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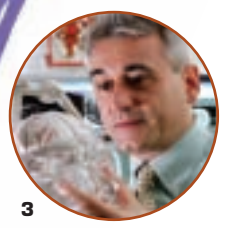
ENGINEERING VANDERBILT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"I tell laboratory researchers that if they can give me the details of how they make diagnoses in a full-scale lab, I can miniaturize the process for them."

— Professor Li

Lab-on-a-chip

New Flowers Professor survives Chinese Cultural Revolution to revolutionize technology

Dongqing Li's dream is to create a miniature, portable laboratory the size of a business card, capable of on-the-scene diagnosis of diseases and rapid detection of biochemical warfare agents. The new H. Fort Flowers Professor of Mechanical Engineering is well on his way to creating this and other revolutionary "lab-on-a-chip" technologies.

Professor Li learned the fine art of rapid response and portability long before entering his first laboratory. A youngster during the Chinese Cultural Revolution, he was only 11 when his family was forced by the government to leave their home in Hefei, the large capital city of the Anhui province, and move some 1,000 kilometers away to the countryside. Li and his family subsisted on wheat, sweet potatoes, and apples grown in their new home.

"To this day I do not like whole-wheat bread," Li says with a smile.

Seizing Opportunities

Hardship had its advantages, Li says. It taught him to seize and appreciate opportunities and to surmount obstacles. It also taught him the value of processing a great deal of information in a short period of time.

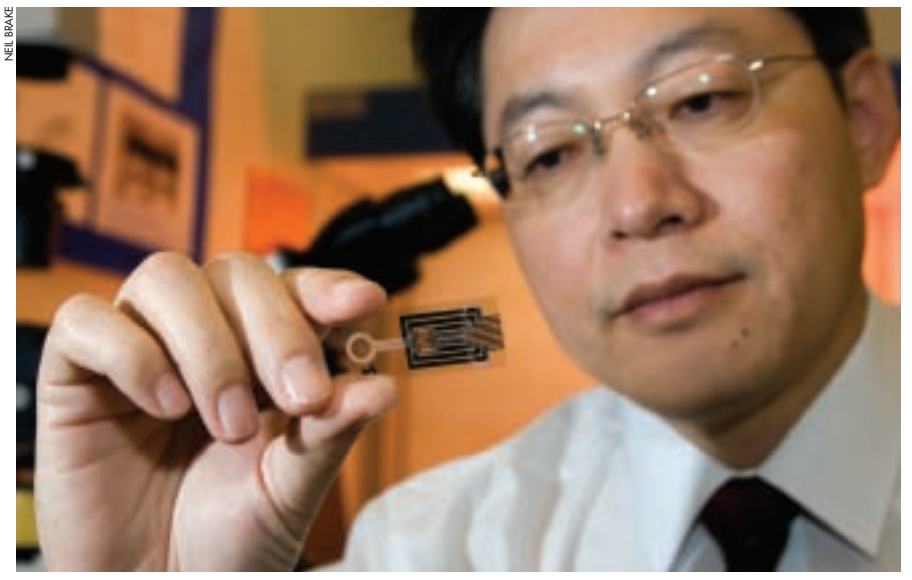
"When the Cultural Revolution ended and we moved back to the city, I was given about six weeks to prepare for an entrance exam to the newly opened university," he says. "The exam covered all high school subjects, and I had not attended school since we moved to the countryside."

Borrowing a review book, Li crammed for the exam. Not only was he admitted to Zhejiang University, but he was assigned to study thermophysics. The fact that he had no choice in what he would study did not disturb Li. He was far too busy feeling lucky. "I felt like I caught the last train out," he says. "I was already 22 years old at that point."

After graduating in 1982, good fortune arrived again two years later in the form of opportunities to take graduate courses abroad. Given permission by the Chinese government to attend a Canadian school, he was accepted by the University of Toronto.

He received his Ph.D. degree in mechanical engineering in 1991 and completed a post-doctoral fellowship at Toronto the next year. He then held faculty positions in mechanical engineering at the University of Victoria and the University of Alberta, where he became a tenured professor. He returned to the University of Toronto as full professor in July 2000.

NEIL BRAKE

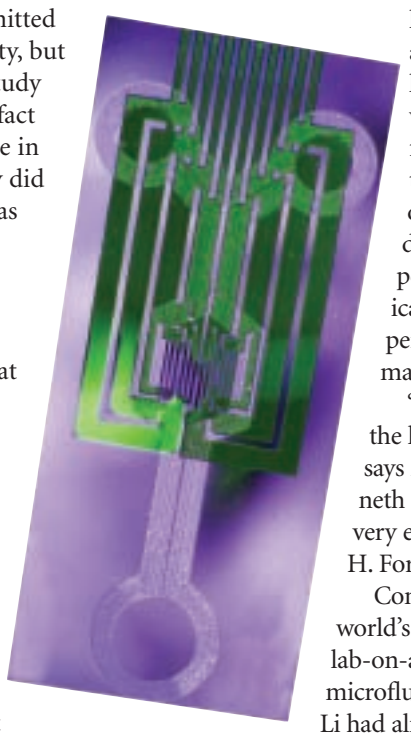


Professor Li is considered one of the world's leading researchers in lab-on-a-chip technology.

Pioneering Work

Freed at last to follow his own research interests in graduate school, Li focused on surface thermodynamics and quickly realized that he was in a good position to contribute to a better understanding of fluid flows in microchannels. These research areas became particularly important in the last few years as lab-on-a-chip technology began to emerge.

"Lab-on-a-chip" technology refers to hand-held devices that are able to quickly analyze DNA and proteins within miniature but fully integrated laboratory systems. These devices can be used directly in the field by police, emergency medical technicians, security personnel, and hazardous materials assessors.



"Dr. Li is a pioneer in the lab-on-a-chip" field," says Engineering Dean Kenneth F. Galloway. "We are very excited to have him as H. Fort Flowers Professor."

