.
VP Research & Development
Simulab
Providence, RI

Steve Lane
Chairman, Chief Venture Officer & Co-Founder
xmedica
Providence, RI

Corporate Affiliates Board Mission:

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Advisory Council Members:

The EAC meets twice a year in October and February and provides critical support and advice on the School and provides important feedback to the Provost and the President.

Sangenta N. Bhatia ’90
Professor, Investigator, Director: Laboratory for Multiscale Regenerative Technologies
MIT
Cambridge, MA

John Bramman
President
Bucknell University
Lewisburg, PA

Seth Coe-Sullivan ’99
Chief Technology Officer
ODVision
Lexington, MA

Rick Fletcher ’76 Ph.D. ’81
Author/Adjunct Professor
Brown University
Providence, RI

Deirdre Hanford ’83
Chairman, Senior Vice President, Global Technical Services
Synopsys, Inc.
Mountain View, CA

David Hibbitt Ph.D. ’72 PMAT ’96
Co-Founder
AQAUS, Inc.
Providence, RI

Fazle Husain ’87
Managing Director
Metalmark Capital
New York, NY

Mary Lou Jepsen ’87 Ph.D. ’97
CEO and Founder
Pixel Qi Corporation
San Bruno, CA

Alejandro Knoepffler ’82
Principal
Coho Capital
Nottingham, UK

Charles L. Stanley ’78 Ph.D.
Chair, Professor of Chemical Engineering
University of Utah
Salt Lake City, Utah

Andrew Marcuortz ’71 P.06
Founder, Chairman
Aponio Capital, LLC
Lincoln, MA

Advisory Council/Development Committee:

Corporate Affiliates Board:

Support and advise the development, execution, and attainment of the School of Engineering’s strategic goals.

Ensure the School of Engineering is providing the highest quality educational experience for its students, and is embarking on the highest impact, highest quality research program.

Coordinate with the Engineering Development Committee to ensure that our strategy and financial initiatives are achieved.

Work with campus leadership to ensure their continued support of the School of Engineering, and recognition of the key role Engineering plays in the vitality of the entire Brown community.

Executive Advisory Council members with Brown University President Christina Paxson (seated, center).

Development Committee:

Charlie Giancarlo ’79 P.08 P.11
Managing Director
Silver Lake Partners
Menlo Park, CA

Theresa Gove ’90
Partner
Acel Partners
Palo Alto, CA

Steven Price ’84
Chairman and CEO
Townsquare Media
Greenwich, CT

Joan Wernig Sorensen ’72 P.06 P.06
Providence, RI

Paul Sorensen ’71 Sc.M. ’75 Ph.D. ’77 P.06 P.06
Co-Founder
AQAUS, Inc.
Providence, RI

Engineering Advisory Council Mission:

Advise on the growth and development of the School of Engineering.

Provide guidance and support to the Brown School of Engineering’s leadership.

Ensure the School of Engineering is providing the highest quality educational experience for its students, and is embarking on the highest impact, highest quality research program.

Coordinate with the Engineering Development Committee to ensure that our strategy and financial initiatives are achieved.

Work with campus leadership to ensure their continued support of the School of Engineering, and recognition of the key role Engineering plays in the vitality of the entire Brown community.
Six new faculty representing biomedical engineering, neuroengineering, chemical engineering, and solid mechanics will join Brown’s School of Engineering, part of a multiyear investment in the school’s growth. In April, Brown announced gifts totaling $44 million to the School of Engineering, kicking off a $160-million campaign to support the school’s growth. Expansion plans include new teaching and research space to be built on College Hill and the addition of new faculty. The newest additions include three in biomedical engineering, one in neuroengineering, one in chemical engineering and one in solid mechanics.

“One of our priorities in growing engineering at Brown is to recruit world-class scholars to join our faculty,” said Larry Larson, dean of the School of Engineering. “This new group of young faculty members is a reflection of that effort. They are all doing important and impactful research at the cutting edge of their disciplines. They will be fantastic additions to the scholarly community here at Brown, and we’re very pleased to welcome them.”

