Dear Alumni and Friends,

I am thrilled to brag about a great honor that was awarded to a faculty member and friend: Professor Emmanuel Detournay was elected to the National Academy of Engineering (NAE) for his major advances in hydraulic fracturing and drilling dynamics.

One of Emmanuel’s trademarks is his ability to develop creative answers to practical engineering problems using rigorous mathematical tools and well-conceived physical concepts. Perhaps even more important, he has an ability to instill in his students this first-principled approach to solving applied problems. NAE membership is a huge honor. We are so proud and happy to have this distinguished engineer as a colleague.

But there is much more going on in the department, which shows the breadth of possibilities that are created with a degree in civil, environmental, or geo-engineering.

In this issue you will meet an alumna who moved from heavy construction of locks and dams to owning her own manufacturing company. You will be introduced to two recent graduates who are passionate about their new field, and you will hear about faculty who are making a difference in drinking water quality. And you will see the many distinguished lecturers that have visited in the last several months.

We could not do the work we do without our great network of alumni and friends. We are pleased to acknowledge our supporters, who make so much of our work possible.

We are happy to offer you a glimpse of all that is going on here through this spring issue of the CEGE magazine. Please write and or visit; we would like to hear from you.

Joseph Labuz
MSES/Miles Kersten Professor & Head
Department of Civil, Environmental, and Geo- Engineering

Correction: Kelsey Holthaus graduated with a Bachelor of Civil Engineering in 2014. (Her graduation date was incorrectly reported in the Fall 2015 issue.)
OF SPECIAL NOTE

EMMANUEL DETOURNAY has received one of the highest distinctions awarded to an engineer—election to the National Academy of Engineering (see back cover).

WILLIAM A. ARNOLD has been selected as a Distinguished McKnight University Professor, a recognition of outstanding faculty members who have recently achieved full professor status. Arnold’s environmental engineering research centers on the environmental fate and impacts of manmade chemicals on which modern society relies. He seeks to define the processes by which industrial chemicals, pesticides, and pharmaceuticals are transformed in aquatic systems. He evaluates chemical persistence in lakes and rivers, identifies potentially harmful reaction products, and develops technologies to clean up contaminated waters to reverse or prevent environmental damage. His work ensures safe, clean water for people and ecosystems. Arnold will hold this title as long as he remains at the University of Minnesota, and his name will appear on the University’s Scholars Walk.

The Association of Public and Land-grant Universities (APLU) has recognized the UNIVERSITY OF MINNESOTA as the most innovative public research university in the nation. The University of Minnesota took the prize in the innovation category due in part to the Minnesota Discovery, Research, and Innovation Economy (MnDRIVE) initiative, which has helped catalyze the launch of a record 16 startups in 2015, bringing the total to 86 since 2006. CEGE Professor PAIGE NOVAK is the co-director of MnDRIVE’s effort on advancing industry and conserving our environment. For more information about research and the commercialization of intellectual property at the University of Minnesota, search “research by the numbers” on cse.umn.edu.

JIA-LIANG LE was named the 2015 Young Engineer of the Year by the American Society of Civil Engineers Minnesota Chapter (ASCE-MN).

The award honors his contributions to engineering education, scientific research, and technology transfer. Le participates in several committees and serves in leadership roles. Within CEGE, Le teaches structures courses at both undergraduate and graduate levels, and performs research on fracture and failure behavior of engineering structures. Le’s work has led to the improved resilience of buildings, and his results represent a new paradigm for analysis and design of structures.

FACULTY

JILL KERRIGAN, her advisor BILL ARNOLD, and their collaborators have published “Quantification of Hydroxylated Polybrominated Diphenyl Ethers (OH-BDEs), Triclosan, and Related Compounds in Freshwater and Coastal Systems” in PLOS One (DOI: 10.1371/journal.pone.0138805). Their study shows that the levels of OH-BDEs have been increasing over time, likely due in part to human activity. Hydroxylated polybrominated diphenyl ethers (OH-BDEs) are a new class of contaminants of emerging concern whose roles and sources remain uncertain.

A paper from BILL ARNOLD’s research group was named as one of three top papers of 2015 by the journal Environmental Science: Water Research & Technology. “Triclosan, chlorinated triclosan derivatives, and hydroxylated polybrominated diphenyl ethers (OH-BDEs) in wastewater effluents,” by R. Noah Hensley, Jill F. Kerrigan, Hao Pang, Paul R. Erickson, Matthew Grandbois, Kristopher McNeill and William A. Arnold, (DOI: 10.1039/C4EW00102H).
In September Target asked suppliers to remove several chemicals from their products. ABC News affiliate KSTP interviewed BILL ARNOLD, who researches chemicals in the environment and was instrumental in research that led to the ban on triclosan in Minnesota (beginning in 2017). See the TV report at kstp.com.

ADAM BOIES, CEGE Assistant Professor, was awarded the Excellence in Review Award by Environmental Science & Technology. Boies’ research focuses on advancing low-carbon and energy-efficient transportation solutions.

EMMANUEL DETOURNAY received funding for a study on Modeling and Analysis of the Drilling Trajectory of Downhold Directional Drilling Tools from Halliburton. The project will run through July of 2016.

EFI FOUFOULA-GEORGIOU has been named the Robert E. Horton Lecturer in Hydrology for 2016 for her scientific, programmatic, and educational contributions advancing the science of hydrometeorology. Foufoula-Georgiou is president of AGU Hydrology Section and holds the Joseph T. and Rose S. Ling Chair in Environmental Engineering.

JOHN GULLIVER was the recipient of the 2016 Richard P. Braun Distinguished Service Award from the Center for Transportation Studies. This award is given annually to a transportation professional for outstanding leadership in research and innovation. Gulliver received the award for his research and innovation on the water quality treatment of road runoff and stormwater hydrology.

RAY HOZALSKI was one of several experts called on to help explain the problems experienced in Flint, Michigan. Hozalski stated, “Certainly, an increased corrosion rate means that the metal is dissolving away more quickly...But the lead service connections and the water mains are pretty thick so the risk of them failing because of the increased corrosion over the past few years is likely not much of a concern in my opinion.” (Detroit Free Press, January 30, 2016).

