Whither the Job Market?:
Amid shifting winds of change, the career forecast for young engineers has never been brighter.
The opening of the Computational Science and Engineering Building this fall was an exciting time for the entire Hopkins community. The building itself combines the best of form and function. Bordering the new Decker Quad, it is adjacent to Mason Hall, and its presence contributes to the Homewood campus’s new “front door.”

The building makes a strong statement about the Whiting School of Engineering’s commitment to leadership in cross-disciplinary research. The centers, institutes, and labs devoted to the fast-growing fields of robotics, computational medicine, and language and speech processing are housed here. But in addition to that, I believe the building makes an even more important statement about the school’s long-standing commitment to pushing the boundaries of every discipline in engineering, producing groundbreaking research, and educating students in ways that effect positive change in the world.

On the building’s ground floor, across from the robotics high bay (one of the most technologically advanced and largest robotics research spaces in the world), is a 60-foot-long multimedia display (see above right) that offers an absorbing snapshot of the school’s strengths, breadth, and history.

As I walked by earlier this week, a video of Abel Wolman ’13 appeared on one of the plasma screens. It occurred to me that his vision from almost a century ago—the importance of providing clean drinking water to the world—and the role Hopkins Engineering could play in improving health and society, remain integral elements of the school’s vision today. Moving along the display, I was struck by how its many examples of faculty, student, and alumni research and accomplishments provide evidence of this commitment. Examples range from a highly advanced “feeling” prosthetic hand and videos that show WSE’s important contributions to robots being developed for deep underwater exploration, to plaques that honor significant alumni discoveries over the years and the school’s historic milestones. I encourage you to visit and see for yourself.

Sincerely,

Nicholas P. Jones
Dean, Whiting School of Engineering
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New Provost An Engineer at Heart

Kristina Johnson's engineering path seems as though it was destined. Her father and grandfather were both electrical engineers for the Westinghouse Corporation and first-class tinkerers. Johnson's father, who died her sophomore year of college, fashioned his own ham radio at age 13 and pieced together an electronic keyboard during his senior year in high school—back in 1932.

Johnson exhibited signs early on that she inherited that same engineering gene. She loved math, regularly checking out math books from the library, built telegraph sets, and treasured the slide rule she received as a present. “That might have been when all the trouble started,” she jokes.

After considering a math major in college, then physics, she eventually chose electrical engineering. “It combined the best of both worlds, I thought,” says Johnson, who on September 1 became the university's 12th provost and senior vice president for academic affairs. She is also the first woman to hold Johns Hopkins’ second-ranking position.

A pioneer of applications with liquid crystals, Johnson holds more than 40 patents and is the co-founder of several start-up companies. She comes to Hopkins from Duke University’s Pratt School of Engineering, where she served as dean since 1999—and also the first woman at Duke to hold that position.

Johnson was born in Webster Groves, Missouri and raised in Denver, Colorado. Her road to Johns Hopkins University has been an impressive one. As a senior in high school in 1975, her science fair project that used holography to map the growth of a fungus won a city, state and national contest and ended up garnering first prize in the Department of Army Awards and a second prize at the International Science and Engineering Fair. The editors at the Denver Post took notice, electing her to the paper’s annual Hall of Fame.

Johnson enrolled at Stanford University on a Westinghouse Scholarship and graduated with distinction in 1981 with both bachelor’s and master’s degrees in electrical engineering. After earning her PhD at Stanford in 1984, she spent two years on a NATO post-doctoral fellowship at Trinity College in Dublin, Ireland, before joining the faculty at the University of Colorado. During her tenure there (1985 to 1999), she earned a National Science Foundation Young Investigator CAREER Award and worked her way up to full professor before leaving for the top engineering post at Duke.

Johnson has worked on microdisplays for high-definition projection televisions, a 3-D holographic puzzle, HDTV color separations, and optical symbol processing. Her company ColorLink, which she co-founded and sold in 2007, worked on circularly polarized 3-D technology for animated movies such as Chicken Little, Polar Express, and Monster House.

She is perhaps best known in research circles for pioneering work in the field of “smart pixel arrays,” which has applications in displays, pattern recognition, and high-resolution sensors, including cameras.

The new provost’s life does not start and end with her work, however. A sports enthusiast, she started women’s lacrosse at Stanford and also played field hockey. She has a red belt in tae kwon do, played for Ireland’s President’s Eleven ladies cricket team, and rides horses recreationally whenever she can.

She’s also very passionate about involving young people, in particular women, in science. In 1990, she partnered with a television weatherman in Denver to create a 10-part educational series called Physics of Light. The highly successful series, geared toward 5th- to 8th-graders, aired on a local NBC-affiliated station and was later distributed to more than 500 schools throughout the Rocky Mountain region.

“All my life since college, I’ve been trying to get women and girls interested in science and engineering. It’s been a passion of mine.” —Kristina Johnson
Diagnosing Cancer
By the Numbers

If you're trying to create a diagnostic test for cancer, you'd expect that the more information you consider, the better. But recent work by Whiting School mathematicians shows that winnowing down the information you're looking at can be a better strategy.

Advances in gene chip technology now allow researchers to take a tissue sample and easily construct gene expression profiles for thousands of individual genes. Computer programs can then compare the profiles of healthy tissue to cancerous tissue and decide whether a particular kind of cancer is present.

It's not always easy, and even when the prediction works, it often depends on the combined expression levels of hundreds or even thousands of genes. So the information isn't much help for researchers looking for clues about what causes the cancer.

Now the winnowing method developed by department chair Daniel Q. Naiman and Donald Geman, both professors in applied mathematics and statistics, is proving itself not only effective but simple enough for humans to understand, apply, and draw hypotheses from.

Rather than consider the levels of hundreds or thousands of genes, their method depends on the relative levels of only two genes. “We decided to go to the other extreme, to do something as simple as possible,” says Geman.

The idea occurred to him when he was reading an article about programmed cell death. It turned out that by finding the levels of only two proteins, called Bax and Bad, you could tell if a cell was programmed to die. If there was more Bax than Bad, the cell would die; otherwise it would live.

Geman and Naiman wondered if the same thing would work with a test for specific cancers. They obtained microarray data for tissue samples that had been confirmed to be cancerous and took all of the gene-expression levels, threw away the actual numbers, and simply ranked each gene from lowest to highest. Then they compared every gene to every other gene, until they found two genes that by themselves predicted whether a sample was cancerous or not.

“It’s cancer if the expression level of A is less than B. It’s normal if vice versa,” Geman explains.

Although the technique requires a fair amount of number crunching to find the two genes in the first place, it’s something that can be done in a fairly short time on a laptop. And once the pair for each kind of cancer is found, subsequent tests only have to look for those two genes.

Geman and Naiman proposed the idea in a 2004 paper, showing that it worked to predict breast, prostate, and leukemia cancers.

Then earlier this year, researchers from the Institute for Systems Biology in Seattle and the University of Texas in Houston confirmed that the technique also works in telling the difference between two cancers—gastrointestinal stromal tumor and leiomyosarcoma—that can appear similar to diagnosticians but require different treatments. Their results appeared in the Proceedings of the National Academy of Sciences.

And because researchers have an idea of what those two genes do, they have a new lead to follow in trying to understand the underlying mechanism of the cancers.

The technique has its limitations. It doesn’t provide a universal test for cancer—each particular kind of cancer has to be analyzed to see if two genes can be found that predict it. “It’s not a magic bullet,” Geman acknowledges. “So far, none of these methods has made it to the point where it’s part of your blood test.” But stay tuned.

—Kurt Kleiner

Kudos
West Garners National Medal of Technology

In 1962, James West and Gerhard Sessler revolutionized the field of sound technology when they invented the electret microphone, found today in everything from cell phones to hearing aids, from children’s toys to the devices astronauts use to communicate from outer space. More than 2 billion electret microphones are produced each year—95 percent of the total number of microphones in use today.

West, who joined the Whiting School’s Department of Electrical and Computer Engineering faculty in 2001 after a 40-year career at Bell Laboratories and Lucent Technologies, was honored this past July with the 2006 National Medal of Technology for his achievements in the field of sound recording and voice communication.
New Paths of Excellence

On first meeting, Elliot McVeigh's laid-back demeanor comes through immediately. But don’t be fooled. It’s a serious kind of laid-back, an approach to life and work that should serve him well as the new Massey Professor and director of the Department of Biomedical Engineering (BME). The internationally renowned department is unique at Hopkins; it straddles the schools of Engineering and Medicine and includes close to 500 undergraduates, 140 PhD and 40 master’s students, and 25 faculty members.

Consider McVeigh’s vision for BME:
“When we hire new people or admit new students, they have to be the very best. And we have to be open-minded,” he says. “They may not be the people whose research areas we were looking for when we started the process, but they have to possess superb scientific acumen. It means we have to be willing to let them lead us down new paths of excellence—maybe even ones we hadn’t thought of before.”

An inventor on 11 patents for real-time interventional MRI and real-time MRI devices, McVeigh earned his PhD in medical biophysics from the University of Toronto and began his academic career at Hopkins in 1988, when he joined the Department of Radiology. He made the shift to Biomedical Engineering at Hopkins three years later. Then, while maintaining a part-time appointment at Hopkins, McVeigh joined the National Institutes of Health in 1999 as a senior investigator in the Laboratory of Cardiac Energetics. “My recent research is in developing new imaging techniques and devices to perform therapeutic interventions under image guidance,” he explains.

When the opportunity arose to return full-time to Hopkins and assume leadership of the rapidly growing BME Department, he jumped at the opportunity. “Who wouldn’t want this job?” McVeigh asks with a smile. “I’ve been given a fantastic starting place,” he says, noting in particular the work of the department’s earlier directors, Dick Johns and Murray Sachs, both of whom remain on the faculty as teachers and...
scholars. Says McVeigh, “I know that we can continue to make it even better.”

Included in the growth McVeigh expects in the next few years are two new research centers, one of which will focus on regenerative tissue sciences. “This will encourage the School of Medicine to work closely with us, sharing common ideas and solutions,” he says. The other center will establish BME as the organizing force behind Hopkins’ many medical imaging research groups, including those in radiology, cardiology, electrical and computer engineering, and oncology. “BME will be the central connection between these areas, sharing ideas and serving as a training program for our students,” he says.

Combined with the Center for Bioengineering Innovation and Design (CBID), a new student design center at the Whiting School, both of these new areas “will enable closer relationships with industry and will allow us to provide industry with the best-trained people,” McVeigh says. He adds, “It will connect BME with industry and translational research, offer our students opportunities to work with top people in industry, and continue to bridge the gap between the Homewood and the medical campuses.” —Abby Lattes

The Homewood campus debuted its new “front door” on the evening of October 27, 2007, when the Alonzo G. and Virginia G. Decker Quadrangle, the Computational Science and Engineering Building, and Mason Hall were formally dedicated at a gala that included more than 800 Johns Hopkins alumni, friends, faculty, and students.

Before dinner, guests had the chance to explore the Whiting School’s new state-of-the-art engineering facility, speak with faculty and students working there about their research, and enjoy student-led tours.

Mason Hall houses the new undergraduate admissions office and visitors center and includes historical displays about the university, electronic media about all aspects of Hopkins, and an alumni board room.

Honored at the dinner in speeches and videos were former chair of the university board of trustees Raymond A. “Chip” Mason, and his wife Rand, and the late Alonzo G. Decker, and his wife, Virginia, after whom the admissions and visitors center and new quadrangle are named. The event also recognized Willard Hackerman ’38, president of Whiting-Turner who oversaw construction of the entire project, and Rae and Richard Swimow ’55, who are providing support for the Computational Science and Engineering Building’s mock operating room.

A MacArthur Fellowship for Ruth DeFries

Ruth DeFries can see the forest through the trees, or more precisely, through satellite data.

DeFries, PhD ’81, has spent the better part of the past two decades using sophisticated satellite-imaging systems to obtain a clearer picture of the processes transforming our planet.

An environmental geographer, she uses this imagery to detect human modifications of the landscape and its impact on the biochemical processes that regulate the Earth’s habitability. She’s been able to observe land cover and land use change at regional and global scales to explore the implications on climate regulation, the carbon cycle, and biodiversity.

To honor her work, the John D. and Catherine T. MacArthur Foundation recently named DeFries a MacArthur Fellow. Often referred to as a “genius grant,” the award comes with $500,000 in no-strings-attached funding over five years.

DeFries, a professor at the University of Maryland College Park, has focused her research on land use in tropical regions, an area that has witnessed a substantial shift toward agriculture at the expense of forests. She initially studied Central Africa and moved on to map areas in Southeast Asia and the Brazilian Amazon.

