DARTMOUTH
Engineer
SPRING 2021
THAYER SCHOOL OF ENGINEERING

THE GIFT OF FAILURE

CAMERON PLANCK TH'21 WATCHED AS FIVE OF HIS PROTOTYPES BROKE DOWN IN THE ARCTIC.

THEN HE LEARNED THE VALUE OF RESILIENCE.

inside

First Look

WINTER WINTERLAND

Snow blankets the Dartmouth campus, transforming the Green.

Photograph by Robert Gill

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Editor
Kathryn Lapierre

Designer
Wendy McMillan

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Theresa D'Orsi

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Contributing Editors
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Editorial Board
Alexis Abramson (ex officio), Eun Lee Koh '00 (ex officio), George Cybenko, Harold Frost, Yan Li, Lee Lynd, Peter J. Robbie '69, Rahul Sarpeshkar, Jennifer Seiler, Holly Wilkinson

Contact Us
Office of Communications
Thayer School of Engineering
14 Engineering Drive
Hanover, NH 03755

dartmouth.engineer@dartmouth.edu
Tel. 1+ (603) 646-3521
Fax: 1+ (603) 646-9133

Dartmouth Engineer Online
dartmouthengineer.com

Thayer School Website
engineering.dartmouth.edu

Report Address Changes
engineering.alumni.records@dartmouth.edu

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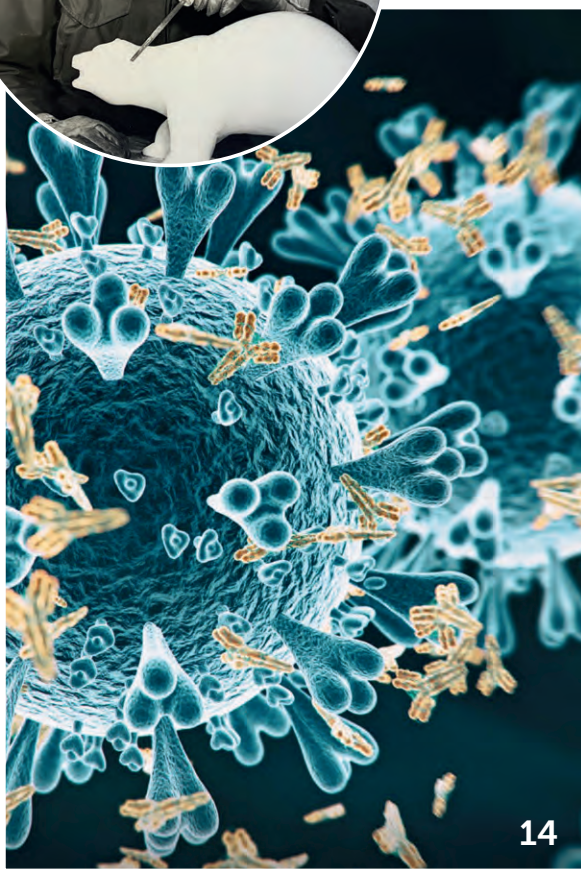
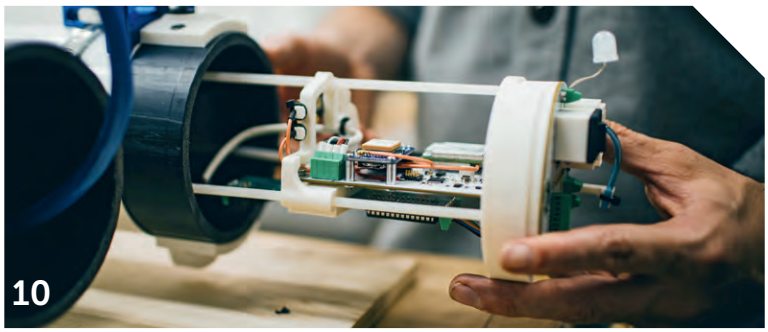




DEPARTMENTS

COVER:
Photograph by Robert Gill

THE Great Hall

NEWS FROM AROUND THAYER SCHOOL

CONSTRUCTION UPDATE

Despite challenges posed by the COVID-19 pandemic, construction on the 160,000-square-foot Center for Engineering and Computer Science is scheduled to be completed this fall. Throughout the past year, the rise of the new building—along with the construction of the Arthur L. Irving Institute for Energy and Society at the end of Tuck Drive—has transformed the silhouette of Dartmouth's West End. Highlights include an expansive, light-filled building with dedicated maker-spaces, a design loft, and additional labs for hands-on projects. An integral part of Dartmouth's technology and innovation hub, the new center will expand learning and research opportunities for engineering and computer science majors, help bring new ideas to market, and prepare leaders who can better the world.

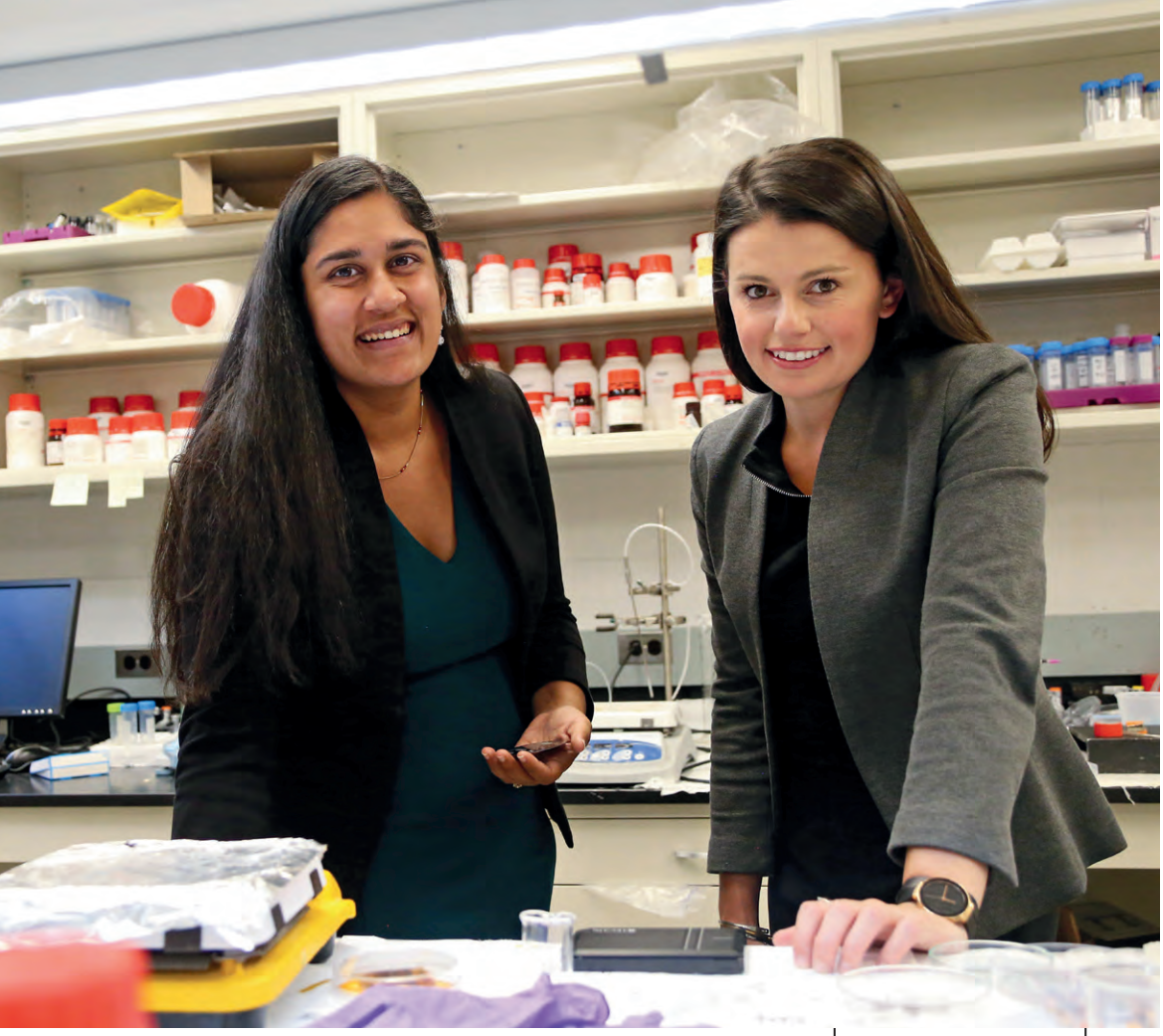
AWARD 2020-21

Mazilu Engineering Research Fellowship

AB/BECANDIDATEJASONLIU'21 has been named the 2020-21 Mazilu Engineering Research Fellow to support his work with Professor Fiona Li to build safer, more efficient battery systems.

"I am honored to be this year's Mazilu Fellow to tackle the challenges of electrochemical energy storage," says Liu. "Fast-growing industries involving mobile electronic devices, electric vehicles, and renewable energy generation require stricter performance and safety guidelines for batteries of the future. Professor Li's work on synthesizing solid electrolytes to develop safe, cost-effective, and high-energy solid-state batteries tackles these demands and has inspired me to delve into the world of energy storage."

He adds: "With how impactful advancements in energy storage can be for our growing energy-consuming society, I am excited to use the electrical and energy engineering skills I have developed at Thayer." *—Catha Mayor Lamm*



OPPOSITE PAGE: JARED BENEDICT; TOP: *UNION LEADER*

Amogha Tadimety & Alison Burklund

Q&A

The difference between minutes and hours to diagnose an illness can literally mean life or death. That's why PhD candidate Alison Burklund and Amogha Tadimety Th'20, a recent PhD Innovation Program graduate, were determined to spin their Dartmouth research into a startup focused on developing lifesaving technology. The two friends and former lab mates recently launched Nanopath, whose diagnostic tool has the potential to save hundreds of thousands of lives a year.

What drew you to this work?

BURKLUND: Our big-picture goal is to improve health worldwide. When I joined the lab, Amogha was working on highly sensitive technologies for cancer monitoring. I'm passionate about infectious disease and global health. With infectious disease, diagnostic time is critical. We saw this opportunity to couple my work in rare cell and biomarker capture with Amogha's work in ultra-sensitive biosensing.

What impact does Nanopath's technology have for patients?

TADIMETY: Right now the method of diagnosing patients with bloodstream infections and finding the right treatment requires a lot of steps and hospital visits. There are about 2 million cases a year and about 8 percent of patients in the ICU end up with a bloodstream infection. Mortality rates increase by about 7.6 percent every hour that treatment is delayed, so quicker diagnosis is key to saving lives.

"Our goal is to get the total diagnostic timeline down to less than one hour."
—ALISON BURKLUND

BURKLAND: There's also a growing problem of antibiotic resistance. This means clinicians have to be very careful in how they administer antibiotic treatments. Our tool will help them better target their therapy quickly and more accurately.

How does it work?

BURKLUND: The patient's blood sample goes into what is essentially a small benchtop machine on a disposable cartridge.

TADIMETY: Our technology eliminates nucleic acid amplification requirements—reducing so-called "noise"—so it is able to pinpoint the pathogen much more quickly.

BURKLAND: Our goal is to get the total diagnostic timeline down to less than one hour.

How did the PhD Innovation Program support you in your research and your startup venture?

TADIMETY: It's the only program of its kind where you do your full work as a PhD and are also provided resources to translate your research. I had access to Dartmouth's business and medical schools, the hospital, and a whole entrepreneurial network. I learned the nuts and bolts of putting together a business plan, how to file an IP, and opportunities for grant funding to get things off the ground.

BURKLUND: It helped reframe our mindset and approach. Often people invent something really cool and then try to find a market for it. It's deeply frustrating to see knowledge sitting in publications or a technology trapped in a lab. What the PhD Innovation Program helped us do is look for the global problem and use our knowledge and core engineering skills to develop solutions for human need.

—Charles R. Spydell

COMMUNITY

Virtual Lab Captures Thayer's Buzz

"THAYER WAS VERY MUCH A hands-on place before the pandemic. It was buzzing, and anytime you walked down the hall you'd see some cool project going on. When we moved to remote learning, we had this question of how to make virtual spaces that are as dynamic as the physical spaces that we have."

Jane Reynolds, user analyst support in Computing Services, faced this challenge when the pandemic forced disclosure. As Thayer shifted to remote work and learning in response to COVID-19, staff wondered if and how it would be possible to translate all that "buzz" to the digital sphere.

As has often been the case in this new era, technology was the answer. Using Zoom's back-end software and the talents of Thayer graphic designer Patricio Sarzosa, the computing services team was able to digitally recreate one of Thayer's most iconic spaces: the Couch Project Lab.

Upon entering the Virtual Couch Lab, the user has an aerial, illustrated layout that represents the actual physical space, including tables, couches, and even the break room. Each area represents a separate Zoom meeting room, and users can float between Zoom meetings throughout the room illustration. Users can also see thumbnail images and names of others currently using the space, including where each person is "sitting."

