Columbia Engineering has had a significant impact on bettering the human condition since its founding in 1864. The School’s first dean, Charles Frederick Chandler, a chemist, improved safety standards in New York City for milk and water, regulated gas companies and slaughterhouses, supported compulsory smallpox vaccinations for children, and invented the flush toilet.

While Chandler was still dean, Michael I. Pupin, an 1883 graduate who became a professor of electrical engineering, created an X-ray tube that produced an image after only a few seconds of exposure. Pupin’s 1896 discovery was only weeks after Wilhelm Roentgen found that X-rays would produce an image after several hours of exposure. The first use of the Pupin X-ray tube was medical: he helped a surgeon determine where buckshot was imbedded in a patient’s hand.

As more became known about fighting disease, biochemical engineering emerged as a promising field. Elmer L. Gaden, a chemical engineer, received his BS in 1944 and, after serving in the Navy, returned to Columbia for graduate work. His doctoral thesis contained a process for mass production of antibiotics by supplying the optimum amount of oxygen for the rapid growth of penicillin mold. This discovery earned him the title “father of biochemical engineering.”

Gaden was a professor at Columbia for 26 years. In 1962, he headed the Committee on Bioengineering, with faculty members from the College of Physicians and Surgeons (P&S) and Engineering. It provided an early forum for interdisciplinary cooperation. For many years, it was chaired by Edward F. Leonard, professor of chemical engineering.

In 1974, a University-wide Bioengineering Institute was established under William Nastuk, M.D., professor of physiology at P&S. Four years later, Richard Skalak ’43, ’46, ’54, a professor in the Department of Civil Engineering and Engineering Mechanics, became director. Skalak applied his knowledge of hydraulics to microcirculation, developing new approaches to cellular and molecular engineering, tissue engineering, and orthopedic biomechanics. His discoveries on blood cell mechanics, pulmonary circulation, and tissue growth have been applied to research on cancer, sickle cell disease, hypertension, atherosclerosis, and other diseases.

By the mid-1980s, Columbia boasted one of the largest orthopaedics research labs in the country, following the recruitment of Van C. Mow and W. Michael Lai. Both held joint appointments, the first of their kind at Columbia, as professors of mechanical engineering (SEAS) and orthopedic biomechanics (P&S).

In 1995, a Whitaker Foundation grant spurred the creation of the Center for Biomedical Engineering. Mow was named director of the Center and Leonard became associate director of academic affairs. A second Whitaker grant, supplemented by significant funds from The Fu Foundation School of Engineering and Applied Science (SEAS) and the University, transformed the center into a full-fledged department. The department was launched on January 1, 2000, with Mow, who now holds the Stanley Dicker Professorship in Biomedical Engineering, as founding chair. Today it is one of the most popular majors in the School, leveraging the School’s historic strengths in biomechanics, biomedical imaging, and cell and tissue engineering.

As you will see in the following pages, the scope of health-related research at Columbia Engineering involves almost every department. Amazing breakthroughs have happened or are about to happen as our faculty fight diseases and conditions, bringing to bear their exceptional and unique talents to chip away at problems that affect the quality of life and, indeed, life itself.
Little is known about the biological causes for psychiatric disorders like schizophrenia and bipolar, which combined affect an estimated 10 million people nationwide. Columbia researchers are working hard to change that by exploring the role of genetics from a multidisciplinary approach.

Electrical engineering professor Dimitris Anastassiou’s aim is to discover novel biological mechanisms responsible for psychiatric disorders. Given the limited success of identifying significant individual risk-conferring genetic variants, such as single mutations in DNA, Anastassiou says discovery of responsible interactions among multiple genetic variants may reveal new disease mechanisms.

Anastassiou and Maria Karayiorgou, professor of psychiatry and medical genetics at the Columbia University Medical Center, are principal investigators on a project that will identify single nucleotide polymorphisms (SNPs, pronounced “snips”) that are jointly, rather than individually associated with disease.

A SNP is a small genetic change that can occur within a person’s DNA sequence. The genetic code is specified by the four nucleotide “letters” A (adenine), C (cytosine), T (thymine), and G (guanine). SNP variation occurs when a single nucleotide, such as an A, replaces one of the other three nucleotide letters—in this case C, T, or G.

An example of a SNP is the alteration of the DNA segment AAGGTTA to AAGTTTA, where the fourth letter in the first snippet, G, is replaced with a T. On average, SNPs occur in the human population more than one percent of the time, but, because neighboring SNPs are statistically linked, researchers only need about one million of them to analyze our genomes.

The traditional approach looked only at individual SNPs. Anastassiou’s research investigates the possibility that a person may be predisposed to a disease if two SNPs at different locations in the genome have the unusual letter combinations, rather than each one of them alone, a phenomenon called “synergy.” There is a huge number (about a million squared) of “synergy” pairs of SNPs, resulting in significant computational and statistical challenges for this project. To perform this research, Anastassiou has a high-performance computer cluster containing 800 processors at his disposal.

Karayiorgou and her team biologically interpret Anastassiou’s resulting computational outputs and attempt to genetically validate the identified interactions. If the resulting biological hypotheses involving two genes are deemed promising, they will test those using in vitro neurobiological experiments.

“The aim is to discover the biological mechanisms responsible for psychiatric disorders,” says Anastassiou. “Once such mechanisms are discovered, the ultimate vision is to develop drugs that would interfere with these mechanisms.”

Anastassiou, who received his PhD from the University of California, Berkeley, is a prominent leader in digital technology. His research has resulted in Columbia being the only university in a consortium that licenses MPEG-2, the technique used in all forms of digital television transmission, including DVDs, direct satellite TV, HDTV, digital cable systems, personal computer video, and interactive media.

An IEEE Fellow, he is also the recipient of an IBM Outstanding Innovation Award, a National Science Foundation Presidential Young Investigator Award, and a Columbia University Great Teacher Award, and he holds 11 U.S. and 8 international patents, which combined have so far brought close to $100 million in revenues to Columbia University.
Motor vehicle accidents account for more than half of the 1.5 million traumatic brain injuries (TBIs) that occur each year. Finding ways to prevent, treat, and repair TBIs is the basis for the research of Barclay Morrison, associate professor of biomedical engineering, and his Neurotrauma and Repair Laboratory team.

At the moment of injury, some brain tissue is instantaneously destroyed and can never be saved by post-injury treatment, so prevention becomes all the more important. Using an atomic force microscope, Morrison is measuring material properties of anatomical structures within the brain that can be used by the National Highway Traffic Safety Administration to set standards for automotive manufacturers.

“We’re determining the safe limits of brain deformation, which is the underlying cause of TBI, to learn what the brain can withstand, so safety systems can be designed to minimize the trauma,” says Morrison.

Morrison’s group is also working with the aftermath of TBIs. One approach investigates the brain’s own initial response, which is an attempt to repair the damaged neural connections and replace lost tissue. For reasons yet unknown, this repair process is aborted. If Morrison can find a way to short-circuit this response, it may be possible to harness and control the brain’s innate potential for repair.

