Mechanical Engineering News

University of Delaware

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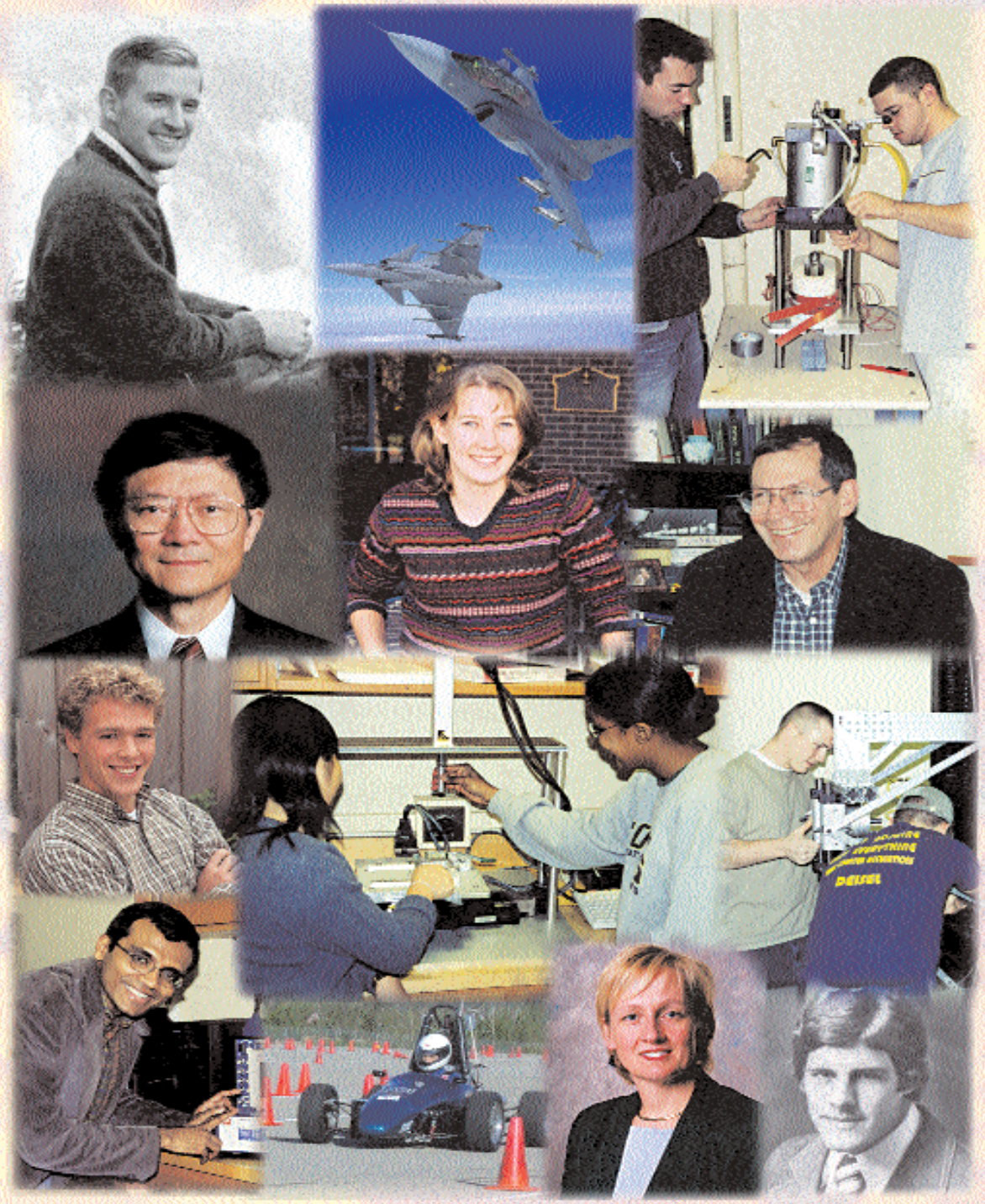


Inside: Faculty Highlights • Student Profile • Senior Design • Awards • Alumni News • SAE

Message from the Chair

Tsu-Wei Chou

I am amazed each time I begin to write this column that there is always something new to talk about in ME—new faculty, new facilities, new research programs….

It is always exciting to have new faculty members join our department. They bring fresh ideas and innovative approaches while adding to the breadth and depth of expertise we offer. This issue of ME News introduces Anette Karlsson, whose research focuses on computational and analytical work in the area of solid mechanics. We're very pleased to have Anette with us and look forward to the contributions she will make to our research and education programs in high-temperature materials and advanced composites.

The new year also brings us new facilities. With the completion late in 2002 of the DuPont Hall addition, the University's Department of Materials Science and Engineering moved out of Spencer Lab and into DuPont. This move will enable ME to renovate Spencer and provide new laboratory space for our very active research programs. New areas like biomedical engineering and nanotechnology require modern facilities, and the DuPont Hall project will enable us to renovate our space and equip it with the latest instruments needed to carry out this work.

This is where our alumni have the potential to make a real impact. It is the generosity of people like Pierre Samuel du Pont, whose philanthropy provides the funds for the building a half-century ago, that enable us to establish new capabilities and improve existing ones. We hope that you will come back to campus and tour the new building to see how much the University and the College benefit from those who take an interest in our educational institutions. We need your help in continuing to develop new programs and equipping the facilities needed to conduct them.

We look forward to hearing from you—including your own success stories and your ideas for how to help us be more successful.

Editor's Note

Our cover page for this edition of ME News provides a glimpse of the features inside. It also suggests the diversity of the family of Mechanical Engineering! Our vision of this family includes alumni, faculty, and students working together associatively in a mutually beneficial relationship. As you read through the ME News, we urge you to consider the ways in which you might participate in this relationship. Let us know what your ideas are, and please enjoy this issue.

The high performance aircraft at the top center of the front page is intended to be emblematic of the world of possibilities resulting from mechanical engineering. At the risk of being trite it also represents the forward direction of our "Mechanical Engineering Association". We got the idea from one of the articles in this issue – can you find where it came from?

IN THIS ISSUE

Faculty Focus

Mike Greenberg

As a teaching assistant at Cornell University, where he earned a bachelor's degree in mechanical engineering and graduate degrees in Theoretical and Applied Mechanics, ME Professor Michael Greenberg had lots of opportunity to teach. "The TAs there taught small sections; we didn't just grade papers." At his request he taught all five of the undergraduate courses taught by his department, including engineering mathematics, dynamics, strength of materials, and advanced strength of materials.

Growing up during World War II Greenberg was fascinated with the fighter planes and was drawn to being an engineer, but over the years his interest has gradually shifted. "While my interest in planes got me going, eventually I found myself most deeply interested in the mathematical aspects of engineering, and in teaching and writing."

After working at a small aeronautical engineering research company in Ithaca, NY, for several years, Greenberg joined the UD faculty in 1969, attracted by the University's new status as a Sea Grant Institution and its accompanying focus on hydrodynamics. He also encountered an environment that was very receptive to a faculty member who wanted to make teaching and writing his primary areas of interest. At the same time, though, Greenberg has enjoyed his research here. He has worked in aerodynamics and naval hydrodynamics, and was able to develop vortex sheet methods for computing nonlinear flows such as large amplitude water waves and the flow induced by helicopter rotors.

Textbooks proved to be an opportunity for Greenberg to expand his interest in teaching and pedagogy, and to expand his "class" beyond UD. His first book, on the method of Green's functions, was only 128 pages long and was more of a monograph than a textbook. But based on the response to that book the publisher suggested that he write a textbook on engineering mathematics. He agreed, since that idea fit well with his desire to work on the ME Engineering Analysis sequence that he was teaching. At this point he has published four books that have reached thousands of engineering and science students over the past three decades, and he is currently working on two more. "Writing on engineering mathematics is interesting," Greenberg says, "because on the one hand one must be very tight and formal since, after all, it is mathematics, and at the same time there is a desire to be more informal and engaging with engineering and science students, especially in discussing applications." He believes that there is an opportunity to bring to the writing some of the understanding and instincts of an engineer so that engineering students can see the connections and feel more at home.