MIKI HONDZO and fellow researchers from UMN’s College of Science and Engineering recently received a $1.5 million grant from the National Science Foundation Major Research Instrumentation Program for developing a small-scale solar-powered Unmanned Aerial Vehicle (UAV), also known as a drone. The proposed unmanned solar-powered glider will be equipped with hyperspectral camera and meteorological sensors that will generate environmental data. The glider could potentially fly for multiple days at a time. The data could be used to develop internet-based models for tracking harmful algal blooms, water temperature, and nitrate concentrations in Minnesota waters. Hondzo emphasizes that the technology could change how Minnesota waters and other aquatic ecosystems are monitored and managed.

JOE LABUZ, CEGE Department Head, was one of only five speakers who were invited to celebrate the 80th anniversary of the geotechnical group of École Polytechnique Fédérale de Lausanne (EPFL), the Swiss Federal Institute of Technology in Lausanne, Switzerland — one of the world’s leading universities.

Several Minnesota cities are involved in lawsuits alleging that chemical companies inflated the price of alum used for water treatment. TIM LAPARA explained the process: “Alum works by enlarging particles in water that often contain pollutants, allowing them to be more easily removed…Alum is probably one of the most cost-effective and simplest ways to achieve particle removal.” (Minneapolis Star Tribune, January 4, 2016).

Several Minnesota cities are involved in lawsuits alleging that chemical companies inflated the price of alum used for water treatment. TIM LAPARA explained the process: “Alum works by enlarging particles in water that often contain pollutants, allowing them to be more easily removed…Alum is probably one of the most cost-effective and simplest ways to achieve particle removal.” (Minneapolis Star Tribune, January 4, 2016).

DAVID LEVINSON researches accessibility of urban transportation systems. His work is highlighted in a video put out by the College of Science and Engineering. He will be measuring cities across the US to determine how easily people can travel to jobs. Metro Transit is improving signage at bus stops throughout the Twin Cities. Additional information will include route numbers, stop IDs, route maps, bus frequencies or methods for determining real-time arrival information. DAVID LEVINSON noted that these efforts will be “…especially important in converting nonusers into users” (Star Tribune, “Metro Transit Adding Information at Bus Stops,” October 14, 2015).
LAUREN LINDERMAN has received funding from the Minnesota Department of Transportation to study the Feasibility of Vibration-Based Long-Term Bridge Monitoring Using the I-35W St. Anthony Falls Bridge.

WALTER MAIER, former Professor of Civil Engineering at UMN, passed away on November 7, 2015, in his home in Tucson, Arizona. He was 89. Maier was born in Dillingen, Germany, and emigrated to the U.S. in 1938. He was a decorated WWII veteran and a research engineer with Exxon for 12 years. Maier was a pioneer in the field of environmental engineering. During the 30 years he taught at the University, the field of environmental engineering was expanding from a focus on waste water management to management of air pollution and control of solid waste. His commitment to the environment and to education was of great value to CEGE. Maier’s obituary was printed in the Arizona Star newspaper.

SOFIA MOGILEVSKAYA presented “Lost in Translation: Crack Problems in Different Languages” as part of the ADVANCE Distinguished Lecture Series at Kansas State University on February 18. Her presentation explored difficulties of keeping up with research written in different academic areas or different countries. In particular, she examined major techniques for modeling elastostatic crack problems, providing “translation” between different academic languages that describe the same problem. Mogilevskaya has published over 70 archival journal papers and coauthored a chapter in a book on complex hypersingular Boundary Element Methods (BEM) in plane elasticity problems. She also teaches a graduate course on BEM.

A study by HEINZ STEFAN and colleagues is helping MnDOT balance the effects of road salt on the environment. KAAL-TV ABC News 6 (southern Minnesota and Iowa) picked up the story (January 6, 2016). Author Andrew Sander said the news piece would let the public know the limit of effectiveness and the fate of road salt: about 23% is transported out of the watershed via the Mississippi River, the remaining 77% is retained in some fashion in the watershed. It is estimated that all the chloride ends up in the surface and groundwater due to its high solubility and conservative nature once in solution. Novotny, E. V., Sander, A. R., Mohseni, O., and Stefan, H. G. (2009). “Chloride ion transport and mass balance in a metropolitan area using road salt.” Water Resources Research.

STUDENTS

2016 ACARA Challenge winners include three undergraduates from CEGE. HENRY CROLL won the Domestic Division Bronze for his project, “Let’s Grow.” Let’s Grow uses a simple, recently developed hydroponic system that allows growers to plant and forget their fresh vegetables, until they are ready to be eaten. KRISTIN CARLSON and LUKE HORSAGER worked with students from the College of Biological Sciences and the Carlson School of Management to create MobiLite, an affordable and portable light and energy system that enables additional cell-phone functionality for urban slum residents in India. Their project won Bronze in the International Division and was also chosen as the Crowd Favorite — International Division.

A study by HEINZ STEFAN and colleagues is helping MnDOT balance the effects of road salt on the environment. KAAL-TV ABC News 6 (southern Minnesota and Iowa) picked up the story (January 6, 2016). Author Andrew Sander said the news piece would let the public know the limit of effectiveness and the fate of road salt: about 23% is transported out of the watershed via the Mississippi River, the remaining 77% is retained in some fashion in the watershed. It is estimated that all the chloride ends up in the surface and groundwater due to its high solubility and conservative nature once in solution. Novotny, E. V., Sander, A. R., Mohseni, O., and Stefan, H. G. (2009). “Chloride ion transport and mass balance in a metropolitan area using road salt.” Water Resources Research.

STUDENTS

2016 ACARA Challenge winners include three undergraduates from CEGE. HENRY CROLL won the Domestic Division Bronze for his project, “Let’s Grow.” Let’s Grow uses a simple, recently developed hydroponic system that allows growers to plant and forget their fresh vegetables, until they are ready to be eaten. KRISTIN CARLSON and LUKE HORSAGER worked with students from the College of Biological Sciences and the Carlson School of Management to create MobiLite, an affordable and portable light and energy system that enables additional cell-phone functionality for urban slum residents in India. Their project won Bronze in the International Division and was also chosen as the Crowd Favorite — International Division.

MARIA GARCIA-SERRANA (advised by John Gulliver) was the recipient of the 2016 Matthew J. Huber Award for Excellence in Transportation Research and Education from the Center for Transportation Studies. Garcia-Serrana’s doctoral thesis is on water quality treatment of road runoff provided by roadside drainage ditches through the process of infiltration.

