University of Houston Cullen College of Engineering

[ParamETErs]

Spring 2006

Bionanotechnology:
The Edge of Detection

D E A N ' S   M E S S A G E

The old adage that change is the only constant has been proven true again and again at the UH Cullen College of Engineering. Over the past several months and years, the college has undertaken many changes, all in an effort to bring ourselves to new levels of excellence.

In research and resources, we are responding to the demands of industry and prospective students. While our established programs remain important to the college and community, we are encountering increased interest in programs that revolve around fields of growing importance and prominence, including petroleum engineering and nanotechnology. One of my goals over the coming months and years will be to adjust our offerings to meet these demands.

Fortunately, there are many individuals within the college who already have the expertise in these areas. In this issue of *Parameters*, in fact, you can read about some of the efforts of faculty members in the emerging field of bionanotechnology. The research performed by Richard Willson, Kirill Larin and Peter Vekilov, among others, could radically alter the way in which diseases are detected and diagnosed in the human body.

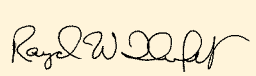
The makeup of the college's faculty has changed, as well, growing significantly younger in recent years. In fact, about one-third of our faculty members joined the college within the last six years, for the most part replacing faculty who retired or left for other reasons. One of these individuals is Pradeep Sharma, assistant professor of mechanical engineering, whose theoretical research in the field of quantum dots is profiled in this issue. By adding outstanding young faculty like Sharma, the college has taken an important step in ensuring its continued excellence for years to come.

In addition to the faculty, the college is in the process of updating its infrastructure. The old Y-building was put up as a temporary structure more than 60 years ago and is well past its prime. I'm happy to report that we have contracted an architect to design plans for a new engineering building to be located in the Y-building's place. This new facility will offer students and professors the most modern laboratories and classrooms available and will serve as home for the college's many student organizations.

Of course having plans for a new building and having the means to make that building a reality are two distinct things. To that end, we are in the process of establishing a leadership committee to oversee the fundraising efforts for the construction of this new facility. I'd ask that you keep this in mind as you consider your charitable gifts over the coming months.

Finally, I want to note one change that leaves us with a little less than we had before. Frank Tiller, the first dean of the Cullen College of Engineering, passed away earlier this year at the age of 88. He was instrumental in establishing the conditions for the college's future successes, including greatly upgrading the faculty's education levels and raising funds for the college's first permanent building. He'll be most missed for the impact he had on those who worked with him, though. When I was just an assistant professor at UH, Frank served as an unofficial mentor to me, giving generously of his time and wisdom, and I know he filled the same role for many other faculty members and students over the years. He was a pillar of this college and he will be deeply missed.

Sincerely,



Raymond W. Flumerfelt, *Dean*
Elizabeth D. Rockwell Endowed Chair

pa·ram·e·ter
Pronunciation: pə-'ram-ə-tər
Function: noun
Etymology: New Latin, from para- + Greek metron measure
Date: 1656

1: *a.* an arbitrary constant whose value characterizes a member of a system (as a family of curves); also: a quantity (as a mean or variance) that describes a statistical population
b. an independent variable used to express the coordinates of a variable point and functions of them — compare PARAMETRIC EQUATION

2: any of a set of physical properties whose values determine the characteristics or behavior of something <parameters of the atmosphere such as temperature, pressure and density>

3: something represented by a parameter: a characteristic element; broadly: CHARACTERISTIC, ELEMENT, FACTOR <political dissent as a parameter of modern life>

4: LIMIT, BOUNDARY — usually used in plural <the parameters of science fiction>

C O N T E N T S

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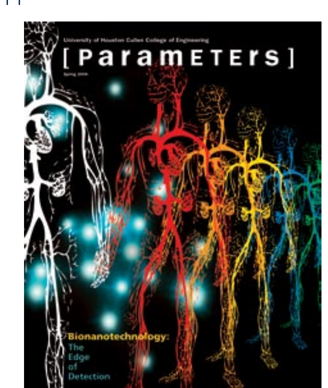


BIONANOTECHNOLOGY: THE EDGE OF DETECTION
Researchers at the University of Houston Cullen College of Engineering are on the edge of achieving several technological advancements that will revolutionize the world of bionanotechnology. Until cures for diseases are found, such technologies will allow dangerous pathogens within the human body to be detected on the molecular level, often before disease symptoms develop. The ability for these nanodevices to alert individuals to emerging health dangers will give doctors the opportunity to treat illnesses long before they become life threatening.

UH Professor, Graduate Student Make Strides in Diabetes Research

Researchers at the University of Houston Cullen College of Engineering have made a major discovery in the field of diabetes research that is also an historic find in the area crystal formation and use.

Peter Vekilov, associate professor of chemical engineering, and doctoral candidate Dimitra Georgiou (2003 MSChE), discovered a new mechanism for the formation of insulin crystals in the pancreas.

While the finding will play a significant role in gaining a better understanding of diabetes, it is also only the third mechanism of crystal formation ever discovered. The finding is significant enough, in fact, to have been showcased on the cover of the Feb. 7, 2006 issue of *Proceedings of the National Academy of Sciences*, one of the world's leading scientific journals.

Since insufficient insulin production in the pancreas is one of the primary causes of adult-onset diabetes, Vekilov and Georgiou are studying the process of how insulin is produced. Understanding how the body creates this hormone, Vekilov said, will make it easier for researchers to discover why some individuals do not produce enough insulin and thus develop diabetes.

Specifically, the two have focused on the creation of insulin crystals, the form in which insulin is stored in the pancreas before it is released in the bloodstream.

"It is possible that the insulin deficiency happens when the crystals don't form properly and then part of the insulin that is produced gets destroyed," Vekilov said.

It has long been known that proinsulin, a molecular precursor to insulin itself, is the basis of these crystals. After an insulin molecule is produced from proinsulin, it attaches to an insulin crystal only in special locations where other insulin molecules have formed right angles, called kinks.

Using atomic force microscopy, Vekilov and Georgiou discovered a new mechanism by which insulin molecules attach themselves to crystals to form these kinks. Groups of insulin blocks, they found, create large protrusions, dubbed mounds by Vekilov and Georgiou. The very nature of these mounds results in the creation of multiple kinks—far more, in fact, than the other methods of kink formation.

By providing so many spaces where insulin molecules can attach to an insulin crystal, mounds allow for the rapid growth of that crystal.

Interestingly, these mounds only form when there is a surplus of insulin that allows for rapid crystal growth. This is noteworthy because, in addition to growing at kinks, insulin crystals dissolve at kinks. Since no mounds appear when there is a lack of insulin, mounds are, in effect, important sources of a crystal's net growth.

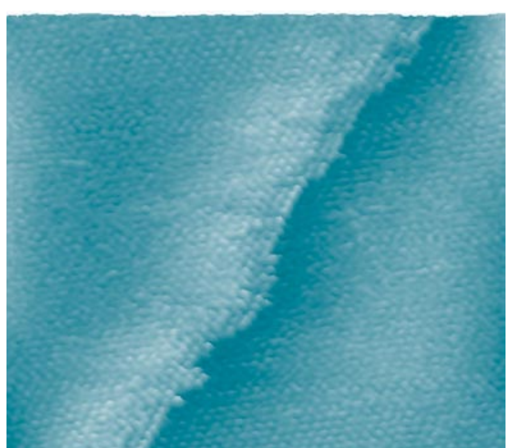
"Typically in nature, [a mechanism that enables] fast growth also results in fast dissolution," said Vekilov. "But this process cheats physics because when there isn't a lot of insulin, mounds don't form. It's an asymmetric mechanism."

While this discovery is important to the field of diabetes research, it should also have a major impact on the study of crystal formation. Before this finding there were only two known ways that crystals grew.

The first was proposed in the 1870s by Josiah Willard Gibbs, the father of modern physical chemistry and the first person to receive a doctorate in engineering in the United States. Russian Physicist V.V. Voronkov proposed the second mechanism in 1968. This is only the third mechanism ever discovered.

It is possible, said Vekilov, that crystals composed of materials other than insulin also grow in this manner. If so, this discovery could significantly impact any number of fields that deal with crystals.

"This is a new mechanism of crystal growth, which can help us understand all processes of crystal formation, including semiconductor and optical materials, geological crystallization, ice formation, and the physiological and pathological crystallization of proteins and small molecules," said Vekilov.



Thousands of block-shaped insulin molecules, each measuring 5 nanometers apiece, attach themselves to crystals in special locations known as kinks. Vekilov and Georgiou found that groups of insulin blocks form mounds, resulting in the creation of multiple kinks. These additional kinks provided by the mounds allow for rapid growth of insulin crystals.

Colleagues Gather to Celebrate Ernest Henley's Career

Emeritus Professor Ernest Henley was recently honored by his colleagues and friends for a lifetime of contributions to chemical engineering education and to the University of Houston Cullen College of Engineering. Dean Raymond Flumerfelt and Michael Harold, Dow Chair Professor and chair of chemical engineering, hosted the event to celebrate Henley's many academic achievements, as well as countless personal accomplishments, business ventures and philanthropic endeavors. Henley joined the college in 1962 and was an important contributor to the department's rise to becoming one of the top 10 chemical engineering programs in the nation.

College WELCOMEs New Program for Women

WELCOME
WOMEN IN ENGINEERING LEARNING COMMUNITY
FOR MAXIMIZING EXCELLENCE

A new program was launched last fall by the UH Cullen College of Engineering in an effort to help recruit and retain women in the field of engineering. The Women in Engineering Learning Community for Maximizing Excellence (WELCOME) is a newly designed program by Julie Trenor, director of undergraduate student recruitment and retention and assistant professor, and Fritz Claydon, associate dean of undergraduate studies, to establish a support system for women, giving them the opportunity to meet fellow classmates and interact with women currently working in the field of engineering.

"WELCOME will provide our female students with an academic support system and opportunities for professional development, while addressing the isolation that many female students feel in their engineering classes," Trenor said. "We hope to see increased retention rates among female students in the college."

Supported by a grant from the Texas Engineering and Technical Consortium, the program's initial focus is on creating a sense of community among the college's female students.

"Most classes only have a handful of women, so to see a forum of over 50 female students was very exciting to those who attended the first WELCOME meeting," said Trenor.

Throughout the fall and spring semesters, several professional and academic development activities were created, giving students a chance to attend seminars and participate in student-to-student and professional-to-student mentoring programs.

"Our peer mentoring program allows incoming students to be paired with junior and senior level students who can provide insight about adjusting to the academic environment," said Trenor. "Our professional-to-student mentoring program is less about academic adjustment and more about maximizing employability and preparing for the working world. The response from local female engineers has been fantastic. There are a lot of women in our community who recognize the importance of mentoring the female engineers who are following in their footsteps."

For more information about WELCOME or to participate in the program as a professional mentor, visit www.egr.uh.edu/welcome.

Assistant Professor Julie Trenor is pictured with several WELCOME students, including (front) Kristin Reddoch, Sharon James, Jessica Abbas, Sree Reddy, Tessa Steil, Trishia Saulog, Vanessa Aririguzo, Judy Rodriguez, Sandra Geffert, (back) Chidiogo Madubike, Cris Cavazoz, Rachel Jones, Shifatu Ruqiat, Akshaya Koshy, Eloisa Avalos, Ashleigh Orsak, Lauren Piper, Andrea Wolfowicz and Titi Ottum.

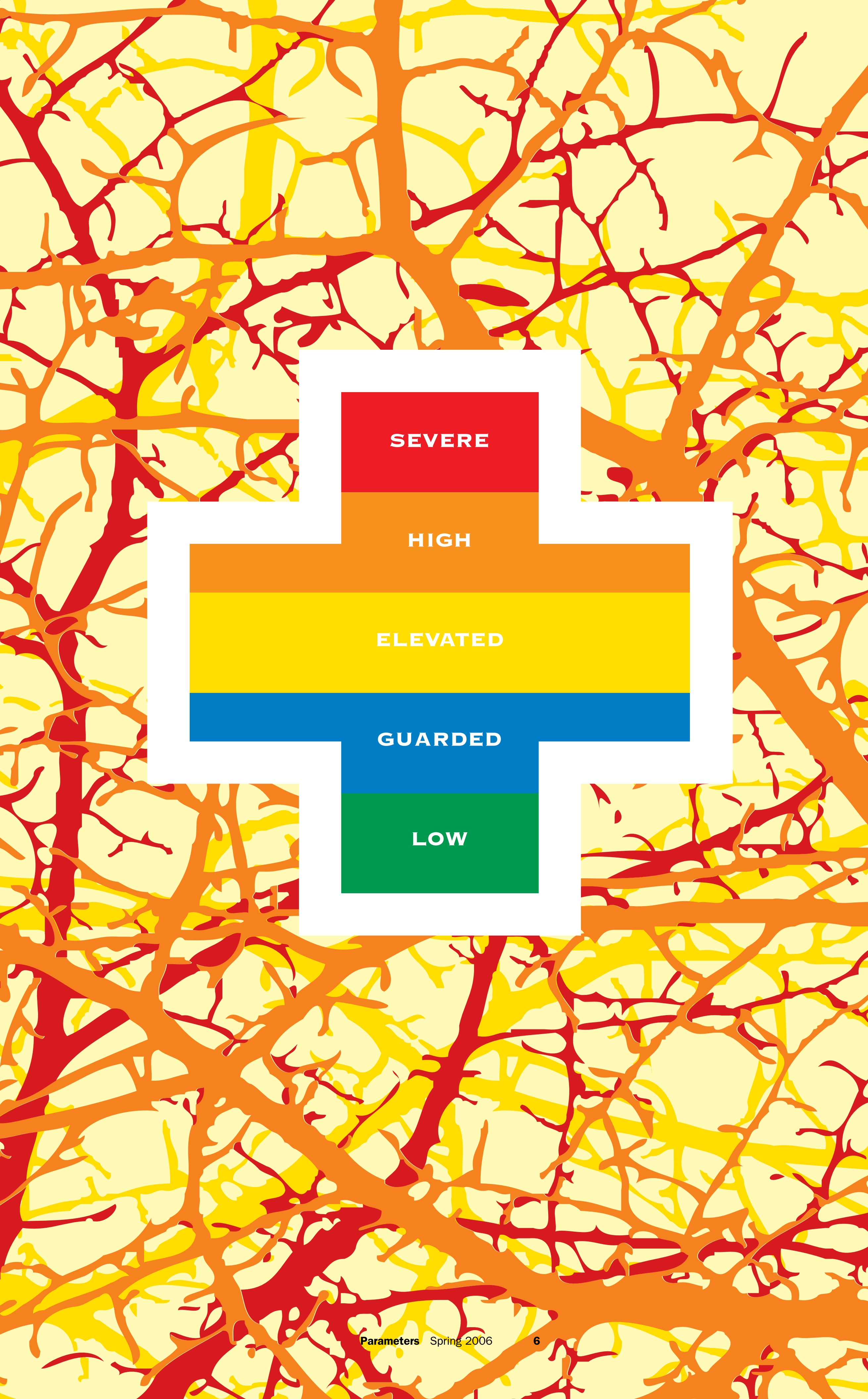
Homecoming 2005

Following a luncheon hosted by the UH Cullen College of Engineering on Nov. 13, 2005, the Engineering Alumni Association (EAA) celebrated Homecoming with a tailgate party at their pavilion. EAA displayed their awards for an Outstanding New Program for their creative EWeek activities and the 2005 Red Banner Year Award that they received earlier that day from the Houston Alumni Organization. This was the seventh year that EAA has won this prestigious Banner Year Award.