In a scenario directly from The Six Million Dollar Man or The Bionic Woman, Morrison sees the possibility of interfacing neurons directly onto silicone circuitry to control a prosthesis. While this technology is now only imagined, he continues to investigate the factors that influence the ability of neurons to form connections with silicone circuitry, hoping for a breakthrough that can immediately impact the lives of thousands.

After receiving his PhD at the University of Pennsylvania, Morrison was a postdoctoral researcher in TBI there and later at the University of Southampton, U.K. 

People suffering from brain diseases and conditions ranging from traumatic brain injuries to brain cancer to progressive brain diseases could be helped if therapeutic drugs could be delivered to the affected area. The blood-brain barrier (BBB), composed of high-density cells, acts as part of the body’s defense system to block bacteria and other substances carried in the blood from invading the brain. It is so effective that it makes it all but impossible to deliver important diagnostic and therapeutic agents to the brain also.

Scott Banta has had significant success in solving this problem by using a biochemical approach, creating specific cell penetrating peptides (SCPPs) that can cross the BBB and target specific brain cell populations. Banta, an associate professor of chemical engineering, and his research group are engineering new peptides that are specific for different cell and tissue types. The plasma membrane protein cells by regulating the access of molecules to the cellular cytoplasm. Only compounds within a narrow range of size, charge, and polarity are able to cross the membrane.

Using the process Directed Evolution, the Banta group is creating new SCPPs that are able to both target and penetrate specific cells. These peptide sequences can deliver therapeutic cargos, such as DNA, proteins, drugs, or other exogenous materials, to the targeted cellular cytoplasm.

Collaborating with Barclay Morrison of the Department of Biomedical Engineering, Banta is seeking to create SCPPs that are specific for different brain cell types. There is a narrow window of time following a brain injury where the targeted delivery of neurotrophic agents to injured cells could provide a significant benefit to the head-injured patient. In addition, delivery of neurotrophic factors via SCPPs could be beneficial in slowing down the progress of diseases such as Parkinson’s, Alzheimer’s, and Huntington’s.

Before joining Columbia SEAS, Banta, who received his PhD from Rutgers University, was a postdoctoral researcher at Harvard Medical School’s Center for Engineering in Medicine, and at Shriners and Massachusetts General Hospitals.
Walk into any clinical research lab and you will undoubtedly find one or more microscopes. The problem with conventional microscopes, however, is they can only show images of thin slices of dead tissue or cells in a dish. It takes a special kind of instrument to produce images from inside the living body, which is exactly the kind that Elizabeth Hillman is building.

“It is a significant technical challenge to build imaging systems capable of studying cellular or molecular processes in living organisms,” says Hillman, assistant professor of biomedical engineering and radiology. “You need devices that can image very fast and in 3D and that show you lots of different things at once. It’s a complex problem, one that forces you to think about physiology and physics at the same time.”

One of the primary areas of focus in Hillman's lab is using optical imaging techniques such as microscopy to investigate the brain, particularly the relationship between blood flow and neuronal activity. Functional magnetic resonance imaging (fMRI), one of the most ubiquitous tools used to investigate neuronal activity, relies on detecting subtle changes in blood flow in the brain. “The problem is, we really don’t understand why these changes in blood flow occur,” says Hillman. “Even the best neuroscience textbooks only devote a page or so to blood flow in the brain.”

Hillman hopes that ultimately many of her imaging tools will prove useful in the clinic and as laboratory research tools, where they can be used to improve fundamental understanding of both physiology and disease. She is quick to point out, however, that although optical methods are extremely well suited to clinical application, she does not expect her techniques to entirely replace MRIs. “Optical imaging isn’t going to be the next MRI,” she says. “MRIs do some things well, but they can’t tell you things like how bad the burn on your arm is or whether you have good blood flow in the back of your eye. Our systems can.”

Because all of these measure different wavelengths of light, none require the heavy shielding or careful dose monitoring necessary in radiologic imaging. Moreover, almost all take advantage of existing contrast agents, such as blood, which changes color as its oxygenation level changes, or green fluorescent protein (GFP), which can be modified to label specific types of cells.

Hillman hopes that ultimately many of her imaging tools will prove useful in the clinic and as laboratory research tools, where they can be used to improve fundamental understanding of both physiology and disease.

Hillman, who received her PhD from University College, London, did postdoctoral research at Massachusetts General Hospital’s Center for Biomedical Imaging before coming to Columbia.
Epilepsy and seizures affect almost 3 million Americans of all ages, with approximately 200,000 new cases occurring each year. Recently, new cases have developed as a result of traumatic brain injury to soldiers in the aftermath of IED attacks in Iraq and Afghanistan. For 25 percent of these people, neither medication nor surgery can control their seizures.

Working with neuroscientists at Columbia University Medical Center, SEAS senior research scientist David Waltz, director of the Center for Computational Learning Systems, is developing a wearable “early warning” device to give epilepsy patients enough time to prepare for a seizure.

This warning device will use detector software based on advanced machine learning technology to detect an impending seizure. Co-PI Columbia neurophysiologist Catherine Schevon is collecting data via microelectrodes implanted in patients’ heads that supply the sample data at a rate of 30,000 times per second. This faster sample means higher-frequency brain waves can be detected, and these may play a pivotal role in seizures.

Once the software is developed, a patient would carry a small computer that monitors brain activity. The system would then reliably warn the patient in advance of seizures. Such a system would allow patients who cannot be treated successfully today to live a fuller and more active life.

The researchers’ long-term goal is to design machine-learning interfaces that could learn what brain-wave features predict seizures in individual patients. Hypothetically, this system could eventually take the form of an implanted “brain pacemaker,” stimulating the brain to prevent the seizure from happening in the first place.

Waltz received his PhD from the Massachusetts Institute of Technology, where his thesis on computer vision originated the field of constraint propagation. Along with Craig Stanfill, he also is well known as the originator of the memory-based reasoning branch of Case-Based Reasoning.

Rheumatoid arthritis (RA) is an autoimmune disease that affects nearly 20 million people worldwide, striking young people as well as old, causing pain, stiffness, and swelling of the joints. Early diagnosis and treatment can slow or prevent joint damage and increase the likelihood of leading an active and full life.

Leading an international team of engineers, scientists, and physicians from Germany and the U.S., Andreas Hielscher, associate professor of biomedical engineering and radiology, has developed a 3D optical tomographic (OT) imaging system that displays disease activity in joints. Results from recent clinical trials indicate that his system can identify affected joints earlier than any other method.

In another project, members of his Biophotonics and Optical Radiology Laboratory are completing a dynamic optical imaging system for the diagnosis of breast cancer. Breast cancer afflicts one in nine women during their lifetime and is the second leading cause of cancer deaths in women. Hielscher’s patented imaging technology has been licensed by a New York company and clinical pilot studies using the new imager are underway.

