It’s spring and time for our latest edition of the EES Newsletter. This issue brings you news about peer recognition of Professor Paul Roberts’ and Professor Jim Leckie’s achievements in science and teaching; Professor Craig Criddle’s slightly different chemistry textbook; a new program and new classes recently introduced. You will also read about students’ involvement in global public service activities, and the creative programs being designed to bring environmental science and sustainability to school children and the local community.

As you can tell, we have lots of news about EES, but not enough about you, our readers. Please take a few minutes to contact us. Send us an email, call us on the phone, write us a letter, send a fax...whatever means of communication works best. Let us know where you are, and what you are doing, share your news with other alumni and friends. We’re eager to hear from you! We can be reached at: julieste@stanford.edu

In this issue

- Professor Paul Roberts receives AEESP Founders Award
- Awards for the Leckie group
- Chemistry can be fun!
- The capstone design class
- The Luthy group news
- Atmosphere & Energy Program
- Creative ways to stimulate interest in science & engineering among local schoolchildren...
- Engineers for a Sustainable World is expanding...
- Reducing bioavailability of polychlorinated biphenyls to clams
- Philip Gschwend, Shimizu visiting professor
- Alumni news

Paul V. Roberts, C.L. Peck, Class of 1906, Professor of Engineering, Emeritus, is shown above with his wife, Inge, and a group of former students at a dinner in his honor at Antoine’s in the French Quarter of New Orleans. Roberts had just received the AEESP Founders Award.

See story on next page.
Alumni, colleagues and friends gathered to honor Paul V. Roberts, C.L. Peck, Class of 1906, Professor of Engineering, Emeritus, and his wife Inge in New Orleans last October. He was the recipient of the Association of Environmental Engineering and Science Professors (AEESP) Founders Award, presented at the annual Water Environment Federation meeting there. This distinguished award is given annually to an individual who has made "sustained and outstanding contributions to environmental engineering education and the profession". Over 30 former graduate student advisee, colleagues and contemporaries, including three previous Founder’s Award recipients wrote letters to support Roberts' nomination for this honor, all expressing their deep respect for and admiration of him personally, as a researcher, and a teacher. Not only has he made significant, ground-breaking contributions to environmental research leading to his election to the National Academy of Engineering in 1997, but through teaching and mentoring he has exerted a strong, lasting influence on all his students, many of whom are successful academicians or environmental engineering professionals.

Professor James Leckie is elected to the National Academy of Engineering.

Susie Stone, CEE Department Manager, has received the 2004 Kay Bradley Award in grateful recognition of her outstanding service to students. The award is named for Kay Bradley who was Student Services manager in the Department of Mechanical Engineering for many years. On Friday, March 18, 2005, Susie also reached another landmark-35 years of service to Stanford!

Professor Paul Roberts receives AEESP Founders Award

Professor James Leckie is elected to the National Academy of Engineering.

Awards for the Leckie group...

In February, Professor James O. Leckie, C.L. Peck, Class of 1906, Professor of Environmental Engineering, was elected to the National Academy of Engineering, one of the highest professional distinctions for an engineer, and a well-deserved honor recognizing his scientific accomplishments and teaching contributions. When making the announcement, the Academy referred specifically to his work on “advances in our understanding of metal and oxyanion adsorption on environmental surfaces that have led to novel strategies for soil and groundwater remediation”. Now six Environmental Water Studies faculty have received this honor-Jim, and Professors Luthy, McCarty, Roberts, Street and Kavanaugh (Consulting) - more than any other environmental engineering program in the country.

And more...