Considered one of the world's leading researchers in lab-on-a-chip technology, microfluidics and nanofluidics, Li had already developed many lab-on-a-chip technologies at Toronto before joining Vanderbilt last semester.

"I tell laboratory researchers that if they can give me the details of how they make diagnoses in a full-scale lab, I can miniaturize the process for them," Li says.

Li will develop more of these technologies at Vanderbilt, in addition to conducting fundamental research in fluid behavior at the micro- and nanoscale. One device he is working on will be able to detect bacteria, viruses and cancers by using fluorescence and a miniature laser multiplex system. The instrument will be able to complete tests within 30 minutes, compared with 4-6 hours required by conventional laboratory tests. Another device will be able to separate white blood cells and DNA from a single drop of blood.

A prolific writer and researcher, Li is editor-in-chief of the journal *Microfluidics and Nanofluidics*. He has published one book and more than 155 papers in leading international journals.

Engineer, Inventor, Philanthropist

The H. Fort Flowers Chair in the School of Engineering was created through the contributions of the Flowers family to honor the late H. Fort Flowers, who received a B.E. degree in engineering from Vanderbilt in 1912 and an M.E. degree in 1915. A highly successful engineer, inventor, manufacturer and philanthropist, Flowers invented the side-dumping gondola railroad car for transporting and delivering bulk materials. He founded the Differential Steel Car Company to manufacture these cars which were widely used by railroads, mining operations and steel mills. A man of wide interests, Flowers held more than 80 patents. A former vice president of the Vanderbilt Alumni Association, he was awarded the Distinguished Engineering Alumnus Award in 1975, posthumously.

— Vivian F. Cooper

STEVE GREEN

Steve Lainhart, BE'74

Wanted: Alumni to Help Recruit Engineering Students

As one of its many efforts, the Engineering Alumni Council (EAC) is encouraging engineering alumni to become involved with Vanderbilt at their hometown level through the Alumni Recruitment Committees (ARC).

These locally based ARCs are an established joint venture between the offices of Undergraduate Admissions and Alumni Relations. Their mission is to coordinate alumni efforts to attract and enroll the best possible freshman class each year, personalize the admissions process, convey the Vanderbilt story, and increase the University's visibility to prospective students and the community. Alumni involvement in student recruitment is an excellent match, because alumni know the Vanderbilt experience, can provide a personal element to the process, and can help bring the University to life for a prospective student.

You can become involved in several different ways:

- Participate in college fairs — Pass out information, gather inquiry cards, and share your personal experiences about your time spent at Vanderbilt with prospective students.
- Call local admitted students, congratulating them on their admittance and encouraging them to make a decision to commit to Vanderbilt.
- Attend your local admitted students program in April hosted by local Vanderbilt alumni, Alumni Relations and the admissions office.
- Get involved in the newly established alumni interviewing program to further promote Vanderbilt to prospective students and help admissions to better evaluate the applicant pool.
- Write an alumni letter of recommendation on behalf of a prospective student.

There are ARCs in more than 40 cities currently helping Vanderbilt to strengthen the applicant pool and improve the admitted yield (number of admitted students who enroll). Interested alumni should contact Cami Isaac in the Alumni Relations Office at (615) 343-8385 or *cami.isaac@vanderbilt.edu* to find out the name of the ARC chair in your city and get involved in the process.

The EAC is sure that focused engineering alumni involvement can provide additional recruitment support for the School of Engineering. We hope you will join us in this effort.

— Steve Lainhart, BE'74
EAC Vice-President of Student Recruitment

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Vanderbilt University is committed to principles of equal opportunity and affirmative action.

Faculty Notes

Benoit Dawant, professor of electrical engineering and computer engineering, was recently re-elected chair of the steering committee for the Institute of Electrical and Electronics Engineers (IEEE) *Transactions on Medical Imaging.*

Peter T. Cummings, John R. Hall Professor of Chemical Engineering, has been elected a fellow of the American Physical Society. Each year, no more than half of 1 percent of the APS membership become fellows.

Daniel M. Fleetwood, professor of electrical engineering and chair of the Department of Electrical Engineering and Computer Science, has been elected to the administrative committee of the IEEE Nuclear and Plasma Sciences Society.

Kenneth F. Galloway, dean of the School of Engineering, chaired the 2006 Engineering Deans Council Public Policy Colloquium, held in February in Washington, D.C.

Thomas R. Harris, Orrin H. Ingram Distinguished Professor of Engineering and chair of the Department of Biomedical Engineering, recently presided over the American Institute for Medical and Biological Engineering Annual Event in Washington, D.C. For the past year, Harris has served as president of the organization. He has also been appointed to the 2005 inaugural class of fellows and received a distinguished service award from the Biomedical Engineering Society.

Two other faculty members also were named fellows of the Biomedical Engineering Society: **Paul H. King**, associate professor of biomedical engineering, and **Robert J. Roselli**, professor of biomedical engineering.

Bridget Rogers, associate professor of chemical engineering, has been elected to the American Vacuum Society board of directors.

Richard E. Speece, Centennial Professor of Civil and Environmental Engineering, emeritus, received the 2005 Founders' Award from the Association of Environmental Engineering and Science Professors (AEESP) last October. Professor Speece also delivered the invited keynote address for the AEESP/Water Environment Federation annual meeting.

DANIEL DUBOIS

Assistant Professor Sanchez in her lab

Sanchez receives NSF CAREER Award for nanofiber concrete research

Cast in concrete is not all it's cracked up to be. Concrete structures from bridges to condominium complexes are susceptible to cracks, corrosion, and other forces of natural and man-made chemical assault and degradation. Aging structures can be repaired, but at significant cost.