Hielscher also employs OT imaging to localize green fluorescent proteins (GFPs), developed by Columbia’s 2009 Nobel laureate Martin Chalfie. GFPs and their derivatives make it possible to see and monitor cell and tissue behaviors during development, including observation of cancerous tumors in vivo. Hielscher and his colleagues use GFP to study the growth of cancers in the stomach, liver, and brain. Most recently, he is applying this technology to monitor drug effects in difficult-to-treat early childhood cancers, such as neuroblastoma and Wilms tumors.

He received his PhD degree in electrical and computer engineering from Rice University, was a postdoctoral fellow at Los Alamos National Laboratory, and was on the faculty at State University of New York Downstate Medical Center prior to coming to SEAS in 2001.
It is very difficult to ask a computer to find something that is funny to a particular person on the Internet. It is even more difficult to build a computerized vision system that can find something that is funny or suspicious or interesting—and find its way around a room.

Yet, countless times a day—often without realizing it—humans make split-second decisions based on what we see and on our subjective knowledge. It might be as simple as clicking a link that catches our interest online, or recognizing a friend from a 50-millisecond glimpse of their face across a crowded room. But no matter how effortless the decision-making process may seem, the effort to translate that into an automated system has proved daunting.

“We can build a computer that’s good at very constrained decision-making, but general purpose, rapid decision-making is difficult,” says Paul Sajda, associate professor of biomedical engineering and radiology. “It might be able to detect what is interesting or novel, but it doesn’t always know what’s interesting or novel to you.”

Those two tasks—rapid decision-making and identifying subjective interests—are, however, exactly what Sajda (SHY-da) and his team are succeeding in building. At the same time, Sajda is attempting to reveal the most basic neural structures in the brain that process visual information.

In his Laboratory for Intelligent Imaging and Neural Computing (LIINC), Sajda connects subjects to an EEG and flashes a series of images on a computer screen to record the neurological equivalent of the “Aha!” moment signaling interest or recognition. Once the “cortically coupled computer vision system” is calibrated to recognize the things that interest an individual, it can present more images that are likely to pique that person’s interest.

His work has drawn the attention of the Defense Advanced Research Projects Agency (DARPA) for its potential to help conduct a sort of visual triage by sifting quickly through petabytes (that’s a million gigabytes) of satellite imagery or hours of surveillance tapes. At the same time, he is also working with researchers at Columbia University Medical Center on techniques that enhance the brain’s ability to make quick decisions. But the question that most fascinates Sajda is what his studies of the brain’s visual recognition networks can do to reveal the organ’s fundamental ability to process massive amounts of information.

“It’s still unclear at what scale the brain processes information,” says Sajda. “It could be groups of neurons, it could be the whole brain. We don’t know.”

Growing up on Long Island, Sajda knew he wanted to be an engineer, but said he was also fascinated by the anatomy and physiology of living things and the fact that a collection of ions and some sugars can band together to form a living organism. At the same time, helping his father deal with multiple sclerosis focused Sajda’s interest on the brain. That fascination with living systems continues to infuse his work, at the same time that his engineering perspective is helping redefine what we know—and what may be knowable—about the human brain.

Sajda, who received his PhD from the University of Pennsylvania, was head of adaptive image and signal processing at Sarnoff Research Center prior to joining the SEAS faculty in 2000.
Many sports-related injuries involve soft tissues such as ligaments, which connect bone with bone, and tendons, which join muscle to bone. Each year, more than 200,000 people suffer damage to their anterior cruciate ligament (ACL), the primary ligament that stabilizes the knee joint. Tears of the ACL are especially common in professional football players. But ACL tears are not just an injury for the guys. Statistics show that ACL tears have become a mini-epidemic for young women playing soccer or any other sport with lateral motion.

With the rate of ACL tears and other soft tissue injuries increasing in all segments of the population, it is a hopeful sign that Professor Helen H. Lu has developed a new approach to help the body heal after these debilitating soft tissue injuries. One of the major hurdles preventing healing lies in integrating soft tissue grafts with the body, and Lu’s group has focused on engineering the interface that connects soft tissue to bone. While tissue engineering has traditionally involved a single-tissue approach, Lu is growing multiple tissues to build functional organ systems that will integrate with the body.

“With the ACL-bone interface, we see three distinct yet continuous tissue regions—ligament, fibrocartilage, and bone,” says Lu. “As we understand how the biological interfaces between these different types of tissues are formed and how to reestablish these distinct tissue-to-tissue boundaries post-injury, we can regenerate the native soft tissue-to-bone interface and promote integration.”

Lu has developed a novel “scaffolding” to grow these three different tissue types within one functional system. This interface scaffold is stratified, with each layer differing in architecture, porosity, and composition to best nurture each particular cell type, while integrating seamlessly with the adjacent tissue. Each portion of the scaffold is biocompatible and biodegradable, and will ultimately be replaced by living tissue, thus becoming part of the body.

In collaboration with Dr. Scott Rodeo, an orthopedic surgeon from the Hospital for Special Surgery, Lu and her research group are working on the design of an integrative interference screw. The interference screw, used to fix an ACL graft in place, is usually made of titanium alloys, but a tissue-engineered screw has none of the drawbacks of a permanent metallic implant and promotes integrative repair.

This new method will move ACL repair from traditional mechanical fixation to biological fixation, resulting in longer-lasting and stronger repair. Lu’s pioneering work on the ligament-bone interface was recently recognized when she received the Presidential Early Career Award for Scientists and Engineers (PECASE), the nation’s highest honor for young scientists.

Lu’s group is extending the interface tissue engineering approach to the repair of another critical soft tissue-to-bone transition area, the rotator cuff. The rotator cuff is where four delicate muscles and tendons hug or “cuff” the shoulder’s ball and socket. Tears in the rotator cuff are one of the most debilitating and common injuries of the shoulder, and similar to the ACL, integration of the tendon and bone remains a critical challenge.

In collaboration with Dr. William Levine, a shoulder surgeon at Columbia, Lu is developing special nanofiber-based scaffolds that mimic the native tissue in organization as well as functionality for integrative rotator cuff repair. This work is funded by the NIH and a recent grant from the New York State Stem Cell Science (NYSTEM) Initiative.
Osteoporosis is a major public health threat for more than half of all Americans. An estimated 10 million already have the disease and another 34 million are at high risk of developing porous bones, shortening lives and increasing health care costs.

Christopher Jacobs, associate professor of biomedical engineering, is working to unlock a stem cell mystery that could provide significant advances in the treatment for osteoporosis. He has received a $1 million New York State grant to research stem cell behavior related to the condition. Osteoporosis occurs when bone marrow stem cells fail to produce bone-forming osteoblasts in sufficient numbers. Very little is known, however, about the cellular mechanism by which bone marrow stem cells sense and respond to changes in their mechanical loading environment.