Congratulations to Paloma Beamer, Ph.D. student in Leckie’s Exposure Research Group, who has won the Best Student Paper Award for 2004. This award is presented at the International Society of Exposure Analysis annual conference every year, and three of the five Ph.D. students in the exposure group have won this award; the other two are Valerie Zartarian in 1995 and Alesia Ferguson in 1996.
In the Capstone Class, aka CEE179C, Environmental Engineering Design, students apply and polish their engineering skills while coping with the many non-technical issues that are part and parcel of engineering careers. The goal is to ensure that students graduate with an understanding of how economic, social and regulatory considerations must be integrated into any project. The focus of the class is typically local, dealing with issues that resonate with the students. This year students will consider water issues, including preservation, treatment, re-use, and storm water collection and management, in the context of the proposed Green Dorm (SEE Autumn issue of the EES Newsletter). Though the concept is still in the preliminary stages, there is substantial support for the Green Dorm throughout the Stanford community, and the Capstone class is taking advantage of the many unique considerations and opportunities inherent in the Green Dorm concept.

As conceived, the dorm will be a living lab, so it must be designed to fit research seamlessly into a high quality living environment. Flexibility is key. Technologies, research issues, and teaching foci are likely to evolve over the life of the dorm. Water systems must mesh with other systems (air quality and energy for instance). Over both short and long terms, Stanford must manage its water demands, wastewater generation, and storm water flows and Green Dorm water needs to fit with, and preferably assist in meeting, these constraints. Finally the Dorm’s water systems must be compatible with building and other codes, codes whose authors may never have envisioned something like a Green Dorm.

This combination of issues and constraints should both challenge and engage this year’s Capstone class. In years to come other aspects of the Green Dorm or sustainability at Stanford might provide other Capstone classes with projects on which to cut their teeth. In any case, the objective of the class will always be to offer students ways to apply their engineering skills to a real-life situation while dealing with the non-scientific, non-engineering issues that are integral to everyday practice in the outside world.

Capstone is required for an undergraduate degree in CEE. Teaching is shared between EES and EFMH.

The Cartoon Guide to Chemistry
- chemistry can be fun!

Two years and over 12,000 e-mails in the making, The Cartoon Guide to Chemistry, a light hearted romp through chemistry, will be published in May this year. The book is the result of collaboration between San Francisco cartoonist Larry Gonick and Professor Craig Criddle. Gonick is well known for his Cartoon Guides on topics ranging from physics to sex to a history of the universe. In 2003 his guide The Cartoon History of the Universe Part III won the Harvey Award for “the year’s best graphic album of original material”.

This story began when Criddle was seeking an illustrator for a book on aquatic chemistry. Knowing Gonick’s work, Criddle contacted him to see if he might be interested. Gonick asked to see some chapters, and after reading them he made Criddle a counter proposal: would Criddle be interested in a more expansive effort covering the whole of chemistry? Thus began an intense two-year collaboration.

Criddle describes the project as a valuable learning experience. Squeezing the detailed and complex material of chemistry into the “one page, one concept” format of a comic book was a tremendous challenge. “I came away with enormous respect for Larry and what he does”, says Criddle. Equally challenging was responding to Gonick’s insatiable curiosity. “It was like dealing with a really smart Ph.D. student. Gonick’s determination to get to the bottom of things made me look for better explanations and examples, and that has had a happy side effect on the classes I teach”, says Criddle.

Criddle hopes that The Cartoon Guide to Chemistry will help those who fear chemistry or have struggled to understand it, while also inspiring and amusing those who already have a good grasp of it. “One of the beauties of cartoons is the chance to make things more human and less abstract”, says Criddle. “Some atoms and molecules fall in love and bond, others explode. Cartoons can give us an intuitive feeling for the why, and deeper understanding can grow from that intuition”.

The Capstone Class

by Sandy Robertson (EES)
A preliminary field test of an in situ remediation strategy of mixing activated carbon into PCB-contaminated sediments was completed in summer, 2004 through a major collaborative effort led by researchers in Professor Richard G. Luthy’s lab. Postdoc Dennis Smithery and graduate student Yeo-Myoung Cho helped conduct the project at Hunters Point Naval Shipyard in San Francisco with funds provided by Naval Facilities Engineering Command, Southwest Division (NAVFAC). A barge-like machine called an Aquamog was used to mix activated carbon into the sediment as a means of sequestering PCBs. Preliminary results indicate that the carbon was successfully mixed into the sediments, and as a result a reduction in PCB uptake into semipermeable devices was observed.