JILL KERRIGAN, Ph.D. student, has been selected as a winner of one of the 2016 Graduate Student Awards in Environmental Chemistry of the American Chemical Society. This award recognizes graduate students working in areas related to environmental chemistry; it is based on students’ academic record and research productivity.

AUSTIN STROMING (CivE 2017) is part of the CSE team that competed in the 2016 GOFIRST Robotics Club ION Autonomous Snowplow Competition. Team Ground Squirrel designed a two-wheel drive vehicle with a caster to steer and a camera with a LIDAR sensor for vision tracking and navigation. They have already started working on a new model for the next competition.

Undergraduate Winter Graduation. Twenty-one CEGE graduates participated in the CEGE Commencement and Order of the Engineer ceremony in December. These CEGE graduates have been hired by BKBM; CNA Consulting Engineers; MnDOT; PCL Construction; Shavlik Technologies; Short Elliot Hendrickson; SRF Consulting Group, Inc.; TKDA Engineering; Uni-Systems Engineering; and WSB and Associates. LINDSAY GAINES was the student speaker at the event. PHIL GRAVEL of Stantec was the distinguished speaker. Read the speeches and see photos online at cege.umn.edu.
ALUMNI

PANOS DIPLAS (Ph.D., 1986) now heads the Department of Civil and Environmental Engineering at Lehigh University. Diplas studies river meander and scour (the leading cause of bridge failure in the US) at Lehigh’s Imbt Hydraulics Laboratory. In his studies and teaching, Diplas takes a big picture, systems-level approach to solving river-related problems.

CHAD HANSON (CivE, 2001) works as a bridge engineer for MnDOT. Hanson was involved in a paralyzing accident while at UMN, but came back and completed his education. He was profiled on WCCO-TV (March 8) for his work as manager of a major bridge project in Red Wing, Minnesota. The project is estimated to take about 10 years and cost about $110 million. Hanson says he is “just an engineer who’s figured it out.”

AARON JOHNSON (CivE, 2015) was chosen as PCL Construction’s Nationwide Student of the Year based on the leadership and initiative he displayed during his internship. He was recognized for his strong engagement skills, his notable contributions to the company, and his potential to be a future leader. Johnson completed two internships with PCL, and was hired on full-time in PCL’s Minnesota office beginning in February.

BENTON JOHNSON (CivE, 2005, MS 2007, advised by Catherine French) now works at Skidmore, Owings & Merrill (SOM) in Chicago. SOM’s projects include Burj Khalifa and One World Trade Center. Johnson works on SOM’s Timber Tower Research Project, which strives to reduce the amount of resources used to build highrise buildings. He was featured in a video taken at the AIA Convention in October 2015.

WENDELL TANGBORN (GeoE, 1958) is an expert on glaciers, having studied them for over 55 years and publishing over 40 papers in the area of glaciology. A recent editorial of his was published in the Guardian. He was also featured in the Star Tribune, “Glaciers as Sentinels of Climate Change.” His current focus is mass balance of glaciers. He has developed a computer model that calculates a glacier’s mass balance from routine weather observations.

DAVID TIMM (CivE 1996, MS 1997, PhD 2001) holds the Brasfield & Gorrie Chair of Civil Engineering at Auburn University, Auburn, Alabama. He works with the National Center for Asphalt Technology Pavement Test Track, is the chair of the TRB Committee on Flexible Pavement Design, and is a registered professional engineer in Alabama. Timm returned to CEGE in February to deliver a Warren Lecture. His presentation, “Long Life Pavement Design—The Road to a Sustainable Future,” can be seen on the Warren Lecture YouTube channel.

SHERRY VAN DUYN, PE (CivE, 1987) was named president of Landmark Environmental, Bloomington. Van Duyn was vice president since 2000 and is a founding member. She is also a member of CEGE’s professional advisory board.

DEPARTMENT

THE 64TH ANNUAL GEOTECHNICAL ENGINEERING CONFERENCE was held at the University of Minnesota on March 4, 2016. The conference provides information and discussion on current geotechnical topics and a forum to interact with peers, meet specialty contractors, and hear researchers and practitioners discuss theory and applications of geomechanics. Dr. Richard Woods, Emeritus Professor and former Chair of the Department of Civil and Environmental Engineering at the University of Michigan was the Kersten Lecturer. His research interests center on foundation dynamics, vibration measurements, site characterization for seismic mitigation, and applications of geophysics in geotechnical engineering. He co-authored a textbook Vibrations of Soils and Foundations (1970), a NCHRP Synthesis on Dynamic Effects of Pile Installations on Adjacent Structures (1997), and published over 100 papers and reports on his research and consulting activities. Professor Woods was elected to the National Academy of Engineering in 2003 and made an Honorary (Distinguished) Member of ASCE in 2004.

The CEGE WARREN LECTURE SERIES has moved to a new time, 10:10 a.m. Friday between September and May (see full schedule page 15.). All recordings can be viewed on the Warren Lecture YouTube channel.

CEGE hosts many student groups who come to explore college and engineering. In March a group of students from Valley Middle School of STEM in Apple Valley, Minnesota, had a chance to build structures and test their earthquake resistance on a shake table.

The 20th Annual National Road Research Alliance PAVEMENT CONFERENCE was held at UMN in February. This year’s conference drew record attendance. The Skok Lecture was delivered by Michael I. Darter, PE, Ph.D., of Applied Research Associates. He spoke on the “Impacts of Research, Practice, and Teaching on Pavement Engineering.” Among the highlights was the announcement of a new scholarship for undergraduate students in honor of Eugene Skok.
Karin Gessner has deep roots in the Department of Civil, Environmental, and Geotechnical Engineering; her great-grandfather Algøt Johnson graduated from the School of Mines in 1910. His presence continues to greet all students who enter Room CIVE 205, which bears his name. And though Gessner was young when her great-grandfather died, she still carries on his legacy through the Al Johnson Construction Company Scholarship. These deep family ties explain a lot about Gessner’s commitment to engineering, quality, ethics, and community service.
Gessner began working in the family business after completing her Bachelor of Civil Engineering and Master of Science in Industrial Engineering at UMN. Al Johnson Construction Company focused on heavy construction, and her first project was building a new lock at the Winfield Lock and Dam in West Virginia. “It was a 3-4 year project and I was there for the first year of the project. I loved it! That was my first big experience with heavy construction on my own. After that, I came back to Minnesota and continued working in heavy construction with my father and all the guys.”