After 30 years of working at the juncture between engineering and mathematics Greenberg looks ahead to an increasing involvement in applied mathematics from the biological sciences. "There's probably no such thing as a 'simple' biological system. Even systems such as the pinhole eye of the nautilus, which is often described as 'primitive' compared to the human eye, are deeply complex, and that complexity invariably involves nonlinear and challenging mathematics." In his current writing he is including more applications to biology, such as the "action potential" firing of the nerve cell and ecological systems.

Greenberg has six children and six grandchildren, the oldest of the grandchildren being a sophomore at UD. He and his wife share a deep love of art, and when they travel they always look for new art museums, galleries, and so on, to visit. He has been both a ceramist and a painter, but is only now beginning to get back to those things. "It's difficult to start and stop, with art, if one is serious, just as it is with academics. So, for the foreseeable future I'm just grateful to have a job that enables me to do what I love, to teach and to write."

Anette Karlsson

by Diane Kukich

Like a lot of engineers, Assistant Professor Anette Karlsson always liked math, but her path to a faculty position at Delaware was not as traditional as her interest in numerical methods. She earned the equivalent of an associate's degree in her native Sweden and immediately went to work as a structural engineer for Saab Missiles AB and Saab Aerospace AB in Linkoping. While working there, she continued her education and completed her master's degree. Ready for a change after a few more years at Saab, she accepted a position as Technical Attaché for Materials Science at the Swedish Embassy in Washington, DC.

"At that point, I decided I want to go on for a doctoral degree," she says, "so I went to Rutgers, where I earned my Ph.D. in solid mechanics. I then went on to Princeton as a postdoc for three years."

At that point, Karlsson was ready to look for a faculty position. Delaware, she says, was on her "radar screen" because she had learned about the University's Center for Composite Materials (CCM) while working in Washington. She had a strong interest in advanced composites from her work at Saab, where she had helped to design the wing, made of carbon-fiber reinforced epoxy, of the JAS-39 Griffin.

Since coming to Delaware, Karlsson has continued to work on advanced materials for aerospace applications, but her interest has shifted to high-temperature materials for engines. "I'm looking at the failure mechanics of the coatings used to prevent degradation of engine components," she explains. For now, her lab is a computer at her desk, as she is focusing primarily on computational and analytical work. However, her future lab is currently being built on the third floor of Spencer Laboratory, and will be a state of the art computational facility. She also hopes to explore collaborating with faculty in CCM, where extensive experimental facilities are available.

Karlsson currently teaches an undergraduate course in solid mechanics and is developing, in collaboration with faculty in civil engineering, a graduate-level course in failure mechanics. "I want to apply numerical methods in my teaching to make topics such as buckling, plasticity, and thermal stress more relevant to students using modern research methods," she says.

When Karlsson isn't teaching or doing research, she can probably be found talking about teaching and doing research with her husband, who is also an engineer and is on the faculty at Rutgers. The two currently have a long-distance relationship during the week, but when they get back together on Friday evenings, it doesn't take them long to make the transition—they unwind by talking about issues each of them understands well in the other's life.

Karlsson may have first heard about the University of Delaware because of the University's composites program, but her initial connection actually goes back much farther. "We used Mike Greenberg's textbook when I was a student," she says. "He is a great mathematician, and his book is very concise and easy to read. When I first came here, I was very excited to meet the author of this book."

Kausik Sarkar

by Diane Kukich

"Tiny Bubbles" might sound more like the title of a vintage song than the topic of cutting-edge research, but Assistant Professor Kausik Sarkar knows that there are literally thousands of practical applications for these very fundamental objects he is studying. In the medical field, for example, micro-bubbles can be inserted into the body to deliver therapeutic drugs, destroy tumors, and enhance ultrasound images.

Sarkar actually began investigating bubble dynamics as a graduate student at The Johns Hopkins University. His work was funded by the Navy, which was interested in learning more about this topic because of the effect that bubbles have on SONAR—as good sound deflectors, they tend to interfere with SONAR ranging. But, as Sarkar points out, the knowledge can be applied to a variety of problems, from counting fish to locating petroleum stores.

For Sarkar, the fundamentals have always been at the forefront: "Bubbles, particles, and drops are all simple objects that behave in a mechanical way," he says, "and we need to understand the fundamentals of their behavior mathematically so that we can apply them in useful ways."

In traveling the path from his undergraduate education at the Indian Institute of Technology to his position on the UD-ME faculty, Sarkar went to graduate school at Johns Hopkins, worked for a short time in industry, and served as a post-doctoral researcher at the University of Illinois at Urbana-Champaign. Through these various institutions, he has experienced the entire range of philosophical approaches to ME—from the applied to the theoretical and back again.

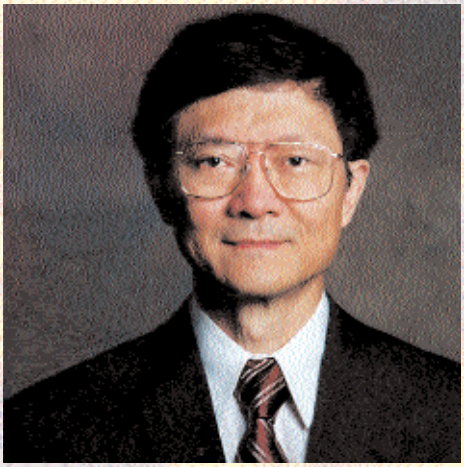
UD falls at the theoretical end, according to Sarkar, which is not surprising because that is typical of a research university. "But all ME departments are grappling with this," he admits. "As the field has matured, it has passed the stage of 'tinkering' and progressed toward the quantitative, but we have to be careful not to go too far with that. We have to achieve a balance, especially if we want to avoid turning off our students."

"Like civil engineering, mechanical engineering is a very old field," Sarkar continues, "so we have to reinvent ourselves, we have to decide where we want to go. Nanotechnology is a good example of a new direction for us. It's not a new technology, but it's new for mechanical engineers, who are used to seeing things from the macroscopic perspective. It's important for us to look at where our students are going to be employed; for example, many of them may be absorbed by the medical field. We have to prepare them for work in cross-disciplinary fields so that they know how to talk to others in a language that everyone can understand."

Sarkar loves to teach and finds that it forces him to learn new things himself, especially when good topical textbooks are not available in the subjects he is asked to teach. He also still believes strongly in the fundamentals—"If your fundamentals are strong, you can do a wide variety of things," he says. "The most important thing for us as teachers is to figure out what we want students to take with them in order to be successful."

When he is not teaching or getting his new lab set up, Sarkar spends his free time working with a student group whose goal is to promote literacy in his native India. He is also active in a local Bengali community. "India is really a conglomeration of separate countries whose people speak different languages, dress differently, and eat different food. It's nice to be able to get together with people from my area of India."

Faculty Highlights



In addition to being named the University's first P.S. du Pont Chair of Engineering (see story on page 11), ME Department Chair **Tsu-Wei Chou** recently received two other honors: (1) designation as a "Highly Cited Researcher" in the field of materials science by the Institute of Scientific Information (ISI) and (2) recipient of the Worcester Reed Warner Medal conferred by ASME. In earning the "Highly Cited Researcher" designation, Chou joins a very exclusive group comprising less than one-half of one percent of all publishing researchers. The Worcester Reed Warner Medal is awarded for outstanding contributions to the permanent literature of engineering in the form of single papers, treatises or books, or a series of papers. Chou received the award at the 2002 International Mechanical Engineering Congress and Exposition, held from November 17-22 in New Orleans.

