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E@M

THE MAGAZINE OF THE A. JAMES CLARK SCHOOL *of* ENGINEERING

Mpact

Fearless Ideas for World-Changing Sustainable Solutions

A battery made of wood

THE UNIVERSITY OF MARYLAND

STORIES

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Please note that ***Engineering @ Maryland*** refers to the A. James Clark School of Engineering by that name in all cases, including stories that describe alumni who graduated before the name was established, in 1994, to honor Mr. Clark's outstanding philanthropy.

COVER PHOTO
John Consoli

Dear Friends of the Clark School,

The opportunity to innovate and design novel products and solutions that can improve millions of lives is a unique aspect of the engineering profession.

Here at the University of Maryland's A. James Clark School of Engineering, we place a special emphasis on aiming for this ultimate outcome—transforming fearless ideas into engineering innovations that benefit millions. This is what we call "Mpact."

We can achieve Mpact in a number of ways.

Here at Maryland, we continue to attract students who select engineering as their major because of the potential it offers to help others on a global scale. We believe in preparing our young engineers for success through early hands-on educational experiences and participation in national and international competitions and outreach activities like Engineers Without Borders, giving students the opportunity to work in teams and understand the real-world obstacles they must hurdle to reach their goals in the professional world. We are planting seeds of Mpact that will bloom years from now in the leaders and entrepreneurs who emerge from our programs as Clark School alumni.

Our cutting-edge, interdisciplinary research initiatives are focused on the most challenging and critical issues of our time. Maryland faculty members are also newly incentivized to engage in creative activities that result in technology transfer, moving research ideas from the bench top to the market. In this issue of *E@M*, you will learn about our innovations in energy and sustainability, including groundbreaking fuel cell and energy storage technologies. You will also learn about a new "Energy 101" educational program designed to serve as a national model, developed in partnership with the U.S. Department of Energy, the Association of Public and Land-grant Universities, and the Environmental and Energy Study Institute.

What is Mpact?

From designing new technology that could change the future of electricity generation and energy storage for millions to introducing a new educational approach to help prepare young people to make sound decisions on critical energy and sustainability issues, these initiatives aim for widespread Mpact.

Our capabilities for Mpact are not confined to energy and sustainability. We are leading research advancements in aerospace, bioengineering, robotics, biomedical devices, nanotechnology, disaster resilience, fire protection, and cybersecurity, among other areas. From the universal product code to satellite radio, SMS text messaging to the implantable insulin pump, our students, faculty, and alumni have engineered life-changing innovations for millions.

On October 23-26, we invite you to participate in Mpact Week, a four-day event on our College Park campus aimed at showcasing the Clark School's research, education activities, and entrepreneurial ecosystem (see back cover). Learn more and register for Mpact Week: www.clark.umd.edu/mpact. We hope to see you there.

Darryll Pines
Dean and Farvardin Professor of Engineering

Mpact

FEARLESS IDEAS FOR WORLD-CHANGING SUSTAINABLE SOLUTIONS

CLARK SCHOOL RESEARCHERS CREATE EFFICIENT, SUSTAINABLE ENERGY OPTIONS

When President Barack Obama announced the details of a plan this summer to reshape U.S. electricity production and speed the adoption of new technologies, Clark School researchers were ready. From batteries made of wood fibers to solid oxide fuel cells, Clark School researchers and entrepreneurs are preparing to introduce some of the most promising, sustainable innovations to the commercial marketplace. These exciting new ventures have the potential to transform the world's energy infrastructure and change how millions of individuals across the globe access energy—all part of the growing list of Clark School innovations with a broad social Mpact.

Fuel Cell Technology Delivers AFFORDABLE SOLUTION FOR UNINTERRUPTABLE POWER

All told, last fall's Superstorm Sandy caused 8.5 million power outages across 21 states, the highest outage total ever, according to Associated Press reports. Despite all of the warnings in the days preceding the storm, utility companies were largely at a loss for ways to prevent the outages or provide short-term energy solutions. Eric Wachsman, director of the University of Maryland Energy Research Center and William L. Crentz Centennial Chair in Energy Research, may have the answer.

Wachsman has devoted his career to solving the world's energy challenges, ultimately concentrating on the solid oxide fuel cell (SOFC). These fuel cells, which Wachsman originally designed more than two decades ago, are the foundation for Redox Power Systems LLC, a start-up company that is looking to provide safe, reliable, continuous electricity on site at about one-tenth the cost and size, and 10 times the power density, of current commercial fuel cells. The SOFCs could have enormous applications for the transportation, military, utility, and building industries.

"Twenty-four hours a day, seven days a week, we can provide baseline energy to commercial or residential settings in a continuous operation. We do not need to rely on variables beyond our control, like the wind blowing or the sun shining," says Wachsman, who now serves as Redox's scientific advisor.

The company's entry into the commercial marketplace could not be more timely. In mid-August, the U.S. Department of Energy released a report citing the increasing importance of grid resilience. The report recommended greater use of distributed power generation, or small-scale power sources such as renewable energy, to be installed in communities or near critical facilities, such as hospitals, to avoid outages caused by down power lines or flooded transmission substations.

Redox Power's initial product is a patented SOFC technology called the Power SERG 2-80 or the Cube, which can connect to a natural gas line and electrochemically convert methane to electricity. Unlike the proton exchange membrane (PEM) fuel cell used by car companies that relies solely on hydrogen to generate power, SOFCs can oxidize all fuels, such as natural gas, propane, gasoline, biofuel, or hydrogen. The Cube has no engine and no moving parts, and can operate off the grid or complement current grid services. "Businesses and individuals are interested in constant, consistent access to electricity. In weather disasters, like last year's Superstorm Sandy, the Cube

The Cube is composed of stacks of small ceramic solid oxide fuels.

Top page 3, Redox Power Systems CEO and Director Warren Citrin (left) and Scientific Advisor Eric Wachsman, who designed the solid oxide fuel cells.

PHOTOS COURTESY REDOX

could add to grid reliability and provide energy security," says Wachsman.

The Cube consists of stacks of small ceramic solid oxide fuel cells, which are roughly the height of three sheets of paper, between stainless steel interconnect plates. Like a battery, SOFCs have three parts: two electrodes—a cathode and an anode—and an electrolyte. But rather than storing energy in a battery, SOFCs pull oxygen ions from the air and conduct them through the cell, where they meet and oxidize fuel on the other side, creating electricity. Because of the advanced ceramics and low-cost stainless steel plates, the Cube is not only less expensive, it can also generate 10 times the power at nearly half the running temperatures (600 degrees Celsius) of any similar products on the market.

A GREAT FEAT OF ENGINEERING

While a graduate student at Stanford University, scientist at SRI International, and professor at the University of Florida, Wachsman created and refined an electrolyte that could operate at much lower temperatures than other SOFCs. "There were so many delays and so much red tape in obtaining research funding, it really slowed our work," recalls Wachsman. Clark School Ph.D. candidate Colin Gore, who followed Wachsman from Florida to Maryland, has developed anodes to work with hydrocarbon fuels that run for long periods of time with high stability and good conductivity. Gore describes the Cube as a "great feat of engineering. The overall design is elegant and, from an engineering perspective, it is a viable high-performance, distributed power generation device."

Due to its high efficiency, the clean technology emits one half to one third the carbon dioxide of conventional energy with negligible amounts of nitrogen oxide, sulfur oxide, or carbon monoxide. The first version of the Cube will be configured to 25 kilowatts (kW), which can comfortably power a gas station, moderately-sized grocery store or small shopping plaza. It can be configured to provide residential (5kW) to industrial (up to 80kW) power based on need.

"When a storm strikes and the power goes out, people turn to loud, gas-burning generators. SOFCs solve both those problems," adds Gore. "If you had a neighborhood power system fueled by SOFCs, it would be accessible, quiet, and provide the comfort of safe energy when you need it."

After receiving a boost through the university's Maryland Technology Enterprise Institute (Mtech) Venture Accelerator program, the company quickly attracted interest and support from Clark School Board of Visitors Member Warren Citrin, a successful entrepreneur whose companies include Solipsys, a radar technology firm that he sold to Raytheon for $200 million in 2003.

"I recognize a breakthrough when I see it," says Citrin, now CEO and director of Redox. "This is a game changer for society." Redox Power Systems, which holds the record for the shortest amount of time in the university's incubator program, continues to exceed expectations. "What was predicted to be a five- to 10-year effort to move into manufacturing has taken us less than 12 months," says Citrin. "We organized a team of the best in the business to design and manufacture the Cube, and we are heading toward an extraordinarily profitable company with great benefits to society. Investors have been pleased with the design of the product, which is so important in this industry."

One of the biggest decisions Redox faces is where to locate its manufacturing plant. "In our first five years of operation, we will create hundreds of jobs in assembly and testing. Our location must be affordable, and Mtech is helping us navigate spaces," explains Citrin.

As the company prepares to enter the marketplace, Citrin views the grid as its key competitor. "More and more individuals and industries, including regulated utilities, understand the need for continuous, uninterrupted power. People are not quite ready to generate their own electricity, but if we can package and explain the technology correctly, the sky is the limit."

FLAME DESIGN RESEARCH COULD REDUCE POLLUTION

Soot is the most deadly airborne pollutant, resulting in some 60,000 deaths annually, according to Fire Protection Engineering Associate Professor Peter Sunderland. It also has a profound environmental impact on climate. "Soot is second only to carbon dioxide in contributing to global warming," says Sunderland.

For more than a decade, Sunderland has been part of a research team, led by Professor Richard Axelbaum of Washington University, that is developing a flame system that could lead to a cleaner environment through more efficient combustion processes that reduce soot formation. "Soot moves out of the atmosphere in days, but carbon dioxide stays in it for centuries. However, when soot deposits on ice and snow, it greatly increases melting," explains Sunderland. "Few materials absorb sunlight as well as soot does."

His research on the Flame Design project includes observations of soot formation in spherical flames in microgravity. Recent tests performed at NASA Glenn Research Center in Cleveland in its 2.2 Second Drop Tower have offered the opportunity to closely examine the flames that produce soot. "Without gravity, we are able to independently control the direction of flow and where and when nitrogen is supplied," Sunderland notes.