Gessner says that her interest in civil engineering came about, not because of the work per se, but because of the people she knew who were engineers. She had always been very comfortable working with the civil engineers she knew through the family business. “It might not have mattered what they were doing, I just really liked the people. This realization really came home for me when we had a consultant come in for a strategy session just a few years after I had started working at the company. Part of that effort was to complete a personality assessment. We all came out with the exact same personality type! We all thought that was hysterical, but the consultant thought that, as a company, we needed to get some people who think differently, some diversity of thought. That experience explained for me why I was so comfortable with these people. I had found my place, and it was the people that brought me into engineering.”

In the later 1990s, it became apparent that the company was facing limited growth in their narrow niche market of building locks. Gessner’s forward-looking father, Tom Gessner, began the process of winding down the company and looking for ways to diversify. Because the company had large projects throughout the United States, it took about 5-8 years to wrap them all up and complete the closure.

“In that process my father had purchased Red Devil Equipment, a family owned business—like ours—in New Jersey. The company made paint mixing machinery. They were transitioning from the third to the fourth generation and needed to sell off the equipment division.

“Before the purchase, my dad had contacted Sherwin-Williams, the largest paint company in the area. He asked their advice about purchasing the paint mixer manufacturer. Sherman-Williams was positive about the purchase, stating that it would be valuable to have another mixer company in the area. So, we went forward with the purchase and almost overnight moved the whole company from New Jersey to Minneapolis. One day several trucks of equipment rolled up. We didn’t really know what we were doing, but we jumped in and figured it out—which is what engineers do! We unloaded the trucks, looked at the drawings, and took it from there. Sherwin-Williams has been a faithful customer ever since. “When we bought the company 25 years ago, everything was belt driven and we switched it over to gears. My dad wanted to build something that would never break down; belts just inherently break. So we made a conscious decision to build something that lasts forever. We are known for that; we make our equipment extra durable. Our products last for millions of cycles, with 20- to 30-year life spans. Some people tell us we should plan in some obsolescence so customers have to regularly buy something new, but we don’t do it that way. It goes back to our core values. ‘Build it to last’ is our philosophy. That’s who we are and it’s worked so far.

“When the construction companies were all wrapped up, I came over to Red Devil full time. My father said to me, ‘Either you run this or I’m going to sell it.’ I told him, ‘I’m all in!’”

Gessner has been the CEO for 15 years now. The company recently went through a rebranding and changed the name from Red Devil (which was problematic in some overseas markets) to Radia. The new name has been well received by customers.
“My father is now the Chairman of Radia. He is involved on a fun, creative level; we call him ‘the chaos maker’! He comes in with very common sense ideas—it is the civil engineer in him. He has very practical, solution oriented ideas. He comes in to talk with the engineers, and he always brings it right to the core. It is helpful for the engineers to think things through with him.

“I am the oldest of three and we all work together at Radia. We know how lucky we are and we all appreciate that. It is rare: we all get along and they are happy to let me run things!

“I realize that I am very comfortable with people who have an engineering mindset. For me, that means a practical, problem solving approach—very practical common sense. Our employees have to be able to solve problems quickly, or at least jump in, engage in the conversation, and throw down some ideas. Civil engineers, especially, are the least ethereal of all engineers. Our hands are literally in the dirt!

“As we bring new people into the company, I have to work a little harder with other types. By the time I see candidates, their technical capabilities have already been vetted. So what I look for is a spark in their eyes, an energy and enthusiasm, a willingness to jump in, and a lack of entitlement. It is hard to find that, but it is so fun when you do. Those people really magnify the energy in the room.”

“Radia is committed to family and community. A value of giving back started with my great-grandfather, Algot Johnson, and his gifts to the University. I did not know him well, but my parents instilled in me values of education and community service. I am trying to pass them on to my children, now, too. My family and our business are committed to education, especially promoting science and engineering for upcoming generations.

“I very much enjoyed my time at the U. I had gone to a small east-coast school (Bucknell University in Pennsylvania) for my first two years, but decided that was not for me. When I came back to Minnesota, I was really ready to be a serious student. I knew I was going to work for my dad, and I was motivated to finish school and start work.

“Steve Crouch, now Dean Crouch, was then the head of the civil engineering department; he brought me on board and guided me through the transfer process and helped me develop a plan for graduation. I studied with Professors John Gulliver, Catherine French, and Andrew Drescher.

“Even though my job is now management, I still draw on my engineering training. It is all about problem solving, which is one of our core values here at Radia. I am problem solving all day long. That mindset came from my upbringing and was reinforced in my civil engineering training. It is all about block and tackle, defining variables, determining what is really important and what is not. Engineering training is where you get to be really good at problem solving skills. I wish everyone could get exposure to that kind of training because there is so much value in it. Not everyone needs to differentiate an equation, but everyone needs to know what an equation is, and how to understand what the pieces are.

“I love supporting education and STEM (science, technology, engineering, and math) education in particular. I think having more engineers is key for the continued success of the country, so whatever we can all do to encourage students in that direction, we should do. If a student has even a little interest, I would encourage them because STEM skills are valuable and transferable, even if the student does not see it
all the way through to get an engineering degree.

“I have three children. My middle child is a total STEM guy. He loves Legos—he was doing kits for ages 11-16 when he was six years old! We do everything we can to encourage him. However, as parents, we have to seek out STEM experiences and often pay for them independently. There are very few STEM-focused schools. I hope that someday STEM training will be more mainstream. That is why Radia supports Rogers Elementary STEM Magnet School.

“Radia supports other community projects, too, like the Ronald McDonald House (RMH). That is such a tremendous organization. As a company we participate in Cook for Kids a couple times a year. It is great to interact with the families who are so inspiring.

“I got connected with the Ronald McDonald House through a friend of mine who had been on the board for years, through his mother and his grandmother. I had been talking to him about how to connect with the owners of a compactor company we’d bought, whose main client was McDonald’s. My friend hand delivered me to the person who was running the House, and I got appointed to the Board of Directors. It has been such a wonderful connection. It started because of the compactor business and their connection with McDonald’s, but when I saw the RMH video, I was in tears. I was instantly committed to the cause. I’ve been there five years now. I bring the small business, entrepreneurial spirit to the board. They have a lot of high-profile people. My role is to bring the civil engineering, get-it-done perspective. It is a good balance. That experience has been really rewarding and fun.