The Virtual Couch Lab enables informal meetings, such as when coworkers want to catch up during a quick break or students want to meet in study groups.

"We're getting a little bit of that sense of fun, buzz, creativity, and playfulness that everyone was really missing, and it's all built on Zoom," said Reynolds.

The Virtual Couch Lab even provides a space for campus groups outside of Thayer looking to create community online.

"The Virtual Couch Lab has been great for some of the groups I lead on campus," says Ryan Hickox, professor of physics and astronomy and the house professor for West House. "The West House community held a virtual dinner with first-year students, and we're hoping to be able to organize some events to bring first-year and upper-class Westians together in the coming weeks, with tables organized by interest or Big-Little student groups. I've also used the Virtual Couch Lab for meetings of my astronomy research group. It's been refreshing to be able to gather on the 'couches' just as we would in my office in Wilder Hall!"

The Virtual Couch Lab was named the winner in the "Exemplary Educators" category of the 2020 Zoomtopia Innovation Awards, which showcases how customers are using the technology. Thayer has also been invited to attend Zoomtopia 2021 and was featured on Zoom's blog and social channels. *—Julie Bonette*

NEW FACULTY

Welcome

ETHAN MURPHY joined Thayer last April as an assistant professor of engineering. His research involves physics-based electrical modeling, imaging electrical properties with a technique called electrical impedance tomography, and improving these methods for practical biomedical applications using computational techniques. He earned his BS in mathematics from Worcester Polytechnic Institute in 2002, MS in industrial mathematics from Worcester Polytechnic Institute in 2002, and PhD in mathematics from Colorado State University in 2007.

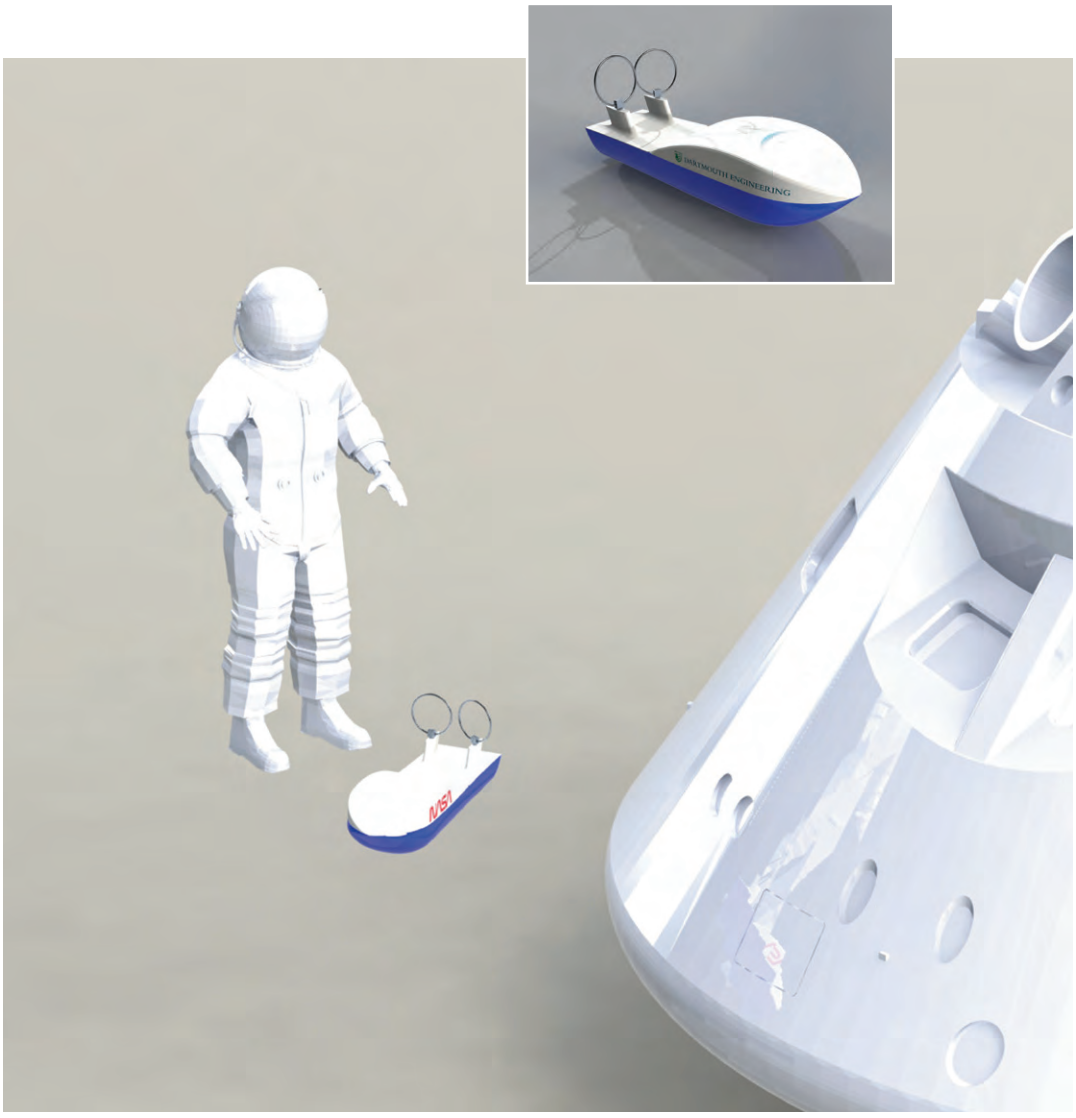
ELIZABETH MURNANE joined Thayer last July as the Charles H. Gaut and Charles A. Norberg Assistant Professor of Engineering. Murnane's research focuses on the design, engineering, and evaluation of technologies aimed at promoting human well-being and the welfare of the natural environment. Her work emphasizes translational approaches to meaningfully engage with and shape industry practices, local communities, and policymaking. She earned her SB in mathematics with computer science from Massachusetts Institute of Technology in 2007, PhD in information science from Cornell University in 2017, and postdoctoral scholarship in computer science from Stanford University in 2020.

GEOFFROY HAUTIER joined Thayer in October as the Hodgson Family Associate Professor of Engineering. Hautier's research focuses on computational materials discovery and design using atomistic modelling. His research group uses especially high-throughput, large-scale computational screening to search for new materials of interest for a wide range of applications, from electronics to energy storage and production. He earned his MS in engineering from École Centrale Paris (France) in 2004, MS in materials science and engineering from Université Libre de Bruxelles (Belgium) in 2004, and PhD in materials science and engineering from Massachusetts Institute of Technology in 2011.

KIMBERLY SAMKOE joined Thayer last July as an associate professor of engineering. Her research interests include quantitative fluorescence molecular imaging, fluorescence-guided surgery, biomedical systems engineering, biological models of cancer, cancer diagnostics and therapeutic monitoring, optics in medicine, and photodynamic therapy. She earned her BSc in biochemistry from University of Regina (Canada) in 2001 and her PhD in biophysical chemistry from University of Calgary in 2007.

Lunar Emergency Vehicles

BE students **Mit Patel Th'21, Garrett Rawlings '20 Th'21, Rafael Rosas '20 Th'21, Andrew Skow '21**, and **Ty Teodori '20 Th'21**—with advisor Professor **Laura Ray**—are finalists in NASA's Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) competition. The challenge was to design a self-driving and self-navigating marine surface vehicle to help in the case of an unplanned maritime egress during the 2024 Artemis mission to the moon. "Space mission frequency and crew sizes are both increasing, so in an emergency—such as a launch abort or capsule re-entry—first-responders will be stretched thin," says Rosas. "First-responders could deploy our Surface Autonomous Vehicles for Emergency Rescue (SAVERs) to astronauts in distress and provide essential first-response and survival equipment." One of the greatest challenges has been designing remotely during COVID-19. "We are incredibly proud of the quality of work we have been able to collaboratively produce while working over Zoom," says Rosas. The team was back on campus for winter term, prototyping and optimizing SAVER's subsystems in preparation for a preliminary design review in February. "We plan to conduct several of our tests, including drop dynamics and autonomous navigation system, in Zimmerman Pool," he says. The prototype is due by the end of May, with testing scheduled for mid-June in the NASA Johnson Space Center Neutral Buoyancy Laboratory in Houston, Texas. *—Theresa D'Orsi*



OPPOSITE PAGE, TOP LEFT: ISTOCK THIS PAGE: ELI BURAKIAN

PATENTED A "smart" orthopedic gyroscope to help optimize alignment of artificial knees devised by lecturer **Ryan Chapman Th'18** and **Professor Douglas Van Citters '99 Th'03 Th'06** has been awarded a patent.

NAMED **Professor Jifeng Liu**—whose research focuses on renewable energy and reducing the energy consumption of information technology through integrated photonics—has been named a fellow of the Optical Society.

AWARDED Researchers from Dartmouth and DHMC—including professors **Ryan Halter Th'06, Vikrant Vaze**, and **Ethan Murphy**; research assistant **Alexandra Hamlin '16 Th'17 Th'19**; and PhD students **Navid Rashedi Th'21** and **Yifei Sun Th'19**—earned the Society of Critical Care Medicine's Gold Snapshot Award for development of technologies to detect internal bleeding.

PUBLISHED In the November issue of the American Chemical Society's *Central Science* journal, PhD student **Edward Matios Th'21** and **Professor Fiona Li** argued that more research on new battery chemistry based on sodium could yield more sustainable and higher performance alternatives than lithium-ion batteries.

STUDIED **Adjunct Professor Jeremy Faludi** and senior research engineer **Carrie Van Sice** assessed the "State of Knowledge on the Environmental Impacts of Metal Additive Manufacturing," a study commissioned by the Additive Manufacturer Green Trade Association.

FUNDED Two professors have received funding for research pilot projects from the N.H. Center for Multiscale Modeling and Manufacturing of Biomaterials. **Professor Yan Li** is developing polymer-derived ceramics to replace metallic materials in implants. **Professor William Scheideler** aims to develop porous sensors to monitor the inflammatory response to implanted biomaterials.

APPOINTED **Professor John Zhang** has accepted a temporary appointment as program director in the electrical, communications, and cyber-systems division of the National Science Foundation.

PUBLISHED **Dean Alexis Abramson** coauthored a paper in a December issue of the Public Library of Science's *Plos One* journal on using virtual energy audits to identify buildings' energy-saving opportunities.

I Want One of Those!

STUDENT PROJECT

HANGNOW

In an effort to foster spontaneous connections among students—who are discouraged from attending large gatherings due to COVID-19—a team of undergraduates designed and built HangNow. When students are craving company, they simply turn to the physical box. It features buttons offering four options—hang now, walk now, study now, and food now. A press of the button connects them via text message to others who pressed the same button. Users receive names and phone numbers so they can easily connect with others. "The product was built to encourage meaningful connection in the age of COVID-19, and we're passionate about the prospect of bringing these spontaneous interactions to the '24 class," the winning team reported in its project video. Inventors **Derek Lue '21, Brady McCallister '21, Zoe Schwartzman '21**, and **Sunaina Sekaran '22** won the Phillip R. Jackson Award for best overall performance in ENGS 21: Introduction to Engineering. Their teaching assistant was **Ellie Baker '22**. *—Kathryn Lapierre*

FOREIGN STUDY

Sustainable Engineering Study Abroad in Berlin

IN A FIRST JOINT PARTNERSHIP, Dartmouth's Thayer School of Engineering and the department of German studies will launch a new multidisciplinary study-abroad program focused on sustainable engineering in Berlin, Germany.

The new program, "Green City: Sustainable Engineering in Berlin," will offer engineering coursework, taught in English, with German language and culture studies. Students will be placed in homestays with local German families to enable full language and cultural immersion.

"Our program takes interdisciplinary learning to a new level, as it gives students the opportunity to explore central engineering concepts through the medium of the German language and culture," said Associate Professor of German Studies Petra McGillen. "We'll be in a setting where sustainability is a lived practice, not a chapter in a textbook, and I look forward to seeing engineering and language learning come together in this setting in meaningful and exciting ways."

Professor of Engineering Petra Bonfert-Taylor adds: "We are specifically studying Berlin as a green city and its sustainability practices, which are so far ahead of what we do in the United States. Berlin is a bustling, amazing city where people are much more conscientious of their environment."