The NAVFAC study was done to identify any unforeseen problems with activated carbon application, PCB resuspension and sampling techniques in preparation for a larger demonstration project that will be funded by the Environmental Security Technology Certification Program (ESTCP) in 2005-2007. The ESTCP project seeks to demonstrate that the activated carbon amendment will reduce PCB bioaccumulation as previously observed in the Luthy lab. If this in situ remediation strategy is found to be successful, it may circumvent the need to do expensive dredging and controversial disposal of sediments containing PCBs and other similar hydrophobic organic contaminants.

In addition, Luthy group graduate student Lei Hong has begun a project with sediments from Lake Union in Seattle, WA. Sediments in the lake contain one or more contaminants above sediment quality values, and the primary chemicals of interest are heavy metals and polycyclic aromatic hydrocarbons (PAHs). This project will help assess the nature of PAH contamination in northern Lake Union sediments that will be used in the future site risk assessment and cleanup goal establishment.

In September, 2004 the Department of Civil & Environmental Engineering welcomed its first class of masters degree students to the newly established Atmosphere & Energy Program. Professor Mark Z. Jacobson (EFMH) initiated the merging of CEE’s separate, smaller programs in energy and atmosphere after he and others realized that these naturally related programs would surely benefit from the close connection among research projects and faculty expertise that a combined program would produce. Professor Gil Masters (EES), who had been a long time advocate of energy in CEE, provided significant input for the merger, with the support of Professor Lynn Hildemann (EES). Professors Criddle and Spormann are also among the program faculty.

Rather than designing their own majors as required in the past, students can now graduate with an M.S. or Ph.D. in Civil & Environmental Engineering, with emphasis in Atmosphere & Energy; undergraduates can focus on atmosphere and energy.

As the diagram on its Website [http://www.stanford.edu/group/atmosenergy/] shows, the new program is linked closely to other programs within and outside CEE, offering increased opportunities for collaboration and interdisciplinary research.
Raising awareness of the importance of science and engineering education for the country’s future and stimulating interest in these fields among elementary and high school students are among the major goals of the National Science Foundation (NSF), and efforts to achieve them form an integral part of all NSF funded projects. Professors Martin Reinhard, Craig Criddle, Alfred Spormann, Ali Boehm, Dick Luthy, and their research teams working on the NSF funded Center of Advanced Materials for Water Purification with Systems (WaterCAMPWS) and related water research, are excited about their plans to meet this challenge within the local community. The groups are planning several creative programs that will help teachers bring the science of sustainability into the classroom, help students of all ages appreciate the effects of their actions on the environment, and train graduate students at Stanford to communicate the concept of “sustainability” to members of the community. Descriptions of three of these projects follow and there will be further details in the Newsletter as others are launched.

A spring quarter class for Stanford graduate engineering students entitled Teaching Science Literacy for a Sustainable Society forms the core of the Stanford program. Its objective is to teach graduate students how to communicate scientific principles to middle and high school students and the general public, with particular emphasis on the environment and the sustainability of water resources. Meeting this objective will involve coursework in the educational process including curriculum development, learning styles, tailoring content for specific audiences, oral and visual communication, the role of scientists and engineers in media communications and inquiry-centered learning. In terms of the specific topic of sustainability, the class will design modules aimed at middle and high school students focusing on drinking water issues.

The class will be a seminar co-taught by Criddle and Reinhard, with support from prominent local educators; Naoko Munakata, a graduate student working with Reinhard, is coordinating the program. Students will put their skills into practice in a workshop after the seminar in which they will work with local community partners to develop educational modules. Class partners include the Santa Clara Valley Water District and the San Jose Tech Museum of Innovation where a second segment of Stanford’s efforts to reach out to middle and high school students is being developed.