“Engineers have to develop a somewhat humble mindset, more than some other areas. Engineers cannot assume they know the answer, and they need to be aware of how things might fail and what to do if that happens. There are so many consequences to a bad engineering decision. Other disciplines, like business majors perhaps, don’t appreciate that as much as engineers do, at their core.

“I was so glad to learn about the Order of the Engineer ceremony that CEGE now offers as part of the departmental graduation. I don’t think anything similar to that exists in business school or other areas. Not that it is acceptable to be unethical in these other fields, but when an engineer has to sign her name on a PE certificate and say I verify this work, it makes a difference. For all those reasons, it is important to emphasize the ethics and responsibility of being a civil engineer.”

Karin Gessner is a great example of the thoughtful, practical, ethical mindset CEGE tries to cultivate in our students. It’s clear that the world needs more people like Karin Gessner!

DRIVEN TO DISCOVER

To Treat Sewage as a Novel Solution to Antibiotic Resistance

Tim LaPara says changes to wastewater treatment facilities could save lives

The University is highlighting researchers who are Driven to Discover in advertisements for television, online, and print media. Recently, two individuals from CEGE were featured. TIM LAPARA treats sewage as a novel solution to antibiotic resistance. PAUL CAPEL traces the fate of chemicals so that we understand their consequences. You can see all the stories on the driven-to-discover.umn.edu site.
A safe and reliable water supply has been a concern since the dawn of civilization. Advances made by engineers to ensure a clean drinking water supply, such as the use of filtration and chlorination, have been credited with saving more lives than medical doctors. Drinking water quality continues to be of prime concern, even making headline news (recall recent stories of lead contamination in Flint, Michigan). In Minnesota, water purification and public water supplies generally are safe and reliable. However, as recent news illustrates, we cannot take these valuable resources for granted. Researchers in the Department of Civil, Environmental, and Geo-Engineering are committed to protecting and improving the quality of our drinking water supplies.

Unpleasant taste and odor can give citizens an impression that drinking water is unsafe. The substances that affect taste and odor, however, often are natural compounds that are not harmful. Nevertheless, when water systems personnel get complaints about taste and odor, they take them very seriously. System fixes require extensive testing and often take time. Engineers always proceed cautiously as making changes to deal with a problem like taste or odor could upset a very complex system. In other words, cities want to be sure that changes made to make the water taste better do not compromise the safety of the drinking water supply.

When Minneapolis wanted to address some taste and odor problems, they reached out to CEGE Professor Raymond Hozalski, who has had success investigating a similar problem for the city of St. Paul, where geosmin was causing an earthy odor in the city water supply. After a pilot study (from 2004-06), Hozalski recommended St. Paul replace their water utility's existing anthracite-sand filter beds with granular activated carbon (GAC)-sand beds. The full-scale changeover at the plant dramatically improved drinking water quality, evidenced by a precipitous drop in customer complaint calls. In the St. Paul project, Hozalski and his team saw that the GAC filters were continuing to be effective much longer than expected. The filters were getting the geosmin out of the water right away, and the filters were not becoming “saturated” or exhausted; they continued to effectively remove geosmin from the water beyond the expected life of the filters.

"If we see removal happening after the expected limit (beyond the estimated sorption capacity of the GAC), then we look for another process taking place—most likely a biological process. It turned out the filters in the St. Paul plant were being regenerated biologically. We were able to demonstrate in the St. Paul plant that the microbes growing on the filter media were beneficial to the removal of geosmin.” A balance had been achieved. The removal of geosmin was maintained and the carbon filters continued to be effective.

So, St. Paul is benefitting from the microbes living in the filters. Because of this, St. Paul has not needed to replace the GAC filter media, which is quite expensive. In fact, no additional action is necessary—the microbes and the GAC just do their work. St. Paul may never need to regenerate the activated carbon for the purpose of treating geosmin. The fact that the filters don’t have to be regenerated makes the bioactivated carbon filters a viable, economical, and sustainable technology, saving the city an estimated one million dollars a year. That savings is a great bonus, but the real win is that
the water is clean and tastes great. St. Paul water even beat out 15 cities to win the 2016 Great Minnesota Tap Water Taste Test.

St. Paul is a great example of what advanced technology can do to improve water quality. The researchers are hoping to build on what’s been done in St. Paul by working with other utilities around the state and beyond.

ONE RIVER,
TWO CITIES,
FOUR RESEARCHERS,
EIGHT CHEMICALS OF EMERGING CONCERN,
MILLIONS OF BACTERIA

Hozalski is the primary investigator on this project, but he has a great team working with him to address all the interconnected parts. The key players from the University include Ben Ma, a graduate student in environmental engineering; Professor Tim LaPara, an expert on bacterial communities; and Professor Bill Arnold an environmental chemistry expert.

Sometimes, in the course of trying to solve practical water quality problems like the taste and odor issue, novel scientific discoveries are made. In 2006, Hozalski and his team made such a discovery in the St. Paul GAC filters. LaPara explained, “We had assumed the microbes in the system were going to cycle carbon, but it turned out the majority of the bacteria were actually cycling nitrogen, which was unexpected.” The conventional knowledge is that ammonia oxidation is a two-step process: it goes from ammonium to nitrite, and then from nitrite to nitrate, and different organisms are responsible for each step. In St. Paul, the researchers found only one of the expected organisms was present, the one responsible for that second step. That had not been seen before. They published the discovery about this novel situation, proposing that there was a novel organism doing that first step, processing ammonium to nitrite. Very recently researchers from Europe demonstrated that the organism detected in St. Paul’s biofilters was responsible for doing both steps itself. Environmental researchers had not seen this in the 150 years of microbiology studies.

Hozalski and his team are hoping to build on what’s been done in St. Paul and to discover a similar solution for Minneapolis. It will not be a simple repeat, however. The Minneapolis project presents several new challenges.

System Inputs
The water supply in Minneapolis is somewhat more challenging to treat than the one in St. Paul. Although both cities ultimately get their water from the Mississippi River, the St. Paul supply is passed through a series of lakes before entering the city water treatment facilities. The lakes act as natural settling basins, which results in pretty clean and consistent input into the city’s water works.