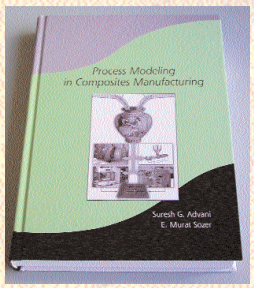
Work by **Hai Wang** was featured in a conference held July 3 in Yerevan, Armenia, to mark the five-year anniversary of that country's National Foundation of Science and Advanced Technologies. The event is being viewed in both the United States and Armenia as a milestone for international collaboration and particularly for the U.S. Civilian Research and Development Foundation (CRDF), which helped create the organization to promote scientific development in the Armenian republic. Wang is

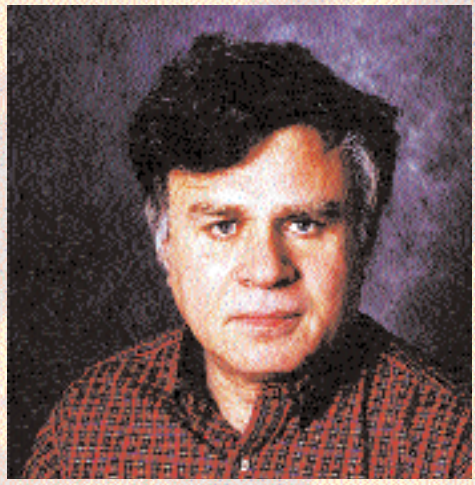
working with Adolph A. Mantashyan of the Institute of Chemical Physics at the Armenian Academy of Sciences on a process to eliminate the industrial emissions of sulfuric gas.

Thomas S. Buchanan was appointed Editor-in-Chief of the *Journal of Applied Biomechanics*. He also serves on the editorial board of the *Journal of Biomechanics*. He was recently appointed Raine Visiting Professor at the University of Western Australia for the

spring 2003 semester (http://www.raine.uwa.edu.au/rvp/). As Director of the Center for Biomedical Engineering Research, Buchanan was principal investigator on a five-year, $3.1-million award from the NIH to study the use of function electrical stimulation, rehabilitation robotics and biomedical modeling to re-train stroke patients how to walk.

Suresh Advani has been named the North American Editor (Manufacturing) of *Composites A: Applied Science and Manufacturing*. Also, his new book, *Process Modeling in Composites Manufacturing*, has been published by Marcel Dekkar.





Len Schwartz was Visiting Professor of Mechanical Engineering at the Naval Postgraduate School in Monterey, CA, for the Fall Semester 2002. He is also assisting the Navy in evaluating protective coating performance on turbine and compressor blades that are used in Navy ships and airplanes.

Kausik Sarkar has started a collaborative biomedical project with the Radiology Department of Jefferson Medical College on microbubble-based contrast agents for diagnostic ultrasound. A joint proposal on ultrasound-mediated detection of prostate cancer has secured funding from the Department of Defense. Professor Sarkar's lab will model and characterize the behavior of microbubble agents, while clinical studies will be performed by the Jefferson group.

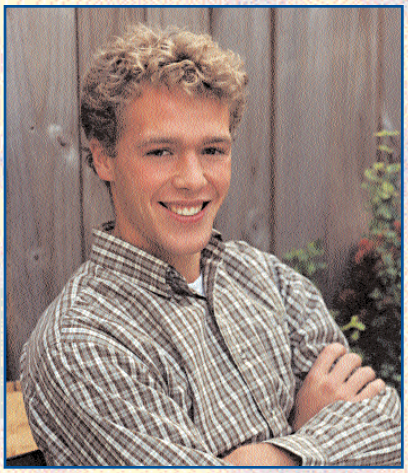
Jack R. Vinson, H. Fletcher Brown Professor, is the General Chairman of the 44th Annual Structures, Structural Dynamics and Materials Conference, which will be held in Norfolk, VA, from April 7-10, 2003. The conference is sponsored by the American Institute of Aeronautics and Astronautics, the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Helicopter Society, and the American Society for Composites. It is attended by approximately 600 engineers each year in the above specialties.

Vinson, with Robert L. Sierakowski, has also published a new textbook, *The Behavior of Structures Composed of Composite Materials* (Kluwer Academic Publishers). Sierakowski is Chief Scientist of the Munitions Directorate of the U.S. Air Force. The book is a complete revision of a 1986 text of the same title that sold about 4,000 copies and was used at some time in at least half of the universities in North America that offer courses in composite materials. The seventh textbook authored or co-authored by Vinson, it has been referred to as "an essential reference that every composites engineer should own." Another reviewer wrote, "This book is highly recommended both as a text for courses in structural aspects of composites, as well as for practicing structures engineers and researchers involved with composites. In fact, a copy of it belongs in the library of every composite structures designer, analyst and researcher."

Undergraduate Education

Student Focus: Dirk Veenema

by Diane Kukich



With a father who's a mechanical engineer, Dirk Veenema was "pretty set on ME as a major" while he was still in high school. "There wasn't much question about it for me," he says. "I've always liked the analytical side of things, and ME is the most physical of the engineering disciplines—I like things that can be manipulated."

He may be an engineering major, but Veenema's interests are those of a Renaissance man. While in England last summer participating in UD's exchange program with Imperial College (IC), he not only conducted independent research on fuel cells but also enjoyed attending theater productions and mountain biking in the hills between Oxford and London. And he plans to attend graduate school next year somewhere in the U.K.—studying theology and economics.

When he is finished with that, he will return to the United States and earn a doctorate in engineering. "I've gotten a great technical education here," he says, "but I'd like to explore philosophy and ethics before going back to engineering."

From Wilmington, Del., Veenema came to the University on a Eugene du Pont Scholarship. He has participated in research every summer of his undergraduate program and has gained valuable insights from the experience.

"Doing research forces me to wrestle with my class material long after I've learned it—it makes me go back and think about it in a whole different way," he says. "I've also learned a lot about the research process itself—for example, I've come to realize that everything takes about four times as long as I thought it would." He is continuing his summer research on fuel cells for a senior thesis at UD under the joint advisorship of Dr. Ricardo Martinez-Botas from IC and Prof. Hai Wang from UDME.

Despite the demands of the ME curriculum, Veenema has found time for extracurricular activities, including moderating a program called "Inquiry for Truth," a lecture series sponsored by the Church and Campus Connection. He is also a member of several honor societies and service groups and has served on a student advisory committee for curriculum change.

For his senior design project, Veenema is on a team that is designing a support system for an antenna array. He didn't realize the extent of the challenge involved until he found out that the antenna was huge—about 13 feet by 9 feet.

"The project has been interesting," he says, "because most of our work so far has just been to understand the problem. Every idea we come up with raises another question."

Sounds like a valuable lesson to come out of senior design….

Solar House Results

by Diane Kukich

UD's Solar House on location at the National Mall

After months of preparation, the UD Solar Decathlon team finally made it to the big event, which took place on the National Mall in Washington, D.C. from September 26 to October 6. In the final judging, the UD house received an overall ranking of 10 out of 14. The highest scores for the Delaware team were in the Energy Balance and Comfort Zone categories, with third- and fourth-place finishes, respectively. Top ranking overall went to the University of Colorado at Boulder.

Regardless of the final rankings, the team learned a tremendous amount—about not only solar power but also the logistics of pulling off a major project. Issues ranged from those associated with the house itself (design, livability, hot water, heating, etc.) to others—many times more complex—involved in getting all the parts for the house, putting all the parts together, and getting it where it needed to be.

The UD solar house was the only one in the competition with a semi-circular shape, according to the on-line team diary. "The thousands of visitors going through the house have remarked on the tall ceilings and the bright, airy feel to the house," they wrote. "Visitors enjoyed the openness of the floor design and the flow of living spaces. Passive ventilation from the front windows to the back windows provides a noticeably refreshing environment within. Many visitors commented on this aspect."