(Left) Leonard and Cynthia Coleman (1971 BSChE), EAA treasurer, talk to Terri Kellough (2005 BSEE) at the tailgate party before the homecoming game.

(Top left) Margaret and Joel Johnson (1968 BSEE) were among the many engineering alumni and friends who enjoyed the Homecoming festivities in EAA's new tailgate pavilion.

(Top right) Tony Catalano (1979 MSChE), EAA secretary, gets a college update from his former mentor Raymond Flumerfelt, UH engineering dean.



Like the Homeland Security Advisory System, ***the inspiration for this illustration***, **many advancements in bionanotechnology provide threat information to key decision makers. Researchers at the University of Houston Cullen College of Engineering are working toward developing technologies that will ultimately alert patients and doctors when dangers are detected within the human body.**

Bionanotechnology:

The Edge of Detection

Features by Toby Weber & Ann Pearson
Photos by Jeff Shaw

The world is shrinking.

Telephones are carried in pockets or purses and thousands of songs can be squeezed onto an MP3 player the size of a deck of cards. For the most part, these technologies provide the same tools as before, just in more convenient packages.

This is not news.

But there are areas where miniaturization still holds revolutionary potential; bionanotechnology is one of them. The medical application of nanotechnology promises to change the very nature of healthcare, largely through the creation of early diagnostic and detection systems that will alert doctors when potential dangers are found.

The source of this potential lies in the unimaginably small scale in which nanotechnology operates.

Nanodevices typically range in size from just a few to several dozen nanometers, a nanometer being one-billionth of a meter. By operating at that size, biomedical nanodevices can alert people to the presence of disease on the molecular level, when it first appears in the human body. This can be long before a patient begins to show any symptoms of a disease and long before it can develop into a significant problem.

By addressing health concerns at this stage of development, nanotechnology provides patients with one of the biggest advantages in medicine: time. The sooner a disease is discovered and diagnosed, the sooner it can be eliminated.

Since nanotechnology is an emerging field of science, many of its principals and possibilities are still being discovered, and the earliest efforts on the bionano front revolve around disease detection and diagnosis.

Researchers at the University of Houston Cullen College of Engineering are working on several bionanotechnology projects that will have major impacts on the areas of clinical diagnoses and biosafety. Such projects include the development of an extremely small chip that can be implanted under a patient's skin that will alert doctors to the presence of any one of hundreds of thousands of diseases long before the first symptoms appear; a nearly foolproof tool that can remotely detect the presence of toxic gases or bioterrorism agents such as anthrax; and tests for cancer and other diseases that produce results in a matter of hours, not days.

While these technologies are not direct cures, the speed and accuracy with which they detect disease is astonishing. And until actual cures are found, scientists will continue to work diligently toward the fastest, most accurate means of detection, providing people the chance to live longer, healthier lives. ■

BIODETECTION: MAKING LIFE BETTER ONE MOLECULE AT A TIME

The vast scientific and medical knowledge accumulated in the last quarter century has opened new doors for disease diagnosis and control. Researchers now have the ability to work in the nano realm, a world so small that individual molecules can be manipulated not only to detect disease and other foreign agents immediately, but also to develop unprecedented measures for treatment and prevention. The ability to recognize the specific molecular structures of pathogens, viruses and DNA sequences is critical in this process.

Richard Willson, professor of chemical engineering and professor of biochemical and biophysical sciences at the University of Houston, has spent nearly two decades working to identify and analyze individual protein, DNA molecules and disease organisms, a research area known as molecular recognition. For instance, Willson and his team are able to determine if a particular antibody or DNA molecule will consistently bond with a disease-causing virus or toxin, and to characterize the speed and energetics of the association. If the research can prove that this bond is formed on a regular basis, then scientists can harness the molecular recognition for diagnostic or treatment purposes.

In an application funded by the Homeland Security Advanced Research Projects Agency, Willson is working with Yuriy Fofanov, assistant professor of computer science at UH, (who Willson says has developed "the world's best algorithms for exhaustive searching of genomes") and George Fox, professor of biology and biochemistry and professor of chemical engineering, (who co-discovered the Archae, one of the three classes of living things on the Earth) to identify and validate specific DNA probes for organisms of biodefense interest. In other words, if the research identifies a specific DNA probe sequence that will bond to the anthrax virus, and officials fear anthrax is present in an area, researchers could use that DNA probe to verify or disprove the presence of the disease, enabling authorities to take appropriate measures quickly, if necessary.

"Biological molecules can be amazingly good detectors, capable of recognizing one type of bacterium or virus in the presence of its closely-related 'cousins', or a particular genetic sequence out of millions," said Willson. "The air in Houston and every major U.S. city is routinely monitored for biothreat agents and a false alarm is just unacceptable in a civilian application."

Willson and his team are working to understand the structural and energetic basis of specific interactions between molecules in order to make these interactions useful in medical diagnostics, purification and biodefense. Specifically, Willson's research revolves around characterizing and improving the ways detector molecules, such as antibodies and DNA probes, recognize their targets, and using these interactions to purify biomolecules. He will also be working to improve ways in which a detector will recognize its target. ▸▸

Retroreflectors

In one of many ongoing research projects, Willson and his team are working with Paul Ruchhoeft (1998 MSEE, 2000 PhD EE), assistant professor of electrical and computer engineering, to develop a new biomolecule labeling system and diagnostic tool utilizing optical signals returned from corner-cube retroreflectors.

"Most people are familiar with the related safety technology, which makes a jogger's shoe heels shine in your car's headlights at night," says Willson, "but with modern fabrication techniques developed by Ruchhoeft and John Wolfe, professor of electrical and computer engineering, we can use retroreflectors for a whole range of new biological and biomedical applications."

Specifically, these retroreflectors are tiny cubes, mirrored on three sides, that return light back in exactly the same direction from which it originated, making them extremely detectable even through tissue or at a distance. Retroreflectors have long been used in both scientific and consumer applications. In fact, the Apollo program placed retroreflectors on the surface of the moon as part of ongoing experiments on lunar orbital dynamics. Commercially, retroreflectors are utilized daily as road lane markers and on running shoes, safety vests, reflective road signs and bike pedals, but have not previously been used in bioanalytical methods.

Because of their extremely high detectability, retroreflectors can be utilized as a low-cost diagnostic tool with many possible applications, such as the detection of antibody-targeted colon cancer markers and continuous glucose level monitoring in diabetic patients. Currently, typical diagnostic sensors and the equipment that read the output signals are relatively bulky and expensive, making continuous monitoring of biomarkers impractical outside a laboratory setting. Working in the nano realm allows researchers to produce a more readable, more accurate signal from an extremely small sensor, allowing doctors and patients to gain a more complete understanding of the disease or condition being treated.

The team will construct self-assembling, chemically responsive micro-retroreflectors used for remote monitoring of toxic gases or bioagents for biodefense. With the ever-present danger involving the detection of such agents, newer technology is needed to safely and carefully locate areas affected by toxins.

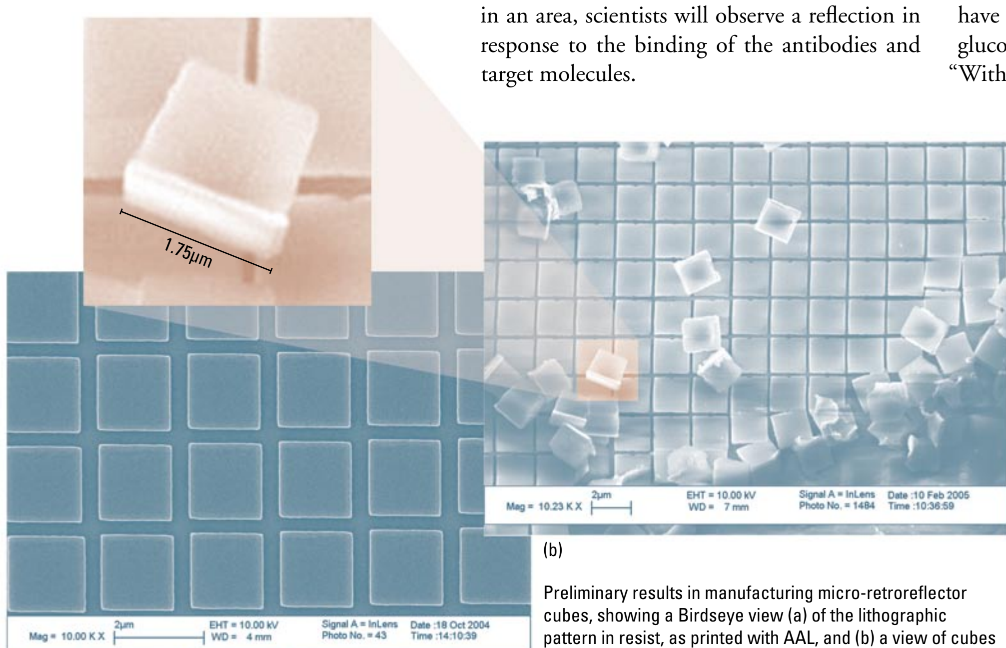
So, how does it work? Willson explains that one side of the micro-retroreflector will be coated with antibodies but missing a mirror, deactivating the reflector until the target molecule (e.g., a bioagent) "bridges" gold nanoparticles with the surface, assembling the third mirror and restoring retroreflectance. If a bioagent exists in an area, scientists will observe a reflection in response to the binding of the antibodies and target molecules.

"If we can monitor the dangerous elements continuously, at a distance, then we have accomplished a great deal," says Willson.

Such self-assembling micro-retroreflector technology could also be used in a new class of implanted, long-term, continuous glucose monitors in which patients and doctors could detect the retroreflectance through the skin using inexpensive LED optics. Continuous glucose monitoring is a long-sought goal in diabetes treatment. Recent clinical recommendations emphasize the value of testing glucose levels far more frequently than most patients do now.

"For the treatment of diabetes, the development of better monitoring technology is crucial, because right now doctors and patients don't have a practical and reliable way to monitor glucose levels continuously," Willson explains. "Without this ability, doctors cannot treat the disease as effectively as they could with the additional information our self-assembling micro-retroreflector technology may allow."

The micro-retroreflectors designed by the team for biomedical purposes will be only a few micrometers wide (smaller than a red blood cell), which will allow the biological sample doctors need for analysis to be very small. For long-term monitoring uses, the micro-retroreflectors could be designed as a non-irritating implant that displays the needed signals through the patients' skin or in a pill form for ongoing diagnoses in real time.



(a) (b)

Preliminary results in manufacturing micro-retroreflector cubes, showing a Birdseye view (a) of the lithographic pattern in resist, as printed with AAL, and (b) a view of cubes that have been "scraped" off of the surface using a scalpel.

Nanomagnetic Sensors

Professor Richard Willson, PhD student Maria Añez (2004 MSChE) and postdoctoral researcher Ekaterini Kourentzi (1999 MSChE, 2002 PhD ChE) determine the composition and purity of RNA and protein samples.

In addition to retroreflectors, Willson is working with atomic lithography pioneer Wolfe and Dmitri Litvinov, associate professor of electrical and computer engineering, to develop a nanomagnetic sensor array capable of detecting single molecules using the sensor technology at the heart of high-density magnetic disk drives like that in the iPod. While the biomolecular recognition technologies today can carry out genome-wide profiling of clinical specimens, they require relatively large samples, which are often not readily available, especially in medical applications. Researchers currently have a critical need for new technologies that enable clinical specimen analysis of ultra-small samples.

"These joint research endeavors enable us to utilize the expertise of scientists from a variety of disciplines to achieve more than any of us could alone," says Willson.

Recently funded by the National Institutes of Health (NIH) for $891,000, the group will develop an ultra-sensitive, highly-stable nanomagnetic sensor array that is capable of evaluating a variety of samples, outputting real-time, high-quality data.