In June 2004, the Tech Museum began planning a project entitled “Green by Design” with the aim of “…challenging the notion that technology is inherently destructive”. The exhibit, scheduled to open in April 2006, will target middle school children, but will attract and instruct people of all ages. The designers envision displays that will show how to work with nature rather than against it and how to create a sustainable environment with innovative and advanced technologies. The theme fits neatly with the goals of Stanford’s Institute for the Environment and CEE and its concept of engineering for sustainability, and both are contributing. At the same time it offers the Stanford WaterCAMPWS team an opportunity to provide support and expertise for a project that will greatly benefit the community by educating a new generation (and an older one) in ways to live, work and design sustainably.

Jenny Nyman, a graduate student working with Criddle, is coordinating the Stanford group that will work with the Tech Museum in setting up exhibits related to water pollution and treatment, creating activities such as simple experiments to test water quality, and answering questions posted online at the museum. By providing scientifically grounded advice, the group will help ensure the integrity and feasibility of exhibits and programs as they are developed. The Rooftop Wetlands, on the rooftop of the museum, will be a focal point of their project. It will be a wetlands ecosystem with native plants, trees and fish showing the impact wetlands have on natural water systems, what leads to water pollution, how water can be purified and reused. The group will also help set up exhibits displaying novel, environmentally sound designs such as membranes for water purification, and others demonstrating the destructive effects on the environment and ecosystems of technology and our lifestyles, such as the large amounts of garbage produced, non-biodegradable products, and expanding landfills.

A third segment involves collaboration with the Industry Initiatives for Science and Math Education (IISME). This Bay Area consortium “…exists to address the critical need for a strong, highly skilled workforce in mathematics, science and technological fields” by giving local teachers opportunities to expand and refine their skills and thus improve classroom instruction. Stanford’s 10-week summer program will give local high school teachers the chance to conduct research in a Stanford laboratory. With the guidance of faculty, teachers will work in the lab four days per week and spend the fifth day in group activities such as seminars or field trips. Financial support for the teachers will be provided through fellowships from WaterCAMPWS and related projects.
Since its founding in late spring 2003 by EES graduate student Sophie Walewijk, the Stanford Chapter of Engineers for a Sustainable World (ESW) has become a flagship chapter for the national organization. Across the country, ESW mobilizes scientists and engineers to address problems faced by developing communities. With its experienced and creative engineering faculty, its commitment to environmental stewardship, and its legacy of social entrepreneurship, Stanford has proved to be the ideal partner for ESW.

ESW-Stanford kicked off the academic year last fall when over 600 students, professionals, and academicians participated in the 2004 National Engineers for a Sustainable World Conference, held here on campus. Nearly 100 presenters shared their expertise in technology-based development work with participants via presentations, hands-on workshops, and keynote addresses. Participants said they were inspired by the impressive array of presenters, and enjoyed the first-of-its-kind gathering for those interested in applications of technology to development issues.

The theme “Solutions for a Shrinking Planet: Sustainable Engineering and Enterprise for Human Development” shaped a conference in which scientists, engineers, and entrepreneurs explored creation and implementation of technology-based solutions to concerns of developing communities. Discussions of appropriate solutions, environmental concerns, and local/global market forces framed a holistic approach to the broader goal of securing basic human rights for every individual on the planet. The conference highlighted the rapidly growing group of socially and environmentally concerned students and professionals around the nation and world.

Notable speakers included William McDonough and Michael Braungart, founders of McDonough Braungart Design Chemistry and co-authors of the influential Cradle to Cradle: Remaking the Way We Make Things. Recent McArthur Fellowship winner Amy Smith, Whirlwind Wheelchair’s Ralph Hotchkiss and Kurt Kornbluth, Berkeley energy guru Dan Kammen, the Acumen Fund’s Yasmina Zaidman, and sustainable enterprise expert Stuart Hart presided over highly popular sessions. The conference also showcased the greater Stanford community: alumni Martin Fisher (co-founder of ApproTEC) and Ross Evans (founder of Xtracycle) presented a keynote speech and an overflowing workshop, respectively. Current Stanford professors Ray Leavitt, Gary Schoolnik, and James Patell (among numerous other Stanford affiliates), as well as students Scott Cannon and Kevin Hand, presented their own work with developing communities.