SAE Car

by Diane Kukich

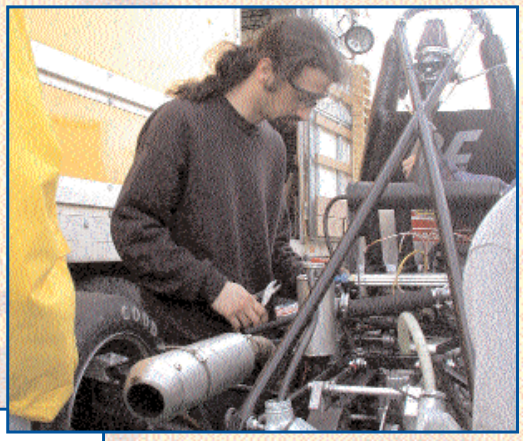
When a middle-school student asks why she needs math to build a car, Silvia Pineda is ready with an answer. President of the University of Delaware's Formula SAE Team, Pineda has extensive knowledge about what it takes to design and build a high-performance race car. But she also knows what it means to leave the high-tech world and get her hands dirty—she has found herself in a junkyard weighing engines to see which ones are the lightest and will enable the team to save weight on their vehicle.

UDFSAE is a competition sanctioned and organized by the international SAE organization with sponsors such as Ford, Chrysler, and General Motors. The program allows students to conceive, design, and build a Formula style racecar to compete against other colleges at an international level. Held at the Pontiac Silverdome in Michigan every May, the competition brings together more than 140 teams from countries including the United States, Venezuela, Japan, Australia, Puerto Rico, Mexico, and Canada.

The competition includes static events such as design, cost and manufacturing, and presentation, as well as dynamic events including acceleration, endurance, and fuel economy. According to faculty advisor Mike Keefe, Formula SAE teaches the students not only engineering but also teamwork, business and marketing, problem-solving, and decision-making skills.

The students also learn time management—they have to balance their coursework with the time spent on the car, as UD does not award academic credit for participation in the competition. "It was a conscious decision not to connect the SAE activities to a class," says Keefe. "We wanted students to participate because they wanted to, not because it's a course requirement."

Some 30 students are involved in the project, and one goal of the team is to offer all members the opportunity to drive the car. That will be a real challenge this year, as one participant measures in at 6 ft. 5 in. "We have to kind of build the car around him," says Pineda. "But that's a one-of-a-kind experience when you go up to 50mph three inches from the ground."



In the 2002 competition, UD's entry placed third in crash-worthiness and 51st overall out of 125 colleges, an improvement of 12 places over the 63rd place scored in the 2000 competition. Last year's carbon-fiber monocoque design has given way to a steel frame this year. "It's heavier but faster to build," points out Tim Grypa, team Vice President. "All of these decisions involve tradeoffs, and we have to be able to explain our choices to the judges."

The competition is tough, and as always, Cornell will be the school to beat. "Our main goal is just to improve on last year's car and try to learn as much as we can," says Pineda.

It sounds like she's already learned quite a bit—including how to find the lightest engine.

Senior Design

Seniors convert their design concepts to reality

by Nate Cloud

"Several project teams are shown here working on the "Proof of Concept" phase of their Fall 2002 Senior Design Projects. Eleven teams worked closely with their industrial sponsors (see logos) to design; and prototype their concepts for how to meet the needs of their sponsors for product or process improvements.

Final presentations were held at the Pencader Conference Center on December 13th. Friday 13th proved once again to be just a superstition as all eleven teams were successful and achieved high marks for their successful completion of the challenging Senior Design Course.

Industrial sponsors were very pleased with the results and a number of the teams have elected to continue to develop their projects further for their sponsors over the spring semester. A new course—Special Topics in Engineering Design & Development has been set up for student to elect for credit in pursuing this work. Several projects were judged by their sponsors to have patent potential.

An ASME panel selected the following projects as outstanding based on their impression of the final presentations: Case New Holland-*Improved Bail Kicker*; PolySeal-*Disc Top Enclosure*; Airproducts *Bag Packer Improvement*.

For more information contact*:

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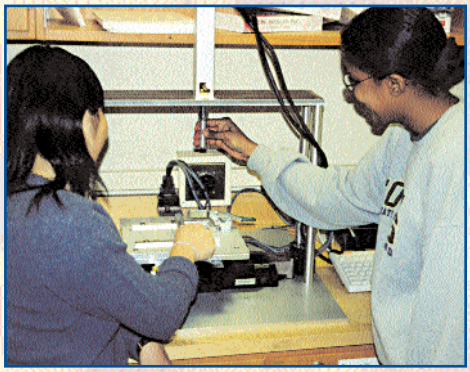
A growing number of Alumni have been instrumental in leading their business to sponsor a Senior Design project in the past three years, and/or have been the primary student team contact for the project: Scott Hemphill,'86 - Hardcore Composites; Mike Smoot, '82 - Xymid, LLC; Matt Savage, '00 - Daimler Chrysler; Dave Friemuth, '90 – Harley Davidson; Bob Andrews, '92 - Johnson Controls; Alexis Cox '01 - AstroPower; Jim Kegelman '88 - Dade Behring; Scott Hanson '01 - Northrop Grumman; Joe Welch '86 and Ralph Weis '72 - ILC Dover."

If you think your enterprise would like to sponsor a Senior Design project next year (Fall 2003) please contact Nate Cloud.



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Awards

ASME Design Contest – Rochester Receives Award

Jared Rochester (left) and Jason Pusey display ASME documentation of Rochester's award winning design, accompanied by Faculty advisor Sunil Agrawal, and Department Chair, Tsu-Wei Chou.

When Prof. Sunil Agrawal expressed an interest in design of a robotic expanding structure for such applications as traversing rough terrain in space exploration, undergraduate Jared Rochester rose to the occasion. With some guidance from Agrawal and graduate student Jason Pusey, Rochester developed a proof-of-concept for a device and went on to win second place in a national student design competition sponsored by ASME.

Students competing in the event had to meet a rigorous set of requirements—first, submission of a paper describing the project and then, after selection as a finalist, participation in a poster session at the society's biannual meeting in Montreal. The device itself could not be transported to the exposition, so Rochester showed videos on a laptop during the poster session.

For his efforts, Rochester received a $300 award as well as expenses paid for his trip to Canada.

The initial design and construction took about four months, but that was really just the beginning. "Now that we've demonstrated that it works," Rochester says, "we're working on the next generation. We want to make the device small so that it can be easily transported."

The device is basically a four-wheeled cart whose wheels change diameter to accommodate impediments like rocks and potholes. "The expanding wheel is a unique concept," says Rochester. "Implementing the control system for it was very complex."

Rochester was assisted by Pusey, who offered ideas when needed. The experience proved valuable for both "teacher" and "student."

"I really enjoy watching people learn," says Pusey. "Both of my parents are teachers, and I may want to teach someday."

For Rochester, the project put him "leaps and bounds" ahead, in terms of being able to deal with the challenges of completing his senior design requirements and interviewing for jobs. He worked as a summer intern at the Aberdeen Test Center in Maryland, plans to complete a co-op assignment there over winter session, and already has an offer for a full-time job when he finishes.

The project also raised his interest in taking more-advanced classes. "I may continue my education at night after I start working," he says.

Juggling a job and school will be another challenge—but undoubtedly one that Jared Rochester can handle.

Prof. Chou Honored by ASME

by Diane Kukich

Dr. Tsu-Wei Chou, P.S. du Pont Chair of Engineering at the University, was recently honored by the American Society of Mechanical Engineers (ASME) with the Worcester-Reed Warner Medal. He was recognized for outstanding contribution to the literature in analytical modeling, processing science, and damage mechanics of fiber composite materials.