Experiments in normal gravity show that redirecting nitrogen can improve the flame structure and reduce soot output. These nitrogen exchanges can produce permanently blue flames, which are soot free under all conditions, and are stronger, extinction-resistant flames. "This process could be performed in engines that use gas recirculation and industrial burners that use oxygen enrichment," explains Sunderland.

Flame Design will be tested on the International Space Station in 2016. The results can be used to develop more stable, less polluting combustion devices that take advantage of oxygen-enrichment technology. The results also will shed light on fire spread and toxicity.

CLARK SCHOOL TEAMS WIN ARPA-E GRANTS TO IMPROVE ELECTRIC VEHICLE ENERGY STORAGE SYSTEMS

Two teams from the University of Maryland Energy Research Center (UMERC) were recently awarded grants from the Advanced Research Projects Agency-Energy (ARPA-E) to develop transformational electric vehicle (EV) energy storage systems using innovative chemistries, architectures, and designs. The two projects were among 22 selected nationwide that received funding from ARPA-E's new program, Robust Affordable Next Generation Energy Storage Systems (RANGE), which aims to accelerate widespread EV adoption.

Professor of Chemical and Biomolecular Engineering Chunsheng Wang in partnership with Kan Xu at the Army Research Laboratory is developing a hybridized-ion aqueous battery that could cut the lithium-ion battery system cost in half and double EV travel time per charge. A team led by UMERC Director and William L. Crentz Centennial Chair in Energy Research Eric Wachsman will leverage multi-layer ceramics processing methods to produce a solid-state battery pack for EVs with lower weight and longer life.

For more information about these projects, see www.energy.umd.edu.

Charging Ahead with FLEXIBLE BATTERY Production

FLexEl Founder and Professor Emeritus Martin Peckerar, center, oversees development of the FlexEl battery cloth.

PHOTOS BY HAIWEN DING AND COURTESY FLEXEL

What began as a project to create power supplies for distributed networks of sensor arrays for the Department of Defense in 2006 has evolved into a company that recently won its founders, Electrical and Computer Engineering (ECE) Professor Neil Goldsman and Professor Emeritus Martin Peckerar, the inaugural University System of Maryland (USM) Board of Regents Entrepreneur of the Year Award. Established in 2008, FlexEl, LLC produces batteries composed entirely of environmentally-friendly materials, with a unique chemistry and topology that provides the highest charge density of any known thin-film battery.

FlexEl's battery cloth can be scaled to any size, fabricated to fit any form factor, and can meet demanding capacity and discharge rate requirements. These characteristics make it suitable for use in a wide variety of demanding applications including high-performance, wearable electronics, remote sensing and transmission, military applications, and novel consumer products. The rechargeable batteries gather energy from environmental sources such as solar energy, vibrations, and radio waves, and can even be recharged simply by pointing a cell phone at them.

Peckerar attributes the company's early success to support from the university's Technology Advancement Program (TAP). "Throughout the company's early formation and technological development, TAP has been instrumental in helping us succeed," he notes. "Its expertise was critical for learning basic business processes, like setting up a payroll and handling tax filings and even finding our CEO."

Under the direction of CEO Bob Proctor, FlexEl now employs 15 scientists and engineers, with more than 15 undergraduate interns on staff. The research team is a past winner of the UMD Business Plan Competition and the UMD Invention of the Year Award. Two Clark School graduates helped create the technology and now oversee research and development for FlexEl: Zeynep Dilli, '07, Ph.D., ECE, senior research and development engineer, and Mahsa Dornajafi, '10, M.S., ECE, research and development manager.

Peckerar, who now serves as chief technology officer for the company, admits his role is a bit different from teaching. "Entrepreneurship has been very rewarding, but you must be prepared to move at a fast pace and under pressure." The company has completed a multi-million dollar strategic investment agreement with a Fortune 500 company to develop a specialized power source tailored for a novel consumer electronics device with major milestones to meet in the months ahead. "In 2014, we will be moving out of the TAP Building to larger quarters where we can conduct beta site testing for battery manufacturing. Our goal is to supply 100 million parts annually, so we will need to ramp up the process quickly," says Peckerar.

FlexEl currently makes batteries using printing techniques, which enable high-volume, roll-to-roll manufacturing that reduces the cost of FlexEl's batteries nearly tenfold compared to thin-film, lithium-ion batteries. Researchers are developing advanced printing and assembly technologies to support a growing number of demanding and sensitive flexible device applications.

FlexEl is also working with the U.S. Department of Homeland Security on a proposal for first-responder gear and Navy underwater applications in collaboration with the Maryland Fire and Rescue Institute. The FlexEl technology could be used in helmet lights for firefighters, LED-powered life vests, and position assessment systems to locate downed firefighters.

Nature Inspires
BATTERY MADE OF WOOD

Assistant Professor of Materials Science and Engineering Liangbing Hu, left, and Associate Professor of Mechanical Engineering Teng Li continue to refine the battery made of wood.

When it comes to inspiration for engineering breakthroughs, nature offers no shortage of models. One of the latest Clark School innovations, a battery made of wood, was inspired by trees, according to Liangbing Hu, assistant professor of materials science and engineering, and an affiliate faculty member in the University of Maryland Energy Research Center and Maryland NanoCenter. "The wood fibers in a tree once held mineral-rich water. They are strong, soft, flexible, and ideal for storing liquid electrolytes, making them not only the base but an active part of a battery," he says.

The wood component of the battery is actually microscopic fibers from yellow pine trees that are fashioned into sheets a thousand times thinner than a piece of paper. The wood fibers help the nanoscale batteries keep their structure. The slivers are then coated with tin and packed into small metal discs. Charged particles move around in the wood fibers, creating an electric current. Typical batteries use charged particles of lithium, but the wood batteries are made with sodium. As it turns out, wood and sodium work quite well together and are relatively cheap, as well as sustainable.

"Pushing sodium ions through nodes made of tin often weakens the tin's connection to its base material," says Teng Li, mechanical engineering associate professor and a member of the Maryland NanoCenter. "But the wood fibers are soft enough to serve as a mechanical buffer, which can accommodate tin's changes. This is the key to long-lasting sodium-ion batteries."

Existing batteries are often created on stiff bases, which are too brittle to withstand the swelling and shrinking that happens as electrons are stored in and used up from the battery. Hongli Zhu, lead author of a paper on the research that appeared in a recent issue of *Nano Letters*, and other team members noticed that after charging and discharging the battery hundreds of times, the wood wrinkled but remained intact. Computer modeling by Zheng Jia, a mechanical engineering graduate student, showed that the wrinkles relax the stress in the battery during charging and recharging so that it can survive many cycles.

"The fiber can effectively relieve the stress associated with the charge and discharge process. It will be useful for low-cost, large-scale energy storage, such as the grid," says Hu, who is hoping the new batteries can be scaled up to store the vast amounts of energy generated by solar arrays or wind farms.

The team's research was supported by UMD and the National Science Foundation.

PHOTOS BY JOHN CONSOLI

Solar Energy Market HEATS UP

The road to creating profitable energy companies is not an easy one. Just ask Stephen Zaminski, '86, Mechanical Engineering; '93, M.B.A., Wharton School of the University of Pennsylvania, who serves on the Clark School's Board of Visitors. Zaminski is the founder and former CEO of Solar Gen 2 LLC, a privately held firm sponsored by Goldman Sachs. Solar Gen 2 executed a 25-year power contract with San Diego Gas & Electric to provide the utility with 150 megawatts per hour from three solar farms in California's Imperial Valley.

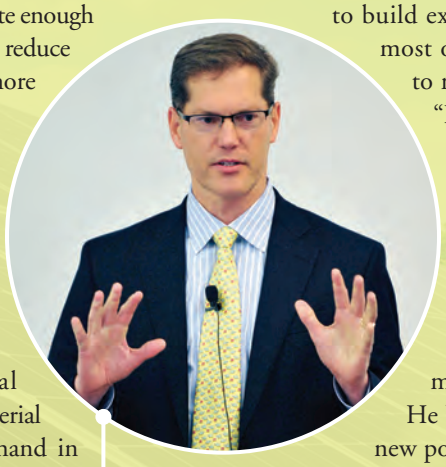
In April, Zaminski sold Solar Gen 2 to publicly traded First Solar Inc. Construction of the solar facility, located near El Centro, Calif., has begun with completion anticipated next summer. The large-scale photovoltaic (PV) solar plant is expected to generate enough electricity to power more than 60,000 California homes and reduce carbon emissions by an amount equivalent to displacing more than 21,000 cars.

Without a doubt, Zaminski says one of the most difficult aspects of implementing large-scale power is politics. "Navigating the long and risky journey from proven technology to installed and functioning solar power generation requires not only technical knowledge but also strong interpersonal skills," he notes. In a 2012 Clark School Whiting-Turner lecture, the entrepreneur discussed how he learned to work with federal, state and local politicians, utilities, the local community in California's Imperial Valley, and capital market participants, who all play a hand in determining his former company's long-term success.

"We tried to develop a series of large solar fields in Imperial Valley, but we ran into challenging political situations with individuals and organizations with their own, often conflicting, agendas," says Zaminski. "We were thoughtful in putting the project together to take into account the president's renewable energy directives, the California governor's jobs initiatives and renewable portfolio standard, and environmental groups' concerns." To that end, the firm chose to locate and create jobs in Imperial County, which not only offers outstanding solar radiation, but has one of the highest unemployment rates in the nation, explains Zaminski. The project also received the support of one of the world's most prestigious environmental organizations, the Sierra Club.

Zaminski, who has more than 20 years of power industry experience, is no stranger to the energy field, having completed more than $13 billion in energy transactions. Prior to Solar Gen 2, he co-founded Starwood Energy Group, where he co-led fund investments in more than $1.5 billion of enterprise value energy assets. In 2008, Zaminski and his partners at Starwood Energy Group successfully closed the $433 million energy fund. Prior to Starwood, Zaminski was an investment banker and also worked as a management consultant, advising Fortune 500 energy industry clients. He began his career with UltraSystems Development Corporation, an independent power developer now owned by Louisville Gas & Electric.