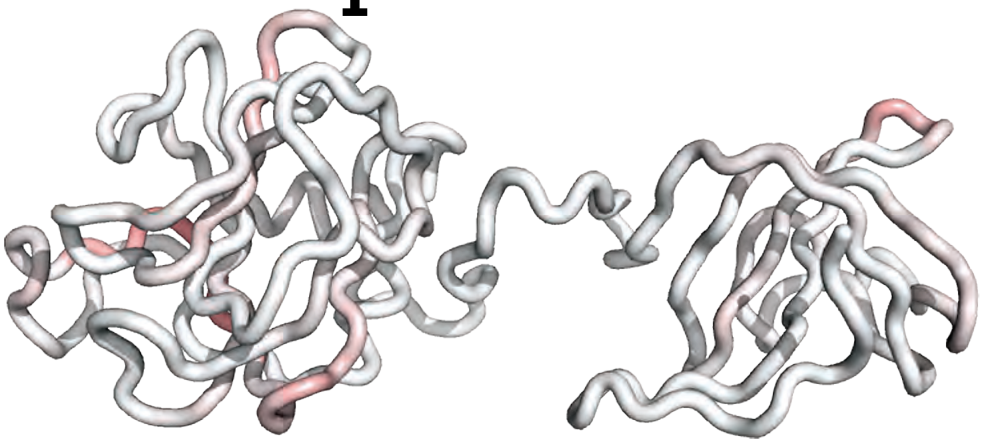
The program, expected to launch in spring of 2022, will be co-led by Bonfert-Taylor and McGillen. Mary Tobin '20 Th'20, a recent engineering graduate, helped drive early interest in the program, including by conducting student surveys. *—Julie Bonette*

NEW LOOK

Thayer School of Engineering has unveiled its new and improved website, aimed at modernizing the School's online presence with an updated design, architecture, and navigation, as well as increased web content accessibility. In addition, the redesign better highlights Thayer School's mission to prepare leaders to tackle the world's most difficult challenges through education, research, and innovation with human-centered impact.

FAR LEFT: HANGNOW GROUP; TOP RIGHT: ISTOCK; BOTTOM RIGHT: GRAPHIC BY PATRICIO SARZOSA

lab report



Treatment for Drug-Resistant Bacterial Infections

THE CENTERS FOR DISEASE CONTROL and Prevention (CDC) has prioritized finding effective treatment of methicillin-resistant *Staphylococcus aureus* (MRSA), one of the most common bacterial pathogens and the single most deadly drug-resistant bacteria in the United States. A new study led by Dartmouth engineers shows promise for a lysin-based antibacterial agent that may enable safe, repeated dosing to treat life-threatening staph infections.

In recent years, lysins—enzymes naturally produced by microbes and associated viruses—have shown potential to treat *S. aureus*, which can rapidly acquire resistance to other types of antibiotic drugs.

"Lysins are one of the most promising next-generation antibiotics," says Professor Karl Griswold. "They kill drug-sensitive and drug-resistant bacteria with equal efficacy, they can potentially suppress new resistance phenotypes, and they also have this laser-like precision."

While there is promise in lysins, development has been slowed due to concerns they prompt humans' immune systems to develop antidrug antibodies, which can have negative side effects, including life-threatening hypersensitivity reactions.

F12 is a new lysin-based antibacterial agent engineered and patented by a team that includes researchers in Dartmouth's computer science department, the Lundquist Institute at Harbor-UCLA Medical Center, Lyticon, and Stealth Biologics.

The agent is essentially able to hide from the human immune system, and so does not cause the same negative side effects as natural lysins. It is also the first lysin-based treatment with the potential to be used multiple times on a single patient.

"We have engineered this super-potent, super-effective anti-MRSA biotherapeutic, and we've done it in a way that renders it compatible with and largely invisible to the human immune system. By making it a safer drug, we've enabled the possibility of dosing multiple times in order to treat even the most highly refractory infections," says Griswold.

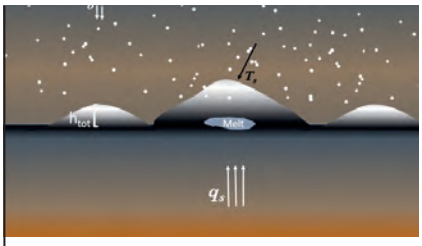
The team's paper, "Globally deimmunized lysostaphin evades human immune surveillance and enables highly efficacious repeat dosing," was published in *Science Advances* last fall. The work was the result of two grants totaling $1.7 million from the National Institutes of Health.

The paper details the treatment's positive results in rabbits, mice with partially humanized immune systems, and studies with extracted human immune cells. "This is the first report of a translation-ready deimmunized lysin, and F12 has serious, bona fide clinical potential," says Griswold.

The antibacterial agent could be ready for human clinical trials as soon as 2023. —*Julie Bonette*

NEW THERAPEUTIC A new study led by Dartmouth engineers shows promise for a lysin-based antibacterial agent that may enable safe, repeated dosing to treat life-threatening staph infections.

TOP LEFT: COURTESY KARL GRISWOLD; TOP RIGHT: COURTESY OJHA ET AL



Life on Mars

A NEW STUDY PUBLISHED IN *Science Advances* suggests that the most habitable region for life on Mars would have been deep below its surface, likely due to subsurface melting of thick ice sheets fueled by geothermal heat.

The study used a model designed and constructed by Jacob Buffo, a postdoctoral researcher working in Professor Colin Meyer's lab, to simulate the physical and thermal evolution of thick Martian ice sheets.

"Using the model, we wanted to determine if environmental conditions existed in Mars' history that would allow the base of the ice sheets to melt," says Buffo. "If melt can occur, it has important implications for the generation of fluvial features—such as ancient riverbeds—on Mars' surface, as well as the production of potentially habitable environments on ancient Mars."

The conditions needed for subsurface melting of thick ice sheets would have been ubiquitous on ancient Mars. But even if Mars had a warm and wet climate 4 billion years ago, with the loss of the magnetic field, atmospheric thinning, and subsequent drop in global temperatures through time, liquid water may have been stable only at great depths. Therefore, if life ever originated on Mars, it may have followed liquid water to progressively greater depths.

Scientists soon will be able to better assess the role of geothermal heat in the habitability of Mars thanks to NASA's Mars InSight spacecraft, which landed in 2018. —*Julie Bonette*

PHOTOGRAPHS BY ROBERT GILL

THE GIFT OF FAILURE

BY JULIE BONETTE

Cameron Plank Th'21 watched as prototype after prototype broke down in the Arctic ice.

Failure pushed him to create a better tool to help scientists "see" climate change as never before.

Cameron Planck set out to capture elusive but essential data on Arctic sea ice, which was becoming increasingly difficult as more ice melted out each summer.

No place on Earth is warming—and melting—as fast as the Arctic. In a race against time, Dartmouth engineers have joined international polar expeditions to better understand the scale of climate change and how it might impact the planet. Satellites can show if the ice cover is growing or shrinking, but without more data, it's impossible to understand why.

"Our understanding of the Arctic is limited by our ability to observe it," says Planck. "So any opportunity to observe is sought after—and every piece of data is coveted."

He deployed what he thought was a successful buoy design—only to watch as the first and then four follow-on prototypes failed within one month. Since the buoys were in some of the most remote places in the world, it wasn't feasible to retrieve the equipment and examine what had gone wrong.

The only option was to go back to the drawing board.

WHEN PLANCK CAME TO DARTMOUTH in 2015, he teamed up with engineering professor Donald Perovich, who had received a grant from the National Science Foundation for the Seasonal Ice Mass Balance (SIMB) buoy project. He also tapped into seasonal buoy research from adjunct engineering professor Chris Polashenski '07 Th'07 Th'11.

Alongside fellow graduate student James Whitlock Th'18, Planck set out to engineer the third generation of the SIMB buoy (SIMB-3) to survive the Arctic summer and measure a variety of parameters, including sea ice thicknesses and water and air temperatures.

Planck and Whitlock quickly realized that to capture the range of data, they had to design custom electronics. They also had to decrease the cost of buoys, as changing ice cover would destroy units within a year.

When their initial prototypes failed in the Artic ice, the pair began the exhaustive process of re-engineering every aspect of their design.

"We tested as much as we could, but there were just a lot of things that we didn't know," says Planck. Without the original devices to examine, he was forced to double-check every element of the design, from the system's software to the custom hardware to the manufactured components. "You have to refine and make better every little part of the process," he says.

Although failure forced him to start again at the beginning, Planck learned how to systematically eliminate its root cause.

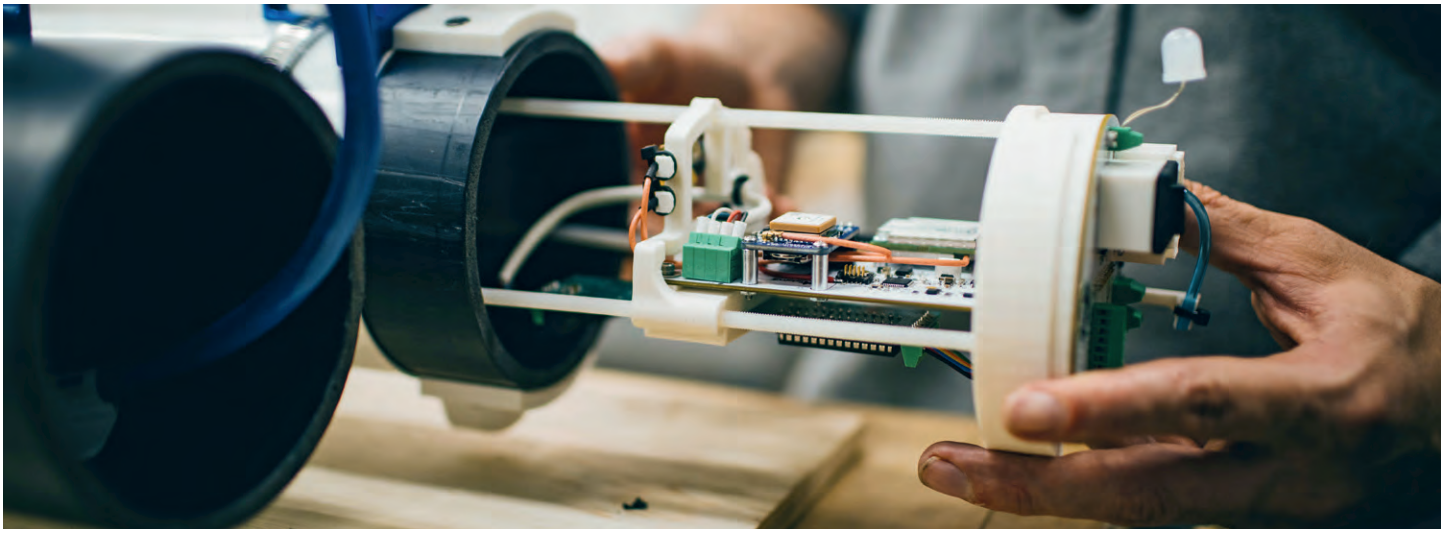
"It's about figuring out how to do simple things really well—and that's a lot harder than it sounds," says Planck. "It's a lot of trial and error and making wiring diagrams and thinking about all these little overlaps that get overlooked."

> **"Our understanding of the Arctic is limited by our ability to observe it."**
>
> CAMERON PLANCK

He worked his way through the entire system to arrive at a set of SIMB-3 components he believed would survive the harsh environment.

"At some point," he says, "you just have to cross your fingers, send it back out, and hope it works."

WHAT HAS EMERGED IS A SYSTEM that's half the weight and easier to deploy than the original design while still able to collect a wealth of information. The 16-foot unmoored buoy houses a battery, antenna, and embedded control electronics. Once it is frozen in place, two acoustic rangefinders—mounted on the top and the bottom of the buoy—enable researchers to measure how snow depth, ice thickness, vertical temperature profile, and barometric pressure evolve throughout the season.



"We also significantly reduced manufacturing time and instrument cost, which resulted in a design that's scalable," says Planck, who successfully defended his thesis in November.

He says the redesign made the buoys more mechanically sound, waterproof, and better able to withstand the environment. It also added an important feature: a special chip called a watchdog timer that resets the buoy datalogger after an unexpected lockup.

Not a single instrument has prematurely failed since.

"It was just amazing to me," says Perovich. "When I built the first buoy around 30 years ago, I just got a bunch of parts, stuck them together, and hoped for the best. This is very well done."

That success prompted Planck to enter Dartmouth's PhD Innovation Program to commercialize the technology. In 2017 he and Whitlock, who graduated with an MS in engineering sciences, cofounded Cryosphere Innovation in Lebanon, N.H. Planck serves as president and principal engineer and manages day-to-day operations. Whitlock, an electrical engineer at nearby White River Technologies Inc., continues to serve as primary electrical engineer. They recently hired their first employees: Derek Alvarez '21 and Paal "Henry" Prestegaard '22.

"We are now able to build this thing that really no one else in the world builds—and we can do it 30 or 40 times and have the exact same outcome every time," says Planck. "At the end of the day, our buoys bring in more data, which means more science."

"It's really been impressive to see this go from a quirky scientific instrument to a company that produces instruments that are of value," says Perovich. "Cameron is the guy. He's the engineer who made this happen."