Jacobs’ Cell and Molecular Biomechanics Laboratory will determine whether a novel cellular sensor, the primary cilium, is responsible for the stem cell’s ability to sense mechanical loading. His lab was one of the first to show that primary cilia act as mechanical sensors in bone cells. The project will characterize the ability of transplanted stem cells to home in on sites of bone loading and form new bone and then determine whether the stem cells retain this ability if their primary cilia are first disrupted.

“If the hypothesis is proven to be true, it will be a breakthrough in skeletal mechanobiology and suggest approaches for new anti-osteoporosis drugs,” Jacobs says. “It will also be a significant advance in relating primary cilium dysfunction to human disease.”

Jacobs, who earned his PhD from Stanford University, was an assistant professor in the Department of Orthopaedic Surgery at Pennsylvania State University before coming to SEAS.

Nearly 3 million people in the U.S. are infected each year with the hepatitis C virus, the major cause of liver cancer. Worldwide, roughly 3 percent of the population is infected.

Mechanical engineering assistant professor Jung-Chi Liao is making progress toward the effort to find an effective treatment for the virus. He has focused his research on exploring the DNA helicase—or enzymes—of the hepatitis C virus.

Liao’s work is related to the recent discovery of a peptide that inhibits the functioning of the hepatitis C virus enzyme NS3 helicase, providing new insights. Specifically, several hot-spot residues have been identified to convert ATP energy to separate the virus’s DNA. Liao is currently conducting comparative studies among different helicases to better understand the variations of coupling mechanisms.

Based on his discovery of dynamical coupling mechanisms and the resulting different conformations, pharmaceutical companies may now be able to identify better drug candidates to inhibit ATP binding sites of hepatitis C virus NS3 helicase. Liao has been invited by InterMune Inc., one of the major biotechnology companies focusing on drug development for hepatitis C virus infections, to give a seminar presentation of this work.

Liao joined Columbia SEAS in 2008 after posts as a research associate in the Department of Bioengineering at Stanford and as a postdoctoral fellow in molecular and cell biology at the University of California, Berkeley. He earned his PhD from the Massachusetts Institute of Technology.
In 2009, an estimated 785,000 Americans will have a new coronary attack, and about 470,000 will have a recurrent attack, while more than 35 million Americans suffer from TMJ—temporomandibular joint disorders. What is the connection? The work of Professor Gordana Vunjak-Novakovic of the Department of Biomedical Engineering, who is building complex human tissues that may help resolve both these debilitating conditions.

“As a biomedical engineer actively involved in this field, I look forward to unlocking the full regenerative potential of human stem cells, so we can cure disease and live longer than our failing organs,” she says.

Whether it is bone or muscle, the fundamental engineering and developmental biology principles are the same. As director of Columbia’s Laboratory for Stem Cells and Tissue Engineering, Vunjak-Novakovic uses biomimetics, “the science of imitating nature,” to create environments promoting tissue development or regeneration.

Each tissue should ideally receive its own kind of scaffolding and its own culture environment. To engineer thick, vascularized, and electromechanically functional cardiac tissue, Vunjak-Novakovic cultures stem cells, the actual “tissue engineers,” on a channeled elastomer scaffold perfused with culture medium containing oxygen carriers, to mimic blood flow. Electrical field stimulation is applied during culture to mimic electrical pacing within the heart.

This research may lead to a heart patch that could be laid over injured heart tissue to restore normal function in someone who has suffered a heart attack. Another promising application for engineered cardiac tissue is drug testing. The use of patient-specific engineered human tissues, instead of cells alone or in animal models, may be a way to determine the drug’s actual effect on the ultimate user.

Vunjak-Novakovic’s work in craniofacial tissues is now concentrated on the human mandibular condyle, the end of the lower jaw. This only moving part in the head has a complex structure and function, and is not easy to restore. Her goal is to produce a fully functional, anatomically shaped vascularized graft to replace a worn TMJ.

When she came to SEAS in 2005, Vunjak-Novakovic helped design her own top-of-the-line lab for human stem cells and functional tissue engineering in the Vanderbilt Clinic on the University Heights campus. Her lab hosts the Bioreactor Core of the National Institutes of Health (NIH) Tissue Engineering Resource Center, just renewed for another five years. With its “bioreactor shop” and a group of 25 talented students and postdocs, the lab is the place to go if you need an advanced culture system. Last year she led the team of 26 investigators to bring to SEAS a new Stem Cell Functional Imaging Core, established through a grant awarded by New York State’s Stem Cell Board.

“This sophisticated bioreactor and imaging instrumentation has moved stem cell research from the ‘flat biology’ of petri dishes to controllable models of high biological fidelity, which can be studied in real time to observe the interacting factors mediating self-renewal and differentiation of stem cells,” she says. “We now have the capacity to develop entirely new research paradigms and approaches to engineering human tissues.”

Vunjak-Novakovic is one of the country’s leading tissue engineers. She received her PhD degree in chemical engineering from the University of Belgrade, and was at the Harvard-MIT Division for Health Sciences and Technology for 12 years before coming to SEAS. She is a fellow of the American Institute for Medical and Biological Engineering, one of 70 women in the Women in Technology International Hall of Fame, the chair of her NIH study section, and a highly cited author of more than 240 scientific articles and two textbooks.

MAKING AN IMPACT

fixing broken hearts and bones

GORDANA VUNJAK-NOVAKOVIC | BIOMEDICAL ENGINEERING
Each year in the U.S., approximately 650 children are diagnosed with neuroblastoma, a cancerous tumor in nerve tissue, most often in the adrenal glands in the abdomen. For this, and for many other childhood cancers, surgery is not an option.

At Columbia’s Pediatric Tumor Biology Laboratory, a new way to deliver tumor-killing gene therapy is being developed by Mark Borden, assistant professor of chemical engineering, and his pediatric oncology colleagues. The vehicle is microbubbles, tiny gas bubbles—about 100 times smaller than the width of a human hair—that can be safely injected into the bloodstream without the danger of forming emboli.

In groundbreaking research sponsored by St. Baldrick’s Foundation, which supports research of childhood cancers, Borden has shown that microbubbles can encapsulate tumor-killing gene therapy, protecting the cargo in the bloodstream. When the bubbles are at the tumor site, he uses ultrasound to release the genes into the tumor cells.

“The microbubbles oscillate strongly with ultrasound,” says Borden, “and the bubbles implode, causing holes in the tumor walls. The genes enter the tumor and repair the defective cancer-causing cells.” This methodology is much safer than using viruses to carry the gene therapy to the tumors. Viruses often trigger the body’s natural defenses, including anaphylactic shock, resulting in patient death.

Borden also uses microbubbles to create clearer images of pediatric tumors and assess the efficacy of treatment. Using a contrast medium carried by the microbubbles, high frequency ultrasound can show changes in tumor growth to evaluate how well treatment is working.

