DARTMOUTH
# Engineer
THAYER SCHOOL OF ENGINEERING | SPRING 2023

## POWER PIONEERS

PROFESSORS JASON STAUTH TH'00 AND CHARLES R. SULLIVAN LEAD EFFORTS TO MAKE THE TECH WE USE EVERY DAY CHEAPER, SMALLER, AND MORE EFFICIENT.

inside

First Look

**INTELLECTUAL EXERCISE**

Engineering students work in Bissell Hall in 1926. Thayer School of Engineering moved into Bissell, Dartmouth's former gymnasium on the site of the current Hopkins Center for the Arts, in 1912. More than 25 years later, in 1939, faculty and students moved into Cummings Hall, the first facility built specifically for Thayer.

*Photograph from Dartmouth College Archives*

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➤ Students explore Berlin—known as the "Green City" for its sustainable infrastructure—with a new German studies-engineering study abroad program. Photo by Jordan Koehler '23






COVER PHOTO BY ROB STRONG '04


## DEPARTMENTS

**"Understanding how the brain works is arguably the No. 1 scientific inquiry right now."**

—PROFESSOR HUI FANG

**CAMPUS CONVERSATIONS**
Dean Alexis Abramson (left) talks with Professor Hui Fang.



Leading Thoughts

# Revolutionizing Brain Research

Dean Alexis Abramson speaks with Professor Hui Fang about his advances in application-driven technologies.

*Professor Fang is developing the next generation of neural probes to revolutionize how researchers study the human brain. We spoke about the potential directions of his work with nanomaterials and where he is finding collaborators in the Dartmouth community.*

**Can you tell us a little bit about your research with materials and structures, particularly nanomaterials?**

FANG: I'm primarily working on neuro-electronics, especially implantable devices for the brain. Our fundamental innovation is in new material structures and devices. We create new structures where we can engineer and optimize their properties for certain device applications. An example is where we create so-called "transparent electronics." The need is to bridge this field of neuro-electronics—an electrical approach to the brain—with optical methodologies. They're complementary. You can do electrical recording and optical imaging, and even optical stimulation, at the same time.

We created these nanostructures in our lab to enable that optical transparency. We start with the same kind of thin-film electrode materials that people use in flexible and soft neural interfacing devices. Usually, these are noble metals—gold, platinum—because you want them to be biocompatible. And then we need electrochemical materials on top of these noble metal interfaces to make that good electrode-electrolyte interface. It's stacking a combination of different materials and films on top of each other to produce a functional device.

**Can you talk a little bit about the applications?**

FANG: The most important application is to create devices for neuroscience investigations. Just understanding how the brain works is arguably the No. 1 scientific inquiry right now. We have a whole psychological and brain sciences department [PBS] on campus working on that goal, so we get to directly interface with them. They not only validate our tools, but the tools can also directly serve their research. That's super-rewarding.

The second application is contributing to the biomedical domain, both in studies as well as industry. There's certainly a lot of neurological diseases—epilepsy, Parkinson's—that are very hard problems to solve, to even understand the pathology. We're part of a whole group at Dartmouth-Hitchcock Medical Center that has started meeting monthly, and there's a group that is epilepsy focused—so certainly we are thinking about what we can contribute there, too. We're also engaging people who work on brain stimulation to address various diseases such as Parkinson's. We have a new project—developing a probe that will be able to monitor electrical signaling *and* the chemistry inside the brain—that could be very important for them.

**You've made a lot of connections since you arrived in 2021. Can you talk about what brought you to Dartmouth?**

FANG: Great people are what really excite me here—great colleagues and staff and students, both undergraduate students and graduate students and postdocs. Second is the prospect of collaboration. We talked about PBS and DHMC already, which are natural places for me to collaborate with. Thayer's spirit is "human-centered," and I would call our research human-centered too because we are working always on application-driven technology. There's fundamental science about neuro-electronics, but we always engage with end users, for example, in the neuroscience community, in the medical community. What eventually is going to make a big impact is something that is going to be useful for them.

**You've taken on a leadership position to help us think about the design of Thayer's new micro-nanofabrication lab. Why do we need the space?**

FANG: Currently, we have to leverage our neighbors and other resources; for example, we go to Boston or other places to do certain types of work, but it is not always ideal. The new space will enable us to have the full capability here and make us more productive and more capable. Existing faculty and student research will have a state-of-the-art facility, which is also important to attract new talent. Research is always evolving, there are always cutting-edge techniques, tools, and equipment. Having these here and being ready to meet the needs of the future are certainly important as we are growing the engineering school.

**When you think about the training and education and research that will get done in the new facility—why is that important to society?**

FANG: The current world, of course, is full of AI—but without physical infrastructure, there's no such thing. There's always competition between the soft side and the hard side. Right now, there's a lot of interest in the AI domain, but soon you will see that the hardware supporting these AIs is not going to be enough. It could be the performance is not high enough or the energy consumption is too great. So there's always this interest in the fundamental innovation on physical infrastructure, the computing device side, for example, to meet the needs of the ever-growing development of the soft domain, such as AI.

PHOTOGRAPH BY ROB STRONG '04

# THE Great Hall

NEWS FROM AROUND THAYER SCHOOL

**"There's really innovative work being done on transitioning to renewable energy right here in the Upper Valley and we're excited to enable Dartmouth students to contribute to it."**

**—PROFESSOR MARON GREENLEAF**

CLASSROOM

## A Service-Learning Model

**"MEANINGFUL COMMUNITY-BASED RESEARCH IS** energizing and inspiring," says Professor Sarah Kelly, an Irving Institute for Energy and Society research associate.

Through "Environmental Justice" and the complementary Energy Justice Clinic, Kelly and Professor Maron Greenleaf give students the tools and hands-on opportunities to explore that type of research—in the Upper Valley and around the world.

"It's kind of an engaged, service-learning model," says Greenleaf. Housed in the anthropology department, the clinic partners with the Irving Institute, Center for Social Impact, as well as the Design Initiative at Dartmouth (DIAD), the Thayer-led effort that supports Dartmouth students and faculty seeking to integrate design thinking into their learning, teaching, or research.

"Many environmental issues benefit from a multidisciplinary perspective, and we also find that our students appreciate learning about them in this way,"

ROB STRONG '04

says Greenleaf, an anthropologist who studies the politics of climate change and green economies. "Sarah has done a lot of work in community-based research and learning in Chile and elsewhere. My training as an environmental lawyer gives me a background in policy."

This collaborative approach extends throughout the classroom and into the field. Greenleaf serves as faculty director of the clinic and primary professor in the classroom, while Kelly is director of practice and works with students on their clinical work and engagement with community partners.

The professors earned the 2022 Apgar Award for Innovation in Teaching for the course—which considers how various communities experience environmental harms—and credit design thinking with expanding their impact. A DIAD grant enabled them to develop related experiences through the clinic. Last summer, they piloted peer-to-peer training between Dartmouth students in which DIAD teaching assistants led a two-day workshop for clinic research assistants.

"DIAD training has helped us to facilitate students working in three different applied projects on energy justice in the Upper Valley, southern Chile, and east Africa," says Kelly. "Students are involved via social impact practicum and as research assistants, interns, and via independent studies."

For the Upper Valley study, engineering sciences student Gannon Forsberg '25 researched community power initiatives in California and Colorado to inform a Hanover plan. The town joined the Community Power Coalition of New Hampshire (CPCNH) to aggregate energy purchases to reach 100-percent renewable electricity by 2030 and lower energy prices for residents. "Learning from the past successes of other communities is important," he says. "There's been a lot of thought that's gone into this so it's economical and going to deliver value and be reliable."

COURTESY OF ADRIANNE GOWIE

**Adrianne Gowie Th'27 is researching the use of safer biocompatible medical implants with Professor Ian Baker.**

PHD HONOR

# GEM Fellow Shines

**PHD CANDIDATE ADRIANNE GOWIE TH'27 IS STUDYING HOW** to make medical implants safer for the human body with Professor Ian Baker. She is also the first Dartmouth student to receive an engineering GEM fellowship—a program aligned with the National Consortium for Graduate Degrees for Minorities in Engineering and Science (GEM) that covers tuition and fees and provides a stipend to promising students underrepresented in STEM fields.

Her introduction to engineering was an assignment to build a small robot in high school. "The robot was made out of little plastic pieces and had a battery attached to it with a code that was connected to a computer," she recalls. "It wasn't anything fancy, but back then it was mind-blowing." She was so engrossed in the bi-pedal robot project—"like seeing a baby start to walk"—that she realized her future was in mechanical engineering.

Working with Baker, who is also her advisor, Gowie is researching the use of zinc alloys in biodegradable, biocompatible medical implants that won't be harmful when they break down in the body.

Gowie, the first generation in her Jamaican family to be born in the United States, says she welcomes the opportunity to be a visual representation of change: "If more women and people of color were in the field, engineering would look more like the real world." *—Betsy Vereckey*

SERVICE TO SOCIETY

# Students Cook Up Green Collaboration

**The final system relies on eight solar collectors and a solar-powered circulating pump that heats 130 gallons of water.**

**DARTMOUTH HUMANITARIAN ENGINEERING (DHE) STUDENTS HAVE** overcome Arctic temperatures, long Zoom meetings, and monkeys to deliver an effective solar water heater to a campus kitchen 7,000 miles away. Dubbed "DHelios," the two-year project was designed to help school kitchens in Uganda—and potentially throughout sub-Saharan Africa—save money, improve health, and reduce carbon output by using solar rather than firewood.

In winter 2022, the team set up a functional prototype outside the Lyme, N.H., home of Stephen Doig '82, a senior advisor with the Irving Institute for Energy and Society who advised the students as they refined their design. It was "13 degrees when the students arrived, and never got above 17 degrees—so they were testing a system for equatorial Africa in Arctic conditions," he says. "They got the water temperature up to 125 degrees!"

Then it was time to bring the plans to Uganda Christian University (UCU).

There, DHE students led by Noah Daniel '22 and including Ethan Aulwes '22 and Veronica Yarovinsky '24 met the UCU students they had been collaborating with via Zoom. "It was so much easier to share ideas in person," says Daniel. Together, the students gathered supplies and began construction. "They were building alongside us—they designed critical components, such as the structure containing the water tank," says Daniel.

The team also brought in the end-users—cooks who prepare meals in UCU's kitchen—for feedback. "We would be actively changing our design based on the feedback we were getting from the cooks," says Daniel. Further changes were based on availability of materials—and monkeys. "You have overhanging pipes and you have to reinforce them because you could have a 20-pound monkey swinging on them!"