The company still faces some hurdles—the pandemic has prompted the cancellation of a number of buoy orders—but Planck is proud of its progress. To date, he has built and shipped 38 buoys to scientists, energy companies, governments, and nonprofits—including the historic Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition.

Learn more about the improved SIMB-3 buoys, with real-time, open-source data via an interactive map, at CryosphereInnovation.com.

STEFAN HENDRICKS

JULIE BONETTE is contributing editor to *Dartmouth Engineer*.

MOSAiC ARCTIC MISSION

Historic expedition offers insights on the causes and consequences of diminishing sea ice.

Dartmouth researchers, with an international team of scientists, spent nearly a year adrift on a research vessel in the Arctic ice to study the staggering scale of sea ice melt, the ravaging effects of climate change, and its impact on our planet.

Never before had an icebreaker with science and engineering's best minds ventured so far north during the harsh Arctic winter to gather such comprehensive data in the region of the world hardest hit by climate change.

The Multidisciplinary-drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition ended last fall, concluding the largest Arctic research expedition of all time.

Now, even more important work lies ahead.

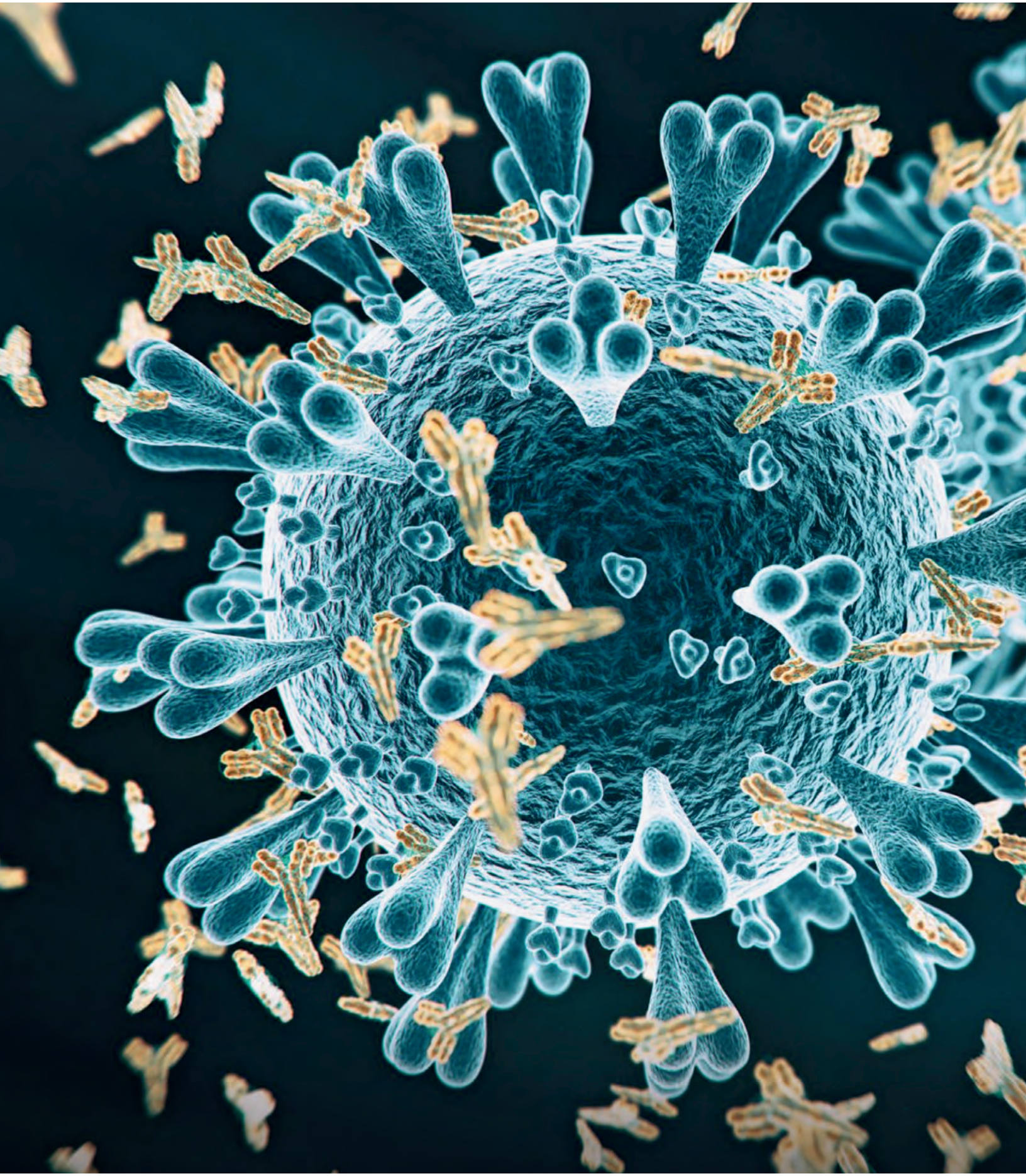
Professor Donald Perovich, co-leader of MOSAiC's sea ice team and a member of the project board, and adjunct assistant professor Christopher Polashenski '07 Th'07 Th'11 have been analyzing and interpreting the approximately 100 terabytes of data produced.

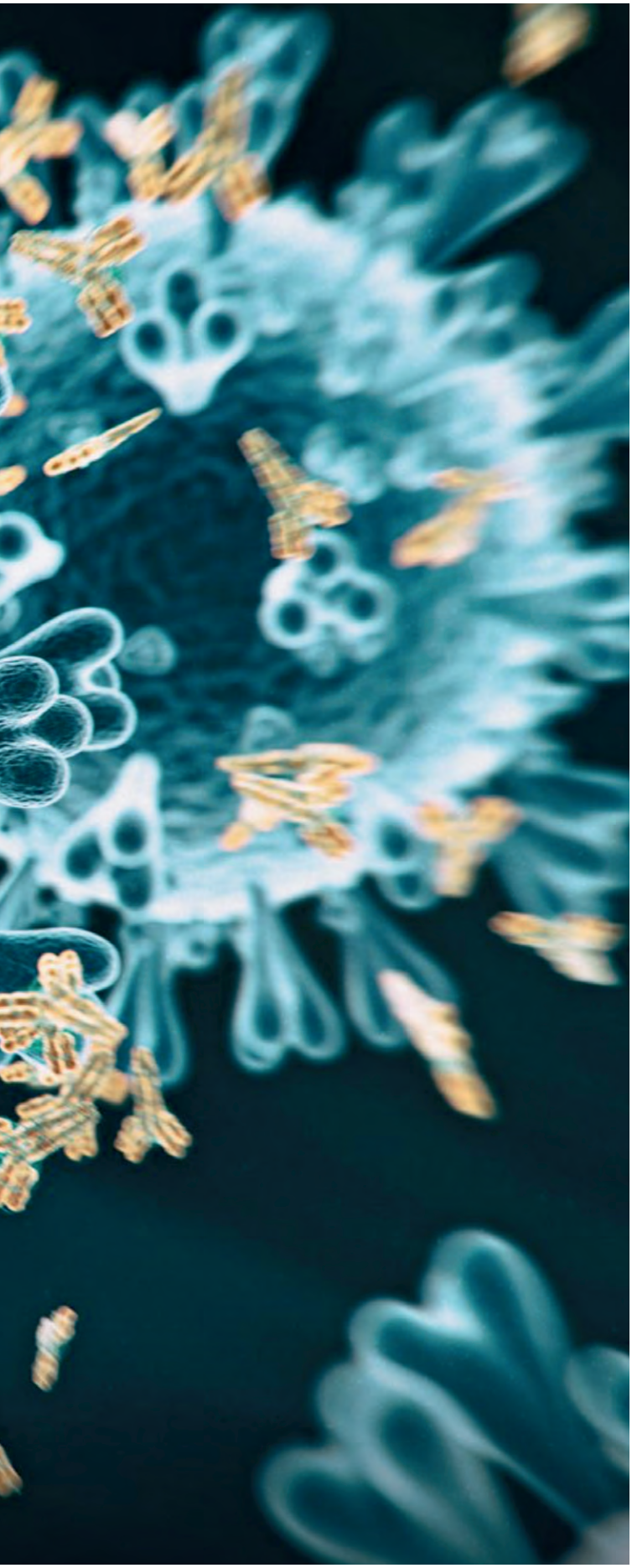
"The data is the legacy," says Perovich. "This data set will be used by scientists for years and decades to come, so that's really pretty exciting." The goal is to better understand the causes and consequences of diminishing sea ice.

"MOSAiC is providing many insights on what's happening, but as human beings, we are never satisfied with just knowing what's happening now, we want to know what's going to happen in the future," says Perovich. "Our best means of looking ahead into the future is through climate models—and MOSAiC was designed with those models in mind. Once our data is incorporated into these models, I expect much better predictions about future Arctic states."

The average person will likely feel the results of MOSAiC's data, even if they don't realize it.

"You're probably not following when the next improvements in climate models are going to come out," says graduate student David Clemens-Sewall '14 Th'18, "but you are probably following how much your fire insurance is going to cost, how much your flood insurance is going to cost, what actions your elected representatives are taking to help prepare your community for the climate changes that are coming. I hope the research from this expedition will inform our predictions of the future of climate so that your insurance is being set at a fair rate and your elected representatives are taking the right steps to protect you and your community in the future."





The Battle Against COVID-19

DARTMOUTH ENGINEERS JOIN THE GLOBAL FIGHT AGAINST COVID-19

BY JULIE BONETTE

One common theme dominated headlines and conversations around the world in 2020: COVID-19.

As the number of cases across the nation and the world rose ever higher, scientists from all corners of the earth became singularly focused on preventing and treating the deadly SARS-CoV-2 virus. In the first six months of the year, more than 23,000 scholarly articles were published on the Web of Science and Scopus alone. By the end of the year, the World Health Organization database had logged nearly 150,000 articles about coronavirus.

Dartmouth engineering faculty, staff, and students were compelled to contribute to these efforts. And last spring, as normal campus activities shut down, many labs geared up to fight the virus and its spread.

Faculty Startup Raises Capital for Clinical Trials

Perhaps most notably, engineering professor and biotechnology entrepreneur Tillman Gerngross has raised $130 million in venture capital for his newest company, Adagio Therapeutics, to begin clinical trials of antibodies engineered to protect against SARS-CoV-2.

An Adagio team began looking for neutralizing antibodies against SARS-CoV-2 in March 2020, and by spring "knew we had something really special," according to Gerngross. He is the cofounder and CEO of Adagio and parent company Adimab, an industry leader in translating target hypotheses into therapeutically relevant antibody drugs.

Gerngross filed an investigational new drug application with the U.S. Food and Drug Administration (FDA) in late November and anticipates administering the first dose of engineered antibodies to a human patient as we go to press.

"We isolated, characterized, and engineered monoclonal antibodies from a survivor of the 2002-2004 SARS-CoV outbreak that also react with SARS-CoV-2, the causative agent of COVID-19," says Daniel Maurer Th'17. Maurer, who spent two years as a predoctoral research associate at Adimab, took a break from his PhD studies at Harvard to return to the Lebanon, N.H.-based company and work on COVID-related projects. He says several of these engineered antibodies neutralize both SARS viruses as well as SARS-related coronaviruses circulating in bats. This suggests the new antibodies have the potential to help prevent and treat current—and future—coronavirus outbreaks.

It's that forward-thinking possibility that enables Adagio to stand out.

While vaccines have been rolled out across the globe, Gerngross's team is working on broad neutralization to prevent against the next outbreak. His goal is to develop a biannual injection that would protect against sarbecoviruses, a group of viruses that includes COVID-19.

"Coronaviruses have been spilling over into the human population now in three documented cases during the past 20 years," says Gerngross. "There is no reason to believe that the spillover is going to end."

Contributing to Adagio's success is another familiar face at Dartmouth: Terry McGuire Th'82, chair of Thayer's board of advisors from 2008 to 2020. McGuire is a founding partner of Polaris Partners, which played a large role in financing Adagio's efforts.

"I've invested in every company that Tillman has started," says McGuire. "We back him repeatedly. We find his creativity enormous and his candor and can-do attitude extraordinary. What's beautiful about Tillman is that he's so incredibly decisive—he's just an extraordinary entrepreneur."

While vaccines have been rolled out across the globe, Gerngross's team is working on broad neutralization to prevent against the next outbreak.

GERNGROSS, SHOWN ABOVE WITH DR. LAURA WALKER, DIRECTOR OF ANTIBODY SCIENCE AT ADIMAB

JAMES M. PATTERSON/*VALLEY NEWS*

Campus Labs Transform to Join the Fray

Investigating the role of antibodies in understanding and combating the virus

Back on Dartmouth's campus, Professor Jiwon Lee is concentrating on the human immune system. He's investigating whether the antibodies that help some people recover from the virus can be turned into medicine for others.

