FALL 2019

CBEUPDATE

CHEMICAL & BIOMOLECULAR ENGINEERING

Graduates as Leaders & Innovators

In This Issue:

Big Top to Rocky Top / Building Bridges to the Future of Modeling / Senior Design Showcase / DOE Fuel Cell Project

Lighting the Way: 225 Years of Volunteers

UT will spend the 2019–20 academic year celebrating our 225th anniversary

CBE UPDATE CONTENTS

FEATURES

Big Top to Rocky Top **2**
Former Circus Aerialist Jessica Ossyra Graduates

Building Bridges to the Future of Modeling 4
Manolis Doxastakis Focuses on Process over Product

Rhodes Less Traveled 6
Grant Rigney Selected as a Rhodes Scholar

Chase Toth 8
2019 Torchbearer

Annabelle Large 10
Lands Fulbright Adventure to Sweden

Shining a Light on Hard Work **12**
The McKinley Scholarship Provides Opportunity for CBE Students

Senior Design Showcase **15**

Zawodzinski to Lead DOE Fuel Cell Project 16
Project Leverages Renewable Energy over Long Periods

DEPARTMENTS

A Message from the Department Head 1

Staff Spotlight: Kerri Cline 11

2019 CBE Department Awards 14

Faculty Notes 18

Student Notes 19

Alumni Notes 19

2019 Hall of Fame Inductees 20

In Memoriam: Charles Shaw 21

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A MESSAGE FROM THE DEPARTMENT HEAD

Chemical and Biomolecular Engineering (CBE) at the University of Tennessee in Knoxville (UT) maintained another year of positive momentum during academic year 2018-2019. Our students, faculty and staff have been very productive at all aspects of education, research and service, with 87 new BS degree graduates and 18 PhD and MS students leaving our department to join international corporations, academic institutions, national laboratories, and highly reputable graduate schools. Many of these students have left UT with highly competitive honors, such as a Fulbright Scholar, a Rhodes Scholar, a Goldwater Scholar, a UT Torchbearer, and so on. (You can read about these students herein.) Our research profile continues to ascend, with expenditures and publications likewise rising to historic levels, and a new ranking of our graduate program within the top 40 public academic institutions nationwide.

The department's research profile continues to ascend, with expenditures and publications both reaching record highs this past year: $6.7 million in research dollars and our number of ISI indexed refereed publications is at 314.

In spring of 2019, the CBE Department added three new members to its Hall of Fame, which was instituted in 2016 to honor former students and faculty members who have made memorable contributions to our department, the university, the State of Tennessee, and the world at large. Joining former inductees this year were Prof. Emeritus Charles Moore, who taught in CBE for more than 50 years, and two of his former students who went on to highly successful industrial careers, James Downs of Eastman Chemical Co. and Virginia Butler, recently retired from the UT Health Science Center. More details concerning the new inductees can be found within these pages.

As I close this year's message, I want to take the opportunity to sincerely thank all of our alumni, donors, and corporate sponsors who have continuously supported CBE over the past years to enable the tremendous growth that you can read about in this report. For your generous help, we are continually grateful and feel blessed to have such a talented and highly motivated group of constant supporters at our back. Thanks to each of you, our vigorous expansion that began way back in 2006 has continued unabated, in terms of teaching, research, and impact. With each passing year, our footprint gets larger as we march into the future. Thank you for your support.

Bamin Khomami
Granger and Beaman Distinguished University Professor
Head, Department of Chemical and Biomolecular Engineering

From Big Top to Rocky Top

> “At the end of the day, it gets back to the Volunteer spirit, because I don’t know how I would have done it without volunteers helping me.”

Ossyra Embodies Volunteer Spirit

By David Goddard. Photography by Steven Bridges.

Many college students celebrate graduation by traveling or having a grand adventure—something that will let them see the world from varying perspectives.

Jessica Ossyra has been there, done that.

Ossyra, who graduated with a bachelor’s degree in chemical and biomolecular engineering in May, has already visited all 50 states and 30-plus countries thanks to her time as a circus performer.

“My uncle was a lawyer in Chicago for more than a decade when he decided to run away and join the circus,” Ossyra said. “I was very young when he did this, so I always had an uncle in the circus. My mom was a teacher, so during the summers off from school, we’d travel and visit him. We were able to see the country, earn a little summer money selling toys and concessions, and—best of all—learn how to perform.”

Ossyra said she traveled with the circus for three years, performing aerial stunts, riding elephants, serving as a magician’s assistant, climbing ropes, swinging from ladders, and helping to set up rigging and take down tents.

“It was an incredible experience,” she said.

Being a circus performer may not have been typical college preparation, but Ossyra said her time in the big top taught her the value of teamwork and showed her how to view the world in broad strokes—skills that helped her succeed on Rocky Top and promise to serve her well as she begins her career working as an engineer for Diageo at its Captain Morgan rum distillery in Christiansted, Saint Croix.

After leaving the circus in 2008, Ossyra earned a bachelor’s degree in animal science and biotechnology at the University of Illinois. She got married, had a child, and moved to Tennessee.

She said she chose chemical engineering because she enjoys lab work and was intrigued by the role the field plays in manufacturing.

