ME News

MECHANICAL ENGINEERING

Fall / Winter 2013

Inside:

The NOvA Project
New Faculty Profiles: Cari Dutcher and Peter Bruggeman
NEW Murphy Engines Lab

UNIVERSITY OF MINNESOTA

Driven to Discover℠

Dear ME Alumni and Friends:

It is my great pleasure to address you again, having just been appointed to my second term as ME department head.

I am starting this term more excited than ever, because I believe the ME department is heading in the right direction – and is **moving forward quickly**. Over the past six months we have made significant progress, but we will need your help to continue and to reach our goals.

First and foremost on my mind is the renovation of the old ME building, which was built in 1948 and has not seen a major renovation since. I admit, "old" and "new" are relative terms and some of you may remember this building as the "new" ME building. Regardless, this 1948 building houses our entire undergraduate teaching laboratories and quite a few of our research laboratories. I am getting progressively concerned that with our 1948 building, we are having an increasingly difficult time to compete for the best ME undergraduate students, who are also heavily recruited by our peers at Wisconsin, Purdue, Illinois, and Ohio State, all of which can show off new or newly updated buildings. I am worried that once our best students leave Minnesota for other states, they may not return – a case I have been trying to press with the many legislative groups that have toured the old ME building in the last three months.

While the state legislature approved the first $10 million for the renovation of old ME in 2012, we are still $34 million shy of a complete infrastructure upgrade. I am asking you to support the ME department in its quest for funding to renovate the old ME building! Please take a moment to download an example letter to Governor Dayton from our website at

www.me.umn.edu/alumni, and mail your letter of support to the Governor's office. I promise, your letter will make a difference! Later in the session, we will also ask you to contact your local state representative and senator in support of our case. **Please take a few moments to support the ME department!**

I am happy to share news on another project that is already nearing completion. In early October, we celebrated the Grand Opening of the Thomas E. Murphy Engine Laboratory. This brand new, $5 million facility will provide a new home for the ME department's future in engine research and replaces the old 4th floor engine lab. The old 4th floor lab had been threatened to be shutdown by the fire marshal, because of the amounts and types of flammable liquids present in the lab. New codes and standards could not be met in the old ME building. The new Murphy Engine Lab, which is located close to Como Avenue, breaths new life into our engine research, as it enables our faculty to use a much wider range of fuels and pursue a much broader scope of research projects.

The $5 million investment into the new engine lab was made possible by generous support from the State of Minnesota, the College of Science and Engineering, and the ME Strategic Initiatives Fund, which many of you support with your annual gifts. **Hence, please accept my sincere thanks for your support!** However, a new laboratory space itself does not yet make a state-of-the-art facility, if not supplemented by state-of-the-art equipment. When we contemplated moving 1950s equipment into the 2013 Murphy Engine Lab, ME alumnus Charles Lo and his wife Maryanne stepped up and decided that the new lab also deserved new equipment. Their significant gift to the engine lab enabled us to equip the lab with two brand new dynamometers. With similar support, we are hoping to build the Murphy Engine Lab into one of the nation's premier engine research facilities.

Sticking with our theme of "Moving Forward Quickly," I should let you know that ME professor Max Donath led a team that won an award for a $10.4 million regional University Transportation Center consortium focusing on traf-

ME News is published twice a year by the Department of Mechanical Engineering for alumni, students and friends of the department. Circulation is 11,000+.

Comments or submissions may be sent to:
Nancy G. Johnson, editor, 111 Church Street SE, Minneapolis, Minnesota 55455 or by e-mail: menews@me.umn.edu.

ON THE COVER: Professor Tom Chase with ME and other U of M undergraduate students at the factory where they are building the Neutrino Particle Detector for the NOvA Project (story page 8).

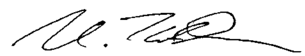
fic safety. The center, which also includes institutions from Ohio, Illinois, and Michigan, will focus on high-risk road users and systematic safety improvements. Donath's research will make a big contribution to saving the lives of many teenage drivers.

Finally, let me share with you my excitement about the ME department's important role in the NOvA particle detector project, which is based on an $80 million grant to the University of Minnesota. This detector, to be located near Minnesota's Ash River, will enable physicists from Fermilab and more than 30 other institutions to study the mass of neutrinos. ME professor Tom Chase was responsible for the entire mechanical design of the NOvA detector, a 14,000-ton plastic structure that will be roughly 200 feet long and 50 feet high and wide. The most exciting thing is that the construction of the more than 11,000 detector modules provides jobs to more than 250 engineering undergraduate students in the College of Science and Engineering. What an exciting opportunity for our students not only to help finance the cost of their education but also to participate in an experiment that will shape how we think about the nature of the universe!

I hope you find what you have read here as exciting as I do. I hope that you too think that we are moving forward quickly. I promise that we will keep up the pace!

I wish you a happy holiday season!

Sincerely,

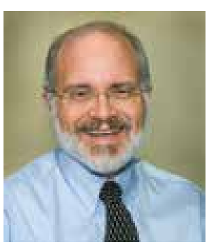


Uwe Kortshagen
Distinguished McKnight University Professor
and Head of Mechanical Engineering

P.S. Please watch the main page of the ME website (www.me.umn.edu) for news on our Spring 2014 Mechanical Engineering Alumni Network (ME-AN) events.

Accolades and Awards

Assoc. Professor Peter Bruggeman has been awarded the 2013 Young Scientist Medal and Prize in Plasma Physics of the International Union of Pure and Applied Physics. The prize was awarded at the 31st International Conference on the Physics of Ionized Gases, in Granada, Spain, July 14-19, 2013.



Professor Max Donath will lead a new Region 5 Center for Roadway Safety Solutions funded by the US Department of Transportation. The $10.4 million Center will be a regional focal point for transportation safety research, education and technology transfer initiatives.

Asst. Professor Chris Hogan has received the Smoluchowski Award 2013, named after the physicist Marian Smoluchowski (1872-1917), to recognize significant research contributions to aerosol science. The award was conferred during the European Aerosol Conference in Prague in September.

Professesor Allison Hubel received a Scholar Award from the National Blood Foundation in recognition of pivotal scientific research and commitment towards the NBF and its mission.

Professor Rajesh Rajamani invented a handheld probe that can measure tension in soft tissues, such as tendons and ligaments, during invasive orthopedic surgery which is being produced by FocusStart.

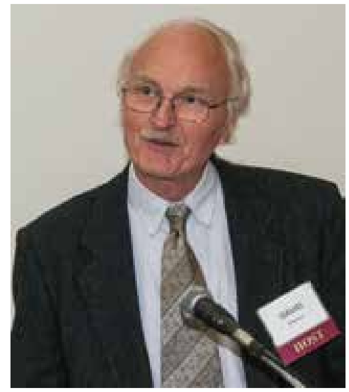
Professor Kumar Tamma was awarded the International Conference on Computational & Experimental Engineering and Sciences (ICCES) Outstanding Research Medal for his "outstanding research in computational structural dynamics."

