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 Cicero’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 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.

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, developed an understanding and command of their own learning style, they were only half educated. Because, you see, the second purpose of liberal learning was, and still is, to instill an insatiable thirst for more knowledge, slaking that thirst by means of the learning style that best suits you.

I don’t believe that the explanation for engineering’s exclusion from the Trivium and 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.

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

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 and engineering 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. 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. Hopkins does now and must continue to lead by example.
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 his 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 at Hopkins in mechanical engineering. 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 colleagues and friends. “The entire reason I went to Hopkins to pursue my PhD was because Charlie was there. I didn’t apply anywhere else,” says Tobaison. 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 Tobaison. “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 our rug.”

Tobaison 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—I 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 Tobaison. “No matter where we were, we were always learning from him.”

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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 Tobaison, 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, Tobaison 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.

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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 with 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 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 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.

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.
“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 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.”
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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 Whitaker 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
Magellan Systems division and general manager of the Space Systems Group.

Earlier in his career, Griffin served as chief engineer and as associate administrator for exploration at NASA, and as deputy for technology at the Strategic Defense Initiative Organization. He has also been an adjunct professor at the University of Maryland, Johns Hopkins University, and George Washington University.

Griffin is the lead author of more than two dozen technical papers, as well as the textbook Space Vehicle Design.

A registered professional engineer in Maryland and California, Griffin is a member of the National Academy of Engineering and the International Academy of Astronautics, an honorary fellow of the American Institute of Aeronautics and Astronautics (AIAA), a fellow of the American Astronautical Society, and a member of the Institute of Electrical and Electronic Engineers.

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.