The final system relies on eight solar collectors and a solar-powered circulating pump that heats 130 gallons of water to about 160 degrees Fahrenheit for cooking. It is on track to cut the use of 8.2 metric tons of firewood and 1.2 metric tons of $CO_2$ emissions each year. This summer, the project team led by Anna Hugney '24 expects to return to the UCU campus with plans to double the system's capacity.

The team's ambition for DHElios goes beyond the UCU campus, however. "We're also working with an organization led by a Ugandan woman named Jamila Mayanja, who started Girls With Tools, a trade program for women," says Hugney. "We're trying to engage them in the process so they can get some of the technical skills necessary to build systems elsewhere."

INVESTMENT

# Expanding STEM

**E.E. JUST UNDERGRADUATE** Fellows recently enjoyed a tour of Dartmouth Engineering's Machine Shop. The two-year fellowship serves as model for increasing the number of underrepresented minorities who enter STEM fields. Building on the success of that program as well as the Women in Science Project, Dartmouth this winter launched STEM-X, a $100-million effort to increase access for historically underrepresented groups. "Few institutions are tackling this national challenge at the core of their teaching and learning mission, and fewer still are looking at it systematically across the comprehensive university," says Dean Alexis Abramson. STEM-X is part of the $3.5-billion Call to Lead campaign, which includes more than $500 million in investments in the West End and new centers for entrepreneurship and energy-related research.

FAR LEFT: CATHA MAYOR

# lab report

## Polar Ice Heals Itself

**A NEW STUDY OUT OF THE DARTMOUTH ICE** Research Lab shows that surface thermal cracks in ice can heal themselves within seconds—and potentially lessen the degradation of Arctic ice covers. "We think this is a truly incredible discovery," says engineering research associate Andrii Murdza Th'20, first author on the study published in *Geophysical Research Letters*. "For the polar ice caps, cracking may not always lead to major breakups and may increase the floating ice covers' resilience and extend their life."

Murdza, engineering professor Erland Schulson, and earth sciences professor Carl Renshaw used thermal shocking to crack sea ice and lab-grown saline and salt-free ice. As expected, the cracks weakened the materials. "However, within tens to hundreds of seconds of shocking, the strength recovered completely, for the ice had healed," the team reported.

**"We were able to make the ice up to two times stronger."** —ANDRII MURZDA

How does this rapid healing happen? "There's a liquid-like layer on the surface of any hot material," explains Murdza. "And the closer a material is to its melting point, the thicker this layer will be. Given that ice in nature is close to its melting temperature and the liquid layer is relatively thick, we think this layer forming on opposing crack faces, along with local pressure, enables the healing."

Understanding this phenomenon could improve predictions of sudden polar ice breakups that put ships, offshore structures, and coastal villages at risk and accelerate climate change. The study also "points to a possible mechanism for the repair of other crystalline materials, such as many ceramics at temperatures near their melting points," says Murzda. —*Catha Mayor*

## New Approach to Big Data

**PHD CANDIDATE CHASE YAKABOSKI** Th'23 and professor Eugene Santos Jr. have devised a way of extracting knowledge from big data that's valuable for the individual as well as the whole. This two-tiered machine learning algorithm—which results in more certain generalizations as well as more useful details—has a broad range of applications, including for guided biomedical research and individualized medicine.

"We've threaded the needle between capturing information about the whole and capturing information about the parts," says Yakaboski.

"Our goal is also about making knowledge more certain," adds Santos. "Important knowledge is derived both from the individuals and from the whole." The pair coauthored "Learning the Finer Things: Bayesian Structure Learning at the Instantiation Level," presented at the 37th Association for the Advancement of Artificial Intelligence Conference in late winter.

As the ability to collect and store data continues to grow, the demand for help from artificial intelligence to manage and learn from that data grows with it. "What I've been working on for the past 25 or 30 years," says Santos, "is coming up with this model that can capture a level of fidelity that doesn't clobber you from needing too much computation or too much time to deal with it—because that's been one of the problems of big data—and then shows the things that we need to capture: the causality and the context and the individuality."

Yakaboski points to the biomedical researcher who has a lot of data but doesn't have the tools to extract useful information. "Applying what we've done can help them discover the findings they need to make a new drug or a new treatment that then directly helps the patient," he says. —*Catha Mayor*

DAVID MARQUIS; TOP: WILD PIXEL

# Partnering with BioInnovate Africa

**IMPACT ANALYSIS** Icipe-supported PhD students Linda Bih Numfor (left) and Ruth Lorivi Moirana research heavy metal removal from biowaste and ways to detect contaminants in soil.

COURTESY OF ICIPE

**THIS WINTER AND SPRING TERMS MARK THE THIRD YEAR THAYER** professors have provided student training in technoeconomic analysis (TEA) of innovation projects in eastern Africa. The effort is a collaboration with BioInnovate Africa of the Nairobi, Kenya-based scientific research institute, International Centre of Insect Physiology and Ecology (icipe).

"Remote-visiting students from East Africa take a two-course sequence, ENGS 157: 'Chemical Process Design' and ENGS 172: 'Techno-economic Analysis in a Developing Country Context' during the winter and spring terms alongside Dartmouth students," says Professor Mark Laser, who leads the program with Professor Lee Lynd Th'84 Th'87.

The six-month sequence builds students' capability to assess the potential of early-stage bio-based technologies with real-world applications in developing countries. The courses also consider inadequate infrastructure, financing limitations, and weaknesses in the enforcement of government policies and standards and enables students to participate in improving these systems in their respective localities using TEA concepts. "Students are able to learn valuable experiences that have the potential to help spawn sustainable project development in their countries and enhance the well-being of many," says Laser.

Eligible students are enrolled in a master's or PhD program in Burundi, DR Congo, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania, or Uganda. Participants have included students assessing the de-hairing of animal skin using enzymes, feasibility of bio-oil generation from rice husk waste, and potential of biogas generation by the conversion of municipal waste. "I learnt new skills, including how to generate leading questions that guide the final assessment of any business venture," says Tadeo Mibulo of Makerere University in Kampala, Uganda. "The knowledge shared guides me as I continue my work involving energy generation from agricultural wastes."

## Kudos

**APPOINTED** **Professor Eugene Santos Jr.** has been appointed to the U.S. Department of the Air Force Scientific Advisory Board. Santos works in the area of artificial intelligence, with an emphasis on how machines can learn complex behaviors such as innovation and creativity.

**PITCHED** MEM student **Martin Roeck Th'23** won The Pitch $1,000 Startup Prize from the Dartmouth Digital Applied Learning and Innovation (DALI) Lab and Magnuson Center for Entrepreneurship. His ZappShot technology, developed with fellow MEM student **Prutha Atre Th'23**, provides business with instant decarbonization assessments.

**PUBLISHED** MS student **Logan Bateman Th'24, PhD student Kendra Hebert Th'26**, and **Samuel Streeter '13 Th'14 Th'21** outlined a new way to evaluate imaging agents in "Preclinical evaluation of molecularly targeted fluorescent probes in perfused amputated human limbs," published in the *Journal of Biomedical Optics*.

**SELECTED** **Professor Petra Bonfert-Taylor** is one of five Dartmouth faculty leaders joining the inaugural class of Ivy+ Faculty Advancement Network Leadership Fellows, a group of 12 research universities that collaborate to advance diversity, equity, and inclusion among faculty.

**AWARDED** Professors **Vikrant Vaze** and **Peter Chin** are part of the interdisciplinary team that earned the Levy Health Care Delivery Incubator Award for their work with the Family Heart Foundation to identify individuals with a genetic condition that causes high cholesterol.

**NAMED** New Schwarzman Scholar **Michelle Wang '21 Th'22 Th'23** will receive a one-year graduate fellowship to a master's program in global affairs at Tsinghua University in Beijing.

**FEATURED** **Professor Geoff Parker** discussed key considerations in business-to-business platforms on the *Future Sight* podcast.

**HACKED** The team of **Khanh Le Th'25, Remi Kauderer Th'25, Jhujhar Sarna Th'23, Ozgur Tuna Ozturk Th'25**, and **Muhammad Ussaid Mustajab Th'25** won the 2022 Energy Hackathon, sponsored by the Dartmouth Energy Alliance and Irving Institute. "Our team tackled a mix of the carbon-counter and energy-access challenge," says Mustajab, with a consolidated energy data platform "that allows people to understand what a carbon count means."

**FUNDED** A $1.3-million National Science Foundation grant will enable the Dartmouth Institute of Arctic Studies to continue training future climate-change scientists. The funding will support efforts such as those by PhD candidate **Ayobami Ogunmolasuyi Th'24**, who developed and delivered online lessons for the program.

**HEARD** *The Big REthink* Podcast recently featured **Dean Alexis Abramson** discussing "What Is Human-Centered Engineering and How Is It Helping Fight Climate Change?"

**SUPPORTED** The Dartmouth Innovations Accelerator for Cancer split its most recent $100,000 Stu Trembly Th'83 Award—named for the engineering professor and entrepreneur who died in 2021—among four engineering research teams. Professors and the research they're leading include **Margie Ackerman** on B cell immunotherapies, **Petr Brůža** on guided surgical resection by detection of hypoxic tumor cells, **Katie Hixon** on tissue engineering to promote bone regrowth following tumor resection, and **John Zhang** on automated exosome capture and loading.

**QUOTED** **Professor Don Perovich** was quoted in an article in *Inside Climate News* about his recent study published in *The Cryosphere*: "Timing is really critical, and this shows that the timing is changing," he said about the freeze-thaw cycle in the Arctic Ocean.

**COVERED** Figure 1 from "Motion-based microwave tomographic measurement device for three-dimensional coverage in a magnetic resonance system"—coauthored by **Professor Paul Meaney**, systems engineer **Timothy Raynolds**, **Shireen Geimer Th'95, David Ouma '20 Th'21, Grace Player '21 Th'21**, and **Professor Keith Paulsen**—was chosen for a recent cover of *Medical Physics*.

TEAM EFFORT

# Design Integration

**"Our all-female group wanted to solve a problem that largely impacted women."**

The team that designed and built SanoStove won the Phillip R. Jackson Award for best overall performance in ENGS 21: "Introduction to Engineering." **Margaret Frazier '25, Sophie Goldberg '25, Abby Hughes '25, Sara Magdalena Gomez '25,** and **Alda Zeneli '25** worked with teaching assistant **Jhujhar Sarna Th'23** and Machine Shop instructor **Joe Poissant** to create a smokeless stove to reduce dangerous cooking conditions for communities that lack access to electricity. "The SanoStove team took the initiative to understand combustion and was not afraid to learn SolidWorks, welding, plasma-cutting, and more," says Professor Vicki May. "They also spent time reaching out to users around the world to get their thoughts and feedback, which they incorporated into their designs."

