

tennessee engineer



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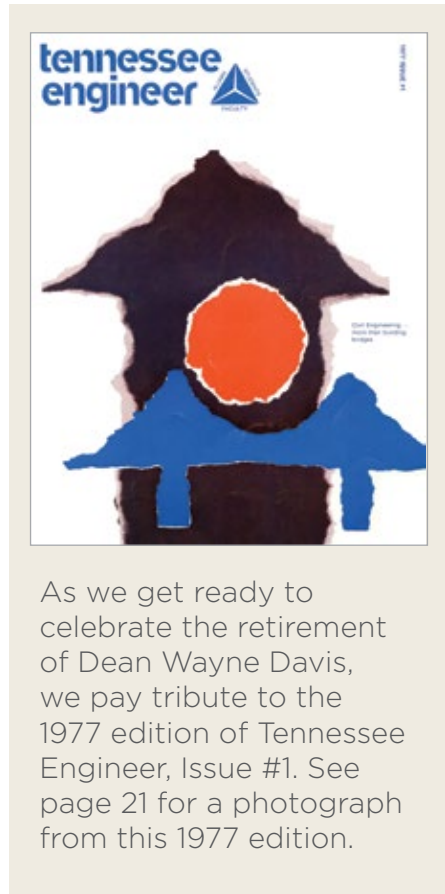
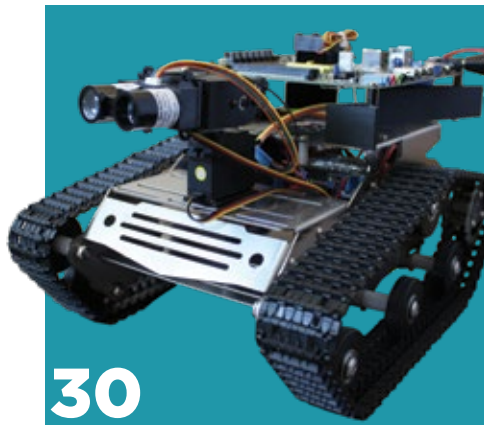
The alumni magazine of the Tickle College of Engineering

1971-2018

Celebrating the legacy of Dean Wayne T. Davis

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Dean's Message



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There's a 2,500 year-old saying: "the only constant is change." The truth of that statement is evident as you walk through our campus, talk to our students, faculty, and staff, or connect with other alumni. We are a college on the rise; our rankings, enrollment, faculty, staff, and facilities continue to grow by leaps and bounds. Many of these changes will be highlighted for you as you read through the pages of this issue of *Tennessee Engineer*.

We will soon break ground on our latest campus addition, the as-yet unnamed \$129 million facility that will house our Department of Nuclear Engineering, the Stoneking *engage*™ engineering fundamentals and Cook Grand Challenge Honors programs, the Min H. and Yu-Fan Kao Innovation and Collaboration Studio, and various laboratories to help us advance engineering research.

This new space will finally give our nuclear engineering students and faculty a space befitting their highly-ranked national status, while also helping us place an even greater emphasis on our freshmen students and maker spaces, all while serving as a new gateway to engineering and, indeed, a new focal point for people coming to our campus.

While many of our successes are detailed within, what's made me proudest as dean are the unseen numbers behind our growth.

Our percentage of female students is on par with the national average and stands poised to increase with this next incoming class of freshmen.

Speaking of freshmen, we consistently welcome incoming classes with an average 4.0 GPA and a math ACT score of more than 30.

Our expanding faculty includes some of the highest-profile researchers in the country along with up-and-coming stars of tomorrow, including a record five NSF CAREER award winners.

Our doctoral program—one of the two largest at UT—has skyrocketed with 40 percent growth in PhD enrollment since 2012. We're also thrilled to announce our ranking of 29th for all public graduate programs of engineering.

Finally, in my last semester as head of our college, I would like to sincerely thank all of you for the support, ideas, energy, and involvement you've contributed over my last decade as dean. All of the growth I have mentioned, as well as countless other successes, are traced directly back to your efforts.

In many ways, this magazine is as much as a testament to your help as it is a celebration of the Tickle College of Engineering.

Wayne T. Davis
Wayne T. Davis Endowed Dean's Chair in Engineering

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On the cover:
Then graduate student Wayne Davis working late into the evening in Estabrook Hall, 1973.

T TICKLE
COLLEGE OF ENGINEERING
THE UNIVERSITY OF TENNESSEE, KNOXVILLE

Made in America

By David Goddard. Photography by Shawn Poynter.

Like many businesses, Krawlers Edge started as a hobby.

Thomas Kincer had an affinity for taking older model Ford Broncos and preparing them for use as rock crawlers, the recreational activity of driving up and over seemingly impassable terrain.

As his expertise in restoring Broncos grew to include custom builds, Kincer and his sister Sabrina Kincer Stallings refocused the business—named with a “k” to honor their last name—as a full-time endeavor.

Their focus is on “first generation” Broncos, those built between 1966 and 1977 and considered a classic by enthusiasts. Refurbished models from that era can sell for well more than \$100,000, placing Krawlers Edge in a niche market.

As their business picked up, the duo sought out advice on how to more efficiently manage their inventory.

“We grew up with a dad who was always involved in business, very entrepreneurial,” said Kincer Stallings. “When we really got going, we turned to the Small Business Association and they pointed us to UT.”

Thomas explains the manufacturing process to the ISE student team (L-R): Carly Johnson, Rahul Ravikumar, Sabrina Kincer Stallings, Thomas Kincer, Abigail Harr, Joseph Pettey, and Jake Fountaine



A connection was made with the Department of Industrial and Systems Engineering (ISE) and Assistant Professor of Practice **Floyd Ostrowski**, who assembled a student team of seniors and sophomores to the project.

Lean manufacturing—the process of streamlining production and stripping inefficiencies without sacrificing quality or output—has long been a departmental specialty, and is a critical focal point of the students’ project.

“We went in and examined a lot of what they did, from taking inventory to where they placed their supplies,” said team member **Abbi Harr**. “It’s lean manufacturing to the extreme.”

Prior to the students’ involvement, Krawlers Edge had no formal system of monitoring their parts or stock, sometimes only knowing to order more parts if they ran out.

“We designed a whole new supply chain for them,” said **Joe Pettey**, another team member. “We’re now helping them work on scheduling deliveries and thinking of things from an efficiency standpoint.”



Siblings Thomas and Sabrina

The students reorganized stations on the floor so parts storage is now adjacent to assembly, and a new highly visible interactive board now tracks inventory so employees know to place refill orders prior to the depletion of stock.

These changes have been particularly helpful since the company recently opened a satellite warehouse for parts storage and early frame development.

“They’ve really made a big impact on how we do things,” said Kincer. “We’ve been able to save a lot of time in our workflow—time that we can use to do what we do best: build.”

In addition to fully rebuilding Broncos, Krawlers Edge has also seen a sharp increase in demand for both the standard and highly customized chassis they create, providing yet another opportunity for the ISE students to apply their supply chain knowledge.

A known issue with classic Broncos is frame corrosion. By using materials that weren’t available 50 years ago,

Kincer is able to provide his customers a far more reliable option for restoration or retrofitting.

Frame production has already increased from one a month to three, with an eventual goal of scaling up to 15 a month, making the help UT’s students provide even more vital.

“We have the coolest projects with the best kids,” said Ostrowski. “People want to hire graduates with experience, and, along with our college’s co-op and internship program this is a way for them to do that.”

Ostrowski designed the course to introduce students to the project during their sophomore year.

That way, even when the project’s current seniors graduate in May, future student groups have valuable insight that may continue to help Krawlers Edge run as efficiently as possible and help implement new innovations as they arise over the coming years.

Team members Abigail Harr, Carly Johnson, Tim Love, Joseph Pettey, and Jake Fountaine discusses a custom chassis.



Hurricane Maria was the 10th most powerful storm on record when it tore through the Caribbean last fall, leaving behind nearly \$92 billion in damage and changing lives forever.

Higher education felt an intense impact, with wrecked infrastructure forcing many students off the islands and into institutions in the mainland United States to continue their educations.

“I’ve never experienced a storm so strong, never seen anything like that,” said Puerto Rican student Benjamin Mercado. “No one has experienced that since the San Felipe hurricane [of 1928]. It was the kind of thing you only heard stories about from your grandparents.”

Now, six months later, Mercado and six other students from the University of Puerto Rico, Rio Piedra, are continuing their careers at UT, thanks in large part to joint UT-ORNL Governor’s Chair for Environmental Biotechnology Terry Hazen.

Mercado, Jelissa Reynoso, Cesar Perez, Alfredo Gonzalez Cintron, Rosana Wiscovitch Russo, Yadeliz Serrano, and Luz Serrato-Diaz have resumed their research in microbiology as part of the Hazen Lab.

Their path to UT came about because Hazen taught at their university from 1979 to 1988 and still serves as an adjunct faculty member.

One of his former postdoctoral students, Gary Toranzos-Soria, currently serves as a professor and was mentoring Gonzalez Cintron and Wiscovitch Russo.

“I have a lot of good memories of my time there, and I maintain a strong connection to the university,” said Hazen. “Right after Maria hit I tried to contact Dr. Toranzos. It took more than a week, but I finally got in touch with him by cell phone and told him I was more than happy to help in any way I could.”

Gonzalez Cintron said that the help of Hazen and Associate Vice Chancellor for Research and Research Integrity Robert Nobles has been immeasurable, connecting the students with everything from housing to scheduling, making them all feel welcome at UT.

Wiscovitch Russo said the loss of electricity was a major setback to the island’s researchers and scientists. Since a lot of the University of Puerto Rico’s work in biology and microbiology depends on a steady supply of power, destruction of the power grid brought activity to virtual standstill.

While her work was not lost, Wiscovitch Russo said that coming to UT was a great opportunity to continue her research without delay.

Temporarily relocating to Rocky Top has also provided some new experiences for the students outside the classroom.

“It’s the first time most of us have seen snow,” said Wiscovitch Russo. “When it first snowed here, we ran outside and made snow angels, tried to make snowballs, snowmen—all the things we’ve only seen on TV or movies but never experienced.”

Proof once again that even the most powerful storms cannot stop the human spirit.



Details of the damage caused by Hurricane Maria to the students' lab and building at the University of Puerto Rico, Rio Pedra.

WEATHERING THE STORM

By David Goddard.



(L-R) Jelissa Reynoso, Cesar Perez, Yadeliz Serrano, and Benjamin Mercado.

Worth its Salt

By Whitney Heins. Photo by Shawn Poynter.

Remember a year or so ago when Samsung Galaxy smartphones kept exploding? They were recalled but the threat still exists...in every smartphone we use.

Well, actually, in a lot of things we use.

The source of the explosion was the failure of the phones' lithium ion batteries—the standard kind of battery used in many tech products.

“The batteries' electrolytes have numerous carbonate additives,” explained Joshua Sangoro, assistant professor in chemical and biomolecular engineering. “One of the major problems with those is that when mixed with lithium ion salts, spontaneous chemical reactions are known to occur at temperatures as low as 140 degrees Fahrenheit. These reactions release hydrofluoric gas which is highly toxic and can easily catch fire.”