“The tropics are a region in transition. It’s dynamic and rapidly changing,” she says. “We’re trying to understand precisely what is going on. We’re looking at the implications of deforestation and changes in the climate, specifically the levels of carbon emitted into the atmosphere.”

DeFries says, “We’re looking to develop the scientific underpinnings for land use and find that proper balance for what is best for us in the long run,” she says. “We tend to think in terms of economic benefit, but there are implications to be considered: How does land use impact ecosystems, climate, biodiversity, and water quality?”

Grace S. Brush, a Hopkins professor of geography and environmental engineering who was DeFries’ mentor at the Whiting School, says her former student capitalized on technical advances in satellite imagery to advance the field.

“She is very clear in her thinking, very smart, and I’m really happy that her work is being recognized.” —GR
A Hospital Head Who Listens

On a recent afternoon after receiving an award for corporate leadership from the Greater Dallas Asian-American Chamber of Commerce—one of several awards she has garnered in the last few years—Winjie Miao ’98 returned home with an 11 x 17-inch foam-board headshot of herself. “I was proud of the award, and flattered, but what do you do with a giant poster of yourself?” she laughs. “Maybe make a dartboard … or cover a big bathroom wall.”

For someone who was recently appointed president of Harris Methodist Northwest Hospital, one of 13 acute-care hospitals under the Texas Health Resources (THR) umbrella, Miao maintains a sense of humor and a centered look at what is important to her—in her work and her personal life.

“…at the end of the day, I make decisions based on what is right for the patient. You can’t go wrong with that.” —Winjie Miao

And at 30 years old, Miao is one of the youngest nationwide to hold such a post.

With a bachelor’s degree in biomedical engineering from the Whiting School and a master’s in health care administration from the University of North Carolina, Miao jumped right into her career, taking two stairs at a time. In 2000, she joined THR at Presbyterian Hospital of Dallas. During her seven years there, she completed her administrative residency and fellowship and moved on to don several hats, including heading up Oncology Services, Clinic Services, and—at the tender age of 23—Planning and Construction.

In that role, she oversaw a $207 million campus expansion plan, which included a new bed tower; new diagnostic and treatment space; new labs and a radiology department; a new parking garage; and an additional hospital building.

“I was lucky. I came around at the right time,” she says, adding that her foundation in biomedical engineering helped her land the plum position.

“One of the most satisfying parts of overseeing the expansion project at Presbyterian was being able to use my engineering skills and knowledge to figure out how all the pieces would ultimately fit together,” she says. “When you’re spending that much money to create something new instead of simply replacing it with a more state-of-the-art version, you want to ask questions, create improved processes and best practices, and ultimately, end up with a hospital complex where function drives form, instead of the other way around.

“No matter what project I am working on, the key for me has invariably been my willingness to listen. And at the end of the day, I make decisions based on what is right for the patient. You can’t go wrong with that.”

In her new post at Harris Methodist, she has already added new technologically advanced equipment and is looking into creating a more robust education program, wooing more specialists to the roster of physicians, and continuing to reach out to the community through programs like hand-hygiene and CPR education, car seat checks and safety, and a health and wellness program for seniors that includes line dancing. “Already, I see how committed people are to this hospital and its rapidly growing community,” she says. “There is so much energy.”

Before falling asleep each night, Miao analyzes her day. “I think about each conversation I had and what I heard. I ponder the decisions I made and the ones I will need to make. And I always ask myself, ‘What can I learn from that?’”

What drives Miao in her work is knowing that every decision, every idea, is a step toward making the experiences of her patients—and staff—as smooth and positive as possible. “No one wants to be in the hospital; it can be terrifying and painful,” Miao says. “But knowing that I can impact an entire experience for a patient—the big picture for that person and for all of us—moves me to keep asking questions and then, to go forward from there.”

—Victoria Tilney McDonough

Fixing Fick’s Law

Marc Donohue, the Whiting School’s vice dean of research, places a cup of water on a table in his office. A cherry-flavored Life Saver rests at the bottom. “That’s diffusion,” he says, pointing at the cup.

Donohue has been working to better understand diffusion for nearly a decade. Recently, he and a team of colleagues shed new light on a classic diffusion equation—known as Fick’s Law—that has caused questions among mathematicians and researchers for nearly a century.

“Einstein gave a lot of credence to the idea that Fick’s Law is correct,” says Donohue, a professor in the Department of Chemical and Biomolecular Engineering. “But,” he concludes, “his analysis of it was overly simplistic.”

First described by physiologist Adolf Fick in 1855, Fick’s Law provides a mathematical explanation for diffusion. Specifically, it holds that during diffusion (the process by which molecules randomly and gradually spread from a high concentration to a low), the flux—or rate—at which the molecules spread is proportional to the concentration gradient.
Mechanical and Engineering Building was completed in 1914.

Joseph Evans Sperry designed the building, which cost roughly $285,000—a bargain when you consider the price tag of its new neighbor, the recently completed Computational Science and Engineering building: $37 million.

Not to say that Maryland Hall was not state-of-the-art for its day. It contained classrooms and labs equipped for experiments in photometry, high-voltage electrolysis, wireless telegraphy, fuel analysis, refrigeration, materials testing, and a range of other uses.

To illustrate, Donohue uses the submerged Life Saver and the ring of reddish-pink that slowly colors the water at the cup’s bottom. Left to sit for a week, the red coloring slowly creeps toward the top, until finally all the water in the cup is an even shade of pale red.

Classical Fick’s Law holds that the time it takes for the red to reach the top of the cup depends on the concentration gradient. “But, for the past century, everyone has known that concentration is not really the right variable to use in the equation,” says Donohue. “Instead, everyone believed that the flux is proportional to the gradient of the chemical potential.”

In other words, the amount by which the free energy of the system (i.e., cup’s water) would change if another particle (i.e., Life Saver) was introduced.

So, Donohue, along with Gregory Aranovich, a fellow professor in the department, and a cadre of graduate students, set out to determine whether the chemical potential is the true driving force for the equation.

They concluded that it isn’t.

At the same time, they discovered an even bigger problem. “We knew that concentration is not the driving force for diffusion,” Donohue says. “We soon learned that chemical potential is not, either. But then we determined that the equation itself is wrong.”

To develop a more robust and accurate theory, the team began to look at instances in which Fick’s Law doesn’t work. “One of the things we then predicted is that while diffusion is a dissipative process in which molecules move from high to low concentration, it also includes a wave phenomenon.” Previously, it was thought that during diffusion the random movement of molecules occurs on an infinitesimally small scale; that each molecule moves in one direction a tiny bit and then in another a tiny bit, and so forth. Donohue found that those distances can be large and, in some instances, density waves are created that lead to a layered buildup of molecules.

Profiled across a graph, classical Fick’s Law looks like a loaf of bread: an even distribution of molecules over time. Donohue’s theory, on the same graph, looks like a frontal silhouette of Batman’s head. It’s generally round, but the density waves create two spiky ears. “We call it the Batman Profile,” Donohue explains with a hint of a smile.

The team found that density waves manifest in a variety of conditions. For example, in low pressure gases, or when diffusion occurs on a really small scale, such as in nanoporous materials, or on a really large scale, such as in outer space where molecules travel long distances before colliding with anything. Ultimately, it means that the definition of Fick’s Law as Einstein derived it is flawed, and that there is a better explanation to be found.

“But, this is not going to be solved completely in my lifetime,” Donohue says. “Our biggest contribution is that we’ve shown people that the current theory is limited in its applicability, and we’re pointing them in the direction of a more complete theory.” —Angela Roberts
Work That’s All Fun and Games

He-Man and Voltron action figures no longer rule the toy store. And while there are a few classic games and toys that seem almost guaranteed to remain popular forever, like Monopoly and Barbie dolls, even these favorites need helpful extras each year to keep sales brisk. (Witness Barbie Girls: A doll that doubles as an MP3 player and also instantly links girls to an interactive website.)

Keith Millman ’99, who studied mechanical engineering as an undergraduate, knows all this and pretty much everything else there is to know about toys. He knows who designs them, who manufactures them, and how long they’ve been selling. But Millman isn’t your average toy enthusiast; he’s a professional toy inventor.

Together with his business partner, Westley Ciaramella, Millman owns and operates Catapult Concepts, a toy inventing company the pair launched in 2004. They currently have three toys on store shelves: their successful Piranha Panic, a small table-top game involving dice, marbles, and plastic piranhas that threaten to send players back to “start”; a card-balancing game of skill called Shakedown; and Barbie Gymnastics Divas Twirl Team (the duo invented a way to make Barbie twirl a ribbon in one hand while performing a back-spring crowned by a split).

Millman, who loved playing with Legos as a kid, landed his first real job after graduation from Hopkins back in his hometown of Hillsboro, New Jersey—in a strip mall.

“All my friends were going to law school or working in big-time finance jobs and I was working retail in a toy store,” he says. “But, I knew that to be an inventor, I needed to know what manufacturers were doing and where the trends and industry were going.” With a notebook always on hand, he recorded toy brands and manufacturers, new advances in technology, and sketches of his own toy ideas. By summer’s end, he knew exactly what role he’d play in the toy industry.

“I realized inventing would be a mix of engineering and design; everything I like, from imagining to executing a product and solving all the mechanical problems in between.” That fall, he entered the nation’s premier toy design program at New York’s Fashion Institute of Technology, where he later befriended Ciaramella. “For my application portfolio, I included some toy designs I had done but also used an AutoCAD drawing I had done in a senior year engineering course. I do think being an engineer from Johns Hopkins definitely helped my application.”

Completing the two-year program in 2001, Millman joined Big Monster Toys (BMT), one of the nation’s leading toy design firms. After three years with the company, he was itching to start his own. The following year, he wrote a business plan, raised the necessary start-up funds from friends and family, and he and Ciaramella launched Catapult Concepts.

The partners set up shop in the basement of an apartment complex in Long Branch, New Jersey. “With help of a family connection, we rented an apartment on the first floor to live in and used the basement as our workspace and office,” Millman recalls. “We even bought some of our work equipment off eBay, things like a metal working lathe, a mill, a vacuum form machine. Our shop kind of looks like a high school woodshop classroom.”

The start-up company experienced success almost immediately. “In our first year, we had three Mattel products, which is amazing,” Millman says. “Two made it to the shelf—our Piranha Panic game and a new feature for stuffed animals: a way for a stuffed cat’s eyes to close and its head to tilt when it’s being petted,” he explains. “If next year it goes to a dog, we will get an additional royalty.”

In the past two years, the pair has sold six more ideas. “Since it’s all still proprietary information I can’t talk about the actual products,” Millman says, but adds, “I can say that there is a game, a feature doll, a card game, and one is… a girls’ product.”

Though Millman today is light-years away from working retail at the mall, he still gauges the market the same way he did when he was fresh out of Hopkins.

“We go to the toy store a lot. Walking down the aisle, we know what’s considered a hit, who is gaining market share over whom, what toys are doing well, and where there’s room for something new,” he says. “We’re constantly thinking about toys.” —AR

Millman’s Piranha Panic uses plastic marbles and gravity to keep kids enraptured.
And They’re Off!

Adam Baumgartner, a sophomore mechanical engineer, is talking in a corner of Latrobe Hall’s basement. He’s describing his involvement on the Hopkins Baja-SAE team and is so excited that he’s actually jumping up and down in place. Standing 6 feet 8 inches (he’s also a forward on Hopkins’ men’s basketball team), he has enthusiasm that is both contagious and, in this cramped setting, slightly overwhelming.

The object of his excitement? A 10-horsepower, dune buggy–type vehicle that he and his Hopkins classmates are crafting to compete in an intercollegiate design competition run by the Society of Automotive Engineers (SAE). The single-seater must be equipped to race across rough terrain, catch air, and chug through deep water. The team’s goal: to create the most efficient machine that can take part in speed, distance, and endurance competitions in a wide variety of settings.

Baumgartner’s co-captain for the 2007–2008 season is Avik De, also a sophomore mechanical engineer. Together the two are leading a group of 14 undergraduates (many from Mechanical Engineering, but others from Physics, Biomedical Engineering, and even International Relations) in the design and construction of the vehicle.

After planning, refining, and strategizing their design within the constraints defined by the SAE, the students will build and test the car. Later this spring, the team will compete in a series of international competitions against schools from across the United States, Canada, Latin America, and Korea. They will be judged on their design, cost, speed, traction, land maneuverability, water maneuverability, and endurance.

This marks the fourth year that a Whiting School team will compete in the contest. “Two super-motivated students started it here in 2004 and it is students that have made it a success,” says Lester Su, an assistant professor of mechanical engineering and the team’s faculty advisor.