"My lab focuses on developing new technologies that allow us to take blood from people whose immune systems have successfully fought off an infection and determine the amino acid sequences of the different antibody molecules in the blood," says Lee. "For COVID-19, knowing the antibody sequences enables us to test and determine which antibodies are the most effective at neutralizing or preventing the infection."

Collaborating with clinicians, scientists, and engineers from Dartmouth and the University of Texas at Austin, Lee says his lab is trying to understand antibody responses to COVID-19 and identify antibodies with therapeutic potentials.

"We're also focusing on collaborating with local companies and research labs," he says. "We've been looking at the quality of antibodies generated by COVID-19 infections and their persistence following recovery from the virus and how they may differ for individuals with different levels of symptoms."

Across campus, three PhD students in Dartmouth's molecular and cellular biology program coauthored a study that found COVID-19 patients with milder cases exhibit an increased presence of Immunoglobulin A (IgA) antibodies in their mucosa. The results of the study were detailed in the paper, "Features and Functions of Systemic and Mucosal Humoral Immunity Among SARS-CoV-2 Convalescent Individuals," pre-published at *medRxiv* in August.

Their research—conducted with engineering professor Margie Ackerman and Dr. Peter Wright '64 DMS'65, a pediatrics professor at the medical school—was the first to correlate a type of antibody response to mild disease severity. It also suggests the kind of immune response that could protect against infection and reduce the likelihood of transmission.

"Everyone is wondering how long antibodies will be around after a positive test and how long people are protected," says co-first author Savannah Butler. "So we measured diverse antibody features and functions, allowing us to see specific characteristics of those antibodies present in patients with both severe and mild disease."

The researchers collected blood, nasal wash, and stool samples from 20 locals one month after they tested positive for COVID-19. They then examined the COV-specific antibody response across the disease and six other endemic human coronaviruses.

Results suggest patients exhibit either a strong IgA response or Immunoglobulin G (IgG) response—but not both. That divergence could help explain the broad range of severity of the disease.

The team is now working on a second study with a cohort of 100 patients and will test for antibodies three and five months after a positive COVID-19 test. Testing multiple times will enable researchers to understand how the antibodies look long-term and how long protection may last.

"We are still looking at similarities and differences between COVID-19-positive patients who were hospitalized and those who were able to recover at home to determine what kind of immune response might lead to a good outcome," says co-first author Harini Natarajan. Andrew Crowley also served as co-first author on the study.

Despite the fact that multiple COVID-19 vaccines have been developed and are now rolling out to the nation's population, there is plenty more to be done. And Dartmouth engineers will remain at the forefront of understanding, treating, and preventing the disease.

▲ TOP RIGHT: PROFESSOR JIWON LEE

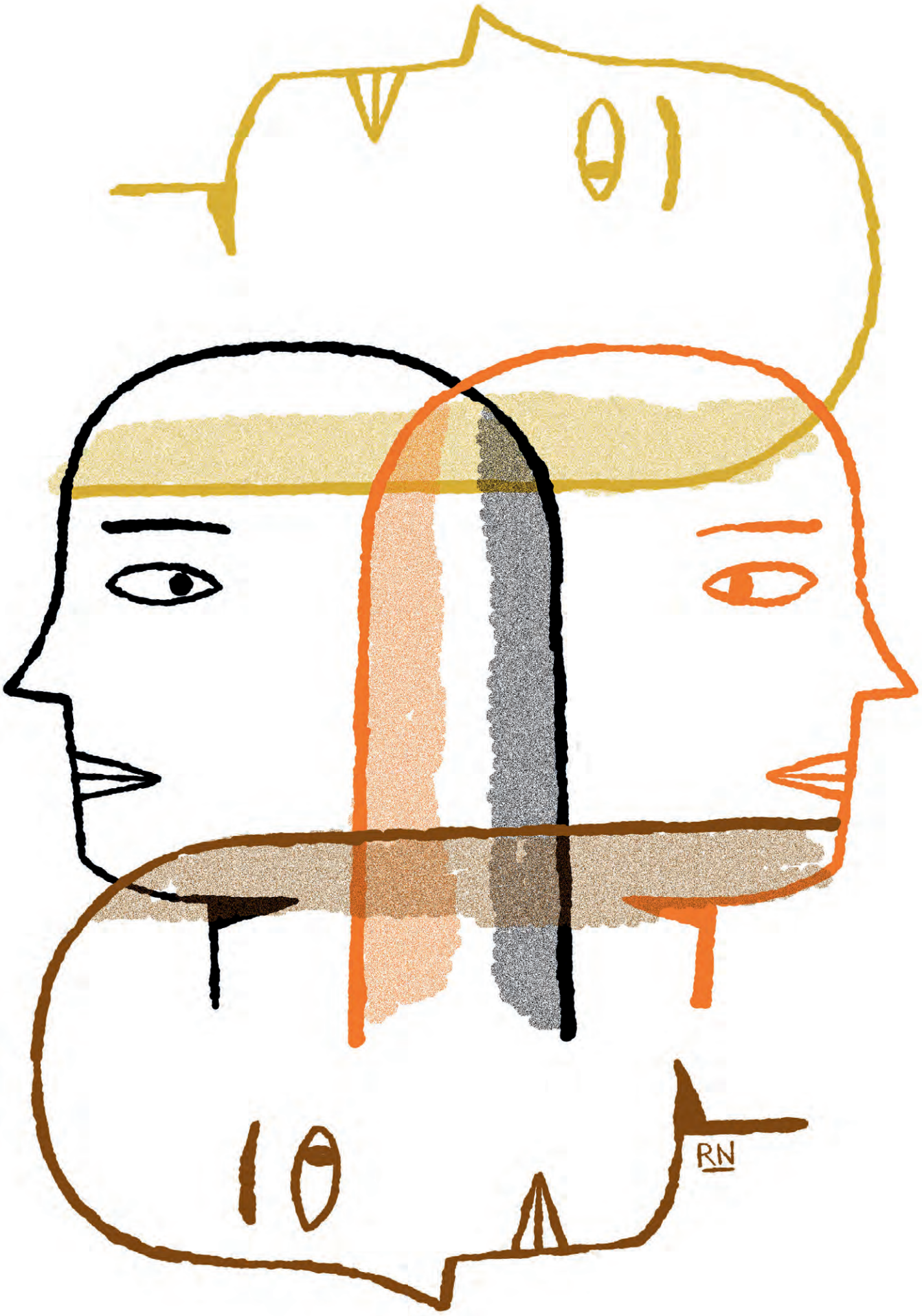
▲ PHD STUDENT ANDREW CROWLEY WORKS IN THE LAB AS PART OF THE MOLECULAR AND CELLULAR BIOLOGY PROGRAM

INNOVATION THROUGH DIVERSITY

AS GLOBAL CHALLENGES GROW INCREASINGLY COMPLEX, DARTMOUTH ENGINEERS LOOK FOR UNTAPPED SOLUTIONS BY FIRST, BUILDING A DIVERSE AND INCLUSIVE COMMUNITY.

BY EUN LEE KOH '00

ILLUSTRATION BY ROBERT NEUBECKER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The events of the past year—a worsening pandemic; deepening economic divide; the deaths of George Floyd, Breonna Taylor, Ahmaud Arbery and the ensuing cries for racial justice; the storming of the U.S. Capitol; raging wildfires; rising sea levels; and devastating hurricanes—are enough to paralyze some.

For Petra Bonfert-Taylor, professor of engineering and new associate dean of diversity and inclusion at Thayer School, the confluence of complex but interconnected problems demonstrates the ideal challenge for engineers.

A Renewed Focus

"What has become clear is that we can't solve problems in silos, with the same groups of people," Bonfert-Taylor says. "More people are recognizing what a lot of people in marginalized communities have known for a long time: the importance of including diverse voices, perspectives, and leadership in problem-solving—and what can happen when we don't."

The solutions to increasingly complex global challenges, experts say, will require the talents and perspectives of the people who directly wrestle with the issues—from Indigenous communities in the Arctic impacted by the alarming pace of climate change to members of Black communities who bear the brunt of inequities in policing and healthcare access.

For Dean Alexis Abramson, who took Thayer's helm in 2019, diversity and inclusion has been an important priority, and it remains imperative that the culture reflects the human-centered approach encouraged in its teaching, research, and practice.

"We have to embrace diversity, not just because it's the right thing to do, but also because it's a critical driver of problem-solving and innovation," Abramson says. "Our experiences in life shape our worldview and how we look at problems. When we say that we take a human-centered approach to engineering, we have to ask ourselves, which humans are at the center? And who are we leaving out?"

Early on, Abramson appointed Professor Laura Ray to oversee faculty development and recruitment and bring candidates who would not only advance Thayer's research and educational mission, but also bring diverse perspectives to the community. During the height of the pandemic, as Thayer's diversity, equity, and inclusion efforts came into sharper focus, Abramson appointed Bonfert-Taylor, a long-time advocate for women in engineering and students of color at Dartmouth, to take the lead.

Bonfert-Taylor witnessed how education could change the trajectory of a person's life. Prior to her new role, she co-founded Dartmouth Emerging Engineers to support students, particularly women and underrepresented students of color, through engineering prerequisites and developed an entry-level math course to prepare students, whose path to STEM may not have been traditional, for the rigors of upper-level engineering.

"We have to embrace diversity, not just because it's the right thing to do, but also because it's a critical driver of problem-solving and innovation."

—DEAN ALEXIS ABRAMSON

"We have everything to lose when we exclude qualified, talented individuals, because it means we are not using the fullest potential at our disposal," says Teja Chatty Th'23, a third-year PhD Innovation Fellow. "This is a huge loss, especially at a time when we need to tackle big problems such as climate change expeditiously."

Growing Movement for Change

Last summer, as demands for racial justice grew nationwide, Chatty and PhD candidate Steffi Muhanji Th'16 Th'21 helped organize virtual conversations around race, identity, and equity—an effort that is remains ongoing.

"We felt we could work to improve inclusivity at Thayer for ourselves and other underrepresented students," says Chatty.

Chaired by Bonfert-Taylor, Thayer's Diversity, Equity, and Inclusion (DEI) Committee, which evolved from a working group established 2016, is currently focused on initiatives: expanding access to the bachelor of engineering program, creating mentoring and networking opportunities for underrepresented students, strengthening partnerships with historically Black colleges, and revamping the graduate student recruitment process.

"As engineers, I know that many of us want to help the world, but when we don't seek input from the right people, it falls flat," says Professor Vicki May, a member of the DEI Committee. When she studied various ENGS 21: Introduction to Engineering projects, May was able to pick out one common thread: "The more diverse groups, especially the ones that took a human-centered design approach, were more successful. They looked at problems in ways other teams hadn't considered. We can't just show up somewhere and pop in new technology without cultural context or understanding the full societal impact. Having the right people from the start helps."

Across Thayer, faculty are focusing on diversity—from race and gender to ethnicity and culture to technical skills and academic disciplines. Earlier this year, Amy Keeler, associate director of career services and a DEI Committee member, collaborated with faculty to develop lessons on inclusion within student teams. Research shows that roles can fall along gender lines, with male students as technical leads and female students playing support roles. To avoid these pitfalls, Keeler worked with students to become more intentional in their approach. For instance, she asked students assigning team tasks to consider not just skills, but also perspectives and life experiences. She also suggested they alternate non-technical, support tasks.

"For any project to be successful, you need all of your best ideas at the table," Keeler says. "That can't happen if not everyone has the opportunity to demonstrate their talents or for their voices to be heard."

The Road Ahead

While increasing diversity among faculty and students remains an important goal, the more challenging work is in building—and sustaining—a community that is truly inclusive.

Zachary Price, a member of the DEI Committee and development officer for Thayer, sees the importance of inclusion in his work with alumni, whose connection to the community is tied to their willingness to invest in Dartmouth's future. The most engaged are alumni who feel an innate sense of belonging.

"Dartmouth is a unique cultural place. Anyone who wants to come here has to be willing to learn about the things that makes Dartmouth Dartmouth," Price says. "On the other hand, what could Dartmouth do to make sure that people here feel as though they truly belong? What are barriers and how can we erase them, so people feel empowered here?"

As part of Dartmouth's Campus, Climate, and Culture initiative (C3I), the College has been conducting surveys to identify elements of Dartmouth culture, policies, and practices that help or hinder progress toward more inclusive and equitable academic environments.

According to May, a co-leader of the climate survey, the data will help departments appreciate where they stand, foster practices that work, and identify opportunities for growth. Bonfert-Taylor and Keeler have also kicked off a DEI learning series at Thayer, with weekly videos, podcasts, and academic papers that culminate in community-wide discussions.

Career Services is also identifying ways to better support students, particularly from underrepresented backgrounds, in their transition from school to work environments.