Florence Sanchez is looking into the tantalizing world of nanoscience for ways to strengthen concrete by adding randomly oriented fibers ranging from nanometers to micrometers in length (a nanometer is one billionth of a meter), and made of carbon, steel or polymers. The assistant professor of civil and environmental engineering has won the prestigious CAREER Award from the National Science Foundation (NSF) for her research on long-term durability of nano-structured cement-based materials *(please see additional article about Sanchez on pp. 4-5).*

The award, given to select junior faculty for their exceptionally promising research, will enable Sanchez and her associates to study the complex chemistry of nanofiber-reinforced cement-based materials and how these new materials will perform over time, in a variety of conditions due to weathering.

"Cement is an ancient material that has been used for centuries, but its chemistry is still not well understood," Sanchez says. "We mix cement with aggregate to create concrete, which we often reinforce with steel rebar. The rebar corrodes over time, leading to significant problems in our transportation and building infrastructure."

Sanchez wants to explore how new materials being developed by the nanoscience community might contribute to solving the problem. Nanofibers made of carbon, for example, might be added to a concrete bridge, making it possible to heat the structure during winter or allowing it to monitor itself for cracks because of the fibers' ability to conduct electricity.

In addition to analyzing the characteristics of the nanofiber-reinforced concrete, Sanchez will give students the opportunity to participate in the research.

— Vivian F. Cooper

Bend It Like Buckyballs?

Soccer-ball-shaped "buckyballs" are the most famous players on the nanoscale field, presenting tantalizing prospects of revolutionizing medicine and the computer industry. Since their discovery in 1985, engineers and scientists have been exploring the properties of these molecules for a wide range of applications and innovations.

But could these microscopic spheres represent a potential environmental hazard?

A new study published in December 2005 in *Biophysical Journal* struck a cautionary note regarding the safety of buckyballs when dissolved in water. It reports the results of a detailed computer simulation that finds buckyballs bind to the spirals in DNA molecules in an aqueous environment, causing the DNA to deform, potentially interfering with its biological functions and possibly causing long-term negative side effects in people and other living organisms.

The research, conducted at Vanderbilt by chemical engineers Peter T. Cummings and Alberto Striolo (now a faculty member at the University of Oklahoma), along with Oak Ridge National Laboratory scientist Xiongce Zhao, employed molecular dynamics simulations to investigate the question of whether buckyballs would bind to DNA and, if so, might inflict any lasting damage.

"Safe is a difficult word to define, since few substances that can be ingested into the human body are completely safe," points out Cummings, who is the John R. Hall Professor of Chemical Engineering and director of the Nanomaterials Theory Institute in the Center for Nanophase Materials Sciences at Oak Ridge National Laboratory.

DANIEL DUBOIS

Professor Cummings' simulations suggest buckyballs might damage DNA.

"Even common table salt, if eaten in sufficient quantity, is lethal. What we are doing is looking at the mechanisms of interaction between buckyballs and DNA; we don't know yet what actually happens in the body," he says.

Surprising findings

Despite the caveat, Cummings suggests that his research reveals a potentially serious problem: "Buckyballs have a potentially adverse effect on the structure, stability and biological functions of DNA molecules."

The findings came as something of a surprise, despite earlier studies that have shown buckyballs to be toxic to cells unless coated and to be able to find their way into the brains of fish. Before these cautionary discoveries, researchers thought that the combination of buckyballs' dislike of water and their affinity for each other would cause them to clump together and sink to the bottom of a pool, lake, stream or other aqueous environment. As a result, researchers thought they should not cause a significant environmental problem.

Cummings' team found that, depending on the form the DNA takes, the 60-carbon-atom (C_{60}) buckyball molecule can lodge in the end of a DNA molecule and break apart important hydrogen bonds within the double helix. They can also stick to the minor grooves on the outside of DNA, causing the DNA molecule to bend significantly to one side. Damage to the DNA molecule is even more pronounced when the molecule is split into two helices, as it does when cells are dividing or when the genes are being accessed to produce proteins needed by the cell.

"The binding energy between DNA and buckyballs is quite strong," Cummings says. "We found that the energies were comparable to the binding energies of a drug to receptors in cells."

It turns out that buckyballs have a stronger affinity for DNA than they do for themselves. "This research shows that if buckyballs can get into the nucleus, they can bind to DNA," Cummings says. "If the DNA is damaged, it can be inhibited from self-repairing."

More research needed

What the researchers don't know is whether these worrisome binding events will take place in the body. "Earlier studies have shown that buckyballs can migrate into tissue," Cummings says.

"We don't know whether they can penetrate a cell nucleus and reach the DNA stored there. What this study shows is that if the buckyballs can get into the nucleus they could cause real problems. What are needed now are experimental and theoretical studies to demonstrate whether they can actually get there. Because the toxicity of nanomaterials like buckyballs is not well known at this point, they are regarded in the laboratory as potentially very hazardous, and treated accordingly."

—Vivian F. Cooper

Brain morphing helps Parkinson's patients

Tens of thousands of people who experience movement disorders associated with Parkinson's and a variety of other neurological conditions stand to benefit from a new guidance system that uses computerized brain-mapping techniques to significantly improve an increasingly popular procedure called deep brain stimulation (DBS).

DBS has proven to be highly effective in the treatment of movement disorders when standard drug therapies either do not work or have lost their effectiveness. However, the fact that it is an extremely long, difficult and expensive operation, which involves implanting electrodes deep in the brain, has limited its availability.

To improve the procedure, a team of Vanderbilt electrical engineers and neuroscientists has developed a pilot guidance system that automates the most challenging part of the operation: identifying the proper location to insert the electrodes. To work, the electrodes must pass through small nuclei deep in the brain that are about the size of a pea and are not visible in brain scans or to the naked eye. The researchers — writing in a special issue of the journal *IEEE Transactions on Medical Imaging* published in November 2005 — report that the new system can do a better job of identifying the initial location to insert the electrodes than an experienced neurosurgeon.