Each team starts with the same 10-horsepower Briggs & Stratton engine and is allowed to cannibalize a percentage of parts from its previous year’s entry. “We’re making it substantially lighter than last year’s by taking out unnecessary tubes, completely redesigning the drive train, and making our own two-stage chain reduction box,” De says. “It’s a completely redesigned chassis,” adds Baumgartner.

When De explains that the car is designed entirely on the computer, Eric Harden, the department’s senior machine shop coordinator, chimes in, “But just because the computer says it works, that doesn’t mean it works.” While competing is clearly a thrill, the team obviously enjoys putting classroom learning to hands-on use. “There are trade-offs we have to make at every stage. But we’ve had the chance to learn how to use all these tools,” Baumgartner says, walking through the machine shop. “We learned to weld, which is cool. This is a dream come true for me. Definitely something to check off on my life ‘to-do’ list.”

To find out how the 2007–2008 team fares, check its website, http://www.jhu.edu/asme/baja.html, later this spring.

—AL

Expanding Worlds

Each summer, several undergraduate recipients of the Whiting School’s Vredenburg Scholarships receive funding to apply their engineering, technology, and applied science skills in an international setting. We checked in with three 2007 Vredenburg Scholars upon their return to Hopkins in the fall to find out more about their research and travels.

As a kid, Blair Johnson ’08 was afraid of waves. She wasn’t a strong swimmer and the thought of getting knocked over and rolled into the undertow filled her with horror. Back then, she never could have imagined herself as an undergraduate drawn to coastal engineering; in fact, she never knew such a discipline existed. Flash forward 15 years and Johnson found herself in Granada, Spain, where she passed her summer studying wave patterns, ports, breakwaters, and coastal structures.

Here in Baltimore, the civil engineering major spends much of her time in the basement of the Stieff Building studying the nature of waves. In particular, she’s interested in how waves dissipate over mud, because mud is more elastic than a harder surface like sand and absorbs more of the water’s energy. Her hours logged alongside the 20,000-gallon wave tank gave her the foundation—for more solid than
mud—to land the Vredenburg Scholarship and further her research abroad.

In the gorgeous city of Granada, where centuries-old buildings stand against a backdrop of jagged peaks, Johnson worked in a lab of almost 30 people, most of whom—professors and doctoral students—were older and more experienced. “We worked on port and harbor construction, specifically creating a new breakwater design,” she says.

The existing breakwater in the Port of Gijon, north of Granada, can dissipate the waves during calm weather. But when weather turns severe, it can’t prevent the waves from battering the beach and port. “We designed a berm that would be an extension, serving as a sort of sandbar in front of the existing concrete-block breakwater, which would help break the waves at an earlier point in their pattern, especially during storms,” says Johnson.

The breakwater design is being finalized, and its construction in the Port of Gijon should be complete within a year, she notes.

The young engineer says she chose to pursue coastal engineering because it would allow her to combine her interests in waves and oceans with structural engineering. “And, I’d get to travel to some amazing places all over the world.”

Her summer abroad as a Vredenburg Scholar didn’t disappoint. “I absolutely loved the culture there,” she says. At first she was surprised when everything shut down from 2 to 5 p.m. every day for siesta. “But soon I learned the pleasure—and importance—of reading a book by a fountain or spending a day walking in the countryside with a friend. People there are incredibly productive, but they also take the time to enjoy the good moments.”

And although she still isn’t a strong swimmer, Johnson hopes to return to the lab—and to the ocean—for a year of post-graduate work. “There is so much more to learn and do in Granada,” she says. “My summer there opened up the world for me.”

Julia Dixon ’08 spent one month training in Costa Rica and a second month in the town of Olanchito in Honduras where she repaired biomedical devices in a small public hospital. A pre-med student majoring in biomedical engineering, Dixon wanted to combine her studies in medicine and engineering. Working with a student partner from the Engineering World Health Summer Institute and a technician from the International Aid’s Medical Equipment Training Program, Dixon devoted her days to finding workable fixes for blood pressure cuffs, EKG machines, pulse oximeters, and nebulizers—all key equipment for a basic hospital. Because their funding was limited, Dixon and her colleagues had to be creative in their approach to repairs, such as switching or rebuilding parts from several broken oximeters to create a single functioning one.

“The work was often frustrating because we didn’t have the resources we needed,” says Dixon. “But I definitely think the summer gave me a full picture of what health care is like in developing countries. I was impressed that the clinicians would do their work every day with so few resources—and make a difference in the lives of so many people.”

As a physician, she says, “I would like to return to Honduras or another Latin American country. If we in the United States are to help hospitals in [developing nations], we need to tailor our solutions based on their resources. It’s not just a matter of shipping them state-of-the-art equipment.”

Although he grew up in Botswana, Vredenburg Scholar Kwadwo Tettey ’08 gained a deeper insight into his homeland during his summer doing HIV/AIDS research. Working at the Botswana-Harvard Partnership for HIV Research and Education in the capital city of Gaborone, the chemical and biomolecular engineering major studied protein expression versus viral load in HIV/AIDS. The goal: to deepen understanding of the dynamics of the virus and how it progresses.

When he wasn’t setting up experiments and analyzing data, Tettey would visit the nearby hospital. “My research became very real to me,” he says. “Walking the hospital corridors, I would see so many HIV/AIDS patients—men, women, children, every age and sort of person.”

Tettey plans to pursue graduate work in nanotechnology, hoping to combine that work with further HIV/AIDS research. “A lot of people around the world are working very hard to understand and combat HIV/AIDS,” he says. “It is not fast enough, but I believe scientists will come up with a cure. I would like to go back [to Botswana]. And someday I’d like to be a part of finding that cure.” —VTM

Tettey captured this shot during a safari trip and scenic flight over Botswana’s Okavango Delta.
The Sum of Its Parts

For Chieh-San Cheng, MS ’91, everything he ponders is made up of parts—parts, or data, that ultimately create a whole picture or system. Cheng is the co-founder and president of Global Science & Technology (GST), a company devoted to solving the technical and scientific challenges fundamental to technology-based enterprises. These enterprises range from creating meteorological imaging systems for global climate forecasting to a portable system designed for soldiers in wartime to receive—in real time—information via satellite. Working with the Goddard Space Center, GST’s scientists have even been involved in testing the Hubble Space Telescope’s wide-field cameras. The company currently has 200 employees, working at six different locations around the country.

Although Cheng created his company, in partnership with two colleagues who were also NASA contractors, with a foundation in meteorology and systems engineering, he insists he has never been an expert in any one specialty. “Neither am I a born leader,” says Cheng, who also earned a master’s in meteorology in 1975 from the University of Maryland. “But I do like people and I wanted to create a company that would not only provide a unique, healthy, and socially aware culture to its employees, but one that would also provide answers and options to the fields of science, engineering, information technology (IT), and technical support.”

In a relatively short time, GST has done just that, serving clients that range from NASA, the FBI, and NOAA (National Oceanic and Atmospheric Administration) to private global and IT companies. GST even uses RenderMan, the same data processing system that, for instance, Pixar used to create the throng of feisty four-wheeled friends in its recent movie Cars. “Pixar uses the program to entertain,” says Cheng. “We use it to tell stories about the Earth—like those of global warming and ocean patterns.”

Cheng started GST in 1991, just as he completed his master’s through the Whiting School’s Engineering and Applied Science Programs for Professionals (EPP), a degree he had worked toward for four and a half years while he was a NASA contractor.

“The curriculum in that program gave me the confidence I needed…and the big picture in technical management,” he says. “I knew as a child that I wanted to create my own fate, my own vision, and to work for myself. This program provided me with the missing pieces.”

Looking toward GST’s future, Cheng is focusing on medical imaging. “The medical industry has yet to take full advantage of 3-D imaging. Look at Earth and space sciences technology…and look at what Pixar is doing in animation; those technologies are so far ahead [of medical technology],” Cheng says.

“We are developing software and programs, using the same technology we have been using to study the ozone hole or forest fire patterns, for example, that could be used to image the whole body at once—and through a low-cost, and lightweight system. Why look at only one section of the body when seeing the whole physical system in a more holistic way could answer so many more questions?”

—Chieh-San Cheng

Beware the Eavesdropper

In the past decade, millions of people have begun to use Voice Over Internet Protocol (VOIP) services that route their telephone calls over the Internet. Because the public nature of the Internet makes eavesdropping relatively easy, VOIP providers are increasingly encrypting the conversations to protect users’ privacy.

But the encryption scheme has a weak spot, according to Whiting School computer scientists. Although the words will be garbled, a clever eavesdropper will be able to figure out what language is being spoken. And the researchers suspect that the encryption scheme in some circumstances might “leak” even more information, such as who is talking.

In the arcane world of encryption a vulnerability that gives this much information away is a pretty big deal.

“We can’t be naive about how determined or dedicated the attacker can be. Information, even in small amounts, if gathered in a timely way can have enormous benefits [to the eavesdropper],” says Gerald M. Masson, a professor in the Department of Computer Science and director of the Johns Hopkins University Information Security Institute.

Of course, intelligence services might want to use the newfound knowledge to zero in on potential terrorists. But corporate spies might also use it against competitors—perhaps getting a heads up about the location of a new plant based on the language being spoken in eavesdropped phone calls.

Masson, along with associate professor Fabian Monrose and graduate students Charles V. Wright and Lucas Ballard, showed that
Corporation Connections

Blackbird Takes Blue Jays Under Its Wing

Computer science major Matt Fedderly can’t say much about what he did last summer as an intern at Blackbird Technologies Inc., but he enjoyed it immensely. “I was working with really smart people, and I learned stuff you can’t really learn in school,” he says.

Based in Herndon, Virginia, Blackbird provides high-level information security and other technical support to government and corporate clients, and much of the work is confidential—some, top-secret. “We develop tools and capabilities critical to the success of the global war on terrorism, as well as to address the information technology needs of the intelligence and defense communities and similar challenges in the private sector,” explains Executive Vice President and Chief Technical Officer Richard Moxley.

“It’s a great place for a technical person to work,” he says. “We invest aggressively in internal research and development, becoming expert in the work of our customers and developing ideas

“We develop tools and capabilities critical to the success of the global war on terrorism.”—Executive Vice President and Chief Technical Officer Richard Moxley

for new products that we then take to them.” For example, the company conceptualized and developed a state-of-the-art, hand-held satellite communication device for the Department of Defense that is now being used in places around the world without a cell phone network. That includes areas where the U.S. military is currently engaged, Moxley notes.

The 10-year-old company’s growth recently prompted Blackbird to seek out potential sources for new employees and research collaborators, and Johns Hopkins was high on the list. In addition to the Whiting School’s stellar reputation in information security and related areas, Blackbird Executive Vice President Steve Pann had first-hand experience with the Whiting School through his son Nick, now a sophomore. After a few meetings with Dean Nick Jones and faculty at Johns Hopkins University Information Security Institute (JHUISI), Blackbird executives were “very impressed with the quality of the students and with the school’s research and programs in the technical areas we’re engaged in,” says Moxley.

This fall, the company funded the Blackbird Technologies Scholarship, which provides a student with an undergraduate scholarship. “We wanted to invest in students,” says Moxley, “and we see this as a first step toward a more robust relationship.” The inaugural recipient is Barrett Duke, a sophomore majoring in computer engineering.

“We’re grateful for this gift, and tremendously pleased by the confidence Blackbird Technologies has shown in the Whiting School,” says Dean Jones. “We look forward to a growing collaboration on both the engineering-education and research fronts.”

Moxley, Pann, and their colleagues are actively exploring opportunities for new partnerships with the Whiting School. “We’re getting to know more about the students, the programs, the faculty, and the staff,” says Moxley. In addition to supporting the Blackbird Technologies Scholarship, the company will again seek out qualified Hopkins undergraduates for its summer internship program, which is being expanded.

Matt Fedderly would be pleased to return for another summer, he says. “It’s a great opportunity.”

—Margaret Hindman
We’re barraged by information—what will happen when it’s too much?

Sanjeev Khudanpur, assistant professor of electrical and computer engineering, Center for Language and Speech Processing

Information overload. That’s indeed what we’re facing.

On any given day, 1,000 articles about my area of research may appear in various publications—and the same holds true for other engineers, scientists, and doctors. Twenty years ago, a doctor wouldn’t have been faulted for not having read a study in an obscure medical journal that could have prevented a patient’s death. Today, if the information is out there, you’re accountable.

Email has grown out of control. For the past six years, every three months, I’ve filed the emails I didn’t have time to read, intending to get to them. This past spring the number of emails in that folder had grown to 1,000—not counting spam.

The enormity of information has repercussions for industry where critical data need to be gathered and synthesized. Companies need feedback from customers around the world about products. Are there recurring problems? Patterns of opinion?