In Minneapolis, water is taken directly from the Mississippi River to the Minneapolis Water Treatment and Distribution Services (MWTDS) system. The urban river gets a lot of runoff from rain and snowmelt, and consequently the levels of particles and dissolved constituents vary over time. This variability in the MWTDS water source requires more diligence and more monitoring to maintain a consistent quality of drinking water.

Biological Community
Different water, of course, means a different biological community. One of the first steps in Hozalski’s current research project is to assess the water in the MWTDS and determine what bacteria are present. LaPara likens his role to that of the FBI doing DNA forensics. LaPara gathers the DNA from the water, tracks down which bacteria are present, and determines the role each of the bacteria play in the situation.

Says LaPara, “Our techniques differ from what the FBI uses because they are tracking only a finite number of people, but when tracking down bacteria, there can be thousands of them at one time. Studying the DNA of bacteria allows us to tell with great detail which bacteria are present in a water sample.”

A common misconception is that all microorganisms are harmful, and the standard approach in water purification has been to kill everything in the water. “In fact,” says LaPara, “it is not easy to say that this bacterium is good and that one is bad. Overwhelmingly bacteria are benign or neutral; in truth, there are as many helpful and essential bacteria as there are harmful ones. We are moving toward using or cooperating with microbes rather than simply wiping them out. That idea can scare people a little bit. We need to communicate the beneficial potential of these microbes.”
Emerging Concerns
The researchers are confident that GAC biofilters will maintain MWTDS water quality while improving the taste and odor of the water. Beyond that, they will be investigating additional potential benefits of the new treatment process by exploring how well the filters capture contaminants of emerging concern (CECs).

Most of the so-called CECs have been present in the environment for a long time. New analytical chemistry tools have allowed researchers to discover how widely these chemicals have spread throughout our environment. Concerns have been raised about the proliferation of these contaminants, although at this time, no associated health problems have been documented and, except for a few specific cases, no requirements have been established limiting levels of these chemicals. Environmental engineers, like Arnold and Hozalski, are interested in tracking these substances. In this project, the team hopes to establish a method for reliably controlling the presence and levels of CECs. In this study, eight particular chemicals are being studied to determine if the GAC biofilters help to control those trace contaminants, too.

CECs were selected based on their probability of ending up in the drinking water supply: contaminants from agriculture (focusing on herbicides), from wastewater (pharmaceuticals and personal care products), and from urban/suburban runoff.

Arnold and graduate student Ben Ma worked together to develop the protocol for extracting and analyzing the chosen CECs. They were able to build on the work of another graduate student, Jill Kerrigan, who had developed a number of those procedures.

Environmentally-relevant Levels
For this research project, the chosen CECs are being added to a pilot-scale treatment system (not to the city water!). The chemicals are introduced at very low levels, levels at which they might actually occur in the environment.

Professor Bill Arnold: “This project is unique in that a number of chemicals are being tracked, and they display a range of chemical properties. The project is also attempting to track these chemicals at the low levels found in the environment. The low levels of contamination make the analysis a little harder (researchers often add in larger amounts of a substance to make the lab work easier), but our process will allow us to more closely model what happens in reality and will make the results practical.”

“Because we are studying compounds at such low levels, we have to start with 1-2 liters and concentrate it. When concentrated, other elements that we do not want to analyze also get concentrated, like organic matter. So then a clean-up step is necessary. We take our cleaned samples to the Masonic Cancer Center, to quantify the CEC levels using a liquid chromatography tandem mass spectrometer. We have used this process to study triclosan in Minnesota lakes, to study estrogens, and for a study of contaminants in San Francisco Bay sediments. The analysis is very sensitive and very specific and helps us track chemicals in very small amounts.”

Raymond Hozalski values projects that involve partnership with city water utilities for the connections and process as well as for the ultimate outcomes. “When doing research with the city utilities, we have real impact on a lot of people. The Minneapolis Water Treatment and Distribution Services affect not only Minneapolis, but also the suburbs, that’s around 500,000 people.

“Working with the city utilities also offers the great benefit of being in the water treatment plant regularly, getting to know the details of the plants and the challenges they face. I bring that experience back into the classroom, where it has been hugely helpful in educating the students, particularly in the water and wastewater classes.”

George Kraynick, manager of the Water Quality and Laboratory Services in Minneapolis, also values this partnership. “This collaboration allows us to tap into UMN’s expertise. The research being done on biologically active filters and CEC removal is relatively new and cutting edge science and will be beneficial to the City of Minneapolis and the water industry as a whole.”
October 2, 2015
Dexter Lecture

GREGORY G. DEIERLEIN
Civil and Environmental Engineering, Stanford University
“Simulation of Ductile Fracture Initiation in Steel Structures with Applications to Seismic Design”

This annual lecture and scholarship honors former UMN professor, Robert Dexter.

Greg Deierlein has degrees from Cornell, University of California, Berkeley, and University of Texas at Austin. He now teaches at Stanford where he is the John A. Bloom Professor and Director of the John A. Bloom Earthquake Center. He is also a member of the National Academy of Engineering.

Deierlein summarized recent research on continuum-based fracture mechanics, where cyclic void growth models are used to assess fracture initiation under large scale cyclic yielding. The models are implemented through finite element analyses and validated through a series of tests on notched axial bars, compact tension specimens, and large scale steel subassembly tests of braces and column base connections. He also described practical engineering applications. Deierlein chose to speak on this particular topic, in part, to honor Bob Dexter’s contributions in this area.

October 23, 2015
Vardoulakis Lecture

JAMES R. RICE
Earth and Planetary Sciences, Harvard University
“Heating and Weakening of Shear Zones in Landslide and Earthquake Mechanics”

This annual lecture honors the legacy of former UMN professor, Ioannis Vardoulakis.

Jim Rice is an international leader in the area of mechanics related to problems in material physics, in civil, environmental, and geo-engineering, and in earth sciences, particularly applied to seismology and the science of earthquakes. He has made major contributions in several areas, especially in crack propagation and earthquake studies. Rice is a member of the National Academy of Sciences and the National Academy of Engineering. Above all this, he is a helpful and inspiring teacher.

Rice acknowledged Ioannis Vardoulakis as a friend and fellow scholar, saying Vardoulakis stood out as he avidly advanced the science of both landslide mechanics and earthquake mechanics when researchers on either side seemed to be ignorant of developments in the other field. Rice followed Vardoulakis to explain narrow shear zone development as a thermo-hydro-mechanical process in granular media, enveloping principles from both earthquake and landslide mechanics.