Ossyra said she’s been impressed that the Volunteer spirit is something people take to heart. People like her, for example.

In spring 2019, she received the Leadership Legacy Award from the Division of Student Life for her service to the campus and the Knoxville community, was named the Society of Women Engineers Pathfinder Award winner for her commitment to the professional and personal development of her peers, and was part of her department’s winning team in the inaugural Tickle College of Engineering Integrated Engineering Design Showcase, claiming honors for the Most Creative Project as well as the People’s Choice Award.

She has helped with WomEngineers Day, a biennial conference where female students talk about how they can leverage networking opportunities and perpetuate a culture of inclusivity in academia and industry.

“WomEngineers is about introducing essential life skills to go along with what you learn in the classroom,” she said. “I tried to stress the importance of those topics to students while at the same time encouraging them to meet with the alumni and board of advisors members who took part in the panels. Students need to realize that they will have perhaps no greater allies than alumni who have come before them and want to see them succeed.”

In the classroom, she has been a prolific worker, producing publications, giving presentations, and even sharing her research at high-profile events like Posters at the Capitol in Nashville.

She has also served as a mentor with UT’s Office of Undergraduate Research, sharing her research experiences with undergraduate students and encouraging them to seek out opportunities.

Within her department, Ossyra has become a member of the American Institute of Chemical Engineers and has served as a teaching assistant in the Eastman Unit Operations Laboratory.

The former circus aerialist admits it’s taken some juggling to make it all work.

“My son, John Emerson, has become a familiar face around here,” she said. “Everyone knows him, and people have pitched in to help watch him when I’ve had tests and things like that. In turn, it has helped him develop a love for UT and a love for the community that comes with it. He was even recognized at our annual SWE awards banquet for his participation in events.”

“At the end of the day, it gets back to the Volunteer spirit, because I don’t know how I would have done it without volunteers helping me.”

Building Bridges to the Future OF MODELING

By Meghan McDonald. Photography by Shawn Poynter.

Computers have come incredibly far, incredibly fast. But when it comes to solving problems in the realm of chemical and biomolecular engineering, there's a significant gap between where they are and where Associate Professor Manolis Doxastakis sees them heading over the next few decades. His research in multiscale computational modeling is building bridges between what exists and what's possible.

"Computers are still very limited in being able to directly, automatically predict macroscopic properties of materials using a single technique and information such as their chemical composition," Doxastakis explained.

That's where multiscale modeling comes in. "It is like a tool box," he said. "You can't use one tool for all jobs. In the same way, there are very different computational techniques to address the behavior of material over different scales of time and length. We bring them together to start from atoms and reach all the way to observed macroscopic properties."

The data derived from probing a material with one technique, at the smallest scale, becomes part of the input for another technique, which then examines the material at the next scale up.

Doxastakis calls this process "building bridges," and through it, he and partnering research teams around the globe can build a much fuller understanding of the mechanisms that underlie specific material properties—the "why" beneath the "what" that can be observed in lab experiments. Through this modeling, researchers can interpret lab results, determine if surprise findings are due to noise in the data or if they're worth follow-up research, and design new materials to achieve specific properties.

"If you don't know why, it's hard to make a new material," Doxastakis said.

The big picture, though, isn't creating a new material. It's creating ever better models. "The 'holy grail,' what we would like to have, is predictive models. Computers that will be able to predict everything and design our materials without even needing to do the experiment," he explained.

His current research includes modeling the design of new elastomers for the automotive industry and improved processes for patterning semiconductors. For the latter, he's working to better understand how small molecules diffuse in the thin films of polymer used to create patterns. As computer chips get smaller and more powerful, semiconductor patterning requires virtually perfect lines.

"There is the experimental approach of trial and error," he said, "or you can create models. We would like the computer to be able to predict what kind of compound we should use for patterns with much higher fidelity."

As Doxastakis focuses on process over product, he is, in a sense, building a bridge between academia and industry. "Being able to have an eye on what industry does and have a view of what is interesting from industries' perspective is very important," he said.

Computational modeling research rarely receives industry backing—it seems too far removed from the point of application. Yet both Doxastakis' elastomer and semiconductor research projects have industry support. The hope is that after he and his collaborators shepherd these projects to a level of maturity, industry researchers will take them the rest of the way to application.

As computational modeling matures, it also attracts more attention from students. Today's digital natives have a much better grasp on how this method can impact lives and industries.

"The job market for people with computational modeling skills will only increase," Doxastakis said. "We just need to get to the last stage—adoption of the modeling by the industries. Then employers will start asking for people with these skills."

In the meantime, the research of Doxastakis and his colleagues as well as the international groups they work with, will continue to build bridges—between scales and computational techniques, between current capabilities and the potential to engineer anything from a new tire to a new medicine using predictive models.

> "The job market for people with computational modeling skills will only increase."

Rhodes Less Traveled

By David Goddard. Photography by Steven Bridges.

Grant Rigney (ChemE, '19) already had a list of honors and rolls to his name when the fall 2018 semester was drawing to a close. Before it ended, he discovered his selection as a Rhodes Scholar—an incredibly humbling honor.