Such a nanomagnetic sensor array will capitalize on dramatic advancements in magnetic disk data storage technology, as represented by Litvinov, who has successfully implemented a number of nanomagnetic concepts in commercial magnetic data storage systems. These concepts can be integrated into a practical sensor array with extremely high densities of individually addressable sensors.

Specifically, the sensor array will be comprised of a million giant magnetoresistive (GMR) sensors, all housed in a single square millimeter of space. In a disk drive, one GMR sensor will scan the surface of a disk bearing tiny magnetic domains. In the biomedical sensor, the many GMR sensors detect magnetic nanoparticles that act as labels allowing detection of individually-labeled molecules. Between the nanoparticle and each GMR sensor, Willson's group will incorporate biorecognition molecules with specific binding capabilities.

In a specific application of NIH interest, the sensor can be used for massive screening of drug candidates for their ability to block interactions involved in disease processes. For example, the sensor array can be decorated with a cell surface protein known to be an entry receptor for a virus such as influenza or HIV. A magnetic nanoparticle bearing one or more copies of the virus' cell-binding protein will bind to the cell protein and to the GMR sensor, producing a high-quality signal that informs researchers whether the molecules have associated. The sensor array allows the simultaneous testing of an enormous number of drug candidates for their ability to block virus/cell association.

In a separate application funded by the Alliance for NanoHealth, the magnetic nanosensor can be adapted to perform molecular diagnostic assays on clinical biopsy specimens, especially in the molecular diagnosis of cancer. A particular goal is to obtain more useful information from the standard "fine needle aspiration" procedure, which uses a fine gauge needle to sample fluid from a breast cyst or remove clusters of cells from a solid mass. This procedure is widely used in part because it is less invasive than many other methods, but the quantity of sample obtained is too small to be used in many of the most useful molecular diagnostic assays.

The nanosensor will be used to test breast cancer markers including the estrogen receptor (ER). The estrogen receptor is the most important growth factor identified for breast cancer; 50 percent of primary breast cancers in women are ER-positive, while most normal breast tissue and benign breast lesions lack the receptor protein. Hormonal therapies for breast cancer have had a bigger impact on recurrence and survival than any other treatment.

"Breast cancer detection is one of many biomedical applications this sensor array can be used for," said Willson. "Once developed, we will be able to detect a variety of disease biomarkers and pathogens in the body, screen for likely drug candidates and look for the presence of bioterrorism agents."

Willson's team is especially well-prepared to capitalize on the synergy of recent advances in nanotechnology, the explosive growth in genomics and proteomics and the unique nanofabrication capabilities at UH. In addition, the college's strategic location near the world-renowned Texas Medical Center allows further collaboration among the biosciences, engineering and medical disciplines, specifically between researchers at UH and M.D. Anderson Cancer Center, Baylor College of Medicine and the Methodist Hospital.

In addition to the National Institutes of Health and the Alliance for NanoHealth, Willson's research is funded by the Welch Foundation and NASA. ■

CRYSTAL CLEAR DIAGNOSIS:

UH Researchers Use Lasers and Nanocrystals to Detect Diseases

Going small is big news in medical research. Scientific researchers are perfecting the use of smaller and smaller devices to perform many of the delicate tasks required to keep humans healthy—technology that is progressing at astonishing rates. Now, the research and the procedures are conducted on an almost unimaginably small level, using nanotechnology.

Nanotechnology is allowing researchers to develop methods that first identify and then attack diseases and toxins in the human body before they can even begin their destruction. The real-time, highly specific diagnoses these methods provide will allow doctors and their patients more time to prevent problems from fully emerging instead of trying to cure established diseases. Pathogens that cannot establish a foothold cannot damage delicate, irreplaceable body systems. That is big news.

One biomedical and mechanical engineering collaborative research team at the University of Houston Cullen College of Engineering is currently working on a project to develop a highly sensitive, laser-based system that can detect the presence of specific disease biomarkers. The lead investigator on the project is Kirill Larin, director of the UH Biomedical Optics Laboratory and assistant professor of biomedical and mechanical engineering, who has a particular interest in diagnostic imaging, biosensing and microscopy. Larin is collaborating with Matthew Franchek, chair of the Department of Mechanical Engineering and director of the Biomedical Engineering Program, and Pradeep Sharma, assistant professor of mechanical engineering.

The system relies on the fact that certain diseases produce biological indicators, or biomarkers, that doctors can use to detect the presence and magnitude of disease in the human body. The project team is using laser-based sensing to identify protein biomarkers in human tissue that may identify cancers or bioterrorism agents within a patient's bloodstream in a matter of moments. Currently, doctors and their anxious patients wait up to 24 hours to evaluate cancer blood tests. While this technology will initially rely on drawing blood samples from patients, Larin envisions an *in vivo* (totally inside the body) system to determine the presence or absence of very specific elements in the blood immediately.

The system falls under the field of Biomedical Optics, a fast-growing area of research in medicine. This particular optical method of diagnostic and functional imaging, detection, and manipulation of cells and tissues draws from the expertise of many disciplines. From the engineering side of the collaboration, the laser-based sensing technology works with specially tailored quantum dots, tiny crystals that glow when stimulated by light. The dots emit various light signals from which the researchers can determine the presence of different agents in a blood sample. Once the laser illuminates the dots, a computer generates something similar to a topographical map, indicating the locations of various quantum dots by sets of peaks. Quantum dots that bind to pathogens will emit a different signal than quantum dots that are unattached, allowing researchers to know whether a pathogen exists.

Generally speaking, the quantum dots are conjugated, or coupled with specific substances, to look for specific pathogens. If one of these pathogens is present, then the researchers will be able to tell based on the shape of the emission signal. These dots, which tell the researchers so much about the disease, are usually between 5–10 nanometers in width. In comparison, one human hair is about 80,000 nanometers in width (hair is considered huge in the nano world).

Quantum dots are critical to this study because the researchers can conjugate the dots with specific antibodies that bind with certain proteins, such as a particular type of cancer. Sharma studies quantum dots, and his role on this project is to make theoretical predictions about what specific antibodies need to be conjugated to which quantum dots to determine the presence of specific cancerous agents or other biomedical problems.

"The crucial part Professor Sharma plays in this research is being able to identify proteins and physical/chemical properties of quantum dots that match up specifically," said Larin.

Franchek's role will be to calibrate and verify theoretical models developed by Sharma through the use of an atomic force microscope. Franchek will analyze the electrical and mechanical structure of the interaction of Sharma's predicted connections between the quantum dots and the proteins. Researchers will determine the next step necessary on a case-by-case basis depending on how strong the signal is from the quantum dots. Franchek and Sharma will amass a body of data that will allow doctors to diagnose accurately from the various signals that are identified in this initial research.

Once researchers document which proteins bind with which specially conjugated quantum dot, they can use those quantum dots to look for that protein in biological samples.

In such a system, a patient's blood sample will be taken and mixed with the quantum dots. The dots would then bind to any present cancerous protein biomarkers. Then, the patient's blood sample would be inserted into the laser-based sensing system, at which time, the quantum dots would illuminate and emit one signal if they had adhered to a cancerous protein and emit a different signal if they did not find a cancerous protein. By evaluating the signals, researchers would know instantly if the cancer is present. The result would be less waiting, less anxiety and less delay when time is of the essence as it is in cancer detection.

The research team is confident that the combination of nanotechnology and engineering for biomedical research will result in faster and more reliable test results for doctors and patients trying to determine the next steps of keeping the human body working at its peak.

"This is our way to help people live longer and happier lives," said Larin. "It's great to be a part of that." ■

Professor Kirill Larin uses a portable time-domain Optical Coherence Tomography system for spectroscopic imaging of quantum dots in tissue.

TINY TOOLS COVER LOTS OF GROUND

UH-Developed Nanodevices Search for Thousands of Diseases

Imagine swallowing a pill that relays a signal to a doctor if a dangerous disease is present in your body. Or imagine being alerted to the presence of a disease long before the first symptoms appear, allowing doctors to begin treatment as early as possible and greatly increasing the odds of recovery.

These real-world applications might be the fruit of biomaterials sensing research conducted at the University of Houston Cullen College of Engineering by Peter Vekilov, associate professor of chemical engineering.

> The ultimate goal of Vekilov's research is to design a medical diagnostic system small enough to fit in a pill and capable of detecting the presence of almost a half million disease markers simultaneously.

Much of Vekilov's work builds on the efforts of researchers across the world tasked with cataloging the attributes of some 400,000 proteins, many of which are specific to diseases, or antibody proteins generated in response to disease pathogens: viruses, bacteria, etc. These antibodies are created by the human immune system to fight disease and each bonds only with a single matching protein that is characteristic to the disease.

Researchers expect to utilize their increasing knowledge of protein/antibody relationships to diagnose illnesses. Simply put, the goal is for medical professionals to expose biological material to a protein antibody. Since each protein antibody can only bond with a specific disease protein, medical personnel can be sure a disease is present if a bond forms.

According to Vekilov, proteins are getting more attention from the scientific community since recent efforts in genome mapping show that humans have only 22,000 genes—far too few to account for everything that happens in organisms as complex as humans.

"The new theory, then, is that processes in organisms are governed by the variability of the 400,000 proteins in them," he said. "Hence the need to detect, identify, analyze, catalogue and diagnose the proteins in a human tissue or organ."

Vekilov's goal is to create an easily mass-producible tool that relies on the formation of protein/antibody bonds to diagnose hundreds of thousands of diseases. The description of such a tool provides a clear picture of how nanotechnology devices are built, as well as some of the challenges that can be inherent in building them.

Specifically, Vekilov's diagnostic tool can be produced easily with available semiconductor technologies. Silicon wafers measuring 30 cm in diameter will be divided into up to 70,000 separate sections measuring one square millimeter each. On each section, researchers will place arrays of 100,000 to 500,000 electrodes.

Before the arrays are physically separated, the first electrode on each will be charged with a single volt of electricity and then bathed in a nanodroplet of a solution of an antibody sensitive to a specific protein. The volume of these solutions is incredibly small, measuring 10^{-16} liters, about 100 attoliters. The charge on the electrodes will allow them to bond with the solution, after which the solution will be rinsed from the arrays. The process will then be repeated hundreds of thousands of times using a different antibody each time.

When an array is exposed to biological material, the antibodies on the electrodes will detect the presence of their matching proteins and an electric signal will be generated and transmitted by additional electronics.

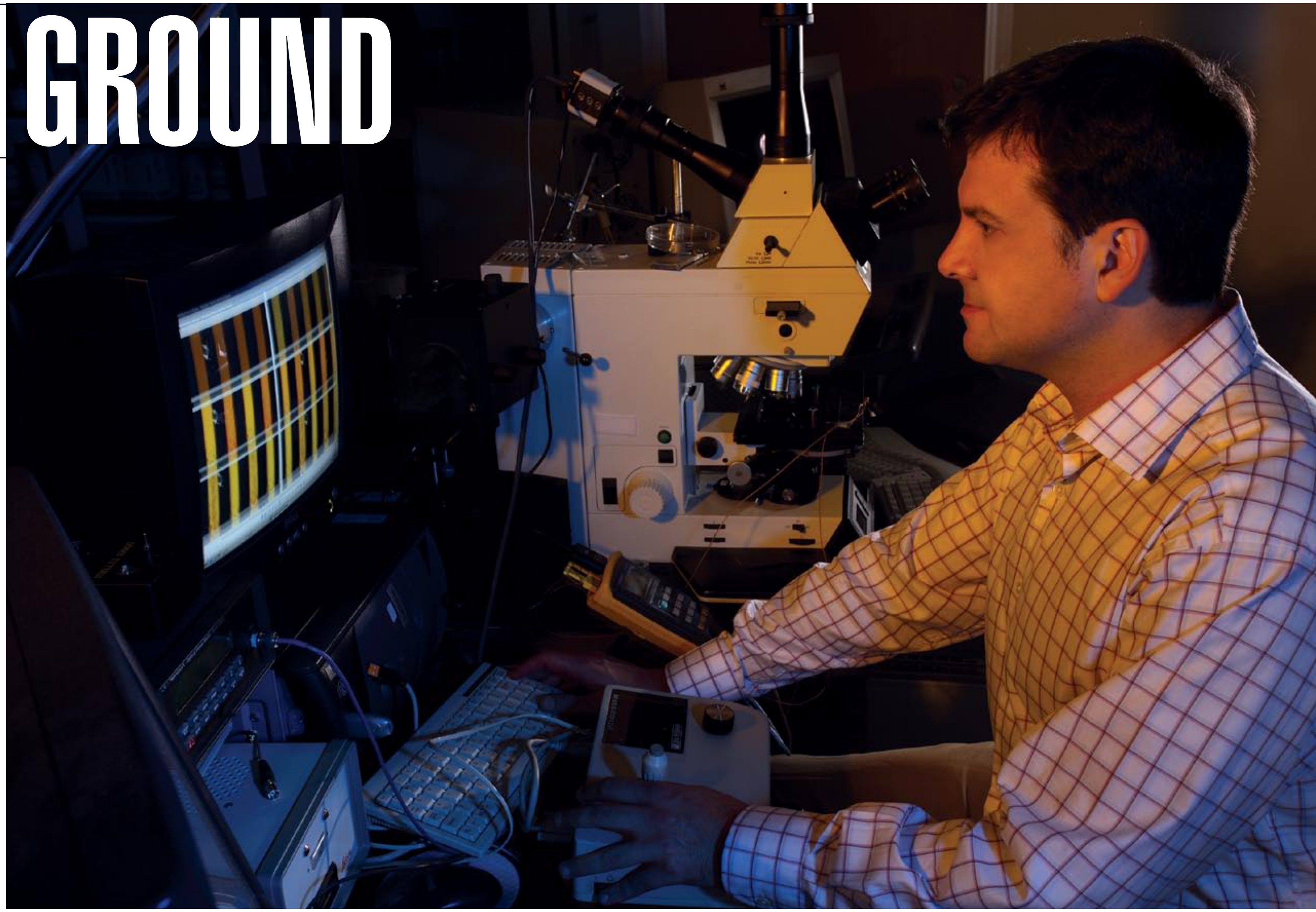
While this general approach has been proven viable, says Vekilov, the real challenge is in making it practical. Dividing a silicon wafer into such small sections isn't the problem; depositing hundreds of thousands of different protein solutions on a single wafer in a cost- and labor-efficient manner is where the challenge comes in. "We recently developed a procedure to deposit such attoliter droplets of a protein on sub-micron sized electrodes."