In addition, after recharging the battery a couple of times, some tree-like patterns called dendrites begin to grow from one electrode towards the counter-electrode of the battery. This leads to an electrical short-circuit characterized by sparks. Fueled by the accumulated hydrofluoric gas and other flammable electrolyte constituents, the sparks ultimately lead to explosion of the lithium ion battery.

There's got to be a better, safer way to power our technology, and Joshua Sangoro's work is getting us closer to that way.

“I would really like to make an impact in changing the type of electrolytes that we have—or be able to design new ones that aren't as dangerous as the current one we use,” he shared.

The answer lies in salt. Liquid salt, that is.

Also known as ionic liquids, these materials have low vapor pressure, are electrochemically stable, non-flammable, form a layer around electrodes to prevent the growth of dendrites, and remain liquid in a wide temperature window.

This all means there's no danger of them spontaneously combusting.

What's more, they consist of negatively and positively charged ions rendering them electrically conductive—a key requirement for rechargeable batteries. However, because ionic liquids consist of large molecules, the electrical conductivity is low compared to standard electrolytes. So, Sangoro is researching the impact different molecular structures have on ionic conductivity. All with the goal of designing a better, safer battery.

Sangoro and his team of students are doing this by leveraging the power of an experimental technique

called broadband dielectric spectroscopy. This method, only being used by a handful of researchers in the country, enables them to alter the molecular structures by exposing the materials to electric fields through a wide range of timescales. Knowledge of timescales is crucial to understanding the physical properties of materials including how much electrical energy a material can store and conduct.

“We apply a small electrical field to disturb the molecules and then monitor how the molecules get back to their equilibrium positions,” explained Sangoro. “The goal is to find ways of designing ionic liquids with higher ionic conductivity.”

“We look at how motions of the ions are affected and what happens if we vary the chemical structures and interactions.”—Joshua Sangoro

Pinpointing optimal energy storage and conductivity in ionic liquids is almost akin to finding a needle in a haystack. Because they have a lot of positively and negatively charged ions, the liquids hold the possibility of creating trillions of new chemically distinct materials with different properties and uses. This makes them very promising for improving all types of technology but also very difficult to study.

“This vast number of chemical structures require scientific design criteria based on understanding of the correlation between structure, interactions, and desired properties,” explained Sangoro.

Sangoro's team consists of postdoctoral, graduate and undergraduate students supported by grants from the National Science Foundation and US Department of Defense.

The researcher says engaging with students inside the classroom and the lab is one of the most rewarding parts of his job.

“It's amazing when you see the students understand the concepts when they arrive not knowing any of them,” he shared. “It is really gratifying.”

Also gratifying? Making our world a safer and better place to live.

“Science should be useful ultimately to society, and we should understand the basics of how everything works so that we can make steps forward.”

Sangoro is working on it.



If you are meeting Candace Brakewood somewhere, there's a good chance she may ask you how you got there.

By Whitney Heins. Photo by Shawn Poynter.

"I have a genuine interest in how people travel," explained the assistant professor of civil and environmental engineering. "I think what makes me different from most civil engineers is that I'm most fascinated by the human aspect of transportation."

This fascination was sparked during a study abroad semester in Zurich, Switzerland. The mechanical engineering major at Johns Hopkins University was introduced to the country's robust rail system. It was easy for people to use, comfortable, efficient, and almost always on time.

"I started to wonder why we don't have systems like this in the US that people can use."

Upon graduation, Brakewood changed her engineering area of focus from mechanical to civil, pursuing a master's degree in transportation at MIT and later a PHD at Georgia Tech. Today, the professor is covering new ground in transportation-related behavior research while teaching the fundamentals and planning of transportation to UT students.

As a millennial with a "smartphone attached to my hand," Brakewood is particularly interested in how mobile phone applications influence behavior. Apps that reveal real-time public transit vehicle location information, enable travelers to buy tickets, and make it easy to hail a ride are disrupting people's transportation habits.

"We want to know how using these apps impacts people's travel behavior," she said. "For example, if you have an app that says when the bus is going to arrive, are you more likely to take the bus?"

In one of her studies of New York City Transit, the answer was a resounding "yes!"

Brakewood obtained three years of data from the city's transit authority and, through statistical analyses, uncovered the impact the city's new bus time app had on ridership. Controlling for factors such as fares, local socioeconomic conditions, and weather she found an increase of almost two percent in ridership—which is a lot considering upwards of a million people use buses in New York City each day.

"That's a lot more people using public transportation each day," said Brakewood.

"And, public transportation is a sustainable and environmentally-friendly mode, so it is a good thing if more people are using it."

Brakewood is currently collaborating with people at a popular app, simply called "Transit," to study how users interact with it (the UT community can thank Brakewood for adding Knoxville to its 125-city roster). The app shares the GPS location of buses and trains and/or their schedules. If a user makes an inquiry—such as for a specific bus route—the app stores that inquiry as data, and Brakewood is tapping into it to investigate, in particular, how people use it to travel between cities. For instance, if a New York City resident moves to Los Angeles, will they use the same modes of transportation?

Transit is adding new features like the ability to reserve a bike in a bike share program or request a ride with ride-hailing companies like Uber or Lyft, and Brakewood plans to explore how people use these shared modes as well.

In another study, the researcher conducted a study of regulations of such ride-hailing companies in major US cities, providing useful information to policymakers.

In yet another project, Brakewood is examining the usefulness of mobile apps where travelers can purchase tickets. She surveyed New Jersey transit mobile app users to see if they would be okay with the app using their location to customize information, also known as geo-targeting. Preliminary results show most travelers responding favorably to the practice with a high interest in alerts when rides were delayed or could be impacted by special events.

The common thread through all these projects is Brakewood's hope that they arm city planners with information to design better transportation systems.

"We need to be thinking towards the future," she said. "As we become increasingly more reliant on our devices as we travel, we need to understand the implications for this on infrastructure."

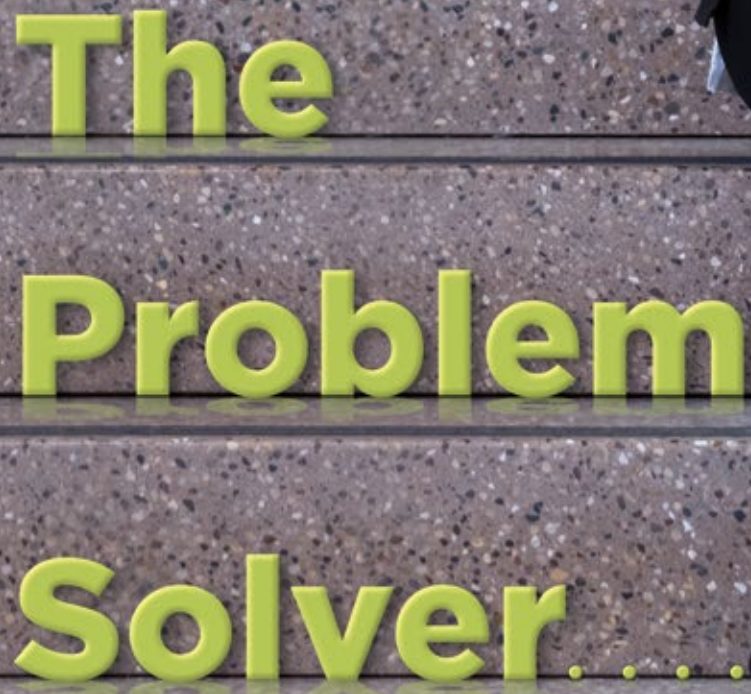
The use of mobile apps is drastically changing the way many of us travel. And, as these changes continue, Brakewood will only become more interested in the way we get from place to place.

"If you have an app that says when the bus is going to arrive, are you more likely to take the bus?"

—Candace Brakewood



SEEKING PLACES GOING



Pop quiz. What do sepsis patients, kidney transplants, driverless cars, and storm drainage all have in common? ● ● ● ● ● ● ● ● ● ● ● ●

The assistant professor of industrial and systems engineering loves being an industrial engineer because it gives her the opportunity to collaborate with a lot of different people to solve many different problems.

Khojandi is involved in a myriad of projects solving important problems which mostly fit into three main areas: health care analytics and medical decision-making, transportation systems, and environmental engineering.

**“Each hour that goes by,
the risk of death increases
by 8 percent.”** —*Khojandi*

Khojandi and her colleagues are testing an algorithm they've developed in hopes it will give an accurate percentage of a patient's risk for sepsis along with how long a medical professional might have to wait to get that accurate prediction. The goal is to have this sophisticated analysis become part of early intervention protocol.

Another problem Khojandi is working to solve has to do with the timing of kidney transplants. Get one too early and you risk losing quality of life sooner than one would have to. Wait too long, and the consequences could be dire.

“Our tool answers the question of when is the best time to undergo this surgery taking into consideration the long- and short-term tradeoffs,” she explained. “This information is made available to physicians who can treat the patients at the optimal time, allowing for the best quality of life possible.”

Yet another problem Khojandi is tackling is making our world safer when it becomes one filled with driverless cars. Driverless cars are getting better, but sensors and radars still fail to see obstacles—leading to crashes.

The challenge is that when someone is in a driverless car, chances are their focus is not on the road. So, every transfer of control can pose a risk. Khojandi and her team are developing methodologies to determine the optimal switching policy to minimize risk, considering the dynamic changes of the road/environment during the trip.

Khojandi's work specifically focuses on developing a strategy that makes sense of conflicting climate models and combines that with information about the existing infrastructure and watershed.

“One climate model may say it’s going to be wetter in twenty years. Another says the opposite,” explained Khojandi. “So, who can they trust? We hope our work helps guide city officials on where to put green infrastructure in a watershed to mitigate flooding, water contamination, et cetera.”

Khojandi's work touches every corner of our lives—from hospital rooms to the cars we may ride in. At UT since 2014, she's only just getting started.

Before, During, and After **THE BOMB**

By Whitney Heins. Photography by Shawn Poynter.

Barely a day goes by that news of a nuclear threat doesn't make it into the headlines. And, what if the unthinkable happens?

Time is of the essence to ensure survivors are safe and those responsible are stopped from doing more harm. Too much time spent trying to figure out what happened, how it happened, and who did it could cost lives and money.

John Auxier II, research assistant professor of nuclear engineering, is on the job. His research, funded by the US Departments of State, Defense, and Homeland Security, is one of few in the country that seeks quick and easy ways to answer such questions throughout the entire bomb cycle.

"Our research is everything from the front and back end of nuclear forensics," he explained, likening his research work to the popular television show CSI, short for crime scene investigation. "We're trying to figure out systems that enable first responders to get information on-site within hours rather than having to send it to the lab and wait for days. Getting data faster helps decision makers make their next move faster."

Auxier, who is on faculty at the UT's Bredesen Center and the Institute for Nuclear Security, conducts research within the framework of three scenarios—when suspicious material is intercepted, when a bomb is detonated, and the aftermath. He seeks to find information that can answer critical questions such as—what kind of bomb was it (aka did it have plutonium or uranium, or was it a "dirty" bomb)? Where did it come from? Who is responsible for it? And, what threat still looms?