"I would not have been able to do this without a lot of help along the way, so I want to thank all of the faculty members, staff, students, and researchers I've been fortunate to work and study with," Rigney said. "Knowing about the list of other Rhodes Scholars who have come before me is both daunting and inspiring, and I can't wait to get started."

While the list of previous winners from around the world includes notable names in politics, entertainment, and law, Rigney has his sights set on using chemical engineering to find better outcomes and reduce suffering during treatment for medical patients.

Specifically, he is exploring the use of phase transfer catalysts to measure how a patient's body responds to procedures such as positron emission tomography (PET) and computerized tomography (CT) scans.

Getting a better picture of what such devices do to specific patients may allow for treatments to be tailored on a case-by-case basis, improving care.

That sense of empathy developed at an early age and has remained through his time as a student, leading him to get his nurse's license in high school, shadow physicians, and develop a clear path toward his future.

"Eventually, I'd like to be a surgeon, specifically in a facility or area that helps improve healthcare for vulnerable patients such as the elderly or in economically depressed areas," Rigney said. "To get hands-on clinical experience, I went to night school while in high school to get licensed as an assistant nurse, which helped me get a job at an assisted living facility the summer between high school and my first year of college. It helped me see healthcare from a different perspective."

Rigney said he took an interest in helping others after he and his mom formed a friendship with a less-than-fortunate man in his hometown of Normandy, Tennessee, an experience that showed him the disparities and challenges that some face.

More recently, he has honed his medical skills as an intern at Harvard Medical School and Massachusetts General Hospital.

Not bad for someone who was once fearful of hospitals and surgery.

"I was really scared of operating rooms, hospitals, all of that when I was growing up," Rigney said. "I got an anatomy book as a gift, and that changed everything. It really opened my eyes to all the possibilities in medicine."

His Rhodes experience began following graduation in May with all-expenses-paid studies at the University of Oxford in England, where he plans to obtain master's degrees in both global health science and epidemiology and in evidence-based social intervention and policy evaluation.

Rigney was initially drawn to UT because of the Haslam Scholars program.

"It offered me opportunities I wasn't likely to get elsewhere and gave me the chance to be part of a smaller group of motivated and driven people," he said.

Rigney was also a Neyland Scholar, the editor in chief of Pursuit, UT's journal of undergraduate research, president of the Student Alumni Associates, and a member of UT's Alumni Board of Directors. He volunteered at Inskip Elementary School and the Fifth Avenue Clinic, and he co-founded UT's Homeless Prevention University and Community Alliance.

He is also a licensed pilot, a triathlete, and an accomplished musician who plays the fiddle and mandolin, having played in his family's bluegrass band at more than 400 concerts across the country and abroad.

A graduate of Tullahoma High School, Rigney is just the eighth student to earn the honor at UT, joining **Bernadotte Schmitt** (1905), **Matthew G. Smith** (1911), **Arthur Preston Whitaker** (1917), **William E. Derryberry** (1928), **Nancy Ann Min DeParle** (1979), **Jennifer Santoro Stanley** (1995), and **Lindsay Lee** (2014).

> “I’m excited to solve problems and innovate in all that I do, especially as a physician.”

2019 TORCHBEARER

CHASE TOTH

Writing and photography by Randall Brown.

Recent CBE graduate Chase Toth received a huge surprise during one of his spring semester classes. Vince Carrilli, vice chancellor for student life, walked in to recognize Toth as a 2019 Torchbearer, the university’s highest student honor.

He was one of only seven seniors across the university to be named Torchbearer, and this year’s sole engineering recipient. The award is bestowed for academic achievement, leadership, and outstanding service.

“It was great to celebrate with some of the people I admire most at UT,” said Toth. “It’s a special moment I won’t readily forget and a true honor.”

Toth, a Knoxville native, is an NAE Grand Challenge Scholar and is in both the Cook Grand Challenge Honors and Chancellor’s Honors programs. As a student coordinator for the VOLbreaks program, he has led student groups on trips to engage in hands-on, direct service while exploring the root causes of homelessness and poverty, along with sustainability practices

He also served as an Ignite team leader and student director, a member of the Leadership Knoxville Scholars program, and participated in activities through the Center for Leadership and Service. Toth tackled his undergraduate degree in chemical engineering while maintaining this level of Volunteer spirit.

“To be quite honest, chemical engineering is tough,” he said. “There were some moments along the way where I questioned whether I had chosen the right major. However, I am extremely thankful to my professors for getting me through, and I’m proud to have survived ChemE.”

Over the summer, Toth applied to medical school and served as an intern in the office of Congressman Jim Cooper in Washington, DC.

“I think the internship is a unique experience to learn about and see how policy work has a place in my career as a physician and community leader,” he said. Likewise, the Cook Grand Challenge Honors program gave him opportunity to explore ways that engineering solutions can improve medical treatment and the healthcare system as a whole.

“Just as ‘Vol’ is a verb, so is ‘engineer,’” said Toth. “The Cook Grand Challenge offered numerous ways to serve as an engineer through my study abroad in China, to do my research, to serve in the community schools of Knoxville. I’m excited to solve problems and innovate in all that I do, especially as a physician.”