After receiving his PhD from the University of California, Davis, Borden was a postdoctoral researcher there in biomedical engineering and in radiology at the Arizona Cancer Center.

The key to unlocking complex problems like the biological cause of cancer—the second-leading cause of all deaths—may lay in the fundamental building blocks of life.

How genes control each other—and how to predict that activity—is a research focus of Chris Wiggins, associate professor in the Department of Applied Physics and Applied Mathematics. He is working to develop models that predict how genes behave to explain how some cells become cancerous.

“The relationship between biology and mathematics has completely changed in the last decade,” Wiggins explains. “New technologies have transformed biology into a data-rich science, and advances in algorithms have made possible data-driven predictive modeling in biology. At the same time, the World Wide Web made it possible for any biologist to share their data with the entire mathematical community with the click of a mouse.”

Wiggins and his collaborators have shown how one can use these data, along with the appropriate math, to learn which genes are controlling which other genes and why. “The problem is a bit like watching stocks go up and down, and trying to predict which stocks are driving each other;” he says.

While the architecture of the underlying genetic network is a basic biological topic, Wiggins says “it is at the root of numerous biological diseases, including cancer, and we are now on the threshold of finding more of those genetic links.”

Wiggins, who earned his PhD in theoretical physics from Princeton and was an NSF postdoctoral research fellow in biomathematics at the Courant Institute, has had his work profiled in Scientific American.
A recent study in the New England Journal of Medicine showed that two-thirds of adults underwent medical tests in the last few years that exposed them to radiation and, in some cases, a higher risk of cancer. Elisa Konofagou, an associate professor of biomedical engineering and radiology, is pioneering new uses for an imaging technology that is radiation free, less expensive than CT scans and MRIs, yet just as effective: ultrasound. Moreover, she is going beyond ultrasound’s traditional application as a diagnostic tool, using it to treat diseases like cancer, Alzheimer’s, and Parkinson’s.

In the area of oncology, Konofagou is developing a tool that could identify and destroy tumors without the need for surgery. Her technology, called harmonic motion imaging, uses ultrasound to probe soft tissue in search of abnormal growths. “You’re basically knocking on different parts of the organ until you detect a different amplitude in one particular location,” she says. She has found that ultrasound can distinguish benign from cancerous tumors and that its beam can be aimed with extreme precision to detect and ablate, or destroy, the abnormality. If proven effective, the technique could be used in inoperable cancers of the brain, prostate, pancreas, and kidneys. She and Columbia breast surgeon Kathie-Ann Joseph plan to test harmonic motion imaging and ablation within the next five years in patients with benign breast tumors who would otherwise have to undergo painful surgery.

In the area of neurology, Konofagou is deploying ultrasound to temporarily open the blood-brain barrier to help treat patients with diseases like Alzheimer’s, Parkinson’s, and ALS. Currently, physicians have few good options when it comes to treating these patients. Their choices include direct injection—taking a needle and sticking it deep into the brain to deliver medicine—or IV drugs. While a small percentage of the latter can cross the blood-brain barrier, they flow across the entire brain, not just the diseased areas, causing, in some cases, severe side effects.

The technique Konofagou has pioneered sends ultrasound waves through a millimeter-specific brain region and the intact skull, causing that part of the blood-brain barrier to open. Medicine would be injected by IV and would reach only its intended target. “The idea is to use this in conjunction with systematically administered drugs that have been shown to work yet have been shelved because of the fact that they are not passing through,” says Konofagou.

Konofagou has also deployed ultrasound in the field of cardiology. As patients, especially men, age, their risk of developing an irregular heartbeat, called atrial fibrillation, grows. The arrhythmia originates in the upper chambers of the heart, which begins sending rapid, disorganized electrical signals to the rest of the organ. Konofagou’s myocardial elastography can identify and localize the culprit portions of the heart. Following diagnosis, the same technique can be used to evaluate treatment, such as after using radiation-free ablation to restore the heart’s natural rhythm. In the future, she hopes her innovations may allow for an inexpensive, noninvasive screening test for heart disease. “I believe ultrasound can do anything,” she says. Each day her research is bringing that statement closer and closer to reality.

A PhD graduate of a joint program of the University of Houston and the University of Texas Medical School, Konofagou was a research fellow at Brigham and Women’s Hospital and Harvard Medical School prior to joining the SEAS faculty.
Nearly 50 million people nationwide struggle with type 2 diabetes or high cholesterol, and rates are increasing annually. The clues to why some people are more susceptible than others are being discovered on a small Pacific Island, where SEAS researchers are discovering new genetic variation and associating it with metabolic disease.

Itsik Pe’er, an assistant professor of computer science, is developing analytical methods for analysis of DNA sequence variants. Recent technological breakthroughs now allow high-throughput observation of these genetic alterations along the genome (an individual’s collection of genetic material). Such heritable changes are thought to be responsible for 40 to 90 percent of population risk to a wide variety of health conditions, from diabetes to schizophrenia. The Pe’er group is studying a population from the Pacific Island of Kosrae, in the Federated States of Micronesia, which suffers from increased rates of metabolic disorders, such as obesity, type 2 diabetes, and high cholesterol.

The unique genetic makeup of the islanders, who have been isolated for thousands of years, makes them ideal for genetic studies, but their interrelatedness makes analysis of their DNA extremely complex.

The Pe’er group has developed computational tools to decipher remote family ties between individuals based on identity of genomic segments inherited by descent from a recent unknown ancestor. These analytical methods enabled examination of 500,000 polymorphic sites along the genomes of 3,000 Kosraeans, representing most of the adult population. The lab was thus able to discover multiple new disease genes for health traits. Based on these disease associations, the researchers were able to sequence the entire genome of representatives of the Kosraean population, resulting in discoveries that have broad implications for anyone with these metabolic diseases.

Pe’er earned a PhD from Tel Aviv University and was a postdoctoral researcher at several institutions, including the Weizmann Institute of Science and Massachusetts General Hospital.

Doctors in developing countries will soon be able to use handheld devices to collect and analyze blood tests at a patient’s bedside to diagnose infectious and other diseases, thanks to research by Samuel K. Sia, assistant professor of biomedical engineering at Columbia SEAS.

The devices, now undergoing field tests in Rwanda, require only a finger prick of blood and provide quantitative results in less than 20 minutes. The aim of the new technology is to significantly reduce the time between testing patients and treating them, without increasing costs or regulatory burdens.

“Nowhere is the need for new diagnostic technologies greater than in developing countries, where people suffer disproportionately from infectious disease compared to the U.S. and Europe,” says Sia.

The “lab-on-a-chip” technology uses microfluidics—the manipulation of small amounts of fluid—to miniaturize and automate routine laboratory tests onto a handheld microchip. The devices are being developed in collaboration between Sia’s lab and Claros Diagnostics Inc., a venture capital-backed startup company that Sia co-founded in 2004.