At the front end of the bomb cycle—finding suspicious material—Auxier and his students are working on a method where responders can determine what the material is by using handheld lasers while at the scene. The laser method, known as Raman spectroscopy, characterizes the surface of the material by illuminating it using a single color of light. The way the light interacts with the material can reveal the material's makeup, and even when it was last machined.

This information can help decisionmakers narrow down a list of suspects since not every country has access to the same kinds of bomb-making materials. And, US intelligence may know when countries likely engineered certain types of bombs or bomb-making materials.

During a bomb explosion, Auxier and his students are tapping into cameras such as those in ATMs, security systems, and people's cell phones to gather information about the weapon. Using a fifteen-inch industrial-grade torch—the same kind used to paint airplane wings—they create atomic lines that they then video for review.

"When atoms get excited, they give off a light like the yellow glow from a street light, for example," said Auxier.

“We can look at the particular colors in that spectrum and relate it back to certain elements and that can tell us what materials are in the bomb.”

—John Auxier

After the fireball is gone and smoking rubble is left, Auxier and his students are investigating another method using handheld lasers, called laser induced breakdown spectroscopy. When this laser is shined on the rubble, it turns the debris into plasma that emits light holding clues to the elements within. This method gives responders an initial idea of the type of bomb that was used and enables them to collect good samples for more detailed analysis at a lab.

Auxier calls himself an “innovative collaborator,” saying he would not be able to do what he does without the help of his students.

"I've had the great opportunity to work with really talented students. We all fit in a small office and throw ideas on the whiteboard. And, I have a lot of bad ideas," he laughed. "The students critique me. They don't understand the limitations, so they look at problems a different way and push science forward."

Auxier is passionate about doing research that supports students locally and can provide a pipeline of skilled workers to US national laboratories and government.

He's also very passionate about doing “fantastically cool science”—and making our world safer.

"We are trying to solve some very challenging problems and create a skillset we hope we never have to use."



Delivering Results

By Whitney Heins. Photography by Shawn Poynter.

There's no denying what Libby Barker's motivation is for her research.

"I want to save the babies."

The assistant professor in mechanical, aerospace, and biomedical engineering (MABE) is on a mission to design a drug delivery system for cancer patients, particularly pediatric patients, that improves the treatments' efficacy while vastly reducing side effects.



Today, for most cancers, chemotherapy is given intravenously. The problem with this mode of delivery is that much of the drug doesn't go where it's intended. This is especially true for brain cancer, where up to 95 percent of the drug goes elsewhere—leading to miserable side effects and a much less effective treatment. In fact, 99% of all childhood cancer survivors develop severe, disabling, or life threatening conditions from the chemotherapy used to treat their initial malignancy.

The solution to this problem is to put the drugs right where you want them—into the tumor. And that's the task Barker has taken on. A mission she began as a master's student at UT.

"I don't think we should be giving systemic treatment for solid tumors where there is localized disease. We should be putting

the drug right where we want it to go to maximize efficacy and minimize damage to healthy tissues."

That's when she began laying the groundwork for a material she calls Amygel. Amygel, which is under patent review, is a water-based gel that can be filled with drugs and injected directly into the malignant mass. What makes this novel material so promising is that it consists of naturally occurring starches that can degrade in the body, releasing the drug.

"The gel is mostly water, like what's found in our bodies. It acts like a sponge, soaking up the drugs and then dissolving away as it releases the treatment," explained Barker.

What's more is that it's not drug specific; the amount, viscosity, and time-release of the drugs can be controlled; and they can be delivered through a thin needle.

Another benefit of injecting a mass directly is that it attacks the core of the tumor which houses the cells responsible for recurrence. Current treatments superficially attack tumors, killing the cells growing on the outside. This shrinks them but doesn't necessarily eliminate the danger.

Barker's big research challenge is minimizing the risk of what she calls "collateral damage."

"If the drug comes out too fast, it could nuke everything," she said. "We don't want to nuke more than just the tumor. So, my goal is control how much comes out and how far it goes."

In preliminary studies Barker injected the core of a tumor and the drug went out to its margins—very promising.

This spring, Barker is preparing to collaborate with the UT Medical Center on preclinical models to further test her design. Pathologists will send her tumors that they have removed from real patients.

"We should be putting the drug right where we want it to go to maximize efficacy and minimize damage to healthy tissues."

—Libby Barker

She will cut the tumors into pieces, put them into immune deficient mice for growth, and then test her system. She'll then report her results back to the hospital in hopes of improving patients' treatments.

"There's a lag time between my work and treatment. So, we will treat the tumors several ways and our data will be put in the patients' charts for physicians to consult," she said.

Being at a flagship university, helping Tennesseans is particularly important to Barker. Just as important to her is the university's mission to educate. That's why she introduced her students to someone called MABELine—a sophisticated, full-body synthetic cadaver.

MABELine, named after the MABE department, makes the college the first in the world to have this resource, offering students unique experiential learning.

"Undergraduate biomedical students will go four or five years without ever seeing a real body," she shared. "I saw this synthetic cadaver and thought, 'we need one of these.'"

MABELine allows students to learn anatomy and design and test medical device prototypes using the most accurate synthetic model of a human body. The musculature and organ systems are the same as in a real cadaver and the skin and tissues feel real. In addition to MABELine, there is also a custom brain tumor model for cancer research and a separate muscled arm and leg for biomechanics studies.

Whether it's improving care for cancer patients, giving back to the community, or preparing students for the real world, nothing will stand in Barker's way.

"I believe, all the research I do—all the work I do—should impact the citizens of Tennessee."

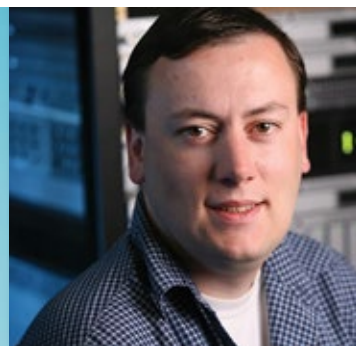


Rebel *with a* Cause

By Whitney Heins.

“This method puts us in the position to catch drug resistance as it is happening.”

—Scott Emrich



Thanks to **Scott Emrich's** rebellious nature, the world is getting a big step closer to saving thousands of lives a year.

When the associate professor of electrical engineering and computer science—newly arrived by

way of the University of Notre Dame—started his undergraduate degree, it was assumed by friends and family he would go to medical school. The thing was, he really loved working with computers—his so-called hobby in high school.

So, he went rogue and pursued bioinformatics and computational biology instead.

The result? A researcher who now has four active awards from the National Institutes of Health (NIH). His most recently funded effort is focused on conducting groundbreaking work in understanding genes in the malaria parasite that are associated with drug resistance—with the ultimate goal of reducing and eliminating the often-deadly disease.

According to World Health Organization, malaria affects roughly 215 million people a year and kills upwards of a half million. How, in 2018, are so many people are still suffering from this ancient disease? It's because malaria increasingly is mutating to outwit modern drugs.

“The challenge is that the parasite becomes resistant and it is doing it faster and faster. First it took hundreds of years, then tens, then even faster,” explained Emrich.

Emrich is collaborating with researchers in South Bend, Seattle, and San Antonio on an NIH multi-million-dollar project that aims to uncover resistance mechanisms by conducting experimental genetic crosses of the malaria parasite. And, then analyzing massive amounts of digital data from each of these crosses.

A genetic cross is the result of breeding two different individuals, for instance, one parasite known for drug sensitivity and one known for drug resistance. The resulting offspring then carry part of the

genetic material from each parent parasite, allowing researchers to identify the genes' underlying drug resistance with enough corresponding data.

In the past, researchers used chimpanzees. But this method was costly, timely, and ethically compromising, causing NIH to halt all chimp-driven research. This time, they're harnessing the power of mice which brings in a lot more data with a lot less time and money.

“The secret sauce of this research are these mice that can tolerate being injected with human liver and red blood cells,” explained Emrich. “The human cells grow on the mouse's liver and this allows for rapid and routine generation of large numbers of parasite progeny.”

Using computational methods, Emrich can then mix and match haploids—single sets of unpaired chromosomes—in the DNA sequence to find out which genes underlie resistance.

The mouse method has already generated more genetic crosses in the past three years than in the decades prior.

“This method puts us in the position to catch drug resistance as it is happening, as well as test unknown effects of resistant Asian and deadly African hybrids in the lab, so we can come up with a plan to combat the parasite head on,” said Emrich.

But malaria prevention isn't the only area of focus for Emrich. In fact, his passions are seemingly unending.

“At Notre Dame, my colleagues joked that I worked with every biologist on campus,” shared Emrich. “But what I see as unique about bioinformatics is that we are able to help solve many problems and have the ability to train students with diverse talents through many cool projects.”

Emrich noted he has graduated nine PhD students and they were the ones who did most of the work on all his very diverse projects.

Only here since the beginning of the spring semester, Emrich is already in talks about collaborating with colleagues across UT's campus in ecology, microbiology, and agriculture, in addition to those within his own department. Most of this early work will be collaborative with four EECS undergrads who have already joined his group meetings.

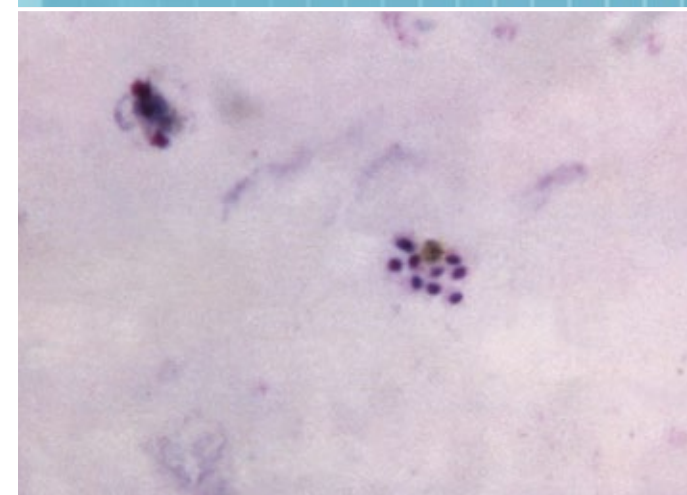
As he builds his program at UT, Emrich hopes to illuminate for his students the potential for collaboration that lies within computing.

“It can apply to so many disciplines and there are so many different career paths. I've had students go on to work at companies like Google, Amazon, and more traditional bio/pharma companies,” he said.

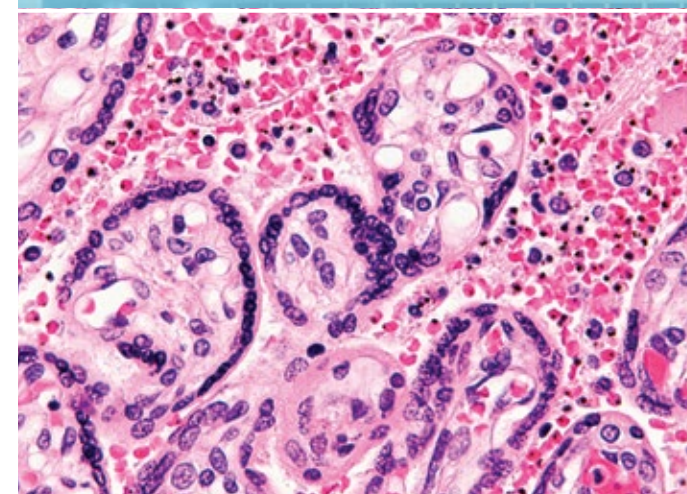
In effect, Emrich hopes his proclivity to push boundaries and rebel against the expected will open a world of possibilities—and fewer problems—for his students.