The greatest challenge to the power industry is discovering efficient ways to store energy, according to Zaminski. "We continue to build extra power plants that remain idle most of the time until they are needed to meet peak demand," he explains. "If we had reliable, efficient power storage, we likely would trigger a review and potential replacement of older, dirtier power plants with highly reliable, sustainable power production facilities, which would eliminate idle plants and dramatically reduce the environmental impact of power production."



He believes the ability to deploy any new power storage technologies into day-to-day use will be slowed by the lack of available financing—a problem that government leadership may need to address to move such technologies forward.

An entrepreneur by nature, Zaminski is taking time to think about his next move in the energy field while following the achievements of his former company. "It was exciting to be a part of Solar Gen 2, which will be one of the largest solar fields in the world. It's a great story," he says. The firm created a way for the local electricity grid—a municipal power and water authority in the Imperial Valley—to use an existing connection to the broader electricity grid in California. "The infrastructure was there more than 20 years ago, but our work allowed two independent systems to operate more collaboratively," adds Zaminski. "In the process, we created many jobs and hope we have enabled further renewable power development in the resource-rich environment of Imperial County."

Citrin Fellow Develops NEW HELIOSTAT Design

TECHNOLOGY COULD ADVANCE SOLAR THERMAL ENERGY

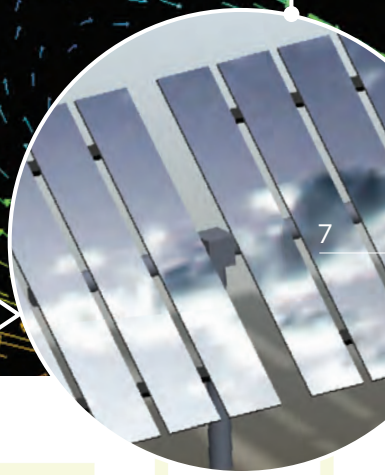
Andrew Oles,'10, Mechanical Engineering, is on a mission to find new sources for clean energy. "Without clean energy, our future is uncertain," says Oles, who researched all types of energy sources before focusing on solar thermal power, specifically more efficient heliostats to better concentrate sunlight on a central receiver.

"Wind loads drive the design of heliostats, large flat squares that can be as big as 10 yards by 10 yards," notes Oles, who participated in the university's Hinman CEOs Program, the nation's first living-learning entrepreneurship program, and was an inaugural recipient of a Warren Citrin Graduate Fellowship for Entrepreneurial Engineering Students. "The problem is that high wind gusts can damage or disorient them, and they cannot maintain the correct angles pointed at the solar thermal receiver."

Oles' innovation is an architecture that changes the way heliostats track the sun. "My lightweight, low-profile heliostat design places the heliostat closer to the ground with the same amount of reflective area," says Oles. "This design could change the industry. The thinner design could make heliostats easier and cheaper to ship, overcoming many of the logistical challenges."

As he works to complete his Ph.D. in 2014, Oles is seeking provisional patents for his design with the help of Mtech. "My next steps are developing a prototype in conjunction with a full-scale test at the Sandia National Lab's National Solar Thermal Test Facility," he explains.

Oles is also conducting initial research to improve the design and efficiency of solar thermal receivers.



Clark School's Abts Introduces A National Model for Energy Education

The Clark School is doing its part to develop the next generation of energy-savvy leaders through a new curriculum that federal officials and education leaders hope will be used at colleges and universities nationwide. The interdisciplinary curriculum, called Energy 101, includes projects and education modules developed in collaboration with the Association of Public and Land-grant Universities, the U.S. Department of Energy, and the Environmental and Energy Study Institute. A UMD course, Designing a Sustainable World, developed by Research Associate Professor Leigh Abts, jointly appointed in the Clark School and College of Education, and College of Education Professor Idalis Villanueva, gives students an opportunity to address a critical issue in energy and/or sustainability. The course encourages students to think creatively and apply design tools to map out and explore innovative solutions. Offered in spring 2013, the course attracted students from disciplines as varied as food science and computer science.

At the invitation of the National Science Foundation, Abts recently spoke at a Congressional briefing on STEM education, which was co-sponsored by the American Society of Mechanical Engineers and *Discover* magazine. His presentation focused on the importance of engineering design projects to help students develop problem-solving and creative-thinking skills.

DEGREE PROGRAM PREPARES ENGINEERS FOR EMERGING FIELD

The Clark School's Master of Engineering in Sustainable Energy Engineering is preparing a new breed of engineers to meet the growing demand for professionals in this highly specialized field. The program gives engineers the opportunity to supplement and broaden their current knowledge through a multidisciplinary curriculum that is offered both on campus and online. Developed by faculty across the disciplines of mechanical, nuclear, reliability, chemical and biomolecular, and systems engineering, the program allows students to customize their educational experience by selecting from three elective sets; nuclear engineering, energy systems, or reliability engineering.

To learn more about the program, which is offered by the Office of Advanced Engineering Education, visit www.advancedengineering.umd.edu/programs/sustainable-energy.

THE COMPETITIVE EDGE

Student Competitions Prepare Graduates for Real-World Engineering Challenges

Since Benjamin Franklin invented the freestanding cast-iron stove in 1742, there have been relatively few technological enhancements in wood stove design. Enter Team Mulciber: a group of Clark School students who applied their engineering know-how to design and construct a green, efficient, and easy-to-use wood stove as part of a national challenge to improve this much-neglected technology.

Named for the Roman god of fire, Team Mulciber was selected as a finalist in The Alliance for Green Heat's Next Generation Wood Stove Design Challenge earlier this year. The 13 finalists must blend consumer appeal and design excellence with optimal energy production and maximum efficiency in their final design to win the top honor on the National Mall in Washington, D.C., in November.

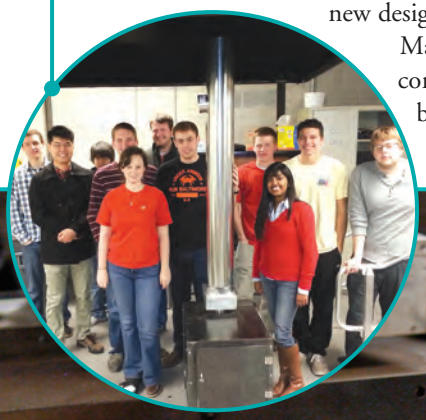
Team Mulciber's stove innovations include: a forced air flow system; a fixed wood configuration; coaxial heat recovery; and a smart control system that regulates the stove to optimize temperature and oxygen concentration. These features combine to create a user-friendly stove that far exceeds Environmental Protection Agency standards for emissions.

Stanislav Stoliarov, fire protection engineering (FPE) professor and team advisor, oversaw the students' efforts through the last academic year. "This was a beautiful opportunity to introduce a new design concept," he explains.

Maryland is the only university competing in the finals and will be pitted against teams of entrepreneurs, wood stove enthusiasts, and companies that manufacture wood stoves. "Obviously, we don't have the same capabilities or experience as manufacturers, but we have the core fire protection and mechanical engineering knowledge that our competitors may not possess," explains Team Captain Taylor Myers, '12; M.S. '13, FPE.

Team Member Ryan Fisher, '12; M.S. '13, FPE, was charged with coordinating schedules and overseeing testing. "It has been interesting to see our progression since our first meeting. We are now exploring commercialization and talking to individuals about financing and marketing the idea," explains Fisher, who plans to stay involved from Charlotte, N.C., where he works as a risk prevention analyst for American International Group (AIG). Joe Praydis,'14, FPE, worked full time throughout the summer on stove enhancements, and the university's Physics Machine Shop manufactured the needed parts for the wood stove.

Team Mulciber is just one of a host of Clark School teams that garnered top spots in national and international student competitions in recent years. The competitions give students practical, hands-on experience solving many of the world's most exciting engineering challenges. The lessons students learn extend far beyond engineering principles and practices. "It was interesting and challenging to direct a large group of people as they moved on and off the project. Developing the ability to manage people and tasks and deal with setbacks in both areas has been a huge learning experience," explains Myers. Stoliarov concurs, "The benefit to students is tremendous. These competitions bring engineering concepts to life and help students understand the value of their knowledge."



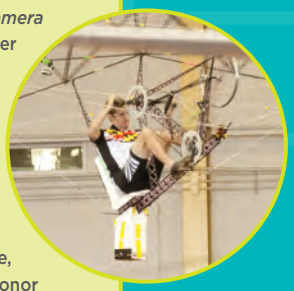
Team Mulciber, left.
Below, Taylor Myers stokes the wood stove fire.

PHOTOS COURTESY TEAM MULCIBER

THE FOLLOWING ARE A SAMPLING OF COMPETITIONS AND CHALLENGES IN WHICH CLARK SCHOOL STUDENTS HAVE EXCELLED IN RECENT YEARS:

UP, UP, AND AWAY

It was an exciting ride for the more than 50 student members of the university's *Gamera* human-powered helicopter team, which achieved a series of breakthroughs in human-powered flight since 2009. Early this summer, a *Gamera* flight reached 10.8 feet (3.3 meters) in altitude, the highest the helicopter has ever flown, while another flight remained airborne for 74 seconds, an unofficial world record for the longest human-powered helicopter flight. Still, the team did not meet the requirements for the American Helicopter Society (AHS) Sikorsky Prize, which requires a minimum altitude of 10 feet, a minimum duration of 60 seconds, and minimal lateral drift, maintaining a hover area within a 30-by-30 foot box, all in a single, perfect flight. Canadian team *AeroVelo*, inspired by the early pioneering flights of the *Gamera* team, managed to capture the AHS prize, winning official recognition from AHS in July. A campus celebration to honor the *Gamera* team's achievements is set for Saturday, October 26 from 7 to 9 p.m. on the College Park campus.



SOLAR DECATHLON WINNER

The university's *WaterShed* team bested peers from top colleges and universities to win the most recent U.S. Department of Energy Solar Decathlon competition in 2011. The *WaterShed* team, including 200 students, faculty, and staff members, 43 mentors, and more than 100 external sponsors, won the international competition staged on the National Mall. The team constructed an 800 square-foot, fully functioning home that was powered only by the sun and operated at the highest level of efficiency.