Former **Regents Professor Ernst Eckert** has been inducted into the Minnesota Science and Technology Hall of Fame for 2013.

Department News

New Murphy Laboratory for Engine Research

Construction started in the spring and the grand opening was held October 4th for the new **Thomas E. Murphy Engines Research Laboratory**, which will separate the research functions from the teaching laboratory located on the 4th floor of the Mechanical Engineering Building. Safety concerns led the effort to move the research laboratory to a more fitting site, and with the generous donations of alumni and friends, including a generous donation from Charles and MaryAnne Lo, the new laboratory will enhance the departments efforts in engines, emissions, and renewable fuels research.



l to r: Professor Will Northrop, Dean Steven Crouch, donors, Charles and MaryAnne Lo, ME Department Head Uwe Kortshagen, and Professor David Kittelson did the honors in July as the new Murphy Engines Research Laboratory was being constructed at the University's Re-Use Center building off Como Avenue SE.

Professor David Kittelson spoke about the history of the Engines Lab and Professor Thomas Murphy, whose vision and leadership we honor. Professor Will Northrop spoke of the vision going forward, and how the new lab will make possible exciting new ventures in engines research for the next century. A future expansion of the laboratory is being planned to include research on controls.

l to r: Bart Murphy, son of Thomas Murphy, MaryAnne Lo, Charles Lo, Professor Will Northrop, Professor David Kittelson, Assoc. Dean Mos Kaveh, Department Head Uwe Kortshagen, Andrew Murphy, grandson of Thomas Murphy, Professor Zhongxuan Sun, and Kellie Lekie, granddaughter of Thomas Murphy.

Introducing New Assistant Professor Cari Dutcher

New Benjamin Mayhugh Assistant Professor Cari Dutcher arrived this fall and will be adding her expertise in non-Newtonian fluid mechanics and atmospheric aerosol science - an interesting blend of two disciplines - to our mechanical engineering program.

Professor Dutcher is a native of Florida but also lived in Kansas, Pennsylvania and Indiana growing up. Her mother is an accountant and her father was in horticulture, before becoming a lay pastor for the Methodist church. They returned to Florida when she was in high school, and she remembers wanting to pursue engineering in college because, she said, "my aunt is an engineer and gets to travel all over the world." Luckily, she also excelled in math and science, making this degree choice possible.

Attending the Illinois Institute of Technology – "in part, because it seemed fun to live in Chicago" – she met two professors who became her mentors. Professors David Venerus and Jay Schieber took her into their laboratory, taught her how to perform research, write papers, and give presentations. She soon realized that this was exactly what she wanted to do, and also knew she needed to go to graduate school to continue pursuing research.

By the beginning of her senior year, Dutcher was engaged. Her soon-to-be husband, Dan, was in the Air Force, having recently graduated with a degree in electrical engineering through the Air Force ROTC program at Illinois Tech. Since he was to be stationed at a base in northern California, she chose to attend graduate school at UC – Berkeley. Her mentors had told her about the very interesting research being done there by Professor Susan Muller.

She joined Muller's lab and completed her Ph.D.. The research was in the area of polymer science and fluid dynamics – largely toward drag reduction applications. She studied how polymer additives influence flow and stability, and suppress them so flow can move more laminarly and with greater energy efficiency. It was largely experimental work in flow visualization techniques.

Although most of us think of drag reduction in large scale applications, like oil transportation - the Trans-Alaska Pipeline System for example, Dutcher's work was applicable for any scale – "even your carotid artery," she said. She was looking at the instabilities arising from secondary flows in geometries too small for traditional turbulence, yet showing features like flow turnover and vortices.

These flow instabilities are possible at the small scale "because you have complicating features due to bifurcations in the geometry, or pulsation in the flow field – like from your heart beat, or complex additives like cells or platelets. We need to understand how to use, and even engineer, traditional drag reducing agents from these larger scales to these more micro geometries," she explained. Doing this work made Dutcher realize her fondness for the field of rheology – the study of how things flow – "in particular complex fluids, and understanding how they respond to changes in temperature, changes in momentum – all the fundamental questions," she said.

Dutcher finished her degree at Berkeley while living in Davis, a midway point between where her husband was re-stationed and the bay area. Happy to be done with commuting more than two hours each way by train, Dutcher decided to investigate post doctoral opportunities at UC Davis. She applied for a position in the renowned Air Quality Research Center, where they were looking at atmospheric aerosol particle dynamics – very different work from her Ph.D. "I think my PIs made the really brave decision to hire me as I had virtually no knowledge in that area," she said. But she thrived in the work, and enjoyed learning a whole new field and the community of people who work in it.

This work involved thermodynamic modeling – trying to understand the effect of temperature, relative humidity, and chemical composition on atmospheric aerosol particles. This work first involved modeling surface tensions and then evolved into activity coefficient modeling – "a parameter that really governs all thermodynamic properties- its vapor pressure, equilibrium phase, and concentration at a given temperature and water content, so it's very important for climate processes and accurate climate modeling," she explained.

At Minnesota, Dutcher will be applying and bringing these two fields together – the study of complex fluids, and the study of aerosol particles – to really contribute

Dutcher - continued on following page

to current understanding of the mechanical properties of particles. She is especially interested in particles that have multiple phases, such as two liquid phases, trying to understand the dynamics along the interface of those phases. Instead of taking the traditional approach of collecting particles in the field or generating them in a lab, where it can be challenging to isolate and study specific features, Dutcher will mimic the interfaces observed in aerosol particles using two-phase microfluidic flows at cold conditions to fundamentally study the chemistry, rheology and mass transfer observed in atmospheric particles.

Atmospheric aerosol particles have an impact on how solar radiation is reflected back up into space, for how clouds are formed, the lifetime of clouds, and also has implications on health, because we breathe them in. By answering these fundamental questions of their properties it will help scientists to more accurately put them into climate models and to understand the effects of man-induced climate change.

Dutcher had made four trips to Minnesota before moving here, for conferences and interviews, but always in the winter. This summer was a wonderful surprise - "Why doesn't everybody want to live here?" she asked. With her family, including 3 year-old Carrigan, she has discovered the pleasures of biking along the river road, hiking, and the community of other young professors at Pillsbury Court. The next step is learning to find outdoor activities for the winter season, and towards that end, she and Dan have invested in snowshoes and cross-country skis for the family.

Dutcher is also excited to begin teaching, especially a fluid mechanics course. It was because of that class and the professor that Dutcher "got hooked" and started doing research. She is excited to be that professor for her students.