HALEY TUCKER

# POWER PIONEERS

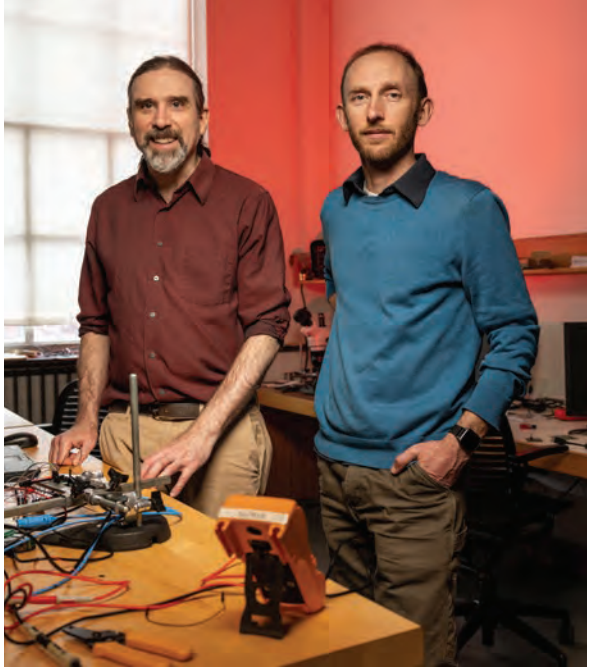
BY MICHAEL BLANDING

PROFESSORS CHARLES R. SULLIVAN AND JASON STAUTH TH'00 ARE LEADING EFFORTS TO MAKE THE TECH WE USE EVERY DAY CHEAPER, SMALLER, AND MORE EFFICIENT—AND OPENING NEW OPPORTUNITIES IN A RANGE OF INDUSTRIES.

PHOTOGRAPHS BY ROB STRONG '04

"It's one thing as an engineer when you make something complicated on the bench and it really works—it's another thing when you walk into a room and something you designed is running the lights."

—PROFESSOR CHARLES R. SULLIVAN



Twenty-five years ago, computers were facing a big problem. Microprocessors were using lower and lower voltage to run more efficiently. But to keep up with processing power, they used higher and higher current—and the combination of high current at low voltage began to test the limits of what the power supply could safely produce.

"Intel called that the 'power wall,' " says Professor Charles R. Sullivan.

So dire was the challenge, in fact, that around the year 2000, experts projected the processors would operate at a "thermal density "equivalent to the surface of the sun," says Sullivan's colleague Professor Jason Stauth Th'00, and a higher clock rate would cause them to "melt and explode."

Into that crisis stepped Sullivan, who was working on new circuit architectures and components to better transfer power. He created a new design combining a magnetic and an electric circuit, using coupling between inductors—components that store energy in a magnetic field. "That has actually become the standard for high-current power delivery," he says. "It allows the circuit to be more efficient, more compact, and respond fast when the processor load changes."

At the same time, Sullivan helped develop new ways to shrink clunky inductors and transformers so they could be integrated into chips with transistors and other semiconductor devices. This setup allows some processors to run for short periods at high power while others continue running at low power. "You use the high power for only a fraction of a second, while you are loading some complicated webpage or something," Sullivan says. That ultimately solved the crisis. It also enabled the modern computing power of both smartphones and datacenters. "It's a combination of technologies that has prevented that large-scale meltdown."

Sullivan—who will be inducted this summer as a fellow of the National Academy of Inventors—has long been a pioneer in the field of power electronics, or, simply put, the use of electronic components to transfer power. In addition to transforming computing, the field has revolutionized industries including lighting, solar power, robotics, and medical devices—and will be key to creating the new infrastructure for electric vehicles.

"There are a lot of ways of using electricity that don't use power electronics—for example, a traditional coffeemaker is just a heating element that connects to the grid and turns on and off," Sullivan says. "But if you look carefully at what's the best, most efficient technology being used today, it almost always ends up using power electronics."

Sullivan, who has been on the Thayer faculty since 1996 and is currently the Sue and John Ballard '55 TT'56 Professor of Engineering, directs the Power Management Integration Center (PMIC), a collaboration between Dartmouth, the University of California San Diego, and 16 industry partners to create technologies for electronics that are increasingly cheaper, smaller, and more efficient. The field, he says, is an exciting combination of concept and practice.

"Sometimes it's very nuts-and-bolts practical and sometimes there's beautiful theory attached to it," Sullivan says. "It's one thing as an engineer when you make something complicated on the bench and it really works—it's another thing when you walk into a room you've never been in before and something you designed is running the lights."

Stauth, who co-directs PMIC with Sullivan, has made his own breakthroughs in the field. "I read something 20 years ago that said power electronics is the fastest-growing field in electrical engineering and nobody knows about it," Stauth says about the initial spark that drew him to the topic as an engineering sciences student at Dartmouth. He went on to earn his PhD at University of California Berkeley before joining the Thayer faculty in 2011.

Soon after, Stauth made a major contribution to the field of solar power by applying power electronics to make photovoltaic systems more efficient. Solar panels use a large number of photovoltaic cells connected in series. "It's like in the old flashlights, where you put a bunch of batteries in series, and if one battery goes bad, it doesn't work," Stauth says. Similarly, in an array of solar panels, if one cell in the array malfunctions—for example, if it is shaded or covered in dirt—"it blocks the power flow, potentially causing problems for the whole array of panels." Stauth developed a technique that moves power around any cells that weren't working as well so the rest of the array would continue to function.

That technique relied on a new class of power electronic circuits, using something called hybrid-resonant switched capacitor converters. "That's a mouthful," Stauth allows, but explains it essentially comes down to better ways of using components that passively store energy: inductors, which store it in the form of a magnetic field, and capacitors, which store it in the form of an electric field. While traditional power electronic circuits mainly use inductors as energy storage elements, Stauth realized that using a mix of capacitors and inductors could move energy more efficiently. "We were one of the early groups that recognized the value of merging switched capacitor and traditional, inductor-based circuits," he says. "It turns out the advantage is sizeable."

The result has been an increase in efficiency for renewable energy. "At this point, a new kilowatt-hour of solar, depending on where you live, is cheaper than almost any other source of energy," Stauth says. "If you can make solar power more efficient or get more energy per panel, then you are helping to reduce that cost even more." What's more, Stauth's lab extended these circuit techniques to other applications, including electric cars, which are often powered by hundreds or even thousands of connected batteries. Several of Stauth's former graduate students—Eric Din '14 Th'16,

> **"A NEW KILOWATT-HOUR OF SOLAR, DEPENDING ON WHERE YOU LIVE, IS CHEAPER THAN ALMOST ANY OTHER SOURCE OF ENERGY."**
>
> —PROFESSOR JASON STAUTH

Matthew Bossart '14 Th'15, Chris Schaef Th'16, and Keith Moffat Th'16—cofounded Hive Battery, which used related technology to make electric transportation more reliable and efficient.

That transfer into a new application represents how the field of power electronics often evolves, says Sullivan. An engineer comes up with a solution for a specific problem, but the theory often has broader implications. "The specific power electronics design that Jason used for those photovoltaic cells was super-innovative," Sullivan says, "and it seeded a whole new area in the development of power electronics that has now become really popular."

Sullivan is currently pursuing a new project to dramatically improve wireless power transfer, technology that could revolutionize consumer electronics, vehicles, and medical implants. More than five years ago, he cofounded Resonant Link with former postdoctoral research associate Aaron Stein, Grayson Zulauf '12 Th'13, and Phyo Aung Kyaw Th'19. It now has offices in Boston; South Burlington, Vt.; and Zurich, Switzerland.

The technology relies on a totally new type of circuit architecture that changes the way energy moves. "I've been interested in it forever, but we started working on it in earnest when we figured out a way to make a fundamental change in the way it is done," Sullivan says. Typically, energy resonates back and forth between inductors and capacitors, losing a little bit of energy as it sloshes back and forth. That might not matter in a wired electrical system but can dramatically reduce efficiency when dealing with wireless power, Sullivans says. "If you lose even 1 percent, the efficiency ends up being terrible." To help fix that problem, he and his cofounders created a way to integrate capacitors directly into the magnetic coil of the inductor, combining both components into a single entity.

"Now it can travel just microns apart between those different elements," Sullivan says. "As a bonus, we don't need a separate capacitor," meaning they can make the components smaller as well.

Their new technology could dramatically increase the range of wireless charging by five times. "We're talking one to five centimeters, not 500 miles," he qualifies—but that distance can make all the difference for medical devices that are implanted inside the body. Currently with those devices "either you have surgery regularly to replace the battery, which nobody wants, or you have a wire that goes through the skin, which is uncomfortable." This technology could allow doctors to regularly charge a device inside the body without having to remove it first, reducing stress on patients and opening implants to a wider range of people who need them.

Stauth, meanwhile, is working on a new project involving microrobotics, using power electronics to create small-scale electromechanical systems. These systems use piezoelectric actuators, which require high voltage to provide force or movement, but Stauth's lab has come up with a new way to recycle energy used to drive the actuators, reducing the power needed by more than 10 times. This allows the system to run off very small batteries or even on-chip micro solar cells. The technology could be used to create tiny robots, such as walking or flying mechanical insects, or small-scale actuators that give sensory feedback when a button is pushed on a smartphone or video game controller.

Looking ahead, one of the more exciting applications of power electronics is in the ongoing revolution in electric vehicles. The technology could be key to not only optimizing battery management within the vehicles themselves but also in transferring power across the vast infrastructure of electric chargers to keep the vehicles running.

"Some of those use really high-power levels that require some pretty intensive power electronics using a lot of the kinds of things we have worked on," Sullivan says. The technology will be essential in charging vehicles quickly on-demand, but the grid can also work in the other direction, using vehicles to return power to the grid when they are not in use. That option makes the whole system more efficient.

In that way, power electronics is helping to make the power grid more sustainable, both by using less power overall and distributing it more efficiently to where it is needed. The more we electrify technology such as vehicles, the more we can rely on renewable energy such as wind and solar to power them rather than polluting fossil fuels. "But once we are using renewable energy, the variability becomes challenging to control and we need all the flexibility we can get," Sullivan says. "Power electronics can give us that control and flexibility we'll increasingly need." As power electronics enable people to live better—with smaller and more powerful consumer devices, longer-lasting lifesaving medical devices, and more efficient electric vehicles—the technologies will be better for the planet as well.

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**MICHAEL BLANDING** is a Boston-based journalist whose work has appeared in *Wired*, *Smithsonian*, *The New York Times*, *The Nation*, and *The Boston Globe Magazine*.