Anopheles stephensi is a primary mosquito vector of malaria in urban India. Photo: Center for Disease Control



Plasmodium malariae



Plasmodium falciparum

Crystal Clear

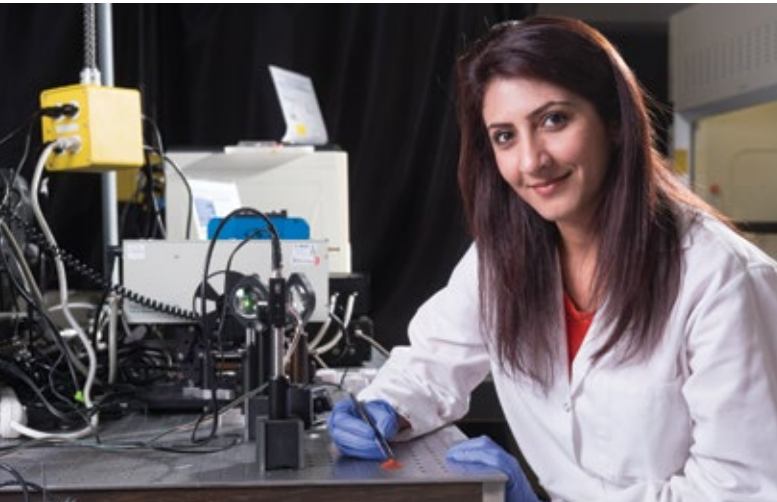
By Whitney Heins. Photography by Shawn Poynter.



Ask Mahshid Ahmadi who she credits for getting her interested in science and she'll tell you it was Professor Balthazar.

Was this a professor she had in undergrad? No, he's a cartoon character that she used to watch as a young girl growing up in Iran. The zany inventor made chemistry look fun. Now, as an assistant research professor in materials science and engineering (MSE), Ahmadi still thinks chemistry is fun—especially when placed at the intersection of materials science, physics, and electronics.

"This position gives me the opportunity to see science problems from different perspectives," she shared. "It lets me think outside of the box which is the key to finding innovative solutions."



Ahmadi and her colleagues MSE Professor Bin Hu and Assistant Professor of Nuclear Engineering Eric Lukoski, are innovating as part of one of the first few groups in the world to investigate a novel class of materials for multifunctional detectors, such as the dual gamma ray-neutron detectors used to detect high-energy radiations.

The non-conventional group of materials Ahmadi is working with is called hybrid organic-inorganic perovskite materials. Organic materials are cheap, easy to make, and flexible. Inorganic materials like silicon can have strong optical and electronic properties making them the go-to for solar cell and sensor devices. Put them together and you have the dream team—the ability to design efficient devices that are relatively easy and inexpensive to make.

"I'm very passionate about transforming technologies through the development of new high-performance and non-conventional materials with the potential to change the way we architect opto- and electronic devices," Ahmadi shared.

Translated to the everyday world, it means more energy-efficient and low-cost rooftop solar panels, cheaper medical imaging equipment for disease diagnosis, and security systems that can more easily detect threats, to name a few advances.

These powerful properties are housed in a beautiful, almost Tennessee-orange-colored crystal. Discovered several decades ago, scientists had all but given up on harnessing the strong capabilities of the hybrid perovskite due to its complicated properties.

Researchers typically must mix the materials together, melt them at high temperatures using large, expensive equipment, and then wait several weeks for the crystals to grow. Inside the lab at JIAM, and with financial support from the US government, Ahmadi is not daunted by the complexity of the task. She is working on a more cost-effective technique to grow single crystals in just one day that contain properties finely tuned to the desired application.

"The organic component renders good chemical solubility and facilitates solution growth," Ahmadi explained.

The final product is an extended network of crystalline building blocks with good electronic properties. The material can grow as a very thin film—just a few nanometers in size—for use in tiny solar cells like in a watch or calculator. Or, it can be grown in a larger three-dimensional crystal, about a millimeter in size, for use in sensors and detectors.

Ahmadi finds this basic research exciting on every level and feels especially grateful to be able to conduct her work at a world-class facility with the strong support of her departmental colleagues, staff, and head—all at a place that seems to be getting better every day.

"When I walk through UT's campus, I always see new construction, new research facilities, and this shows how people are working hard to make UT the best place for education and learning," she shared. "I am glad to be part of this development."

Ahmadi does her part in education by involving students in her research. She hopes to inspire them as her colleagues—and Professor Balthazar—have inspired her.

"Science is both an art and a profession. And, being a scientist is very rewarding. You are solving important problems and the work is very, very valuable," she said.

Indeed, being a scientist has the power to change lives, including your own.





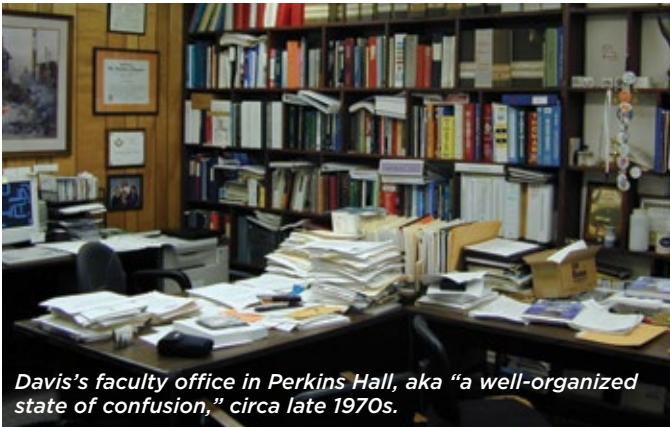
Dean Davis throughout the years, 1971-present.

Dean Wayne T. Davis

A Legacy

One of the best ways to take measure of someone's career is to listen to the voices of those whose lives they've impacted. As Dean Wayne Davis prepares to retire at the end of June, we reached out to his former students, faculty, staff, and friends to get their perspective on the 47 years he spent as a PhD student ('71-'74) and then faculty member ('74-2018) at the university. Here, now, are some select words about what Dean Davis meant to some of those individuals.

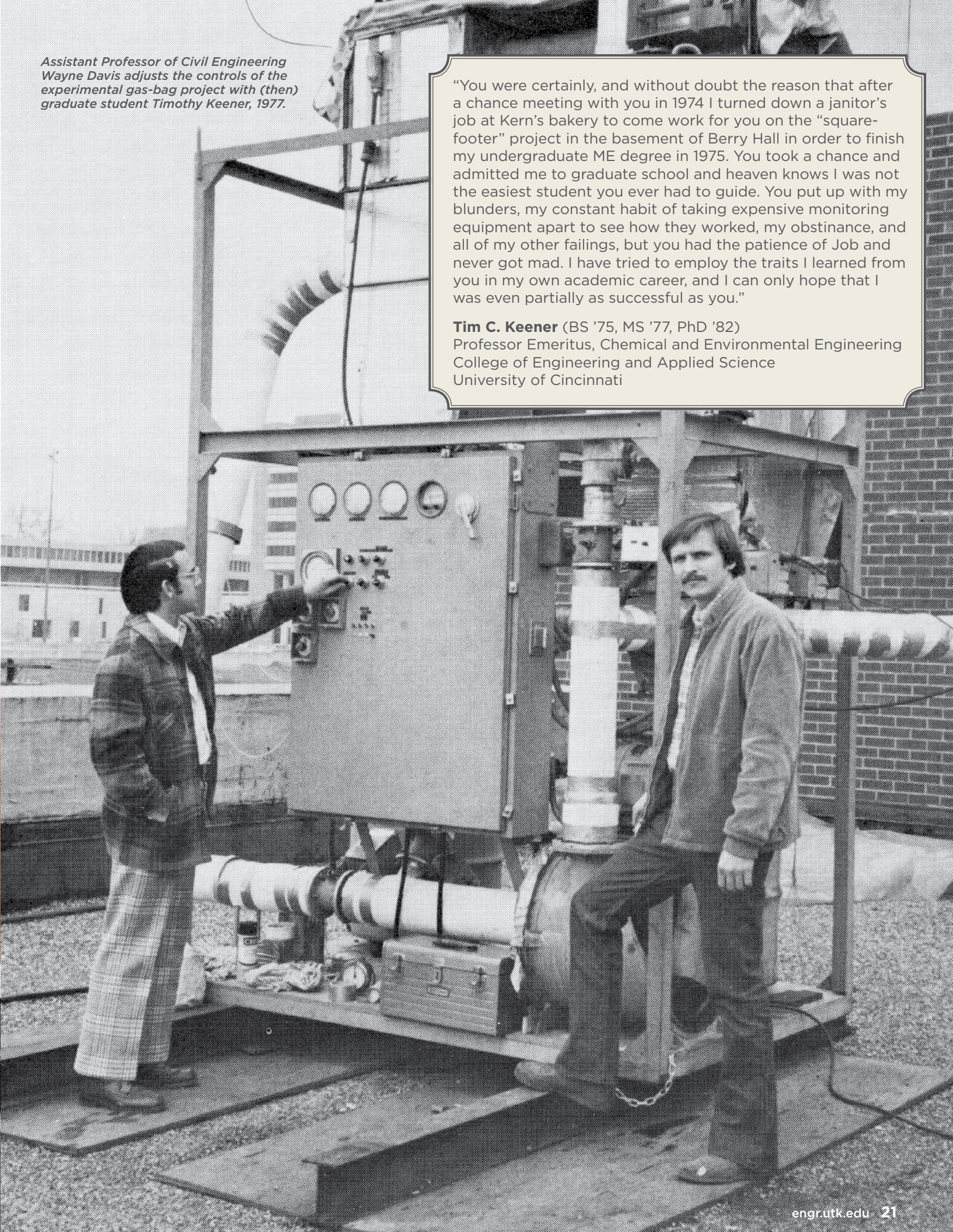
Visit tiny.utk.edu/deandavis to see comments and to share your own memory of Dean Davis or wish him well for his retirement!



Davis's faculty office in Perkins Hall, aka "a well-organized state of confusion," circa late 1970s.



Dean Davis with engineering students on the Tickle Bridge celebrating the college's 175th anniversary in 2013.



Assistant Professor of Civil Engineering Wayne Davis adjusts the controls of the experimental gas-bag project with (then) graduate student Timothy Keener, 1977.

"You were certainly, and without doubt the reason that after a chance meeting with you in 1974 I turned down a janitor's job at Kern's bakery to come work for you on the "square-footer" project in the basement of Berry Hall in order to finish my undergraduate ME degree in 1975. You took a chance and admitted me to graduate school and heaven knows I was not the easiest student you ever had to guide. You put up with my blunders, my constant habit of taking expensive monitoring equipment apart to see how they worked, my obstinance, and all of my other failings, but you had the patience of Job and never got mad. I have tried to employ the traits I learned from you in my own academic career, and I can only hope that I was even partially as successful as you."