David Borton is currently a Marie Curie postdoctoral fellow at the Swiss National Institute of Technology in Switzerland. He leads a team of engineers, neuroscientists, and mathematicians creating and implementing state-of-the-art neural interfaces and kinematic sensors for the study of Parkinson’s disease and potential therapies for spinal cord injury. His work is multidisciplinary, characteristic of Brown’s brain science and neuroengineering community, and directed toward fundamental research, novel brain science, and translation of novel engineering design to clinical therapy. Borton received his Ph.D. in biomedical engineering from Carnegie Mellon University in 2011 as an NSF Graduate Fellow.

Kareen Kreutziger is a bioengineer specializing in cardiac tissue engineering, muscle mechanics, stem cell biology, and regenerative medicine. Her current focus is using human pluripotent stem cells to engineer tissue that mimics human heart tissue in structure and function, with the goal of developing regenerative therapies for ischemic heart disease. She received a B.S. degree in biomedical engineering from the University of Rochester in 2001; a Ph.D. degree in bioengineering from the University of Washington in 2007; and postdoctoral training in pathology at the University of Washington.

Anita Shukla, a native Rhode Islander, is currently a NIH Ruth Kirschstein postdoctoral fellow in the Department of Bioengineering at Rice University. Shukla’s postdoctoral research focuses on developing biologically inspired micropatterned surfaces to direct stem cell differentiation. At Brown, Shukla’s research group will design innovative biomaterials for applications in drug delivery and regenerative medicine. She received a B.S. in chemical engineering and biomedical engineering from Carnegie Mellon University in 2006, an M.S. in chemical engineering from MIT in 2008, and a Ph.D. in chemical engineering from MIT in 2011 as an NSF Graduate Research Fellow.

Ian Wong’s research program will focus on engineering new technologies to study how cancer cells invade and resist therapeutic treatments. He is particularly interested in understanding how materials and mechanical aspects of the tumor microenvironment regulate malignant behavior. Wong is currently a Damon Runyan Cancer Research Fellow at Massachusetts General Hospital and Harvard Medical School. He received his Ph.D. in materials science and engineering as an NSF Graduate Fellow at Stanford University.

“We are excited to launch the Campaign for Engineering and by the initial leadership support we have already received to help us get to over $35 million as of June 30. However, we need all alumni, parents and friends of the School of Engineering to join us in this effort. Our plans for the growth of the School are ambitious and we need everyone’s support to help us reach our goals.”

Steven Price ’84, Engineering Development Committee

For more than 160 years, Brown University’s engineering program has sustained an exciting and unique environment for learning, teaching, and research. What began in 1847 has grown into a distinguished School of Engineering characterized by global impact, innovation, multi-disciplinary pursuits, and outstanding faculty and students.

These characteristics provide a unique opportunity to help transform the School of Engineering into a force for global technological and entrepreneurial innovation by:

- Hiring and supporting transformational faculty in key areas of explosive technological growth and profound societal impact
- Establishing a Center for Entrepreneurial Innovation
- Transforming undergraduate engineering education

Brown has built a strong platform from which to grow and launch new, groundbreaking initiatives. The time to begin these initiatives is now. Philanthropic, visionary individuals are encouraged to seize this unique opportunity to make a difference in our community and in the world.

Giving Opportunities

Faculty Support
Endowed Professorships
$4 Million each
Dynamic teachers and researchers to lead and inspire students, including one with an Entrepreneurship focus.

Endowed Visiting Professorships
Entrepreneurship scholar bringing real-world experience to the program

$2 Million

Student Support
Endowed Graduate Fellowships in Engineering
$750,000
Support for imaginative, resourceful graduate students

New Engineering Facility
Center for Entrepreneurial Innovation
$20 Million
The focus of entrepreneurial research, collaboration and science

Entrepreneurship education classroom
$1 Million

School of Engineering Building Fund
$100,000 and up

Transforming Undergraduate Education
Endowed First-Year Seminar Fund
$500,000
Provides funding for one first-year seminar each year

First-Year Seminar Fund
$50,000
Provides funding for one first-year seminar

Dean’s Fund for Engineering Excellence
Support investment in novel research and curriculum innovations, and the creation of new ventures

$500,000

$1 Million