However, with this recently developed procedure, researchers must customize the conditions of the liquid solution in which the antibody proteins will be mixed in order to deposit them successfully. Different proteins require their solutions to have a specific temperature or acidity level, for example.

Determining the precise solution properties for each protein would require years of research and millions of dollars. And even if the exact solution for each protein were formulated, using hundreds of thousands of solutions to mass produce arrays would be practically impossible.

"We want to avoid that," says Vekilov. "We have to develop a general procedure where even if you know nothing about the protein, you'll still be able to deposit it."

This problem, Vekilov says, can be overcome by creating a universal solution that can be used in conjunction with any protein.



Vekilov theorizes that this can be accomplished by creating a single solution that masks proteins' attributes that require specific solution properties. A search for suitable agents is underway.

If this theory proves correct, every protein could be mixed with a single solution. This one solution would result in the development and mass production of this diagnostic tool becoming much simpler and more cost-efficient.

"The practical result is that even without knowing anything about a protein you'll be able to deposit it. You won't have to study it, you won't have to use different conditions," Vekilov says.

Once Vekilov devises a solution to mass-produce arrays efficiently, the next question becomes how to deliver them.

There are several possible ways to accomplish this, Vekilov says, each of which could be used for different purposes. For example, an array, which measures just one square millimeter, could be placed in a pill-sized capsule, which by practice measures up to nine square millimeters. The remaining space could be used to house data recording and transmission equipment. A patient would then simply swallow the capsule, which would radio out information to a medical professional about any protein/antibody bonds that form.

Alternatively, individuals could have an array embedded underneath their skin that would constantly monitor for the presence of protein/antibody bonds and, in any number of ways, alert the individual should a bond be detected.

Peter Vekilov, associate professor of chemical engineering, reviews arrays of electrodes magnified by a high-power microscope.

These different delivery methods demonstrate the advantages of such a diagnostic system. In pill form, patients experiencing symptoms of an unknown disease or condition can be diagnosed in minutes. An array embedded underneath the skin could serve as an early detection device, alerting at-risk individuals that a disease is present long before symptoms appear.

Will people be able to discover and fight illnesses before their effects are even felt? Is a "smart" pill capable of diagnosing practically any disease in minutes in the near future? Vekilov believes so and is developing tools that will make these seemingly futuristic technologies a reality. ■

Electrical Engineering Professor Gerhard Paskusz

RETIRES, LEAVES LEGACY IN PROMES

By Portia-Elaine Gant

After an illustrious career in academia that spanned more than half a century, Gerhard Paskusz has retired from the Cullen College of Engineering faculty and as the director of *PROMES (Program for Mastery in Engineering Studies)*, the program that has graduated minority students in engineering for more than 25 years.

Paskusz, who joined UH in 1961 after earning his Ph.D. from the University of California, Los Angeles, founded PROMES in 1974 after listening to an address from the then-CEO of General Electric, Reginald Jones.

"[Jones] stressed that if we were going to get minorities into the economic mainstream, engineering is the way to go, and so we ought to have programs that get minorities into engineering," Paskusz said. "Our goals were always to graduate minority students in engineering, and if not in engineering, to make sure they graduated from college because a degree in something was better than nothing."

The problem was never that minority students were less capable of graduating, but that their prior academic experiences had not been sufficient.

At a dinner in honor of his retirement, Gerhard Paskusz celebrated with co-workers and friends. Pictured are (front) Reagan Flowers, Sharon Gates, Paskusz, Jenny Bennett, Merion Luckett, Mamie Moy, (back) Dean Raymond Flumerfelt, UH Vice President Elwyn Lee, Tom Cummings, Richard Price and John Matthews.

"The students who need PROMES come from inner-city schools where higher math courses are not offered," Paskusz said. "They don't have the academic background to have a good chance of succeeding."

One of Paskusz's remedies was to link PROMES students together through study groups and outside workshops. In addition, the students were grouped together in the same sections of their math, science, and freshman- and sophomore-level engineering classes.

The program, of course, has encountered challenges over the years. A 1996 court ruling on affirmative action in higher education could have spelled the end for PROMES, then called the Program for Minorities in Engineering Studies. Paskusz, however, merely changed "Minorities" to "Mastery" and used the Hopwood case as an occasion to expand the program's scope.

"This affected the effectiveness of the program because now students were no longer confined to a minority group but are operating in an integrated group to start with, which is obviously helpful for when they go out in industry," Paskusz said. "The Hopwood case, which was supposed to throw a monkey wrench into the program, has actually helped us."

The court ruling and financial shortfalls from a lack of outside funding are obstacles that PROMES has overcome in its history and will continue to face, Paskusz said. In spite of these upsets, PROMES has proven itself a hugely successful program.

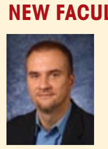
"We have the same percentage of students as the College of Engineering on the Dean's List," Paskusz said. "Our graduation rates are comparable, and our four-year retention is usually slightly better than that of the college as a whole. Our major accomplishment is that we are able to do what we set out to do—graduate minority engineering students." ■

FACULTY, STAFF AND STUDENT ACCOLADES

FACULTY PROMOTIONS

Ramanan Krishnamoorti (ChE) was promoted to full professor and named associate dean for research. He also received UH's Excellence in Research and Scholarship Award for his research on polymers.

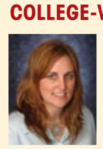
NEW FACULTY



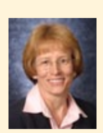
Stanko Brankovic joined ECE as an assistant professor. Previously, he was a researcher at Seagate Research Center. He received a Ph.D. in science and engineering of materials from Arizona State University in 1999 and a B.S. in chemical and biochemical engineering from the University of Belgrade in Yugoslavia in 1994. He did his postdoctoral research at the Brookhaven National Laboratory in New York. His research interests are in the areas of nanofabrication, electrochemical thin film growth, interfacial thermodynamics, magnetic materials, electrocatalysis and novel sensor concepts.

Qianmei (May) Feng joined IE as an assistant professor. She received a Ph.D. and M.S. in industrial engineering from the University of Washington in 2005 and 2002, respectively. She received her M.S. in management science in 2000, and a B.S. in mechanical engineering and in industrial engineering in 1998 from Tsinghua University in China. Her research interests are in the areas of applied probability and statistics, quality engineering and management, management information systems and application of system optimization in manufacturing, transportation and healthcare systems.

COLLEGE-WIDE HIRES



Lindsay Lewis joined the college as director of communications in August 2005. Previously, she directed and produced all communications for the UH College of Pharmacy. Prior to UH, she was a lecturer at Baylor University, where she received her M.A. in communications studies (focus on production) in 2001. She received a B.A. in communication studies from Texas Lutheran University in 1999. She replaces Angie Shortt, who stepped down in February 2005.

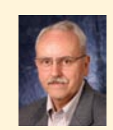


Katherine Zerda joined the college as director of the Program for Mastery in Engineering Studies (PROMES). Previously, she was a business development manager and site manager for Hewlett Packard, where she worked for eight years providing day-to-day management and leadership of all aspects of a $3 million, 70-employee business group handling outsourcing, as well as other duties. She received her Ph.D. in virology from Baylor College of Medicine in 1982, her M.B.A. from Texas A&M University in 2003 and a B.S. in microbiology from the University of Notre Dame in 1977. She replaces Gerhard Paskusz, founder and director for 31 years of the PROMES program, who retired Aug. 31, 2005.

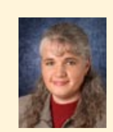
FACULTY AWARDS

Vermuri Balakotaiah (ChE) received the Best Environmental Paper Award from the Environmental Division of the American Institute of Chemical Engineers (AIChE).

Ji Chen (ECE) received the 2005 Junior Faculty Research Award from the college.



Dennis Clifford (CEE) received the 2005 Career Teaching Award from the college for excellence in teaching and service to students.



Reagan Herman (CEE) and former professor Todd Helwig received a Top Research Innovation Award from the Texas Department of Transportation (TxDOT) for their work on the bracing of steel bridges during construction. The approach they developed allows permanent metal deck forms to be used to provide bracing, leading to cost and time savings both at construction and in the routine inspections required over the life of a bridge. A paper on this project by doctoral candidate **Ozgur Egilmez**, Helwig and Herman also received the Vinnakota Award from the Structural Stability Research Council. Herman was awarded Best of Session and Best of Session by a Younger Member from the Texas Section of the American Society of Civil Engineers for the paper, "Steel Box Girder Bridge with Skewed Supports: Field and FEA Results."

Valery Kalatsky (ECE) received a Sloan Research Fellowship in Neuroscience from the Alfred P. Sloan Foundation.

Maher Lahmar (IE), **Jagannatha Rao** (ME) and **Paul Ruchhoeft** (ECE) received a 2005 Outstanding Teaching Award from the college.

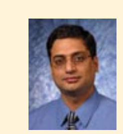
Richard Liu (ECE) received a Research Innovation Award from TxDOT for his research designed to measure the thickness of reinforced concrete pavement. His project, "Development of Low Frequency Radar to Measure the Thickness of Steel Reinforced Concrete Pavements," offers a non-invasive and cost-effective way for the agency to test the quality of Texas roads and highways.

Dan Luss (ChE) received the 2005 AIChE Founders Award for outstanding contributions to the field of chemical engineering. He also received the Distinguished Speaker Award at Chemcon, a series of international conferences on chemical control legislation and trade aspects.

Mohammed Mansour (CEE) and **Kahled Gad El Mola** (IE) received a 2005 Outstanding Lecturer Award from the college.

Kishore Mohanty (ChE) received the 2005 W.T. Kittinger Outstanding Teacher Award from the college.

Haluk Ogmen (ECE) was invited to serve a four-year term as a member of the National Institutes of Health (NIH) Central Visual Processing Study Section, Center for Scientific Review.



Vineet Sethi (ME) received a Graduate Research Award from the UH chapter of Sigma Xi, the scientific research society, for his research contributions through ME's Smart Materials and Structures Laboratory.

(Continued on page 18)

JOHN LIENHARD

CELEBRATES 2,000 RADIO EPISODES, 17 YEARS ON THE AIR

By Portia-Elaine Gant

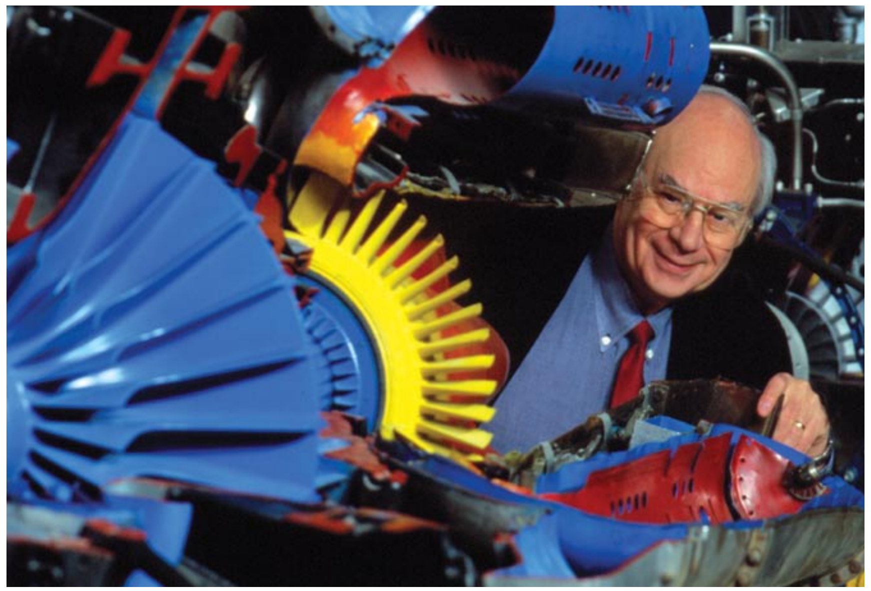


PHOTO BY MARK LACY

Engineering is defined as the application of science and math for practical use. However, John Lienhard, M.D. Anderson Professor Emeritus of Mechanical Engineering and History, has challenged that notion for years through his radio show, *Engines of Our Ingenuity*, a favorite on Houston-based public radio station KUHF. After airing his 2,000th episode last summer, and celebrating his 75th birthday, Lienhard continues to use his notable radio program to dispel the preconceived ideas of what engineering is and "tell the story of how our culture is formed by human creativity."

"Engineering is presented as detached objectivity; it isn't," Lienhard said. "It's not a science. It's a technology. Engineering is derived from the notion of using your ingenuity to create. I like to call science, on the other hand, the process of divining the set of matters of fact. One deals with the world as it is, and one deals with the world as it might be."

Lienhard's distinctive way of thinking has mesmerized audiences since the program's inception in 1987. Then engineering dean Roger Eichhorn suggested a radio program as a method of rousing interest in the UH Cullen College of Engineering. Delighted at the idea, Lienhard immediately drafted three sample scripts and received a commitment from KUHF station manager John Proffitt to begin airing the daily featurettes at 7:35 a.m. and 3:55 p.m.