Since the conference, the past year has been a wild success. Last spring, ESW-Stanford launched a class through the Civil and Environmental Engineering Department entitled Design for a Sustainable World (CEE 177s/277s), in which students work on technology-based development projects. After two quarters of success, we are working to make this course a permanent fixture on campus. Beyond the classroom, we have arranged over 20 presentations by experts from various fields, attracting audiences from all backgrounds. Our high profile this year has led to a huge increase in membership: at present, we have over 400 Stanford members involved in some way with ESW-Stanford, and we recently helped launch a Bay Area Professional ESW chapter. All this means more people-power for effecting real changes!

Currently, we have several working groups assessing how Stanford students, affiliated faculty and staff, and local professionals can best help the tsunami relief effort transition from disaster relief into sustainable rebuilding over the coming months and years. We have been researching and working with contacts in the Andaman and Nicobar Islands, and our work for the next two quarters (including speakers and the class) will focus on tsunami-related research and needs assessment in that region. We are dedicated to creating a project team to help with the difficult task of long-term recovery and future disaster-preparedness. Beyond our technical project focus, we are also co-sponsoring a public panel series with Stanford Students for Relief, VIA, and the Haas Center for Public Service entitled “After the Waves,” which will address various components of post-tsunami relief and recovery.

For more information on our chapter and our activities, you may visit our website at http://esw.stanford.edu. Stanford University as a whole is working in many ways to be a steward for global service and sustainable development, and we strongly believe that engineers and scientists have much to add to this. We look forward to continuing our partnership and growing for many years to come.
Reduction of bioavailability of polychlorinated biphenyls to clams

- Pamela McLeod, Ph.D. student working with Professor Dick Luthy, describes her presentation to the 25th annual meeting of SETAC.

In mid-November, Chris Higgins, Jeanne Tomaszewski, Pam McLeod, and Sarah Rubinfeld traveled to Portland, Oregon to participate in the 25th annual meeting of Society for Environmental Toxicology and Chemistry (SETAC). Conference participants included representatives from academia, business, and government, in such diverse fields as ecotoxicology, risk assessment, environmental chemistry, and environmental modeling.

Jeanne, Chris, and Sarah presented posters detailing their work with remediating DDT-contaminated sediment, determining environmental transport and fate of perfluorinated organics, and detecting nitromusks in the environment, respectively. Pam delivered a 20-minute oral presentation entitled “Reducing Bioavailability of Polychlorinated Biphenyls to Clams” in the session “Contaminated Harbor and River Sediment.”

Pam’s talk described work she’s done to investigate activated carbon amendment as a remediation strategy for sediments contaminated with polychlorinated biphenyls (PCBs). Using this strategy, activated carbon is added to contaminated sediment where it out-competes natural sorbents to bind and sequester PCBs. When PCBs are sorbed to the added carbon particles, they are much less available for uptake into the water column and biota. In absorption efficiency studies previously performed, Pam showed that when the clam Macoma balthica ingested activated carbon particles spiked with a tetrachlorinated PCB, less than 2% of the PCB was taken up into the clam’s tissues (McLeod et al., 2004. Environ. Sci. Technol. 38: 4549). When she exposed the same species of clam to sediment from Hunters Point Naval Shipyard (San Francisco Bay, CA), she found that contacting the sediment with activated carbon for one month reduced PCB 28-day bioaccumulation in the clams by up to 80%.

Additional tests with Macoma and Hunters Point sediment investigated the effects of activated carbon particle dose and size on the treatment efficacy. In general, higher dose and smaller diameter particles resulted in lower PCB uptake by the clams.

As Pam explained in her presentation, her work with clams complements prior physicochemical tests (aqueous equilibrium, semi-permeable membrane devices, flux) and biological tests (worms, amphipods) performed by colleagues at Stanford and the Army Corps of Engineers’ Waterways Experiment Station (WES). Taken together, the positive results of this body of experiments provide multiple lines of evidence supporting activated carbon amendment as a novel in-situ PCB remediation strategy. A field-scale trial is currently underway at Hunters Point Naval Shipyard to assess the effectiveness of the technique under field conditions.