All of this presents the Center for Language and Speech Processing (CLSP) with a major new challenge—creating digital tools that enable computers to understand and categorize what constitutes relevant, critical information.

As I see it, there are two pieces to the problem. There’s “the fire hose”: There’s so much information coming at you at once, how do you organize it? The other is “the ocean”: How do you fish out the most pertinent information and reel in just what you want?

Language is ambiguous, variable, and context dependent. So we’re investigating how to represent the meaning of a sentence, of words, so that a computer can understand and assess it well enough to index it correctly. Right now, under “friendly” conditions we can do this. But “friendly” conditions mean the speaker is fluent in American English, isn’t too old, too young, or emotional, and there’s no reverberation. These are big limitations, so interpreting text and understanding the intent of communication is a much larger problem than just writing down words.

In the future, computers will be smarter and will serve our individual information needs. While this will impact politics, industry, and consumers, it will be especially important in education. Eventually, every kid who goes to school will bring along a device that records, indexes, and is able to contextualize information. The device will be able to recall all that was said, read, and seen that day, provide a reminder about an assignment, a sample math problem from a week before, and a relevant part of a lecture.

Communications have exploded. The CLSP is enhancing our ability to take advantage of and manage information, ultimately improving communication between people.

Friends We’ll Miss

Jack Spangler

William Jack Spangler, whose affiliation with Johns Hopkins spanned 45 years, died on September 16, 2007 at the age of 62. Spangler began at Hopkins in a work/study position during his senior year of high school and was hired by the Department of Physics immediately upon his graduation in 1963. In 1995, he transferred to the Department of Civil Engineering, where he remained as a senior instrument designer until his retirement last August. He received the Whiting School of Engineering’s Outstanding Staff Service Award in 2002.

“Jack was truly gifted,” says Nick Jones, dean of the School of Engineering, who worked with Spangler on numerous bridge-related research projects over more than a dozen years. “He had a tremendous gift for understanding electromechanical systems, and would diagnose and repair complex mission-critical systems in a calm, unfappable manner.”

Says Spangler’s former colleague Emeritus Professor Aihud Pevsner from the Department of Physics and Astronomy, “Jack could reassemble a television set in the time it took me to cough.”

“Jack was always working in the background,” says Jones, “and his commitment to delivering the highest quality product has strongly influenced the careers and lives of many Hopkins faculty and students.”

Bob Pond

Robert B. Pond, an emeritus faculty member who taught at Johns Hopkins from 1947 until his retirement in 1998, died on October 5, 2007.

Pond was devoted to teaching, research, consulting, and lecturing in the field of physical metallurgy. He was also known to generations of students for the bow ties he fashioned out of aluminum for himself and each new professor in the department.

Bob Green, who recently retired from the Materials Science and Engineering Department, recalls his colleague and friend of more than 40 years with whom he founded the department in 1983. “Bob Pond was one of the best teachers at Hopkins Engineering. He knew all the things that are in the books but he also knew the practical side of things from his industry experience at Bethlehem Steel. He was friendly and enthusiastic and as a teacher he was very approachable. All the students loved him. He taught me most of what I know and was a wonderful mentor and friend.”

Pond’s research involved solidification phenomena, the practice of cire perdre casting and growing multiple metallic single crystals in a single mold. For many years, Pond studied the nature of ductility at deformation rates exceeding the velocity of sound in metals and alloys and the deformation of single crystals on a microscopic scale. He took the first high magnification movies of slip bands forming and propagating during tensile formation, using a technique he christened “cinemicrography.”

Dean Nick Jones notes that Pond’s dedication as teacher and scholar continues to be recognized through two awards at the Whiting School: The Robert B. Pond Senior Achievement Award and the Robert B. Pond Excellence in Teaching Award.
Whither the Job Market?

We tapped a bevy of engineering “forecasters” to find out what fields will be hottest in the decade to come.

Surprising as it may sound, the most common undergraduate degree among today’s CEOs isn’t business or economics. It’s engineering.

More than ever, engineers are venturing into just about every niche of corporate America. Both Lee Raymond, who runs ExxonMobil, and Jack Welch, the man who famously brought GE back from the edge, have PhDs in chemical engineering. Philip Condit’s combined degrees in mechanical and aeronautical engineering helped him run Boeing from 1996 to 2003, and Gordon Harton, the retired president of the Lee jeans brand, didn’t study fashion design; he earned a degree in industrial engineering. Here at Johns Hopkins, both President William R. Brody and new Provost Kristina Johnson are electrical engineers.

It would be an understatement to say that the demand for engineers has broadened beyond labs and engineering firms. Without a doubt, engineers will continue to be needed to fill the roles we’ve come to expect—designing bridges, building robots, creating computer code. But today, the pace at which highly trained engineers are being sought by sectors of America’s non-engineering job market is increasing faster than ever.

The U.S. Bureau of Labor optimistically predicts a 9 percent to 17 percent increase in engineering jobs between 2004 and 2014 (with the caveat that the boosted job market “varies by specialty”), while a 2005 report to Congress from members of the National Academies predicts an alarming dearth of American engineers over the next 10 years. All of this comes at a time when U.S. companies, particularly in the fields of manufacturing and engineering, are moving significant portions of their operations overseas—from their customer help desks to their manufacturing facilities.
In such a dramatically shifting job market, young engineers collectively scratch their heads and wonder: In 10 years, how many jobs for engineers will exist in the United States, what will those jobs be, and how do we best prepare for them?

Gusts of Change

In 1853, a young man named Daniel Coit Gilman sailed to Europe to serve for two years as attaché of the American legation at St. Petersburg. During his time abroad, the newly minted Yale graduate became an arduous observer of the European educational system, visiting colleges in Britain and across Europe. But it was the German institutions that caught his attention, and he found himself attending lectures at the University of Berlin during the cold winter months of 1855.

The time in Germany had an impact. Gilman, who became Johns Hopkins’ founding president in 1875, built a university on the principles of German education, emphasizing research and scholarly publications. Gilman was a genius for his ability to understand society’s need for scientific study and professional training at an advanced level. Under his guidance, Johns Hopkins became the country’s first research university, setting the course for the development and future success of the university’s School of Engineering.

When admitting its first engineering students in 1912, Johns Hopkins adhered to its original mission of the pursuit of knowledge through research. For nearly a century, the School of Engineering has continued to fuse advanced scholarship with research and applied technologies, preparing students to think broadly and beyond the narrow constraints of a single field of study.

But that kind of research-based preparation isn’t the norm among American universities according to Bill Kelly, the manager of public affairs for the American Society for Engineering Education (ASEE). He points a disappointed finger at the “fairly slow” rate at which the majority of American academia has customized the education of engineers to match the rapidly advancing technologies of today’s world.

Kelly, who before joining the ASEE in 2007 served as dean of the School of Engineering for The Catholic University of America, explains that America’s trend toward outsourcing overseas has focused mainly on routine engineering work and says that, meanwhile, the “demand for expert thinking has grown.” As the work being performed in the U.S. becomes increasingly sophisticated and technology-dependent, he says that the marketplace will demand more engineers like those from Johns Hopkins who can apply concepts and theory in a highly innovative setting.

“Overall, change in engineering education is going to have to pick up the pace,” he says. “Advancing engineering education will require getting undergraduates into faculty labs, into internships and study abroad programs, performing work that isn’t routine, and gaining experience that reflects the type of work happening in the real world.”

Whiting School Dean Nick Jones couldn’t agree more and notes that Hopkins is ahead of the curve regarding this educational philosophy. “Here at Hopkins, we’ve always believed that engineering education should be highly conceptual and theoretical,” he says. “We’ve also placed a growing focus on the application of

Mock Interview Night: A Serious Approach to the Job Hunt

In November 2006, Zan Liu, MS ’06, PhD ’07, attended the Whiting School’s annual Mock Interview Night hoping to get advice on the job market and network with industry professionals. He ended up with that and much more, including, by the time he graduated, a job offer.

Sponsored by the JHU Society of Engineering Alumni (SEA), Mock Interview Night is an opportunity for current engineering students to practice their interviewing skills in an informal setting with volunteers who include JHU alumni and professionals from the business community. “Going to the mock interview night was absolutely very successful for me,” Liu says. After the event ended, Liu introduced himself to Russ Lindemann ’85, who graduated with a degree in mechanical engineering and is now product applications manager for Baltimore Aircoil Company (BAC).
practical experience. This includes required senior design courses, the chance to take part in mock interviews with alumni, opportunities to study abroad, engineering-related business courses, and collaborating with faculty on research. All of these activities prepare our graduates to succeed in the workforce by giving them a highly effective balance of theory and application.”

Such is the case with civil engineering major Zach Rosswoog ’08, who supplemented his Hopkins coursework with two internships. “Interning after my sophomore year and my junior year really gave me an advantage,” he says. The first summer he worked for three months at STV Inc., a structural design firm in Baltimore, and the following summer at American Bridge, a building contracting firm in his hometown of Pittsburgh.

“At STV, I was involved with a lot of design projects, which included lots of analysis and office work,” Rosswoog recalls. “At American Bridge, the work was much more hands-on. We did projects like bridge inspections, where we spread cables apart to check for corrosion before then re-compacting them. I learned a lot more when I was out in the construction site, experiencing everything in real life instead of designing projects at a computer.” He adds with a sheepish smile, “I like to be outside, not sitting behind a desk.”

Just a month after his internship ended last summer, American Bridge sent him a letter asking him to join them as a field engineer after he graduates in May. “I wasn’t expecting it at all,” he recalls. “They had told me to follow up with them in six months, so it was a real surprise.”

In addition to his civil engineering major, Rosswoog pursued a minor in entrepreneurship and management, the most popular minor at Homewood according to Mark Presnell, director of Student Career Services on the Homewood campus. “I don’t know of another school that offers this—it’s like a business school within an engineering school,” Presnell says. “It produces engineers who have quantitative backgrounds and fantastic business skills.”

The program includes classes in calculus and statistics, business and finance, leadership and organizational behavior, international trade, and operations management. While teaching fundamental leadership skills, the courses also expose students to topics such as ethics and psychology.

This preparation is particularly valuable in today’s job market. “I’ve noticed an increased demand for well-educated engineers from many business sectors”—including consulting firms and those on Wall Street, he says.

“Overall, all of our graduates understand the theoretical base of engineering. And that conceptual engineering knowledge is enhanced by research-based coursework and through minors and concentrations in other areas that combine to give them, as graduates, an edge that their peers from other universities may not have,” says Presnell.

Sarah Parola is a prime example. She earned an undergraduate degree in Biomedical Engineering (BME) in 2001 and immediately landed a job doing bench research at Merck in Rahway, New Jersey. However, she says that her Hopkins BME background made her “want to see the bigger picture.” Soon, she was working her way up the ranks toward management.

“Now I’m in the manufacturing division in Whitehouse, New Jersey, doing strategic capacity management. We look at all of the assets in the company—all the vaccines we own, all the chemical-based drugs, all the facilities—and then we determine, for example, at what location new products should be produced.” In this larger role, Parola works on a team with other engineers to make those strategic decisions. Yet, she says, because she’s the only team member with a background in biology, she has a unique perspective that adds much-needed value to the group.

Parola’s desire to see the “bigger picture” hasn’t diminished. She’s already added a master’s degree in chemical engineering to her skill set and is broadening her focus even more by working toward an MBA at New York University.

In the view of Murray Sachs, who recently stepped down after 17 years as the director of

The two exchanged follow-up emails and when BAC had a job opening the following April, Liu was invited to interview. A month later, he received his PhD in mechanical engineering and joined the ranks at BAC. “I now work for Russ as a product applications engineer, helping to provide technical support to our sales reps around the world in the Heating, Ventilation, and Air Conditioning (HVAC) market.” Liu says. “It’s a perfect fit with my background.”

What initially motivated Lindemann to volunteer was a combination of wanting to support his alma mater and his need to find new avenues to identify potential employees. “The entire process was very rewarding,” he says. “I was able to give back to Hopkins in a small way and, since I was able to recruit someone of a very high caliber, I got a prize, too!”

This past November, Lindemann returned to the Homewood campus to volunteer at Mock Interview Night. “This year,” he says with a chuckle, “I dragged Zan with me!” —AR
Hopkins’ BME department, Parola’s experience isn’t unusual. “Because of the breadth of their education,” he says, “and because of the evolution of the industry, BME graduates have more interesting careers than ever before.”

Elliot McVeigh, Sachs’ successor as department director, concurs. “Our graduates are fully prepared to enter rapidly growing industries like the medical device or pharmaceutical industries. There are thousands of companies to choose from, from small start-ups to big companies.”