Asst. Professor Cari Dutcher with her laboratory group of graduate students at the new Goldy Sculpture outside Coffman Union. l to r: Nikolas Wilkinson (1st year CEMS PhD student), Andrew Metcalf (postdoc, recent Caltech PhD graduate), Eric Ruud (1st year ME PhD student), Peter Ohm (1st year ME PhD student), and Prof. Dutcher.

Mural Shines in Solar Energy Laboratory

A new mural was recently completed on the exterior of the Solar Energy Laboratory's concentrating solar simulator. This was funded through a generous gift from an anonymous donor. Professor Jane Davidson's original vision for a mural arose from her interest in public art as a means to help educate visitors to the laboratory and to honor the long history of art devoted to appreciation of the sun. A Minnesota artist, Ruth Mason, shared this vision and her completed mural brings together the engineer's and artist's visions of creating fuels using concentrated solar energy to drive chemical reactions that produce fuel from water, recycled carbon dioxide and sustainable biomass, with the historical and multi-cultural symbols used to represent the power of the sun in human spirituality and science. Mason spent countless volunteer hours to create this vision and the final installation brings beauty to the laboratory.

2013 Summer Heat Transfer Conference Highlights
75th Anniversary of the ASME Heat Transfer Division

The 2013 Summer Heat Transfer Conference was held in Minneapolis in July, and several members of the faculty were honored for their contributions to ASME Heat Transfer Division on its 75th Anniversary. The Heat Transfer Division was founded in 1938 and has grown to be one of the most active technical groups in ASME with an international reach through its conferences and journals.

The pivotal role of the Thermodynamics and Heat Transfer Laboratory, founded by the late Prof. Ernst R. G. Eckert, in the development of Mechanical Engineering Department, was highlighted in a history that appeared in the Journal of Heat Transfer and Mechanical Engineering. The department along with a few others – University of Delaware, Illinois Institute of Technology, UCLA, University of California-Berkeley, MIT, Purdue, and University of Michigan – were the leaders in establishing the field both academically and technically in the United States. Today, the department's heat transfer and thermal sciences graduate program encompasses active research activities in atomic and nanoscale thermal sciences, alternative fuels, bio-heat transfer, cooling of microelectronics, convection heat transfer, computational heat transfer and fluid flow, gas turbines, multi-phase flow and heat transfer, plasma science and heat transfer, solar and renewable energy technologies, and reacting shear flow.

Special medals to honor contributions to the Heat Transfer Division were awarded to Professors Richard Goldstein, Ephraim Sparrow, Terrence Simon, and Frank Kulacki. Alumni and former faculty members receiving medals were Sumanta Acharya (Louisiana State University), Avram Bar-Cohen (University of Maryland-College Park), Ta-Shen Chen (Missouri University of Science and Technology), Abdolhossein Haji-Shiekh (University of Texas-Arlington), John R. Lloyd (Naval Post Graduate School), W. J. Minkowycz (University of Illinois-Chicago), Javad Mostaghimi (University of Toronto), and Suhas Patankar (University of Minnesota – Professor Emeritus).

The conference featured a full week of invited keynote lectures and special events. Avram Bar-Cohen spoke on future trends of cooling high performance imbedded computers, and Prof. Jane Davidson spoke on opportunities and challenges for solar thermo-chemical fuels. A pre-conference workshop sponsored by the National Science Foundation on emerging trends in heat transfer engineering, science and education, chaired by Frank Kulacki, was attended by 80 mostly young engineers who attended the conference. Professor Thomas Keuhn and several other alumni organized a technical symposium and reception in honor of Regents Professor Richard Goldstein. Panel sessions were organized on a wide range of topics, and several members of the faculty were invited to make presentations in them.

In addition, Department Head Uwe Kortshagen organized laboratory tours of the department and a reception for attendees, which attracted about fifty people, many of them younger members, from all parts of the globe. Professor Frank Kulacki chaired the 75th Anniversary Steering Committee which organized the special events of the conference.

Regents Professor Richard Goldstein was honored with a symposium at the 2013 Summer Heat Transfer Conference. Pictured with Goldstein are former students who attended the conference. Goldstein continues his research, teaching, and advising for the department.

Department News

NOvA Project puts undergrads to work

The sensing elements of the massive "bubble bottle" used to ensure that every NOvA module is free of minute leaks. If a leak exists, bubbles form in a shallow pool of water in each chamber that are "counted" by a photodetector. The basic operating principles are the same as those of a cruder device used to test for leaks in 1920's vintage player pianos.

Today we hear a lot about interdisciplinary research and collaborations. But how exactly does it happen? One way is to put yourself squarely in the sights of your targets – as the new CSE Medical Devices Center has done, building in the heart of the Medical School area. Centers formed with funding from federal agencies often link researchers from various colleges and universities. For Professor Tom Chase, the simple act of sitting next to a colleague from Physics on the bus ride home from work led to "the largest research project of my entire career," he said. It started 18 years ago.

His colleague, Professor Roger Rusack, asked Chase if he would be willing to give them "a little engineering help on this neutrino detector project" that they were working on. "I had never heard of a neutrino," said Chase. He began sitting in on some meetings. Chase found the physics milieu dazzling, and admitted, "near the beginning, I had not a clue what they were talking about."

At that time the MINOS experiment was in its formative stages. The Fermi National Accelerator Laboratory, or Fermilab, outside of Chicago, had built a machine to generate a beam, loaded with neutrinos, aimed toward northern Minnesota, where a massive detector was to be built in a retired iron mine to "see" them. Neutrinos are among the most abundant particles in the universe, a billion times more abundant that the particles that make up stars, planets and people. A trillion naturally occurring neutrinos from the sun and other bodies in the galaxy pass through us each second.

Their mass is so inconsequential that a typical neutrino passes through normal matter unimpeded. "Until roughly twenty years ago it was believed that neutrinos had zero mass. They were like a photon, pure energy," explained Chase. "And that's where these experiments turned modern physics on its ear, as they found that that is not true. They have mass, and because they do they can change from one type to another. This has been a revolutionary finding in the world of high-energy physics."

Chase explained that physicists are very bright people – interested mostly in basic science, and "are smart enough to realize that they might not be the best engineers." They are comfortable prototyping in the lab, but they are not familiar with design for manufacturing. The MINOS Detector contained 4,000 modules, the basic structural unit of the detector. Needing thousands of modules they recognized the need for well-engineered modules that would be both rugged and repeatable-.