*"Our program takes interdisciplinary learning to a new level, as it gives students the opportunity to explore a central engineering concept through the medium of the German language and culture," says Professor McGillen (above left). A tour of the city of Bonn (far right), the capital of Germany from 1945 to 1990, includes the University of Bonn (yellow building), the birthplace of composer Beethoven, and the Haribo gummy factory.*

LEFT: COURTESY PETRA BONFERT-TAYLOR; RIGHT: JORDAN KOEHLER

# Green City

**A NEW FOREIGN STUDY PROGRAM IN BERLIN BRINGS SUSTAINABLE ENGINEERING TO LIFE.**

"One crucial piece of a successful liberal arts education is the ability to speak and interact in a foreign language and to study foreign languages and cultures abroad," says Thayer Professor Petra Bonfert-Taylor. Engineering students, however, often find it difficult to step away from the demanding curriculum to participate in a study-abroad program while at Dartmouth. The solution: the joint German studies-engineering foreign study program (FSP) "Green City, Sustainable Engineering in Berlin." Says Bonfert-Taylor: "It invites students to explore one of the most innovative and pressing topics of their primary field—'green' and sustainable engineering—while enabling them to satisfy their language requirement in an environment in which sustainability is a lived practice." The spring program launched last year with Bonfert-Taylor and Petra McGillen, German studies professor, leading 17 students through a combination of coursework in sustainable engineering and German language and culture studies. "The FSP showed me all the ways sustainable engineering can be simply implemented yet drastically shape the way a city is run," says chemical engineering major Jordan Koehler '23.

➤ *Students tour Bagger 1452 (near right), a decommissioned excavator used in lignite (brown coal) mining, in Hagenwerder. "We got to climb all over the 75-meter-long monstrosity and learned from a former operator about the process and the profession, which used to be highly regarded," says Bonfert-Taylor. Gardens (far right) are in bloom at Potsdam's Sanssouci Palace, the summer palace of Prussian King Frederick the Great.*

LEFT: COURTESY PETRA BONFERT-TAYLOR; RIGHT AND BELOW: JORDAN KOEHLER

➤ *Students tour Wasserwerks Beelitzhof, one of nine water plants in the city of Berlin. The plant manages the cleaning and distribution of water for much of the western side of the city, making it an ideal site to learn about urban planning and management.*



LEFT: COURTESY PETRA BONFERT-TAYLOR; RIGHT: JORDAN KOEHLER (2)

LEFT: COURTESY PETRA BONFERT-TAYLOR; RIGHT: JORDAN KOEHLER

▲ *The founder of the Kiezboten Projekt (top), a startup developing electric-powered mail-delivery bikes with a goal of reducing carbon emissions, explains his design. A rooftop solar farm (below) helps power Freie University, partner school for the FSP.*

◀ *Students enjoy a boat tour in Cologne (far left) and a visit to the Schloss Drachenburg in Königswinter (near left), along the bank of the Rhine River.*

# Welcome to the Crowd

## HARRY SANGREE '79 TH'80 INTRODUCES AID ORGANIZATIONS TO THE POWER OF CROWD-SOLVING.

INTERVIEW BY KAREN ENDICOTT

When COVID-19 hit in 2020, serial entrepreneur Harry Sangree steered his latest venture, SeaFreight Labs, into new waters, recruiting nonprofit humanitarian organizations to try crowd-solving to generate innovative solutions to tricky problems. With his wife, Lydia, Sangree is reaching out to NGOs with the global capacity to impact hundreds of thousands or even millions of lives. From his home in New Providence, N.J., he spoke with *Dartmouth Engineer* about the concept of humanitarian crowd-solving: You never know who's going to come up with a great—and doable—idea.

**How did you first get involved in humanitarian work?**
After graduating from Dartmouth, I went to Zaire for four months with Habitat for Humanity in a program I put together with funding from various Dartmouth scholarships. It wasn't part of Thayer, but the dean at the time, Carl Long, said, "If you're going to work with Habitat, come back and become an engineer when you're done." I returned for my BE year and asked my advisor, Professor Francis Kennedy, what I could do to keep helping people. He got me involved in a project to make a better brick-making machine, which we called the DartRam. We even got a U.S. patent for it. I tested it with Habitat for Humanity in Guatemala in the mid-1980s. The design was faster and more efficient than the industry's leading model, but it broke down more. Habitat opted for maintenance over speed, so my design was shelved. But it launched my interest in humanitarian innovation.

**At the time, did you have a career path in mind?**

I wanted to start my own company. I had always wanted to be an entrepreneur. Then, it was not as common as it is now. People wanted to get jobs in big companies. My first job was for Exxon, and I quickly found out I'm not a good "big company" person. Big companies need people to follow the rules, the structure, and do the things that make those companies successful. Smaller companies give you lots of problems to solve and lots of reward if you can solve them smartly. I was better in the small-company, entrepreneurial environment, which is what I did for my career.

**What was your entrepreneurial path?**

Following my short-lived Exxon days, I went to Columbia Business School. At Columbia, I met someone who also wanted to start a company, and we heard about a guy who needed people to sell his export-management software. We said, "We could do that." We didn't know anything about exporting or software. I had learned BASIC at Dartmouth, so I had some false confidence in my technical skills. It turned out that the guy didn't want to have people selling his software after all, because he didn't want to modify it to what the market wanted. So we said, "There is a market here. Let's just do it ourselves. How hard can it be to create software?" We didn't know how hard it is, but we had this view that we could learn how to do it. I was the technical person, and my partner was the sales guy, and that was how we started our company, SYNTRA, which stands for Systems for International Trade.

Our vision was to create software to automate exporting and, later, importing. The company grew over a 17-year period from the two of us to about 200 people, with major customers, including Maytag, Trane, BASF, and Warner-Lambert. That was how I got into logistics work. Then I was on the senior leadership team of another startup, INTTRA, to bring e-commerce to the ocean container shipping industry. I started SeaFreight Labs to spur innovation in the container, shipping, and logistic space. I wanted to help companies make use of global crowd-solving to address problems such as how to decarbonize the industry.

**What is global crowd-solving and how does it work?**

Crowd-solving is looking outside your company for solutions to problems you have. I've partnered with the InnoCentive Open-Innovation Network/Wazoku, which links problems with more than 600,000 problem-solvers from all over the world. Companies post challenges they can't solve internally and offer a monetary prize for solving them. People submit solutions, and the challenge sponsor evaluates the different submissions to see which is the best.

Lots of big companies and agencies—chemical and steel companies, NASA, and the military—face problems that have never been solved and nobody knows what to do about them. Putting them to the global crowd, they often get ideas their internal scientists and experts wouldn't have thought of. During the last 25 years, InnoCentive has run more than 2,500 successful challenges by leveraging people who like solving problems.

I thought this could work for container shipping, which is a very insular industry. Crowd-solving would be a way to get new perspectives. Big shipping companies have lots of money they could put up for prizes to attract lots of solvers, and if one shipping company got a problem solved, others might imitate it. I knew that anybody who has massive ships going all around the world and 100,000 employees must have problems that need solving.

**How does humanitarian work come into play?**

I was ready to launch SeaFreight Labs in March 2020 at a major trade show, and then the pandemic hit and scuttled that plan. Sitting at home, locked down, I wondered who else could use this crowd-solving process. I thought of Steve Jobs' famous quote: "The people who are crazy enough to think they can change the world are the ones who do." So I thought, why not try using the crowd to solve humanitarian problems.

**"ENGS 21 showed me that you could know nothing about something and still create a solution to the problem just by trying. That's been the story of my whole career."**

—HARRY SANGREE '79 TH'80

I already had connections with Habitat for Humanity and World Vision, which helps people globally. I reached out to both organizations and told them about crowd-solving. Each initiated a project with me to see if we could find some hard problems that were crowd-solvable, then put them out to the crowd and see what would happen. During the next two years we ended up running eight challenges. Six got good solutions, and four are being field-tested—two in Kenya and one each in the Philippines and Mexico.

One of the problems World Vision posed was related to clean water in Africa. Moving beyond digging wells, World Vision is now building low-pressure water systems to pipe well water to each house. But then you have to use chlorine to clean the water sitting in the pipes, and commercial chlorine sensors cost $5,000 to $6,000. World Vision wondered if somebody could invent a sensor that costs one-tenth that price. InnoCentive/Wazoku said, if World Vision wants to run the challenge, we're willing to do it. SeaFreight Labs helped convince professors, scientists, and others to take it on. We got 22 quality submissions. One is close to costing one-tenth the price of current sensors, and World Vision is building some units to send to Kenya for testing in rural communities. That's very exciting.

Another test case centers on helping rural Kenyans keep mosquitoes out of their mud-and-thatch houses to lower their risk of contracting malaria—for under $200. Someone who answered the challenge had the idea of cutting holes into the mud walls, inserting PVC pipe, and putting mesh over the pipe openings—achieving light, ventilation, and protection from mosquitoes. A retrofitted home tested in a controlled environment had 89 percent fewer mosquitoes. The next test will compare mosquito rates in 30 retrofitted houses and 30 traditional houses. The World Health Organization asked us to let them know what happens, because if the idea works, they want to help spread it more widely.

These projects show the power of asking everybody, "Can you think

LYDIA S. SANGREE

about this?" and then incenting them with prize money and seeing what happens. Humanitarian crowd-solving doesn't always have stories like that, but it's had enough.

**What role does SeaFreight Labs play?**
As the founder of SeaFreight Labs, I've joined the "Pledge 1%" movement started by the CEO of Salesforce, Marc Benioff, who thought companies have a responsibility to do more than just make money for their shareholders. Companies should donate 1 percent of their product, time, or resources to a charity of their choosing. I signed up SeaFreight Labs early in the pandemic to help promote and run humanitarian crowd-solving projects.

**Did you coin the term "humanitarian crowd-solving"?**
I did. I applied to a *Fast Company* magazine competition for the "Best World-Changing Ideas." I described the work I was doing for Habitat and World Vision as humanitarian crowd-solving. We got an honorable mention in the North America category in 2021.

**What are you working on at the moment?**
We're in the early stage of working with another international agency on open innovation through humanitarian crowd-solving. The engineers at Dartmouth would all understand open innovation as the category name for this kind of work.

**It sounds as though it's straight out of ENGS 21, Thayer's introductory engineering course. What was your ENGS 21 project?**
It's what made me decide that engineering was right for me. The project was called Deadweight Enterprises. At the time, Dartmouth was one of the national leaders in the 35-pound weight event, the indoor version of the hammer throw. The 35-pound weight is a large plastic ball with lead weights in it. The guy spins around three times and then throws it. The problem was that when it landed, the ball sometimes popped open and lead pellets would go across the floor. We tried to solve that problem. We created a lead ball with a polyethylene material around it that could absorb energy when it fell on the ground. It never became commercial, but we were proud of our solution. And, for people who hadn't taken any engineering classes, it was amazing that we got this whole thing built. We were calling up manufacturers about various materials and getting them to give us samples and actually got somebody to build us a prototype. The track coach tried it and said, "It's 35 pounds and it doesn't break. It's good."