UMD CYBER SLEUTHS

The University of Maryland won the 6th annual CyberWatch Mid-Atlantic Collegiate Cyber Defense Competition (MA CCDC) in 2011. Throughout the MA CCDC competition, a team of more than 25 hackers launched relentless attacks against eight university teams with the UMD team demonstrating the greatest success in defending against the attacks.

SPACE MISSION READY

NASA has chosen two teams from the Department of Aerospace Engineering to participate in the 2014 eXploration-Habitat (X-Hab) Academic Innovation Challenge. A total of seven teams were selected nationally, and Maryland was the only university to have two teams selected: Vertical Habitability Layout Studies and Neutral Buoyancy/Parabolic Flight Habitat Studies. The university's teams will be preparing their products for delivery to NASA in May 2014.

ROVING ROBOT

The Department of Aerospace Engineering Demeter Team captured second place in the 2013 RASC-AL Exploration Robo-Ops Competition (Robo-Ops). The engineering competition, sponsored by NASA and organized by the National Institute of Aerospace, challenges students to build a planetary rover prototype robot that can perform a series of complex tasks.

SOLAR STILL DESIGN EXCELS

A team of students from civil and environmental engineering and chemical and biomolecular engineering met the challenge of the 2013 Environmental Design Contest to design and build a more efficient solar still. Their prototype, which produced the most and purest water in the international competition, earned them the Judges' Choice Award and United States Bureau of Reclamation's Renewable Energy Application Demonstration Award. Bureau representatives were so impressed by the design of the still they asked to display it at their facility and invited team members to apply for internships.

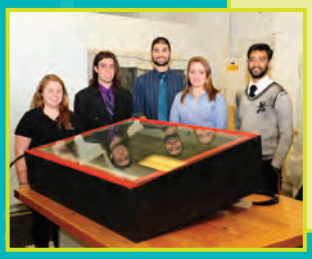


PHOTO BY AL SANTOS

COMPETITION LAYS GROUNDWORK FOR INNOVATION

In an op-ed piece that appeared in *The Baltimore Sun* last spring, Clark School Dean and Farvardin Professor Darryll Pines wrote about the importance of competitions to the student experience. The following excerpts describe the positive impact that competitions have on students.

"The future economic growth and competitiveness of the United States depend on our capacity to innovate. Many ideas have emerged from government, industry, and academia regarding how best to inspire and support innovation. But nothing spurs creativity more than a combination of incentive and challenge: a reward for achievement combined with the urgency of a dare to succeed and the reality that we must race against others. We are at our best when we compete.

"This is why I believe that prizes and competitions are crucial to create a climate of innovation and entrepreneurship and for driving new advances in targeted areas. At the University of Maryland, I have personally seen the positive impact that competing for external prizes has had on the development of our students. In 2012, our *Gamera* student team set the world record for the longest human-powered helicopter flight. The $250,000 American Helicopter Society's Sikorsky Prize has fueled the team's drive for success.

"When competitions and prizes are properly posed, they can inspire creativity, invention, and entrepreneurship; leverage external financial investment that is typically five to ten times the prize value; bring diverse groups of people together to solve a single problem; accelerate technology advances; and launch new industries, boosting job creation and economic development."

RACING TO PLACE

The Terps Racing Baja Team placed 13th overall out of 100 teams in the Baja SAE Tennessee Tech competition in 2013. One hundred schools registered to participate in this competition in seven different categories. UMD placed 28th in endurance, 8th in suspension and traction, 11th in the pulling event, 26th in land maneuverability, 4th in acceleration, tied for 8th in design, and placed 29th in cost. In 2011, the Terps Racing team was the Sports Car Club of American Solo National Champion in the Formula SAE Class.

ROBOTICS RULES

Robotics@Maryland placed fourth among more than 30 teams at the Association for Unmanned Vehicle Systems International (AUVSI) and Office of Naval Research (ONR) 16th Annual International RoboSub Competition in July. In 2008, the Robotics@Maryland team won the AUVSI competition in only its second year of participation and finished third in 2010.

FRESHMAN TAKE OFF

In what has become a semester-end tradition, the Kim Building rotunda is transformed into a hovercraft fly zone during the biannual Hovercraft Competition, which serves as a final exam for ENES100: Introduction to Engineering Design. Teams of freshmen launch colorful, hand-built vehicles, each floating on a cushion of air, which must maneuver into, around, and out of a walled track, while capturing a payload. The course equips first-year students with interpersonal skills, problem-solving strategies, confidence, and other qualities to help them throughout their student careers and as practicing engineers.

BREAKING THE CODE

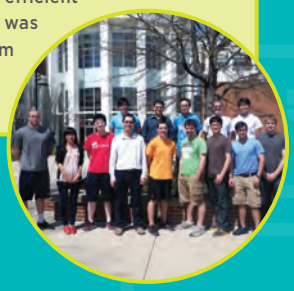
Seventeen teams comprised of more than 60 UMD students competed in the 2013 Windward Code Wars, a day-long competition for students from top universities worldwide. Teams analyze a programming problem, create a solution, and pit their skills against each other. Two of the university's teams, String Theory and Terps, made it to the quarter-final and semi-final rounds before String Theory took second place overall in the final competition.

TEAM THIRSTY TURTLES

Team Thirsty Turtles took fourth place in the American Institute of Chemical Engineers' (AIChE) mid-Atlantic regional Chem-E Car Competition in April 2013. The top-5 finish earned them a spot at the national competition, to be held at AIChE's annual meeting this fall in San Francisco. Team Thirsty Turtles took second prize last year.

ACHIEVING ENERGY EFFICIENCY

For the second straight year, mechanical engineering students won first place in the U.S. Department of Energy's Max Tech and Beyond Design Competition for Ultra-Low Energy Use Appliances and Equipment. The team's energy-efficient residential air conditioning system was the 2012 winning entry. This year the team won for an energy-saving, two-stage heat pump clothes dryer.



TO THE RESCUE

A team of aerospace engineering students won the American Helicopter Society's 30th Annual Student Design Competition late this summer. The 2013 competition challenged students to design a search and rescue helicopter for rescuing victims of a natural disaster. The team's HeliX design featured key components, such as a variable diameter tiltrotor and outboard wing extensions that increase speed, range, and altitude capabilities. This marks the ninth first-place win for UMD.

BUILDING BRIDGES

The Clark School's Steel Bridge Team took third place at the 2013 ASCE Mid-Atlantic Student Conference, qualifying the team for the 2013 National Student Competition sponsored by the American Institute of Steel Construction and the American Society of Civil Engineers (ASCE). The team placed 26th out of the 49 teams in the national competition and captured first place for its region.

GOING GREEN

A team of UMD students received the grand prize in the Hydrogen Education Foundation's 2011-2012 Hydrogen Student Design Contest, topping teams from 28 universities representing nine different countries. The multidisciplinary, 28-member UMD student team received the award for their proposed design of a university plant using fuels derived from campus waste streams and the local community.

SAFER BATTERIES

A Clark School undergraduate's pitch for a patent-pending, solid polymer electrolyte designed to make lithium-ion batteries safer won second place and a $10,000 prize in the American Chemical Society's (ACS) Green Chemistry Institute Inaugural Business Plan Competition. The company's pitch to commercialize a safer electrolyte for lithium batteries won second place at the inaugural $100K ACC Clean Energy Challenge business plan competition in 2012.

ENGINEERS WITHOUT BORDERS

Clark School engineers are making the world a better place through their involvement in Engineers Without Borders (EWB). Some 150 students work on EWB projects annually, managing four to six projects in developing countries at an average cost of $50,000. UMD is home to one of the largest and most active EWB chapters in the country. The chapter recently received a grant from Bechtel to help fund its stormwater management work in Addis Alem, Ethiopia.

MENTORING TO WIN

Clark School undergraduates mentored a local student robotics team that earned a top position in the Washington, D.C., Regional FIRST Robotics Competition. Team Illusion 4464, comprised of middle and high school students from Maryland, was among three of 58 participating teams in the D.C. regional competition selected to advance to the FIRST Championship Competition in St. Louis. Team Illusion also earned the Rookie All Star Award in recognition of the team's success in its first year competing. The Clark School's Mentors Advancing STEM Education (MASE) helped organize support for Team Illusion and worked with students on their entry.

To learn more about Clark School student teams engaged in competitions and challenges, visit www.eng.umd/current/competitions.

Largest-Ever Software Grant from Siemens Brings Leading Industry Technology to the Clark School

PHOTO BY AL SANTOS

From left, UMD Vice President and Chief Research Officer Patrick O'Shea, Siemens PLM Software President and CEO Chuck Grindstaff, President and CEO of Siemens Corporation USA Eric Spiegel, UMD President Wallace Loh, and Clark School Dean Darryll Pines.

Clark School students and researchers now have access to a highly sophisticated design and simulation tool for coursework, research, and team-based competitions, thanks to the largest-ever, in-kind software grant from Siemens PLM Software. The in-kind grant to the university has a commercial value of more than $750 million for Siemens' product lifecyle management (PLM) software—the same technology that companies worldwide use to develop and manufacture innovative products in industries such as automotive, aerospace, biotechnology, manufacturing, shipbuilding, high-tech electronics, and others.

"We are very grateful to receive this valuable software from Siemens that will help our students develop innovative design capabilities and prepare them for advanced technology careers," says UMD President Wallace Loh. Graduates with Siemens PLM Software training are among the most highly sought after students by corporate recruiters to fill advanced engineering and technology positions.

"Global manufacturers need highly trained graduates to help them make smarter decisions that result in better products," explains Chuck Grindstaff, president and CEO, Siemens PLM Software, a leading global provider of PLM software and services with seven million licensed seats and more than 71,000 customers worldwide. NASA used the software to develop Curiosity, the Mars rover, and Calloway uses it to design golf clubs."This grant enables UMD to integrate world-class PLM technology into its curriculum."

SOFTWARE WILL ACCELERATE DESIGN PROCESS, BOOST PRODUCTIVITY

"We integrate the Siemens software with our model-based systems engineering environments and tools," says Lockheed Martin Chair in Systems Engineering John Baras, who directs the Maryland Hybrid Networks Center. "The applications include automotive systems, energy-efficient buildings, power grids, robotics, sensor networks, and smart manufacturing."