Sia, who holds a PhD from Harvard University, received a CAREER Award from the National Science Foundation that supports his work in developing biocompatible microelectromechanical systems and implantable medical devices, such as glucose sensors.

More than a million people with type 1 diabetes—an autoimmune disease that is life-threatening unless treated with frequent doses of insulin—will soon be able to check their blood sugar levels without the daily drawing of their own blood.

A team of researchers, led by mechanical engineering associate professor Qiao Lin, has invented a microfabricated, miniature sensor that can eventually be implanted in a patient's body for long-term, continuous glucose monitoring. It will be part of a closed-loop system that will automatically deliver insulin to diabetic patients based on blood sugar levels.

Lin’s glucose sensor consists of a microscopic diaphragm (or cantilever), which vibrates under remote magnetic excitation in a microchamber filled with a glucose-sensitive polymer solution. When glucose enters the chamber through a semipermeable membrane, it binds reversibly with the polymer, changing the viscosity of the solution. As the viscous damping on the diaphragm vibration directly depends on the viscosity, the glucose concentration can be determined by wireless vibration measurements. Depending on the result, insulin can be injected to maintain a normal glucose level.

The reversible binding of glucose to the polymer is key.

“It is a physical process and so the glucose is not consumed,” says Lin. This is a key difference between his device and current, less reliable, sensors that use an irreversible electrochemical reaction of glucose with an enzyme.

In the realm of national preparedness, few scenarios are as scary as the possibility of a “dirty bomb.” The National Institutes of Health (NIH) is funding a $25 million grant to find new technologies that will provide rapid mass-screening of radiation exposure.

Professor Y. Lawrence Yao, chair of the Department of Mechanical Engineering, together with researchers from Columbia University Medical Center and department colleagues, are part of a multi-institute consortium that, among other tasks, is charged with developing a high-throughput “biodosimetry” device capable of rapidly testing a large swath of the population in the event that a RAD (radioactive dispersal device), commonly called a “dirty bomb,” is detonated in a major metropolitan area.

Yao’s group is collaborating on an effort to design the most effective and quickest technologies that involve advanced imaging, lasers, and robotics. Radiation affects cell division. When cells divide under normal conditions, the break is clean, with no extraneous cellular material. After radiation exposure, however, pieces of damaged chromosomes, micronuclei, appear along with divided cells and can be tested for DNA breaks.

The advances in these technologies being pioneered by Yao and his colleagues will accelerate the screening process based on blood from a finger stick. With the help of a highly automated, efficient, and eventually portable device—a prototype of which is already whirring in Mudd’s basement—doctors can quickly determine the scope of radiation exposure and whether medical treatment is needed by processing tens of thousands of samples per day, instead of only a few hundred.

“This group is confident that this device can operate at high volume and full throttle, with the hope that it is never needed.”

Yao and his colleagues, and the NIH, are confident that this device can operate at high volume and full throttle, with the hope that it is never needed.

Yao, who received his PhD from the University of Wisconsin, Madison, engages in multidisciplinary research that includes nontraditional manufacturing, laser materials processing, and robotics in industry and health care.
Not everyone who looks at red bell peppers immediately sees the solution to the manufacture of biocompatible, microrobotic gears, but SEAS associate professor Xi Chen did. Chen, who first explained why some fruits and vegetables have ridges, has applied these same buckling principles of engineering mechanics to the creation of small gears that can be used in surgical robots.

Today, creating gears requires a complicated and time-consuming lithography process, and the resulting pattern features are essentially two-dimensional. “Our breakthrough involves self-assembly created by mismatched deformation,” says Chen. “If we bond a thin film to a compliant cylinder substrate, upon relative shrinking of the substrate, the only way the system can handle the extra film surface is to buckle the film and form structures like teeth on a gear.”

This methodology can create three-dimensional biocompatible structures that are impossible to make with current lithography techniques. Chen and his team have shown they can predict the number and depth of the teeth, as well as create inclined and zigzag gears.

“Our goal is to find ways to manipulate patterns by playing with different geometrical and material parameters to force the substrate to make the pattern we want,” he says. “Our approach is quick, simple, and the cost is very low. We are now working to reduce the size of these gears to micrometer scale for use in surgical robots.”

Chen, who received his PhD and postdoctoral training at Harvard, received a Presidential Early Career Award for Scientists and Engineers (PECASE) last year for his outstanding research in mismatch damages in thin-film and nanoscale self-assembly.

Even in the steadiest of surgeons’ hands, placing cochlear implants in patients can be tricky and the risks of trauma are high. Help is on the way for surgeons to implant such electronic devices, which provide a sense of sound to a person who is profoundly deaf or severely hard of hearing due to damaged neuroepithelial (hair) cells.

Assistant Professor Nabil Simaan and his team have developed a steerable, snake-like electrode array for implant surgery that helps surgeons install cochlear implants safely and trauma free. Otolaryngologists at the Columbia University Medical Centre have taken an active interest in his lab’s development of a robot-assisted system for such surgeries.

Simaan says it will be a big step forward from the existing implantation procedure, in which surgeons must manually thread long, flimsy electrodes into the cochlea, carefully navigating its delicate passageways with extreme precision. The slightest wrong move or force can damage the delicate structures of the cochlea and may even cause additional hearing loss beyond what the surgery is trying to correct.

He is also developing other surgical robots, including one that will both filter a surgeon’s hand tremor as well as keep the surgeon from moving the surgical tool into the wrong area. This will be especially useful for minimally invasive surgery performed through the abdomen.

“Designing new mechanical architectures for robots geared for surgery is my passion,” Simaan says, “and my hope is that Columbia’s novel work in robotics finds its way into operating rooms everywhere.”

Simaan received his PhD from the Israel Institute of Technology and was a postdoctoral research scientist at Johns Hopkins University’s National Science Foundation (NSF) Engineering Research Center for Computer-Integrated Surgical Systems and Technology prior to coming to SEAS. He recently received an NSF CAREER Award to support his research.
analyzing 3D video ultrasounds of the heart
ANDREW F. Laine
BIOMEDICAL ENGINEERING

relief for aching joints
CLARK T. HUNG
BIOMEDICAL ENGINEERING

untangling the mystery of Alzheimer’s plaque
SANAT KUMAR
CHEMICAL ENGINEERING

predicting bone strength, preventing osteoporosis
X. EDWARD GUO
BIOMEDICAL ENGINEERING

delivering drugs to the right place
JEFFREY T. KOBERSTEIN
CHEMICAL ENGINEERING

figuring out how viruses invade cells
BEN O’SHAUGHNESSY
CHEMICAL ENGINEERING

developing an artificial kidney
EDWARD F. LEONARD
CHEMICAL ENGINEERING

trying to grow strong cartilage
GERARD A. ATESHIAN
BIOMEDICAL ENGINEERING

personal diseases, personal cures
DANA PE’ER
COMPUTER SCIENCE

Making an Impact
predicting bone strength, preventing osteoporosis
X. EDWARD GUO
BIOMEDICAL ENGINEERING