ENGS 21 showed me that you could know nothing about something and still create a solution to the problem just by trying. That's been the story of my whole career.

**Did your Thayer education influence your thinking about how to solve complex problems?**
There were four things Thayer taught that really influenced my life. The first is Thayer's generalized view of engineering, which is helpful for problem solving because you aren't stuck in a single silo looking at things a certain way. You can think more broadly. Second, you need to have a team with interdisciplinary skills, as in ENGS 21. No one of us could have achieved the results we got by ourselves. You need people with different perspectives, capabilities, and interests. Third, solutions are not just technical—there are people issues and process issues—and a solution needs to have all three of those threads together being worked on. And last, to solve complex problems, you need to think about all these things at the same time and iterate over and over again. These are lessons I've applied to all my endeavors.

# Crowd-Solving Smarts

## Harry Sangree's advice on posing a good problem.

Defining a good problem is key to successful crowd-solving. The problem can't be unrealistic—such as eradicate malaria or solve inflation in developing companies—and should be narrow in scope so the global crowd can contribute ideas you haven't thought of, including repurposing existing solutions from other domains and applying them to the aid sector. In my experience, problems are best identified by the people doing the work on the ground.

I subscribe to InnoCentive cofounder Alph Bingham's "LASSO" criteria for defining a good problem.

- **Limited in Scope:** A solution can be generated by one person or a small team in less than a few weeks.
- **Actionable:** A solution can be implemented by the organization on a timely basis.
- **Specific:** The problem statement must be clear with key constraints such as cost and materials explicitly stated.
- **Supported:** The problem must be important to your organization's objectives.
- **Owned:** An expert should "own" the problem statement and a senior official of the organization should "own" any plan for implementation.

In addition, I think humanitarian organizations should focus on problems that also meet these two criteria.

- **High Impact:** Any solution should have the potential to impact at least tens or hundreds of thousands of people (this type of problem is most likely to attract many diverse solvers and generate scores of quality proposals).
- **Universal:** Any solution should be something that can be shared across the humanitarian space and applied by other NGOs.

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**KAREN ENDICOTT** is a former director of communications for Thayer and a former editor of *Dartmouth Engineer*.

# Alumni News

FROM AROUND THE WORLD

## spotlights

### "Human Helper"

As the chief technology officer at OpenAI, **Mira Murati Th'12** is leading the teams behind DALL-E, which uses AI to create artwork based on prompts, and ChatGPT, the wildly popular AI chatbot that can answer complex questions with eerily humanlike skill. "ChatGPT is essentially a large conversational model—a big neural net that's been trained to predict the next word," she tells *Time* magazine. "And the challenges with it are similar challenges we see with the base large language models: It may make up facts." She sees that as a core challenge—and one that can be addressed through dialogue and feedback. Future conversations may also involve input from regulators and governments, which she welcomes. "It's not too early" to get them involved, she tells Reuters.

Mira Murati Th'12 ▲

Last fall, she shared her thoughts on the ethical and moral questions of using AI—as well as its creative capabilities—on *The Daily Show* with Trevor Noah. "The technology we're building has such a huge effect on society, but society can and should shape it," she says. "There are a ton of questions we are wrestling with every day. We see them as tools, as an extension of our creativity." Murati pointed to the ancient Greeks' idea of "human helpers," engaged to balance infinite powers of knowledge or strength with vulnerabilities. "These concepts of extending human abilities and being aware of the vulnerabilities are timeless," she says. "In a sense, we are continuing this conversation by building AI technologies today."

### New Mediums

"I believe in abundance," says **Cole "The Renaissance" Douglas '20 Th'20**. With art shows across L.A. and the recent publication of his photography, City Heights in Winter, the San Diego, Calif.-based mechanical engineer is flush with opportunity. "I came up with the name 'the Renaissance' as a reaction to feeling boxed in before exploring my artistic pursuits," he says. "I wanted a name that encapsulated the possibilities now that I appreciate the abundance of opportunities." He began to discover those opportunities as an undergrad. "My friends introduced me one medium at a time: paint nights with the roommates, photo walks with the homies." Since graduation he has continued to mix mediums, working as a development engineer at medical device company NuVasive while exploring street photography, abstract painting, poetry, and digital art. He finds his engineering mindset enhances his art. "I'm fascinated with the 'why' behind people's actions," he says. "The engineer in me loves understanding the fundamentals of how things work. My art is to life as physics is to an engineer—questioning the fundamentals of how people operate."

Cole Douglas '20 Th'20 ▲

**"I failed at a startup, so I went to work at a growth equity firm to learn how to buy businesses and be an entrepreneur from accomplished entrepreneurs."**

**—ZAC CARMAN '02**

### Rave Reviews

**Zac Carman '02** appreciates the value of second chances: "I failed at a startup, so I went to work at a growth equity firm to learn how to buy businesses and be an entrepreneur from accomplished entrepreneurs." Those lessons helped the engineering sciences major convince a group of investors to acquire consumer-review website ConsumerAffairs in 2010. As CEO, he has bootstrapped the business to 220 employees and more than $100 million in annual revenue.


# The Innovators

*FORBES* PROFILES THREE INDUSTRY LEADERS

From powering a more sustainable future to developing life-saving diagnostics, Thayer alumni are shaping the future within their industries. *Forbes* profiled three such leaders in its 2023 "30 Under 30" lists.

Engineering sciences major **Ben Parker '16** launched San Francisco-based Lightship to bring EV technology to the $55 billion recreational vehicle market. Parker worked as a battery engineer for Tesla's Model 3 and became interested in RVs while doing a side project to electrify food trucks. In 2020, he rented a Winnebago for a three-month tour of the American West: "It was one part soul searching, one part business research," he says. He launched Lightship from the road and has since raised $27 million from investors, including Prelude Ventures, Obvious Ventures, and Congruent Ventures. A prototype is expected this spring.

**Atri Raychowdhury Th'17** is a founding member of Sony Music's data strategy group, where he launched two analytics tools: one for artists and another for the label's executives. A child of Indian immigrants, Raychowdhury conceived and now co-leads Sony Music's STEM Leadership Program, introducing underserved New York City youth to STEM and career paths in music. "I believe musicians play an integral role in enriching society—from providing the backdrop for life's poignant moments, inspiring disruptive change globally, unifying people across boundaries," says the Lexington, Mass.-based senior product manager. "I want to inspire more technologists to leverage their skills to empower artists."

**Alison Burklund Th'21** is chief technology officer for Nanopath, the Cambridge, Mass.-based company she cofounded with Amogha Tadimety Th'20. Nanopath, which spun out of the pair's PhD research at Dartmouth, creates diagnostics that test pelvic and gynecologic infections during a single visit, so treatment can begin right away. "Our big-picture goal is to improve health worldwide," says Burkland. "We saw this opportunity to couple my work in rare cell and biomarker capture with Amogha's work in ultra-sensitive biosensing." Recently, the company closed a series A funding round of $10 million, bringing its total funding to $11.5 million.

Tula, Okla.-based ConsumerAffairs is a repository for free online reviews, which also provide valuable insight to companies—for a fee—about their customers. "We help consumers throughout life's hardest moments—aging, moving, home ownership—by teaching them how to buy and connecting them with the right companies," says Carman. "Every day we match more than 12,000 consumers with brands."

## Back on Track

After two years of virtual events—including "Vrooom by Zoom" in 2021—Formula Hybrid + Electric Director **Mike Chapman '76 Th'77** is happy to be back on the N.H. Motor Speedway in Loudon for a second year. Founded and run by Thayer School since 2006, Formula Hybrid challenges students to design and construct a race vehicle with a hybrid or all-electric drivetrain that focuses on fuel efficiency in a high-performance application. After a career in project management, Chapman took the lead in time for the 2019 competition. He runs the international program out of offices at Thayer, juggling on-site inspections, finding sponsors, and supporting student teams. "Registration is strong for the 2023 competition—we're expecting 23 teams for the on-track competition and 14 for the virtual racing challenge," he says, including five new teams from Cornell, MIT, San Jose State, and the universities of Maryland and Toronto.

## Full Circle

When **Jennie Cunningham '17 Th'18** took a class with Professor Benoit Cushman-Roisin, he introduced her via a Ted Talk to bamboo designers in Indonesia. Fast-forward almost a decade and she is bringing their techniques—learned last year through a build-and-design course at Bamboo U—to Hanover with Cushman-Roisin's course, ENGS 171: "Industrial Ecology." "I am coming to campus to lecture and serve as a project consultant for students' term projects," says Cunningham, a Boston-based environmental engineer at Burns & McDonnell. She is drawing on her experience creating a bamboo serving tray at the Bali-based program. "I wanted to create a product that demonstrated the natural strength and versatility of bamboo," she says. "My biggest takeaway was that a design will change many times during the process, but in the end, you land on the design that was meant to be all along.

Jennie Cunningham '17 Th'18

## "Paved a Path"

**Emily Koepsell '09 Th'10** was one of the top non-Nepali female finishers in last year's Everest Marathon. She trained by trail running around the Bay Area, where she worked as program manager for Apple and then in technical operations for Lunar Energy. "Because the race is such a unique event, my main goal was to enjoy the experience. Therefore, I went into my training with a fairly relaxed outlook," she says. "Typically, I would run several days after work and on weekends I would do a long, hilly trail run with a weighted running vest." She upped her distances and weights as race day approached, then headed to the Himalayas for the 10-day hike to Everest Base Camp at 17,598 feet, the starting point for the marathon. It was one of the greater challenges for Koepsell, who has been balancing extreme sports and a demanding profession since she left Dartmouth with degrees in environmental earth science and engineering. She earned a Fulbright scholarship, which enabled her to study sustainable energy at the Technical University of Denmark before she pursued an MBA and MS at MIT. "I think adeptly juggling both work and personal pursuits is much easier said than done. It has only been in the past couple of years that I've realized how important this type of challenging adventure is for me," says Koepsell, who has since left Lunar and moved to Seattle to be closer to the mountains. She most recently climbed the highest mountain in South America, Aconcagua in the Andes, and this year is aiming to climb Mount Kilimanjaro and run the Polar Circle Marathon in Greenland. "When I'm in my 70s or 80s, I want to be able to look back on how I lived my life and know that I seized every opportunity, tried my hardest, didn't buckle under a fear of failure, and paved a path so others can follow."