Established in 1930, the Medal is awarded annually to individuals for outstanding contribution to the permanent literature of engineering in the form of single papers, treatises or books, or a series of papers. Chou received the award at the 2002 International Mechanical Engineering Congress and Exposition, held from November 17 through 22 in New Orleans.

Chou, who has been on the UD faculty since 1969, has received a number of honors, including ASME's Charles Russ Richards Memorial Award, the University's Francis Alison Award, and the American Society for Composites' Distinguished Research Award. He was also recently recognized as highly cited researcher in Materials Science by the Institute of Scientific Information. In addition, Dr. Chou is a Fellow of ASME, the American Society for Composites, ASM International, and the American Ceramic Society, as well as an Associate Fellow of the American Institute of Aeronautics and Astronautics.

An ASME press release announcing the Warner award says, "Chou's pioneering research in structural and functional composites perhaps best demonstrates his vision of and approach to composites. He has elucidated the integration of fiber perform manufacturing, composites processing, characterization, and analysis/modeling."

Chou was a founding member of the Center for Composite Materials at UD and has taught composites-related courses for more than 30 years. His current research focuses on nano-composites.

P.S. du Pont Honored in Named Chair and Building

Adapted by Diane Kukich from articles by Larry Elveru and Jerry Rhodes

At the conclusion of dedication ceremonies on Sunday, September 22nd, for P.S. du Pont Hall, UD President David P. Roselle announced that Tsu-Wei Chou, ME chairperson, would be the first to hold the P.S. du Pont Chair of Engineering. Funded by the Unidel Foundation, the endowed chair honors the memory of industrialist and philanthropist Pierre Samuel du Pont.

"Tsu-Wei Chou is an internationally known researcher and scholar of materials science," Roselle said. Chou joined the University faculty in 1969 and was a charter member of the Center for Composite Materials. He is the author of more than 250 archival journal papers and book chapters, as well as several books on composite materials. He has received a number of prestigious awards during the past several years, including the University's Francis Alison Award as an outstanding faculty member, as well as ASME's Charles Russ Richards Award and Worcester Reed Warner Medal.

A sought-after visiting professor, Chou has lectured and conducted research at a number of institutions around the world, including Argonne National Laboratory, British Science Research Council, University of Witwatersrand in South Africa, National Commission for the Investigation of Space in Argentina, U.S. Office of Naval Research in London, German Aerospace Research Establishment, Tongji University in China, Tokyo Science University and Industrial Research Institute in Japan.

Both the chaired professorship and du Pont Hall, home of the College of Engineering, honor the memory of P.S. du Pont, an educational visionary whose generosity began with an anonymous gift of land to Delaware College (now the University) in 1915.

At the ceremony, Carol Hoffecker, Richards Professor of History at UD, described du Pont as a reserved businessman who became a public advocate for educational reforms in the First State. She noted that his remarkable gifts to UD and to education throughout Delaware "were never motivated by a desire to be famous, powerful or remembered. The thought of having a building named for him always made P.S. du Pont uncomfortable. His motivation was to improve the educational opportunities for all Delawareans."

She added, however, that although Mr. du Pont would not have wanted the building named for him, it is "rather that we here today need it. For it is we who must remember and learn from the lessons taught by this most rational, scientific, determined man who single-handedly led so many Delawareans to realize the gift of education."

"We owe a great debt to people like P.S. du Pont," says Chou. "I'm very proud to fill the chaired position that bears his name."

ME Alum Receives Major UD Award

by Diane Kukich, with excerpts taken from an article in UDaily by Lauren Dalton (AS 2003)

Dr. Nancy Sottos, BME86 and PhD91, was among twelve University of Delaware alumni who were honored with Presidential Citations for Outstanding Achievement during Homecoming on Friday, October 11, in Mitchell Hall, at the Newark campus. The citations recognize distinguished alumni who graduated within the last 20 years and have exhibited great promise in their professional or public service activities. Sottos was one of 12 young men and women to receive the honor.

Sottos became the first female faculty member in the 101-year history of the Department of Theoretical and Applied Mechanics at the University of Illinois, Urbana-Champaign when she was hired in 1991. To date, she remains the only female faculty member in that department. In 2002, she was named University Scholar at the University of Illinois, one of six outstanding faculty members given funding each year to allow for scholarly growth. She continues the work in fiber composites and applied mechanics that she began as a graduate student at UD.

"The University of Delaware provided me with an extraordinary set of educational, athletic and enrichment opportunities," Sottos said. "My academic training was first rate, and I was fortunate to participate in the outstanding campus undergraduate research program that introduced me to scientific research at an early state and at the Center for Composite Materials, where I was immersed in interdisciplinary research. Equally important were the opportunities for personal development through participation in the women's varsity track and field program and many extracurricular activities. But, when I reflect on my years at Delaware, I realize the most profound influences came from the professors who I had the privilege to work with and learn from, in particular my Ph.D. adviser Roy McCullough, as well as the coaches, academic professionals, and close friends I met along the way."

ME Chair Tsu-Wei Chou said, "To me and my colleagues in the Mechanical Engineering Department as well as the Center for Composite Materials, it was quite evident that Nancy would be a "rising star" in her chosen field. From observing her career development, reading her archival scientific journal publications, and listening to her presentations at international conferences, I have no doubt that Nancy's performance has exceeded our expectations."

"Last November I was very pleased to attend the Women of Promise Award ceremony at Clayton Hall, when Nancy was the guest of honor," Chou said. "In her keynote speech to the 85 awardees, she shared her experience as a female faculty member in a largely male-dominated engineering educational environment. The speech was very inspirational and well received by the students. Knowing very well her scholarly accomplishment and learning more from her speech about the effort she made to excel, I feel that Nancy is a role model for not only female students but also all young educators."

Alumni Focus

Alexis Cox finds career home at AstroPower . . . experiencing Senior Design from two perspectives in two short years!

With the job market for mechanical engineers extremely favorable in 2001, Alexis Cox (BME01) was more concerned about sorting through the offers she already had than in seeking out any additional opportunities as her senior year wound down. But sometimes offers come when you least expect them, which is what happened to Cox.

"I was helping out at the 'lawnmower tune-up,' a large fundraiser for the SAE car team during the spring of my senior year," she recalls. "I hadn't slept much in a few days, I was wearing a baseball cap to keep my hair off my face, and I was covered in oil, when John Tomanovich from AstroPower, Inc. brought in his lawn mower and encouraged me to send in a resume."

Cox already had an AstroPower connection, as the company had sponsored her senior design project. Her team developed the design for a robot that unloads and inspects product coming off a furnace belt at the company's plant in Newark, Del.

Shortly after the lawnmower incident, Cox had the opportunity to hear AstroPower President and CEO Dr. Allen Barnett speak at an entrepreneurship class she was taking. After the talk, he too urged her to submit a resume. "At that point I started to get curious," she admits. She applied and was offered a position as a process engineer beginning in June 2001.

In a path that has made a full circle, Cox and Tomanovich this fall sponsored a senior design team charged with developing a "solar cell counter" for the company. Cox brings a unique perspective to her role as "customer," given that she was a student team member herself just two years ago.

"One of the most difficult aspects of senior design is communicating with the vendor in an efficient way," she says. "Official communications tend to be good, but there are many informal opportunities in between that the students tend to miss. I see our student team doing this now, just as I did when I was in their shoes. I try to think about where they are now and what I was facing when I was in their position to anticipate some of this."

Cox also notes that the students have a tough time balancing the design and academic sides of the project. "Design is very time consuming, and it's difficult for them to figure out how to manage their time and achieve a balance between the two."

One of the things that makes Cox both a good teacher and a good learner is her remarkable ability to take advice and open herself up to constructive criticism. She knows what her strengths are, but she is also very cognizant of where she lacks experience and could use some guidance.