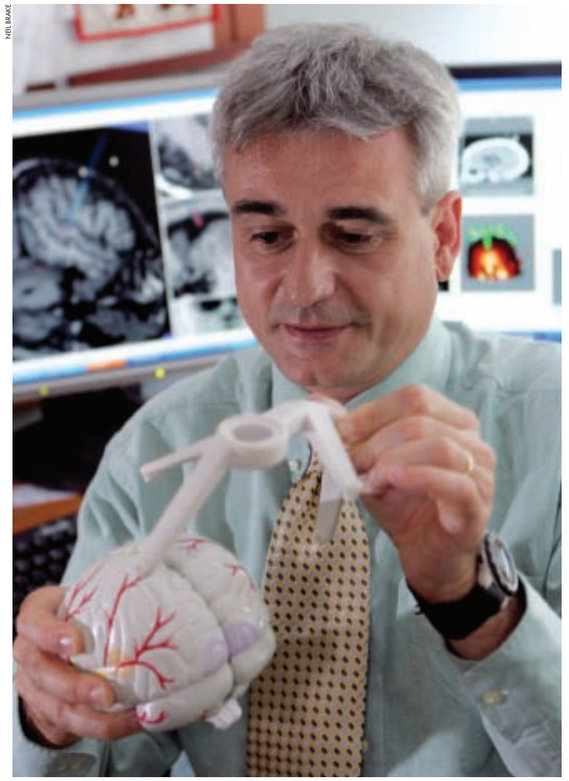
"The biggest problem with the procedure is that the surgeons cannot see the structure where they have to put the electrode and, as a result, they must spend a considerable amount of time searching for it," says Benoit Dawant, professor of electrical engineering, computer engineering and radiological sciences. Dawant is developing the guidance system in collaboration with Peter Konrad, associate professor of neurological surgery and biomedical engineering.

The computer-aided guidance system consists of a three-dimensional brain atlas that was built up by combining the brain scans of 21 postoperative DBS patients into one another using sophisticated computer-mapping methods. To predict the location of the target area in a new patient, the researchers map the reference atlas onto the patient's brain scan. When the neurosurgeons have used the system's predictions, they have hit the target area on the first insertion two out of three times, compared with one out of five times when working without it.

According to Konrad, this innovation has reduced the length of the operation from two days down to five hours.

Not only does the guidance system save the patient from the risk of a prolonged procedure or undergoing two procedures, it also should cut hospital costs significantly, Konrad adds.

— David F. Salisbury



NEIL BRAKE

Professor Dawant and colleagues have developed a computer-aided guidance system that significantly improves surgery for patients with movement disorders.

Cleaning Up Coal

Scientists and policymakers might debate the existence and causes of "global warming," but no one debates the need for clean air or the desirability of cleaning up emissions from coal-fired power plants.

Vanderbilt researchers David Kosson and Florence Sanchez want to make sure that new technology designed to remove mercury from power-plant emissions doesn't create an unintended byproduct of polluted ground water (please see photo and additional story about Sanchez on page 2).

The problem they're wrestling with is that taking pollutants out of the power plant smoke produces contaminants concentrated in the ash and other solid residues that have to be properly managed so they don't end up in our drinking water or in fish. Solving one problem can create another.

Kosson, professor and chair of civil and environmental engineering, and Sanchez, an assistant professor in the same department, have been collecting data to help the U.S. Environmental Protection Agency (EPA) regulate power-plant mercury-emissions control in ways that will protect human health at every stage of the process, from power production to waste disposal. The EPA issued its final Clean Air Mercury Rule on March 15, 2005, which the agency estimates will result in the reduction of mercury emissions from coal-fired plants by nearly 70 percent per year by 2018.

Indeed, the technology exists that can accomplish this feat. But Congress asked the EPA to research whether the mercury extraction technology might adversely impact groundwater, streams and rivers. Kosson and Sanchez were asked to provide technical management of this research in conjunction with ARCADIS, Inc, a contractor for the EPA Office of Research and Development.

The researchers found that doing a better job of removing mercury from smoke is not likely to result in dangerous releases of mercury into the groundwater after waste disposal. But there may be difficulties with arsenic and selenium.

"Leaching" is the action of a liquid passed over and through a solid. Kosson likes to use drip coffee as an example of a leaching process.

Research Assistant Professor Andrew Garrabrants worked with Professors Kosson and Sanchez to develop a leaching protocol which provides a powerful and adaptable tool for power engineers and environmental engineers.

Surprising Results

Arsenic is one of our most notorious toxins. However it takes a concentrated amount to have a deleterious effect on health, and most of us have trace amounts of arsenic in our bodies. Selenium, a highly beneficial mineral in small amounts, is poisonous in larger concentrations.

The arsenic and selenium results in the research were a bit surprising, Kosson says, and will require additional research.

He and Sanchez studied coal combustion residues from selected power plant facilities that use new mercury emissions reduction equipment, subjecting them to a series of tests to get a good sense of how much mercury and other contaminants might leach out into groundwater.

"What we found was that mercury concentrations remained below the mercury drinking water maximum contaminant level, but the arsenic and selenium concentrations present the potential for adverse environmental impacts with and without the new controls" he says.

The good news is that Kosson and Sanchez also found, much to their satisfaction, that the testing series and interpretation software they have developed to evaluate and predict how contaminants will behave under various environmental and waste-management scenarios is as valid as they had hoped it would be.