delivering drugs to the right place
JEFFREY T. KOBERSTEIN
CHEMICAL ENGINEERING

trying to grow strong cartilage
GERARD A. ATESHIAN
BIOMEDICAL ENGINEERING
engineering the body’s defenses
LANE KAM
BIOMEDICAL ENGINEERING

creating personalized DNA chips for everyone
JINGYUE JU
CHEMICAL ENGINEERING

measuring how heart cells work
HAYDEN HUANG
BIOMEDICAL ENGINEERING

biology on a chip: big changes writ small
KEN SHEPARD
ELECTRICAL ENGINEERING

reprogramming cells to boost immunity
JAMES HONE
MECHANICAL ENGINEERING

building tiny muscle-like engines
HENRY HESS
BIOMEDICAL ENGINEERING

how flies’ brains identify odors
AUREL A. LAZAR
ELECTRICAL ENGINEERING

treating non-Hodgkins lymphoma
TRUMAN R. BROWN
BIOMEDICAL ENGINEERING

cartilage destruction and reconstruction
VAN C. MOW
BIOMEDICAL ENGINEERING

to read more about these and other faculty members and their exciting work, go to:
columbia.edu
SEAS BY THE NUMBERS

SEAS Undergraduate Applications

Selectivity Rate for First-Year Classes

Number of Applications for Graduate Programs

PhD Acceptance Rate

Average SAT Scores for SEAS Admitted Classes

Mean GRE Quantitative Scores of New Entrants in Doctoral Program

Number of PhD and Master’s Students

to read more about Columbia Engineering, go to engineering.columbia.edu
Columbia Engineering has taken a historic step in its globalization initiatives by signing a dual certification agreement with the University of Bologna that provides an opportunity for students from both universities to obtain a master’s degree in civil engineering from each institution with only one additional year of study. Academicians and cultural representatives from Italy joined with their Columbia counterparts to celebrate the new program that, beginning in the fall of 2010, will train SEAS students to work anywhere in Europe.

Shown here during ceremonies at Low Library are (front row, left) Pier Paulo Diotallevi, dean of the University of Bologna’s faculty of engineering, and Columbia University’s Feniosky Peña-Mora, dean of The Fu Foundation School of Engineering and Applied Science. Back row, from left: University of Bologna Professor Francesco Ubertini; SEAS Civil Engineering Professor Raimondo Betti; Professor Marco Savoia, chair of the Department of Civil Engineering at the University of Bologna; Columbia University Vice Provost Rose Smith; Régine Lambréch, director of global initiatives and education at SEAS; and the Hon. Francesco M. Talò, consul general of Italy.

—Photo by Eileen Barroso

MS Students Gain Global Advantage

SEAS Parents Council

The SEAS Parents Council continues to build momentum as it enters its second year. The Parents Council is the principal connection between the dean and the parent body as a whole, advising the dean on ways to strengthen the student experience and acting as liaisons with other parents. Members also serve as informed ambassadors for SEAS in their community and country. A key focus of the Council is advancing the goals and vision of the School through supporting the Parents Fund. Last year, the Parents Fund raised $348,582 from 320 families, both of which were new records.

This year, the Parents Council will be led by Chairs William ’81, ’86 and Mary Haney (above) parents of Nora ’12. The Parents of Alumni chairs will be Mark and Angela Arnold, parents of Andrew ’09. They are joined by 23 couples from all over the U.S. as well as Hong Kong, South Korea, Switzerland, Finland, and Taiwan.

Bill Haney, who earned his bachelor’s and master’s degrees in operations research from SEAS, said, “I could not have attended Columbia without the financial aid I received while an undergraduate student. I believe that the investment that Columbia makes in enabling the very best students to matriculate benefits everyone associated with the Columbia community. Current students are direct beneficiaries of an enhanced academic experience, and alumni and current and future students are beneficiaries of an enhanced overall reputation for academic excellence at Columbia. Mary and I are thrilled to be leading the Parents Council this year and continuing its efforts to assist SEAS and its students in achieving their fullest aspirations.”

For more information about the Parents Council or the Parents Program, contact Ryan Carmichael, Parents Program Officer, at seasparents@columbia.edu or 212-851-7891.
2003
Class Correspondent: Smadar Abon<br>smartab@wharton.upenn.edu
2004
Class Correspondent: Eric Blase<br>eric.blase@gmail.com
2005
Class Correspondent: Eric Blase
2006
Winston Chao, who recently turned 29, is currently in San Francisco/Oakland Bay Bridge. After spending his last summer traveling to Asia and having finished her first year of medical school at New York Presbyterian/Weill Cornell, Angela continues: “I am an environmental engineer at Matchamines, a firm that systematically eliminates the irrational.”

2007
Ben Stern is currently studying at Yale Law School. This summer he worked for a boutique intellectual property firm in hailed and plans to practice patent law.

2008
Class Correspondent: Nick Jennings at nickjennings@columbia.edu

2009
Class Correspondent: Amy Lin at amylin24@gmail.com

2010
Class Correspondent: James Lee

2011
Class Correspondent: Matthew Anderegg

2012
Class Correspondent: Angela Segars

2013
Class Correspondent: Angela Seger Anandoo, who writes that she and Al will attend the class reunion in June 2014 and is currently with Credit Suisse as an associate in the EMEA equities division. The couple plans to be engaged this fall, and moved to Manhattan this summer.