Her experience so far at AstroPower has been a very positive one. "When I was trying to filter through job offers, I realized that I cared less about the type of work I would be doing than about the kind of people I would be working with and how seriously the company viewed the work unit I was in. Here, I've been exposed to very different spheres of interaction—the full spectrum of temporary personnel through management."

Does Cox see herself as a candidate for management? Maybe, but not for a while. "I still have way too much to learn," she says. "In particular, managing people is very challenging—I'd be sure to use a really good leader as a role model."

Working at AstroPower has taught her a lot about working with people. "We have great resources here," she says, "especially when it comes to training and interacting with people."

Cox has learned that the data-driven approach she brings from engineering may not be as effective when she's training employees who operate the equipment and run the processes she's helped design. "I realized pretty quickly that I have to slow down and present things differently if I expect to be effective," she says.

Cox's personal background probably played a role in her development of a maturity beyond her years. When questioned about where she was from during the interview for this story, Cox was stumped. With a father who made the Army his career, Cox lived in more places during her first 18 years than most of us will in a lifetime. "I'm going home for Christmas," she says, "but I've never been there before."

Now retired from the Army, her father holds a State Department job in Vienna, Austria. "You can't get much better than that for a place to call home," Cox says.

The robotic handling and inspection system that has been implemented at AstroPower as a result of Alexis Cox and her senior project team from Fall 2000.

Alumni Class Notes and Feedback

Joe Caulfield recently jumped a building in Philadelphia, qualifying for his BASE #. I'm now BASE 729.

(BASE is an acronym for Building, Antenna, Span, Earth; when you have parachuted from all 4 objects, you get a BASE #). You can learn more about Joe's activities on his webpage www.base729.com.

Curtis Ebersold '92 earned a master's degree in mechanical engineering at the University of Washington in 2000. He is currently the Facilities Manager at Arlon in Bear, DE. He and his wife Mareia, who is pursuing her Ph.D. in chemical engineering at UD, had their first child in February 2002.

Philip E. Fok '83 is Senior Vice President and Chief Administrative Officer of Solectron Corporation in Milpitas, CA, an electronic manufacturing services company. His responsibilities include quality, communications, facilities, security, government relations, and corporate ethics. He previously worked for eight years at IBM in San Jose, CA, after receiving a master's degree in Industrial Engineering from Stanford University in 1985. He has been married to Janice Fok since 1994. They live in Los Gatos, CA, with their son Brian, who was born in April 2002.

Michael J. Grimme '78 and his wife own and run three businesses in Fort Lauderdale FL, a hotel www.waterfontinns.com, an on-line business solutions company www.weperform.com, and a hotel and office furniture liquidation business www.amcliquidators.com . The couple have 4 children and invite anyone who wants to get out of the cold to come visit.

Michelle Guzniczak '94 and **James Stein** '91, were married on September 14, 2002, in Lewes, DE. Both are employed at ILC Dover in Frederica, DE. Jim is a Senior Design Engineer currently working on lander bag systems for Mars Exploration Rover missions, and Michelle is the Deputy Program Manager for Space Suit Assemblies.

Scott T. Holmes '90 received his master's degree in Mechanical Engineering at the University of Delaware in 1994. He has held engineering positions in McDonnell Douglas and then Boeing, where he has led several strategic R&D programs in composites structures and manufacturing technology for fixed wing, unmanned vehicle, and rotorcraft applications. Through R&D within industry and at UD's Center for Composite Materials, Scott has been granted three patents related to composites manufacturing technology. He now leads the assessment of technology for the V-22 Osprey Affordability Program at Boeing's Ridley Park, PA, site for military rotorcraft. He currently resides in Oxford, PA, with his wife Celia, and four children, Jeffrey, Amanda, Charlie, and Zachary.

Joseph M. Konieczny changed jobs and has a new e-mail address. He can be contacted at Volpe and Koenig, P.C., Suite 400, One Penn Center, 1617 John F. Kennedy Boulevard, Philadelphia, PA 19103; 215-568-6400 (voice); 215-568-6499 (fax); jmk@volpe-koenig.com.

Kirk Miller '00 is currently employed at the Salem/Hope Creek nuclear generating stations in New Jersey. His duties include performing thermo-hydraulic analysis of various plant systems including emergency core cooling systems and dose consequence analysis for postulated design basis events. His wife, Lauren Miller, gave birth to their first child, Jack Lewis Miller, on September 6, 2002. Their current address is 8 Celtic Street, Bear, DE 19701. Kirk can be reached at PSEG Nuclear LLC at 856-339-1043.

Jack N. Pezza '98 is a Mechanical Engineer with the Naval Surface Warfare Center - Carderock Division. After graduation from UD, he remained in the Philadelphia region and took a position with the Survivability and Structures Branch. He currently is lead engineer to several Ship Survivability Programs. Currently, Jack is attending Villanova University in pursuit of a Masters of Mechanical Engineering (~ 2004 graduation anticipated). Jack is engaged to be married to Marylouise C. Slegel in June of 2003.

Dave Rubin received his MS degree in Biomedical Engineering from Boston University. His research involved studying the relationship between acoustical stimuli and hearing loss in mice.

Bob Shoemaker '71 is married to Pat Gregory (Elem Ed, 1971), has 2 daughters, and is Vice President and Engineering Manager for the Delaware office of BE&K, an E&C company based out of Birmingham, AL. Bob recently presented a paper on "Engineering Productivity Measurement"at the annual Construction Industry Institute conference in San Francisco.

Michael Smoot has moved to Chesterfield, VA, as a result of a transfer within Xymid LLC. He can be reached at 8200 Fair Isle Terrace, Chesterfield, VA 23838; 804-796-6448.

Nancy Sottos (PhD91) has been selected to receive the 2002 Presidential Citation for Outstanding Achievement. See story on page 11.

Michael V. Vari, P.E., '86 (95 MME) is a Project Engineer with APEX

Piping Systems, Inc., in Newport, DE. He approached UDME in pursuit of fuel-cell-related R&D and education, and UD is now is a member along with APEX, of Delaware's Fuel Cell Working Group reporting to Governor Minner's Energy Task Force. Michael is married and has three children.

Robert C. Wetherhold was promoted to Full Professor (8/02) and is Graduate Director for his department at UB-SUNY (since 9/01). In addition, he is on the Materials Division Executive Committee for ASME 2001-2006, serving in 2001-02 as Secretary.

Scott H. Werny '85 and his wife, Sylvia, had their first baby on August 23, 2002, a daughter named Riyana Inez.

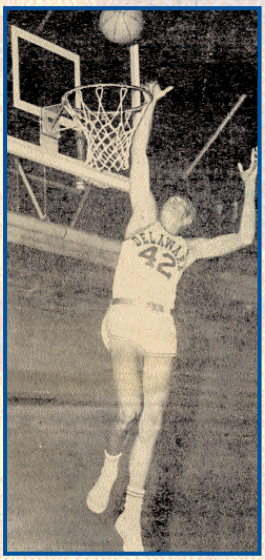
E. Woldesenbet (Ph.D.97) is now an assistant professor at Louisiana State University. He recently published a paper with Prof. Vinson and N. Gupta, "Determination of Moisture Effects on Impact Properties of Composite Materials," in the *Journal of Materials Science* (Vol. 37, No. 13, 2002, pp. 2693-2698).

Rob Woolley '74, is SILEX Technology Manager at USEC Inc., in Bethesda, Md. SILEX is a laser-based isotope enrichment technology. He lives in Rockville, MD, with his wife Aileen. Their children, Kate and Ben, are in college.