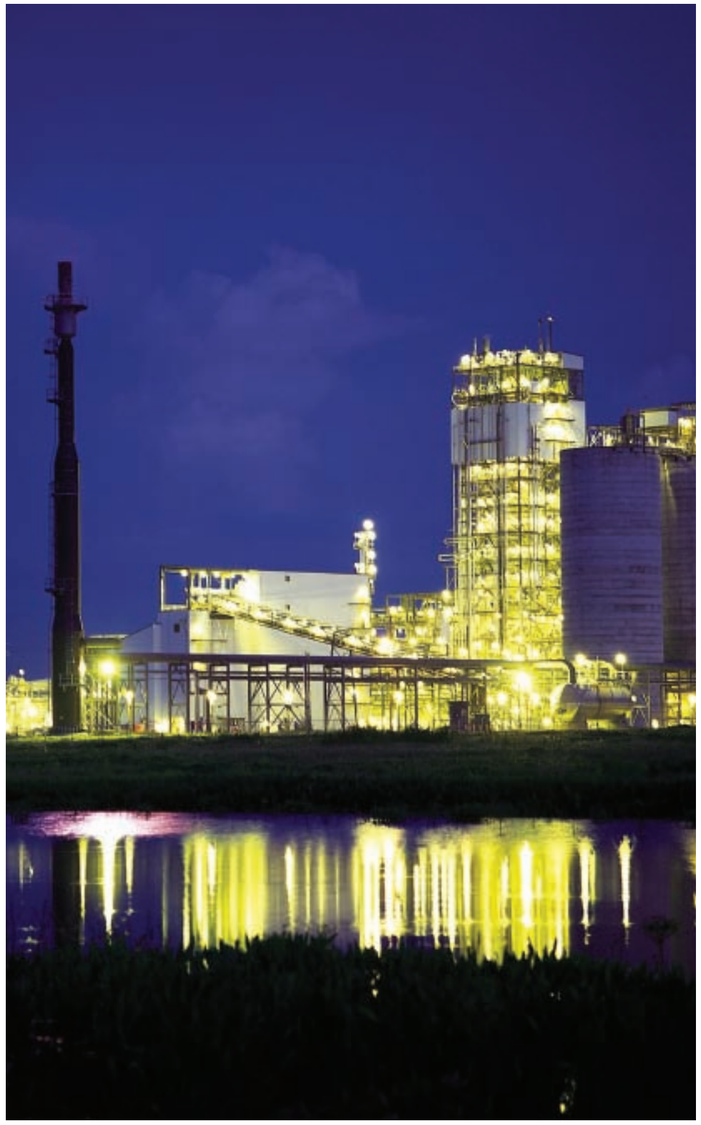
"The protocol is very solid," Kosson says with a smile.

Napkins and Coffee Grounds

Kosson and Sanchez have reason to be proud. The leaching protocol they developed, along with Vanderbilt colleague Andrew Garrabrants and H.A. van der Sloot of the Netherlands Energy Research Foundation, is a powerful, highly adaptable tool for power engineers and environmental engineers.

"The protocol considers the range of known coal combustion residue chemistry and management conditions," Kosson says. "The method also permits development of data that are comparable across U.S. coal and residue types. The approach has also been demonstrated to be applicable for evaluating potential environmental impacts from a wide range of solid materials for beneficial use and disposal."

Published in *Environmental Engineering Science 2002*, the protocol had its beginnings in the 1980s, when Kosson was on the faculty at Rutgers and was trying to help the state of New Jersey figure out what to do with solid waste residue after incineration. Kosson happened to meet van der Sloot during a conference in Europe, and they discovered they had similar frustrations with the existing frameworks for assessing leaching.



A nighttime view of a large coal-gasification plant. Vanderbilt researchers are studying coal-combustion residues to help the Environmental Protection Agency regulate power-plant emissions in ways that will protect human health.

"Leaching" is the action of a liquid passed over and through a solid. Kosson likes to use drip coffee as an example of a leaching process.

Leaching is a very important thing to consider when planning what to do with wastes, because most waste disposal properties, such as landfills and impoundment ponds, are subjected to rain. The amount of rain water will vary from place to place and from day to day, which is one reason why predicting how much pollutant might leach out from the waste can get a little tricky.

Another factor complicating the prediction process is the wide variety of pH levels in the disposal site soils and in the waste material itself. The degree of acidity or alkalinity affects the rate of leaching and hence the amount of contaminant released.

Add those difficulties to the variations in waste management techniques and blending of materials, and it gets, well, messy.

Kosson and van der Sloot put their heads together to design a more comprehensive and adaptable protocol than the traditional method. "A lot of the initial design work was sketched out on napkins while riding the train to and from Washington, D.C.," Kosson says.

Their idea was to determine the intrinsic leaching properties of contaminants of interest and to develop computer simulation models that use the intrinsic properties to predict contaminant behavior under various conditions in the field. The traditional protocol attempted to mimic conditions in the field, which basically required "reinventing the wheel" for each facility. The new protocol is based on intrinsic data and known dynamics, and variations from site to site are accounted for using the simulation modeling.

"The leaching protocol we developed, and continue to refine, is based on characterizing fundamental parameters of leaching dynamics of contaminants and then modeling them to predict outcomes in different field scenarios," Kosson says.

As part of this project, Kosson and Sanchez ran tests to check the validity of their protocol in predicting actual results in the field.

"The Leaching Framework was able to fully satisfy our quality assurance and quality control requirements," Sanchez says.

Mercury rising

The protocol, which is being adopted in Europe and is being used by the EPA in several situations, can be employed in a variety of industrial and public utility situations. Kosson and his associates have been working with the agency to replace the traditional method with the new protocol, so this summer's research that validates the approach represents a welcome milestone.

This summer's research teamed Vanderbilt with ARCADIS of Durham, N.C., to sample fly ash and sludge from power plants to test the waste for mercury, lead, cadmium, selenium, arsenic and other pollutants.

The team ran a battery of tests of sample fly ash produced both with and without new mercury emissions control technology. Tests included assessments of alkalinity, solubility and release as a function of pH; solubility and release as a function of the liquid-to-solid ratio; electrical conductivity; surface area and pore size distribution; carbon content; moisture content; mercury content; and content of other metals. These and other tests gave the researchers the raw data they needed to feed into software models that can give a comprehensive analysis and prediction of contaminant behavior across a range of waste management and environmental conditions.

"We found that leaching of arsenic may be of concern for some land disposal scenarios, independent of whether activated carbon injection is in use," Kosson says. Activated carbon injection is the new technology used to reduce mercury and other contaminant emissions.