View the full presentations on the Warren Lecture Channel on YouTube.
Spring 2016

Since 1989, the Warren Lecture Series has been bringing accomplished scholars from around the world to share their work with students, faculty, and friends of the Department of Civil, Environmental, and Geo-Engineering. This spring, the lecture series experienced a few updates.

In January 2016, the Warren Lecture Series moved to a new time, 10:10 a.m. on Friday mornings. This new time fits well with graduate seminars held on Fridays and allows more students and retired friends to attend. Lectures still meet in the George J. Schroepfer Conference Theater in the Civil Engineering Building. Recordings are available via YouTube on the Warren Lecture Channel.

The Warren Lecture Series is made possible by a generous, renewing gift given by Alice Warren Gaarden in 1961.

Upcoming in April and May

APRIL 1  KEN CHRISTENSEN  
   Aerospace and Mechanical Engineering,  
   University of Notre Dame

APRIL 8  RAMESH GOEL  
   Civil and Environmental Engineering,  
   University of Utah

APRIL 15 ADARSH KRISHNAMURTHY  
   Mechanical Engineering, Iowa State University

APRIL 22 THE SEHLIN LECTURE: SHARON L WOOD  
   School of Engineering, University of Texas at Austin

APRIL 29 DENNIS KOCHMANN  
   Engineering and Applied Science,  
   California Institute of Technology

MAY 6 JEROME P. LYNCH  
   Civil and Environmental Engineering,  
   University of Michigan

Recorded Presentations

JANUARY 22 MARTIN OSTOJA-STARZEWSKI  
   Mechanical Science and Engineering,  
   University of Illinois at Urbana-Champaign  
   “Randomness in Mechanics of Materials”

JANUARY 29 MARK BENJAMIN  
   Civil and Environmental Engineering,  
   University of Washington  
   “In Search of the (Membrane) Holy Grail: A 20-Year Journey”

FEBRUARY 5 ELIZABETH A. BARNES  
   Atmospheric Science, Colorado State University  

FEBRUARY 19 DAVID H. TIMM  
   Civil Engineering, Auburn University  
   “Long Life Pavement Design - The Road to a Sustainable Future”

FEBRUARY 26 MICHELE GUALA  
   Civil, Environmental, and Geo-Engineering, University of Minnesota  
   “Extracting Energy from Wind and Water: Influence, Manipulation and Control of Boundary Conditions”

MARCH 4 JAMES R. CRAIG  
   Civil and Environmental Engineering, University of Waterloo  
   “Towards More Trustworthy Hydrologic Models: Evaluating Model Choices and Learning from Data”

MARCH 11 ALFRED SPORMANN  
   Chemical Engineering and Civil/Environmental Engineering, Stanford University  
   “Microbial Life by Reductive Dehalogenation”

MARCH 25 BLAISE A. BOURDIN  
   Mathematics, Louisiana State University  
   “A Phase-field Hydromechanical Model of Reservoir Simulation”

Recordings are available on our website at www.cege.umn.edu.
Passionate about engineering is an apt descriptor for these two recent graduates from Civil, Environmental, and Geo-Engineering. Lindsay Gaines (right) and Shelly Matsuda (left) both graduated in December 2015 and both found a good fit in the Surface Transportation Division of TKDA, a company that strives to hire people who are passionate about engineering.

Gaines has a passion for traffic engineering that started when she attended a seminar on autonomous vehicles and Intelligent Traffic Systems. “That was really interesting, and autonomous vehicles are just super awesome! It seemed that transportation would be a field in civil engineering that would be growing—not just in the sense of job security, but also in the sense of new technologies coming out and the whole infrastructure changing with the onset of autonomous vehicles.”

“I landed an internship in a traffic department and worked on traffic studies and traffic safety. I learned some software programs that are used in the industry (Microstation, Synchro) and discovered I really like using fancy software. After that, I was committed to roadways and traffic.”
Matsuda became fascinated with bridges in high school while researching occupations. “My whole senior year I shadowed a structural engineer in Oahu, Hawaii, where I am from. For my honors program, I studied the Sydney Harbor Bridge. I made a model with K’NEX and presented my research. I had to explain why it was a good design and how civil engineers work to figure out good designs. That experience sparked my interest in civil engineering and convinced me that I wanted to work on bridges. In the process, I came to really appreciate the beauty of bridges and the engineering that goes into them. I get a little geeky about it!

“I first met Kevin Cullen, the Vice President of TKDA’s Surface Transportation Division, at a career fair at UMN. I walked up to TKDA’s booth and announced, “I love bridges and I want to be a bridge engineer!” I went back the next year and he remembered me. I guess I stuck in his head because of my declared love for bridges! When there was an opening in the TKDA bridge department, Kevin contacted me and I started working here the next summer. I got lucky in that I got to work in my chosen niche almost immediately after graduating.”

Matsuda works in the Bridge Group, and Gaines works in the traffic subset of the Highway Group. Both are currently involved in the expansion of Highway 610. TKDA is handling design and construction on this large, complex project.

Gaines has been working with Jeff Hilden, PE, on maintenance of traffic (MOT) signage for the highway project. “We put together plans for where to place signs for lane closures and detours and where to place barrels to keep traffic flowing. I have also been working on signal plan sheets, which show where all the pedestals should go and what should be placed on the signal poles (push buttons, etc.). I’m also working on wiring plans for Hwy 610 and some other projects, including a trail.

“I’ve also been modeling intersections in a software called Synchro, which helps us see what the traffic impacts will be when we make lane changes. That is what I did for my CEGE Capstone project, and it has been really helpful to my day-to-day work. I first learned Synchro in a traffic class with Prof. Gary Davis; he gave us really good Synchro projects. I am now the resident Synchro expert!

“On the Hwy 610 project, I was modeling a lane drop on a county highway (CSAH 81) that connects to Hwy 610 to see what the traffic impact would be. I work with a Professional Engineer who checks my work. There is a cycle: do some work, get it checked, do more work, get it checked, do more work, get it checked—even more than in school.”

Matsuda and Gaines offered the following advice for students still studying in CEGE:

Look around. Notice roads and buildings and how they are built. Watch construction sites and see how things are built. You need to know how construction works.

Learn software. Any experience is helpful. You need to become comfortable learning software because it keeps changing.