Emily Koepsell '09 Th'10

## Biotech Leaders

**Joey Anthony '12 Th'13** reports a cluster of Thayer alumni are making a difference at biotech startup Ultima Genomics in Stockton, Calif. "**Jake Wolf '12 Th'13** and I have been working there since 2018, when there were only about 40 employees. We were some of the first mechanical engineers," says Anthony. "More recently, we had **Noah White '21 Th'21, Philip Bennet '19 Th'20**, and **Nolan Sankey '21 Th'22** start with internships and join full time." The contingent is helping the Bay Area, Calif.-based company deliver a genome sequencing for $100. It's an effort that made news at the Advances in Genome Biology

**Jeff Spielberg '10 Th'11** ▲

and Technology conference last year and headlines in *The New York Times*' "Upstart" column: "Can Start-Ups Significantly Lower the Cost of Gene Sequencing? Companies like Ultima Genomics say they have the technology, which could lead to medical breakthroughs." The days of 'statistical oomph'— meaning an explosion in the amount of data gleaned from lower-priced tests—appear imminent," according to the report. "Whole genome sequencing for that price can potentially accelerate the development of a massive database that can be mined to find genes that cause illnesses, to shed light on the complex influence groups of genes have on one another and to detect genetic changes that indicate the presence of cancer before a PET or M.R.I. scan could."

## Security Team

**Jeff Spielberg '10 Th'11** founded River Loop Security in 2012 with computer science majors **Ryan Speers '11** and **Ricky Melagres '11** initially to support the consulting work they were doing outside their day jobs. "It took us several years to recognize our experience filled a huge gap in our massively connected digital world," says Spielberg. In 2019, the trio focused full-time on building a team of electrical engineers and computer scientists to design and build cybersecurity solutions. When Two Six Technologies acquired River Loop last year, the customer base included Fortune 100 utility and electronics companies as well as the U.S. Department of Defense's Defense Advanced Research Projects Agency. Now, as Two Six's director of product and service delivery, Boston-based Spielberg can tap into more resources and help refine research-and-development efforts. Two areas he's eager to explore: Security capabilities baked into hardware at the silicon level and new applications for machine learning. "While the security industry has lagged in its adoption of machine learning, I expect our team to bring new products to market in 2023 that commercialize many years of research in this domain."

## Creating Spaces

As the Thayer representative on the Alumni Council, **Austin Boesch Th'16**

**"I felt motivated to help enable recent grads' access to resources that can be valuable at the early stages of their career,"**

**—AUSTIN BOESCH TH'16**

says he'll "encourage current students and recent alumni to 'learn how to ask' so they can more effectively leverage the powerful network Thayer and the broad Dartmouth community has created." He is drawing on his experience in Hanover to help young alumni navigate their lives and careers after Dartmouth. "Having attended Thayer later in life than a typical PhD student seemed daunting at first," he says, "but I found a lot of the volunteer, social, and entrepreneurial activities at Dartmouth helped me transition back to academia from industry and created spaces for me to build lasting relationships." Those connections with students, professors, and alumni enabled him to cofound biotech firm Zepteon Inc. while on campus and then fueled his service on the Dean's Council from 2016 to 2019. "I felt motivated to help enable recent grads' access to resources that can be valuable at the early stages of their career," he says. Boesch continues to serve as CEO of the Boston-based company, has worked with biotech firms Tidal Therapeutics and Sanofi, and is currently "pressure testing some new technology ideas with aims to launch more companies in the biotech space."

## Gallery

1. Andy Wilson '88 reviews the water supply at Diamond Valley Lake, an 800,000-acre-feet reservoir outside of Los Angeles.
2. Michael May Th'22 Th'25 married Madison Smith in December.
3. Mike Chapman '76 Th'77 helps a grandchild build a gingerbread house.
4. Adam Han '03 Th'04 and wife Amy Lee are raising Eleanor and Noah in northern California.

# thayer notes

## 1960s

**Ward Hindman '65 Th'68**: As a retiree, I don't get a chance to do much engineering. I go to my grandson's games, take care of the yard and the house. I've been messing with my genealogy for decades but now I have time to really work on it. That's about it from Texas. Go Green.

## 1970s

**Mark Totman '71 Th'72**: How does one person get two 2-by-6 14-foot pressure-treated crossbars (2-by-8s were too heavy) up into the trees for his grandchildren's swing set at our home on Silver Lake in Madison, N.H.? My solution: One end is allowed to pivot and the other is allowed to slide. Dean Carl Long would be proud! I recall that on the east end of West Wheelock Street (south side) there's a building up on stilts. In Long's class we calculated the resonant frequency, then visited the building and marched around at that cadence. The resultant movement of the structure was quite impressive!

**Mike Chapman '76 Th'77**: During the holidays, I was consulting on construction projects with our grandchildren.

**Doug Cogswell '77**: I just started a new business focused on healthcare fundraising (fundraising-analytics.com). I'm working to solve some tough data integration challenges and use complex data to create useful content in an ethically appropriate manner. I've spent the past couple of decades leading a venture capital and private-equity-funded data analytics software company. I sold that business a couple of years ago and recently finished the integration into the parent company. Once that happened, people in the industry contacted me about working with them on unsolved data challenges—so I'm giving it a try! Almost all of the data analytics that are being provided to this sector have a very simplistic approach of pulling data to the cloud and then applying standard modeling algorithms. The problem with this is multifold: many healthcare providers do not want their patient data managed by someone else in the cloud; healthcare fundraisers run multiple systems that do not naturally key to each other; there is a lot of raw data that has to be synthesized into usable metrics before it becomes useful; and each healthcare operation is different (models need to be customized). We're working to solve those four problems. We also control who gets access to what level of detail. For example, the management team needs just aggregate metrics, many of the analysts need the model outputs but not the detailed patient data that goes into those models, and the providers actually need to see the patient details to figure out what went on and what it means. So, it's very important to aggregate and provide access to the data in a manner that addresses the specific end-user needs but also provides patient privacy from those who don't have the need or right to see it.

## 1980s

**Kim (Smith) Quirk '82 Th'83**: A few years ago I sold my 10-year-old solar installation company, Energy Emporium, to ReVision Energy, an employee-owned B-Corp that installs renewable energy equipment in New Hampshire, Maine, and Massachusetts. I am now focused more on engineering and less on entrepreneurship, specifically in the design of commercial and residential battery energy storage systems. This is a great new field to focus on and I'm having lots of fun—it is nice to take a break from "being in charge" and spend some time diving deeply into technical issues!

**Andy Wilson '88**: I have just completed my almost eight-year "tour of duty" as a city councilmember in Pasadena, Calif., where I chaired the municipal service committee that oversaw our $300-million wa-

ter and power department. My day job is running the Alliance for SoCal Innovation, which is an innovation ecosystem catalyst not-for-profit focused on elevating the region as a global leader in technology, innovation, and entrepreneurship. Though we have a broad mandate at the alliance, much of our work focuses on the commercialization of frontier research coming out of academic and private labs. My eldest son, Spencer, is spending his junior year at the London School of Economics and will return this fall to Babson, where he is studying entrepreneurship. My youngest son, Dylan, had the good fortune of being accepted early decision to Dartmouth, class of 2027, which is extremely exciting and will have me coming to Hanover more often!

## | 1990s |

**Robert Haupt Th'96**: Since graduating from Thayer School with my M.S., I have been employed by MIT Lincoln Laboratory. I am a senior scientist in the active optical systems group. I am also a research associate at MIT in the civil and environmental engineering department, where I lead research efforts in topics such as noncontact laser ultrasound (NCLUS) for medical imaging, radio frequency ultrasound (RFUS) for brain imaging, seismic-cloaking methods, explosives-detection methods, and standoff landmine detection. I have a number of patents, publications, and awards on those topics. Our NCLUS work is advancing to a system prototype being funded by the U.S. Army for field-forward medicine. Our results were recently published in Nature: "First In-vivo Human Noncontact Laser Ultrasound Imaging." We have multiple patents on this topic and are working toward transitioning to the commercial sector. RFUS is a more recent development and is ongoing research to make a fully noninvasive transcranial ultrasound system for brain imaging and diagnostics.

**Qi Wang Th'97**: I've been working for MegaTrust Investment (HK), a boutique China fund manager based out of Hong Kong and Shanghai. We help global investors manage China A-share portfolios. In addition, I run an investor newsletter called Daily Reflection on China (qiwang.substack.com), talking about Chinese economy, markets and stocks. Recent articles include "Year of the Temperamental Tiger: My Predictions vs. Outcomes," "China's First Climate Friendly Investment Database," and "U.S.-China Relations: Biotech, Artificial Intelligence and Quantum Computing." Happy to sign up any alumni who may be interested.

## | 2000s |

**Joe Brown '00**: My big update is that I received tenure and promotion to associate professor of mechanical engineering at the University of Hawai'i at Mānoa last summer.

**Brian Nickerson '00**: There are some exciting updates on external recognition for MagicLinks in 2022: named No. 208 in Deloitte's "Technology Fast 500 Winners"; No. 876 in the Inc. 5000 (third year in a row on the list); No. 10 on Los Angeles Business Journal's list of "Fastest Growing Private Companies"; and named to Built In's "100 Best Places to Work in Los Angeles" list. MagicLinks helps brands scalably invest in creator partnerships on YouTube, TikTok, and Instagram through our e-commerce marketplace and Match Intelligence creator to brand matching artificial intelligence based on product sales data. We are based in Venice Beach, Calif., and are hiring for several engineering and developer positions.

**Adam Han '03 Th'04**: I've recently become a partner focusing on renewable energy at Environmental Resources Management (ERM), a pure-play consulting firm operationalizing sustainability for companies around the world. Two projects with which I'm currently consumed—Eleanor and Noah 2—are new motivations to pursue this sustainability line of work.

**Afua Amoah Th'06**: I am the managing partner of Delwik Group (delwikgroup.com), based in Zurich. We are a venture capital-focused investor since 2018. We serve direct investors and are specialist in private markets. We provide access to invest directly in seed-stage companies with a clearly defined exit path. We will be happy to link students coming out for Thayer with our investors!

**Peng Wang Th'09**: I am now a managing director at Fosun Group, a large Chinese private conglomerate. I also serve as a partner at RZ Capital, the venture capital and growth private-equity arm of Fosun, responsible for RZ's international fundraising and investment. My wife, Yihan Hao '08, is now a principal at the China Office of Rocky Mountain Institute (RMI). She is leading RMI's subnational carbon neutral demonstration initiative in China, developing and managing research and collaboration projects focused on enabling the rapid evolution of solutions on provincial carbon neutrality, regional zero-carbon demonstration, and corporate carbon-neutral actions.