He looks for ways to address public health in the Knoxville community with an engineering mindset.

“I’ll be staying in Knoxville over the next year after my internship in DC, and I’ve been networking with organizations to see where I may be a good fit and where I might fill a need,” said Toth. “I’ve considered AmeriCorps, Great Schools Partnership, and spending some more time in a healthcare system. Knoxville has offered me so much, and I am looking forward to the opportunity to stick around for another year.”

He plans to stay involved with the UT community and find ways to serve the city. Down the road, he hopes to practice medicine in a city similar in size to Knoxville.

“I think it’s big enough to have everything you could ever want while also being small enough where you can make a difference,” said Toth. His ongoing interest is in emergency medicine and working to advance health equity for vulnerable populations.

“Again, engineering is a way of thinking that I intend to utilize in all of these future endeavors.”

Annabelle Large Lands Fulbright Adventure to Sweden

Writing and photography by Randall Brown.

Annabel Large has a trip to Sweden planned for September as a 2019–2020 Fulbright Scholar. The chemical engineering major will work on a 10-month collaboration between ORNL and the Swedish University of Agricultural Sciences (SLU) in Alnarp.

Large will return stateside afterward to tackle the joint bioengineering PhD program at the University of California at Berkeley and UC San Francisco, and eventually work in research.

"My career goal would be to become a staff scientist at a Department of Energy national laboratory," she said.

The Jonesborough, Tennessee, native built a firm foundation for Fulbright and beyond during her time as an Engineering Vol. She worked with Assistant Professor Steve Abel on computational modeling and simulations of the cell membrane between 2015 and 2017, and took the summer of 2016 to enjoy a summer research experience looking at protein engineering and structural investigations of caffeine enzymes at the University of Alabama.

"I've generally been working in the space of bioengineering, with both wet-lab and computational experience. Perhaps what's unusual about my research experience is that I took a co-op year after my junior year to pursue two full-time research appointments," she said.

Her co-op rotations included time at Lawrence Berkeley National Laboratory working with automation and scale-up of synthetic biology experiments and, closer to home, handling bioinformatics and large-scale data analytics at ORNL. She settled back into the UT Knoxville campus for the spring 2019 semester and maintained a part-time position at ORNL while capping off her senior year.

Large already has experience with her future Swedish colleagues via a collaboration through her group at ORNL.

"I'm going to apply the techniques and knowledge I've gained while at ORNL to a different project under the guidance of Erik Alexandersson, a professor at SLU," Large said. "So, some of the same skills from ORNL, but different research focus and high potential to learn new skills."

The Fulbright will also allow her to pursue at least one of her favorite pastimes.

"I enjoy traveling (clearly—ha, ha), coffee, and caring for my two hamsters," said Large. Her hamsters, with the coffee-friendly names of Arabica and Robusta, will have to stay home in Tennessee while she is in Sweden. "Hopefully, I'll get to bring them with me to California. That's for a later life-planning session, though."

The Fulbright program is the flagship international educational exchange program sponsored by the US government and is designed to increase mutual understanding between the people of the United States and the people of other countries. The program was established in 1946 under legislation introduced by late Senator J. William Fulbright of Arkansas. It is sponsored by the US Department of State's Bureau of Educational and Cultural Affairs.

Staff Spotlight: **Kerri Cline**

Writing and photography by Randall Brown.

Kerri Cline helps students craft their course schedules as the academic advisor for CBE, but that is only a small portion of what she does.

"I also plan events in the department for our students, such as a sophomore information session and the graduating senior ice cream social," said Cline. "I am currently on the TCE Orientation Committee, as well. My favorite aspect of this position is having the opportunity to listen to students, help them overcome obstacles, and see them reach their academic goals."

Students can come to see Cline for all of their CBE advising needs, even some unexpected ones.

"You can also come see me if you need a Tide pen or other random things that I always keep on me," she said. "I guess after being a mom-on-the-go, I am prepared for anything. I have pulled out the Tide pen before for a student who dropped food on his tie once and was getting ready to go to the Engineering Expo."

Cline is "pretty good" at troubleshooting in Banner, if faculty or fellow staff might run into an issue, and also enjoys working in Argos. Originally from Beckley, West Virginia, Cline graduated from Mountain State University there with a master's degree in strategic leadership. She has worked in higher education since then, finding the most reward from being an academic advisor.

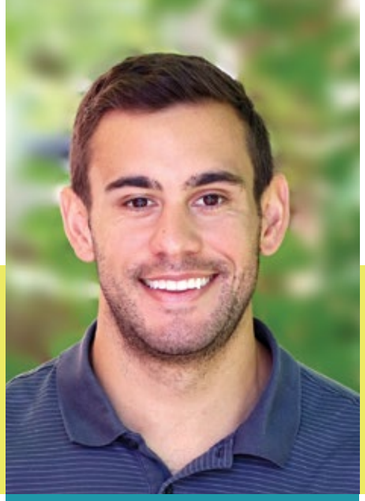
"I was a first-generation student, and did not have an advisor to guide me through my academic endeavors," Cline said. "I hope to be the advisor to my students that I did not have."