Take advantage. There are so many opportunities at UMN; take a variety of classes outside of engineering and take advantage of the variety of activities available in school. It helps make you well rounded and interesting.

Do an internship. It is way easier to get a job when you have that experience.
Without your financial support, CEGE could not do our essential work of preparing and inspiring engineers to advance infrastructure, protect the environment, and responsibly use earth resources for the benefit of society. Thank you to our generous financial supporters!

Jose I. Adachi
Rolf F. & Doris E. Amundson
Rhonda Amundson
David M. Anderson
Scott M. Anderson
Reynold M. Anderson Sr. & Betty Anderson
Yelena Anger
Diego S. Arabbo
William A. & Lora Arnold
John K. Arntson
Leonid Astashinsky
Wenjin Bao
Andrew & Sarah Bardwell
Jennifer Bean Popehn & Nicholas Popehn
Matthew W. Beckman
Eric J. Berg
Amanda R. Bergstrom
Lanny R. Betterman
Matthew A. Beyer
Peter R. Bjornberg
Mark P. & Katherine M. Board
John M. Bratt
Patrick L. & Carol Brezonik
William C. & Marlee J. Brice
Tara Brock
James C. & Edith Broten
Bernie & Lee Bullert
Tucker R. Burch
Christopher N. Call
Colin C. Campbell
Rafic C. Chehouri
Chan Lan Chun & Tsutomu Shimotori
Brian A. Cochran
H. Richard & Faith Coleman
Steven E. Collin
Ronald N. Conrad
Sean C. Cotton
Glen C. Coudron
Henry C. Croll
Jaek J.K. & Agnes Daemen
Bruce H. Dahlquist
Edward J. De La Forest
Curtis D. DeGidio-Scott
Robert L. Degroot
Rachel E. Deitzman
Donald O. Dencker
Robert H. Denkmann
Gary P. Dirham
Terrence R. Dobie
Daniel Doenges
Daniel L. Dorgan
John H. Downs
Samuel J. Duncan
Lloyd A. Duscha
Collette Earley
Craig L. Ebeling
Craig R. Eckdahl
Thomas J. & Mari Oyanagi-Eggum
Tracy L. Ekola
John R. Ellis
Daniel R. Engstrom
Ronald B. & Barbara Erickson
Mark H. Fairbairn
Craig Falkum
Jeffrey T. Faragher
Jessica L. Felix
Jacob E. Finkler
Sonny J. Fite
Edward J. & Mary C. Fleege
Donald J. Fleming
Thomas F. Foley & Ann Dunn-Foley
James L. Freeman
John M. Friel
Noa J. Funk
Theodore V. & Barbara A. Galambos
Amanda Gallagher
William D. Gmiterko
Douglas A. Gordon
Thomas G. Grannes
Louis P. Gravel III
Robert J. Green & Erin L. George
Stephen J. Greenwood
Alina Grigorescu
Mark S. Gronberg
Lawrence W. Gubbe
John & Karen Gulliver
Joseph A. Gustafson
Craig B. Haas
William H. Hall
Anita J. Hall-Frost & Larry A. Frost
Ken W. & Suanne B. Hallberg
Yanhu Han
Jeffrey L. & Judith A. Hansen
Eric C. Hanson
Mark D. Hanson
Ray H. Harlo
Victoria M. Harris
John & Paula Hartley
Sharon Hartsuiker
Nathan A. Hauer
Rosann Hebert
Derek A. Heinecke
Gordon E. Heitzman
Susan J. Hellstrom
Gregory L. Hempen
Leo H. Hermes
Richard D. Herold
Michael M. Heuer
Robert D. Hietala
George H. Hill
Mark & Jean Hindermann
Bruce J. Holdhusen
Mary & Tom Holewinski
Robert J. Holt
Richard A. Hoppenrath
Carol A. Hoskins
Mark W. Hostetter
John R. Hotvet
James E. Howley
Yuying Hu
Robert F. & Mary C. Huber
Laurel J. Hunt
Charles T. Jahren
Jeffrey D. Jeremiason
James A. Jessop
Suzanne D. Jiwani
Dennis J. Johnson
Jeff L. Johnson
Roland V. Johnson
Timothy C. Johnson
Ruth V. Jones
William & Elizabeth Kallberg
Timothy S. Kamenaar & Janelle Rietz-Kamenaar
John M. & Elizabeth L. Kannas
Zachary J. Kartak
Jesse A. Kasim
Chad T. Katzenberger
Lyle G. Keller
Richard S. Kitty
Richard J. Kloskin
Emily M. Knudston
Harold R. & Ida L. Kokal
Catherine A. Kray
Osamu Kudo
Christopher LaBounty
Joseph F. & Kimberly A. Labuz
William J. Laferriere
David E. & Arlene Langseth
Timothy M. LaPara
Scott S. LaVoy
Gregory H. Lefevre
Kristine Legler-Kaplan & John C. Kaplan
Ernest N. Lindner
Brian & Kay Lokkesmoe
Kent M. & Jacquin Lokkesmoe
Howard & Mary Lou Loomis
John V. Loperfido
Thomas & Elizabeth Lorentz
Gary L. & Ronda J. Lovelace
Election to the National Academy of Engineering (NAE) is among the highest professional distinctions awarded to an engineer. Emmanuel Detournay received the honor for his major advances in hydraulic fracturing and drilling dynamics.

A faculty member at the University of Minnesota since 1993, Detournay holds the Theodore W. Bennett Chair in Mining Engineering and Rock Mechanics. Detournay directs a comprehensive research program aimed at developing rigorous reference solutions and robust numerical methods for hydraulic fracturing, as well as pioneering work in drilling dynamics.

Another major area of Detournay’s work is found in the analysis of poroelastic effects in various geomechanical problems, such as hydraulic fracturing, reservoir mechanics, and material characterization. His research in coupled thermo-chemo-hydro-mechanical processes led to the development of a new technique for measuring thermo-hydraulic rock properties in their original location. Detournay also spearheaded a research program to develop the patented Portable Rock Strength Device and a methodology to infer the strength of porous rock from this “scratch” test. This technique is now recognized as a standard in the petroleum industry.

Detournay is the fifth NAE member from the Department of Civil, Environmental, and Geo-Engineering, joining Steven Crouch (Professor and Dean), Peter Cundall (Adjunct Professor), Charles Fairhurst (Professor Emeritus), and Ted Galambos (Professor Emeritus).