It was lucky Rusack met up with Chase, for though none of our ME professors has a background in neutrino physics, Chase does have a background in design. Early on the MINOS collaboration was exploring three different technologies for the MINOS detector – solid, liquid and gas. The Minnesota group looked at liquid technology initially, but ultimately a solid scintillator was chosen. Nevertheless, the collaboration liked the design of Minnesota's liquid modules, so Chase was invited to continue on to engineer the solid scintillator modules. In addition, Chase and his students designed unique rolling machines that formed the module cases. The production machines directly utilized principles developed by one of Chase's Senior Design teams.

The MINOS project was a success and partly because of the mechanical engineering contributions from Minnesota they were asked to come back to work on the NOvA Project. The NOvA project is three times larger than MINOS, but with approximately the same budget ($280 million), which includes a $90 million grant to the University of Minnesota. Because the liquid technology has a lower cost, and since "Minnesota had initially explored a liquid technology, we had the best plan in place," said Chase.

While MINOS was what is called an appearance experiment – looking for a particular flavor of neutrino - the NOvA project is looking for signals that the neutrinos are changing from one type to another on their trip from Fermilab to Ash River, Minnesota. (Neutrinos come in three "flavors" – the muon, the tau, and the electron). The particles will complete the 450-mile interstate trip – underground - in less than three milliseconds.


A student worker loads a NOvA module manifold cover into a glue dispensing robot. It treats the plastic surface with a corona arc to improve adhesion, then it applies a uniform bead of epoxy adhesive.

The detector makes "images" of neutrinos in this way: When a neutrino strikes an atom in the liquid scintillator, it releases a burst of charged particles. As these particles come to rest in the detector, their energy is collected using wavelength-shifting fibers connected to photo-detectors. Using the pattern of light seen by the photo-detectors, scientists can determine what kind of neutrino caused the interaction and what its energy was.


The black plastic manifold attached to the end of each NOvA module is the "business end" of the module. Delicate 0.8 mm diameter optic fibers, which extend down the 51 foot length of each module, are routed to a unique multi-layer optical connector designed in the Mechanical Engineering Department. A 32 channel avalanche photodiode attached to this connector watches for neutrino events.

The detector is massive – weighing 14,000 tons. Chase and his graduate students designed every part in the detector modules except the 51 foot long PVC extrusions used as their foundation and the optic fibers threaded through every cell. Research to develop these designs has formed the basis for graduate theses. For example, selecting the adhesives was "a Masters Thesis and a half doing the testing required to find the best adhesives and to be sure they were going to provide adequate life," he explained.

Chase works closely with two colleagues from the Physics Department: Professor Ken Heller, who oversees the design, and Nathaniel Pearson, who runs a factory near campus where the modules are fabricated. The factory has employed hundreds of undergraduate students. Several of the factory machines were conceived by Chase. For example, a massive "bubble bottle", used to test for minute leaks in the modules, was inspired by a similar, but much smaller and cruder, device used in his hobby of rebuilding 1920's vintage player pianos. Chase en-

NOvA continued on Page 11

New Richard and Barbara Nelson Associate Professor Peter Bruggeman

Associate Professor Peter Bruggeman joined the ME Department this fall adding expertise in non-equilibrium plasma research at the High Temperature and Plasma Lab. He was born in Belgium and did his studies, including his Ph.D. at Ghent University. Starting his studies in general engineering, he changed to the more fundamental topic of physics and obtained both an MSc degree in applied and theoretical physics. As he was closing in on his Ph.D. he actually considered mathematics, but ultimately chose plasmas as the topic of his dissertation work. Though he cannot articulate why, he admits the wonders of plasmas continue to fascinate him.

Visually beautiful, plasma is one of the four fundamental states of matter, the others being solid, liquid, and gas. The sun is a plasma, although very hot and dense. Both lightning and electric sparks are everyday examples of plasma phenomena. Plasma is created when a gas is ionized. He explained, “many plasmas are very hot, not something you can typically touch. But you can create plasmas in ambient air – at short times scales, so that they operate close to room temperature and even though produced with high voltages can be safely touched. This is one of the examples I am working on.”

After receiving his Ph.D., Bruggeman was a visiting postdoctoral researcher at Loughborough University in England. While there, he came in contact with a new, upcoming field - biomedical applications of plasmas. He returned to Belgium for a couple months, and then left for an assistant professor position at Eindhoven University of Technology in the Netherlands where he taught and performed research for four years. There he focused more and more on applications of plasmas, including plasmas for wound healing, environmental remediation and chemical conversion. Though it has been known for some time that plasmas have disinfecting properties – they can kill bacteria, it is not well understood *how* plasmas aid in wound healing. It may be that the wound healing is merely stimulated by the inactivation of the bacteria, however it has also been shown that cell re-growth is faster after treatments with plasmas. Many aspects of the interaction of plasmas with cells and tissue are still not understood, particularly potential long-term side effects. These are interesting questions that Bruggeman would like to answer.

Example of a pulsed plasma produced in water. The length of the plasma filaments is about 3 cm.

He is also interested in plasmas produced in liquids. Similar to the gas phase, you ionize water in this case by applying a high voltage. This opens up new avenues for environmental applications, like water treatment. For example, hospitals have large amounts of wastewater containing residues of drugs that are harmful if allowed into the water supply. Plasmas can be used to break down these chemical components.

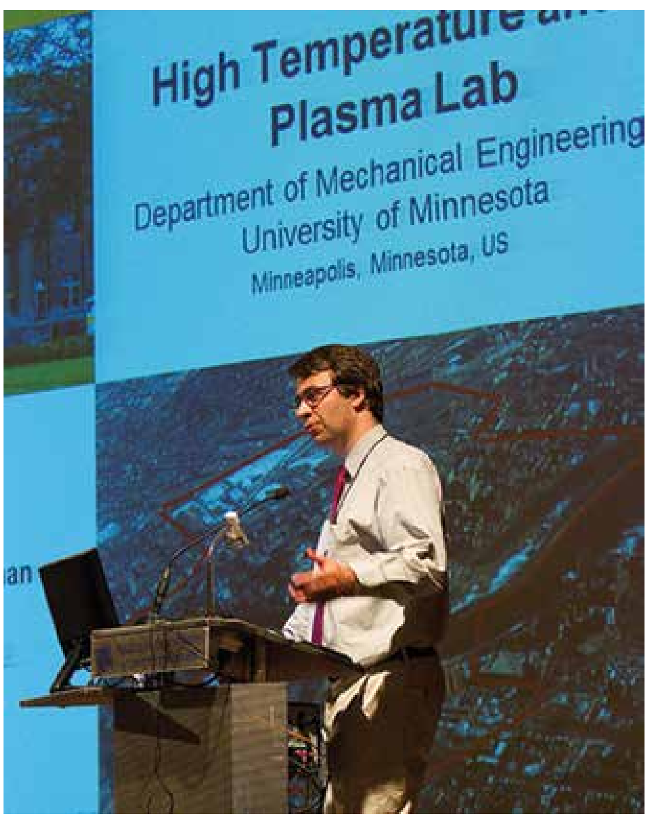
Bruggeman started at the UMN to look into the use of plasmas for energy applications. In this case plasma is used as a chemical reactor. A very successful application of plasmas is ozone generation. “Plasmas provide the unique, non-equilibrium conditions at which you can both dissociate oxygen (which normally requires high gas temperatures) and form ozone which dissociates at elevated temperatures,” he explained.