## | 2010s |

**Rezwan Khan Th'13:** I started a company last year called Pace. We have 15 employees and are growing fast. How we got here: Justin Dignelli and I worked together at MongoDB helping to harmonize a self-service, product-led go-to-market with an existing, top-down enterprise sales motion. A game-changer in this process was to make real-time customer usage data accessible, understandable, and actionable for revenue-generating teams. Founded in 2021 and headquartered in New York City, Pace enables business-to-business software companies everywhere to take advantage of the efficiency of product-led growth with the efficacy of enterprise sales.

**Sean Howe '16 Th'17**: I just got a new job at a solar finance-development-management company in Boston called Sunwealth. My role will be manager on the community solar team. I'm excited to bring solar to underinvested communities across the United States.

**Matt Abate '17 Th'17**: I graduated in August from Georgia Tech with a PhD in robotics. I now work at a robotics startup in Atlanta, Pytheia (www.pytheia.com), where I am a cofounder. At a high level, we sell software for video cameras that converts the 2-D camera images into a 3-D, real-world representation of the scene. Then, we gather data and analytics on what's going on in the camera's field of view. There is some artificial intelligence and machine learning and a lot of physics behind our algorithms. We're in a few markets right now: safety for autonomous robotics, working with a robotics company that uses our cameras as a sensor to track robots and pedestrians in crowded spaces; safety for autonomous vehicles, working with a city in Georgia putting our software into their traffic cameras to create live maps of the road for an autonomous shuttle; and warehousing analytics, working with a warehousing company to find inefficiencies by tracking pallets as they're loaded and unloaded from trucks via forklift.

## | 2020s |

**Michael May Th'22 Th'25**: I got married on December 30! My wife's name is Madison (Smith) May. We are living in Concord, N.H., as that is the midpoint between University of New Hampshire, where she is getting an MS in communication sciences and disorders, and Dartmouth, where I am getting a PhD in energy engineering. I am currently working on a high spatial resolution model of thermal power capacity and transmission siting decisions to meet net-zero climate targets. That means I'm looking at all natural gas and coal generators in America and modeling which generators should be retired, redeveloped into new technologies, or retrofitted with carbon, capture, and storage as well as when these decisions should occur. This is done for multiple possible scenarios corresponding to varying rates of technological development, economic growth, and societal factors, moving toward an output that could aid energy policy or investment decisions in the future.

## in memoriam

### ROBERT C. DEAN JR
### — 1928-2023 —

*"Creativity Can Be Learned"*

Professor and serial entrepreneur Robert Dean died on January 7, 2023. He was 94. Dean was founder or cofounder of 10 companies in a variety of fields, including Creare (contract research and development in the thermal/flow and medical sciences) and Hypertherm (world's largest manufacturer of plasma-arc metal-cutting equipment) in the Upper Valley.

He was both a passionate engineer and a beloved teacher. "Professor Dean totally shaped my career with his energy, creativity, and enthusiasm," says Robert Prescott '64 Th'67. "He taught us that creativity—the sort that results in patented inventions—can be learned. He was inspiring at a personal level and his energy seemed boundless."

Dean earned his BS, SM, and ScD degrees in mechanical engineering at MIT, where he served as an assistant mechanical engineering professor in the gas turbine laboratory from 1951 to 1956. He then became head of advanced engineering at Ingersoll-Rand Co., leaving in 1960 to join the faculty at Thayer.

He was a member of the National Academy of Engineering and a fellow of both the American Society of Mechanical Engineers (ASME) and the National Academy of Inventors. In 1996, the U.S. Small Business Administration gave Dean one of the first Tibbett's Pioneer Awards in recognition of his contributions to the Small Business Innovation Research (SBIR) program. He earned the 1966 ASME Gold Medal and the N.H. High Technology Council's Entrepreneur of the Year Award in 1998.

Other Dean startups included Creare Innovations (xerography and motion control), Verax (mammalian-cell culture systems for biopharmaceuticals production), Synosys (biotechnology instruments and process equipment), Synergy Research Corp. (motion-control, reprographics engineering, and bioengineering), Synergy Innovations (innovation and new venture creation), Simbex (injury-prevention and rehabilitation products), NanoComp Technologies (carbon nanotubes and products), and Synticos (abrasive slurry jet cutters). He is survived by his wife, Nancy.

## obits

**Irenee du Pont Jr. '42** died January 16, 2023, at the age of 103. The engineering major attended Dartmouth for two years before transferring to MIT, where he earned his BS in 1943. During World War II, he was employed as a test engineer at Ranger Aircraft Engines Co., a division of Fairchild Engine and Airplane Corp. In 1946, du Pont was hired into the DuPont Co., where his father, two grandfathers, three great-grandfathers, and two great-great-grandfathers had served in management. In Wilmington, Del., since 1953, he worked in mid-management of plastics, film, and employee relations departments; served as senior vice president and member of the executive committee; and retired from DuPont's board of directors in 1990. Du Pont served on the boards of directors of the Wilmington Trust Co., the Delaware State Chamber of Commerce, and Americans for the Competitive Enterprise System. He is survived by four children and their families.

**William Brown Jr. '53 Th'54**—contractor, businessman, and community volunteer—passed away February 17, 2022. Brown grew up in Yosemite National Park and worked on the Yosemite trail crew during high school and college, where he developed a taste for taste for construction and building bridges. At Dartmouth he was active in the Outing Club, Green Key, and Sigma Alpha Epsilon. After earning his degrees in Hanover, he went on to receive an MS in civil engineering at Stanford in 1955. A stint in the Navy "Seabees" construction battalion in the Philippines led to a lifelong career in construction management. Brown built signature projects and resorts in California, Hawaii, and Hong Kong before retiring to Park City, Utah, and then Port Townsend, Wash. He was predeceased by his wife of 64 years, Joyce. He is survived by sons Alan, Chris, and Andy and their families.

**Harlan "Buzz" Fair '53 Th'54** died on November 20, 2022, at Kendal at Hanover. At Dartmouth, he earned his AB and a master's in civil engineering and was involved in Dartmouth Outing Club, ski patrol, and Alpha Theta. After graduation, he joined the Navy Civil Engineer Corps and served as maintenance officer at Newfoundland Naval Air Station. Following three years of active duty, he continued in the naval reserves for 36 years, retiring as a captain. Fair went on to various management positions in construction—including with Thompson Starrett, where he was project engineer on the observation towers for the New York State Exhibit at the 1964 World's Fair—before founding H. Fair Associates in 1978. He served Thayer as president of the Dartmouth Society of Engineers and earned the Sylvanus Thayer Award in 2013. Fair was predeceased by his first wife, Anne. He is survived by his wife, Granthia, children, Michael, Nancy, and Greg; and eight grandchildren.

**Ralph Thomas Unkefer Jr. '53 Th'54** died at his home in Haverford, Pa., on December 10, 2022. At Dartmouth, he earned an AB and a master's in civil engineering before joining the Navy and serving as a lieutenant in the Construction Battalion. He then earned an MBA at Harvard Business School and went to work with his father at Unkefer Brothers Construction Co. in Philadelphia, becoming president. Under his leadership, Unkefer Brothers grew into one of the city's outstanding general building contractors. The firm's projects included restorations of Smith Memorial Playhouse, the German Society Library, the Philadelphia Museum of Art, and the University of Pennsylvania's College Hall. In 2011, Unkefer Brothers received the Philadelphia Preservation Alliances Board of Directors Award for Exceptional Contributions to Historic Preservation. He is survived by his wife, Jane; children Charles, James, and Emily; son-in-law Dan; and five grandchildren.

**Clifton C. Smith '62 Th'64** of Stow, Mass., died January 21, 2023, of mantle cell lymphoma. After graduating from Great Neck North (New York) High School in 1958, Smith earned a General Motors National Scholarship and matriculated at Dartmouth. There, he earned his AB in engineering sciences and his degree from the Tuck-Thayer program while a member of Delta Kappa Epsilon. Smith married Dyane married in 1964 and

eventually settled in Stow, where he worked as a business manager at defense contractor Itek, solar energy entrepreneur with Daystar, founding partner of venture capital fund Aegis, and professor of entrepreneurism at Boston University's business school. He also served on the boards of the Randall Library, Appalachian Mountain Club, and Stow Conservation Trust. Smith is survived by Dyane; son Eric '91 his wife, Mary; son Bryan and his wife, Beth; brother Arthur '55; and five grandchildren.

**Lyman Bruce Coffey '63** died on October 11, 2022. At Dartmouth, Coffey earned his AB in engineering sciences and was a member of Bones Gates. After graduation, he joined the Navy and served on destroyers for three and a half years before receiving his MBA from UCLA in 1968. He joined Cresap McCormick, followed by Citibank, before joining father Keating '33 in his law company, Presto Food Products, later becoming president and CEO. Coffey was instrumental in the growth of the company and supervised the building of a new plant in City of Industry, Calif. Bruce enjoyed sailing from his family's house on Orcas Island in Washington State, helped found the Orcas Island Foundation, and was a longtime board member of Four Winds Camp on Orcas. He is survived by his wife of 59 years, Marty; children Bruce '86, Keating '88, Gina, and Celeste; and 10 grandchildren, including Kamiar '16 and Kayvon '17.

**Steven J. Hudak '65 Th'68** died on September 24, 2022, in Midlothian, Va. At Dartmouth, he earned his AB in engineering sciences and bachelor's in civil engineering, was treasurer of Alpha Chi Alpha, active in the Newman Club, member of Air Force ROTC, and played defensive tackle on the undefeated 1962 football team. After graduation, Hudak served in the Air Force in Okinawa and Vietnam. Following his discharge, he embarked on a more-than-30-year career with the U.S. Army Corps of Engineers, beginning in Chicago. After 10 years there he transferred to Corps headquarters in Washington, DC, where he was heavily involved in the long-range management and budgeting of several major civil works construction projects. He ably participated in congressional oversight of the U.S. Army Corps of Engineers. He is survived by his wife of 57 years, Maryanne, his wife of 57 years, and children Laura, Melissa, and Steven.

**Steven B. Franzeim '68 Th'72** of Harvard, Mass., died January 18, 2023, from a stroke. He grew up in Pittsfield, N.H., and at Dartmouth was a brother of Psi Upsilon and competed on the men's soccer team, a sport that he continued to play into his 60s and coached with his children's teams. After earning his AB and BE in engineering, Franzeim spent most of his career working as a software engineer. Franzeim valued the friendships he made in high school, at Dartmouth, at summer vacations at Kennebunkport, Maine, and in Jackson Hole, Wyo. He joked that his season pass, earned from employment at Jackson Hole Mountain Resort, was the accomplishment his Dartmouth fraternity brothers would most admire. His wife of 40-plus years, Christine, predeceased him in 2014. He is survived by children Paul and Emma and their families.