Student groups will use the software as they participate in national and international competitions, such as the Terps Racing Formula SAE and Baja Teams and teams participating in

PHOTO BY AL SANTOS

From left, Terps Racing member and Mechanical Engineering student Emily Posey '15, T.G. Marsden of Bowles Fluidics Corp., Mechanical Engineering Department Chair Bala Balachandran, and UMD President Wallace Loh view a Terps Racing Formula SAE car. Terps Racing will use Siemens PLM Software in their future design efforts.

NASA's X-Hab and Lunar Wheel Design competitions. "This university and the Clark School are very supportive of student competitions," says Dave Akin, director of the Space Systems Laboratory, who leads a number of student teams each year, including the NASA Robo-Ops and Lunar Wheel Design competitions. "This system will allow us to do more rapid prototyping and expedite manufacturing."

Jewel Barlow, director of the university's Glenn L. Martin Wind Tunnel, predicts the Clark School will see a boost in productivity with the new software in place. "Once you are knowledgeable about this suite of software, you will not only have powerful tools to assist in the design of a device, you will have powerful tools to help select materials, develop a prototype, plan production, and manage the entire process," explains Barlow.

The software in-kind grant represents an important component of the comprehensive partnership between UMD and Siemens Corporation, which includes student recruitment, as well as collaborative activities in energy, transportation, neuroimaging, biomedical devices, and fire safety, among other research and development areas.

"At Siemens, we believe our success is determined by our ability to anticipate and engineer the future," says Eric Spiegel, president and CEO of Siemens Corp. "This partnership provides us access to the next generation of innovators and inventors and establishes a framework for the mutually beneficial exchange of technologies, research, and ideas." ■

Marvin Weissberg Supports EWB Program

Marvin F. Weissberg knows what it feels like to be in need. "I grew up in a family of five during the Great Depression and times were hard," he says.

The son of a tailor, Weissberg's path has taken him far from his hometown of South Bronx. His parents moved to Washington, D.C., when he was in high school. After graduation, he took engineering courses, but ultimately left school to serve in the U.S. Army. The World War II veteran completed his degree in Civil Engineering at the University of Maryland in 1949, but jobs were scarce, and he took a position selling appliances.

These experiences shaped his current philosophy: "If you can make a difference in someone's life, why not?"

The former door-to-door salesman is the founder and chairman of the board of Weissberg Corp., one of Washington, D.C.'s major commercial real estate development companies.

A strong believer in civic engagement, Weissberg established the Weissberg Foundation, a family foundation dedicated to alleviating human suffering and broadening cultural understanding. "This foundation has been a great experience not only for me, but for my children and grandchildren," says Weissberg, who is eager to instill his philosophy of giving back and helping others in his family of three children and their spouses as well as his six grandchildren.

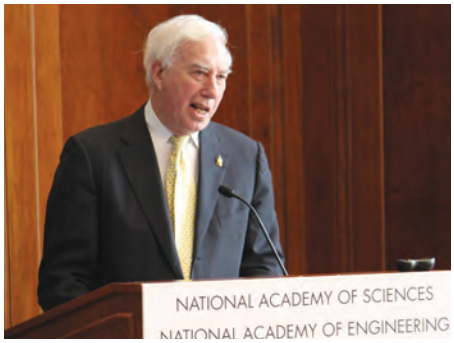
Weissberg is a great admirer of the university's Engineers Without Borders (EWB) Chapter and its campus-initiated program, Maryland Sustainability Engineering (MDSE). EWB is a national program that partners with developing communities abroad to improve quality of life through the implementation of environmentally and economically sustainable engineering projects while developing socially responsible engineering students. Teams of UMD students work within communities to ascertain needs and develop and implement engineering solutions. MDSE's objectives and tactics are similar, but include domestic projects as well as international efforts.

Recently, Weissberg created an endowment for EWB/MDSE, which funds an additional team project every year. The Marvin F. Weissberg EWB/MDSE Team will eventually begin new projects and follow them through to completion. Additionally, Weissberg is providing scholarship support to students who are actively involved in the program. In meetings with students and faculty members involved in EWB, Weissberg and his son-in-law, Stuart Martin, '00, were impressed with the dedication and commitment demonstrated by all the participants.

The Weissberg Foundation has made grants to more than 200 nonprofit organizations, including those in the Washington Metropolitan area and international organizations, but when he talks about EWB, Weissberg's voice is full of excitement. "There's nothing better than watching these young people stand up and say, 'I want to make the world a better place,'" he explains. "It does my heart good." ■

"If you can make a difference in someone's life, why not?"

Awards and Honors



Clark School Professor of Mechanical Engineering (ME) and former president of the University of Maryland, **C.D. (DAN) MOTE, JR.**, began his six-year term as the president of the National Academy of Engineering in July.

DONALD DEVOE, ME, received the 2013 University System of Maryland Regents Faculty Award for Research, Scholarship and Creative Activity.

Associate Director of the Center for Environmental Energy Engineering **YUNHO HWANG** received the Exceptional Service Award from the American Society of Heating, Refrigerating and Air-Conditioning Engineers. ■

FELLOWS & SOCIETY MEMBERS

Professor **MIKHAIL ANISIMOV**, Chemical and Biomolecular Engineering, was elected as a foreign member of both the Russian Academy of Engineering and the Russian Academy of Natural Sciences.

Fischell Distinguished Professor of Bioengineering and Chair of the Robert E. Fischell Department of Engineering **WILLIAM BENTLEY** has been elected a fellow in the American Chemical Society, the world's largest scientific society.

MARTHA CONNOLLY, director of the Maryland Industrial Partnerships (MIPS) program, was inducted into the College of Fellows by the American Institute for Medical and Biological Engineering.

Professor **ALI MOSLEH**, ME, and director of the Center for Risk and Reliability, was elected as a fellow of the American Nuclear Society, a nonprofit that promotes awareness and understanding of the application of nuclear science and technology.

PETER SANDBORN, ME, and director of the Maryland Technology Enterprise Institute (Mtech), was elected a fellow of the American Society of Mechanical Engineers.

Professor **MIROSLAW SKIBNIEWSKI**, Civil and Environmental Engineering (CEE), was elected to membership in Poland's National Academy of Engineering.

FACULTY APPOINTMENTS

JAYDEV DESAI, ME, has been promoted to full professor. The Institute for Systems Research affiliated professor and director of the Robotics Automation, Manipulation and Sensing (RAMS) Laboratory, is recognized for his work on the minimally invasive, neurosurgical intracranial robot.

THOMAS MURPHY, Electrical and Computer Engineering, has been promoted to full professor. In August 2012, he was named director of the Institute for Research in Electronics and Applied Physics (IREAP).

BENJAMIN SHAPIRO, Bioengineering, has been promoted to full professor. The Fulbright scholar and NSF CAREER award winner directs the Control of Miniaturized Systems for Mechatronic, Biological and Clinical Applications Laboratory.

NIKHIL CHOPRA, ME, has been promoted to associate professor. He is the principal investigator for a National Science Foundation nonlinear system tracking control grant. He was recently named an associate editor on the editorial board of *IEEE Transactions and Automatic Control*.

ODED RABIN, Materials Science and IREAP, has been promoted to associate professor. Rabin's Materials and Interface Nanotechnology Lab is breaking new ground in thermoelectric materials and spectroscopy research.

LEI ZHANG, CEE, has been promoted to associate professor. His research interests include many aspects of transportation, and he recently received an NSF CAREER award to study how individual travel behavior affects travel reliability. ■

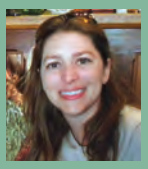
TEN NEW FACULTY MEMBERS JOIN CLARK SCHOOL

The Department of Aerospace Engineering welcomes two new faculty members. **ELAINE ORAN** has joined the department as a Glenn L. Martin Institute Professor of Engineering. Previously, she was senior scientist for reactive flow physics at the U.S. Naval Research Laboratory, where she conducted theoretical and computational research on the fluid and molecular properties of complex dynamic systems. She will now serve as an emeritus scientist there. Oran received both her M.Ph. in physics and Ph.D. in engineering and applied science from Yale University. A member of the National Academy of Engineering, she is a fellow and honorary fellow of the American Institute of Aeronautics and Astronautics. Assistant Professor **STUART LAURENCE** worked in the Institute of Aerodynamics and Flow Technology at the German Aerospace Center in Goettingen. He received his Ph.D. in aeronautics from the California Institute of Technology, where he also completed his postdoctoral work. His research focuses on hypersonic aerodynamics and aerothermodynamics, supersonic combustion and propulsion, boundary-layer transition, naturally occurring hypersonic flows, and the development of experimental techniques.

Assistant Professor **STEVEN JAY** has joined the Fischell Department of Bioengineering. Jay, who earned his Ph.D. from Yale University, specializes in vascular biology and bioengineering, tissue and protein engineering, and therapeutic vascularization—all with an emphasis on clinical translation. He will direct the Vascular Pharmacoengineering and Biotherapeutics Laboratory.

Three new faculty members who joined the Department of Electrical and Computer Engineering (ECE) as assistant professors share a research interest in cybersecurity. **DANA DACHMAN-SOLED** earned her Ph.D. in computer science from Columbia University. Her work focuses on cryptography and security, and she is interested in computational learning theory and property of Boolean functions. **TUDOR DUMITRAS** (photo, lower left) received his Ph.D. in ECE from Carnegie Mellon University. He most recently worked at Symantec Research, where he built the Worldwide Intelligence Network Environment, a program with big data techniques. His research focuses on big data approaches to problems in system security and dependability. **CHARALAMPOS PAPAMANTHOU** (photo, lower right) earned his Ph.D. in computer science from Brown University. He joins ECE from the University of California, Berkeley, where he was a postdoctoral researcher working on applied cryptography and computer security, and his research will continue to explore problems in those areas.

The Department of Materials Science and Engineering welcomes two new assistant professors. **MARINA LEITE**, who also holds a joint appointment with the Institute for Research in Electronics and Applied Physics (IREAP), received her Ph.D. from the Physics Institute at the Universidade Estadual de Campina, Brazil. Her Clark School research will focus on sustainable energy solutions with an emphasis on high-efficiency, photovoltaic solar cells and long-lasting, lightweight rechargeable batteries. **YIFEI MO**, who received his Ph.D. from the University of Wisconsin-Madison in 2010, is a computational materials scientist. At the Clark School, Mo plans to apply his techniques to the study and development of new high-performance materials for batteries and energy applications.