"We also found that leaching of selenium may be a concern for some facilities using activated carbon injection," Sanchez says.

Future research will delve further into the problematic areas and will examine wastes produced by other types of coal-fired power plant facilities, using other types of coal.

—Vivian F. Cooper

The researchers found that doing a better job of removing mercury from smoke is not likely to result in dangerous releases of mercury into the groundwater after waste disposal. But there may be difficulties with arsenic and selenium.

Professor David Kosson is working with Assistant Professor Florence Sanchez to determine whether mercury, arsenic and selenium are leaching into the groundwater from new emission-control technology for coal-fired power plants.

Monitoring Mercury

The EPA announced its intention to require reduction of mercury and other contaminant emissions from coal-fired power plants in December 2000. Reduction of mercury emissions was a primary goal of the new regulations to be developed.

Mercury, as an element and as part of various compounds, has known adverse health effects, particularly on neurological development. Most people in the U.S. are exposed to mercury through eating fish and shellfish containing methylmercury.

Mercury is one of the metals in coal that do not burn and are released as coal combustion residues. Coal-fired utilities produce approximately 105 million tons of coal combustion residues per year. The some 1,250 coal-fired power plants in the U.S. provide more than half of all electrical power generated in the U.S.

Coal combustion constituents that do not remain in the bottom of the boiler are released in fly ash or are removed by a wet scrubbing process using sulfur dioxide. Some 68 million tons of fly ash were produced in 2001.

Flying High

Senior mechanical engineering student Andrew Zachar started down the road to becoming a test pilot when he received his first remote-control airplane at age nine. At 17 he signed up for flying lessons near his Chicago home, earning his pilot's license before his 18th birthday.

While at Vanderbilt, Zachar took elective courses in aerospace propulsion and airplane aerodynamics taught by Professor Amrutur Anilkumar as part of his mechanical engineering curriculum. Last summer, Zachar obtained an internship with Cessna, working in the flight test engineering department on the company's new, very light business jet, the Cessna Citation Mustang. After graduation in May, Zachar will join the company as a flight test engineer, on track to become a test pilot in a couple of years.

"Flight test engineers design, oversee and analyze the tests needed for development and certification of the aircraft," Zachar says. His advice to younger engineering students: "Find something you're passionate about, that makes you want to go to work everyday." The Mustang is pictured at right.

PHOTO COURTESY OF CESSNA

DAVID CRENSHAW

Dean Kenneth Galloway, left, presented Joe M. Dorris, BE'65, with the Dean's Distinguished Service Award during Reunion 2005. Dorris was honored for his support of the school's Formula racecar team.

Valued COV Member Dies

Michael Irvine Mott, a member of the School of Engineering's Committee of Visitors, passed away on November 19, 2005, following a battle with cancer. A Marine aviator, test pilot and Boeing aerospace executive, he received a bachelor's degree in engineering science from Vanderbilt in 1971 and an M.S. from the University of Southern California in 1981.

Michael Mott, BE'71

A winner of the Distinguished Eagle Scout Award, he was a graduate of Battle Ground Academy in Franklin, Tenn. He served in the U.S. Marine Corps for 20 years, retiring in 1991. After graduating from the Naval Test Pilot School, he flew or participated in 89 major test projects. Following his military career, he became associate deputy administrator for NASA. He then served as vice president and general manager of NASA systems for Boeing Aerospace and was responsible for the strategic direction of Boeing's civil space programs.

He is survived by his wife, Kathy; son, Michael Irvine Mott Jr., a 2003 graduate of the School of Engineering; daughter, Ashley; mother, Edith W. Mott, PB'46; and brother, William R. Mott, MLS'78, PhD'80.

Survive and Thrive in Engineering School

Last fall, the School of Engineering co-sponsored with the Bishop Joseph Johnson Black Cultural Center a Distinguished Black Alumni Talk by Tamara Baynham, senior research scientist with Guidant Corporation.

Baynham

In her talk, "Survive and Thrive in Engineering School: Success Through Community," Baynham discussed what faculty, alumni and minority students can do to ensure their success in obtaining an engineering education. She encouraged students to take advantage of undergraduate research opportunities and urged minority alumni to participate in an e-mentoring program with current students.

A native of Charlotte, Tenn., Baynham earned a B.E. degree from Vanderbilt in 1993, with a double major in biomedical and electrical engineering. She went on to earn M.S. and Ph.D. degrees in biomedical engineering from the University of Alabama, Birmingham, in 1997 and 2000, respectively.

Prior to joining Guidant, Baynham was a postdoctoral fellow at the University of Georgia. She has held faculty positions at Georgia and SUNY Downstate Medical Center in Brooklyn, N.Y.

The author of several peer-reviewed articles in biomedical research journals and a chapter in *Quantitative Cardiac Electrophysiology*, Baynham also has six patents pending in the area of cardiovascular device therapies.

Elliott New, BE'86, center, and his blues band, Elliott & the Untouchables, recently released a CD, "Voodoo Stew," on BluePoint Records. In addition to being a recording engineer/producer, Elliott puts his engineering education to good use as an engineering manager with Intel in Columbia, S.C. Alumni can check out the band at www.ElliottAndTheUntouchables.com.

MARK JACQUE

World traveler credits Vanderbilt for career success

Every time Jim Johnson leaves his Houston home for the airport, he's able to revisit the scene of some of his most fulfilling professional achievements. And it doesn't matter from which of Houston's two major airports he's flying. As an engineer, Johnson, BE'63, PhD'72, has been involved with renovations and upgrades at both William P. Hobby and Houston Intercontinental. But then, he was used to spending a lot of time around airports — especially when he was working in the Middle East.

In the early 1970s, oil-rich countries had a lot of money to spend, primarily on development, says Johnson. When his former firm, Turner Collie & Braden, Inc., set up shop in the Middle East, Johnson moved his family from Houston to Athens, Greece.