ME Alums Inducted into UD Athletics Hall of Fame

Adapted by Diane Kukich from a story in UDaily, Oct. 15, 2002

Nathan "Nate" Cloud (BME64, MME) and **Bauduy R. Grier** (BME50) are among nine former Blue Hen legends making up the 2002 class of the University's Athletics Hall of Fame. The fifth class of the UD Athletics Hall of Fame brings to 52 the total number of former UD athletes, coaches, and friends who have been honored. The Class of 2002 was inducted during a ceremony Nov. 22 at the Bob Carpenter Sports/Convocation Center.



Cloud was a prolific scorer and rebounder, dominating the inside for the Blue Hen men's basketball team in 1960-63 and becoming UD's first All-American basketball player. A 6-6 center from Conrad High School in Wilmington, Cloud led the team in scoring and rebounding all three varsity seasons and was Delaware's No. 1 all-time leading rebounder (882, 14.2 rebounds per game) and No. 2 scorer (1,167, 18.8 points per game) when he graduated in 1964. He earned All-East honors twice and was an honorable mention All-American in 1962-63 when he averaged 21.2 points and 14.5 rebounds per game as team captain. He led the Blue Hens to a school record 18 wins as a junior in 1961-62.

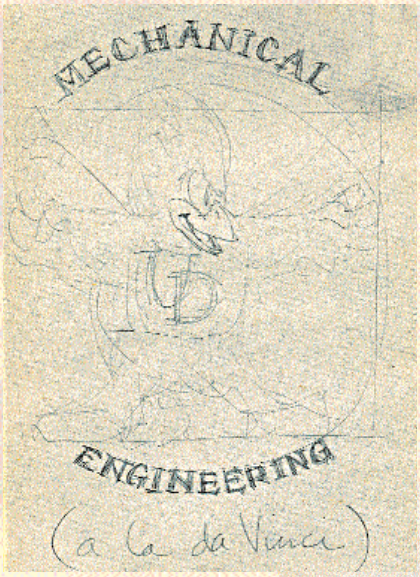
He was later drafted by the NBA's New York Knicks and enjoyed a standout pro career locally with the Wilmington Blue Bombers in the Eastern Basketball League from 1964-69. The 1963 UD Outstanding Senior Male Athlete of the Year, he was inducted into the State of Delaware Sports Hall of Fame in 1984. He earned his degree in mechanical engineering from Delaware in 1964 and later added his master's degree. He worked for 40 years with the DuPont Co. and for the last four years has owned and operated Cirrus Engineering Co. He resides in Wilmington with his wife, Carolyn. They have four children and three grandchildren.

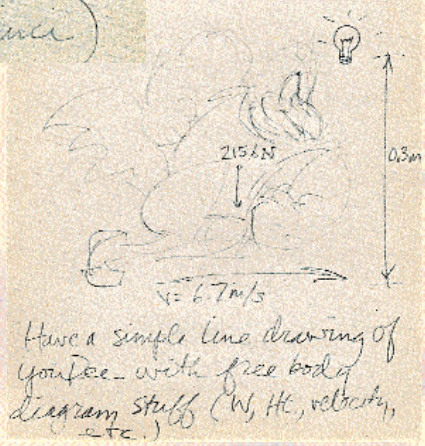
Grier was one of the top divers in UD history, dominating on the boards in the late 1940s. He was a four-year letter winner under UD Hall of Fame coach Harry Rawstrom and won 35 of the 40 dual meets in which he competed during his career. He won the Mason-Dixon Conference title as a freshman and was the Middle Atlantic Conference champion as a senior in 1950. He set school diving records six times and the Delaware pool record twice during his career. He led the team to the 1947 Mason-Dixon team title and advanced to the Eastern Diving Championships in 1950. In addition to his diving exploits, Grier lettered for the UD track and field team as a freshman pole vaulter in 1947 and was a member of the Delaware cheerleading squad. He became well known for his acrobatic cheers and the series of back handsprings he performed after every Delaware touchdown in football. A mechanical engineer, he retired in 1989 after 39 years, including a stint with the Hercules Co. in Utah. He resides in Sandy, Utah, with his wife, Monir. They have four children, six grandchildren, and one great grandchild. A World War II hero, Grier was shot down by the Japanese over the South China Sea in March 1945, and he was rescued after 23 days floating on a life raft.

ME Logo

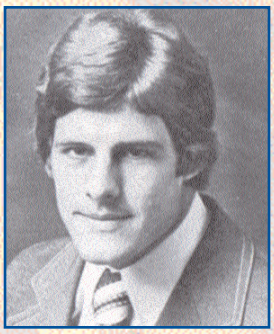
"In the last issue of ME News we asked for suggestions on how to make the current Mechanical Engineering YouDee more representative of Mechanical Engineering today. As you can see YouDee is dressed in a railroad engineer's cap, (include current YouDee again, and put caption under picture – "current official ME YouDee"), and he/she carries a wrench. At least one alum wrote back and thought this was pretty antiquated……even insulting to ME's!

One artistic alum,Thomas Ralph Masino, 1990, took the time to create the pictures shown right. In addition to Tom's artistic talent, we thought the ideas showed a lot of imagination, and so we decided to share the pictures with you. If anyone has any other ideas please let us know, and we will pass them all to the University Public Relations Department, and see if they feel that an upgrade for ME YouDee is warranted.





Reflections & Memories – Bernie Ebersol



I was just reading the 'Faculty Focus' article about you in Mechanical Engineering News. As I moved through the article on your "life history" at UD I remember the kind, gracious, and spirited dean of engineering who helped give me confidence and guidance as well as some summer programs to help me stay eligible and graduate with a degree in engineering. Playing football on our national championship team as a sophomore in 1972, and as a starting defensive back on our outstanding teams in 1973 and 1974 made it difficult for this young person to handle the engineering load. Being one of the few(maybe only one in 1974!) engineers on the football team brought me some notoriety with Tubby who always called me that "clubhouse lawyer in engineering" My grades were certainly not stellar and I often reflect back and regret that I did not truly apply myself better in the classroom. I went through "sports withdrawal" when my college athletic career finished and struggled to finish the academics. However, our success on the field and the sacrifices it demanded, helped me develop tremendously as a person. Those successes, combined with a valuable degree from UD, launched me into sales positions in IBM followed by starting up multiple companies with my wife(also UD graduate). My non-business hours are spent coaching in athletics with my 3 children. I also recommend potential excellent student athletes to see the merits of a UD education. I have always said that teachers and coaches have the most influence over young people, often more than parents at times. Coaches and teachers made huge influences on me growing up, and what they said and how they treated people continue to influence me today. I want to thank you for your kindness, understanding, and generosity for helping me 'help myself' over 25 years ago. When people ask me "about my career" one of the important pieces in it was Dr. Jack Vinson. Remember, people are the greatest composite materials you'll ever work with! Thanks!

Laird Fellowship 25th Anniversary

One of the most unusual fellowships for engineering graduate students celebrated its 25th anniversary in 2002. Established in honor of George (Geordie) Laird (68BME 71MMAE), who was killed in a car accident at the age of 35, the Laird Fellowship is aimed at encouraging recipients to become engaged in "broadening intellectual pursuits that may or may not be of direct application to their chosen field of study." In addition to being engineers, past Laird winners have been artists, writers, pilots, and musicians.

The Fellowship was established in the months after Geordie Laird's death by his widow Ann (now Ann Wick) and a close friend, Ted Ashford. "When someone like Geordie dies at the age of 35, leaving behind a wife and three young daughters, it's truly devastating," friend Randy Barton says. "But our hope was to keep his memory alive in a way that would be meaningful to him. Geordie was an extremely creative and energetic person who was full of fun. I think he would have approved of the fellowship honoring not only the recipients' engineering accomplishments but also their other talents."

To commemorate the 25th anniversary of the award, the 2002 reunion of Laird Fellows included Saturday brunch hosted by Laird's daughters Margaret, Alletta and Irene, followed by a UD football game, a dinner at the home of President and Mrs. David P. Roselle, and a breakfast at the Wicks home. In addition, a commemorative publication was produced covering 25 years of Laird Fellowships. Finally, the former fellows donated a painting of the Brandywine River, an area that Laird loved, to the office of the Dean of Engineering.