### Mostly Sunny With Scattered Clouds

McVeigh predicts a robust job market for biomedical engineers over the next five years as the need increases for “people skilled in bioinformatics who can process and analyze the huge array of patient data that doctors gather.” Already, he says, the amount of information hospitals collect is staggering and soon, “doctors will have more patient information than we know what to do with.” McVeigh believes biomedical engineers will be key to developing these tools.

Similarly, he predicts there will be a major push over the next 15 years toward a reduction in the cost of medicines. “As baby boomers age, economics will force us to turn our attention to more efficient, more effective, and less expensive delivery of advanced health care.” This trend will spur an increased demand for engineers who can successfully unite biology and business, including biomedical engineers, he believes.

McVeigh’s predictions are supported by a recent U.S. Bureau of Labor report, which forecasts job growth rates for the decade between 2004 and 2014. According to that report, the market for biomedical engineers in the pharmaceutical, manufacturing, and related industries is expected to grow by more than 27 percent. The report cites America’s aging population, the growing emphasis on health issues, and the rising interest in cost-effective medical devices as major drivers in American industry.

Of course, biomedical engineering isn’t the only discipline expected to flourish. The report predicts that as society shifts its focus from solving environmental problems to preventing them, companies across the country will increase compliance with environmental regulations and find ways to clean up existing hazards. As a result, the demand for environmental engineers will also increase by more than 40 percent.

Another way to predict which fields will be hot? Identify industries that are investing in employees by funding their graduate degrees. Allan Bjerkaas, associate dean for the Whiting School’s Engineering and Applied Science Programs for Professionals (EPP), says that 95 percent of EPP’s 2,200 students receive company- and government-sponsored tuition reimbursement.

“Our fastest growing master’s program over the last five years is Systems Engineering,” he says. “These engineers develop, manage, and oversee technical solutions for companies and the government. Because they need to understand and satisfy the operational needs of the end user, the schedule and cost constraints of the customer, and the technological options available for the design, they need strong technical management and interpersonal skills along with superior technical know-how.

“In the next decade, I suspect information science and engineering will continue to be...
growth areas, with information assurance and information security presenting especially high demand,” Bjerkaas says. “Where and how data is kept and the need to maintain and verify its integrity will create an increasing demand for computer scientists and electrical and computer engineers.”

According to Bjerkaas, another area ripe for growth is modeling and simulation. As companies look to increase effectiveness and cut costs, he says, there will be a growing need for engineers who can build mathematical models for everything that is really hard, expensive, or risky to do with real objects such as “simulating global climate change or building a training module for operating a submarine.”

Growing at a speed inversely related to the size of its products is the field of nanotechnology. Electrical, computer, chemical, biomolecular, materials science, and mechanical engineers are needed to create everything from drug delivery systems that can target specific parts of the human body and “smart” materials that can change their characteristics depending on their environment to analyzing the potential impact of nanotechnology on the environment.

Robotics, as well, has grown beyond machines that build cars or enhance factory production lines. Robots now perform critical tasks in places that are considered too dangerous, impractical, or unfeasible for humans to enter, from inside the human body to the oceans’ depths and outer space.

Across the country, top engineering schools are focusing on these burgeoning areas and Hopkins Engineering, too, is investing heavily, with three new research centers launched in these areas in the past two years.

James Pitts ’73, MS ’78, the corporate vice president and president of Northrop Grumman’s Electronic Systems sector, directs the operations of more than 21,000 engineers. His biggest concern for the upcoming decade is the “significant and worrisome” trend of an aging workforce heading toward retirement. In the coming decades, job opportunities that rely on science, engineering, technology, and mathematics skills will continue to increase. However, it is predicted that the retirement of baby boomers will deplete our nation’s science and engineering workforce by 50 percent.

“Effective knowledge transfer and management will be a critical activity for most companies to help us preserve precious intellectual property and engineering know-how critical to our business success going forward,” he noted recently.

From his vantage point overseeing thousands of engineers in an aerospace and defense industry that is, more than ever before, driven by computing and network architectures, he sees a dramatically increased need for engineers who can effectively process and manage massive amounts of data and engineers to provide network security. Also needed, he says, are systems and software engineering capabilities that enable the creation of knowledge, with special emphasis on image processing and recognition.

According to the ASEE’s Kelly, engineers today need to be innovative, expert in their thinking, and equipped to operate in a global marketplace. To do this, he says, engineering education must create industry leaders.

Hopkins Engineering graduates are up for the challenge. Consider the case of Rami Subramaniam, who graduated as a mechanical engineer from Hopkins last May. He signed on with S&B Engineers and Constructors Ltd. in Houston, where he joined a team of consultants working for oil and natural gas companies. “Right now, I’m working on a project to help design a transport system to move massive amounts of propane through underground pipes to storage facilities,” he says.

With responsibilities that include not only determining the client’s requirements, but conducting complex stress and wind analyses and performing computer-generated design, he is expected to perform advanced, analytical work that applies theoretical and conceptual thinking to real-life projects—as an entry-level engineer.

Well over a century ago, Gilman set forth to establish a university education steeped in theory and rich with practical knowledge. Today, Johns Hopkins continues that mission, producing engineers who are fully prepared for the demands of an ever-changing job market.

“As a student, you learn how to think like an engineer,” Subramaniam says. “Then you get out there, and learn how to work like one.”
Environmental engineer Ed Bouwer is sure about one thing: When it comes to health risks, uncertainty rules the day.

The *Illusion of Certainty*

*By Fern Shen*
ran flakes or bacon this morning? Schedule that mammogram, or skip it for now? Start up with that powerful new cholesterol-busting drug, or pass on it?

An environmental engineering professor from Johns Hopkins University is probably not the first person most of us would turn to for help in making these potentially life-changing health decisions.

Edward J. Bouwer’s expertise is in urban pollution. His typical workday might include scooping muck samples from Baltimore’s Inner Harbor or assessing how much toxicity was left behind in New Orleans by Hurricane Katrina.

Bouwer, the chair of Geography and Environmental Engineering at the Whiting School, is careful to note in the preface to his new book on risk assessment that it does not purport to offer medical advice. (Neither he nor co-author Erik Rifkin, a Baltimore-based environmental risk consultant, is a physician.)

Still, The Illusion of Certainty: Health Benefits and Risks (Springer, 2007) is meant to influence patients’ decision making. Bouwer would love it if his book taught people how to review the literature objectively and impelled some to decide that, for them, it’s best to skip the mammogram or the statins… and even that it’s OK to indulge in that strip of bacon.

That is pretty far from the message most of us get from our personal physicians, or from Googling articles and looking for citations from the National Cancer Institute or highly regarded academicians conducting multi-center trials. Their statistics-backed advice always seems so definitive:

*Keep cholesterol levels down to lower your chance of getting heart disease. Get a yearly mammogram to increase the chance of catching cancer early and saving your life. If the bran and exercise don’t work, take cholesterol-lowering meds to lower cholesterol and risk of heart attack.*

But these solid-sounding axioms are often actually riddled with uncertainty, argues Bouwer, who has taken the time to look at the research in detail. “These health recommendations seem like they’re based on fact, but to a great degree they are based on a judgment call, on somebody’s determination of what risk is acceptable or unacceptable,” he says.

So how does Ed Bouwer have the chutzpah
Drug companies trying to sell drugs to lower cholesterol...have an obvious financial motivation to present the risks of high cholesterol in the most dramatic way possible.

While Rifkin and Bouwer have been immersed for nearly 25 years in risk management issues regarding environmental contaminants like PCBs, lead, and mercury, the specific impetus for their project was their own health issues.

“I have high cholesterol and [he] has high cholesterol and we were both told we had to lower it,” says the 52-year-old Bouwer, who exercises, doesn’t smoke, and has a serum cholesterol level that hovers between 230 mg and 250 mg. Rifkin’s doctor wanted to put him on statins.

When the two of them dug into the subject, he says, they found that “the benefits of lowering cholesterol are not nearly what we are led to believe.” The co-authors reviewed the data from large studies, such as the Multiple Risk Factor Intervention Trial (MRFIT), which looked at more than 350,000 males over a period of six years. What they found was that out of 1,000 people with high cholesterol (around 280 mg) there will be one additional death per year due to coronary heart disease, compared to 1,000 people with normal levels (between 210 mg and 220 mg).

“That’s an annual risk of 1 in 1,000 or 0.1 percent,” Bouwer says. “Is it worth it, for that kind of risk, to modify your diet, change your lifestyle, and take expensive drugs?”

They wrote up their findings and submitted the paper to medical journals. Every one of them turned it down. “We got laughed at because we weren’t medical doctors,” Bouwer recalls.

Undeterred, they wrote a book instead, recognizing they had a larger story to tell about why patients aren’t getting all the information they need about health risks. Cholesterol remained as a chapter in the book and a prime example.

One of the major insights Bouwer and Rifkin offer readers is that risks are often characterized in relative terms, which makes them sound more dramatic. They demonstrate this with a hypothetical case of a new diabetes drug. The company might say, correctly, that a study showed the drug lowered the risk of getting diabetes by 50 percent.

That’s relative risk reduction and it sounds pretty significant—until you see the actual numbers and figure out the absolute risk reduction. Of 20,000 subjects in the hypothetical study, half got the drug and half got a placebo. At the end of five years, two in the placebo group got diabetes compared to one in the drug-taking group.

That means one person out of 10,000 benefited over five years.

Put another way, the death rate dropped from two in 10,000 (0.02 percent) in the control group to 1 in 10,000 (0.01 percent) in the group taking the drug. Subtract 0.01 percent from 0.02 percent and you have the drug lowering the absolute risk by 0.01 percent.

Viewed now in absolute terms, the study seems less meaningful, the drug’s beneficial effect less certain. It’s much less compelling than being told the new drug will halve your chance of getting diabetes.

Why is risk so rarely presented this way?

In the case of cholesterol, for instance, public health agencies and physicians routinely tell people to lower their levels because they are looking at risks on a nationwide scale, the authors explain. That 0.1 percent risk means that if there are 50 million Americans with elevated cholesterol, “then 50,000 lives might be saved annually by lowering those people’s cholesterol levels.”

Drug companies trying to sell drugs to lower cholesterol, meanwhile, have an obvious financial motivation to present the risks of high cholesterol in the most dramatic way possible. Screening tests and other forms of cholesterol-reducing care are also revenue producing.

“And if you look at their ads, they always use relative numbers,” Bouwer notes.

Included in the book are numerous charts using Risk Characterization Theater as a concept for unique graphics. For instance, if there were 1,000 people sitting in a theater with significantly elevated cholesterol levels of 280 mg, there will be one additional death per year from coronary heart disease as compared to 1,000 people with normal cholesterol. This leads the authors to conclude: “The benefits of lowering cholesterol are not nearly what we are led to believe.”
Patients themselves bear some responsibility, he also argues. Some might not want to take the time to sort out statistical issues or prefer not to have their faith in medical authorities shaken. And then there’s the issue of how perception of risk can be skewed by its presentation. The authors cite a 1999 study, for example, in which patients, told that a drug has a 98 percent chance of having no serious side effects, will take that drug. But told that 2 percent of people do experience serious side effects, many of the same patients will refuse the drug.

According to Bouwer, another reason uncertainty tends to get lost is that so much of our health care advice comes via the news media, which is inclined to tell the story in the simplest and most dramatic way. An October feature on mammography in The Baltimore Sun, for example, had a sidebar recommending mammograms every one to two years for women 50 or over.

The article makes no reference to a subject discussed at length in The Illusion of Certainty, the controversy over the value of regular mammography to screen for tumors, the rate of false positives and negatives, the side effects of the test, etc. Several chapters in Bouwer’s book address the benefits and risks of other screening tests, including those for colorectal and prostate cancer.

“What I do not like… is the lack of any information on the benefits (absolute numbers) of the various screening tests discussed,” Bouwer notes. “The edict is, ‘you should have all of these tests done.’”

Rifkin and Bouwer see their book as an analytical toolkit, enabling patients to pull away hype and oversimplification and get a clearer view of the facts. They include a tool that they call the “Risk Characterization Theater,” which uses a seating chart for a 1000-seat theater to help readers more effectively visualize risks (see illustration on page 22).

For patients trying to decide whether to take certain drugs, undergo chemotherapy, get screened for cancer, Rifkin says, there’s a lot at stake.

“These drugs are all expensive, they may result in all sorts of adverse side-effects and costs,” he says. “Patients have the right to have the best information available.”
One of the most promising new areas of research in sustainability involves something that can’t be seen or even held. But it can be harnessed. And that’s why Charles Meneveau’s research on wind energy just received a grant from the National Science Foundation (NSF) under their newest funding category, Energy for Sustainability.