Tim C. Keener (BS '75, MS '77, PhD '82)
Professor Emeritus, Chemical and Environmental Engineering
College of Engineering and Applied Science
University of Cincinnati

"He's moved the college farther than I've seen anyone move it. It's been really impressive to see the way he's expanded the number of structures, the number—and high quality—of faculty and students, and the opportunities available there. He's done all the right things, from connecting personally with alumni and corporations to expanding and solidifying the relationship with the research being done in Oak Ridge, particularly at Oak Ridge National Laboratory. No other place in the country has a better relationship between a university and a national laboratory, and he's a big part of making that happen."

Chad Holliday (BS '70)
Chairman, Royal Dutch Shell
Former CEO, DuPont
Former Chairman, Bank of America

(L-R) Chris Cox, Davis, Bruce Robinson, Terry Miller, and Jim Smoot enjoying a bike ride at Cades Cove, 1992.



"It has been an honor to assist Dean Davis for the past five years. He is so insightful and it is truly a learning opportunity to work with him. I especially remember the times I've gone into his office with a problem. He calls them "hiccups." We would sit at the table and talk through the issue—whether it was a schedule glitch on his calendar, a policy question, or a travel dilemma. He expects these hiccups and uses them as an advantage to learn something new, address a policy, or alter the original issue. I value his perception and have tried to learn from him and apply these principles in my own work."

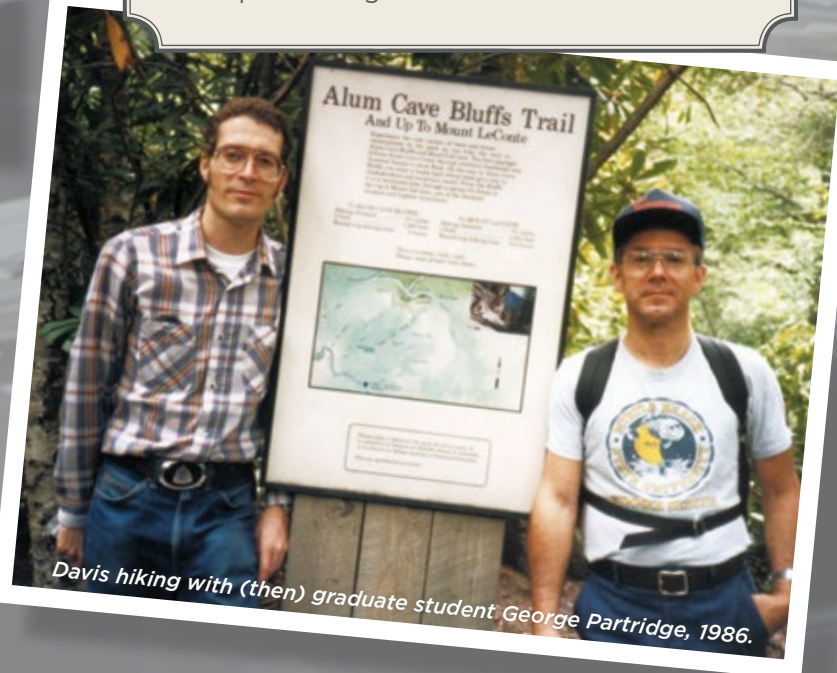
Leah Buffington
TCE Special Programs Coordinator

Wayne and Sylvia Davis, 1969.



"Dean Davis was very enthusiastic and supportive of my coming to UT, and he was unrelenting in his determination to find space and support for establishing the Ion Beam Materials Laboratory. I am grateful for his continued support of our research, for his leadership and guidance to the college and faculty, and his service to UT."

William Weber
UT-ORNL Governor's Chair for Radiation Effects on Materials



Davis hiking with (then) graduate student George Partridge, 1986.

"Over the years, I have had the pleasure of not only working with Wayne but also having him introduce me to hiking in the mountains and playing mountain music (he encouraged me to play the fiddle and at least I'm still trying to on my part). Through all the years of teaching, research, and service to UT, Wayne has always focused on progress and quality. His dedication to teaching in spite of demanding responsibilities was impressive. How he ever found time to write a popular textbook is beyond me. His concern for student success and welfare has been a hallmark of his career. His administrative abilities became apparent long before he was named dean. His selection was no surprise. He has been an extremely effective dean in strengthening the college in learning, research, and facilities and he deserves all the accolades that come his way."

Greg Reed
Former Associate Vice Chancellor for Research
Former Interim Dean, College of Communication and Information
Former Department Head, Civil and Environmental Engineering



"Always researching something." Davis outside the Hecla Mining Company, Idaho, 1983.

"Thank you for all you have done for UT's COE, and especially for your vision, leadership and direction that has made the college a better place for students, faculty, and affiliates. Your expertise, skills, friendliness and personal connections made for memorable and enjoyable work on the Board of Advisors as well as within and for the college. It was always a pleasure to talk and work with you. I'm thankful for you and will remember you fondly."

Karyl Bartlett (BS '84)
Director (retired), Composite Manufacturing Center, Boeing Fabrication



Davis speaking at the celebration of the naming of the Tickle College of Engineering in 2016 as former Chancellor Jimmy Cheek looks on.



Davis shaking hands with music hero Bill Monroe, 1995

"Dean Davis and I worked together very closely beginning in 2005 to establish the Scintillation Materials Research Center. At that time, the concept of a research center sponsored jointly by the university and private industry was largely unknown at UT, but Dean Davis fully supported the idea from the beginning and was determined to find solutions to the many legal and intellectual property issues that arose. He worked tirelessly with the UTRF legal team and the university administration as well as with Siemens leadership for most of a year to ultimately create the agreement between the university and Siemens that established the center. Without Dean Davis's determination, I really doubt that the SMRC would exist today."

Chuck Melcher
Director, Scintillation Materials Research Center

Davis and Chuck Melcher enjoy a scintillating discussion at the 10th anniversary of the SMRC, 2016.



Davis serves as Honorary Coach for the Vols vs. Vanderbilt game, November 2013.



"I met Dr. Davis in April 2010 at James Pippin's retirement celebration. He is very passionate and supportive about student success. He always displays a positive and motivational "Let's Do It" attitude when handling the toughest challenges."

Travis Griffin,
Director, TCE Engineering Diversity Programs

Davis looking at building plans during the construction of the Min H. Kao Electrical Engineering & Computer Science Building, circa 2010.



"To say I was sorry to see you retire would be a huge understatement. Your leadership has accelerated the progress of moving Tickle Engineering into the top tier and has given all us graduates bragging rights again. However, as one who has retired, and finding it to be a great time of life, I am very happy to congratulate you on your many contributions to UT and our profession and I wish you and your family great health and all the fun you can stand."

Jim Porter (BS '65)
President, Sustainable Operations Solutions, LLC

"Washington, DC, was shutdown by snow. That didn't stop Dean Davis. He put on his snow boots and walked from Georgetown to my office across from the White House. He was committed and determined to meet and visit an alumnus. That action said more than any words he could have expressed during our terrific visit. It put me to shame, it inspired me, it got me to thinking: If he is that committed, how can I stand on the sidelines? ... When you leave, you will be missed. Your work will be still and always be there to serve, to inspire, and remind us you were there and made a difference."

Dwight Hutchins (BS '86)
Asia-Pacific Managing Director,
Accenture's Strategy Consulting Practice for Products

Davis above the footprint of the future John D. Tickle Engineering Building, circa 2011.



"Dr. Wayne Davis is a warm and caring person. He provided constructive advice during my master's program, my attachment in an air pollution consultant company in Knoxville, and my career in the Environmental Protection Department in Hong Kong. To me, he is both a helpful teacher and a friend."

Tsui Wing-Sing (BS '78, MS '80)
Environmental Protection
Department, Hong Kong

Doctoral Student Davis, 1975.



"I remember 30 years ago when you taught me as a grad student that you were energetic, accessible, and a great instructor. Now, as a parent of two daughters in Engineering at UT, I can honestly say that only your title changed—the man remained the same. You will be greatly missed, and I know that UT can never "replace" you in my eyes. If it had not been for educators like you, I would have never completed that graduate degree nor earned my PE. I do not exaggerate when I say that both of those accomplishments have been life changing for me in an overwhelmingly positive way ... UT has some large shoes to fill."

Eric T. Newberry Jr.
General Manager, Athens Utility Board
Father of Hope (BS '16) and Abby (current student)

"Dean Davis has always gone above and beyond for students like me. He had my father as a student years before, and stayed in touch with him often enough that when my sister and I came to campus, he not only recognized us, but he always asked how we were doing and how he could improve things for students in the college. I am going to miss seeing him around campus, but I wish him all the best in his retirement."

Abby Newberry
(current student, ChemE)



Wayne and his grandfather, circa 1950.

Built for the Future

By David Goddard.

Engineering at UT has undergone almost constant change since its first courses in surveying were offered 180 years ago.

Departments and disciplines have come and gone, barriers and boundaries of study have emerged and been developed, and the students, faculty, and buildings on campus have continued a steady drumbeat of growth.

The next phase of the Tickle College of Engineering's evolution will soon begin with the construction of a \$129 million, 228,000-square-foot building that will house the nuclear engineering department, the innovative Jerry E. Stoneking *engage*™ Engineering Fundamentals program, the Joseph C. and Judith E. Cook Grand Challenge Honors program, the Min H. and Yu-Fan Kao Innovation and Collaboration Studio (ICS), and many other laboratories for advanced engineering research.

The yet-to-be-named building is being designed to serve as a "Gateway to Engineering," and to present a new look for the university by creating a new entrance for campus via the Hill and surrounding areas.

A newly created assistant deanship—whose role will be to build collaborations between the college, the university, and corporate partners to enrich student design projects—will be based in ICS.

"This building is the latest sign of both our growth and our university's commitment to providing the best experience possible for our students," said Dean Wayne Davis. "We will be able to enhance the educational journey of our honors students and our freshmen, and we will finally be able to have our nuclear engineering department be in a building worthy of their nationally recognized status."

For nuclear engineering, having a building designed with modern loadbearing standards means the department can have laboratory, classroom, and research space and equipment not previously possible in its former home in Pasqua Hall.

Nuclear engineering students will have more opportunities to conduct research as well, thanks to a unique design feature of the building.

The western portion of the building closest to the stadium will house student instructional spaces and offices. It is required to close during major stadium events, whereas the eastern portion can remain open. It will include both general and nuclear engineering



research laboratories, allowing experiments to run continuously without interruption.

The building will be particularly important for undergraduates, with all first-year classes, labs, and design laboratories to be located there, as well as observation areas where passers-by and tour groups can watch students at work. ICS will also support design work done by sophomore, junior, and senior students.

"The building illustrates an excellent view of the significance of engineering as a profession and as an important component of the UT campus," said Masood Parang, associate dean of academic and student affairs. "It will also provide our students with new and better opportunities. We are certainly placing a premium on engineering labs, classrooms, and maker spaces, all of which will help better prepare our students for their educational and professional needs."

Honors students will also see their opportunities expand in the new space with greater emphasis placed on equipping them with the tools to find new ways to solve some of the world's most pressing challenges.