Since that initial broadcast on Jan. 4, 1988, over 2,080 episodes have aired and the show has been made available nation-wide. While Lienhard has invited 10 guests to share their ideas over more than 40 episodes, he has created the vast majority of these shows on his own. The topics have ranged from literature and the arts to engineering and other technological advancements.

"There are two billion ideas to select from, and that's probably an underestimate; we live in a very creative world," Lienhard said. "What I do is float around ideas. I have all of these elements coming together in a funny way. We've got this puzzle, and I have to find the story that will pull the disparate items together."

One of Lienhard's frequent topics is technology, which he attributes to humankind's dependence on the advancements it creates.

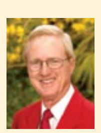
"We are the only species that cannot survive without technology," Lienhard said. "We cannot eat meat that we have not killed without devices of some sort whether it be for the farming or hunting of animals. We are the only species that cannot survive the climate without clothing that we have manufactured or homes that are conditioned to be livable for us. We live and die by 'techni' (the art and skill of making things)."

Though the show's subject matter caters to an academic audience, Lienhard said that his focus is to make it accessible for all listeners.

"I write my prose for a listening audience on the seventh grade level, and that makes it accessible," Lienhard said. "Any number of young adults will say to me 'my parents turned on the radio when I was a kid going to school and I loved it.' There's a difference between speaking a complex language and dealing in complex ideas. I'm not simplifying my ideas to the same level that other public media would, and my audience likes me for that." ■

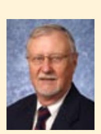
FACULTY, STAFF AND STUDENT ACCOLADES

Pradeep Sharma (ME) received the Office of Naval Research's Young Investigator Program Award for his proposal on the "Novel Size-Effects in the Coupled Mechanical Deformation and Opto-Electronic Behavior of Quantum Dots and Wires." The award totaling $262,471 will support his research for three years.



James Symons (CEE), Distinguished Cullen Professor Emeritus of Civil Engineering, was awarded the Abel Wolman Award of Excellence, one of the most prestigious honors granted by the American Water Works Association (AWWA). The lifetime-achievement award is intended "to recognize those whose careers in the water works industry exemplify vision, creativity, and excellent professional performance." Symons, who was a UH professor from 1982 to 1997, received multiple awards for his teaching and research efforts, which focused on challenges presented by water purification techniques.

Cumaraswamy Vipulanandan (CEE) received the 2005 Fluor Daniel Faculty Excellence Award from the college.



Lewis Wheeler (ME) received the Dedicated Service Award from the American Society of Mechanical Engineers for serving as the technical editor of the *Journal of Applied Mechanics.*

Richard Willson (ChE) received the 2005 Senior Faculty Research Award from the college. He was also named president of the International Society for Molecular Recognition.

STAFF AWARDS

Jeff Shaw and **Harriet Yim** in Engineering Communications, along with former director **Angie Shortt** and former writer/editor **Brian Allen**†, received nine awards in 2005 for *Marvels of Engineering*, the college's undergraduate recruitment brochure, and for photography. The *Marvels of Engineering* brochure received a 2005 Excalibur Award from the Public Relations Society of America (PRSA Houston) and a 2005 Bronze Quill Award from the International Association of Business Communicators (IABC-Houston).

From the Council for Advancement and Support of Education (CASE) District IV in 2005, the college won two Gold/Grand Awards of Excellence, an Excellence Award and two Achievement Awards for the *Marvels of Engineering* brochure and mailer. The University Photographers' Association of America (UPAA) presented two awards to the college in 2005 for science and research photos and general publication photos.

STUDENT AWARDS

Maria Clara Añez (ChE) placed second in the Keck Annual Research Conference research poster competition.

Freshmen engineering students **Leif Bagge** (ECE), **Michael Fernandez** (ME) and **Kevin Weaver** (ME) placed first at the Texas A&M Regional Conference design competition.

Barry Craver (ECE) placed second at the 30th Semiannual Texas Center for Superconductivity at UH Student Symposium for his nanotech-device fabrication research.

Ying Hu (ECE) and **Julian Vargas** (ME) were named the college's 2006 Outstanding Senior and Junior, respectively. Both students were recognized during National Engineers Week.

Phuc Huynh (ECE) was named a recipient of the Goldwater Scholarship, one of the most prestigious awards available to undergraduate students. The scholarship provides funding to students who plan to pursue a career in research.

Sandy Geffert (ME) was named one of 20 national recipients of the Harriett G. Jenkins Predoctoral Fellowship Program at NASA.

Hassan Khalil (BioE) was awarded a $500 fellowship from the American Society of Artificial Internal Organs for his abstract detailing his research with a model of the human vascular system. Though artificial organs have been in use for some time, his model of the human vascular system will allow for new experimentation in artificial organ control. It was written with the aid of professors Kamuran Kadipasaoglu, assistant director of the Cardiovascular Surgery Research Laboratories at the Texas Heart Institute, Matthew Franchek (ME) and Ralph Metcalfe (ME).

Rui Qiang (ECE) and **Dagang Wu** (ECE) won the Best Student Symposium Award at the 2005 IEEE Electromagnetic Compatibility Symposium.

PASSAGES

Brian Allen†, award-winning writer and editor, died in September 2005 at the age of 45. Over the course of his employment as a writer/editor for the Cullen College of Engineering, Brian researched, wrote and edited 198 features and news stories for the college's online newsroom and wrote 53 stories that were used for media relations efforts to promote the college. He served as editor of *Parameters* magazine since December 2001, which received four awards from IABC-Houston and a Gold Excalibur Award from PRSA Houston. Many of his scientific writing collections received awards from CASE District IV, IABC and PRSA. Brian graduated from UH with a B.A. in English Literature and was a member of PRSA, IABC and Toastmasters International.

KEY

BioE	*Biomedical Engineering*	***ECE***	*Electrical & Computer Engineering*
ChE	*Chemical Engineering*	***IE***	*Industrial Engineering*
CEE	*Civil & Environmental Engineering*	***ME***	*Mechanical Engineering*

Setting the Stage for **Nanotech Breakthroughs**

UH Professor Conducts Theoretical Research that Advances Experimentation

By Toby Weber

Scientific breakthroughs are usually portrayed as being achieved by people conducting complicated experiments in equipment-filled labs.

While this picture is certainly true at least part of the time, many of the most important discoveries are also made by individuals working with nothing but pencil and paper. These scientists use their knowledge in any number of fields (including mathematics, physics, mechanics and many other disciplines) to uncover the nature and potential of new technologies and forms of matter. By revealing how something—from a naturally occurring chemical to a man-made machine—will behave under certain conditions, these individuals, known as theoreticians, provide a framework from which experiments can be designed and their results interpreted.

This is the role filled by Pradeep Sharma, assistant professor of mechanical engineering at the University of Houston Cullen College of Engineering. "For experimentalists, if you have theoretical work, you have a sense of what to expect," he said. "Even if you get raw data, how are you going to interpret it without theoretical work? So instead of shooting in the dark, experimentalists often like to be guided by theories."

One area Sharma and his research team are exploring is quantum dots. Quantum dots, which fall under the realm of nanotechnology, are tiny crystals made of semiconductor material that measure just a few nanometers wide (a nanometer is one-billionth of a meter).These dots can be constructed practically one atom at a time in highly specific formations, allowing scientists to tailor the amount of energy they produce and absorb or the wavelength of light they emit.

When used in different ways, quantum dots can impact everything from lighting systems, to medical diagnostics, to bioterrorism preparedness, to data storage for computers. For example, by manipulating the wavelength of light quantum dots emit, scientists are constructing blue-light lasers that, by their very nature, have smaller wavelengths than standard red lasers. This smaller wavelength allows data on compact disks to be stored in spaces that are physically smaller than the amount of space required by red lasers, thus greatly increasing the capacity of CDs and DVDs.

Sharma and his research team are now using mathematical modeling to predict how quantum dots will react in particular situations and under particular conditions, thus providing other scientists with the framework for performing their own research.

In the case of quantum dots, experimentalists need some understanding of how these nanoparticles will (or, at least, should) behave in order to most efficiently design their experiments, analyze the results and eventually design products. Many times such analysis reveals properties that are not at all intuitive but are present naturally at nanoscales. Experiments are then designed to verify the existence of such characteristics, which might lead to some unconventional applications.

Indeed, Sharma's theories are currently being applied in research conducted by other researchers at UH. A research team led by Kirill Larin, assistant professor of biomedical and mechanical engineering, is developing a laser-based medical diagnostic tool that utilizes specially tailored quantum dots that reflect light at a particular spectrum when they bond to particular disease proteins, thereby informing doctors of the presence of a disease. *(See article on page 12).*

Not surprisingly, the process of formulating theories on the behavior of quantum dots is not performed in a typical "lab." Rather, Sharma calls on the qualities he has crafted during his engineering career and his understanding of several different fields, including physics and mechanics, to devise these theories. He then works with his research team, comprised primarily of graduate students, to perform further calculations to determine the accuracy and implications of his ideas.

"Some part of (developing these theories) is creativity, some part of it is mathematical knowledge, some part of it is your knowledge of the field. It's a mixture of things. You have to be knowledgeable and aware of what other people are doing in order to keep up to date," he said.

Currently, one of the areas Sharma is paying particular attention to is the effect of mechanical strain on quantum dots. Mechanical strain is simply the physical deformation of an object. When you stretch a rubber band, you are subjecting it to mechanical strain.

Professor Pradeep Sharma works with graduate students Mohamed Sabri Majdoub, Nikhil Sharma, Ravi Maranganti and Feng Shi to analyze the effects of length-scale on a material's behavior.

"Traditionally," Sharma said, "scientists have held that impact of mechanical strain on the mechanical properties of an object do not change as the size of the object changes." New research by Sharma and his team, however, shows that mechanical strain impacts materials differently at the nanoscale versus the macroscale, the realm in which most of the world operates. "In the bulk state, everything averages out," said Sharma. "As you get smaller and smaller, though, the quantum effects become more prominent."

These changes in mechanical properties, in turn, impact other attributes of materials. "How do changes in mechanical properties that occur with changes in size affect the electronic properties? That's what we're studying. We're trying to come up with theories that predict those changes," Sharma said. "More specifically, we are studying the impact of mechanical strain on quantum dots' 'bandgap,' the property that dictates how much energy is needed to make a semiconductor conduct electricity."

In the bulk or macroscale, a material's band structure is predetermined by nature. If researchers need a specific band structure to perform a task, then they must find another material that offers that property and hope that it meets their other needs, as well.

At the nanoscale, however, variations in size and mechanical strain can change a material's band structure, in effect setting up a situation where scientists should be able to tune a bandgap to a specific frequency in order to meet their particular needs. This is where Sharma's work is applied. His theories provide experimentalists with guidelines for applying mechanical strain to a quantum dot in order to attain a specific bandgap or more generally, a specific band structure.

With a tunable band structure, he says, researchers could construct more efficient and sensitive energy sensors that could be used to track missiles or make night-vision goggles, or more powerful lasers that improve data storage or act as tools for diagnosing diseases.

For any of these to become reality, though, the pioneers of experiments need an idea of what's possible in the nanorealm, and that is exactly what Sharma gives them.

"Hopefully my work provides some guidelines for experimentalists," said Sharma. "Theory and experiments have to go hand-in-hand." ■

DONOR ROLL CALL

SEPTEMBER 1, 2004 – AUGUST 31, 2005

The list below reflects private support made to the UH Cullen College of Engineering during the period of September 1, 2004 through August 31, 2005. The college regrets any errors or omissions and would appreciate notification of corrections. To make a gift to the college, contact Vita Como at 713-743-4216 or vcomo@uh.edu.

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(Continued on page 25)

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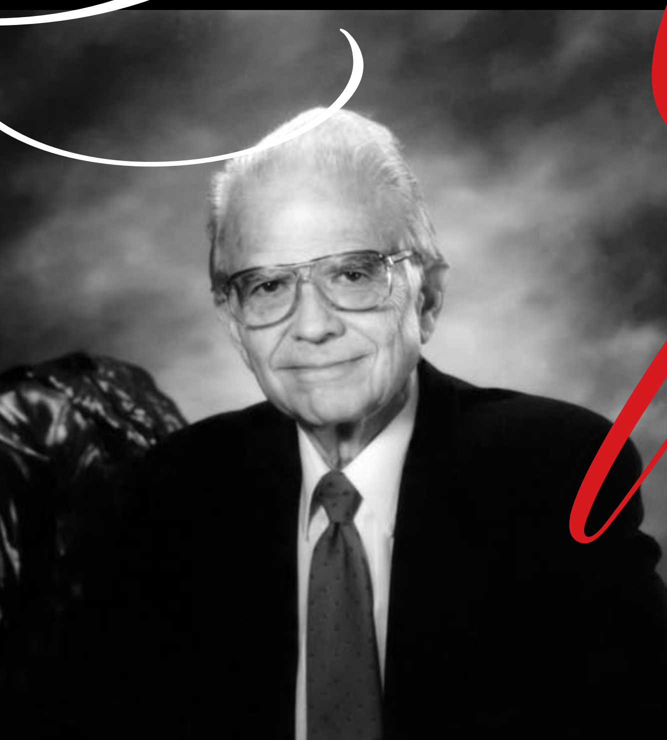

PHOTO BY BERYL STREWSKI PHOTOGRAPHY

In Memoriam:

Frank M. Tiller

1917–2006

After spending a lifetime educating and giving to others, Frank Tiller, the first dean of the University of Houston Cullen College of Engineering, passed away in January at the age of 88.