"What's at stake if we don't get this right?" Keeler asks. "What we could lose is our potential for innovation, all of the patents for life-saving devices and technology—things that can change the world. We miss out on the very things that move us forward."

WHY INNOVATION NEEDS DIVERSITY—AND HOW WE GET THERE

Dean Alexis Abramson recently wrote that schools can raise their capacity for innovation by increasing diversity within their faculty and student ranks. Below is an excerpt from her blog post.

The problem actually begins before students arrive at the front door of most colleges and universities. Competitive applicants to top engineering schools are on the STEM track for years. But, what if this path doesn't readily exist or it was not encouraged early on? These students may have the potential to be the next Nikola Tesla or Katherine Johnson, but they've been shut out of STEM from day one.

So, how do we fix this?

1. OPEN THE DOOR WIDE

Engineering shouldn't be an exclusive endeavor. Any student admitted to Dartmouth can take an engineering course and choose to major in engineering. The results speak for themselves: Approximately half of our engineering graduates say they did not seriously consider engineering when they walked in our doors.

2. IDENTIFY AND REMOVE BARRIERS

When we learned that we lose some potential engineering students early on in required math courses, we developed an introductory course to build stronger math foundations. We open our Introduction to Engineering course to the entire student community. In a welcoming and fun environment, students take risks, experiment, build, and prototype in teams, while exploring scientific and engineering concepts through hands-on projects.

3. TAKE A HUMAN-CENTERED APPROACH

At Dartmouth, we also make the liberal arts foundational to engineering and STEM education. Students gain a broader perspective of humanity through the liberal arts—and by that I mean the study of literature and history, or political science and psychology, through philosophy, religion, and design. Without that deep consideration of the human condition, we limit engineering's future.

I challenge other engineering educators to consider how we can open our field further to a broader population. If we are successful, we not only create a talent pool that includes more women and people of color, we also strengthen innovation with fresh perspectives and new ideas to solve some of the world's most complex challenges—for all of humanity.

EUN LEE KOH '00 *is senior director of communications at Thayer School of Engineering at Dartmouth.*

Alumni News

FROM AROUND THE WORLD

spotlights

Creating with Meaning

"Industrial designers can act as a nexus between engineers, artists, marketers, strategists, architects, and founders," says **Evan Landau '15**, founder of N.Y.C.-based Landau Design Strategy + Consulting. "There's just so much *stuff* in the world now that I think it's important to prioritize creating products with meaning that can make someone's life better instead of just flashy objects and battery-operated wine openers." Design is also in his blood: His father is a product designer and manufacturer, his mother is an interior designer, and his grandmother was an artist. The three owned a showroom in Long Island where they offered designer products and furniture. "I've spent a lot of time surrounded by everyday objects that I've since seen in museums and textbooks and that certainly had an influence on me," says Landau. Recent clients include a company in the auto industry, a psychologist, and a produce grower-distributor. "I'm also working for a startup founded by **Patrick Sheehan '15**, helping to create a line of functional food and beverage products to improve sleep and performance," he says. Landau hopes to eventually tackle waste—using materials typically tossed out to create new objects. "My master's thesis focused on ways to process mixed-paper waste into a manufacturing material to offset the use of plastics," he says. "I've been in hot pursuit of design solutions for putting the world's waste to use."

"Industrial designers can act as a nexus between engineers, artists, marketers, strategists, architects, and founders."

—EVAN LANDAU

Charged Up

Resonant Link Chief Scientific Officer **Phyo Aung Kyaw '19** and CEO **Grayson Zulauf '12 Th'13** have been named to the 2021 "*Forbes* 30 Under 30" list of top entrepreneurs in the field of energy. They are developing a wireless charger that can quickly and autonomously recharge fleets of robots, drones, and EVs. "With no private capital, the Burlington, Vt.-based startup has reached profitability with more than $1.5 million in customer revenue and non-dilutive funding, including multiple Fortune 500 customers," according to *Forbes*. Also leading Resonant Link's efforts are Thayer Professor Charles Sullivan, who is the firm's senior scientist and a leader in electromagnetics for power electronics, and former Dartmouth research postdoc Aaron Stein, who serves as president and chief technology officer.

Natalie Afonina Th'16 Th'17 ▶

Sheer Focus

Natalie Afonina Th'16 Th'17 is taking a sabbatical from robotics to scale other challenges this winter. "I want to dedicate more time to my ambitions as a professional ice climber," says Afonina, who previously worked for Mapbox and Uber's advanced technologies group. She is teaching ice clinics at festivals and climbing across the United States. She says she brings a similar focus to climbing and engineering. "Both in my climbing and at work, I focus on zooming in to pay attention to the micro-details and zooming out to keep an eye on the bigger picture," she says. "When scaling frozen waterfalls with sharp tools in your hands and crampon claws on your feet, the only rule is, 'do not fall.' People assume that I'm an adrenaline junky, but friends know I'm the exact opposite of that: I'm a planner, a risk-mitigator." A favorite climbing area is in the mountains of Wyoming, though Lake Willoughby in Vermont is a close second. "I have fond memories of driving up there Tuesday afternoons to get a couple laps in between engineering lectures and problem sets."

Rock and Roll

When his 9-year-old nephew was able to operate a robotic rock-picker, **Brent Frei '88 Th'89** knew his design was working. Growing up on a family farm in Grangeville, Idaho, Frei hand-picked a lot of rocks out of fields. And when he saw his then-80-year-old father

On the Job

ALEXANDRIA (FECYCH) FAVAZZA '07 | STEM TEACHER

Favazza's greatest lesson from nine years of teaching STEM topics: A child's developmental readiness is the biggest factor in his or her learning success. "Some kids will understand a new idea the first time they hear it, while others might hear it every year for a decade and not understand it until the 11th year," says the Rockport (Mass.) Middle School math teacher. "You just keep giving them opportunities to succeed and keep reminding them that failures are actually an important part of learning."

What prompted you to shift from practicing science and math to teaching it?
I worked in a research lab at MIT with a fantastic group of graduate-level students and fell into an advisory role on a lot of the practical aspects of designing and conducting experiments and processing data. This happened when a huge contingent of my extended family was of adolescent age, and I realized I wanted to be doing similar work with younger students, particularly during the turbulent middle school years and especially with girls.

Are there favorite concepts?
They really love learning Cartesian coordinates because they're so visual and the statistics because they start to understand some of the concepts they've heard about for years. I love the projects that are completely engineering (like Rube Goldberg) and projects where they need to create a plan, and then I swap their work and they need to execute someone else's work.

How have you adapted to a remote classroom?
We have come a long way since March. The toughest part throughout this pandemic has been accountability and student engagement. I try to use relevant and interesting problems that they have some knowledge or experience with—such as baking or other food—or make it silly but approachable—such as, "If you spent the whole school day walking instead of doing school, how far would you walk and where could you go?" I've got a whiteboard and a webcam at my house and I'm lucky to have mostly students who want to do well and will persevere through any challenge. They're 11 or 12; they all want to connect but they don't always know how yet or remember the importance of sticking with it in the moment! *—Interview by Theresa D'Orsi*

spotlights

◀ Brent Frei '88 Th'89 envisioned "a Roomba for rock picking."

▼ Huabei Jiang Th'96 has found scientific inspiration in the Chinese arts.

still picking them up by hand, the former founder of Onyx Software envisioned "a Roomba for rock picking." Launched in 2017, his TerraClear uses drone photography to map rocks in a field and a treaded claw mounted to a tractor or other vehicle to lift them out of the dirt. He's testing the device in Grangeville, where his father, brother, and sister manage the 6,000-acre Isidore Farms. "We built six pickers for testing this past fall," Frei says. "Our goal is to enable picking a rock every three to five seconds—a five- to ten-times improvement over current methods." The 23-member TerraClear team is selling units in the Northwest and refining an autonomous picking option. "My dad is no longer picking rocks," Frei says. "Instead, he's enjoying the fruits of that."

Arts and Science

Biomedical engineer **Huabei Jiang Th'96** has found scientific inspiration in the Chinese arts he first began exploring as a child. "My ability and skill in art helped me make breakthroughs in scientific research by sensing the beauty contained in mathematical equations I derived," he says. Currently the director of the University of Florida Center for Advanced Biomedical Imaging, Jiang has made pioneering contributions to the field of diffuse optical tomography (DOT) and has developed techniques that use DOT to detect breast cancer, epilepsy, and osteoarthritis. His 23-year career teaching and doing research has also been enriched by a lifetime of painting and practicing calligraphy. "Memories and photographs of my hometown of Sichuan and other places in China that have similar landscapes draw my inspiration," says Jiang, who works in ink, pencil, and pastel. The author of more than 400 peer-reviewed scientific articles also took up poetry three years ago. "I focus on subjects related to my hometown, my parents, my friends, and my experience in America since early 1990—I actually wrote a few about my years in Hanover." His connection to the College—where he earned PhDs in engineering and philosophy—runs deep. His most recent book, *Fluorescence Molecular Tomography*, is dedicated to Thayer and Dartmouth.

Noise Control

Acoustician **Kenneth Kaliski '85 Th'02** has earned the Institute of Noise Control Engineering's William W. Lang Award for the Distinguished Noise Control Engineer. "Noise is unique in that it is something everyone can relate to," says Kaliski, senior director of Resource Systems Group in White River Junction, Vt. "We are all experts in what we consider noise, but there are only a few of us that understand the complex mechanisms such that we can engineer successful solutions." His work focuses on wind turbine, architectural, and transportation acoustics as well as community noise monitoring and modeling.

Detecting Liver Disease

About 25 percent of the U.S. population suffers from fat in the liver, which can lead to fibrosis of the liver and liver failure. **Chris Frangieh '17 Th'17** is part of the MIT team that has developed a diagnostic tool to detect those conditions. He is a lead coauthor on the research study, which appeared in a November issue of *Nature Biomedical Engineering*. The 6-by-4-inch sensor uses nuclear magnetic resonance to measure how water diffuses through tissue, which can reveal how much fat is present. The research is an outflow from his biomedical engineering studies at Thayer. "In ENGS 21 I gained experience with imaging, low-cost medical devices, and patient-centered design; in ENGS 89/90 I worked on a bioimpedance device for monitoring hydration levels in athletes," he says. He's now applying his PhD studies in computational biology and biological engineering to assess why some cancer patients

don't respond to immunotherapy drugs. "I hope to focus on projects that have the potential to impact human health," says Frangieh, "and transition these technologies into the clinic."

Zoo Keeper

As chair of the Maryland Zoo board of trustees, **Jennifer Lowry '90 Th'91** helps oversee more than 1,500 animals across 135 acres in northwestern Baltimore. Lowry, who is also vice president of risk in corporate finance for global spice company McCormick, has brought in J. Kirby Fowler Jr. '88 as the zoo's new president and CEO and is supporting a $20-million renovation of the lion, giraffe, and elephant habitats. The former center on four Ivy League championship women's basketball teams, Lowry earned a BE from Thayer and a master's in management from Northwestern University Kellogg School of Management.

Reengineering Education

Sara Atwood '03 Th'04 Th'05 has been named founding dean of the Elizabethtown College School of Engineering, Mathematics, and Computer Science. There, she has established a research program in engineering education with almost $1 million in funding from the National Science Foundation. Atwood's most recent grant funds research into the role internships play in forming engineering professional identity and internship accessibility for first-generation, low-income students. Her initial analyses show these students are significantly less likely to have an engineering internship (42 percent) compared to their continuing-generation, higher-income peers (58 percent). "Statistical modeling shows that first-generation and low-income status remain significant factors in predicting having an internship, after controlling for other factors such as GPA, institution, engineering field, and other demographic factors," she says. Her goal is to engage students from a broad range of backgrounds—building on STEM studies they were exposed to in middle and high school. STEM "programs have doubled the percent of women in engineering, and more people are being exposed to it at an earlier age," says Atwood. "Ten years ago, people came in here and didn't really know what engineering meant." Her efforts are gaining a national reach, most recently with a chapter, "Mastery-Based Learning in Mechanical Engineering," she coauthored in the 2020 *Mechanical Engineering Education Handbook* and a workshop she led at the 2020 meeting of the American Society for Engineering Education.

▼ Sara Atwood '03 Th'04 Th'05

On the Job

DAVE SELIGER '12 | SERVICE DESIGN ADVISOR

"Local government needs engineers more than ever."

Since his ride-alongs with the Hanover police for his honors thesis, Seliger has searched for ways to improve complex municipal systems. "Thayer students should know their skills and mindset will serve them if they're willing to take on our cities' biggest challenges," he says. He has since tackled issues ranging from workforce development to affordable housing.

What was the focus of your thesis?
I intended to create a tool to help keep police officers safe. However, I realized the real issue was that they were miserable in their jobs. I started reading any book I could find on systems engineering and organizational psychology.