**Chris Bustard '10 Th'11 Th'14** died on December 29, 2022, after being hit by a car in Sarasota, Fla., where he grew up. He was 34. At Dartmouth, Bustard participated in the music foreign study program in London and Dartmouth Outing Club's Woodsmen's Team and Trail Crew, a member of the crew team and Dartmouth Wind Ensemble, and a brother of Alpha Chi Alpha. He earned his AB and BE degrees in engineering and an MEM in 2014 before beginning a career in digital healthcare. He served Dartmouth Engineering as a member of the Dean's Council, 2015-18. Bustard married Kate Lyon '05 in Hanover in 2017. They moved back to the Upper Valley after the birth of their son, Theodore ("Teddy"), in April 2021. Bustard was known for his mental and physical toughness. He finished nine 100-mile ultramarathons, including the 220-mile Tor Des Geants in northern Italy. He is survived by Kate and Teddy and his parents, David '68 and Elaine.

# in memoriam

## PETER M. FAHEY '68 TH'69 TH'70

## — 1946-2022 —

*"An Incredible Legacy"*

Longtime Thayer board member and Dartmouth trustee Peter Fahey died November 26, 2022, after an extended battle with pulmonary fibrosis. He was 75.

Fahey dedicated his time and energy to the Dartmouth community for decades, serving as a member of the College's board of trustees from 1994 to 2004 and for more than 30 years on Thayer's board. In recognition of his contributions to the engineering community, the School awarded him its highest honor—the Robert Fletcher Award. From Dartmouth, he received an Alumni Award in 2007 and an honorary Doctor of Humane Letters degree in 2018.

"Peter's dedication to Dartmouth is unmatched," says Dartmouth Engineering Dean Alexis Abramson. "In the time I have known him, I deeply felt his tremendous and long-lasting impact on Thayer. He leaves an incredible legacy."

Fahey earned his AB in chemistry at Dartmouth, where he was active in men's basketball and track and field and cross country and was a member of Phi Delta Alpha fraternity and Sphinx senior society. He then earned his bachelor of engineering and master's from Thayer before pursuing a career as a chemical engineer. He later earned an MBA from Harvard Business School and began a decades-long career in corporate finance with Goldman Sachs. He was named a general partner in 1983 and was part of the firm's "10,000 Women" and "10,000 Small Businesses" initiatives.

When asked to provide a 25-word note to humanity for his college application, the teenage Fahey wrote: "You have but one life on this earth: Do not waste it. Utilize every minute of your life to improve yourself and help your neighbor." He followed through on this philosophy, giving back to the Dartmouth community throughout his adult life, supporting the construction of multiple facilities—including an undergraduate dorm—and creating endowments for undergraduate and graduate student scholarships and the athletics department.

He is survived by his wife, Helen; children Kimberly '92, Peter Jr. '94, Michael '97, and Katie '06; 10 grandchildren including Ashley '22 Th'23 and Emily '25; and siblings Stephen '70 Med'72, and Timothy '74.

# Collaborations

**Professor Li's team is developing composites that can take the heat.**

Li is researching the sensing and energy storage capabilities of "preceramic polymers."

ROBERT STRONG '04

## Sensors for Space

Professor Yan Li is leading the effort to design new materials for self-powering sensors that can withstand higher temperatures than conventional sensor materials.

"For sensing, energy storage, and energy harvesting capability in space, temperature tolerance is important," says Li, adding current materials lose all functionality at more than 200 degrees Celsius.

Li and her team—PhD students Huan Zhao Th'26 and Xiangbei Liu Th'27 and Luce Fellow Anisia Tiplea '24—received $750,000 from NASA to develop new composites in collaboration with NASA's Jet Propulsion Laboratory, Dartmouth's Irving Energy Institute, the University of New Hampshire, and Sandia National Labs.

Li will also tap into Suprock Technologies and Micro-Precision Technologies, local industries with extensive experience developing high-temperature sensors. The team aims to develop piezoelectric materials—those that accumulate an electric charge in response to mechanical pressure or movement—for self-powering sensors that can enhance damage monitoring and quality control for future in-space manufacturing.

"At elevated temperatures, [these materials] undergo a unique phase transformation into ceramics that exhibit great thermal stability as well as excellent corrosion and creep resistance," says Li, "which is highly desirable for space applications such as 3-D printing on the moon or even Mars."

*—Catha Mayor*

@thayerschool

How will content-creating generative #AI like ChatGPT affect video platforms (Netflix, YouTube, Hulu, etc.)? Professor Geoff Parker (@g2parker) co-authored an article in @HarvardBiz examining these impacts and potential challenges.

@worldscientific

Prof. Douglas Van Citters of @thayerschool @dartmouth authored a review that focuses on the addition of nanoparticles to various parts of arthroplasty #surgery. Carbon additives proved to be the most widely studied. #MedTwitter #nanotechnology

@thayerschool

#Climatechange is affecting the timing of the freezing and melting of the #Artic ice, according to Professor Don Perovich from his co-authored study in The Cryosphere (@EGU_TC). He told @insideclimate: "Timing is really critical, and this shows that the timing is changing."

@thayerschool

Thayer was one of three schools chosen from over 50 applicants to receive silver-level recognition from the @ASEE_DC. Thayer was recognized for its "significance of achievements to-date" in the representation of women among faculty and graduate students.

@thayerschool

For their capstone, Sophie Edelman '22, Kaulana Kanno '23, Harrison Munden '23, Nate Roe '23, and Adelina Sederman '23 assessed the energy efficiency of Dartmouth's Montgomery House. They identified retrofit options that could save as much as $3,000 in annual energy costs.

## Intro to Engineering Project

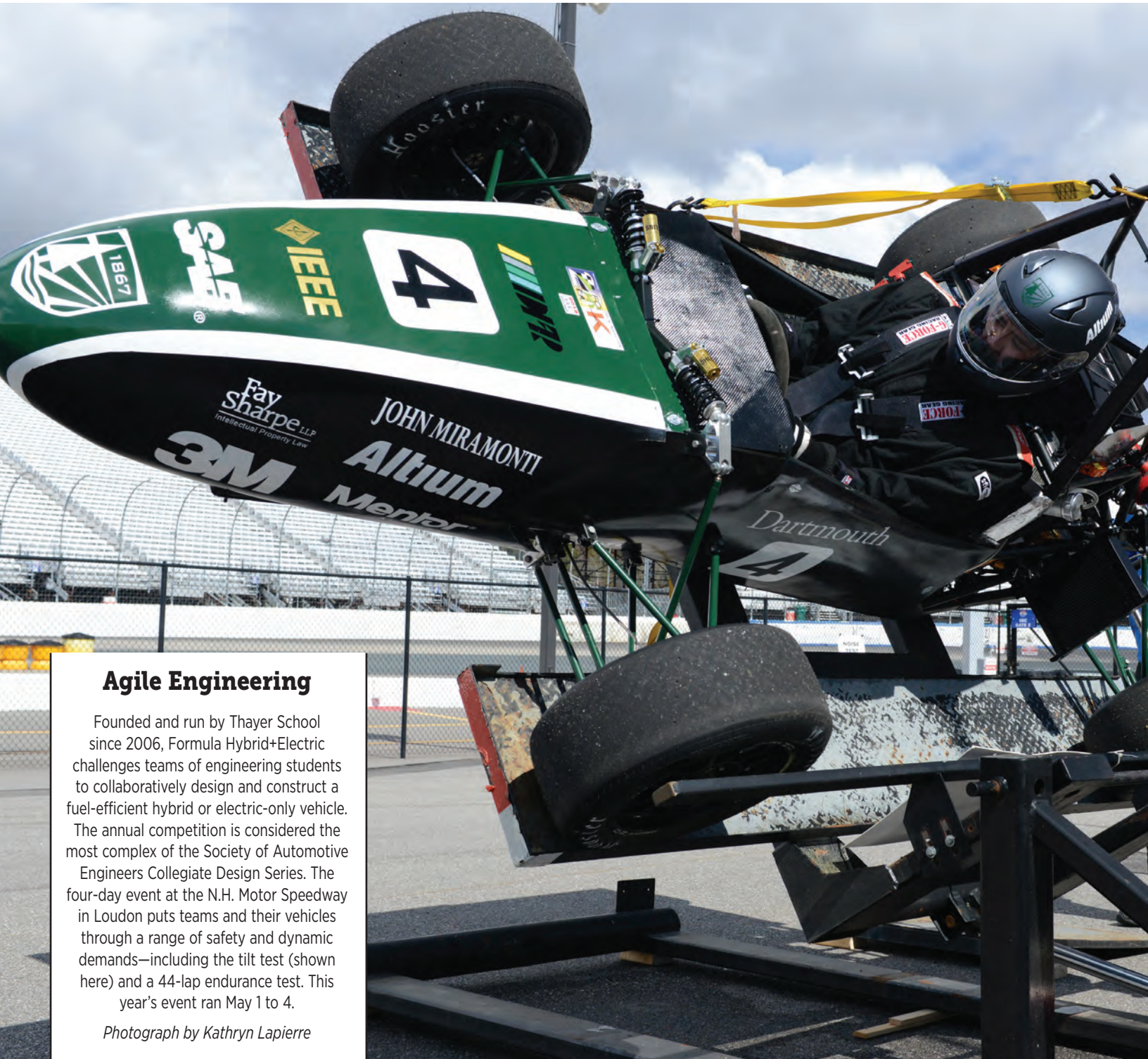
**A team of Dartmouth undergraduates who designed and built "Oh Buoy!" won this term's Phillip R. Jackson Award for best overall performance in ENGS 21. The team's prototype is designed to prevent small children from drowning.**

@thayerschool

MEM student Serena Yombe and PhD Innovation fellow Gideon Kassa represented Thayer at this year's National Society of Black Engineers (@nsbe) Convention! BE student Onyedika Onuorah, Natasha Herring '12 Th'13, and other alums also stopped by the booth!

DARTMOUTH ENGINEERING

DARTMOUTH COLLEGE
15 THAYER DRIVE
HANOVER, NH 03755




## Agile Engineering

Founded and run by Thayer School since 2006, Formula Hybrid+Electric challenges teams of engineering students to collaboratively design and construct a fuel-efficient hybrid or electric-only vehicle. The annual competition is considered the most complex of the Society of Automotive Engineers Collegiate Design Series. The four-day event at the N.H. Motor Speedway in Loudon puts teams and their vehicles through a range of safety and dynamic demands—including the tilt test (shown here) and a 44-lap endurance test. This year's event ran May 1 to 4.

*Photograph by Kathryn Lapierre*