Lastly, he hopes to develop collaborations for his interest in establishing methods for anticipating the environmental impacts of newly designed chemicals and materials, including those associated with nanotechnologies. His aim is to collaborate with industry on research into the various ways a product, and the processes used to make, use, and dispose of it, might affect the environment before that product is fully launched in the marketplace. The intent is not to ban potentially damaging chemicals and materials, but to look at smart ways to design and use them, thereby lessening their impacts while still taking advantage of their benefits.

EES and CEE are fortunate to have Phil Gschwend, Ford Professor of Engineering in Civil & Environmental Engineering at MIT, as a Shimizu Visiting Professor. He will be at Stanford from mid-January to mid-June this year.

Gschwend’s area of interest is the behavior of organic chemicals in the environment. In particular, he works to understand how organic compounds move about, interact with solids, and are transformed. The overarching objective is to quantify our exposures to these substances.

One very effective way of measuring human and ecosystem exposures to these chemicals is to use common plastics like polyethylene.

Analysis of such plastic after it has been exposed to air, water or sediment for a period of time indicates the amount of chemical exposure in those locations, because the plastic absorbs the molecules. Using the data from these analyses can help us decide whether sites are hazardous with respect to toxic substances and just how much effort and money must be invested in cleaning it up. See “Plastic packaging helps monitor ocean pollutants”.

Gschwend, co-author of the text “Environmental Organic Chemistry”, has three main goals for his time at Stanford. The first is to improve on his textbook by developing a solutions manual for some of the text’s problems. Another goal is to continue his research into exposure assessments, particularly at sites with contaminated sediments.
Alumni news...

Daniel Yeh, until December 2004 a postdoc with Professor Craig Criddle, has taken a position as assistant professor in the Dept. of Civil & Environmental Engineering at the University of South Florida where he will continue his research focusing on biological and membrane processes. He welcomes visitors to his new location: “Please do make a point to stop by if your travels take you to Florida. Tampa is just a short drive from Orlando, home to many WEF and AWWA conferences.” He can be reached at dhyeh@eng.usf.edu; his Web address is http://www.eng.usf.edu/~dhyeh.

John Zimmerman, Ph.D. 2004, writes from Virginia: 'My family has settled in somewhat here in Virginia, and we are enjoying life. Kristi is making friends, Abraham is enjoying kindergarten, Noah likes his preschool, and Martha is prattling away. Admittedly we miss Stanford; we had such a great time there.

With regard to my work, I spend about half my time doing “due diligence” work. When a company goes up for sale, we visit the facility (facilities) and try to quantify any potential environmental liabilities, such as contaminated soil or ground water, or compliance issues, such as the need to obtain permits for water or air emissions. The other half of my time I spend in a variety of work, including litigation support, risk assessment, and other sundry projects. I may be doing some sediment work in the somewhat near future. I enjoy the work. It has been interesting to be involved in a wide range of projects.’ He can be reached at jzimmerman@environcorp.com.

Jerry L. Jones, M.S. 1974, writes: "After spending almost 20 years at SRI, the last 10 as the head of the chemical engineering lab and development center, I spent about 8 years as head of EHS for Raychem and for the last 4 +years have been the VP of operations for a startup company in South San Francisco making liquid crystalline optical coatings with a lot of interesting chemical engineering challenges. [I will be leaving Optiva soon] to join Genentech as the head of EHS for their manufacturing operations to put in place an integrated process risk management system much like what I did for Raychem.” He can be reached at jjonespe@sbcglobal.net.

Robert Canales, Ph.D. ’04 Robert is currently an Alonzo Yerby Post-Doctoral Fellow in the Harvard University School of Public Health, Boston where he has been working on several modeling projects funded by the USEPA. He is participating in the Spring course on Introduction to Human Exposure Analysis, CEE276, where he will give lectures on dermal exposure.

Environmental Engineering & Science
STANFORD UNIVERSITY
B-9, Terman Engineering Center
Stanford, CA 94305-4020