A similar approach can be used to synthesize methanol from methane, which is abundantly available in the U.S. The issue is that methane, although with a smaller environmental impact than coal and oil, is very stable, and difficult to convert to other, useful molecules for fuels or chemical industry. Currently this is done, in large power plants in an energy consuming, two-step process and plasma has the potential to become an alternative.

In all these studies Bruggeman focuses on the very nature of plasma processes and mechanisms. Though the pursuit of so many projects may look overly broad, Bruggeman explained, “fundamental processes for the completely different applications have a strong common base.” The interdisciplinary nature of his research allows him to collaborate with chemists, medical doctors, biologists. He enjoys these collaborative aspects and believes this approach, with its increasingly complex technologies, is the way to solve problems.

He is also excited to begin teaching next semester, when he will take on the large introductory measurements lab. “We talked mostly about research,” he said, “but one of the main goals of our profession is educating people.” His philosophy is to teach analytical skills - ways of thinking that can help people find solutions, to follow procedures, to be accurate. “By doing you learn,” he said, “and being able to form your own informed opinions, is one of the most important skills that students should acquire.”

Bruggeman is married and has a two-and-a-half year old son. He was a swimmer in high school, competing at the national level. After university he turned to fencing, which he enjoys “because it takes your whole focus – so it is a very good distraction and relaxation,” he said. He finds the Twin Cities “more European-like and easy going” than most other cities he’s visited in the U.S. “I like it very much, but it has only been two months and winter still needs to come,” he said. “So far the impression is very positive.” We can say, likewise.



Prof. Bruggeman giving the IUPAP Young Scientist Medal and Prize in Plasma Physics award lecture at the XXXI International Conference on Phenomena in Ionized Gases in July 2013 Granada, Spain.

NOvA continued from page11

listed teams of students from the Zurich University of Applied Sciences who attended his Design Seminars in the College of Science & Engineering in the summers of 2008 and 2010 to develop the concepts for two factory machines: robots for applying uniform beads of adhesive to the module end seals and automated flycutters used to finish connectors for the optic fibers.

Chase commented: “I’ve gained many great examples from the neutrino projects to use in my classes and that’s been fun. It was really exciting to be working so closely with the physicists and it was exciting to attend meetings at Fermilab – you just feel like you are doing something important.”

The NOvA experiment has started to collect data, and the module construction will be complete in January 2014. The first run will last six years. Scientists suspect that neutrinos played a major role in the evolution of the universe, contributing to its mass as much as stars and planets. NOvA will study the strange properties of neutrinos, especially the elusive transition of muon neutrinos into electron neutrinos.

ME-AN

Mechanical Engineering Alumni Network

The Mechanical Engineering Alumni Network invites all ME alumni to join with them to promote the department and to enjoy the community of engineers and entreprenuers of all ages. Watch the ME homepage for upcoming events and visit the ME-AN LinkedIn page for news, job information, and to stay connected!

ME Alumnus, Tom Secord mentors students

Tom Secord received his B.S. in mechanical engineering in 2005, and went on to earn his Masters and Ph.D. at MIT in 2005 and 2007, respectively. He returned to Minnesota to work at Medtronic where he works in the Structural Heart Division of the CardioVascular business unit. In his position he works with the Co-op Program, but in addition to bringing students to Medtronic, he has brought projects from Medtronic into the classroom.

How did you decide on mechanical engineering?

I come from an engineering family. Both of my parents are electrical engineers and they provided a great example of what it means to be an engineer. I knew throughout high school that I wanted to pursue mechanical engineering. I had a keen interest in Newtonian physics and applied mathematics, so I knew that it would be a good fit. Furthermore, mechanical engineering is very versatile, with multiple areas of depth that appealed to me. But even early in my undergraduate years, I was toying with a dual major in physiology because I have always had an interest in biomedical applications as well.

Describe your experience at Minnesota.

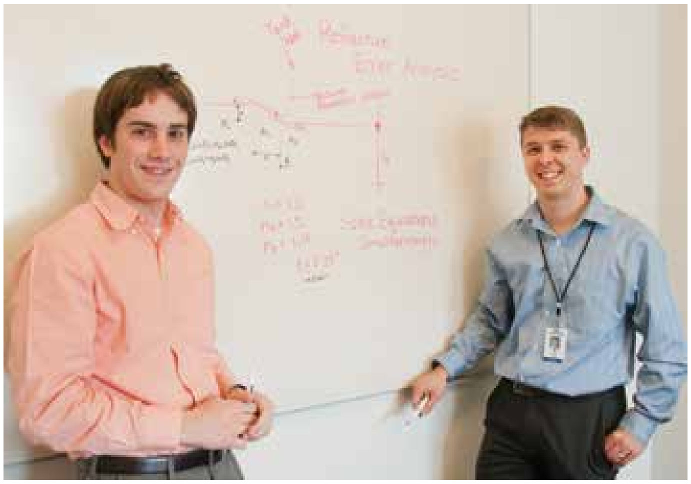
I had a great experience. After entering upper division, I participated in the honors program my junior and senior year and worked very closely with Professors Kim Stelson and Sue Mantell on a dual project. It had a heavy analysis component but also an experimental component. On the analysis side, I worked mostly with Professor Stelson. As I entered my senior year, I transitioned into the experimental work with Professor Mantell. That research experience and participation in the honors program were some of the highlights of my undergraduate experience.

How long have you been with Medtronic?

I have been with Medtronic Structural Heart since the summer of 2010. I was also an intern with Medtronic Cardiac Rhythm Disease Management when I was an undergraduate. I started the internship my sophomore year and continued as an intern through my senior year. I was a part-time intern during the school year and full-time during the summer. It was not the Co-op Program structure, per se, since I did not get academic credit for it. Nonetheless, it was still a very valuable experience that factored heavily into my decision to return to Medtronic.

What made you decide to pursue a project with students here in Mechanical Engineering?

It really blossomed out of my participation in the on campus interviews for the Co-op Program. Shortly after I started in the Structural Heart Division, my manager was transitioning out of the Co-op coordination role and had asked me to step in. I began by performing the screening interviews on campus. Our group usually sets up 8 or 10 interviews all in one day, so our interview process is a very concentrated effort. After participating in the interview process, I started advising and mentoring the Co-op students. It was a great opportunity be-



ME student Kevin Mallery on left in photo above, with his mentor, Tom Secord.

cause I love teaching. Now I am involved in all pieces of the program – hiring, interviewing, mentoring and advising, and, more recently, continuing relationships with the Co-op students after they finish the program.