An educator for more than 50 years, Tiller's professional legacy alone is almost too full to chronicle. It includes important accomplishments as a professor, administrator, mentor, educational ambassador and researcher. Tying all these together was a man who was passionate about everything in which he was involved.

Tiller, who held a Ph.D. in chemical engineering from the University of Cincinnati, joined UH as engineering dean in 1955 and was instrumental in laying the groundwork for many of its future successes. Reflecting on Tiller's impact, Raymond Flumerfelt, dean of the Cullen College of Engineering, noted that "Frank was responsible for establishing the early leadership and educational foundations of the college, and was responsible for hiring the early department chairs and faculty who led our emergence to excellence in the 1970s and 1980s."

In 1955, the college of engineering was a relatively new institution—the Cullen name had not yet been attached to it, in fact. As such, the college had only a few faculty members who held Ph.D.s. Remedying this situation became one of Tiller's most important accomplishments as dean.

Stressing the importance of high-quality instructors and professors, Tiller's tenure saw the addition of 14 Ph.D.s to the faculty, bringing the total number to 18. Of those 14, 12 Ph.D.s were earned by existing instructors who themselves went back to school for their terminal degrees, making Tiller's faculty-improvement campaign a huge success.

Tiller was also instrumental in assembling the physical infrastructure necessary for the college to thrive. During his tenure, he attained the first large computer for the university. More importantly, he secured much of the funding for the first engineering building, which to this day serves as one of the college's three primary structures.

In addition to helping establish the college as a whole, Tiller's presence at UH contributed to the rise of the Department of Chemical Engineering. As a scholar, Tiller performed groundbreaking research in the field of fluid/particle separation, earning wide recognition as the father of modern filtration theory. As a pioneer in filtration research, Tiller's presence at UH helped establish the college's Department of Chemical Engineering as one of the best in the nation, said Michael Harold (1985 PhD ChE), Dow Chair Professor and chair of the Department of Chemical Engineering.

"For a department to be highly regarded, you have to have a group of individuals who are pioneers in their respective research areas," Harold said. "He was one of them for chemical engineering."

Tiller's legacy also includes his efforts to establish and improve engineering programs outside UH. After stepping down as dean in 1963, he began working with colleges in Latin America, helping them establish their own chemical engineering departments. Often, these programs would become the most popular on campus, and for this work, Tiller was honored with no fewer than two honorary doctorates and seven honorary professorships from universities in Central and South America.

According to all who knew him, all of these efforts came from a clear love of education and educating. Tiller simply loved imparting knowledge of all sorts to those he came in contact with. According to James Richardson, professor of chemical engineering who worked with Tiller since the 1960s, this passion made its way into practically every one of Tiller's conversations, and sometimes was more than the people he was speaking with would be ready for.

"I once heard somebody joke, 'If you want to know the time, don't ask Frank Tiller because he'll give you the history of clock making and the theory of astronomical time,'" Richardson said. "But that was the educator in him."

As a professor, Tiller had an open-door policy, which would often lead to relationships with students that evolved from teacher and advisor to mentor and father figure.

This intense interest and concern Tiller held for those around them was often most applied to and appreciated by his graduate students from overseas. Many of these students would rely on Tiller's generosity while they were adjusting to life in a new country, to the point that they would often, in fact, stay in Tiller's home while they secured their own housing.

"New students, especially foreign students who had just come to the U.S., who had a problem—family issues or financial issues—would be taken care of by Tiller," said Wu Chen (1986 PhD ChE), who had Tiller as his dissertation advisor.

As Tiller progressed in life, his teaching, research and mentoring activities naturally slowed down. Even then, however, he made efforts to improve UH through financial support. He established an endowed scholarship, made a significant donation to the Justin Dart, Jr. Center for Students with DisABILITIES and established the first charitable gift annuity in the university's history, which resulted in the Frank M. and Martha R. Tiller Scholarship Endowment supporting undergraduate chemical engineering students.

"He had an extraordinary bond with the university," said Tiller's daughter, Fay Bryan. "It was his life, really. He was very committed to improving the quality of the Cullen College of Engineering." ■

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UH Engineering Alumna Develops

HAND MIMETIC DEVICE For Premature Babies, Mothers

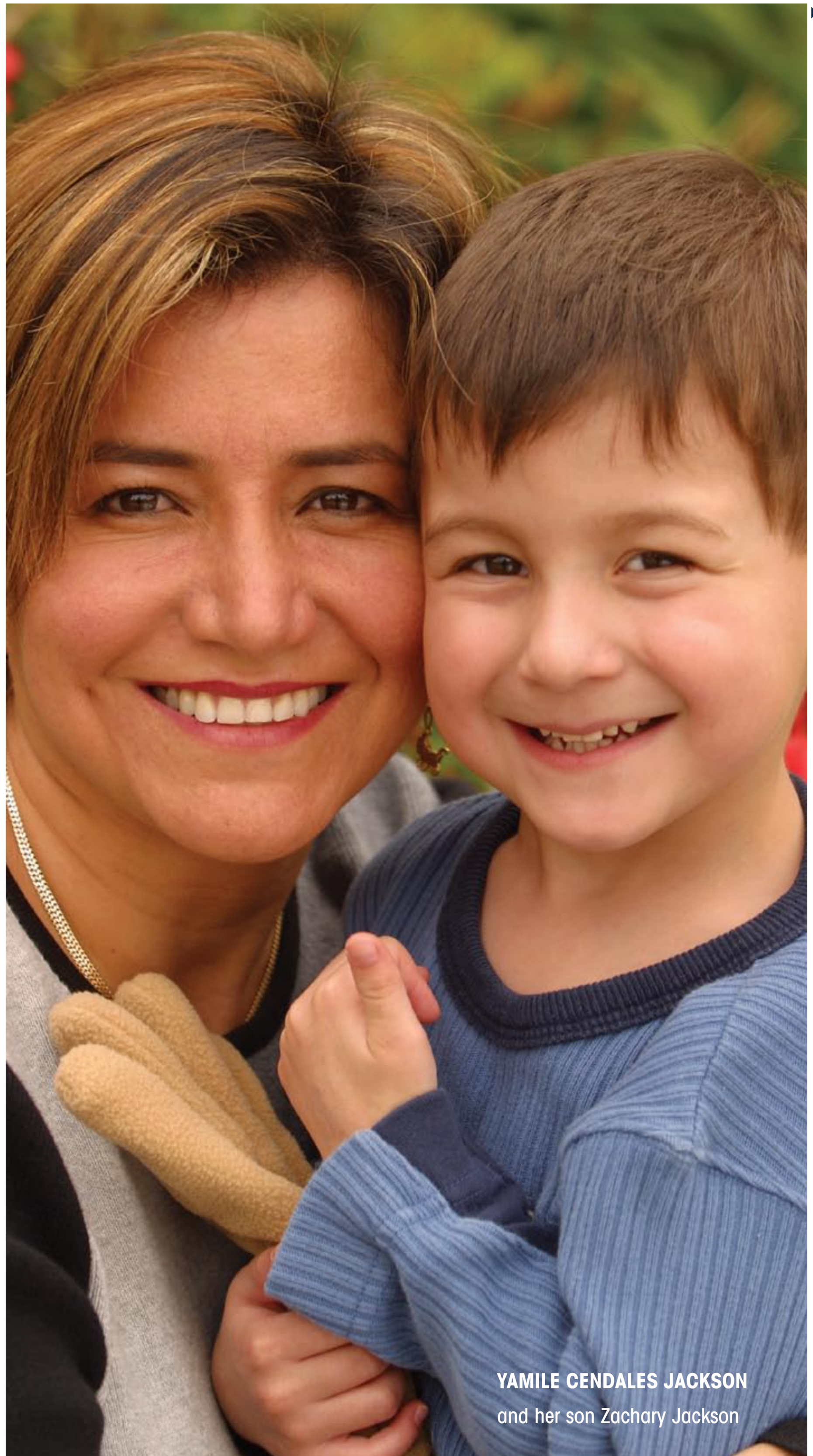
BY PORTIA-ELAINE GANT

When **Yamile Cendales Jackson** (1991 BSIE, 1994 MSIE, 2000 PhD IE) gave birth to her son Zachary, he was 12 weeks premature and weighed only one pound, 15 ounces. Now Zachary is a thriving five year old, and Jackson has used her experience to develop a hand mimetic device, the Zaky, which is named after her son, to help premature babies and their mothers feel protected and closer to each other. »

THE ZAKY

Marketed through Yamile Cendales Jackson's company Zakeez, the Zaky is an ergonomic pillow for premature and full-term babies that simulates the look, feel, touch and scent of their mother's arm and hand. Jackson said she created the Zaky because she wanted to offer her son company, comfort and support while she was away from the hospital.

PHOTOS COURTESY OF ZAKEEZ



YAMILE CENDALES JACKSON
and her son Zachary Jackson

"When Zachary was hospitalized for five months it was devastating for us to see him suffer without being able to do anything. Sometimes he was so sick that we were not allowed to even touch him. We witnessed babies that were sick and not so sick, babies that died, and even babies that were never held or visited by their relatives. At the Neonatal Intensive Care Unit (NICU), I would notice items that were donated to the hospital 'in memory of' babies, and it saddened me that there were not many 'on behalf of' gifts. Did babies have to die for adults to help?" Jackson said. "So I prayed to God to make a pact with me: 'If you let us take Zachary home, I'll help babies.' The Zaky is the way I found to keep my side of the bargain with God."

Though the Zaky is not a medical device, Jackson said the idea for the innovative tool did originate with significant input from nurses, doctors, therapists and mothers in the NICU at Memorial Hermann Children's Hospital in the Texas Medical Center, where the Zaky has been successfully used since 2001.

"There were times when the nurse would place a little beanie baby on top of my son's back," Jackson said. "NICU nurses explained to me that when babies are in the womb they stretch, kick and move, and the womb brings them back to the fetal position. That's why when they are born full-term the mother is taught how to swaddle the baby using towels or blankets. When babies are born prematurely, they can't be swaddled because they have tubes, IV needles and monitors, so when they stretch as they did in the womb, they are not able to return to that fetal position and it results in stress."

"The nurses taught me how to reposition him and to place my hand on top to give him boundaries and allow him to feel close to me. It couldn't be patting or rubbing because these provide too much stimulation. This method of comforting by touching him with my hands and giving him boundaries when I could not hold him on my chest was very effective; however, I was not allowed to stay every night, and the nurses were caring for other babies simultaneously. I had to find a way to help my son and help me with my feelings of separation when I could not be there," said Jackson.

Jackson said she noticed that in the mother's absence, nurses improvised with rolled up t-shirts or towels or even a beanie baby.

Currently, Jackson runs Zakeez from her home to maximize her time with Zachary. The Zaky can be found in baby stores, child-care facilities, pediatrician offices and hospitals in the United States, Canada, Latin America and Europe, and Jackson and Zachary handle their web site sales personally.

"I try to involve Zachary as much as possible," Jackson said. "When we get an online order, he goes and gets the Zaky. We package it together and he puts it in the mail. He understands that the Zaky is going to help a mother and her baby."

For the work she is doing with babies, Texans Can, a non-profit organization that works with young mothers, presented Jackson with their Motherhood Lifetime Achievement Award in 2005. The Zaky also received the Gold Award from Family Review Center in 2006 for its distinct design, appeal and purpose.

In addition to spending time with Zachary, Jackson also maintains her first company, Ringstones Consulting International, Inc., offering project management, consulting and training services internationally in English and Spanish.

"I knew I wanted to be an industrial engineer since I was 14. My father was an engineer, my mother has a Ph.D. in history, and she taught me that I could be anything I wanted to be if I worked hard enough," said Jackson, a native of Columbia. "I really liked science, but I also liked interacting and helping people on a human level, so industrial engineering was the perfect fit for me."

Because there were no Ph.D. programs in engineering in Bogotá, Colombia, Jackson came to the United States with her uncle's help and continued her education at the University of Houston. Studying engineering has allowed Jackson the professional mobility to engage in a number of projects.

"Being an industrial engineer has been instrumental in my ability to go from working

> "Being an industrial engineer and having a passion for product design and project management helped me understand and respond to the needs of babies to feel accompanied, secure and well positioned; the need of mothers to bond with their babies; and the need of nurses to comfort and care for multiple babies simultaneously," Jackson said. "With immense help from nurses, doctors and mothers, the Zaky was born."

at Fluor Corporation and Kvaerner in the construction field for almost 10 years to opening my own international project management firm to helping mothers and babies in what could very well be the most traumatic experience of their lives," Jackson said.

Between her responsibilities as a mother and a business owner, Jackson remains active in the academic side of the field. Since 2003 she has served as an adjunct professor in the MBA program at the University of Applied Sciences of Vorarlberg in Austria, which takes her (and sometimes her son and husband, Larry) to Europe for three weeks each winter and summer.

Jackson has also helped conduct a research study about risk assessment for international capital projects with the Construction Industry Institute (CII) and presented this research at the CII's Annual Conference in Orlando, Florida, and Austin, Texas, as well as the Research Conference of the Project Management Institute in London and the Annual Congress of the Institute of Industrial Engineering in Houston. She is also on the board of directors for the Project Management Institute. In addition to her degrees from UH, Jackson also has a master's degree in industrial engineering from Clemson University.

Jackson's family experience and the Zaky have been featured in the health reports of the news programs on ABC, NBC, Univision, CBN and Fox as well as articles in the *Houston Chronicle* (July 2005), *Star News Newspaper* (Dec. 2005), *Readers Digest* (April 2002), *Institute of Industrial Engineer's Magazine* (July 2004), and *Physician's Practice Magazine* (Nov. – Dec. 2004). The Zaky was also featured in a CBS Special Report titled "Healing from the Storm" (June 2002) and the made-for-TV movie "14 Hours," which aired on TNT (April 2005).