"Athens was a very pleasant place to live," he says. "Although I was traveling about 80 percent of the time, my wife, Karen, and children, Scot and Shelley, could travel to and enjoy all the historic sights and culture in Greece." Scot, BA'92, MBA'94, is also a Vanderbilt alumnus.

While his family was enjoying the local culture, Johnson was working on various projects, including managing the design of housing, community support facilities and infrastructure associated with three community development projects in Kuwait. Johnson's work also took him to Saudi Arabia, where he served as project manager for the expansion of several towns for Aramco, Saudi's national oil company. He was also project manager for the development of infrastructure for the new Jubail Industrial City.

TIGH COWAN PHOTOGRAPHY

Among the photographs that grace Jim Johnson's Houston office is one of Chancellor Gordon Gee (at Johnson's immediate left).

In 1989, Johnson joined Kellogg Brown and Root, Inc. (KBR). He is presently director of program management for the Americas. Over the years, his job has evolved from hands on engineering and project management to marketing and business development.

Today KBR is involved in the hurricane relief effort on the Gulf Coast, helping Navy installations in Mississippi and Louisiana return to fully operational status and repairing levees and flood control pump stations.

Like many engineers, Johnson spent his childhood digging and building and figuring out exactly how things work. After earning his bachelor's degree from Vanderbilt and master's degree from the University of Illinois, he fulfilled his ROTC obligation with tours in Latin America and Vietnam. Then it was time to figure out his next step.

"I'd grown up around attorneys and thought that maybe I'd do that," he says. "But then I decided that I'd make a much better engineer than attorney." So it was back to Vanderbilt for his Ph.D. in civil engineering, a decision he has never regretted. This spring, Johnson will be inducted into the School of Engineering's Academy of Distinguished Alumni.

"To me, the thing that Vanderbilt does better than most other engineering schools is achieve a nice balance between a good engineering education and a good liberal arts education," he says.

These days, scientific and mathematical expertise isn't the only requirement for a successful career in engineering. "Regardless of which path you take in our business, whether you go down a technical path or a management one, your communication skills end up being a real differentiator. When we look at prospective employees or people we're trying to develop, those that offer the most promise are the ones with good communication skills," he adds.

Even though Johnson's career has taken him around the world and back again, he credits Vanderbilt — and the mentors and professors who helped him out along the way — with giving him the foundation he needed to succeed.

— Cindy Thomsen

Introducing Engineering Alumni Council Officers

The Vanderbilt Engineering Alumni Council (EAC) is working in various ways to further the development and educational purposes of the School of Engineering while promoting a mutually beneficial relationship between the school and its faculty, staff, students and alumni. The following EAC officers began their term of office in October 2005:

President Janice Miller Greenberg, BS'80 (engineering science), is the founding principal of the Inform Group, a technical marketing and communications services organization based in Longmeadow, Mass. Prior to founding InFORM in 1988, she held various positions in corporate communications, technical sales and marketing with ALCOA, Emerson Electric Divisions and Telco Research/NYNEX. An active community volunteer, she has been a member of the EAC since 1997 and currently serves on the *Vanderbilt Magazine* advisory board.

Secretary William "Bill" Bond, BS'74 (computer science), is director of membership operations for Environmental Defense in Washington, D.C. After graduating from Vanderbilt, Bond earned an M.B.A in finance from Indiana University. He has worked in various software development, marketing and fundraising positions for American Express, Epsilon Data Management, Target Software, and the Smithsonian Institution. He also co-founded Master Software Corporation, which was acquired by Epsilon in 1987.

Stephen Lainhart, BE'74 (mechanical engineering), is vice-president for student recruitment (please see related article, page 2). Lainhart has been with Thompson Power, a Caterpillar engine distributor, for 15 years and has served as its general manager for the last seven. He has also been an adjunct faculty member at the School of Engineering. Lainhart lives in Franklin, Tenn.

Ronald Lewis, BE'93 (chemical engineering), is vice-president of career and corporate relations. After earning a master's degree in management in 2003 from Fontbonne University, Lewis became an assistant brand manager for Nestlé Purina Pet Care Company in St. Louis, Mo. Prior to joining Nestlé Purina in 1997 as a scientist, he worked as a product development engineer for Procter & Gamble Company in its health care division.

Kent Shalibo, BE'63, ME'67 (civil engineering), is vice-president with responsibility for development and the Lewis Society. After receiving his B.E. degree, Shalibo worked as a public health engineer with TVA's division of health and safety. He returned to Vanderbilt to earn a master's degree in environmental/water resource management, then spent 25 years in various sales and marketing positions with Pfizer Inc. In 1992, he left Pfizer to start his own company, KLS Specialty Products, which distributes specialty chemicals throughout the U.S. Shalibo lives in Toccoa, Ga., and Hilton Head, S.C.

Erika Brown Wagner, BE'00 (biomedical engineering), is a Ph.D. student in the Harvard/M.I.T Division of Health Sciences and Technology in Cambridge, Mass. Originally from Marietta, Georgia, she earned her master's degree in aeronautics and astronautics from M.I.T. For the past four years, Wagner has served as science director for the Mars Gravity Biosatellite Program, an effort to design a new space research platform to study the medical effects of reduced gravity, such as will be experienced on the surface of Mars. In her role as EAC vice-president of student interaction, she hopes to strengthen the ties between current engineering students and alumni through mentoring programs and other collaborative activities.

Alumni interested in serving on the EAC should contact Bill Bond at *bbond@environmentaldefense.org* .

STEVE GREEN

EAC officers, left to right: Steve Lainhart, Erika Brown Wagner, Ron Lewis, Bill Bond, Janice Miller Greenberg and Kent Shalibo.

Master of the Game

International chess champion Dan Fleetwood sees parallels between his serious hobby and his profession.

"In chess, as in science and engineering, you need to be able to break problems down into parts and look for patterns," says the professor of electrical engineering and chair of the Department of Electrical Engineering and Computer Science (EECS). "Chess provides good training in critical thinking, logic, strategy and tactics."