“Wind farms are springing up everywhere,” says Meneveau, the Louis M. Sardella Professor in Mechanical Engineering. “Worldwide, about $23 billion was invested in wind farming equipment in 2006 and it’s expected that total installed capacity will double by the end of the decade. The potential is enormous.”

Meneveau estimates that 3 million giant wind turbines operating at an average power generation of 1 megawatt each could enable wind energy to become our country’s only energy source. Spaced every half a mile, the turbines would cover a square measuring approximately 900 miles on each side (e.g., most of the Midwestern states between the Mississippi and the Rockies). “Of course this isn’t going to happen,” he concedes, but, he adds, “the estimate at least gives us a sense of the massive scale of our energy consumption.”

With wind energy on an “upsweep,” Meneveau, post-doc Raul Cal, and co-investigator Luciano Castillo of Rensselaer Polytechnic Institute, propose to use the NSF funding to study the interactions between wind farms and the atmosphere. “Wind turbines extract kinetic energy. They slow the wind down, but perhaps increase turbulence in their wakes; this in turn may affect evaporation from the ground, and, honestly, we’re not sure what else happens when wind farms are implemented on a massive scale,” says Meneveau.

And what Meneveau ultimately plans to produce is only slightly less ethereal than the wind itself: more accurate computer models that could inform us about the relationship between wind and wind turbines—models that would help environmental planners with the placement of turbines to create maximum energy extraction with minimal negative impact on the environment.

In order to develop these models, Meneveau and collaborators will use “toy” turbines to collect detailed fluid dynamic measurements of the air velocity between and behind turbines. These model turbines, each about five inches tall, are being installed in the Corrsin wind tunnel in Maryland Hall. “We’ll make the invisible turbulent motions of air visible by using advanced laser-based measurement methods. Microscopic particles floating in the air will be illuminated, digitally photographed, and these images can be analyzed computationally. This will enable us to deduce the instantaneous velocity field,” Meneveau explains.

“Wind energy is just one of several options to be developed. If wind farms are to be implemented on a massive scale, we need to improve our tools to predict their interactions with the environment in the lower atmosphere,” he says. “That’s what we’re after.”

A sample turbulent velocity snapshot (above) made visible in the wind-tunnel is shown in this vector map. Says Meneveau, “We will study the fluid dynamics and kinetic energy fluxes from such data and develop the computer models that can then be applied to the full-scale wind farms.”
Though magnetic resonance imaging (MRI) technology has made the interior of the brain visible to clinicians and researchers for more than 20 years, there are still parts of the brain “that would never be visible unless we were to cut the brain wide open,” says Bennett Landman, a graduate student in biomedical engineering who also works with Professor Jerry Prince in the Electrical and Computer Engineering lab. “We’re looking at the impact of tiny, subtle changes that occur in these places,” Landman explains.

In particular, Landman and Prince are focusing on the cerebellum, a small structure of the brain involved in motor control, learning, and planning. “The cerebellum isn’t fixed. It’s behind the brain and not very firmly attached, so it moves around a bit,” Landman says. But what it lacks in size and stability, it makes up for in content. “It’s small and densely packed with neurons,” says Landman. In fact, even though the cerebellum comprises just 10 percent of the brain’s total volume, 50 percent of all of the brain’s neurons reside in it.

“We are investigating the cerebellum’s 3-D structure to shed light on how and why some almost imperceptible changes may factor into devastating degenerative diseases,” says Landman, “such as Alzheimer’s disease or spinocerebellar ataxia, a debilitating motor control disease.” But “seeing” inside the cerebellum is no easy matter. MRI alone can’t do it, because the gray matter of the cerebellar nuclei is too small and of low contrast to show on conventional MRI scans. So Landman and Prince are combining MRI with a technique known as Diffusion Tensor Imaging (DTI), which produces precise images of 3-D structures through repeated MRI scans. Combining the technologies enables them to see the bright fiber tracks of neurons entering the cerebellum and discover any “holes” in these tracks.

“The absence of a signal on DTI along with information on the overall structure from a conventional MRI allows us to infer the whereabouts of the cerebellar nuclei,” Landman explains. “Within a couple of minutes, we can see the major white matter tracks of the cerebellum, its surface features, and how certain nuclei are arranged.” Viewing all of these features at once, something that would have been impossible without these combined technologies, allows Prince and Landman to then analyze their findings with statistical shape models.

“Ultimately,” Landman says, “this breadth of new features will enable us to see changes in these little-understood diseases—changes that can help clinicians with the staging, prognosis, and treatment of patients.”
Subtle Movement

Spend some time in a crowded subway station, watching hundreds of commuters move to and fro, and it becomes nearly impossible to discern one person’s gait from another’s. Unless hampered by a limp or some other defining characteristic, most people appear similar in the way they stride briskly along.

But with today’s heightened security concerns, it’s more important than ever to be able to detect subtle movements that are unique to one person but not visible to the casual observer, notes Andreas Andreou, MS ’82, PhD ’86, professor of electrical and computer engineering.

And Andreou is developing the technology to do just that.

“I’m looking for the magic box,” he explains, as he digs through piles of electrical equipment in his Barton Hall lab. “Well, it’s really an ultrasonic micro-Doppler system.” Locating it, he plugs in a receiver and transmitter. “You can get all the parts at Radio Shack,” he divulges. Then Zhaonian Zhang, one of Andreou’s graduate students, places the box on an overturned plastic storage bin, about six inches off the floor, along a crowded hallway. Andreou, hands in pockets, asks “Are you ready?” Standing squarely in front of the contraption, he then strolls back and forth, four times.

The velocity of the moving object (Andreou) relative to the observer (the “magic box”) is recorded—including the motions of his arms, legs, and torso. As soon as Andreou is done, Zhang, with a few quick taps on a computer keyboard, converts the collected data into a colorful graph that represents Andreou’s signature shuffle. If Zhang were to follow in Andreou’s footsteps, the resulting graph would look entirely different.

With this box, Andreou is searching for the defining characteristics of human gait—information that could ultimately help differentiate, for instance, between a man walking slowly because he has an injury and someone walking slowly because he’s otherwise encumbered, perhaps by a bomb-laden backpack.

“Are they in a hurry? Hurt? Carrying a concealed weapon?” Andreou asks. “With this technology we will be able to dissect the language of body movement.”

Tracking Nanoparticles

He’s not using smoke and mirrors, but it sounds mighty close. Professor Denis Wirtz, associate director of the Institute for NanoBioTechnology (INBT), uses light to view and manipulate nanoparticles—particles that are one-billionth of a meter in size and 1,000 times smaller than what can be viewed under a conventional microscope.

The exploitation of these ultra-minute particles, Wirtz believes, may hold the key to our understanding of, and treatment for, a wide range of diseases.

“It’s very simple. We excite them with fluorescent light—very, very intense red, yellow, and green light,” he explains. Illuminating the nanoparticles so intensely creates a halo of light, which serves as a sort of proxy for the particles. “By making them visible,” Wirtz says, “We can then track them, one at a time. We can, for example, put them in cancer cells and follow the process of metastasis. We gain a better understanding of how cancer spreads.”

At the INBT, Wirtz and his colleagues are manipulating the illuminated nanoparticles to interact with proteins to determine if it’s possible to modify the behavior of cells. “We can watch them and see that they’re very dynamic and only inhabit a tiny part of the cell. It’s only now, through this process, that we’re beginning to understand that all proteins in a single cell don’t behave the same way.”

Through tracking nanoparticles, Wirtz and his colleagues are gaining new understanding of progeria, a fatal disease that causes accelerated aging in children. While researchers had long thought the disease’s prog-
ress was like normal aging, just much faster, Wirtz and his colleagues are finding differently. “We use latex beads, 100 nanometers in size, and we ballistically bombard the cells of a person with progeria with these beads,” he says. “The beads lodge themselves inside the cells and then we track them. Because they’ve been illuminated, we can see their displacement with exquisite resolution.”

Wirtz has demonstrated that the cells from people with progeria are brittle and soft. “They behave more like liquid than healthy cells, which are stiff and stretchy,” he explains. He has also observed the disruption of the cytoskeleton from the nucleus in progeria cells. This disruption leads to cells not being able to move as fast and they lose their sense of direction. “We used to believe that progeria was a defect of the nucleus, but now we believe it’s a defect of the cytoskeleton,” he says.

Insights gained through illuminated nanoparticles, Wirtz states, could ultimately change the treatment of many diseases. “We’re working on ways to rescue defective cells,” he adds.

Seeing the Bay’s Future Through Its Past

In order to predict the future of the Chesapeake Bay, professor and paleobotanist Grace Brush looks back 14,000 years and studies a half-meter-long tube of mud. To the untrained eye, the future doesn’t seem very promising, nor does the past appear particularly scenic. In fact, it all looks like varying shades of dark brown sludge.

For Brush, the dark brown sludge gives plenty of cause for concern. “Back in the 1970s, people became concerned about the Bay’s future because of declining fish populations and the disappearance of underwater grasses,” she explains. At that time, the Environmental Protection Agency (EPA) funded a group of engineers and scientists to quantify and define the reasons for those changes. “I attended the meetings and was amazed that nobody wanted to examine the past. I wanted to know if we were looking at a ‘boom and bust’ trend, or if these declines were more recent and unique.”

With some of the EPA funding, Brush took core samples from the Bay, including sediment from approximately 12,000 B.C. to the present. “Looking at these samples under a microscope, we found that the appearance of ragweed pollen increased dramatically in the 1700s, at the time of European settlement, a result of the land surrounding the Bay being cleared for agriculture,” she explains. “By the late 1800s, 80 percent of the Chesapeake watershed was deforested and the effects on the Bay had become obvious in the sediment cores.”

As Brush and her students studied the core samples, they discovered that in addition to the increase in ragweed pollen, dramatic changes had also occurred in the Bay’s algae—an important marker for the Bay’s overall health.

“Over the centuries, as the Bay’s water became more turbid from runoff, there was not enough light for the diatoms [a major form of algae found in sediment] to be able to photosynthesize and produce oxygen.” Much of the oxygen that was available was used up by the decomposition of dead plants and animals. “Eventually,” says Brush, “oxygen became too scarce for many bottom-dwelling animals to survive.”

“What amazed me was that everyone knew the Bay was filling up with sediment,” Brush concludes. “They had begun dredging in the 1800s. People knew there was sediment coming in”—but the major concern was economic, since sedimentation threatened to interfere with the transport of goods and people. “Only within the past few decades,” says Brush, “have people come to understand that the basic problem is ecological.”
“Within every computer is an incredibly complicated piping system through which information flows like water,” explains Scott Smith, chair of the Department of Computer Science. “And what’s streaming through here,” he says, pointing to the Mac on his desk, “is more complex than New York City’s plumbing system.”

As all this data rushes about, says Smith, it encounters an intricate series of forks, merges, and switches. And at each one of these decision points in the data’s path, one of two things can happen: either the information is directed where it needs to go or the data is diverted to where it should not. When the latter occurs, the integrity of the entire system is compromised. “When pollution enters our water supply system, we want to know which consumers will be affected,” Smith says. “And this is the same kind of tracking and integrity we’re studying in computers. For instance, an online bank should be able to tell customers their own balances, but not the balances of other customers. We want to make sure information goes where it should, but only where it should. Safety is our goal.”

In order to do this, Smith, along with graduate student Mark Thober, looks at code—very, very closely. The two develop algorithms that automatically follow the data flow and determine where exactly it branches out and which output locations could affect their data. “We’re very conservative in our approach,” Smith says, “But this is because if there’s truly the potential for something bad to happen, we want to be able to warn programmers.” The other reason Smith and Thober track their data so carefully as it courses through the computer’s innards is related to security. “We don’t want corrupted data seeping in, but we also don’t want secure data leaking out due to badly written code. Essentially, we don’t want anyone drinking polluted water.”
To see a listing of Society of Engineering Alumni and Whiting School of Engineering events go to http://engineering.jhu.edu/calendar

For a listing of all Johns Hopkins Alumni Association events in your area go to http://alumni.jhu.edu/news_events/events.htm

If you are interested in more information on how you can become involved with the SEA, please contact the Whiting School of Engineering Alumni Relations office at (410) 516-8723 or email HopkinsSEA@jhu.edu.

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Engineering and the Liberal Arts: More In Common Than You’d Think

Excerpted from the talk “Inquiry-Driven Engineering: One of the Liberal Arts,” given by James Wagner at the Harriet Shriver Rogers Lecture on April 30, 2007, at Johns Hopkins. Wagner, MS ’78, PhD ’85, is a former Whiting School faculty member and department chair and today president of Emory University.