Of all her accomplishments and accolades, Jackson said her son, and the work she does with babies and kids with special needs, are her greatest achievements.

"The birth of Zachary definitely changed my life, both personally and professionally. I made a commitment to use my soul, experience and education to help improve the quality of life of premature babies," Jackson said. "I want to do more research and product development to improve the lives of more babies, their mothers and their caregivers. I don't want Zachary's suffering to be in vain. I want him to know that he has helped thousands of babies, that we are very blessed for having him and that I am very grateful that he came home with us." ■

::::: 1970's :::::

Durga Agrawal (right) and his wife Sushila with Lynne Cheney (center)

DURGA D. AGRAWAL (1970 MSIE, 1974 PhD ME), president of Piping Technology & Products, and his wife Sushila were invited to a State Dinner at the White House in July 2005. President George W. Bush introduced Durga to Prime Minister Manmohan Singh of India as his good friend from Texas. Prime Minister Singh and President Bush declared their resolve to transform the relationship between their countries and establish a global partnership. Singh was leading a delegation of Indian officials and businessmen for three days of discussions in Washington. Following a meeting with President Bush, the two leaders announced several new bilateral initiatives in health, science, technology, trade, economic development, agricultural production, energy cooperation, disaster relief and strategic partnership.

GUS KOPRIVA (1970 BSCE) is the global project controls leader at Dow Chemical. By day he's a Dow Chemical executive, but evenings and weekends are spent visiting art studios, reading art history, perusing auction catalogs, updating the database of his collection of more than 1,300 objects, and buying works of art—especially contemporary Texas art and German Expressionist prints. He also collects Surrealist work and art of FDR's Works Progress Administration period. An exhibition of 70 German Expressionist prints from his collection has been on display at the Old Jail Art Center in Albany, Texas. He organized exhibitions of Texas art for the Artco Gallery in Leipzig, Germany, in 2002, and for Museo Humboldt during the 2003 Havana Biennial. He has similar shows of Texas art for non-profit and university galleries in Lima, Peru, and in Beijing. He curated the exhibition for Lawndale Art Center's 25th anniversary exhibition last fall and, as a member of the Municipal Arts Commission appointed by Houston Mayor Bill White, has organized an exhibit of work by Houston artists for City Hall. Kopriva has also organized and managed benefits for the American Red Cross, the non-profit Houston Artists Fund and the UH School of Art.

LEO GARCIA (1978 BSCE) was named project executive administrator for the Animal Health Research Center to be built on the campus of the University of Georgia at Athens. When completed, it will be the first facility of this type not to be operated by the U.S. government. As executive administrator, he will be responsible to the State of Georgia and the University of Georgia. He can be reached at lgarcia844@aol.com.

::::: 1980's :::::

GARY L. BROWN (1981 BSIE) was named president of CCSI, an industry leader in corrosion protection for more than 20 years, with more than two million field joints coated worldwide and the largest fleet of field joint coating systems in the world. Previously, he was president of CRP Balmoral Inc. He has been active in the oil and gas industry for over 30 years and has held numerous senior management positions at companies including Halliburton, Dresser Industries, Axelson and Cooper Cameron.

DAVID A. CASEY (1984 BSEE) was named vice president of worldwide sales at California Micro Devices. Previously, he was vice president of worldwide sales at Alliance Semiconductor and held a number of key management positions at Hitachi Semiconductor, including vice president of sales and marketing for their Memory and Mixed Signal Business Unit. Earlier in his career, he also worked for Pioneer-Standard Electronics and AMF Geospace.

PETER CHEUNG (1985 BSCE) and his wife Sue opened a coffee shop, the Pearl Café, in Mountain View, California, offering homemade cookies and muffins, and the Vigal coffee brand roasted in San Jose. They have owned two successful Chinese restaurants.

ANN WHITTON (1985 MSIE) opened Plato's Closet in Katy, which carries name brand, stylish resale clothes in good condition for teens and young adults. She spent 15 years in engineering with the Houston Metropolitan Transit Authority and was occasionally posted to an Alabama bus manufacturing plant to inspect new vehicles. The Whittons, who recently moved back to Houston, lived in Singapore for seven years, where Ann taught high school math and science.

VENKAT (SELVA) SELVAMANICKAM (1988 MSME, 1992 PhD MatE) was recently named Superconductor Person of the Year by *Superconductor Weekly*, one of two people to receive the award in 2005. He is one of the key figures behind SuperPower Inc.'s development of high-temperature superconducting wires, which increase the reliability of electric power transmission. In 1988, he created a new method to fabricate superconductors, setting internationally recognized design and performance marks. His master's thesis on superconductivity became one of the most-cited works on the subject. After receiving his degree, he worked at the Oak Ridge National Laboratory. In 1994, he joined Intermagnetics General Corp., SuperPower's parent company, which was doing its own work on superconductive wires. After starting at Intermagnetics, he left for three weeks to get married. His wife Kala now works as an advisory data engineer at MapInfo Corp. He raised more than $10 million in external funding for the company and in 1996 was recognized by the White House for his discoveries. He has more than 20 patents or patents pending in his name. He used the $500,000 he received from the presidential award to develop a breakthrough superconducting wire at Intermagnetics that was the impetus for the creation of SuperPower in 2000.

JEFFREY HANLEY (1989 BSEE) was appointed manager of NASA's Constellation Program, based at Johnson Space Center. He leads the development of the nation's new spacecraft launch system, including launch and transfer vehicles, landers and other systems designed to take astronauts to the moon, Mars and beyond as part of the Vision for Space Exploration. Previously, he was chief of the flight director's office. From 1996 – 2005, he was flight director for space shuttle and international space station missions.

::::: BIRTHS :::::

COLBY WRIGHT (2002 BSCE) and his wife Sonia welcomed home their first child, Alexander Scott Wright, on Jan. 7, 2006. He weighed six pounds, 12 ounces and measured 21 inches long. Colby was recently licensed as a professional engineer in the State of Texas. He is a project manager at Traffic Engineers, Inc. in Houston and can be reached at colby@trafficengineers.com.

ALUMNI PROFILE

UH ENGINEERING ALUMNUS serves as FIRST VIETNAMESE-AMERICAN in TEXAS LEGISLATURE

By Brian Allen[1]

"I knew I would be able to use my mechanical engineering background because it provided me with the logical reasoning skills that lead to practical solutions to complex problems," **HUBERT VO** said.

State Rep. Hubert Vo (1983 BSME) recently served in his first session of the Texas Legislature. The UH alumnus is a first-generation Vietnamese-American and the first Vietnamese-American to be elected to the Texas legislator. He represents District 149 in Southwest Houston, a district that includes a large portion of Alief, parts of West Houston and one precinct in Katy.

As a fledgling member of the Legislature, Vo felt inspired by his surroundings and the beauty of the Capitol itself. "Every morning, driving to work, I would look up at that beautiful dome, so elegant," he said. "It gives you a good feeling, and it reminds you of all your responsibility to serve your constituents and all Texans."

His education was instrumental in his decision to run for office. "I knew I would be able to use my mechanical engineering background because it provided me with the logical reasoning skills that lead to practical solutions to complex problems," Vo said. "I even used my education when deciding to run. Before you do something, you analyze it from all the important angles. In this case, I analyzed my opponent, the district, the voters and the financial aspects, and put it all together. At that point, I really believed I could win."

Vo, who grew up in South Vietnam, speaks four different languages, including French, Spanish, Vietnamese and English. After graduating from a French high school, he started college. With the fall of Saigon in 1975, he and his family came as refugees to the United States. After living in Lubbock, Texas and attending Texas Tech University for a year, in 1977 Vo and his family moved to Houston where he attended the University of Houston during the day and worked at Hughes Tool Company as a machinist at night. In 1983, he achieved his dream of a college education and graduated with a bachelor of science degree in mechanical engineering from UH.

One piece of legislative work that Vo is particularly proud of was his involvement in drafting a section of the Telecommunications Bill (HB 789) that will impact Texans in a positive way.

"Some internet service providers offer phone services that lack the ability to connect to 911," said Vo. "There was an incident in my district where some home invaders broke into a home and shot a father and mother. Their teenage daughter tried to call 911 but couldn't reach that emergency service through her home phone. Fortunately, she was able to run across the street and use a neighbor's phone, and her parents received emergency medical care and survived."

This legislation makes sure that all internet service providers who do not provide 911 service must notify consumers in writing, on a separate sheet of paper by itself, that they will not have 911 service. "I was able to reach out across party lines and work with senior members of the House of Representatives," Vo said.

A successful businessman, Vo has been a member of the Alief community for over 20 years. He serves on the board of the Alief YMCA and is a council member of the Alief Super Neighborhood Council. He is an active member of the community who strives to provide opportunities to others, as he was once provided, and help better the community as a whole.

Vo's election, which was won by the narrow margin of 33 votes, unseated longtime Republican incumbent Talmadge Heflin. Although his opponent disputed the initial election results, the House ultimately confirmed Vo's election.

Vo's background includes a vast array of work experiences, ranging from being a busboy, cook, salesperson, convenience store clerk, steel worker, business owner, realtor and now a successful entrepreneur and real estate developer.

Vo and his wife Kathy have been married for over 20 years. He is a dedicated husband and a father of three. ■

DEATHS

BILLIE G. ARNOLD (1941 BSE) died Oct. 3, 2005, at the age of 88. A former member of Arnold-Rippey Company, he was the founder and long-time president of Mechanical Products Co. He was a fifth-generation Texan and a member of the San Jacinto Chapter of Sons of Republic of Texas, the Heritage Society and the Museum of Fine Arts. During his lifetime, he completed the Air Force Cadet Program at Ellington Field and served in the Eighth Air Force European Operations during World War II. He is survived by his wife Mickey Rester Arnold.

LLYOD H. (POPPY) LUCKOW (1949 BSChE) died Jan. 3, 2006, at the age of 81. During his lifetime, he served in the U.S. Air Force as a first lieutenant and worked at the Goodyear Tire and Rubber Plant in Houston, from which he retired after 39 years of service. He is survived by his wife of 60 years, Alpha Jo, and daughters Penny White and Kristi Kainer.

FRED E. STAPLETON (1954 BSPE, 1956 BSE) died Jan. 8, 2006, at the age of 85. He traveled throughout his life all over the world: first while serving in the U.S. Army during World War II, then while working for Petty Ray Geophysical for 43 years. He is survived by his wife of 65 years, Rubyetta Nix "Sug" Stapleton, daughter Sallye, son Fred and two granddaughters, Teal and Sarah.

ALFRED WILLIAM KOBS (1958 MSIE) died Jan. 30, 2006, at the age of 86. He served two tours of duty in the U.S. Navy during World War II and the Korean Conflict. He owned and operated Kobs Engineering in Houston until his retirement and was a 50-year member of the Galveston Masonic Lodge #6. He is survived by wife A. Pidd Miller Kobs, sister Margaret Kobs, and daughter Pyddney Kobs Jones and family.

JAMES A. BINKLEY (1961 BSCE) died Jan. 3, 2006, at the age of 76. He served in the U.S. Navy from 1951 – 1955. He was the founder and president of Binkley & Barfield, Inc., Landev Engineers, Inc. and Baseline Corporation. He is survived by wife Ruby Ann, daughter Donna, son James and step-children Stephanna Brinkman and Tim Coppock.

CHARLES J. TAMBORELLO (1961 BSCE) died Oct. 29, 2005. He was a well-known structural engineer who designed and built several concrete bridge structures in Harris Country, as well as oil rig structures in the Gulf of Mexico and Puerto Rico. In 1994, he received the UH Distinguished Engineering Alumnus Award. He is survived by his wife of 52 years, Margie Landry, whom he met while finishing his tour of duty in Korea as a U.S. marine, and by his four children, Terry, Tina, Charles and Toni. In his honor, fellow alumni, friends and colleagues established the Charles J. Tamborello Memorial Scholarship Endowment at UH.

AMANDRE WILSON (1991 BSEE) died Dec. 22, 2005, at the age of 40, with her fiancé, Joseph M. Liebetreu, age 43. She attended the Queens College in Lagos and the University of Ife in Nigeria before traveling to the United States to seek new opportunities. After graduating with honors from UH, she accepted a position at ExxonMobil, where she served as an asset portfolio manager at the time of her death.

SHAWN E. NOWLIN (1996 BSME) died May 6, 2005, after a brief battle with cancer, at the age of 34. Upon graduating from UH, he accepted a position at Baker Oil Tools, where he served as an engineering manager at the time of his death. He is survived by his wife Dorothy and sons Noah and Lucas.

Key:

AeroE — Aerospace Engineering
BioE — Biomedical Engineering
ChE — Chemical Engineering
CE — Civil Engineering
ComE — Computer Engineering
E — Engineering
EE — Electrical Engineering
EnvE — Environmental Engineering
IE — Industrial Engineering
ME — Mechanical Engineering
MatE — Materials Engineering
PE — Petroleum Engineering

SEND US your alumni news about new jobs, promotions, honors, moves, marriages, births, etc. Attach additional news clips or photos separately. Please include a self-addressed stamped envelope if you want your photos returned.