When she isn't paying it forward by sharing her experience and knowledge, Cline enjoys singing and loves all types of music. She is always up for watching a movie ("Not a scary one, though!") and enjoys photography as well.

"My husband Adam and I have three daughters—16, 14, and 11—and our dog, Storm," said Cline. They can be found on Sundays (except maybe for Storm) at the Avenue Church. "We took a huge leap of faith moving to Tennessee three years ago and are so grateful for all of the opportunities that have been given to us."

Shining a Light on Hard Work

James (Jim) R. McKinley (BS/CHE '77) and his wife **Sändra** are long-time supporters of both the department and college. Over the years, they have funded multiple endowments and scholarships, including the Jim and Sändra McKinley Scholarship Fund, which is reserved for CBE graduate students who show a high degree of effort and hard work in their studies. Thanks to the McKinley's generosity, the department was able to recognize the efforts of three outstanding PhD candidates at the department's 2019 awards banquet.



Brian Mendoza

Jonathan Coote

Sergio Garcia

Writing by Adria Amos. Photography by Randall Brown.

Jim and Sändra McKinley Outstanding Graduate Student Award: Brian Mendoza.

Mendoza's time at UT can be summed up with one word: change.

A doctoral student, Mendoza works with Cong Trinh, Ferguson Faculty Fellow in Chemical Engineering, and others on Trinh's Virulent Pathogen Resistance (ViPaRe) program, which seeks to identify and render infectious pathogens inactive through a system that combines biology, computing, and math.

Mendoza originally came to CBE in 2014 hoping to obtain a master's degree and embark on a career in sustainability. He had been working in energy storage after completing two bachelor's degrees in chemistry and classics from Stanford University in 2012, but realized he wanted to explore a different path.

"I wanted to dive into synthetic biology and metabolic engineering," he said.

He anticipated his research would focus on biofuels, but for a number of reasons he joined Trinh's ViPaRe team. He embraced his new healthcare-focused research. The lab uses CRISPR-Cas, a new genome manipulation technology, which he's used to develop computational tools to streamline the manipulation of bacteria and yeast.

"We've mainly been manipulating *E.coli* and *Saccharomyces* right now, and then we're moving to the pathogens *Candida albicans* and *Staphylococcus aureus*, so MRSA basically, and trying to take the system and use it to create antivirals or antimicrobials," he said.

Mendoza enjoyed the research so much, he chose to stay at UT for a PhD to continue his work. All of these unexpected shifts could have derailed him, but he credits his classics education and the people he's surrounded himself with for encouraging his innate intellectual flexibility.

"You don't get anywhere long-term if you set your foot down and become recalcitrant," he said.

Of being selected for the McKinley Scholarship, he said, "I was very excited. I had gotten the Exceptional Progress Award two years ago, so it was a nice validation that they still thought I was doing good work. I wasn't slacking."

Exceptional Progress Award for Outstanding Third-Year Graduate Student: Jonathan Coote and **Sergio Garcia**.

PhD programs tend to have fewer defined goals and milestones, so it can often be difficult for students to be certain they're making acceptable progress. For Jonathan Coote, receiving this award affirmed he is doing something right.

"Getting something like this definitely means a lot. It's a nice indication that I'm on the right track, what I'm doing is working and keep doing it," he added. "That is something that most graduate students need every now and then."

He joined the department as a PhD student in 2016 after working for a stint as a chemical engineer in New Orleans, Louisiana. The modeling work and software being used by the company was new to many members of the team Coote had been assigned to, so it was a time of experimentation and discovery. The experience helped him realize his passion for finding solutions to specific problems.

"That was an indication that maybe research is something I should be going into," he said.

He is advised by Associate Professor Joshua Sangoro and Prados Associate Professor Gila Stein and works on two projects studying block copolymers for energy applications.

"One project is involved in photovoltaic applications, semiconducting polymers, and another project is involved in ion-containing polymers, so more for electrolyte applications, batteries, that sort of thing," he said.

He knew very little about polymers prior to coming to UT, so he credits Stein, Sangoro, and his fellow graduate students for teaching him everything he's learned. Three years into the program, he feels he has found his calling. He plans to stay in academia, whether that's in the form of a post-doc or a faculty position, once he's completed his PhD.

He is extremely grateful for the McKinley's generosity and the creation of the scholarship fund. To Jim and Sändra, he has one thing to say: "Thank you on behalf of all the recipients over the years. It's a great thing."

As one of two recipients of this award for 2019, Sergio Garcia admits he was pleased to be recognized by CBE.

"It is good to feel that someone pays attention to your work," Garcia said. "I like to put effort and a lot of attention into the work I do, and a lot of times it is for my own satisfaction."

Garcia has always been motivated internally and sets expectations for himself in just about whatever he does, including hobbies. He doesn't know what drives him to do so, but accolades aren't what's pushing him to be diligent in his work with his advisor Cong Trinh.

"When it comes to the quality of what I'm doing, I'm not just trying to deliver what was asked, to only show to other people, but rather what I truly believe is important and what should be done. That is how I approach my work. Maybe this award is one of the ways that is paying off."