Two new faculty members have joined the Department of Mechanical Engineering. Associate Professor **PETER CHUNG** comes to the university from the Army Research Lab, where he has worked since 2000. Most recently he was a mechanical engineer team leader for interdisciplinary computational sciences and engineering. Chung received his Ph.D. in mechanical engineering from the University of Minnesota. His current research interests are in understanding and improving the physical foundations of computational mechanics and computational materials. Professor **JELENA SREBRIC** was a professor of architectural engineering and adjunct professor of mechanical and nuclear engineering at the University of Pennsylvania. She received her Ph.D. in building technology from the Massachusetts Institute of Technology. Srebric's work focuses on enabling multi-scale modeling of built infrastructure and providing a reliable assessment of how these systems affect occupant population and energy consumption. ■

Bentley Leads Research on Alternatives to Animal Testing

PHOTO BY TRACEY BROWN

Robert E. Fischell Distinguished Professor of Bioengineering and founding Chair of the Fischell Department of Bioengineering William Bentley

For more than a century, the use of animals in laboratory research has been one of the most hotly debated topics in science. In an effort to address the issue, Robert E. Fischell Distinguished Professor of Bioengineering and founding Chair of the Fischell Department of Bioengineering William Bentley is leading the development of viable alternatives.

Bentley and his research team are developing a way to mimic human organs and bodily systems by growing real cells in a lab and placing them in a specific order on computer chips. The goal, says Bentley in the March/April 2013 issue of *PRISM* magazine, published by the American Society for Engineering Education, is to get human cells and human tissues to function on the chips so their communication with and reactions to each other and certain kinds of stimuli can be monitored. The biomimetic devices could eliminate the need for certain kinds of testing on animals and people. While Bentley does not think the end result will completely replace animal testing, he contends that it will be cheaper, offering a strong incentive, along with the societal benefits of reducing animal-based research, for pharmaceutical companies and institutions to consider this alternative method.

Bentley's research team is part of the Maryland Biochip Collaborative, which spans five research groups and labs throughout the university that use molecular biology to translate the communication between biology and microfabricated systems. The team is analyzing how bacteria communicate with one another through molecules and how to disrupt this communication when the bacteria are near human cells on a chip. Their work could eventually replace the use of antibiotics and stop drug-resistant bacteria in their tracks.

The initiatives are part of a broader effort to modernize the regulatory process for medical research. Bentley is the leading investigator at College Park for the University of Maryland's Center of Excellence in Regulatory Science and Innovation, one of two such Food and Drug Administration (FDA)-sponsored centers nationwide. As part of a cooperative partnership between academia, industry, and the FDA, the center focuses on modernizing and improving the way drugs and medical devices are reviewed and evaluated. ***To read the full article, visit www.prism-magazine.org/mar13/feature_02.cfm.*** ■

USA TODAY, PRINCETON REVIEW RECOGNIZE CLARK SCHOOL

The Clark School's programs in engineering and entrepreneurship are featured in *USA Today's* 2013 Grad School Guide. Produced in collaboration with The Princeton Review, the guide offers information on graduate studies in business, entrepreneurship, law, medicine, health sciences, engineering, and education.

The Clark School is listed as a top graduate program in the northeast and is cited for its unique joint degree programs and state-of-the-art laboratories in the Jeong H. Kim Engineering Building. The Warren Citrin Graduate Fellowships for Entrepreneurial Engineering Students program was featured as a top university program for its support of Clark School students conducting research in the broad area of sustainability. ■

SOCIAL INNOVATION CHALLENGE ADDRESSES HUNGER, EDUCATION, SUSTAINABILITY

Television and radio talk show host Tavis Smiley, in partnership with the Clark School, has launched a $75,000 Social Innovation Challenge to help address three of society's most pressing issues: hunger, education, and sustainability. Aspiring entrepreneurs were invited to submit their proposals this fall to develop transformative solutions for individuals and communities across the nation. Submissions will be evaluated by a panel comprised of representatives from academia, business, community/grassroots organizations, government, non-profit groups, and the technology community. The winners will be announced in January 2014.

The Social Innovation Challenge supports Tavis Smiley's initiative to dramatically reduce poverty in America and the university's commitment to inspire a new generation of entrepreneurs whose efforts have a positive impact on society.

To learn more about the challenge, visit www.tavistalks.com/socialinnovator or via Twitter #socialinnovator. ■

KECK FOUNDATION FUNDS ONE-OF-A-KIND PROJECT

The university recently received a $1 million grant from the W.M. Keck Foundation to support new advances in astronomical instrumentation for ground and space telescopes. The only project of its kind in the U.S., the Keck Photonic Spectrometer is the world's first fully integrated photonic spectrograph.

The multidisciplinary collaboration includes researchers from the A. James Clark School of Engineering, the College of Computer, Mathematical and Natural Sciences, the Maryland NanoCenter, the NASA Goddard Space Flight Center, the university's Joint Space Science Institute, and the University of Sydney Institute of Photonics and Optics. Mario Dagenais, professor of electrical and computer engineering and director of the Center for Green Nanophotonics, Optoelectronics and Nanosensing, will serve as project co-leader.

The project will build on the team's recent breakthroughs in photonics to reverse the size and cost concerns that would otherwise limit capabilities of giant, next-generation ultraviolet, optical and infrared telescopes. The team plans to build a breadbox-sized, near-infrared spectrometer to improve sensitivity fivefold beyond current capabilities. ■

Top Companies Seek Clark School High Shear Mixing Expertise

Cosmetics, salad dressings, laundry detergents, and pharmaceuticals: What do they have in common? From healthcare remedies to the food on our dinner table, many products we use on a daily basis are manufactured using a high shear mixing technique—an area of expertise for Chemical and Biomolecular Engineering Professor Richard Calabrese. In consulting work for many of the world's Fortune 500 companies, including Procter & Gamble, Chevron/Texaco, Dow Chemical, Merck, and Bristol-Myers Squibb, Calabrese and his research team have helped move products from the lab to mass manufacturing.

"Industry does not have the experience in scaling up its products," explains Calabrese. "Taking a new product that has performed well in the lab and scaling it to achieve a similar performance in a mass manufacturing setting requires repeated testing, and lead engineers and mixer operators often rely on experience and instinct." Quantifying results that reflect more subjective qualities, such as the "creaminess" or "spreadability" of a product such as mayonnaise, can be a challenge, according to Calabrese, a fellow of the American Institute of Chemical Engineers and a founding member of the group's North American Mixing Forum.

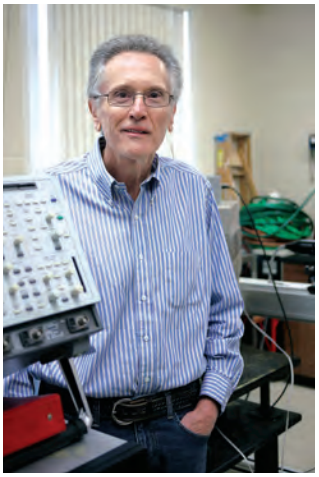


PHOTO BY FAYE LEVINE

Chemical and Biomolecular Engineering Professor Richard Calabrese

Calabrese has dedicated his research to improving the quality, safety, and processes associated with high shear mixing, which combines emulsions (mixtures of usually unblendable substances) and dispersions (evenly-distributed particles within a medium). Calabrese is director of the university's High Shear Mixing Research Program, a 15-member consortium including equipment manufacturers, software developers, and chemical process operators. His team has spent years developing computational fluid dynamics software and methodologies to allow mixing vendors and end users to optimize their equipment, production, and products at any scale.

Closer to home, Calabrese and his team assisted Martek Biosciences, a company launched at the Maryland Technology Enterprise Institute (Mtech), in creating the perfect controlled environment for growing algae to produce one of its leading products. Martek was sold recently for $1.1 billion to the Dutch company, Royal DSM NV. "This is one of the greatest examples of how multiphase flow and high-speed mixing were important in product development," says Calabrese. The group's work can save manufacturing time, reduce consumption of materials, and limit wear and tear on equipment used during the repeated testing that a high shear mixing system can require.

Calabrese's work also can help companies reduce rising packaging and shipping costs. "If you can formulate a laundry detergent that is twice as concentrated and weighs less, the cost of packaging and shipping goes down tremendously," he explains. "That's a big sustainability benefit." ■

CLARK SCHOOL AWARDED MURI GRANTS

Three research teams based in the Clark School have been awarded Multidisciplinary University Research Initiative (MURI) grants by the U.S. Department of Defense. Professor **THOMAS ANTONSEN,** who holds joint appointments in physics and electrical engineering and whose research is based in the Institute for Research in Electronics and Applied Physics (IREAP), will be the principal investigator for "A New Paradigm in Sources and Physics of High-Power Ionospheric Modification," sponsored by the Air Force Office of Scientific Research.

The university will receive $1.2 million for its involvement in a second project, "Topological Decompositions and Spectral Sampling Algorithms for Element Substitution in Critical Technologies." Materials Science and Engineering Professor **ICHIRO TAKEUCHI** is co-principal investigator of that five-year effort led by Duke University.

Electrical and Computer Engineering Professor **P. S. KRISHNAPRASAD** of the Institute for Systems Research and Professor of Chemistry and Biochemistry Christopher Jarzynski are part of a third project called "Information Engines: Nanoscale Control, Computing and Communication out of Equilibrium." The research team is led by the University of California, Davis and includes the University of California, Berkeley, Columbia University, and the University of Maryland.

A highly competitive program, MURI grants were awarded to only 15 teams from nearly 200 applicants in 2013. ■

NEW MASTER'S PROGRAM IN ROBOTICS ADDRESSES DEMAND OF HIGH-TECH MARKET

To meet the needs of the ever-growing robotics market, the Clark School now offers a Master's and Graduate Certificate in Robotics. The graduate-level program provides technical professionals with in-depth knowledge, skills, and abilities to advance the use of robotics in such industries as defense, healthcare, manufacturing, and space exploration.