Engineering disciplines, particularly inquiry-driven disciplines, deserve to be counted among the liberal arts.

When focused too narrowly on the professional nature of our discipline, we as engineers often exclude ourselves from thought and discussion about those matters that address why we live, not merely how we live. Understanding engineering as a “liberal art” opens rewarding possibilities for contemplation and contribution even to those of us whose linear and quantitative minds might at first glance appear unsuited for such pursuits.

Let’s remind ourselves first what liberal learning is all about. Historical accounts probably go back to Ciceró’s time in the first century B.C. It was a time when the aristocracy had leisure to consider cultivating a life of the mind—when attention to matters of survival could, for some, take a back seat to matters cerebral. And so there arose education “appropriate for free men,” as opposed to education in the servile arts.

Liberal education had (and still has) only two primary purposes. First, liberal education is intended as a means for the student to identify and hone a personal learning style. We as engineers tend, most often, to be linear and logical thinkers. Humanists tend more often than not to develop more parallel paths of thinking to form opinions and express thoughts. To help learners identify their learning style, several disciplines became identified as fundamental and were grouped in the Trivium and the Quadrivium.

The Trivium consisted of grammar, dialectic (logic and reasoning), and rhetoric, while the Quadrivium encompassed arithmetic, music, geometry, and astronomy. Only later did the curriculum grow to include history, art, literature, mathematics, the social sciences, physics, chemistry, and biology.

When students, through exposure and attempted mastery of these early disciplines, follow more parallel paths of thinking to form opinions and express thoughts. To help learners identify their learning style, several disciplines became identified as fundamental and were grouped in the Trivium and the Quadrivium.

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The Quadrivium lies in antiquity, however. I imagine, rather, that if academic engineering as we know it had been around in Cicero’s time, it would have been included.

Early on, the French were the most progressive adopters of engineering education for civilians. In 1747, they established the first of many Ecoles Nationales (National Universities), with the first one focused on bridges and highways. Soon the Germans and the Russians followed suit. And for nearly a century, these continental European institutes were nearly alone in their pursuits. However, during the same period, the British pursued and perpetuated the classical liberal arts education. They agreed with Plato that the “mechanics arts were not a fit occupation for the educated citizen.”

In the United States, the first colleges and universities were established on Britain’s models of Oxford and Cambridge and thus became similarly bound to a classical definition of university education. Only in the United States Military Academy at West Point, established in 1802, was engineering taught—military engineering, of course. American universities resisted the demand to educate engineers and scientists.

At the 1876 National Centennial Celebration in Philadelphia, Daniel Coit Gilman, one of the judges of the expositions, was impressed by, and wrote effusively about, the exhibition by two Russian science academies. Gilman, of course, guided Johns Hopkins to break from the classical tradition of education that had been championed by British institutions, moving toward a more European, continental model of graduate education broadly, and of graduate education in the sciences in particular.

The goal must be not merely training professionals but educating people (scholar-citizens) who pursue a profession. And, engineering education, too, needs to continue to move beyond the old “training” mode—the stereotype of producing engineers who are merely “problem solvers.” This definition is too narrow, too passive, and too Dilbert-like. This definition is too narrow, too passive, and too Dilbert-like.

Increasingly, engineers are like our liberally educated colleagues—prepared to be engaged citizens so that they are, first, problem and opportunity identifiers, then translators of problems into engineering terms, and, finally, problem solvers. Johns Hopkins University and its Whiting School of Engineering are places that seek not simply to train professionals but to educate, to develop scholar-citizens who pursue professional service. Johns Hopkins does now and must continue to lead by example.

“Engineering education, too, needs to continue to move beyond the old ‘training’ mode—the stereotype of producing engineers who are merely ‘problem solvers.’ This definition is too narrow, too passive, and too Dilbert-like.” —James Wagner
Parting Shots

The year 2007 saw the retirement of four Whiting School faculty legends. In the reminiscences that follow, some of the people whose lives were forever changed by these stellar academicians share their memories...

Professor Bob Green

When it came to Professor Bob Green, Sandy Buxbaum ’79, MS ’83, PhD ’86 and her classmates knew how to get their papers and projects looked at immediately. “Professor Green was a neat freak,” recalls Buxbaum. “He had fanatically tidy stacks on his desk and shelves; in fact, the piles on his desk were squared perfectly to the corners, so if you were dropping off a paper and wanted to make sure he saw it, you placed it on the diagonal.”

But it wasn’t difficult for Buxbaum to grab the attention of the professor and advisor he had for almost a decade, as he completed three degrees in the Materials Science and Engineering Department. “Professor Green was incredibly loyal to his students. He helped us get exposure and opportunities to show our work at national meetings,” says Buxbaum. “And once you were on his team, you had a strong advocate forever. Green was an energetic—and of course super-organized—guy, and he loved a good joke. He’d even stop a lecture right smack in the middle to share a new joke he’d heard.”

Though Buxbaum’s father, Bob, never studied with Green, he did get his bachelor’s and master’s degrees at Hopkins in mechanical engineering and also created a small endowment for master’s degrees in mechanical engineering. “We had adjacent offices when we were first unpacked his boxes and settled into his new office in the Department of Electrical Engineering, he was joined by a new colleague, Professor Richard Joseph. “We had adjacent offices when we were first in the department and we’d talk briefly every day about our work at the university and our families,” says Westgate. “We’ve been friends ever since.”

In addition to being an outstanding scholar and bringing considerable visibility to the Whiting School for his work—especially for his research in solitons and other propagating wave studies—Joseph was known for his sense of humor. “What I liked most about him was his practical, ’both feet on the ground’ perspective,” says Westgate. “As I moved through a variety of administrative posts as associate dean, department chair, and other positions, I often sought out Richard’s opinion. He was a reliable and invaluable source of good advice—with a generous topping of good humor.”

Joseph, who was named the Jacob Suter Jammer Professor in 1982 and who was also awarded the Distinguished Young Scientist Award from the Maryland Academy of Sciences in 1970, retired last year. “Richard’s students knew he had high expectations for them and they rose to the occasion. He was also a popular choice among doctoral students and the faculty advisors as a reader of dissertations. He was always thorough and gave rapid feedback,” says Westgate.

Westgate looks back fondly on his colleague and friend. Although it was more than four decades ago, it is not difficult for Westgate to picture Joseph and himself in 1966, two professors launching their illustrious careers, leaning on the doorframes of each other’s offices, talking and sharing, sparking ideas and having a good laugh.

Professor Charles O’Melia

“I don’t know much about this, but here’s what I do know…” That’s what Professor O’Melia would often say, but it was always a signal that you better listen carefully because he knew a lot and had great insight,” says John Tobiason, PhD ’88, today professor of civil and environmental engineering at the University of Massachusetts Amherst. “Charlie is humble and fundamentally shy, but he is an incredibly important intellectual leader in his field.”

In 1978, under O’Melia, Tobiason completed his master’s degree in environmental engineering at the University of North Carolina at Chapel Hill. After working for a few years in consulting engineering, he decided to go for his PhD so that he could teach at the university level. By then, O’Melia had moved to Hopkins.

“The entire reason I went to Hopkins to pursue my PhD was because Charlie was there. I didn’t apply anywhere else,” says Tobiason. O’Melia—the Abel Wolman Professor of Environmental Engineering and member of the National Academy of Engineering—started at the Whiting School’s Department of Geography and Environmental Engineering in 1980. He retired last year.

“Charlie and his wife, Mary, opened their home to me from the start,” says Tobiason. “In fact, in the early ‘80s, when visiting Hopkins before coming to do my PhD, my family and I were at his house and my son, who was 1 at the time, took his first steps on their rug.”

Tobiason also remembers his years at Hopkins with O’Melia as exciting and intellectually stimulating. “Charlie is a brilliant and kind man. And a great mentor,” he says. “I was part of a fantastic group of engineering students, too, many of whom—myself included—went into teaching. We worked really hard—for ourselves and for Charlie.”

And their collaboration extended beyond engineering. “We had a long tradition of playing basketball,” says Tobiason. “No matter where we were, we were always learning from him.”

(continued on page 32)
Professor Jack Rugh

What Ed Wysocki ’72, PhD ’77, remembers vividly about being an advisee of Electrical and Computer Engineering Professor Jack Rugh was a tiny office he and his classmates coveted.

“Whoever was the next of his grad students under his advisement got the office,” says Wysocki. “It wasn’t much bigger than a closet, but it was right across the hall from Professor Rugh’s office. In it, you’d have a desk, a chair, and a filing cabinet.” Although it afforded barely enough room to remove your overcoat, it gave Rugh’s grad students, like Wysocki, the space—and lack of distraction—necessary to do their writing, analyzing, and thinking. And when the pressure was too overwhelming, they could meander across the hall and throw some questions or ideas out to the professor, or better yet, get him to chat about sailing.

“Professor Rugh was really into sailing. He had this old wooden sailboat, which I think he sold to two students when I was still an undergrad,” says Wysocki, now employed by Lockheed Martin. “Those students later sold that boat to some other students. It got handed down and inherited within the department.” Rugh’s sailboat, it seems, was like his knowledge and passion for engineering—it was passed on and robust enthusiasm.

Rugh—named the Edward J. Schaefer Professor in 1991—who retired recently, was a member of the Electrical and Computer Engineering Department for almost 40 years.

“I remember when I first saw Professor Rugh,” says Wysocki. “I was a sophomore and taking a general systems class. He walked in, this energetic, blond guy, and I thought to myself that he looked way too young to be a professor.” But Wysocki soon learned that Rugh’s seeming youthfulness had its advantages. “He was a good guy. Easy to talk to. He probably influenced me in more ways than I can think to remember.”

—Victoria Tilney McDonough

Pioneer in Forensic Engineering Aims to “Improve Life”

When Joe Reynolds ’69 launched his first company, FTI Consulting, in 1982, he built it on the academic model he learned as a student and research assistant at Johns Hopkins. “The relationship between faculty and students mirrors the structure of business,” he says. “The concept of multidisciplinary teams is the only way in today’s world to solve problems. No single investigator can solve all the problems.”

At Hopkins, Reynolds earned a degree in electrical engineering and began working in the Physics Department as a research assistant. “My experience at Hopkins molded me in many ways,” he says. “I learned how to solve problems. I learned the value of collaboration.”

When Reynolds left Hopkins, he joined Trident Engineering, based in Annapolis, Maryland. He began working in instrumentation, developing an expendable device to measure the height of waves and seascapes. He also worked on a team that built instruments to detect light and color variations on the moon in order to determine if the moon had any volcanic activity. “At that time, we hadn’t been there yet,” he says with a chuckle.

From Tr Trident, Reynolds went on to join the ranks of a company called Computer Aided Design Company, or Cadcom for short. He designed solutions to prevent power plant failures and aircraft accidents. There, he also met Dan Lusac, a former Naval Academy professor, and his future business partner. Together, they launched FTI Consulting. Based in Annapolis, the company’s focus was the investigation of aviation and utilities accidents and failures to determine the causes and how they could be prevented in the future.

“Eventually we developed the phrase, ‘Forensic Engineering,’” he says. “We practiced engineering in a mirror because we looked backward to determine what happened, reported on it, and testified in court. Sometimes we effected the changes the government might make in terms of public policy. The most rewarding part was improving people’s lives by promoting better safety measures.”

FTI went public in 1996 and changed its focus to economics and accounting consulting. Reynolds left the company and, in 2003, launched a new company with many of the original FTI staff. Like his former company, Reynolds Technological Inquiries Limited (RTI) is based in Annapolis and, with a staff of about 130 people, investigates aviation accidents and failures, serving as international consultants of experienced expert witnesses.

Reynolds is also the founder and president of Anamet Inc., a similar company composed of 50 individuals and located in San Francisco, as well as RTI London, which employs 50 people and has established the company’s presence in Europe and the UK.

Today Reynolds is recognized internationally as a forensic engineer and an authority on the investigation and analysis of large-loss accidents and failures. He has served as the team leader and technical director, as well as principal testifier, in many complex investigations around the world. He is an active member of the Institute of Electrical and Electronics Engineers (IEEE), the International Society of Air Safety Investigators (ISASI), the Expert Witness Institute (EWI), the Academy of Experts (AE), and the Royal Aeronautical Society of London.