Outside will see welcoming plazas and green spaces, while entry through the atrium will present students and visitors alike with information and history about the college.

Demolition will begin this summer, with the groundbreaking set for the fall.

The project will be closely coordinated with the first phase of new improvements slated for Neyland Stadium, which will also begin in 2018 and are set to include a new pedestrian plaza between the stadium and Neyland Drive.



Above, south view of the complex. Below, a cutaway of the atrium and building interior. Renderings by McCarty Holsaple McCarty in collaboration with SGJJR.

A Bridge to Success

By Whitney Heins. Photography by Shawn Poynter.

better understand student learning. Faber also grades students on their work rather than just on whether they got the right answers.

This approach can make a big difference in a student's overall sense of wellbeing and can be the difference in them sticking around when the going gets tough.

"Many of the students get down on themselves if they don't get it right," shared Faber. "So, we teach them how to manage disappointment along with how to develop the mind and skillsets to tackle complex problems."

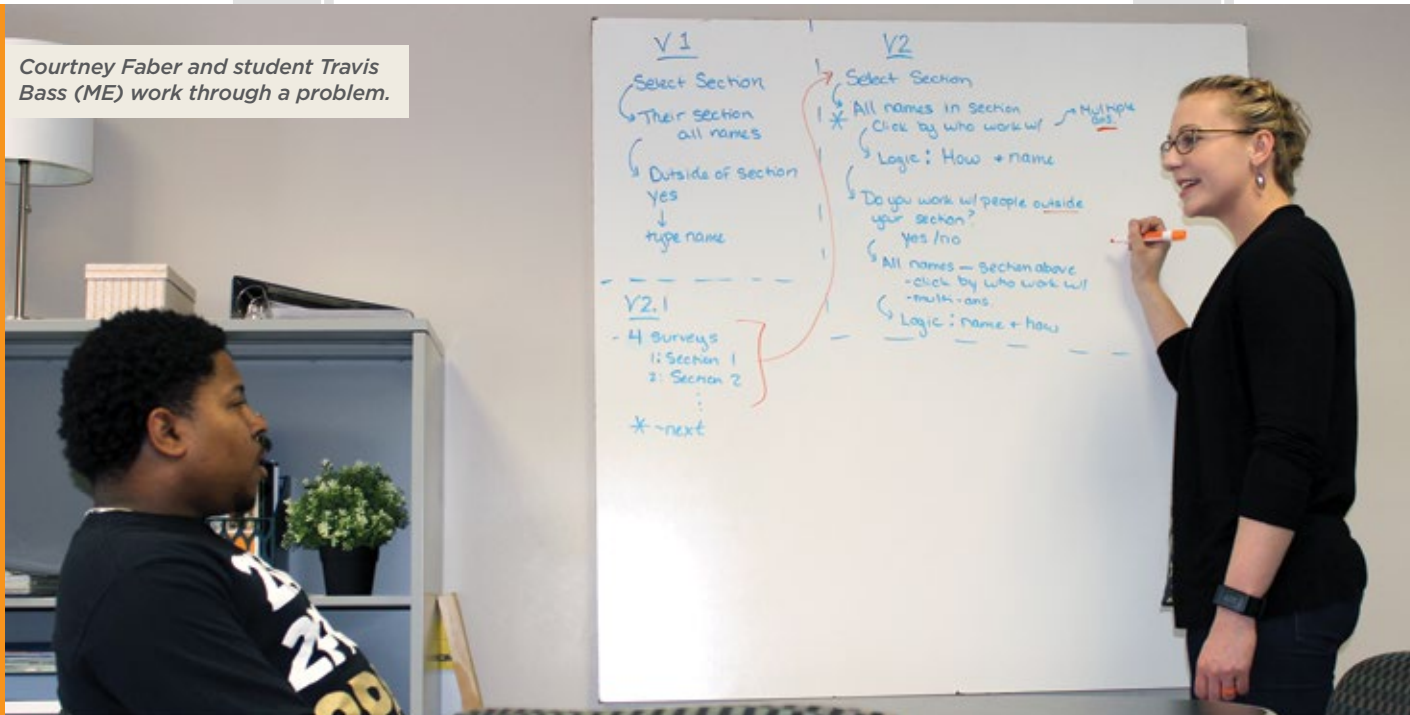
McCord remembers what it was like to always get the right answers in high school but then struggle in college with unfamiliar content and a new workload. That's why she offers her Engineering Fundamentals students Success Enhancement and First Year Studies

If successful, McCord and her Engineering Fundamentals colleagues would like to create more active learning opportunities like this for students. In fact, it has been an important topic of discussion in the design of the New Engineering Complex which will house the freshmen programs.

"Our team is really excited about creating a curriculum that we don't have to fit into existing spaces," she shared. "Now we can dream how we want our classes to run and have the space fit that."

Both Faber and McCord have frequently been told by past students about the impact they've had. Indeed, it seems the professors' work has acted as more than just a bridge to college, but a bridge to overall academic and professional success. Their support has taught students transferable skills like how to

Courtney Faber and student Travis Bass (ME) work through a problem.



Rachel McCord discusses concepts in class with students.



The student that gets really upset when they don't ace a test. **Courtney Faber has been there.**

The student who feels completely in over their head. **Rachel McCord has been there.**

These lecturers' past experiences as students themselves are what make them so great at what they do. They've been there. They know what students need to succeed and they're here to help.

Faber and McCord are tasked with educating first-year engineering students to prepare them for their discipline-specific course load. The task is no small one.

"Many of our engineering students arrive here from high school where everything came pretty easy for them, and they can really struggle with the material and methods to do well," explained Faber.

At times, first-year engineering students can become susceptible to feeling overwhelmed and giving up, but

that's where Faber and McCord come in. These faculty members view themselves as a bridge from students' high school experiences to their college careers where they teach the engineering basics and arm them with strategies to succeed in the program.

For example, Faber's teaching doesn't emphasize getting the right answers. Rather, she emphasizes the process used to get there.

"We focus on the problem solving," explained Faber, who teaches physics and engineering design to students in the Cook Grand Challenge Honors program. "We talk with them about whether the answer is reasonable and makes sense. There's a lot of dialogue."

One way Faber and her team does this is by not giving the teaching assistants (TA) the answers. Instead, the TAs must focus on the method rather than just comparing end results. To support this strategy, Faber works to educate TAs on how to

programs that teach them learning strategies to more rapidly adapt to collegiate life.

The programs are customized to fit students' needs, which is something McCord is big on.

"What support a student may need differs even just based on the semester," she explained. "For example, a major difference between a first- and second-semester student is an understanding of how to navigate the college process and how it differs from high school."

McCord and her colleagues are always looking for new approaches that rise above the status quo. For example, this semester she is teaching a "flipped" curriculum in which she records her lectures for students to watch outside the classroom. Inside the classroom, they work through problems together.

"The students are asking more questions than they normally would have and have told me that they understand the material better," said McCord.

communicate with others that think differently, critical thinking, and the ability to be a good learner both inside and outside the classroom.

"It is really encouraging to hear from students the difference we've made for them," said Faber. "My goal is to see all my students who want to become engineers become engineers."

"These students will be really great in their jobs as engineers because of the strategies we've helped them develop," said McCord. "In the end, we want students to know that we don't just care about their physics content. We care about them as students."

And that, no doubt, shows in the number of successful engineers graduating from UT's program and crossing the bridge into the real working world.

By David Goddard.
Photo by Randall Brown.

Hearing that a project in the Min H. Kao Department of Electrical Engineering and Computer Science involves neon doesn't sound out of the ordinary at first blush, perhaps evoking images of Times Square, Piccadilly Circus, and the signs of yesteryear.

But this neon comes from the computer science side of the department and has more to do with the future of artificial intelligence and robotics.

The project—officially titled NeoN: Neuromorphic Control for Autonomous Robotic Navigation—aims to build a navigation system that uses neuromorphic control.

Graduate student **Parker Mitchell** and undergraduate **Grant Bruer** teamed up with ORNL's **Katie Schuman** ('15, PhD, CompSci) to serve as leads on the project.

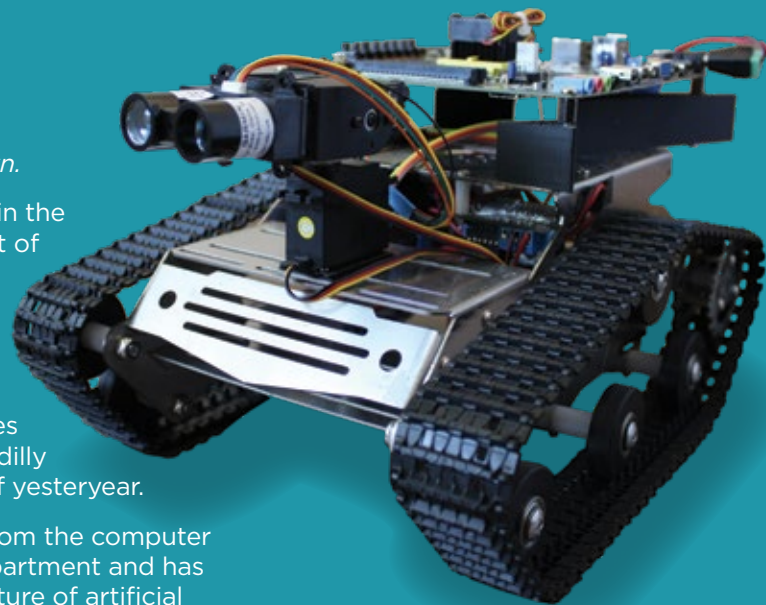
As opposed to programmed control, where the operator designs a framework telling the machine what to do, neuromorphic control allows the machine to learn independently by running through several different computer scenarios.

In this case, the robot was asked to navigate around a series of obstacles placed on the floor of a room, the idea being that a machine could be taught to learn from its mistakes.

Each scenario presented the robot with hundreds of thousands of maneuvers to choose from. As Bruer points out, finding the optimal path would have taken prohibitively long in a physical environment, so the team was forced to find a virtual solution.

Thanks to Schuman's connections at the lab, the answer was Titan, ORNL's room-sized supercomputer.

"We used Titan to run different scenarios through the brain, keeping the ones that worked and 'killing off' the ones that didn't," said Mitchell. "It's the neuromorphic equivalent of survival of the fittest."



From there, the team paired the best performing maneuvers from the simulation with Lidar to help give the machine "eyes."

Lidar uses light to detect objects in much the same way as radar uses sound.

It allows the robot's brain to recognize objects in its path and react to them in the real world the same way it learned to in the virtual world via the simulations, giving the devices a certain level of autonomy.

"The idea is to cover as much of an area as possible while not hitting things," said Schuman. "It first learns to avoid stationary objects and then adapts to avoid moving obstacles."

Schuman pointed out that applications for the project include everything from search and rescue operations to any situation that might be too dangerous for humans.

The team's work could also be applied to drones, further aiding those types of situations.

The idea came out of the department's TENNLab—Neuromorphic Architectures, Learning, Applications—where Mitchell, Bruer, and Schuman are members, along with UT's John Fisher Distinguished Professor **Mark Dean**, Professor **James Plank**, and Associate Professor **Garrett Rose**.