Describe the projects that you give to students.

The general idea is to give the students incremental independence in their projects. Their first term they will start with something that is pretty well defined. There is an ongoing collaborative effort between the co-op student and the manager. A typical first term project might involve various types of data collection. We do a lot of testing on our devices and such testing generates a lot of data that needs processing. The co-op students tend to excel at data processing and manipulation, which keeps them in their comfort zone as they are acclimating to the industrial environment and Medtronics' procedures. It is a good starting point.

In the subsequent terms, their involvement moves into more independent design of test equipment and the tests themselves. An example might be a hydrodynamic test of a heart valve. Students can get involved in the apparatus for such a test later in their programs.

We like to find students that have a desire, not only to do the hands on work, but also to take the data they generate in their design and testing efforts in the lab and bring it back into the analysis phase. Overall, Medtronic's Structural Heart Division has had a long history of great success with the Co-op Program.

What about the course that you got involved in as well?

The idea was born during my time on campus for the Co-op interviews. I happened to talk with Adjunct Professor Kelso over lunch and we discovered that a lot of what I do at Medtronic intersects well with courses he teaches, both ME 3281 and, more recently, ME 4080. Specifically, we discovered that one of our pieces of test equipment, a fatigue test machine, is a great case study for all the concepts taught in ME3281. It is a great, real-life example of how the course concepts are applied and embodied. So we decided to put together a case study featuring that piece of equipment and use it as a teaching tool for those courses.

How many Co-op students do you have working right now?

This term I am working closely with one co-op student; the previous term I worked with two. In total, I have had five students throughout the two years I've been working with Co-ops. All of them have been outstanding employees.

Do any of the Co-op students that have come through the program work here now?

Yes. The Co-op experience has certainly led to a full time position in some cases. It really depends on the timing and availability of positions when their term is completed, but for those co-op students that really exceled and dug in here, it was a very desirable transition for them and us – it's a win-win for both.

In Memoriam

Bernard A. Ackerson	ME 1949	2013
Christianne V. Anderson	PhD 2008	July 14, 2013
David R. Asplund	ME 1980	May 22, 2013
Thomas A. Axelson	ME 1951	September 22, 2013
James C. Borgstrom	ME 1953	June, 2013
Susan Candland Bromley	MS 2003	July 26, 2013
John B. Custer	ME 1948	August 21, 2013
Alexander L. Donaldson	ME 1950	October 5, 2013
Jeremy D. Ecker	ME 1999	August 4, 2013
William N. Edberg	ME 1949	August 13, 2013
Robert W. Ernt	ME 1948	September 20, 2013
Donald G. Estebo	ME 1947	July 28, 2013
James B. Gallea	ME 1949	August 18, 2013
Roy L. Henneberger	ME 1977	September 21, 2013
William J. Jaksa	ME 1953	September 3, 2013
James L. Osterhus	ME 1958	September 7, 2013
Peter A. Potvin	ME 1979	August 2, 2013
James R. Reisdorfer	ME 1973	July 18, 2013
Dwayne A. Rule	ME 1955	2013
Keith R. Shodeen	ME/MS 1993	July 19, 2013
Ralph J. Slavik	ME 1952	July 1, 2013
James L. Talmage	ME 1960	October 16, 2013
John C. Walker	ME 1952	June 8, 2013
Charles E. Wood	ME 1991	2013
John R. Zimmerschied	ME/MS 1964	February 17, 2013

Thanks to all our

This list reflects contributions to the department since September 1, 2012. Bolded names denotes Dean's Club members, ** denotes two years consecutive giving, *** denotes three years of consecutive giving, and ◊ denotes four or more years of consecutive giving. We have made every effort to be as accurate as possible and apologize if we have made any errors. Please notify Jennifer Clarke, 612-626-9354, or email: jclarke@cse.umn.edu, for corrections.