Garcia also received the Extraordinary Professional Promise Award for 2019 at the recent Chancellor's Honors Banquet. This honor is awarded to students who demonstrate professional promise in teaching, research, or other contributions.

The focus of his thesis is taking modular design principles seen in conventional engineering and applying them to understand and redesign biological systems.

"Computers, automobiles, they have parts that are replaceable. That provides advantages when it comes to manufacturing efficiency, predictability, and so on. Modular design is ubiquitous in many fields of engineering, but it hasn't arrived yet to biological systems," he said.

One of the technological applications of his research is in biocatalysis—converting available feedstocks like plant biomass into useful chemicals such as biofuels.

Garcia started his PhD in 2015. He said selecting UT for graduate school was an easy choice. He spent his junior year at UT thanks to the International Student Exchange Programs (ISEP) when he first worked for Trinh as an undergraduate research assistant.

2019 CBE Department Awards

Students pose with their awards following the CBE Awards Banquet.

AIChE Service Award
Maria Bruce

Dow Outstanding Junior Award
Preston Nicely, **Theresa Cahill**, **Tyson Johnson**, and **Samantha Cahill**

Kenneth M. Elliott Outstanding Senior Award
Drake Crawford

Most Exceptional Student Award, Chemical Engineering
Grant Rigney

Jim and Sändra McKinley Outstanding Graduate Student Award
Brian Mendoza

Exceptional Progress Award for Outstanding 3rd-year graduate student
Jonathan Coote and **Sergio Garcia Manogil Fernandez**

Professor Jack S. Watson Graduate Award for Excellence in Separation Research
Dave DeSimone

Professor Jack S. Watson Undergraduate Award for Excellence in Separation Research
(**Constance**) **Taylor Alderson** and **Mary** (**Kathryn**) **Mitchell**

Alpha Chi Sigma Albert Cooper Award
Annabel Large

American Chemical Society Outstanding Senior Award
Grant Bauman

AIChE Outstanding Student Award
Seth Anderson

AIChE Outstanding Baccalaureate Award
Chase Toth

Outstanding Staff Member Award
Kerri Cline

Outstanding Teacher Award
Steve Abel

Outstanding Faculty Mentor Award
Gila Stein

Tom and Ruth Clark Excellence in Chemical Engineering Award
Joshua Sangoro

Senior Design SHOWCASE

The inaugural college-wide Senior Design Showcase, which featured more than 125 teams of Engineering Vols from all disciplines, took place on April 25, 2019. The students showed the creative, innovative, and practical solutions that they developed from real-world challenges presented from university, business, and community clients.

The department presented five awards, including Best Poster, Most Creative, and People's Choice.

Best Poster—CBE 490

Small Scale Avermectin Production

Team Members: Scott Dixon, Wilson Pang, Sarah Wellborn, Sydney Whitson

Advisor: Sankar Raghavan

Sponsor: CBE

(l-r) Scott Dixon and Sydney Whitson

Most Creative—CBE 490/People's Choice

Craft Beer Production

Team Members: Seth Anderson, Justin Holladay, Jake Jolley, Jess Ossyra, Adam Soper

Advisor: Sankar Raghavan

Sponsor: Balter Beerworks Microbrewery

The Craft Beer Production team with advisor Sankar Raghavan.

Best Poster—CBE 488

Extraction of Thorium and Rare Earth Elements from Monazite Ore

Team Members: Patrick Green, Michael Lin, Evan Wilmer

Advisor: Robert Counce

Sponsor: Electric Power Research Institute/CBE

(l-r) Evan Wilmer and Patrick Green

Most Creative—CBE 488

Extraction of Thorium and Rare Earth Elements from Monazite Ore

Team Members: Paige Jones, DeLys Valetine, Morgan Walker

Advisor: Robert Counce

Sponsor: Electric Power Research Institute/CBE

(l-r) Morgan Walker, DeLys Valentine, Paige Jones, and advisor Robert Counce

Zawodzinski to Lead Department of Energy FUEL CELL PROJECT

By David Goddard.

The US Department of Energy has chosen a project led by UT–Oak Ridge National Laboratory Governor's Chair for Electrical Energy Conversion and Storage Thomas Zawodzinski as one of 10 recipients of Advanced Research Projects Agency–Energy (ARPA-E) grants.

The grants are part of the agency's focus on research that can provide a minimum of 100 hours of power to the grid as part of its Duration Addition to electricitY Storage (DAYS) program.

For his part, Zawodzinski's team is taking a new approach to an old problem—efficiency—by changing a critical reaction.

"It has long been a goal to make a regenerative fuel cell, a single device that functions as both a fuel cell and an electrolyzer," Zawodzinski said. "However, such devices have previously suffered from poor overall efficiency. The new project uses an alternative approach by changing one of the chemical reactions in the cell and bypassing the efficiency bottleneck."

As part of their typical processes, fuel cell reactions produce water through the combination of hydrogen and oxygen. In the case of the new device, the team will instead use cells to produce hydrogen peroxide, which can be easily stored.

Depending on need, the fuel cells can provide electricity to the grid while producing peroxide, which will be converted into oxygen during the charging cycle.