All of those TENNLab members helped advise and offer input on NeoN, with nearly two dozen students in the department helping design the body.



(L-R) Maker's Club members Chase Cumbelich, Riley Toll, Chad Duty and Alex Weber

If You Come, They Will Build It

By David Goddard. Photo by Randall Brown.

A recently formed club at UT is providing students an outlet to bring their ideas to life via a mix of traditional and cutting-edge manufacturing methods.

The Maker's Club began in 2017 with the goal of bringing together students and faculty interested in the makers movement, a group united by the idea of people learning and maintaining practical skills that were once common but are now in danger of being lost and to developing skills in cutting-edge techniques such as 3D printing.

The club focus on turning ideas into reality is attracting students from various majors across campus.

"It started because of an idea we had in class," said **Chase Cumbelich**, an electrical engineering junior from Ooltewah, Tennessee, who helped found the club.

"We kept hitting a wall while we were trying to develop something, and we realized our lack of contact with and knowledge of other majors was really hampering us," he said. We reached out across the college and got about 30 people interested, and the club just kind of snowballed from there."

Now that club is changing the life of a classmate.

One of the first things the group was able to produce was a 3D-printed hand, developed with other engineering students. At a group meeting, the question was raised whether anyone knew of someone who might be in need of such a hand.

Riley Toll, a biomedical engineering freshman from Memphis stood up and said, "Yeah . . . me."

"I'd heard about the group and had a lot of interest," said Toll. "Things like this are one of the reasons I was interested in engineering to begin with—to be able to help people and give back. Hopefully this brings some awareness to what can be accomplished through engineering."

Chad Duty, associate professor of mechanical, aerospace, and biomedical engineering, introduced the idea of 3D-printed prosthetics to the club, stemming from an ongoing effort of a group called the Enable Community Foundation. Enable connects patients across the world who are in need of prosthetic appendages with groups like the Maker's Club that have access to 3D printers.

The two parties work together to get the prosthetic limb fitted to the specific size and needs of the patient, and it is delivered free of charge.

Duty pointed out that groups like Enable—that bring people together for a common cause—underscore the role of having a network of makers and the promise that such innovators hold.

"There are a lot of good things that can be accomplished when groups of people work together," said Duty. "The sky is the limit."

A Systems Thinking Approach



Frenando Blevins

Last fall, students from the Integrated Business and Engineering program (IBEP) teamed up with Local Motors to design a bus stop kiosk for Olli, a self-driving vehicle. Here, sophomore **Frenando Blevins** reflects on his experience.

One of the many great things about IBEP is how it cultivates an environment for business and engineering students to work together. We don't just sit and take the same classes; we have intentional activities and discussions that help everyone to understand each other's perspectives. This particular class was Problem Solving and Systems Thinking with Dr. **Rupy Sawhney**, and these concepts proved vital for the kiosk project.

It was our first time partnering business and engineering students for a task, but even with our significant differences, especially in regards to our strengths, we were able to expand what we could achieve and create.

I noticed there were generally two different mindsets: The engineering students asked "how do we solve this problem?" and the business students asked "how can we make the best solution possible?" In a way, these mindsets are the same, they just come from different angles. I now have a new perspective not only on working with business students, but with all people.

Engaging in this experience with a company made it that much more meaningful and useful. It helped me understand what business professionals expect and

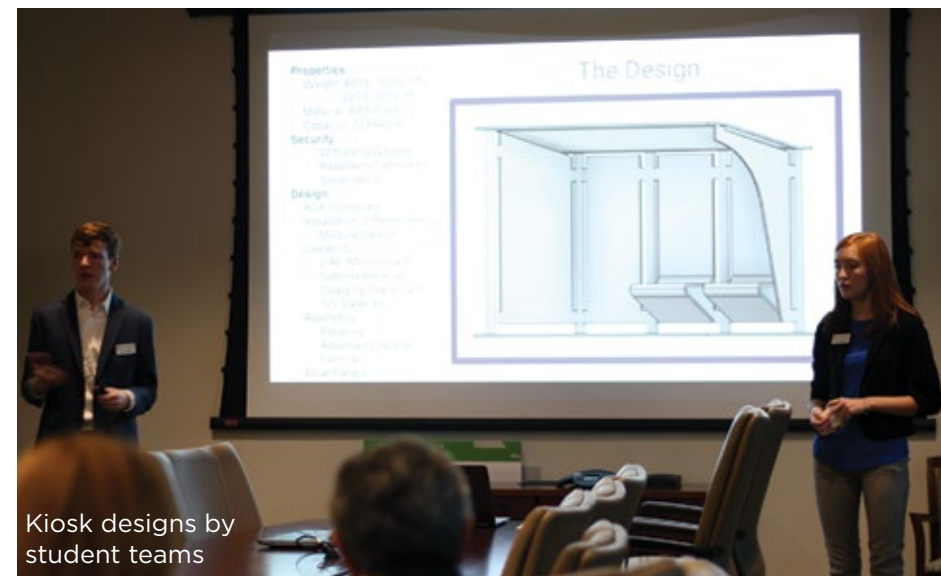
how they typically operate. For example, managers do not have the time to hold your hand and guide you every step of the way, so once you are given an assignment, you need to know where to start.

In class, I learned to think of systems thinking as a mindset. Dr. Sawhney challenged us to put it to practice in our personal lives, and from doing that I began to understand how to go about solving any problem, whether personal or professional.

This strategy of identifying the stakeholders and then finding the root cause of their problem will be instrumental in how we handle problems for the rest of our lives. It proved pivotal for the project, and as a result, all the project groups were successful in creating effective and creative solutions. Local Motors is even considering using some of our ideas in the actual kiosk.

My classmates and I are just sophomores, yet this project was the caliber of Senior Design. Even though the opportunity was somewhat intimidating, I felt well prepared to do what was expected of me. I am humbled just by having had the opportunity to engage in this project and help Local Motors. IBEP provides tremendous opportunities like this project that no student should miss out on, and I am honored to be part of this first cohort of brilliant students, faculty, and alumni.

Meet Frenando at tiny.utk.edu/frenando, and meet Olli at localmotors.com/meet-olli.



Kiosk designs by student teams



Olli, the self-driving vehicle by Local Motors.



Students attend kiosk presentations

The kiosk project gave students a great opportunity to apply systems thinking to a real-world project and recognize that having a diverse team leads to more creative and better solutions.

This year, the students are working on a project for the Knoxville Business Support Network, a combination of five local nonprofit organizations in East Tennessee. They will interview the organizations and some of their clients to understand their goals and determine what makes each of them unique.

By applying what they're learning with systems thinking, design thinking, and professionalism, the students will then design a consolidated website and possibly other materials that will allow potential clients to interact with and see events for all five organizations.

A key element of the program is exposing students to industry through real world projects, site visits, and external speakers. To contribute in any way, contact **Mary Brow** at integrate@utk.edu. Learn about the program at integrate.utk.edu.

Student Notes

Danika Dorris (ISE) received first place in the 2017 IISE Operations Research Division Undergraduate Student Research Dissemination Competition.

A team of MABE students was selected to compete in NASA’s Student Launch project, where 45 teams from across the country will compete to build a reusable rocket capable of carrying a payload at least one mile high and successfully land it back on Earth. The rocket trials will take place at NASA’s Marshall Space Flight Center in Huntsville, Alabama, this April.



Last fall, CEE students and faculty participated in the annual Canstruction competition to help fight hunger in East Tennessee. The event collected more than 44,300 cans of food. View more photos of their interactive ‘holiday house’ at tiny.utk.edu/canstruction.



The Women of Color STEM Conference named **Jasmine Worlds** (MABE) the 2017 recipient of the Student Leadership award from the Career Communication Group last October. Worlds was honored for her work in engineering and for her commitment to volunteering outside the classroom.

Graduate student **Michael Stanford** (MSE) earned the ORNL Graduate Student Researcher award, the AVS Dorothy M. and Earl S. Hoffman Scholarship, and the AVS James Harper award for his research with Professor Philip Rack. The ORNL award is given for outstanding research contributions to focused ion and electron beam-induced processing and defect manipulation in 2D materials. The Hoffman scholarship recognizes and encourages excellence in graduate studies in the sciences and technologies of interest to the American Vacuum Society. The Harper award is the premier competitive graduate student award for the Thin Films Division of AVS.



YNOT, a team of EECS students, took home both the Robot Skills Champion and the Overall Excellence awards at the Purdue Winter Vortex Qualifier in February, and are now moving on to compete at the Vex U World Championships this June in Louisville, Kentucky. “This is what we have been working toward all year. Only 26 spots are open for US teams at Worlds, so it is an honor to get one,” said team member **Grant Kobes**. Purdue judges complimented YNOT on the team’s engineering notebook and interview skills, and told them they were the unanimous Excellence winner.

Nuclear engineering students **Joshua Cunningham**, **Jonathan Gill**, **Colton Oldham**, and **Matthew Tweardy** were awarded positions for 2018 in the Pacific Northwest National Laboratory NNSA Graduate Fellowship Program, a program for highly motivated graduate students interested in a career in nuclear security.



Lia Winter (BME) won the Boyd Venture Challenge for her “Easy Whip” surgical tool. The award came with \$12,500 in seed money.



Join Stephanie.
Join the Journey.

“I am extremely grateful for this generous support to improve the recruitment and retention of women engineers through advising student organizations and providing hands-on undergraduate research opportunities in structural mechanics. I am honored to serve as a passionate student advocate dedicated to inspiring our next generation to reach their goals in memory of Jessie Rogers Zeanah.”

— Stephanie TerMaath, assistant professor and Jessie Rogers Zeanah Faculty Fellow in MABE.

Join Stephanie in guiding our students to become leaders in their fields. Call 865-974-3011 or visit giving.utk.edu/faculty.

Faculty & Staff Notes

Assistant Professor **Jamie Coble** (NE) was recently named the inaugural Southern Company Faculty Fellow.

In March, Research Assistant Professor and Lecturer **Courtney Faber** (Honors) earned the 2018 ASEE Southeastern Section Thomas C. Evans Engineering Education Paper award at the section's conference for her paper entitled "Engineering Students' Epistemic Cognition in the Context of Problem Solving," co-written with colleague Lisa Benson of Clemson University.

Department Head and Granger and Beaman Distinguished University Professor **Bamin Khomami** (CBE) was named a 2018 Fellow by the American Association for the Advancement of Science.

Ivan Racheff Chair of Excellence **Peter Liaw** (MSE) was named a TMS Fellow of the Minerals, Metals, and Materials Society. This pinnacle award is only given to 100 living individuals at any one time.

Jerry and Kay Henry Professor **David Mandrus** (MSE) was recognized as part of the one percent of most cited scientific researchers in the world. He has been cited more than 20,000 times for his research involving the synthesis and crystal growth of new materials through the use of innovative experimental tools.

Assistant Professor **James Ostrowski** (ISE) was selected for negotiation of a financial award under FY2017 by the Early Career Research program. His research in "Symmetric Convex Sets: Theory, Algorithms, and Application" was selected by the Office of Advanced Scientific Computing Research.