David E Aakre
Anew S Ahlfield
Hans Aichlmayr**
Kenneth J Albrecht
Charles A Amann◊
Lawrence L Ambs◊
Loren Amundson
Gregory J Anderson**
David L Anderson
David J Anderson
Truman A Anderson◊
Rolf D Anderson
Peggy J Anderson
Joel A Anderson
Harold L Anderson
Julie K Anderson**
Bradley Anderson**
Dwight D Anderson◊
Theodore and JeriAnn Angelo
Naseem A Ansari***
Mark A Anton
John T Appelen
Arthur J Artrong
Jane H Arrett◊
Fred B Atwood◊
Jay T Axness**
Ronald L Bardell**
Nicholas Barsic**
Mary Bartilson
Christopher S Bassett
Robert N Bateson**
Kirby J Baumgard**
Richard B Baxter◊
Isaac D Beaver
Russell L Beebe◊
John L Benson**
Glenn R Bergum**
Claude L Berman**
John M Berner**
Richard C Bielke◊
Thomas C Bischoff
Roger O Bjerk◊
William Blatt◊
Lawrence J Blattner◊
Jack O Bly**
James Boler◊
Daniel L Boots
Peter & Patricia Boriin◊
John W Bornholdt
Dale L Brady
R Robert Brannon Jr-
Timothy D Bridgman**
John E Brockmann
Gregory R Bromenshenkel***
Bruce C Brooks
Peter F Brown◊
Joanne Brown
Myrna W Brudvig
James L Brudvig
Richard A Budde***
Paul L Buelow**
James Cabak**
Thomas F Canfield***
John E Canfield Jr
Christopher P Carlson***
David E Carmein
Edwin J Carr
Scott E Carroll
Stephanie B Ceniglio
Stephen Cermak III**
Kristi M Cetti**
Yung-Shan Chang***
Thomas G Chapin◊
Thomas R Chase
Stuart R Chastain
Donald R Check***
Anew D Chelsa
Dean B Chenoweth
Sze-Foo Chien◊
Dennis L Christ
Ronald Christenson
Morgan H Clarity
Richard W. Clarke
John M Clemens
Charles C Clendenen◊
Edward N Colburn
Michael R Cotock
Donald J Conlin◊
Michael R Connly
William D Copenhagen◊
Richard G Cornelius◊
Harry E Cotrill Jr◊
Richard T Cox◊
Donald H Craighead
Gerald D Cran◊
Peter K Crawford**
Nihat Cur◊
John A Dahlseng**
Barton E Dahneke◊
Lee Daly
Eugene R Danneman**
Ralph Davis Jr◊
Michael R De Namur***
Gloria K Delano**
David A Depuydt
Cynthia M Dewes***
Duane F Dipprey**
Richard B Diver Jr◊
Forrest D Dohlin
Daniel F Dolan***
Janis M Dorman
Joshua L Dudney**
William K Durfee◊
Rahul Dutta
Roy R Earl◊
Jeffrey A Earles
Michael B Eckhardt◊
Carl H Eckstrom**
Roger Eichhorn◊
Randall M Ellis
Robert A Elm
Thomas R Engels
David R Engh◊
John M Engstrom***
Mark E Erickson
Roger E Erickson◊
Leonard T Erickson◊
Vernon Eriksen◊
Robert G Ertel**
Marvin E Eshelman**
David E Feinberg
Timothy J Fernholz
David J Fetzner◊
Marlin P Filipek
Leroy Fingerson
Conrad F Fingerson
David P Fleming◊
Kenneth E Floren◊
Peter W Freund
George W Frey Jr***
Barbara Gacek
Bernard W Gaffron***
George F Gardner**
Satya P Garg***
Gary W Gauer**
John W Gausman◊
Randy C Gee◊
Gershon L Gendler**
Richard D Gerberding◊
Le Roy E Gerlach***
Cheryl A Gerstler***
Richard I Giertsen◊
Raymond C Giese◊
Isaac M Giesen◊
Thomas K Gifford
Dennis E Gilberts**
Floyd C Gilman**
Steven L Girshick
Richard A Goerger**
Richard J Goldstein
Nathan Goodfriend**
David M Goodwyne**
Robert G Grady
Kristine M Graham**
David R Grandall◊
Donald C Grant
David J Gravel**
Frederick M Green**
Kenneth O Griep**
Richard F Griffith
Beth B Groff◊
Dan A Grohnke**
Nicholas G Gryskiewicz**
Muriel Gunderson
Gary B Gustafson◊
Jeffrey T Haase
Jami Al Hafiz
Raymond I Hakomaki***
Ken W Hallberg**
Larry D Halsne◊
William P Hamann
Patrick M Hamilton**
Paul L Hammel**
Gregory T Handzel◊
Julius A Hanna Jr
Ralph W Hanson◊
Henry A Hanson◊
Thomas E Haskett**
William R Hathaway◊
Steven P Hattenberger
Scott D Haugan**
Stephanie Marie Haugen
Joachim & Yuko Heberlein
James O Hedeen
George D Hedges**
Bruce P Hedlund◊
John W Heer◊
Harwood A Hegna◊
Richard L Heinecke
Adam J Heinzen***
John M Helgeson
Stefan D Helgeson
John R Helland◊
Duane A Helleloid**
Joseph L Henicks◊
Richard D Hermans◊
Mary Hessburg◊
Donald W Hewitt
Jerry D Hinderman
James C Hogan◊
Eugene M Hoganson◊
Gregg A Hohenstein
Roy F Holm Jr***
Jennifer E Holte**
Kun-Chen Hsu◊
Panyin A Hughes◊
Wendell & Judith Hung
Warren E Ibele◊
John L Ibele
Paul A Ice**
M Yousef Jabbari
Steven R Japs
Jeffrey M Jelen**
Carl E Jennrich**
Amber Johnsen
Bradley A Johnson◊
Bruce K Johnson**
Bruce V Johnson◊
David A Johnson**
Gerald W Johnson**
Jack D Johnson**
Kent D Johnson◊
Nancy G Johnson
Paul A Johnson**
Sharon Johnson◊
Timothy L Johnson◊
Scott D Johnston◊
Veikko J Jokela**
David Jungkunz
Rosemary T Jungkunz**
Swatantra K Kachhal◊
Alan D Kaath**
Ramdev Kanapady
Ryan J Kari◊
Bruce A Karjala
Brett W Karnowski
Varsha K Kelkar***
Mark S Kelley***
Barbara Ketter
Timothy L Kiel***
Robert A Kierlin
Keith Kim
Wayne S Kivela**
James W Klein
Jonathan A Knutson***
Earl O Knutson◊
John M Koepcke
Barbara L Kokotovich***
Nicholas S Koop◊
Uday P Korde**
Uwe R Kortshagen**
Steven W Kraft
Mark C Kraus
Daniel J Kraus***
Dennis K Kreid◊
R W Kreutter**
Keith N Krier**
Lloyd F Krocak
Robert L Kuhn◊
Carl Kuhrmeyer
Arnis L Kurmis
William J Kurzeka**
Ted M Kussow**
Joel D Kuyper◊
Arvie A Lake Jr
Patrick H Lamey Jr**
Sara M Langren◊
Christopher R Larson◊
Robert E Larson
Elaine S Larson
Clifford W Larson Jr
Eino K Latvala◊
Wynn C Lau
William G Laveen◊
Michael R LeClaire**
Peter Lee**
Yung-Cheng Lee◊
Jason John Legatt
Jeffrey M Lehn**
Pingyan Lei**
Kenneth (Rob) Lemons
John S Lengyel◊
Daniel P Lerick◊
John W Lester◊
Gordon C Lewis◊
Paul F Lilienthal◊
Zhi-Kui Ling
Duaine L Linton◊
Richard A Lippert***
Benjamin Y H Liu◊
Jun Liu
D Diane Liu
Charles Lo◊
Paul E Loftness◊

generous donors!