What was your first job in N.Y.C.?
When Hurricane Sandy hit two months after I started, I got to deploy the city's massive stockpiles of food, water, and medicine to the 7,500 New Yorkers who sought shelter from the storm. My engineer's mindset was my biggest asset in managing the flow of supplies. When every system fails, we know how to create a plan for putting the pieces back together.

How does that approach help local government?
The classic way to look at public services is individually: a job training program or free health clinic. But the engineer's perspective is to look at the entire system. If a food assistance program isn't working, does the family have everything else they need? What if they don't have a safe place to sleep or were unable to come get the food voucher because they don't have a MetroCard? Government systems are not really all that different from circuits or micro-hydropower systems. They need to be designed so they can be used by real people.

What is your current role?
I'm the senior advisor for service design and delivery for the rental assistance team at the N.Y.C. Department of Housing Preservation and Development (HPD). We help approximately 40,000 low-income households pay their rent. Right now I'm figuring out how to get our tenants free or low-cost internet access so that they can submit forms online!

—Interview by Theresa D'Orsi

just one question

Q. What element of your Thayer School career would you like to experience again?

Perhaps most memorable was the water. Yes, water in the lab. Water in pipes, valves, and flowing through channels and over weirs. This was the hands-on part of courses in Fluid Mechanics, Water Supply, and Sanitary Engineering. These experiments were enjoyed by all—especially the splashing part! Professor Ed Brown's good nature helped temper the hard study with pleasant hours.

I'm especially reminded of the work we did in that greatest laboratory of all: the out-of-doors. Field trips to visit dams, bridges, and local building sites were memorable. So were the expeditions to measure characteristics of water flow in streams and rivers. And of course there was surveying, which took us all over the Hanover countryside. Dean Bill Kimball headed the surveying program himself, and in his kindly, soft-spoken way moved us well along the path toward becoming professional engineers.

—Sam Florman '46 Th'73

The knowledge, sincerity, and friendliness expressed by the faculty civil engineers—Ed Brown, John Minnich, and Russ Stearns—were exceptional. Not only did they encourage my study ambitions while I was at Thayer, all were helpful in various ways during my professional career. They are all long since gone, so this can be repeated in memory only (which I enjoy doing).

—Warren Daniell '48 Th'50

That's easy: outside the classroom interactions with peers. Getting their perspectives on the curriculum and on life in general was a wonderful way to expand the formal educational experience. The opportunity to rekindle those interactions is, in part, what brings me back to reunions.

—Neil Drobny '62 Th'64

One of my best memories of Thayer School was the course taught by Professor Jim Browning, who went on to found Thermal Dynamics Corp., developer and manufacturer of plasma jet systems. Jim opened up the wonders of combustion to me, and I can remember him setting up various burner demonstrations for us, showing the effects of air-fuel ratio, incoming air-fuel mix velocity, and resultant combustion products temperature, flame velocity, and temperature profile. This was all a revelation to me. I still remember Jim's enthusiasm in demonstrating and explaining all of this to us. He was a great teacher.

During my career I spent some time with Surface Combustion, a division of Midland-Ross Co. Jim's course served me well as I dealt with the various furnaces and heating systems that Surface produced.

—Jerry Allyn '59 Th'60

My favorite memory of my Thayer School "career" is the time I spent in Hanover during the summer of 1960, after my graduation from Dartmouth. I was newly married and living with my wife, Pat, in an apartment in Hanover. She worked as a nurse at the hospital; I worked on four-cylinder internal combustion engines in the basement of Thayer. It was the only summer I ever spent on campus—a nice change from four years of frozen tundra!

—Bruce Clark '60 Tu'61 Th'61

Professor Brown's class on Engineering Economics! I understand that his class went away after he retired. I have sure used his interest calculations and comparative costs of two pieces of machinery more than my Fluid Dynamics classes. Bring back personal finance! **—John Pearse '62**

In the early 1970s Thayer was too academically focused (though at a very high level), which denied some students commercial opportunities for work done in the classrooms. I'd go back and take my modeling program (of a cross-country ski) to a ski manufacturer! The course was on structural analysis of various materials and when we got into looking at layered composites, it struck me that I could model the flexibility patterns of a cross-country ski. At the time I did not have access to data on materials used in downhill skis, but it struck me that a Nordic ski would be much easier to model varying width end to end, thickness end to end, and layer (each of wood or fiberglass) thickness end to end. I also defined a specific characteristic, namely even weight distribution, so essentially a ski, once a length was determined, could be designed that would produce an even weight along the entire length for a specific-weight skier.

The project was confined to using standard materials and shapes, but was specifically tuned to an individual skier's weight and length ski desired. It never occurred to me that the modeling capability had economic value. It strikes me that this would not be the case in a world where Thayer is better connected to both Tuck and entrepreneurial studies. **—Mark Totman '71 Th'72**

One of my favorite memories of Thayer was ES 21, a sophomore course to introduce us to modern, real engineering problems. It was designed to give us teamwork experience in research, marketing, construction, and testing of a prototype. It has always been popular with students. We had a great team and we really enjoyed the project. Of course, ours was the best project of 1969, hands down! We worked our way through each phase of the project and came up with a solution that may have had some traction, were it not so bulky and potentially dangerous! (We needed to shred garbage and pyrolyze it to make useful energy from off-gasses). Probably not a truly great idea! **—Peter Areson '72 Th'73**

The ES 21 course and using the shop. The ES 21 project that year was about ice elimination on bridges and roadways. We named our team DE-ICE (Dartmouth Engineers for Ice Control & Elimination). Our design approach was to use infrared heaters on a grooved payment. The grooves were designed to capture the infrared rays at an optimal angle and served secondarily as a non-skid surface. As I recall, the design was practical only on bridge surfaces due to the cost of the grooved surface and the cost to operate infrared heaters. As for the shop, I should have taken better advantage of it. I don't think I ever used it after ES 21 and somehow never elected to take any courses that might have inspired me to use it.

—David von Loesecke '74 Th'76 Tu'83

"Midnight Nerf battles. It was a good distraction from the stress."

—DONALD ZIMMANCK '07 TH'08 TH'09

I'll answer with the one thing I would have liked to experience—the machine shop. Somehow I chose to miss the experience. If I had a do-over, I would take advantage of it, even though my entire career has been in information systems consulting.

—Austin Whitehill '76 Th'77

First choice is the machine shop—building the steam engine was a great experience. Second choice is tensile strength testing.

—Mary McDougall '77

Far and away the experience I would like to relive would be our ENGS 21 class, Introduction to Engineering. It was the closest Dartmouth had to an entrepreneurial class at the time. We conceived, designed, and presented a proposal for review, including the pricing, funding, and marketing aspects of product rollout. I believe now-defunct American Machine and Foundry was our corporate judge. I wish we had had the knowledge to patent our work, since our swimming goggle redesign subsequently became the industry standard, led by Speedo.

—Lawrence Ryan '79

One of the courses I found exceedingly valuable over the years is ENGS

22: Systems. Current students are lucky to have other great courses in this area as well, such as System Dynamics in Policy Design and Analysis and Model Based Systems Engineering. Systems thinking is crucial and I'd love to be back to take these courses in whatever guise they have been updated to take into account all the highly distributed systems that make up the fabric of how we all live today.

—Max Rayner '84

I would like to work on a hands-on design project. While I enjoyed bridge and steam engine building, Thayer has taken the hands-on learning experience to a whole new level as far as I can tell!

—Walter Colsman '89

The element I would like to experience again is the group collaborations done in the engineering 21/190/290 classes, in which teams of motivated and creative individuals work together to solve some unmet human need. These collaborations are some of my fondest memories of my time at Thayer. As a sophomore in fall 2000 I did ENGS 21, which was the first engineering class I took. My group designed a thermal insulated case for stringed musical instruments (for air travel) using vacuum-insulated panels, and we built the prototype with a guitar case. My 190 project was a senior thesis as well (I took the four-year AB/BE option), titled "rowing shell redesign."

Both of these experiences, and the projects in other classes at Thayer, have helped inform the materials and speakers I bring into the classroom now as a tenured associate professor at the NYU Stern School of Business. I have taught new product development at NYU Stern, the marketing core class at NYU and at Duke, and am now teaching a new class at NYU on marketing and sustainability. Jonathan Cedar '03, cofounder of BioLite, was one of my guest speakers this fall.

—Bryan Bollinger '03 Th'03

Camaraderie with fellow students and professors. **—Ali Pasha Th'04**

Short answer: $2 margaritas from Molly's. Does that count?

—Bobby Heuser Th'07

Midnight Nerf battles. It started with just a couple of us. We purchased some fancy Nerf guns for fun and would prepare elaborate ambushes for each other in the middle of the night when one of us was studying for a big midterm or preparing for a thesis review. It was a good distraction from the stress. A lot of us virtually lived at Thayer, so it was a tight community. Pretty soon there would be enough students kitted out with Nerf weapons that occasionally the halls would erupt in full blown battles at 2 in the morning!

—Donald Zimmanck '07 Th'08 Th'09

Late nights in the project lab, hard problem sets, innovative designs, cheap pizza, and stretched limits.

—Scott Decker '09 Th'11

This may sound sappy, but I have distinct memories of waking up early for morning classes, trotting over to the room of Andrew Ceballos '12 Th'12 to nudge him awake, and then spending a lovely 15 to 20 minutes chatting and laughing as we trudged through the snow (often cutting through the graveyard) to Thayer. It was always a nice way to start the day. Honestly, it's these small moments of friendship that I'd love to live through again.

—Sharang Biswas '12 Th'13

I miss constantly learning new things and being exposed to new ideas. It takes more initiative to continue learning outside of a school environment. I would like to experience again the casual interactions when you pass a friend in the Cummings Great Hall and tell them about this cool new thing you've just learned and they share something interesting and you build conversations out of this shared excitement for knowledge.

—Sarah Rote '18 Th'19

Design thinking!

—Wanfang Wu Th'19

I would like to experience the late-night project meetings in Thayer again. I loved working with my friends and problem-solving in Couch.

—Tara Greaney '20 Th'20

thayer notes

1960s

Harris McKee '61 Th'63: Since my retirement from those activities where I was paid, I have worked nearly as hard in volunteer activities, at one time simultaneously chairing the local Master Gardeners, the county literacy council, and Rotary Club. In all of these functions, the computer skills that began with the Thayer Royal McBee LGP-30—which we controlled with a punched paper tape—enable me to provide computer and technical support to residents in my community. I've also been serving as treasurer of our residents' association, and this holiday season played Santa as we delivered thank-you mugs to our staff, who have been heroes as we have all tried to contain the effects of COVID.

Neil Drobny '62 Th'64: In May I retired from a second career at Ohio State teaching courses related to sustainable business practices in the business college. My wife, Betty, and I moved to southwestern Michigan to live on a lake (Lake Sugarloaf a short distance south of Kalamazoo) and to be near a university (Western Michigan), where I can do some part-time teaching and student mentoring. I also continue to consult occasionally with former students on work-related projects and career moves.

Skip Stritter '68: In 2012, a Thayer 89/90 project built a proof-of-concept device for Looma Education Co. (looma.education), then called VillageTech Solutions. The device, called Looma, is targeted to rural schools in Nepal that don't have AC power or Internet. It is a computer plus projector plus sound system that runs on a solar-charged battery. Looma contains the Nepal government textbooks and a huge library of educational material—Wikipedia, Khan Academy, TED, and more—integrated into the curriculum. Looma has been in pilot programs in Nepal schools since 2019, and now that Nepal schools are closed with the pandemic, the government there has endorsed the Looma online version for remote learning. We now have thousands of users, teachers, and students on Looma every day in Nepal! Now there is another amazing 89/90 team working on a high-volume manufacturable version of Looma.

1980s

Buddy Livingstone '81 Th'83 Th'84: As I wind down my career in communications and systems engineering (now at Science Applications International Corp.), my focus has shifted to my sons, who head to college in a year. We successfully managed a snowboarding trip to Stratton Mountain in late January just before COVID with a group of their close friends. In addition to boarding, I still play an occasional game of old-man's league ice hockey (pre-COVID) and endeavor to read and listen to as much Irish literature and music as I can.

Kurt Egelhofer Th'84: After 32 years of working as an engineer, I retired in 2013. After graduating from Thayer I worked for 18 years with the State of Alaska as a village safe water engineer, traveling all over Alaska to help communities with their sanitation problems. It was like working in the Peace Corps, except it was within Alaska and with more funding. I designed and built a number of water and sewer systems, including a circulating water system and a vacuum sewer system in a village on permafrost. That village of 600 Native Alaskans didn't have a single flush toilet before the project. I concluded my career at the Anchorage Water and Wastewater Utility, where I worked for 10 years on the management team as the director of operations and maintenance. The utility is the largest in the state, with a system that serves 300,000 people. I also served as president of the Alaska Water Wastewater Management Association and received the George Warren Fuller Award from the American Water Works Association in 2005.