2014
Class Correspondent: Shirley Cho

2015
Class Correspondent: Daniel Heung Min Lee

2016
Class Correspondent: Kellie Kiyoshi Lee

2017
Class Correspondent: Ben Stern

2018
Class Correspondent: Tom Hong

2019
Class Correspondent: James Lee

2020
Class Correspondent: Matthew Anderegg

2021
Class Correspondent: Matthew Anderegg

2022
Class Correspondent: Matthew Anderegg

2023
Class Correspondent: Matthew Anderegg

2024
Class Correspondent: Matthew Anderegg

2025
Class Correspondent: Matthew Anderegg

2026
Class Correspondent: Matthew Anderegg

2027
Class Correspondent: Matthew Anderegg

2028
Class Correspondent: Matthew Anderegg

2029
Class Correspondent: Matthew Anderegg

2030
Class Correspondent: Matthew Anderegg

2031
Class Correspondent: Matthew Anderegg
IN MEMORIAM

died in February

nursings of his youth at Camp

nym. The family gives special thanks to

nrobbed by a chuck looter, hunter, lover of music, instrum-

acted a special thank you to Simi Val-

theor in her post and ad to

femcon in New Jersey. He was met and mar-

niels and they just marked their 63rd wed-

partmental entrepreneurial ventures in Bay

city included the co-founding of

r and submarine detailer; and

t place in physics and mathematics, an interest in

drum hunter, lover of music, literature and

niversity in 1956 and his mas-

agreement; past board member Lake

s也希望以中文和英文分别提供以下内容的自然语言转写。
IN MEMORIAM

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time friends and simplify their life. allowed them to be near family, long-
looked back. Retiring to the Midwest changed things forever. Over three
days, they visited Northfield, signed a
sued by the start-up which would
served as senior executive. Bell Labs became
the first of a series of demanding po-
hoped it would be. Bell Labs became
Calif. California proved to be even
dering in New York City. In 1974,
ended in 1972.
He became a member of the resi-
dential staff of Ecumenical Institute/ Institute of Cultural Affairs (ICA) re-
iding in New York City. In 1974, Bell Labs transferred him to Naperville, Ill., where he also held
and worked at the global headquarters of the EU/ICA in Chicago. From even more importantly, it set up the cir-
cumstances in which he met Beret,
morally, it set up the cir-
ities (Woodall) Voss (Hank Albert Voss) and
their family; and Gwen Leigh
Iowa; nieces, Gayle Rae (Woodall)
(Cassandra Miles Hanson), and grand-
City; son, Benjamin Daniel Hanson
(Manola Francesca Silva Hanson of
Gaytan Silva), and grandchildren
Greta Elizabeth Hanson, (Rogelio
Andrew Samir Kaldas of Cumming,
children, Evea Dinorah Kaldas and
MaryAnne Vogt and her hus-
Dylan Gattini; sisters, Prudence John-
Gattini; two grandsons, Ryan and
MaryAnne Vogt and her hus-
Dylan Gattini; two grandsons, Ryan and
MaryAnne Vogt and her hus-

He survived by his wife, Beret Elizabeth Brown, Hanoch Griffiss of Northfield, daughter, Dana Erin Griffiss of
Kenwood, son, Brian Andrew Griffiss (Lauren)
San Diego, Calif., daughter, Guri Elizabeth Hanson, (Kogolo-
Gottay Silico), and grandchildren
Griffith was enthusiastically and pas-
their training through the American
organization’s board. After receiving fur-
private family practice in Mequon. In
he was in the family practice residen-
tion at his beloved family summer
time for four years with an outstand-
was a National Merit Scholar. After
Middletown High School, where he
Mass. Hare was born in Middletown,
were most important in his
life. Perhaps in the end it was “spor-
atom” that best describes his essence. Com-
men grew brought meaning to his life. Perhaps in the end it was “spor-
atom” that best describes his essence. Com-

From 1976 to 1988, Hare was in
medical school and engineering, he
received his MD degree from Cornell
University Medical College. He
was in the family practice residents

new Dean Welcomes New Students

New Dean Welcomes New Students

- new SEAS Dean Feniosky Peña-Mora welcomed more than 1,500 new students and their parents, family, and friends as part of Convocation for Columbia College and The Fu Foundation School of Engineering and Applied Science. Peña-Mora (right) joined University President Lee C. Bollinger and new Columbia College Dean Michele M. Moody-Adams at the August 31 ceremony on South Lawn.

“Like all of you new first-years sitting out there, I’m a first-
year,” he said. “Like all of you, I am thrilled to be here and to be
part of this great institution that traces its roots back to 1754.

“I received your congratulations in the classes that you have pre-
ceded you. You are becoming part of an academic lineage that
goes back to the founding of the University’s King’s College, as
Columbia was known then, in its founding mission in 1754, to
‘enlarge the Mind, improve the Polish the whole Man [and today, also women], and qualify them to support the bright Characters in all the elevated stations in life.’

‘To complement the teaching of what we now know as liberal
arts, the mission of King’s College was also to teach ‘the art of
Numbering and Measuring, of Surveying and Navigation . . . the knowledge of . . . various kinds of Meteors, Stones, Mines and Minerals, Plants and Animals, and everything useful for
the Comfort, the Convenience and Elegance of Life.’

‘. . . [F]rom the beginning, Columbia has been an institution
of and for engineers, and as, such our School has a long
history of educating engineers whose laborers whose contributions
have influenced the lives of the world’s citizens.” Calling them
the future of the School, he told the assembling students that
they can impact lives as significantly as such famous alumni as
Papin, Parsons, Pinches, and others who have preceded them.
Go to www.engineering.columbia.edu to read the speech and see the video of De Peña-Mora’s remarks.

IN MEMORIAM

New Dean Welcomes New Students

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Family members may e-mail
mke21@colubma.edu
with this information, for.

PHOTO BY EILEEN BARROS0

PHOTO BY EILEEN BARROS0
The Return of the First-Year Beanie

Dean Feniosky Peña-Mora reestablished the tradition of the first-year beanie as he stood at the door of Havemeyer Hall and personally welcomed each of the 315 members of the SEAS Class of 2013 to their first 9 a.m. orientation session. The first-years were surprised, and delighted, by the warm greeting, firm handshake, and gift of the first-year beanie. Noting that wearing a beanie was a return to a tradition going back to the late 1800s, Peña-Mora told the students it was no longer a “requirement,” but he hoped students would use it as an opportunity to build community among class members.

In the spirit of the welcome, the students doffed their beanies for a photograph and enthusiastically applauded the dean as he unexpectedly leapt into the air.

Jocelyn Wilk of Columbia University Archives says that beanies were proudly worn as symbols of a first-year’s distinctive position on campus. “At one time, the wearing of the beanies was mandatory,” she notes. “The 1927-28 Columbia Blue Book contained rules: the requirement to wear the first-year cap at all times, and a notation that rule-breakers would be ‘summarily dealt with.’”

Making an Impact

Dr. Stanley Dicker received his EngScD in mechanical engineering from Columbia SEAS in 1961. Shortly thereafter he began his long and varied career in the health care field. Presently, he owns and operates two nursing homes, a health homecare business, an adult day care center, an ambulatory surgical care center, and a comprehensive care center. He has dedicated his philanthropy to combining his interests in engineering and health care.

In 1996, he endowed the Stanley Dicker Professorship in Biomedical Engineering, held by Van C. Mow, founding chair of SEAS’s Department of Biomedical Engineering. He later established two scholarships for undergraduates majoring in biomedical engineering in honor of his father and mother, the Jack Dicker Scholarship and the Freda Dicker Scholarship.

Dr. Dicker explains his strong connection to Columbia SEAS, noting, “When I became a graduate student at SEAS, I had a family with two young daughters that I needed to support. SEAS helped me find a position as a research engineer at Columbia which allowed me to complete my doctoral studies.

“When I became able to do so, I decided to give back to the School that had made my education possible. I first created a professorship in biomedical engineering and later two scholarships for undergraduates. I am very proud to hear Dr. Mow introduced as the Stanley Dicker Professor of Biomedical Engineering; and I am always happy to meet and speak to the very talented students that my scholarships support. I am overwhelmed with the depth of knowledge the students possess and how well they articulate themselves to explain their interests in pursuing their careers.

“I am very grateful to Columbia for helping me and affording me the opportunity to create the professorship and scholarships.”