Fleetwood recently finished eighth in the 18th World Correspondence Chess Championship, and first place on board three of the 14th World Correspondence Chess Olympics. The latter takes him halfway to a coveted grandmaster title; there are only six correspondence chess grandmasters in the U.S. Since he plays by email in the evenings and on weekends, "An average game usually lasts one to two years," he says.

Growing up, Fleetwood was used to long days of hard work at his parents' small grocery and 265-acre farm near Seymour, Indiana — a place that inspired John Mellencamp's song, "Small Town." Today, Fleetwood's name graces his high school's Wall of Fame along with fellow alumnus Mellencamp.

Fleetwood says he took up serious chess "relatively late" during his senior year in high school, "when I hung up my spikes." A baseball pitcher with a perfect game to his credit, he idolized Hank Aaron and still pulls for the Atlanta Braves.

After receiving his Ph.D. from Purdue University in 1984, Fleetwood joined Sandia National Laboratories in Albuquerque, New Mexico. While there, he worked for 15 years on radiation effects on microelectronics for space and defense applications.

In 1999, Fleetwood joined the Vanderbilt faculty as professor of electrical engineering. He served as associate dean for research from 2001-2003, and became chair of EECS in 2003.

When speaking of his research, he notes that "Vanderbilt has the top academic research program on radiation effects on microelectronics in the United States and probably in the world." Fleetwood is the author of nearly 300 journal articles in this area and has received numerous research awards during his career.

He and his wife, Betsy, a past president of the Vanderbilt Woman's Club, have three sons — one a sophomore in the College of Arts and Science. Fleetwood says his greatest challenge is "balancing department chair duties with the demands of our research programs, teaching and having a real life."

"EECS is a big department, relative to others at Vanderbilt," he says. "We have 35 tenure-track faculty, two large research institutes — ISIS (the Institute for Software Integrated Systems) and ISDE (the Institute for Space and Defense Electronics) — and the largest graduate program at Vanderbilt, with 175 students. We have about as much sponsored research as physics and chemistry combined. Keeping on top of everything is a challenge."

When it comes to meeting challenges, this chess champion is a master.

— *Joanne Beckham*

DANIEL DUBOIS

Professor Dan Fleetwood is playing for the United States in the 15th International Correspondence Chess Olympics.

E.WEEK

In a series of challenging but fun competitions, Vanderbilt engineering students displayed their ingenuity and inventiveness while celebrating National Engineers Week, February 20-25, 2006.

Building a tower out of marshmallows and spaghetti are Monica Yang, left, Trey Levie, and Courtney Zeiders. Other activities included

- Fastest Geek Competition: Participants raced to assemble a computer, with the winner receiving a free Dell computer and the runner-up, a PDA.
- Potato Gun Competition: Students built potato guns out of supplied parts and competed to see whose gun could propel potatoes farthest and most accurately.
- Egg Drop Event: Winners in this competition fashioned protective coverings for raw eggs from FedEx boxes, then dropped the packages from a three-story building, accurately hitting the target below without breaking the eggs.

In addition to showcasing the engineering field, the competitions and activities were designed to interest students in engineering and science. All events were open to the public.

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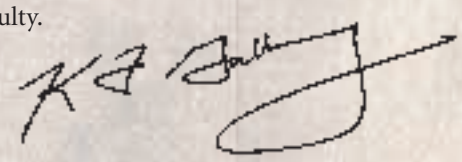
2004-2005

Today, an ever-increasing number of eager, bright young men and women who are considering an engineering degree can now consider Vanderbilt. Our alumni, parents and friends have all played a vital role in this positive development. Many of the School of Engineering's most dedicated supporters are members of the Fred J. Lewis Society. Established 30 years ago, the Lewis Society honors the legacy of Dean Fred J. Lewis. Under his leadership from 1933 to 1959 the school enjoyed a great upsurge in enrollment, an expansion of facilities and, of paramount importance, a strengthening of academic programs. Membership in the Lewis Society is a gesture of affirmation of all that Dean Lewis accomplished and an investment in the School of Engineering's continued success.

In the fiscal year 2004-2005, Lewis Society members' generosity to the School of Engineering exceeded $4,291,000. A portion of this largesse is earmarked for financial aid and scholarship support — funds that will make a Vanderbilt engineering degree a reality for many well-deserving students.

With further support, we will continue the good work started so many years ago by Dean Lewis. I am grateful to all of those who have chosen to invest in the future of the School of Engineering, our students, and our faculty.



Kenneth F. Galloway
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Join the Lewis Society

Lewis Society members have a profound impact on the School of Engineering. To join now or find out more, call Emily Borders in Engineering's Development and Alumni Relations office at (615) 322-4934. Or you can join online anytime at www3.vanderbilt.edu/giving/giftform.html.

Each Lewis Society member is recognized for an annual gift of $1,000 or more, or a five-year pledge of $5,000 or more. For young alumni who graduated between 1996 and 2005, Lewis Society membership and recognition is for an annual gift of $500 or more, or a five-year pledge of $2,500 or more.

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Introducing the Academy of Distinguished Alumni

At the School of Engineering, we've always believed in recognizing our most accomplished alumni. When our alumni succeed, the School of Engineering and Vanderbilt succeed. In the past, we've recognized an outstanding graduate each year with our Distinguished Alumnus Award. Now, to give these alumni — past and future — even greater recognition, we're inaugurating the School of Engineering Academy of Distinguished Alumni.

All past recipients of the Distinguished Alumnus Award will now be recognized as founding members of the Academy. They will be joined by new inductees every year. Future honorees will be selected by a committee comprised of representatives from the Executive Committee of the Engineering Alumni Council, the faculty of the School of Engineering and the Office of Development and Alumni Relations.

Save the Date

This year's awards banquet will coincide with Reunion/ Homecoming activities. Mark your calendars for Thursday, October 19, 2006, to learn about the newest members of our Academy of Distinguished Alumni.