This method uses a recent catalyst discovery in Zawodzinski's lab that is being commercialized for one application by a spin-off company, Peroxygen Systems Inc., which will also participate in the project.

"In effect, the system could allow renewable electricity inputs—such as solar or wind, for example—to be leveraged over long periods," said Zawodzinski.

The Department of Energy's overall goals in selecting the 10 projects are to improve grid performance and reliability, backup power storage, and the integration of renewable energy sources.

Zawodzinski, who works jointly through CBE at UT and the Division of Materials Science and Technology at ORNL, will receive up to $1.5 million through the grant.

He has spent decades conducting research with fuel cells and is considered a leading expert in the field, having also worked on fuel cell design and improvement for more than 10 years at Los Alamos National Laboratory.

He has served as a US representative at international fuel cell conferences and as an advisor or participant in fuel cell discussions with China, Japan, Italy, and the United Kingdom in addition to extensive consulting work.

FACULTY NOTES

Bamin Khomami, CBE department head and Granger and Beaman Distinguished University Professor, was recently elected Fellow of the Society of Rheology (SoR). The SoR Fellowship status recognizes a history of distinguished scientific achievement, a significant technological accomplishment, and/or outstanding scholarship in the field. Khomami will be inducted at the Society Banquet during the 91st Annual Meeting of the Society, to be held this October in Raleigh, North Carolina.

Assistant Professor **Steven Abel** was nominated by students and selected by the Office of Undergraduate Research to receive an Undergraduate Research Faculty Mentor of the Year Award. Recipients must have been nominated by multiple students and at least one of those students must have presented at EURēCA.

Art Ragauskas, UT-ORNL Governor's Chair for Biorefining, was named one of UT's top cited researchers for the 2018–19 school year. While the methodology Clarivate uses is fairly complex, it results in a list of the top 1 percent of researchers in a given field.

Stephen Paddison served as chairman of the organizing committee for the 19th International Conference on Solid State Protonic Conductors (SSPC-19) in Stowe, Vermont, last September. Sponsors were the college and department as well as the Army Research Office.

Professor **Paul Fymier** was selected as the associate dean for faculty affairs for the Tickle College of Engineering in December, having served as an interim in that role since July. Frymier has more than two decades of experience in academia, having won several department-, college-, and university-level awards for teaching and research.

STUDENT NOTES

Recent graduate **Katherine Yolitz** (ChemE, '19) was one of four UT students who earned fully funded scholarships to travel abroad to study languages considered crucial to the United States' future security and stability. Yolitz also minored in Arab studies. She studied Modern Standard Arabic and the local Moroccan dialect at the Arab American Language Institute in Meknes.

Graduate student **Tyler Bennett** had his article, "Jolly green MOF: confinement and photoactivation of photosystem I in a metal–organic framework," selected as the inaugural cover of the journal *Nanoscale Advances*. Additional co-authors are Michael D. Vaughn, Seyyed Ali Davari, Kiman Park, Dibyendu Mukherjee, and Bamin Khomami.

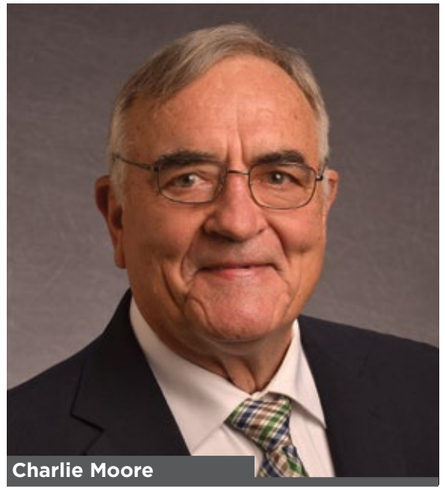
Junior **Brad Bennett** earned second place in last spring's VolCourt pitch competition for Backdoor, a smartphone application to help pet owners track lost pets. The team received $1,000, office space in the UTRF Business Incubator, legal advice from Morehous Legal Group, and design services from Innovative Design Inc.

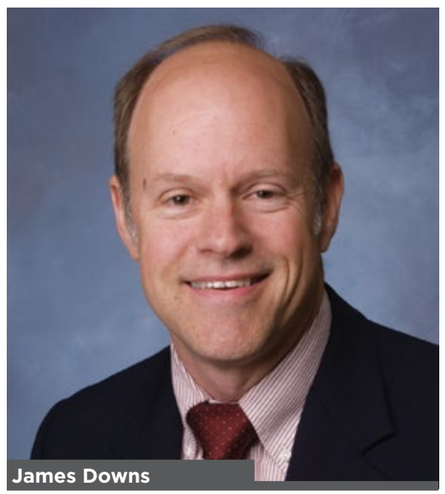
Now-senior **Carl Edwards** was one of two engineering students named as 2019–2020 Goldwater Scholars. The most prestigious undergraduate STEM scholarship in the United States, it is awarded to college sophomores and juniors who intend to pursue research careers in the natural sciences, mathematics, and engineering. Edwards, who has worked with Department Head Bamin Khomami and Associate Department Head Brian Edwards, is an honors computer science and honors mathematics major and has done research at ORNL and through EuroScholars at the University of Zurich in Switzerland.