Henry Goodrich Chair of Excellence **Thanos Papanicolaou** (CEE) was honored by ASCE with the 2018 Hans Albert Einstein award. Papanicolaou was also appointed to serve as co-chair of the Surface Water working group of Governor Bill Haslam's TN H2O Project, established to develop a statewide water plan to better understand strategic water resource needs and priorities for the state.

Assistant Professor **Stephanie TerMaath** (MABE) was recently named the inaugural Jessie Rogers Zeanah Faculty Fellow.

Condra Chair of Excellence in Power Electronics **Fred Wang** (EECS) was selected for induction as a 2017 Fellow of the National Academy of Inventors—one of the highest honors a researcher can achieve.

UT-ORNL Governor's Chair for Computational Nuclear Engineering **Brian Wirth** (NE), was named a Fellow of the American Nuclear Society, the group's highest honor.

A Banner Year for CAREER Awards

This spring, the college is thrilled for the five assistant professors who have received NSF Early CAREER Development awards. The program supports the research of early-career faculty who have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization. At time of publication, the 2018 winners include:

Daniel Costinett (EECS)

Sirus Larsen (CBE)

Joshua Sangoro (CBE)

Andy Sarles (MABE)

Timothy Truster (CEE)



After 32 years of service to the university, Executive Director of Development **Dorothy Bryson** is retiring this spring. Bryson's dedication, enthusiasm, and energy have significantly propelled our college forward in countless ways to impact the lives of all our faculty, staff, and students. Throughout her career, she has been a strong mentor for dozens of development professionals. Bryson will be remembered for her genuine nature and true compassion for improving lives.

Celebrating 45 Years of Diversity in Engineering at UT

By Randall Brown.

Since 1973, the Office of Engineering Diversity Programs (EDP) has grown to support not only multicultural students, but also female students.

More than 1,000 students have benefited from scholarship and resource support provided by the Fred Brown Jr. Minority Academic Endowment, the James Pippin Pre-College Program Endowment, and the Engineering Diversity Excellence Endowment.

EDP's partnership with the Tennessee Louis Stokes Alliance for Minority Participation (TLSAMP) provides students monthly enrichment on subjects involving professionalism and student development as well as post-undergraduate workshops and GRE preparation.

"EDP continues to develop partnerships across Tennessee to support community-based programs with the goal of supporting student learning and engineering exploration," said **Travis Griffin**, director of EDP.

In 2017, the Engineering Volunteers for Ninth Graders summer program was selected for the National Association of Multicultural Engineering Programs Advocates Outreach Program award. This award honors programs that have actively increased the participation of students from historically underrepresented minority populations in engineering.

"We've come a long way, but the journey continues," says Griffin. "We are committed to supporting underrepresented students in any capacity."

The office's renewed focus on outreach and programming to recruit and retain women may already be paying off—this year has seen a marked increase in women accepted to join the college in the fall of 2018.

Griffin's goal is to provide programming to address recruitment, transition, and retention of female engineering students while continuing the strong support for multicultural engineering students and their communities. Efforts will include class clustering, academic workshops, and community building in order to improve academic performance and retention.

View the college's diversity milestones at tiny.utk.edu/EDP45.



Save the Date: Join the college for 45 Years of Community Excellence: A Celebration of Continuing Growth on **November 2**.



Follow the celebration with **#EDP45** and watch videos of our diversity ambassadors at enr.utk.edu/diversity/edp45.



Alumni Notes



Laura Lackey (BS/ChE '87, MS/ChE '92, PhD/ChE '93) has been named dean of the Mercer University School of Engineering in Macon, Georgia, after serving as interim dean in the recent academic year. Since joining their engineering faculty in 1998, Lackey has taught more than 20 different courses and received the school's Teacher of the Year award in 2001, 2007, and 2015. Through the university's Mercer On Mission program, she and her students have taken their research global through efforts in Kenya, Uganda, and Ecuador. Lackey spent six years at the Tennessee Valley Authority as an environmental/chemical engineer before joining Mercer.

Justin Brevard (BS/ME '16) has been named a project engineer at Advent. He first joined the company as an intern in 2016 and has since served as a project coordinator and estimator. In his new position, Brevard will oversee the fabrication and installation of projects, ensuring the structural integrity of Advent's work and the pricing of materials.

Jason Clement (MS/ME '13, PhD/ME '16) is now an instructor at Kansas State University.

Harold Conner (BS/ChE '68, MS/ChE '78) received the 2017 American Society for Engineering Management (ASEM) Fellow award. The award—representing the highest level of membership in ASEM—was presented in October at the ASEM International Annual Conference in Huntsville, Alabama.



Clovia Hamilton (PhD/IE '15) obtained a position at Winthrop University in South Carolina. Hamilton will be teaching operations management in their business school.



Hash Hashemian (MS/NE '80) was appointed by Governor Bill Haslam to the Tennessee Energy Policy Council, which makes recommendations to the governor and General Assembly on how to manage energy resources throughout the state.

Jingke Mo (PhD/AE '16) is now an associate professor at Fudan University in Shanghai, China.



Lee Murray (BS/IE '75), president and owner of Competition Athletic Surfaces in Chattanooga, was honored by *Tennis Industry* magazine and the American Sports Builders Association with its Tennis Court Contractor of the Year award for 2017. Murray was cited for his company's outstanding construction projects, his contribution of articles to the *ASBA Newslines* newsletter, and his attendance at technical meetings.



Ed Reedy (BS/EE '63, ME/EE '64, PhD/EE '68) was recognized in November at the Georgia Tech Research Institute (GTRI) 80th Anniversary Awards for his impact to research and innovation to the institute. He was with GTRI for 33 years and served as director from 1998 until 2003. During his tenure, he helped create programs and a cost recovery model which permitted extraordinary growth and success. Reedy also secured funding for the institute's Food Processing Technology Building and established the Glen P. Robinson Chair in Optoelectronics, the first endowed chair at GTRI.



Angela Yochem (MS/CS '98) was named chief digital officer of Novant Health, an integrated network of physician clinics, outpatient centers, and hospitals based in Winston-Salem, North Carolina, with operations in four states.

In Memoriam

Alumni

Maurice Anderson (BS/NE '67, MS/NE '70, PhD/NE '74), November 11, 2017.

Robert H. Chapman (MS/ME '54, PhD/ES '74), October 21, 2017.

Allen Crick (BS/EPH '49), October 27, 2017.

James Roscoe Evans Jr. (MS/EE '50), September 20, 2017.

James Emmett Goode Jr. (BS/ChE '56), September 24, 2017.

William J. Gustavson (BS/NE '72), November 28, 2017.

Robert W. "Bob" Haubenreich (BS/ME '82), October 4, 2017.

Joe Haynes (BS/ME '59), January 26, 2018.

Frank C. Howell (BS/EPH '73), November 1, 2017.

Max Hurst (BS/IE '57), December 3, 2017.

James White Johnson (BS/ME '53), October 7, 2017.

Douglas Stephen Kinney (BS/ME '79), November 5, 2017.

Gerhard Kreikebaum (PhD/EE '74), October 24, 2017.

James D. "Jim" Lawhon (BS/EE '42), September 27, 2017.

James Martin Moos (MS/NE '77), November 26, 2017.

Paul Newell (BS/ME '58, BS/ME '61), November 7, 2017.

Charles Everett Price (BS/AgE '51), December 22, 2016.

Thomas Gary Price (BS/EE '70), September 16, 2017.

Richard Rosenberg (BS/ME '54), August 28, 2017.

Jeffery Scrugham (BS/ES '00), February 27, 2018.

Conrad Simon (BS/MSE '94, MS MetE '99), November 11, 2017.

Henry "Si" Sineath (BS/ChE '44, MS/ChE '49), October 8, 2017.

Mitchell Dean Smith (BS/CE '54), November 15, 2017.

Joe Vowell (BS/EPH '53), October 13, 2017.

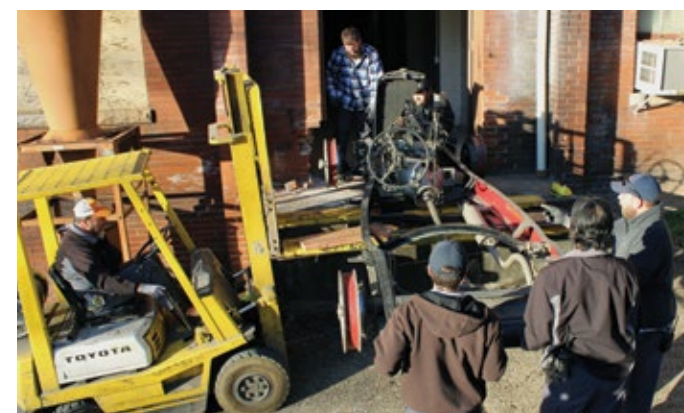
Edward Williamson (BS/ME '49), December 12, 2017.



Joseph "Tanner" Wray (AE Junior) passed away unexpectedly on February 23 while competing for his fraternity in the Ace Miller Boxing Charity Tournament. Tanner was a junior and was described as an exceptional student who was always happy. He will be greatly missed by his fellow classmates and professors.

By David Goddard. Photography by Randall Brown.

Clockwise from bottom left:
The chassis in its former home in Estabrook Hall; the Facilities Service crew starts moving the chassis; the crew widens the doorway to allow the chassis to leave the building; the crew carefully steers the chassis outside onto a waiting forklift; the chassis is maneuvered into the back of the moving truck.



Over the course of its history, Estabrook Hall has played host to a number of programs, from mechanic arts to architecture to civil engineering and computer laboratories.

One of the constants for most of that time was a chassis of a 1920s Dodge Brothers automobile, long since stripped down for use as a model of engineering.

In much the same way that elements of Estabrook will survive to be incorporated into the New Engineering Complex, the Dodge has also found an extended life.

The Gilmore Car Museum of Hickory Corners, Michigan, found out about the chassis and has taken it to be restored to its former glory.

"A lot of our engineering alumni, and alumni across UT are familiar with the car," said Dean Wayne Davis, who took classes at Estabrook as a doctoral student in the early 1970s.

"Having it restored, and having them do it through a learning project, is a fitting result," Davis said.

Gilmore's plan is to have the car restored by high school students from their work-study program, Gilmore Garage Works.

Founded in 2009, the after-school program pairs students with mentors, helping them learn all about automotive technology, repair, and restoration.

The goal is to prepare students for careers in the automotive industry, while at the same time educating them about automotive history through the classic vehicles they restore.

The museum and program both highlight what is often considered the golden age of automobiles, from the 1930s through the 1960s.

The exact year of the chassis from Estabrook isn't known, but Davis pointed out that Dodge Brothers was sold to Chrysler in 1928 and became simply known as Dodge, so the model was from 1927 at the latest.

A team from Gilmore came to UT in mid-January to take possession of the car, with Facilities Services members helping carefully remove it from the building and roll it into the museum's trailer.

While there is major work to be done to completely restore the car, it still had a lot of its original parts, including steel rims, wooden spokes, platforms for running boards, and a still-functioning axle and wheels.

Check in with Gilmore's progress over the coming years at gilmorecarmuseum.org, and watch a video of the delicate process of moving the chassis from Estabrook to the transporter at tiny.utk.edu/chassis.



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