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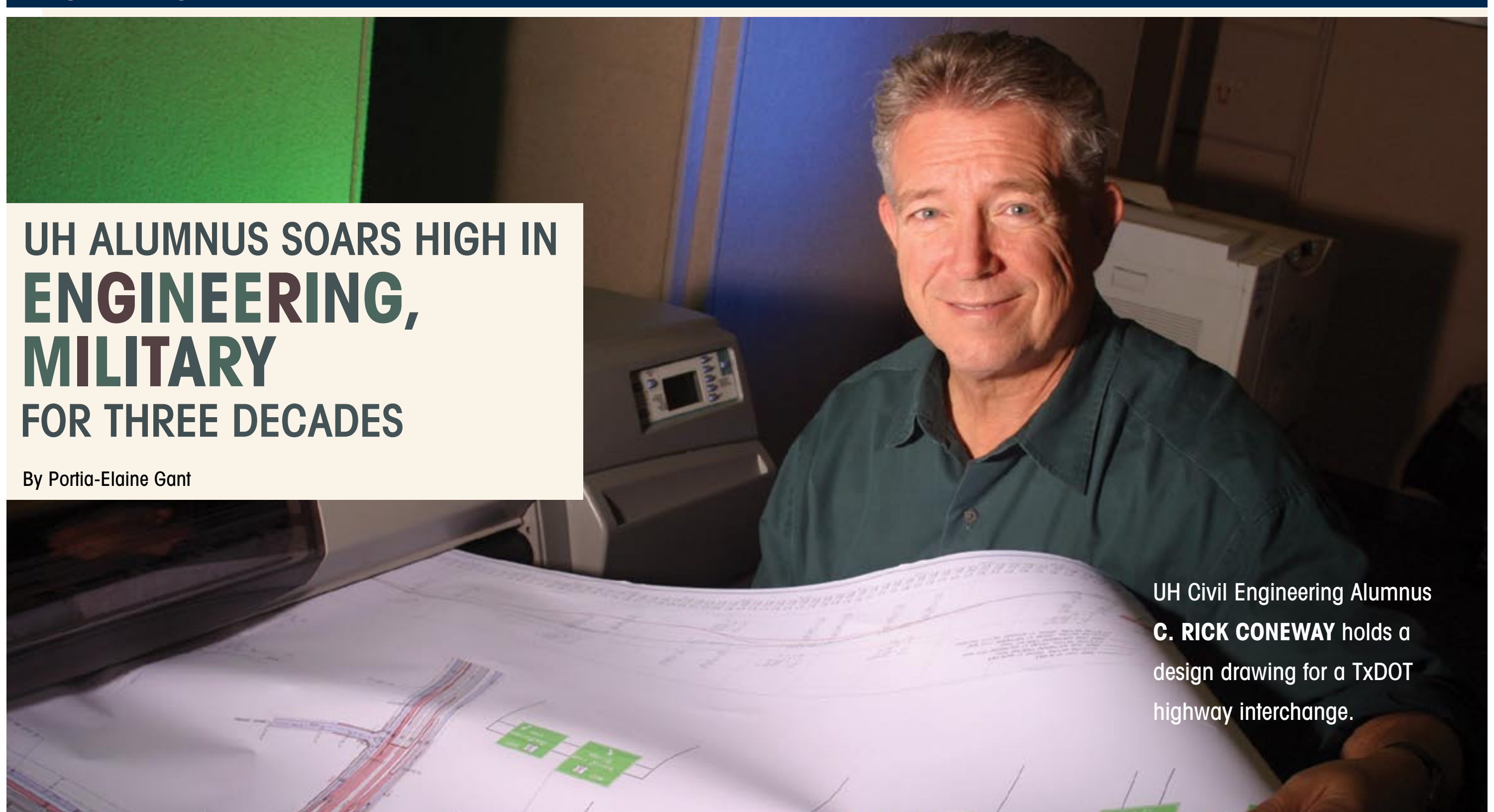
ALUMNI PROFILE

UH ALUMNUS SOARS HIGH IN ENGINEERING, MILITARY FOR THREE DECADES

By Portia-Elaine Gant



UH Civil Engineering Alumnus **C. RICK CONEWAY** holds a design drawing for a TxDOT highway interchange.

C. Rick Coneway (1973 BSCE, 1976 MSCE) always wanted to fly. After receiving his first bachelor's degree in psychology from Tulane University, the native Houstonian launched what is now a 32-year dual career in the U.S. military and in engineering.

Coneway's interest in the field of civil engineering was sparked by the Earth Day movement, which he encountered while serving in the U.S. Navy. "I saw that Earth Day was going to become a part of our culture, and somewhere along the line they would need experts," Coneway said. "I thought it would be my opportunity to participate in helping to solve problems in our environment."

Upon completion of his active-duty obligation with the Navy as a pilot, he returned to Houston to begin engineering studies at the University of Houston. After he completed his bachelor's degree in civil engineering, Coneway decided to pursue graduate studies in the field. It was during that time that his career in engineering began to take shape.

"At UH, I worked with professors who were outstanding and taught me a lot about the community and what I could do with my career," Coneway said. "My strongest influence was my advisor, former associate professor Jack Matson, P.E., D.E.E. He's a real professional and knows how to use engineering knowledge to solve problems in a practical way."

Following the completion of his education, Coneway relocated to Austin, Texas, transferring his duty to the U.S. Air Force (USAF) Reserve to serve as a civil engineering officer. The highlight of his career in this position was returning to active duty to serve as the executive director/commander for the Air Force Center for Environmental Excellence.

Less than a decade after graduating, Coneway developed his own civil and environmental engineering and land surveying consulting firm, Coneway and Associates, Inc. His professional career earned recognition from many professional organizations, including the American Council of Engineering Companies and the Texas Society of Professional Engineers (TPSE). TSPE named him Young Engineer of the Year in 1978 and recognized him once again in 2000 as Texas Engineer of the Year.

Overall, Coneway's illustrious career includes over a decade of service to Naval Aviation and nine years of service as a pilot for the USAF. Coupled with many additional years as a civil engineering officer, a consultant and an entrepreneur, Coneway has found that the sky has no limit. ■

DISTINGUISHED ENGINEERING ALUMNI *Awards* 2005

The Engineering Alumni Association honored Benton Baugh (1967 BSME) and Steven Simmons (1981 BSCE) as Distinguished Alumni at the Distinguished Engineering Alumni Awards Dinner in June 2005 at the Four Seasons Hotel. Eray Aydil (1991 PhD ChE) received the Distinguished Young Engineering Alumnus Award and Cheryl Thompson-Draper received the Roger Eichhorn Leadership Service Award. Electrical and Computer Engineering Associate Professor Betty Barr received the Abraham E. Dukler Distinguished Engineering Faculty Award.

BENTON F. BAUGH

DISTINGUISHED ENGINEERING ALUMNUS AWARD

Benton F. Baugh (1967 BSME) is president and owner of Radoil, Inc., an oilfield engineering and manufacturing company. He also owns Baugh Consulting Engineers, Inc., an oilfield-related consulting and expert witness firm. Some of Radoil's significant product areas include reels for deepwater control systems, J-lay pipeline towers, arctic platforms and pipeline blockage remediation activities. Prior to starting his own businesses, he worked with the Beta Division of Brown Oil Tools, Vetco Valve Company, Vetco Offshore, Cameron Iron Works, Camco and Bowen Tool Company. He is a member of the National Academy of Engineering, fellow in the American Society of Mechanical Engineers, member of the Marine Technology Society and a registered professional engineer. He has written numerous technical papers, holds 96 patents, and has served as chair of the ASME Petroleum Division, president of the UH Engineering Alumni Association, chair of the ASME/UH OTC Cajun Crawfish Boil, on the board of directors of the Offshore Technology Conference and on the board of directors of the Offshore Energy Center. He received his M.S. and Ph.D. degrees from Kennedy Western University.

STEVEN E. SIMMONS

DISTINGUISHED ENGINEERING ALUMNUS AWARD

Steven E. Simmons (1981 BSCE) has served as the deputy executive director of the Texas Department of Transportation (TxDOT) since November 2001. He oversees the daily administrative and engineering operations of an agency with more than 14,800 employees and a $6.7 billion annual budget. Steven also serves as TxDOT's principle Washington liaison, working closely with federal officials and Congress in the transportation funding reauthorization process. He recently headed efforts to produce the department's Texas Metropolitan Mobility Plan, a program designed to reduce traffic congestion in Texas. A native Houstonian, Steven joined TxDOT in 1982 as a project manager in the department's Northwest Harris-Waller Area Office. Earning his professional engineer's license in 1986, he progressed through several positions within the agency. He became deputy district engineer for the Houston District in 1993. Five years later, he was promoted to district engineer in Fort Worth. Under his leadership, the Fort Worth District received the TxDOT Design Excellence Award in 1998, 1999 and 2000. He also served on the civil engineering advisory boards for UH and The University of Texas at Arlington. In 1997, he received the UH Distinguished Young Engineering Alumnus Award.

PHOTO BY JEFF FANTICH

Betty Barr, Cheryl Thompson-Draper, Eray Aydil, Benton Baugh and Steven Simmons were honored at the Engineering Alumni Association's 2005 Distinguished Engineering Alumni Awards Dinner.

ERAY S. AYDIL

DISTINGUISHED YOUNG ENGINEERING ALUMNUS AWARD

Eray S. Aydil (1991 PhD ChE) is a professor at the University of Minnesota Chemical Engineering and Materials Science Department. He received B.S. degrees in chemical engineering and materials science from the University of California (UC) Berkeley, both in 1986. He completed his graduate research at UH under the supervision of professor Demetre Economou. He joined the chemical engineering department at UC Santa Barbara in 1993 as an assistant professor, was promoted to associate professor with tenure in 1998, and was promoted to full professor and vice chair in 2001. Eray has authored and coauthored more than 110 papers and holds four patents in the field of plasma processing and diagnostics. He has received the Norman Hackerman Young Author Award from the Electrochemical Society, the National Young Investigator Award from the National Science Foundation and the Camille-Dreyfus Teacher-Scholar Award from the Dreyfus Foundation in 1993, 1994 and 1997, respectively. For his undergraduate teaching at UC Santa Barbara, he was selected by the students as the Professor of the Year in 1996, 1999 and 2003. He joined the University of Minnesota in April 2005.

CHERYL THOMPSON-DRAPER

ROGER EICHHORN LEADERSHIP SERVICE AWARD

Cheryl Thompson-Draper is a native Houstonian. She was appointed as a commissioner of the Port of Houston Authority by Harris County Judge Robert Eckels and the Harris County Commissioners Court on June 27, 2000 and was reappointed to her third term in 2004. Cheryl is only the third woman to be appointed to serve as a commissioner since the inception of the Ports and Harbors Board in 1909. She is the retired chief executive officer, chair of the board of directors and owner of Warren Electric Group, Ltd., an 83-year-old, $315 million enterprise. Warren Electric Group was the largest woman-owned and managed business in Houston for many years, as well as third-largest in Texas. Cheryl has garnered several honors and awards of distinction. She has been named Texan of the Year by All Those Texans, honored as one of the Women on The Move by the Texas Executive Women and recognized by the Mayor of Houston, U.S. Chamber of Commerce and the Port of Houston Authority as the International Executive of the Year. The Texas Women's Chamber of Commerce named her a Woman of the Century. Cheryl is also in the Ernst and Young Hall of Fame. Her UH endeavors include support of the Cullen College of Engineering and the Houston Alumni Organization, and she serves on the Chancellor's National Advisory Council.

BETTY J. BARR

ABRAHAM E. DUKLER DISTINGUISHED ENGINEERING FACULTY AWARD

Betty Barr is a native Houstonian who attended Houston public schools. She received her B.S., M.S. and Ph.D. in mathematics from UH. Not wanting to leave Houston, Betty was hired as an assistant professor in the Systems Engineering Program of the UH Cullen College of Engineering in 1971. When the systems program was moved from Industrial Engineering to Electrical Engineering, she became a member of the EE faculty. Betty became the director of undergraduate studies in the department in 1982. She was promoted to associate professor and named associate chair of the department in 2003. Betty has received commendations from the college for teaching excellence several times and has been given the Kittinger Teaching Excellence Award from the college twice. She received the university's George Magner Award for Excellence in academic advising, and the college's Career Teaching Award. She was elected to membership in Tau Beta Pi as an outstanding engineering educator. Betty has served as the engineering representative on the UH Undergraduate Council for more than a decade, currently serving on the Degree Programs Committee. She is chair of the College Undergraduate Curriculum Committee and the UH Department of Electrical and Computer Engineering's Academic Standards Committee. She is faculty advisor to the UH section of the Society of Women Engineers and one of the advisors to Tau Beta Pi. She also serves as treasurer of the UH Wesley Foundation. ■

2006 UH Cullen College of Engineering Events

May 13

Engineering Commencement
5 p.m.
Hofheinz Pavilion, UH Campus

May 18

Engineering Alumni Association Annual Meeting
6 p.m.
UH Hilton Hotel

June 2

Distinguished Engineering Alumni Awards Dinner
6 p.m.
Four Seasons Hotel, Downtown Houston
Honoring Michael Ervin, Michael Piwetz, Bryan Kennedy, Larry Witte and Ernest Henley

June 4 – July 21

Summer Camps for High School Students and Teachers
For a full listing of summer camps offered to high school students and teachers by the Cullen College of Engineering, visit www.egr.uh.edu/news/?e=camps

June 20

4th Annual Civil and Environmental Engineering Alumni Luncheon
12 p.m.
HESS Club

For more information about any of these events, call 713-743-4200, e-mail alumni@egr.uh.edu, or visit www.egr.uh.edu/events.

An atomic force microscope captures thousands of insulin molecules, each measuring 5 nanometers in diameter, in the process of forming an insulin crystal. The protruding mound in the center, recently discovered by Peter Vekilov, associate professor of chemical engineering, and chemical engineering doctoral candidate Dmitra Georgiou indicates rapid crystal growth. The finding is only the third mechanism of crystal formation ever discovered. ***(Learn more about this discovery on page 4.)***

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