"We've witnessed a growing need for highly trained technical professionals in robotics," says George Syrmos, executive director of the Office of Advanced Engineering Education that oversees the program. "Our program focuses on the science and engineering expertise required to lead in this expanding area."

Developed collaboratively by the Maryland Robotics Center faculty, practitioners, government scientists, and industrial researchers, the curriculum covers fundamental and applied topics in robotics modeling, control of robotics systems, and planning and perception for autonomous robots. Students can pursue the program without leaving their full-time positions and can tailor coursework to their interests in a number of areas, including optimization and algorithms, performance analysis and design methods, or modeling, systems, and control.

To learn more, visit www.advancedengineering.umd.edu/programs/robotics. ■

Student-Run Incubator Supports Emerging Entrepreneurs

TERP STARTUP SHELL COMPLEMENTS MTECH OFFERINGS

Jeff Hilnbrand, '15, Mechanical Engineering, did not really think of himself as an entrepreneur until he became involved with UMD's student-run Startup Shell. Hilnbrand created his graphic design and media company, JHiL Media Design, while still in high school, but the Startup Shell has brought new life to his venture as he pursues collaborations with other student startups.

"The mission of the Startup Shell is to bring talented, skilled, and passionate graduate and undergraduate students together in a student-run technology collective to work in an open space, support one another, and push our startups and projects forward while engaging with the outside community to promote innovation," explains Hilnbrand.

Inspired by the Stanford University student startup accelerator program, a core group of students from engineering, computer science, business, and other majors with a keen eye for innovation and entrepreneurship began pulling together the resources required to take student startups to the next level. Dean Chang, UMD associate vice president of innovation and entrepreneurship, and Craig Dye, director of the Maryland Technology Enterprise Institute (Mtech) Ventures program, found space for the Startup Shell within the Technology Advancement Program (TAP) Building on campus.

"We feel strongly that the only way for this effort to be authentic is to let the students run the show completely," says Dye. "My role is to clear obstacles out of their way. The students know the Mtech Ventures staff is there for support if needed, but they are uniquely positioned in the Shell to help each other work through startup issues."

Companies in the Shell are in various stages of organization, with some producing revenue and others still finalizing their product offerings. "This is what experiential learning is all about—getting your hands dirty," explains Hilnbrand. "It is about working hard, pulling all-nighters, getting excited about a project, and making it happen. Whether you succeed or fail, the community will be better for it."

PHOTO BY BRENE CARRINGTON

Budding entrepreneurs attend a recent Startup Shell Open House.

Companies currently working in the Shell include: Venture Board, a platform to connect young entrepreneurs to the resources and networks they need to succeed; Parallel Tracks, a social platform for broadcasting music; Imaginex, a creative engineering firm which bridges the gap between science and art; and Food Recovery Network (FRN), managed by a team of students from UMD, Brown, Princeton, Rochester Institute of Technology, and other institutions, that fights hunger and food waste by recovering surplus food from dining halls to feed the hungry. Realizing a management structure is imperative to sustain and grow the Startup Shell, the students have established a network of "point people" to help facilitate and ensure progress for the startup companies.

"While I'm not surprised at what these students have achieved, I am in awe," adds Dye. "Through their innovative ventures, they are transforming the culture of our community."

To learn more, visit www.startupshell.org. ■

36 CLARK SCHOOL STUDENTS SELECTED FOR NIST SUMMER RESEARCH FELLOWSHIPS

A record-high number of 43 UMD students were accepted this summer into the National Institute of Standards and Technology's (NIST) Summer Undergraduate Research Fellowship (SURF) program in Gaithersburg, Md. Among that group were 36 Clark School students, who represented seven of the school's eight departments.

The program allows students majoring in engineering, science, and mathematics to work side by side with leading researchers, using cutting-edge technologies and gaining valuable hands-on research experiences in labs dedicated to: material measurement, physical measurement, engineering, information technology, nanoscale science and technology, and neutron research. Some 190 students were accepted into the program from among 600 student applications representing 136 schools nationwide, with UMD students representing nearly a quarter of the program participants. ■

PHOTO COURTESY NIST/SURF

LEVINE SELECTED FOR NEIL ARMSTRONG SCHOLARSHIP

Edward "Teddy" Levine, '14, Aerospace Engineering (AE), was looking for a field of study "full of unanswered questions" when a high school class project led him to AE. "Private space companies and single-stage-to-orbit spacecraft are all very new," he says. "I could be a pioneer and help the industry get off the ground."

Levine is one step closer to that goal with the support of the Metropolitan Washington Chapter (MWC) of the Achievement Rewards for College Scientists (ARCS) Foundation, Inc. Levine received an ARCS Neil Armstrong Undergraduate Scholarship for the 2013-14 academic year.

Since 1996, the local ARCS chapter has funded nearly $1 million in student scholarships to the University of Maryland. Of the 58 UMD scholar award recipients, 45 were Clark School students. "University of Maryland is one of our chapter's five partner institutions and is receiving the highest amount of funding of any partner school for the upcoming 2013-14 academic year," says Lynn Dillon, president of the MWC/ARCS. "The Clark School has increasingly creative outreach programs and the caliber of students is always extremely high."

Dillon notes that many ARCS members are closely connected to the Clark School as alumni, instructors, or board members. "That personal contact makes our partnership with the school all the more vibrant," relates Dillon. The chapter also has a strong affiliation to Neil Armstrong, which led the chapter to award three scholarships in his name in recognition of his contributions to American science and technology advancement. "He holds a special place in the heart of many members and was a friend and partner with ARCS for many years."

Levine considers the Neil Armstrong Undergraduate Scholarship "the most notable academic recognition I received. It is a wonderful feeling to have ARCS attest to my skills, ability, and dedication," adds Levine, who also has received an L-3 Communications Corporate Scholarship, a Cybercore Technologies Corporate Partner Scholarship, and a President's Scholarship from the university over the course of his undergraduate studies.

Levine, who looks forward to attending graduate school, recognizes the high-quality education he is receiving at the Clark School. "The principles of engineering are the same wherever you go, what makes it different is the level of teaching." In addition, he cites the many team activities the Clark School offers. "On every one of those projects, I bettered myself as a team leader or team member."

As scholarship recipients pursue advanced degrees or careers, Dillon encourages them to stay in touch with ARCS. "We hope these students feel a lifelong connection with us," she notes. This year's ARCS scholars will be honored at a special event in October at the National Academy of Sciences. ■

JERRY KRILL ENTERS INNOVATION HALL OF FAME

Jerry Krill, '78, Ph.D., Electrical Engineering, will be inducted into the Clark School Innovation Hall of Fame for his revolutionary technology to aid in Navy fleet defense. The communications system he developed, called the Cooperative Engagement Capability (CEC), has been described by senior Navy leaders as 'one of the Navy's crown jewels' that greatly enhances the Navy's air defenses. Join us for the Induction Ceremony and the White Symposium on Engineering Innovation.

Tuesday, November 12, 4 p.m.,
Jeong H. Kim Engineering Building

CLASS NOTES

ABDULMALIK ALMEHEINI '11, Chemical Engineering (ChemE), is a product executive at SABIC in Riyadh, Saudi Arabia.

ADEL AL-WAZEER '07, Civil Engineering (CE), is a member of the civil engineering faculty at Higher Colleges of Technology, Dubai.

TIMOTHY BABICH '08, MS, '11; Electrical Engineering (EE), is a systems electrical engineer at the Naval Research Lab in Washington, D.C.

SARA BISHOP '13, CE, is an engineer at Pepco Holdings, Inc. in Washington, D.C.

TAMMY BORKOWSKI '86, EE, completed her Doctor of Management degree from University of Maryland University College in 2012.

KIMBERLY BROWN '98, M.S.; '05, Ph.D., ChemE, is CEO and president of Amethyst Technologies, LLC, in Halethorpe, Md. The firm was one of five companies tapped for the Advance Maryland Program sponsored by the Maryland Department of Business and Economic Development and the Economic Alliance of Greater Baltimore.

JOHN BURCH, JR. '73, CE, is senior vice president for Knott Realty Group in Timonium, Md.

ANDREW CHAMBERLIN '06, Mechanical Engineering (ME), graduated from the Uniformed Services University of the Health Sciences and is pursuing his medical degree.

LUIS CORZO '05, Master of Engineering (M.E.), is a senior risk engineer for Energy, Construction & Engineering, Liberty International Underwriters in Miami.

PAVAN DABADE '08, M.S., Fire Protection Engineering (FPE), is a fire protection engineer at AST Fire Protection Company in Brooklyn Park, Minn.

HARRY FREED '87, CE, is senior civil engineer for the Pennsylvania Department of Transportation in King of Prussia, Penn.

REZA GHANADAN '88, Physics; '90, M.S., EE, is a program manager for the Defense Advanced Research Projects Agency (DARPA) in Arlington, Va.

DELMAR GILLUS, JR. '93, ME, is a member of the Black & Latino Achievers (BLA) Board.

TIMOTHY GIPE '82, Chemistry; '83, ChemE, is an engineer with the U.S. Department of Energy/National Nuclear Security Administration in Washington, D.C.

MOHAMED HELALY '13, M.E., is a project engineer at Astad Project Management in Doha, Qatar.

ZHENYA HUANG '00, M.S., ME, has joined Fidelity Investments as vice president with responsibility for overseeing operational quality and improvement.

ANDREW HUMEN, JR. '81, EE, is president of Smiths Microwave in Tampa, Fla.

CHARLES JOYCE '04, FPE, is director of AKF Group in New York.

MATTHEW LAUVER '09, FPE, is a fire protection engineer for NAVFAC in Norfolk, Va.

EDWIN T. LILLIE '12, ME, is quality and reliability engineer for Intel in Chandler, Ariz.

TARUN LUTHRA '01, M.S., Systems Engineering, is director of technology and Innovation for SAP America, in Newtown Square, Penn.

ANA LUISA RAMIREZ '05, EE, was named Woman of the Year by the Mexican American Opportunity Foundation.

SEONG JAE PARK '05, M.S., CE, is an assistant in the Seoul Metropolitan Government in Korea.

JUSTIN SCHWARTZ '10, FPE, is an engineer with Haines Fire & Risk Consulting Corporation in Southampton, N.J.