Dana R Lonn◊
Jeffrey J Louwagie◊
Jeffrey W Lundbeck◊
John M Lutz**
Clarence A Lysdale◊
John A Magnuson***
Virinchi Mallela
Douglas N Malm
Jerome A Malmquist◊
Susan C Mantell◊
Virgil A Marple
Raleigh L Martin
Daniel E Martin**
Glenn T Mason***
Ronald F Mattson◊
George B Mattson***
Stuart T Mc Comas◊
Vincent Mc Conville
Michael J Mc Donald◊
Thomas J Mc Evoy◊
Stuart G Mc Kneight◊
John G Mc Millan◊
Robert S McClocklin
Michael D McClure
John M McCormick**
Mark McCoy**
Patricia B McDonald**
Thomas J McDonough
Andrew R McFarland
Padraic S McGuire
Kevin Mclennan
Peter H McMurry
Jerry D McNally◊
Daniel R Mcpeak
David M Meier
Thomas G Meier
Dennis E Meisner
Wesley W Melander
Timothy L Mellesmoen
Kenneth M Merdan◊
Terrence R Meyer**
John E Mikesh
Paul R Miller
Jason C Miller
Roger E Miller**
John R Mlinar◊
Kristen Nelson Mock**
Robert D Mohrbacher
Willard L Moline◊
Victor C Moose Jr◊
Joseph Moses**
Patrick J Moynihan***
Craig R Mueller◊
Aaron J Munsinger
George & Judith Murakami
Marshall S Nathanson
Patrick T Nelsen
Pat Nelsen
Tyler L Nelson◊
Floyd L Nelson**
Richard K Nelson◊
Judith A Nelson Lewis***
Darrick L Niccum◊
Stanley B Nickells◊
Lori J Nigon***
John A Noer
Meribeth Nordloef-Pedersen
Roger L Norquist***
Gregory J Novak◊
Dale A Nugent**
R Stanford Nyquist◊
Kenneth T Oas◊
Arthur Oberg
Robert S Ogren**
Kenneth E Oja**
John C Okada**
Scott D Olsen
John H Olson**
Jaymes C Olson◊
John L Olson**
Charles D Olson
James E Oslund***
J Howell J Owens Jr◊
Arthur J Paulson
David C Paulson◊
Timothy M Paulus◊
James W Pearson◊
Richard W Pearson**
David J Pennington◊
James C Perso
David J Peterson
James S Peterson**
Donn N Peterson◊
Craig F Peterson***
Mark D Pfeifer***
Emil Pfender
William H Phillips
Timothy B Phillips***
Peter Pierce
James P Pilger◊
Judith Potthoff
Peter A Potvin PE
Mary Jane M Poynter
Kenneth J Pucel
Charles K Radhamohan
James V Radoki
James and Mary Radomski
David D Radtke**
John E Raetz***
Brian D Raivo**
Gregory J Rajala◊
James W Raey◊
James Ramsey
Jalal S Rana
Michael L Rancour◊
Dean R Rask
Rodney B Rask
Daniel J Raun
Robert M Reinstrom**
James R Reisdorfer**
Richard J Remiarz◊
Sheldon J Resig
Jed M Retherford**
Anew J Reuter
Michelle L Robbin◊
Linda L Robbins-Lach
Mary Jo C Roberts◊
Randolph P Roen◊
Matthew L Roesle
Lauren D Roesner
James P Rohl◊
Gregory A Rolfson
John P Roll◊
Henry F Romer◊
James W Ronkainen◊
Christopher M Root
Thomas K Rose
David W Rosen◊
William F Rottschaefer***
Mohammad A Rouf◊
Norman E Rud Jr
Mark K Ruether
Richard A Ruh Jr◊
Roberto Ruiz
Robert A Rustin**
Mark J Ruter
James L Rutzick**
Christine L Samuelson
Michael M Sandahl
Sue E Sandbulte
Christopher J Sande
John R Saylor
Robin E Schaller**
Maris Schefers◊
Scott S Scheurich***
Mark A Schmidt
Roger N Schmidt***
Roger R Schmidt
Kurt S Schnapp**
Mark E Schneider**
Christina M Schober◊
Erick O Schonstedt Estate
Ryan D Schuldt
Leland D Schultz Jr◊
William K Schwartau
Carl E Schwarz◊
Edward L Schwarz
Thomas W Secord***
Clayton P Sederberg
Dolores E Seidel◊
Gilmore J Sem◊
Steven J Seme
Gary L Showalter
Molly V Silas
Sara N Simma
Nancy J Simon**
Eric M Sims
Christopher Singh
Donald R Sjostrom***
John G Smith◊
Nathaniel L Smith**
Nancy Rogers Smith
Steven J Snell**
Keri B Sobolik**
Dave E Soenen**
Jonathan R Soiseth
Russell G Solheim◊
James A Solomakos
Marian Solomakos
Gino Sovran◊
Ephraim M Sparrow***
Donald D Sporre
Timothy A St. Cyr
Alexander U Stael von Holstein**
Mary Stanek
Nicholas J Stanley***
Dennis L Starner
Richard L Steblay
Eivind Stenersen**
Kathleen Stenersen**
Roger A Stephanson
John F Stewart
Bradley G Stewart◊
Carl W Stiewe
Trupti N Storlie**
Peter C Stryker***
Albert J Sturm Jr**
Mandar G Sukhatankar◊
Wei-Ching Sun◊
Ningze Sun
Zhen Sun
Robert E Sundell***
Nathan J Sunquist
George M Sverup◊
Kevin J Swanson**
Jon A Swanson
John W Swanson**
A Einar Swanson
Roy E Swanson***
Peter A Swenson◊
Lian K Tan**
Lester O Tangen◊
Bryce Tenbroek◊
John D Teppen**
Laura Terry
Craig D Thompson
Ke-Kung Tien◊
Carl L Trabant**
James R. Traeger***
Kim Ngoc T Tran
Kandis A Tsuchiya
Norman R Tuomi
James M Turner
Rodney D Turnquist
Richard J Uhlemann***
Frederick T Varani
Howard S Veith***
Stephen D Vickerman**
David L Vidmar
William C Viebahn◊
Ralph J Volino◊
Gordon O Voss◊
Kurt P Wachtler
Robert Wahlstedt
Brian J Waibel***
Edward B Waldo
Albert C Waldvogel
Dayton J Walker◊
Kent & Marcia Wall◊
Nicholas G Wander***
Haiping Wang***
William F Wanner Jr
Eric A Ware◊
Dennis J Warwick**
Jeanne M Watson
Richard T Weisbecker◊
John W Weiss◊
Curtis H Wentz**
Thomas A Wentz**
Stephen J Wernersbach**
David A Wesley***
Carolyn H Westring◊
David K Wickstrom
Warren M Wiese◊
John R Wiggins**
Ross K Wilcoxon
Eric J Wilkowske**
Daniel D Willard**
Mark A Winslow◊
John Winters◊
Robert G Witte
Neil G Wobschall
Donald Wright
Francis J Yager◊
Bo Yan
Ge Yang
Yan Ye
Marvin J Yeager◊
Gregory D Yetzer**
Robert M Young◊
Jingjun Zhou◊
Eric A Ziegler
John R Zimmerschied◊

ME is truly grateful to our donors for their continued generosity. **40** undergraduate students received scholarships this fall, totalling $114,150!

We want to thank ME alumnus **Eino Latvala** (ME 1948, MS 1953) for his support which helped to set up Professor Dutcher's laboratory. (See her profile on page 5.)

ME News

MECHANICAL ENGINEERING

University of Minnesota
111 Church Street SE
Minneapolis, MN 55455

Nonprofit Org.
U.S. Postage
Paid
Twin Cities MN
Permit #90155

U of M Solar Team finishes 4th in World Solar Challenge

The University of Minnesota Solar Vehicle Project team finished in fourth place in the World Solar Challenge Cruiser Class. The University of Minnesota was one of only three teams from the United States that competed in the World Solar Challenge and the only U.S. team in the Cruiser Class. Teams raced their solar cars across the Australian Outback and were judged on other criteria including efficiency and car comfort. Great job, team!