ALUMNI NOTES

Brandon Wilbanks (ChemE, '17) was selected to receive a 2019 National Science Foundation Graduate Research Fellowship, which provides financial support for three years over a five-year fellowship period.

Matthew Gordy (ChemE, '18) was the lead author on a paper titled "H3PO4 Production Process Utilizing Phosphatic Clay as Feed Material," that was recently published in *Mining, Metallurgy & Exploration*. Gordy followed up on work that began as part of his 2018 senior design project. The article co-authors are Robert Counce, Patrick Zhang, Rasika Nimkar, and Jack Watson.


Charlie Moore


James Downs


Virginia (Jenny) Butler

Department Celebrates 2019 Hall of Fame Inductees

By Meghan McDonald.

Last spring, three new inductees joined the Chemical and Biomolecular Engineering Hall of Fame. These new members share a focus on process control as well as something else—rather, someone else—special. Inductee **Charlie Moore** influenced the career paths of the other two inductees, **James Downs** and **Virginia (Jenny) Butler**.

For 50 years, Professor Emeritus Moore served the department through teaching and research as well as serving as department head from 1993 through 1999. Moore originally chose to build his career at UT because the university promised him a research lab and allowed him to work with industry.

The landscape influenced his decision, too—"UT was the only engineering school that could offer me East Tennessee," he said.

Bridging academia and industry was a driving theme throughout Moore's work. His research focused on aspects of modeling and industrial process control. He not only taught students about these topics, but also provided more than 200 seminars and short courses to practicing engineers in the United States and Europe.

In collaboration with Eastman Chemical, Moore developed the Process Control Internship to give his students a meaningful introduction to the world of industry.

"It provided the students and me an experience much more interesting than the toy problems found in textbooks," he said. "The problems were real, and in most cases the work done by the class was used by Eastman."

Now, the mountains that offered a good place to raise his family are giving him a good place to spend retirement. That doesn't mean Moore has lost touch with the department, though. "I hope to continue to provide a bridge between the department and Eastman," he said.

Downs, manager of the Advanced Controls Technology Group at Eastman, benefitted from Moore's industry knowledge while working on his PhD in chemical engineering at UT.

"New process control technology was introduced through relationships that Professor Moore had," he said. "The understanding and relationships developed during my time there were invaluable in my development as a practicing engineer."

In his role at Eastman, Downs works closely with a team of engineers to design and implement process control systems. "I enjoy bringing the 'how will we operate/control this process' perspective to teams whose focus may be 'how can we design a process for least cost?' I also spend a significant amount of time teaching about process control," he said.

He considers his most important contribution at Eastman to be "guiding new engineers in how they can use their technical skills to edify their work environment and to improve the lives of others."

Eastman is not the only place Downs helps new engineers grow. He regularly serves on PhD committees at multiple universities and he has taught classes at UT as an adjunct professor for 11 years. He also supports the department as a member of the industrial advisory board that provides input during the ABET accreditation process.

Like Downs, Butler was attracted early on to process control and mathematical modeling. She completed her bachelor's and master's in chemical engineering at UT in the late 1960s and early 1970s—a pivotal point in the evolution of computers. "I was hooked from the beginning," she shared.

Her first job, environmental engineering at TVA, used first-generation minicomputers for atmospheric modeling. From there, Butler moved fully into the computer industry. In her role with Digital Equipment Corporation, she provided software support to customers including NASA and their contractors. For the rest of her career, she managed servers and clusters for the UT Health Science Center, providing holistic support from installation to hardware problem resolution.

"I'm thankful for the many opportunities that came my way," Butler said, attributing them in large part to the coursework she took at UT and to professors like Moore with industry experience and relationships. "I cannot count the number of times that something specific that I learned was exactly what I needed to know to do my job well," she said.

Since her retirement in 2016, she has stayed involved with UT through outreach activities such as participating in a Memphis-area panel encouraging high school seniors who have already been accepted to the Tickle College of Engineering.

IN MEMORIAM:

Charles Shaw

August 29, 1957–April 25, 2019

Charles Joseph Shaw, (BS/ChemE, '80) Atlanta resident and Tennessee native, passed away in his home the morning of April 25, surrounded by his family after a long and hard-fought battle against cancer.

He was born in Savannah, Tennessee, on August 29, 1957, to Evelyn and Larry Shaw. He grew up working in the Shaw Motel, became an Eagle Scout, and played high school football. He graduated valedictorian of his high school class in 1975 before graduating with honors from UT in 1980.

Outside of Saturdays in Neyland Stadium cheering on the Vols, Chuck cherished his work with the TVA. His career spanned 38 years. He was director of business development at Koppers Performance Chemicals which earned him lifelong friends and a passion for working hard and helping others. He was a member of the American Institute of Chemical Engineers and the Society of Plastics Engineers.

Shaw was a lifelong Volunteer Football and Lady Vols Basketball fan. He is survived by his wife, Lynne, his daughters, Honey and Maggie, and his brother, Stanley. In lieu of flowers, the family requests donations be made to the Tickle College of Engineering, the National Park Foundation, or the Darryl Worley Foundation for Cancer Research.

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Page 4.