MITCHELL SOLKOWITZ '91, ME, is manager of support services for asset records management for the Baltimore Gas & Electric Company.

CHENGDONG WANG '04, M.S.; '07, Ph.D., Reliability Engineering, is a senior reliability engineer for Schlumberger in Sugarland, Tex.

ROBIN KESSINGER WHITE '07, CE, earned her professional engineering license.

DAVID WILMOT '01, FPE, is a senior consultant for Aon Fire Protection Engineering in Greenbelt, Md.

ERIC YANG '96, M.S., CE, is a program manager for John Deere in Moline, Ill. He received an M.A. in computer information systems from Minnesota State and earned an M.B.A. from University of Iowa.

IN MEMORIAM

The Clark School is saddened to hear of the passing of the following alumni:

PHILIP DINENNO '77, FPE
WINNANT C. MCGINTY '50, ME
ALAN H. SINGLETON '58, ChemE

Clark School Alumni Celebrate Milestone Anniversaries

PHOTO BY AL SANTOS

Clark School Dean Darryll Pines, far left, celebrates Spring 2013 Commencement with the Golden Terps. From left, Walter McKee, '58, Electrical Engineering (EE); Ray Cole, '53, EE; Gail Salzman, '58, Aerospace Engineering; Charles Adams, Jr. '53, Mechanical Engineering; Michael Jones, '63, '75, M.S., Civil Engineering; Robert Abrams, '53, EE; Robert Madey, '63, Ph.D., Nuclear Engineering; John Charles LaBerge, '53, Chemical Engineering (ChemE); Walter Beam, '47, '50, M.S.; '53, Ph.D., EE; and Sanford Sternstein, '58, ChemE.

College commencement day is undoubtedly one of life's most memorable events. Imagine reliving that event 50 years later with fellow classmates, or, in the case of Walter Beam, '47; '50, M.S.; and '53, Ph.D., Electrical Engineering (EE), celebrating your doctoral commencement 60 years late.

Ten Golden Terp engineers—alumni who are celebrating their 50th, 55th, 60th, 65th, or greater reunion year—wore gold medallions and gold robes and led the school's commencement procession at the Comcast Center in May. Beam, the first Maryland student to earn a doctoral degree in EE, was unable to attend commencement 60 years ago. "When I put that robe on, it was my graduation celebration," relates Beam, who finished high school in Lynchburg, Va., at age 14, entered UMD at 15, and completed his Ph.D. at age 23. A former EE instructor from 1947 to 1952, Beam was surprised to reconnect with a former student, who also was a Golden Terp.

Beam began his career at RCA Laboratories in Princeton, N.J., as a research engineer. "I used the first modern-design digital computer in the United States at the Institute for Advanced Study," says Beam. "The notion that computer programs and data should both be stored in the same memory doesn't sound unusual today, but seemed revolutionary at the time."

He worked as a chair and professor of electrical engineering at Rensselaer Polytechnic Institute before joining IBM Research Lab as a senior member of the technical staff—but not before publishing a seminal textbook on solid state electronics, *Electronics of Solids*, in 1965. His early RCA connections led to a position as deputy assistant secretary for advanced technology at the Pentagon for the U.S. Air Force. He finished his career as a consultant in manufacturing data systems after serving as a vice president for research and development for Sperry Corporation and teaching systems engineering at George Mason University.

"Over those 60 years, I have visited the Clark School many times, and met all of the department chairs," says Beam. "Clearly the location of the university and the history of the engineering program have helped the Clark School rise to the top."

A FEMALE FIRST

When Gail Salzman, '58, Aerospace Engineering (AE), received her invitation to join fellow Golden Terps in their 55th reunion year, she was eager to return to campus. "I am so impressed with the Clark School. It is easy to see why the school is recognized for excellence in engineering," she says.

Salzman attended UMD at the advent of the space age. At a time when most women pursued degrees in teaching or nursing, Salzman wanted to do something different. She was so immersed in her studies, she did not realize that she was the first woman to graduate from the AE program until the commencement ceremony. "I spent most of my four years in the library. It was such a demanding course of study, my nose was totally in the books," says Salzman, who remembers how male students always wanted to know her exam grades.

She began her career as a structural engineer on the aerial jeep program at Chrysler Corporation. "We actually got the jeep to fly to an altitude of 20 feet, but it had a stability problem, and the project was scrapped," explains Salzman. She left Chrysler to start a family and spend time with her four children. Following a 15-year absence from the workplace, she took a job at Planning Research Corporation (PRC) as a test and evaluation engineer on naval intelligence process systems (NIPS), then moved to GE and later Lockheed Martin as a systems engineer on Landsat, the earth-observing satellite, and as manager of development engineering on classified programs. "I was one of the first women managers at Lockheed Martin," she recalls. "The men I worked with did not know if they should call me Mrs. Salzman or call me by my first name. How times have changed."

When she returned to the Clark School, Salzman says, "I was happy and proud to see so many women graduates. To be part of this legacy is inspiring. I always have cheered 'Go Terps,' but now it has much more meaning to me."

You don't have to be a Golden Terp to share your story with* E@M*. Send us details on your latest career move, family adventure, or volunteer initiative. We would like to hear more from all of you. Send your latest information to Class Notes at josey@umd.edu. ■

Professor, Mentor Has Long-Lasting Impact

NAMED SCHOLARSHIP CREATES OPPORTUNITIES FOR FUTURE STUDENTS

Like many A. James Clark School of Engineering graduates, Ken Bell, '74; '77, M.S.; '83, Ph.D.; Civil Engineering (CE), and Bill Wainger, '80; '82, M.S., CE, spent the years following graduation building careers and raising families. Recently both men decided it was time to give back to the school that helped lay the foundation for their careers.

What started as a seemingly straightforward process for the two alumni—making a donation to the school to help future students succeed—became a much larger gesture when a common thread emerged. Clark School Assistant Development Director Allison Corbett first met Bell and Wainger when they approached the school about making a donation. She quickly learned that both graduates recalled a particular faculty member who had made a difference in their lives. Her interest piqued, Corbett asked if they would be interested in pooling their efforts for a legacy campaign to honor CE Professor Matthew W. Witczak, and the graduate award in his name was created.

"If not for Dr. Witczak, I never would have chosen to become a geotechnical engineer," says Bell. While pursuing his undergraduate degree, Bell had not considered specializing in a field until he took classes with Witczak. "His enthusiasm for the topic was contagious," recalls Bell.

At Witczak's suggestion, Bell decided to pursue both a master's and a Ph.D. in geotechnical engineering. While working on his Ph.D., Bell, who was married and starting a family, left the university to take a position at Bechtel. Witczak was not pleased with Bell's decision to leave school before completing his dissertation and "he read me the riot act." Witczak continued to communicate with Bell in an effort to get him to return to school. "He pushed me when I needed to be pushed," remembers Bell. "I have spent 33 years in geotechnical engineering, and I trace my success back to him."

Wainger also attributes a large part of his graduate success to Witczak. As a teacher, he said, Witczak "saw the beginning and the end [of a topic] and knew how to get you there"—a vision that Witczak applied in and out of the classroom.

PHOTO BY ARIZONA BOARD OF REGENTS COURTESY OF ASU NEWS

Civil Engineering Professor Matthew W. Witczak

After declining Witczak's initial suggestion that he attend graduate school, Wainger spent nine months working for a large engineering company before deciding that path was not for him. While the previously offered graduate positions were no longer available, that did not stop Witczak from making sure Wainger had a place in the program. "I had the best relationship with him," recounts Wainger. "He was the one professor who challenged me the most."

When asked about giving back to the university and honoring Witczak, Bell notes, "None of us in the professional world would be successful without the education we received and the professors who cared for us and made our education their careers."

***FOR MORE INFORMATION** on the Matthew W. Witczak Graduate Award, visit www.cee.umd.edu/giving/witczak or contact Allison Corbett '12 at acc@umd.edu or 301-405-5841.*

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RSVP AT CLARK.UMD.EDU/MPACT

WEDNESDAY, OCTOBER 23, 2013

MARYLAND INNOVATION MPACT: BRINGING FEARLESS IDEAS TO MARKET

Learn how the University of Maryland is transforming technology transfer and venture creation on campus, in the region, and for the nation as a whole. This session is intended for faculty, students, and industry partners. Hear directly from successful startups that have benefited from our programs and network with regional investors, advisors, and entrepreneurs.

RIGGS ALUMNI CENTER, OREM HALL 2:00-6:00 PM

THURSDAY, OCTOBER 24, 2013

FISCHELL FESTIVAL: A CELEBRATION OF BIOENGINEERING'S POTENTIAL TO IMPROVE MILLIONS OF LIVES

Learn how bioengineers are joining forces with colleagues in the medical field to design the next generation of biomedical devices and advanced treatments that will shape the future of human healthcare.

JEONG H. KIM ENGINEERING BUILDING 1:00-4:30 PM

THURSDAY, OCTOBER 24, 2013 (CONT.)

WHITING-TURNER BUSINESS & ENTREPRENEURIAL LECTURE SERIES

"The da Vinci and Beyond: The Advancement of Surgical Robotics"
Simon DiMaio, Intuitive Surgical, Inc.

JEONG H. KIM ENGINEERING BUILDING 4:30-6:00 PM

FRIDAY, OCTOBER 25, 2013

MARYLAND ROBOTICS DAY

Learn about the Maryland Robotics Center and its innovative robotics research programs. Tour labs, visit with faculty and students, and see robots in action.

JEONG H. KIM ENGINEERING BUILDING & OTHER ENGINEERING FACILITIES
9:30 AM-12:00 PM: SHOWCASE FOR K–12 STUDENTS
1:00-4:00 PM: SHOWCASE FOR INDUSTRY AND GOVERNMENT

SATURDAY, OCTOBER 26, 2013

GAMERA HUMAN-POWERED HELICOPTER TEAM CELEBRATION

Celebrate the world record-breaking accomplishments of our *Gamera* student team. *Please note that this is a limited access event.*

JEONG H. KIM ENGINEERING BUILDING 7:00-9:00 PM

FOR MORE INFORMATION ON ALL CLARK SCHOOL EVENTS, VISIT
WWW.ENG.UMD.EDU/HTML/EVENTS/INDEX.PHP

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