Randy Barton, Ted Ashford, and Ann Wick continue to serve on the selection committee for the Laird Fellowship, along with the current Dean of the College of Engineering, a faculty member from the College, another delegate from the College of Engineering, and a representative from the College of College of Arts & Science. As part of the selection process, the candidates are invited to the Wick's home.

"The Fellows have displayed an incredibly high level of interest in returning for the Laird reunions, which are held every five years," says 1980 recipient Mark Bendett, "primarily due to the family atmosphere that the selection process and the interaction with the committee members engenders. We have a large and growing extended family of Laird Fellows and committee members. I am absolutely confident that no other fellowship at UD or any other university can match the kind of spirit that the Laird Fellowship creates."

Ann Wick with the winner of the 2001 award, Jingbo Wang, MME

For Ann Wick, the most important part of the Fellowship is her personal involvement. "I would encourage people not just to give, but to stay involved with the gift because what you get back is increased tremendously that way."

Ann is also gratified by the generosity of contributors. "We've gotten contributions from 320 people over the years," she says, "ranging from $5 to thousands. The fund is now worth over $600,000."

Tsu-Wei Chou, ME Chair and P.S. du Pont Professor, is grateful for the generosity of Ann, Laird's friends, and other contributors to the Fellowship. "This is a wonderful example of what can be done to honor an alumnus of the department," he says.

Contacts

Contact information for faculty/staff features in this newsletter is included below. We urge you to contact these people if you have any questions or would simply like to talk with them about the topics in this newsletter.

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Development Report

by Kevin Obrien

The *Campaign for Delaware*, the University's first comprehensive fundraising campaign, continues with on-going success. The *Campaign*, which was announced in October 1998 with a goal of $225 million, has surpassed $335 million (as of January 2003) with a year to go in the five year campaign.

The College of Engineering continues to receive substantial support as a participant in the *Campaign for Delaware*. At the beginning of January 2003, the College had received total gifts, pledges and commitments of $37,658,777, or 83.69% of its goal of $45 million. Tangible evidence of the success of the *Campaign* is the completion of P.S. du Pont Hall, a $28 million project, which contains administrative offices and state-of-the-art laboratories for the College.

The Department of Mechanical Engineering is actively participating in the *Campaign for Delaware*. We have been reaching out to alumni and friends of the Department to seek their support and we have received some wonderful commitments. However, we continue our development efforts, and one of those efforts is to share with you the funding priorities for the Department of Mechanical Engineering. They are:

Endowed Faculty Positions – we seek support to help establish endowed chairs and endowed professorships. These endowments are crucial in enabling the Department to retain and recruit professors at the forefront of their fields who are developing new technologies such as fuel cells and nanotechnologies. The reputation of the Department is measured in large part by the quality of its faculty. *Minimum Funding Requirements: Endowed Chair - $1million; Endowed Professorship - $350,000.*

Graduate Fellowships – we seek support to establish endowments which will allow us to recruit the brightest and most talented graduate students who will have the opportunity to perform scholarly work on projects that are new and innovative. The quality of our graduate student population will likewise enhance the Departments reputation. Having the resources available to compete effectively for this talent is critical. *Minimum Funding Requirement: Endowed Fellowship Fund - $50,000.*

Undergraduate Scholarships – we also aspire to attract and retain exceptional undergraduate students in our program. Accordingly, we seek support in the form of endowed scholarships to provide the funding necessary to maintain a strong undergraduate population of gifted students. *Minimum Funding Requirement: Endowed Scholarship Fund - $25,000.*

Facilities and Equipment – we seek support to provide state-of-the-art facilites and equipment to our talented faculty and bright students. Being able to offer outstanding laboratories and classrooms to our faculty and students, and having the resources to equip these laboratories and classrooms with the finest and most advanced equipment, computers and systems, greatly enhances the research and instruction which occurs in these environments, and gives the department a competitive edge in recruiting and retaining faculty and attracting the most gifted students.

Naming Opportunities – we are delighted to recognize our donors by providing naming opportunities in association with their support, e.g., *The John Smith Chair in Mechanical Engineering, The Jane Doe Professor of Mechanical Engineering, The Mary Jones Endowed Fellowship Fund, The Michael Brown Endowed Scholarship Fund, The Joseph Williams Computer Laboratory, etc.*

While we are fortunate to have donors who have the ability to endowed faculty positions, fellowships and scholarships, and can provide the resources to build or renovate a laboratory or a classroom, we also seek more modest support from all of our alumni and friends. You may not be in a position to provide the level of support required for one of these endowments or to outfit a lab; however, you can make a gift and direct that it be used for faculty support, or student scholarship support, or to enhance facilities or equipment. Your gift of any size is very much needed, appreciated, and does make a difference!

In addition to the amount of money we hope to raise through the *Campaign for Delaware*, we seek to substantially increase the number of alumni and friends who contribute to the Department of Mechanical Engineering, and thus to the College of Engineering and the University of Delaware. If you are an alumnus, your gift strengthens the reputation of the Department, the College and the University, and thus increases the value of your educational degree. We invite you to be a partner with us in our future success. Your support and commitment are vital to us.

With grateful appreciation for your support!

Mechanical Engineering Alumni listed by Class year - descending

FY 2002 Donors

$6,000 - $11,000

Mr. Richard J. Harrison
Dr. and Mrs. Andras Z. Szeri
Dr. Donald R. McCoy ..... '75*

$5,000 - $5,999

The Air Products Foundation
Mr. William G. Mavity ..... '72
Mr. James R. Laser ..... '69
Mr. James S. Dick ..... '59

$2,500 - $4,999

Dr. Tsu-Wei Chou
Mr. John S. Thackrah, Jr. ..... '79
Mr. Allen C. Liddicoat ..... '71
Mr. Francis J. Suppe ..... '63
Mr. Robert H. C. Irwin ..... '51

$1,000 - $2,499

Dr. and Mrs. Karl W. Boer
FM Global Foundation
Mr. J. Matthew Scarborough .... '96
Mr. Joseph E. Thompson III PE .. '77
Mr. David R. Helwig ..... '73
Mr. James H. Poole ..... '72
Mr. Ritchie A. Snyder ..... '69
Mr. Peter J. Cloud ..... '65
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Mr. William E. P. Haggerty ..... '64
Mr. William B. Wagamon III .... '62
Mr. William T. Morris ..... '61
Mr. Ferris O. Lee ..... '58
Mr. George G. Tatnall ..... '57
Mr. E. Douglas Huggard ..... '55
Dr. Jules J. Schwartz ..... '53
Mr. J. Ridgeway Jones ..... '52
Mr. Frederick H. Kohloss ..... '51
Mr. Earl W. Favinger ..... '51
Mr. Robert U. Johnson ..... '51
Mr. Price K. Snyder ..... '51
Mr. Richard C. Rhodes, Jr. ..... '50
Mr. David C. Trimble ..... '50
Mr. W. Murray Campbell ..... '50
Mr. C. Jackson Levis ..... '50
Mr. Irvin S. Taylor ..... '30

$100 - $999

Dr. Christian F. Davis
Mrs. Lucille Morgan Grundy
Mr. George H. Sapna III ..... '99
Mr. Alan J. Starr ..... '99
Mr. Brent L. King ..... '96
Mr. Ashok Krishnamurthy ..... '95
Mr. Andrew M. Lennon ..... '93
Mr. Craig W. Murray, P.E. ..... '93
Mr. Dominick A. Azeglio ..... '92
Mr. Sean M. Foster ..... '91
Mr. John S. McWilliams ..... '90
Mr. Jonathan R. Stahl ..... '90
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