And somehow, with three companies and more than 200 individuals under his care, Reynolds finds time to actively support Johns Hopkins University and the Whiting School. Initially, more years ago than he can pinpoint, he returned to Hopkins to lecture to undergraduate engineering students. “I was asked to come talk about what really happens in the business world. I talked about the importance of having a code of standards at work and in engineering. I gave them a different slant on the practice of engineering that maybe the students hadn’t thought of before,” he recalls.
Since then, he has become increasingly involved with the school. Along with his wife, Lynn, he funded a gift to support the Maryland/Krieger halls renovation, endowed an intersession course in the W.P. Carey Entrepreneurship and Management program, and—most recently—endowed a professorship for the Whiting School. He is also currently a member of the university’s Board of Trustees and is the past president of the Johns Hopkins University Alumni Association, the founding chair of the Society of Engineering Alumni, and a member of the Applied Mathematics and Statistics Department Advisory Network.

This past fall, he was named the new chair of the Whiting School of Engineering’s National Advisory Council. In all of these efforts, Reynolds says it’s his way of giving back to an institution that has provided him with so much.

“As you begin to reflect on life, you think about what’s made a difference in your life,” he says, settling back into his chair. “One thing that has become clear to me is that Johns Hopkins made a big difference in my life and was a big factor in my success. I learned how to problem solve. I learned how to work as a team member as a student and research assistant. I saw the value of working together for a common goal and saw how effective it is to do so. I carried those lessons forward when I built my first company. These are things I learned here, at Hopkins. And they’ve never failed me.”

—Joe Reynolds

Dean’s Leadership Fund: Alumni-Supported Research

From research into tsunami-resistant structures to the creation of microscopic disease fighters, the work being conducted by engineers at Johns Hopkins is laying the groundwork for advances that will, over the next decade, change the world. At the core of this research is the innovative, entrepreneurial spirit of our faculty.

Thanks to the generous support of many alumni, the Dean’s Leadership Fund allows the dean to invest in compelling research opportunities as faculty members make groundbreaking discoveries.

Gil Decker ’58, a longtime supporter of the School of Engineering, notes that there is significant competition among the top engineering departments in American universities for innovative young faculty members. “The quality and long-term success of the Whiting School depends critically on attracting and keeping such faculty,” he says. “I specified my gift to go toward the Dean’s Leadership Fund because it is used [in part] to support the research programs for young faculty and their students. I think it’s a terrific vehicle for retaining our superb young faculty members.”

In the Department of Mechanical Engineering, associate professor Allison Okamura has used her funding to develop a new exoskeleton robot. The robot allows her and her colleagues to examine why certain populations have motor control deficits—and to develop strategies for rehabilitation. “As engineers, we are uniquely placed to collaborate with neuroscientists in order to quantify those deficits,” she says. “We can then provide compensation methods that will help people with neurological disorders accomplish activities of daily living with ease.” Similarly, in new prosthetics research, Okamura and her collaborators are working toward an artificial hand that can “feel” things the way a natural hand would, a breakthrough that would radically improve life for people with missing limbs.

In Jonah Erlebacher’s lab in the Department of Materials Science and Engineering, research supported by the fund focuses on the development of highly porous materials for applications in green technologies, using a combination of experimental and theoretical approaches. One of Erlebacher’s recent achievements was the fabrication of a new nanoporous precious metal catalyst for fuel cells that is simultaneously highly active and highly stable.

Associate Professor Ben Schafer, in the Department of Civil Engineering, is using his Dean’s Leadership funding to conduct research focused primarily on engineering thin-walled structures. “As natural resources become scarce, and society seeks to use a minimum of materials, engineers are designing structures that are thin-walled in their construction,” Schafer explains.

“This funding is helping to bring a completely unique experimental facility online for testing structural components under axial, in-plane bending, and shear consistency with a wall under gravity, wind, and collected wind or seismic forces,” he says. This research, which uses computational modeling and experimental testing, will help researchers better understand the fundamental behavior of materials and help bring that understanding into design methods that can be used by practicing structural engineers.

F. Suzanne Jenniches, MS ’79, is one of the generous supporters of the fund and she appreciates the fund’s support for students. “My engineering degree from the Whiting School has changed my life and I want to create similar opportunities for other students,” she says. “I feel honored to contribute to the growth of the Whiting School of Engineering, which permits JHU to raise the bar in leading-edge technology and activities.”

The Dean’s Leadership Fund also assists the dean in the recruitment of new faculty and in implementing strategic initiatives.

Strategic initiatives were on the mind of Bill Ward ’67 when he made his contribution to the fund. “I was so impressed with the Whiting School’s Strategic Plan, spearheaded by Nick Jones, that I was motivated to give to the Dean’s Leadership Fund,” he says. “My gift provides discretionary funding that will enable Nick to support faculty initiatives and implement the Strategic Plan for the school.” —AR
Alumni Awards

The Heritage Award
Established 1973
The Heritage Award honors alumni and friends of Johns Hopkins who have contributed outstanding service over an extended period to the progress of the university or the activities of the Alumni Association.

Walter L. Robb, PhD
A great friend to Johns Hopkins and a chemical engineer by training, Walter Robb served as senior vice president of GE Medical Systems for 13 years, and was subsequently appointed chief technology officer of General Electric Company. In 1992, he founded his own consulting firm, Vantage Management.

For many years, Robb has shared his wisdom and leadership with The Johns Hopkins University by serving on the advisory councils of the Whittaker Biomedical Engineering Institute and the Wilmer Eye Institute. He was a presidential counselor in 2002 and currently holds a seat on the Whiting School’s National Advisory Council.

In 2004, he issued a challenge to Whiting School alumni and friends to support graduate students who choose to pursue advanced degrees in engineering at Johns Hopkins. Donors who gave $50,000 or more toward the creation of a new endowed fellowship received a match from Robb. Thanks to the challenge, seven new fellowships funds were committed within a year’s time.

Robb earned his bachelor’s degree from Pennsylvania State University in chemical engineering and his master’s and doctoral degrees, also in chemical engineering, from the University of Illinois at Urbana-Champaign.

Richard A. Howell, MS
Richard A. Howell graduated from Johns Hopkins with a bachelor’s degree in mechanical engineering in 1955 and later received a master’s degree in the same discipline in 1960.

Howell is retired from the Lockheed Martin Corporation (previously Martin Marietta Corporation), where he served as chief engineer of missile systems and as a program director at Orlando Aerospace. After his retirement in 1993 he taught program management and provided technical and management consultation to aerospace.

He has remained involved in Hopkins alumni events in Maryland and Florida for more than 50 years. He is a proud member of the Alumni Council and has shown his commitment to Johns Hopkins through his long-term dedication of personal time and resources.

Howell was honored as Central Florida Professional Engineer of the Year in 1986 and Orlando Aerospace Manager of the Year in 1991. To show his support for undergraduate education, in 2004 he established the Richard and Joan Howell Scholarship in the Whiting School of Engineering.

Distinguished Alumnus Award
Established in 1978, this award honors alumni who have typified the Johns Hopkins tradition of excellence and brought credit to the university by their personal accomplishment, professional achievement, or humanitarian service.

Vinod K. Agarwal, PhD
Vinod K. Agarwal, a distinguished researcher and notable entrepreneur, earned his PhD at Johns Hopkins in 1977. He also holds a master’s degree in electrical engineering from the University of Pittsburgh and a bachelor of engineering degree in electronics from the Birla Institute of Technology and Science in India.

For more than 14 years, Agarwal was a faculty member at McGill University in Montreal. There he helped establish McGill as the global leader in research and teaching in semiconductor testing. During his academic career, he co-authored and published more than 100 research papers, was appointed as an endowed Nortel/NSERC Industrial Research Chair Professor, and elected a Fellow of the Institute of Electrical and Electronics Engineering (IEEE).

In 1992, Agarwal founded LogicVision; he was its president and CEO until 2003 and chairman until 2005. Innovations pioneered by Agarwal and his team at LogicVision have resulted in more than 100 filed and granted patents worldwide. LogicVision’s customers include some of the biggest names in electronic technology such as Intel, Sun Microsystems, LSI Logic, Sony, and Cisco.

Agarwal is currently president and CEO of SemIndia Inc. The company designs, manufactures, and markets innovative products to Indian consumers and is poised to be India’s leading integrated semiconductor company.

Agarwal is a founding member of Canadian Microelectronics Corp. and Micronet. At Hopkins, he is a member of the Department of Computer Science Visiting Committee. In 2002, he was honored as “Entrepreneur of the Year” by SiliconIndia.

Michael D. Griffin, PhD
Michael Griffin received a bachelor’s degree in physics in 1971 and a master’s degree in applied physics in 1983 from Johns Hopkins. He also holds a master’s degree in aerospace science from Catholic University of America, a master’s degree in electrical engineering from the University of Southern California, a master’s degree in business administration from Loyola College, a master’s degree in civil engineering from George Washington University, and a PhD in aerospace engineering from the University of Maryland.

Nominated by President George W. Bush and confirmed by the United States Senate, Michael Griffin began his duties as the 11th administrator of the National Aeronautics and Space Administration (NASA) on April 14, 2005. As administrator, he leads the NASA team and manages its resources to advance the U.S. Vision for Space Exploration.

Prior to being nominated as NASA administrator, Griffin served as the Space Department head at Johns Hopkins University’s Applied Physics Laboratory. He has also served as the president and CEO of In-Q-Tel Inc., and in several positions within Orbital Sciences Corp., including chief executive officer of Orbital's
Ronald D. Sugar, chairman and chief executive officer of Northrop Grumman Corp., was the honored guest and speaker for the Sydney and Mitzi Blumenthal Lecture and Award for Contributions to Management in Technology on Wednesday, October 31, 2007. In his lecture, titled “Defining the Future,” Sugar discussed the vision and foresight needed to exploit technology to its best advantage. The Lecture and Award was established by an alumnus, the late Sydney Blumenthal ’37, and his wife, Mitzi, in 1993. Pictured here are Mitzi Blumenthal, Ronald Sugar, and Dean Nick Jones.
Final Exam

“We’re in the danger zone.”

That’s how senior Rodwitt Lai describes the Senior Design project he and fellow team members Eric Ngeo and Joel Frankford are working on in the Department of Computer Science. The course, led by Lecturer Peter Froehlich, matches real-world clients with teams of seniors who spend a semester working on technical problems no one else has been able to solve.

Lai’s team is improving the image analysis software used by the National Institute on Aging (NIA). “They have all these images of cells,” Frankford explains, “and they use a computer program to classify them as healthy or unhealthy cells. The user needs to make sure the software is functioning correctly and, if necessary, identify where in the process the computer makes a mistake. We’re building the software to do that.”

The danger? “The work we are doing is under very strict guidelines because we are changing code that is in active use,” Lai explains. “We could introduce problems that could crash the entire system.”

The other team of three has the opposite scenario. Their project, proposed by an independent software engineer in California, wants an “add-on” that will give users of the Web browser Firefox document-sharing capabilities.

“We’re making our own side program and plugging it into the Firefox browser,” explains Firefox team member Ben Schuster. Unlike the NIA project, this one allows Schuster and teammates Ayse Sabuncu and Ryan McLelland to work with whatever programming language they choose.

Nevertheless, the Firefox team ultimately has to sweat it out for three weeks before figuring out how to get the add-on to actually appear in the Firefox browser. “We’re on a good road toward finishing now,” reports Sabuncu, late in the semester. For the NIA team, success is defined as their ability to make progress.

“The most valuable lessons are learned through mistakes,” says Froehlich, who does not require successful completion of the project to pass the course or even earn the highest grade. Instead, he teaches students to focus on making tangible steps toward completion. It’s a win-win, he says. Clients benefit from seeing their projects advance. And the students, who don’t receive any payment for their work, reap the rewards of learning through mistakes as well as successes.

“The advantage of computer science is that you can make progress in little pieces,” Froehlich says. “You can’t build a useful bridge in little pieces, but you can build useful software that way.”

—AR
In 1959 with $1,000 worth of Esso stock, Herb established the William Brown Baxley Scholarship to memorialize his older brother, Brown Baxley, a Hopkins Engineering alumnus from the Class of 1917 who was one of several Hopkins graduates killed during WWI. Herb continued to support the Baxley Scholarship throughout his lifetime and with a significant bequest. Since his passing, Herb’s daughter and son-in-law, Alice B. and Charles Anthony, Jr., and their family, have continued to support and grow the William Brown Baxley Scholarship.

Through the generosity of C. Herbert Baxley and his family, the William Brown Baxley Scholarship has been awarded for nearly 50 years to over 400 undergraduates…and will continue to provide deserving students with the opportunity to receive a Hopkins education for every year to come.

For more information, please contact Kathleen McNally, Johns Hopkins Office of Gift Planning, at 410-516-7954 or 800-548-1268; Email plannedgifts@jhu.edu or visit jhu.plannedgifts.org

C. Herbert Baxley, Class of 1919, died in 1993. This year, Herb and his family are helping sixteen undergraduates attend Johns Hopkins Whiting School of Engineering as Baxley Scholars.

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