My wife, Alison Smith (who received a graduate degree from Cornell while I was at Thayer), and I love to travel around Alaska and worldwide. We have spent many nights in the Alaska wilderness together and have traveled to more than 50 countries. We put our jobs on hold in 1991-92 and traveled around the

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Gallery

1 Alexa Escalona '18 Th'19 and Thomas Lee Hodsden III '18 Th'19 were married October 4.

2 Ari Koeppel '15 is using a NASA grant to better understand the geology of Mars.

3 Drew Matter Th'15 leads product development at Mikros Technologies.

4 Sharang Biswas '12 Th'13 plays the professor in his interactive theater piece, *Basic Principles of Incantation*.

5 Steve Hallowell '01 Th'02 Tu'10, wife Emily, and children Claire, Teddy, and Anneke recently moved to Seattle.

world for 10 months with only our backpacks. That trip included a 175-mile trek around Annapurna in Nepal. Since retirement we have visited Africa and South America. Antarctica is the only continent we haven't been to, but it is on our list!

Walter Colsman '89: For the past year I have been CEO of BrightSpec Inc. BrightSpec sells molecular rotational resonance instruments, a powerful form of rotational spectroscopy with unique capabilities for determining molecular structure and quantitation straight from a mixture. I am excited by the opportunity to bring this innovation to analytical chemistry. I am finally putting my Thayer and business training to good use! Also, the Colsman household is thrilled that our oldest son, Christopher, will be in the Dartmouth Class of 2025!

1990s

Larry Breckenridge '95: I majored in engineering modified with environmental science and subsequently earned an MS in environmental engineering from the Colorado School of Mines. I work as an environmental engineer working on international mining projects. In particular, I help my clients manage mine waste rock, tailings, and water so that they will be able to provide the world with essential metals without compromising the water quality (or having a tailings dam fail).

2000s

Brian Wong Th'00: After spending the last six years at Philips Healthcare—the last three doing finance and strategy in a small startup venture within Philips focused on infectious diseases—I am now director of business development with Sigilon Therapeutics, a cutting-edge cell therapy company based in Cambridge, Mass. Sigilon is focused on treating chronic diseases through a novel cell therapy, with its first disease targets of hemophilia A and diabetes. Familywise, my wife and I are the happy but frazzled parents of three young children.

Chuck Horrell '00 Th'01: I just wrapped up a stint as CEO and cofounder of Akros Medical. Nick Mourlas '92 Th'93 and Jon Thompson '92 and I started the company a few years ago to develop a new concept for repair of syndesmosis injuries of the ankle. All the product development work took place in my garage in Durham, N.C., and after FDA approval we started getting some good market validation, leading to an acquisition by Johnson & Johnson early in 2020. It was a great outcome and solid validation that a small team with a good design can really move a market. Now I'm spending my days chasing around three kids under the age of 5 and spending any leftover free time goofing around with old airplanes and old cars. One day last week I drove a 1947 Willy's jeep that I just finished restoring to the airfield and went for a flight in my 1941 Interstate airplane.

Steve Hallowell '01 Th'02 Tu'10: My family and I recently moved to Seattle, Wash., where I started a new role leading strategic services at Highspot, a software platform focused on helping sales teams be more successful. You can think of sales organizations as wildly complex human systems. In many ways, what I do on a daily basis is helping companies apply engineering rigor and discipline to how they run their customer-facing teams. We also welcomed our third child, Anneke Alice, in June. It's been a busy year!

Renee Cottle '07 Th'09: I am busy trying to get tenure in the department of bioengineering at Clemson University. I am also a primary investigator for a laboratory focused on cell-based gene therapy technologies and point-of-care devices to improve the lives of patients with inherited metabolic diseases. My research employs cutting-edge techniques from life sciences and bioengineering principles to solve challenging biomedical problems. I am devoted to preparing the next generation of the most capable and ethically responsible bioengineers by providing opportunities for quality research training, professional development, and outreach service activities.

Parke MacDowell '07: I'm an architect with Payette in Boston. I established Payette's in-house fabrication space, which leverages conventional and digitally controlled tools for wood, composites, and metals to enhance our design work. I consult on issues

regarding complex geometry, scripting, and methods of full-scale fabrication and material prototyping. I continue to find value in applying the project-based, hands-on approach I experienced as an undergraduate at Dartmouth. A recent project, profiled in *Modern Steel Construction* magazine in the feature, "Bridging the Gap Between Designer and Builder," captures that ethos. It's about Northeastern's pedestrian crossing, PedX, which opened last summer and spans five rail lines to connect campus with Boston neighborhoods, the rail and bus stations, and parking garages. I also did an interesting product-design take on resolving local pandemic-era public health issues. I worked with the COVID-19 Vulnerable Populations Task Force in Lynn, Mass., on handwashing stations to promote public health and safety, but off-the-shelf handwashing stations were not available with the necessary speed. Payette partnered with the nonprofit Beyond Walls to create stand-alone, hands-free wash stations throughout the city, enabling a return to public spaces. I designed laser-cut sheet-metal parts that flat-pack and can be simply assembled by anyone. They have implemented 35 stations in the area so far. Another recent project in Lynn responded to the challenge to safely and attractively define the boundary between street-side diners and vehicles. With the FoLD project, we developed laser-cut stainless parts that could be folded by hand and fastened with sheet metal screws.

| 2010s |

Max Fagin Th'11: After five years with Made In Space, the company I joined after graduation, I have moved to Seattle to start a new job with Blue Origin, working as part of the national team designing the lunar lander for NASA's Artemis program.

Sharang Biswas '12 Th'13: Lots going on career-wise recently! Super proud of the release of *Honey & Hot Wax: An Anthology of Erotic Art Games,* which I coedited. Not only did it receive two grants to help us create it, but it was also nominated for a couple of awards at the International Festival of Independent Games (IndieCade). This is my second nomination at the festival—I won an award the first time for my game Feast. Max Seidman '12 and I have been doing a lot with our interactive theater piece, Basic Principles of Incantation, sometimes with the help of Nick O'Leary '14. The game is set in the Victorian School of Magic and is based on real linguistics, drawn from my three linguistics classes at Dartmouth. It is one of my pieces I'm most proud of! We've now run it as a performance at an art gallery, a game at a conference, a fully produced theatrical piece in N.Y.C., a corporate team-building experience, and, most recently, as an online theater experience during the pandemic. Right before the pandemic hit full-force, Nick O'Leary and I were commissioned by the Museum of the Moving Image (MoMI), in partnership with the Jim Henson Foundation, to create a site-specific, live-action roleplaying game at the MoMI for *The Dark Crystal: Age of Resistance* Netflix show and traveling exhibition. It was super cool! I subsequently joined the museum as game artist in residence at the education department. Currently we're running a series of role-playing games online.

I ran my first Kickstarter! *Strange Lusts/Strange Loves: An Anthology of Erotic Interactive Fiction* was 177-percent funded—and we're excited to bring together a team of diverse writers to create sex-positive interactive fiction. We're going to be published by the multi-award-winning magazine, *Strange Horizons*, and I'm excited about that. I've been doing a lot of game design work at the intersection of sex-positivity and games, perhaps as a natural consequence of me joining the Sexperts team while at Dartmouth!

Pauline Schmit '13 Th'13: I recently defended my PhD thesis on viral vector engineering at Harvard and became Dr. Schmit! I'm looking forward to relaxing over the holidays as I search for biotech jobs in the Boston area.

Ian Schneider '14 Th'14: I finished graduate school at MIT at the end of 2019. I was the first PhD graduate of the new Institute for Data, Systems, and Society. I joined Google as a data scientist last February. I am working on a few projects in support of Google's 24x7 carbon-free energy goal, including carbon-aware computing.

Ari Koeppel '15: I am a planetary scientist. Since graduating from Dartmouth and Thayer, I earned a master's in geology from the City College of New York. I am now doing analog studies to better understand the geology of Mars as part of my PhD at Northern Arizona University. I was recently awarded a three-year grant from NASA to study how thermal emission signals can be used to diagnose the environments recorded by sediments, thus aiding in the search for habitable conditions on Mars. We know that Mars once hosted liquid water on its surface, which indicates that life may have been viable, but the timing and extent of those conditions isn't well understood. Sediments and sedimentary rocks contain records of past environments in the form of properties like grain size—which depend on how those materials were transported—and mineral cements, which depend on the style and amount of water present. Thermal emission data is highly sensitive to these properties and can thus be used to interpret past environments from orbit.

My work aims to improve the links between specific sediment properties and trends in thermal emission data. I started with a pre-existing hexacopter setup and integrated a thermal infrared camera and a 10-band multispectral imaging system that can be controlled from a tablet. This has involved both hardware and software modifications. I also am using a suite of ground measurements—soil and air temperature and moisture sensors, temperature calibration targets, and a radiometer—that I have also had to wire and calibrate. I am taking everything to Iceland, the Southwest, and Hawaii for a series of 24-hour-a-day field campaigns. I'm targeting a wide range of settings on Earth, from cold and wet to warm and dry, in order to cast the widest reasonable net on the types of sediments that we might be able to find on Mars. Ideally, a statistically significant set of trends will emerge from the data, allowing us to make direct links between what we're seeing in satellite imagery and what we expect surface materials to be made up of, as well as the climates they record. We have already done a couple test runs and anticipate doing our first data collection campaigns in February, pending COVID-related restrictions.

Drew Matter Th'15: I lead new product development at Mikros Technologies, a Claremont, N.H., company that designs and manufactures microchannel liquid cooling systems for high-performance computing, A.I. systems, lasers, and other high heat-producing applications. A spin-off of Creare Inc., Mikros was born from a project with NASA's Johnson Space Center to cool the space station in 1991. I love putting my MEM and ME degrees to work assessing new markets in a rapidly transforming computing industry, designing thermal management systems, leading teams to build prototypes, and collaborating with high-profile clients. I have been fortunate to stay connected to Thayer through involvement in the MEM Corporate Collaboration Council and student coaching. Mikros is also sponsoring a Thayer ENGS 89/90 capstone design project. My family and I have been in Hanover since coming to Thayer; we love our neighborhood here and life in the Upper Valley. We are eager to break out our Nordic skis and make the most of a beautiful New Hampshire winter.

Alexa Escalona '18 Th'19: I married Thomas Lee Hodsden III '18 Th'19 October 4—six years to the day of when we first started dating—at Simon Pearce in Quechee, Vt., in a tiny ceremony that showcased all the things we love about our relationship and the time they spent at Dartmouth. We met a month into freshman year and have been inseparable ever since!

Ned Berman '16 Th'17: I'm joining Differential Ventures in January to invest in datacentric, seed-stage startups.

Angelina DiPaolo '17: Continuing my interest in the tech space that I gained from Thayer, I recently accepted a position as a tech investor at Premji Invest in Silicon Valley. The firm operates as a subsidiary of the Azim Premji Foundation, which educates millions of people in India. It's extremely fulfilling work, has meaningful impact, and is funding the growth of cutting-edge tech companies that are improving the way we work and live.

in memoriam

WAYNE NILS TOBIASSON TH'74

— 1939-2020 —

The 1992 Engineer of the Year was dedicated to cold regions work.

Wayne Tobiasson—an engineer whose love of cold regions work led to civilian applications around the world—died August 14, 2020, of cancer. With a bachelor's in civil engineering from Northeastern, Tobiasson moved to Hanover to earn a master's in engineering from Thayer School. He then embarked on a 39-year career with the nearby U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL).

His work took him across the United States and internationally to Scandinavia, Greenland, and the South Pole. Tobiasson developed innovative solutions to move a 3,300-ton DEW Line Ice Cap building in Greenland; repaired the geodesic dome that sits on the South Pole; and led national snow load research and standards design, for which he was named U.S. Army Corps of Engineers Engineer of the Year in 1992.

When he retired in 1997, Tobiasson received the American Society of Civil Engineers Can-Am Civil Engineering Amity Award in honor of efforts to advance professional relations between Canada and the United States. He continued to consult, speaking at conventions and symposia and creating courses on roofing for the Roofing Industry Educational Institute. Tobiasson earned the Roofing Alliance's William C. Cullen Fellowship Award in 1998 for research regarding venting steep-slope, compact roof systems. He also served as a member of the American Society of Civil Engineers, chairman of the ASCE Task Committee on Snow and Rain Loads, and president of the Eastern Snow Conference.

Tobiasson is survived by his wife, Elizabeth, and their three daughters and their families. *—Theresa D'Orsi*

obits

Dana Evarts Low '54 Th'55 of Hanover and Fairlee, Vt., died August 27, 2020. He graduated summa cum laude from Dartmouth and earned his MS in civil engineering from Thayer. He served as chief engineer on the destroyer USS *Hawkins* from 1955 to 1958. Dana then joined engineering consulting firm TAMS Consultants Inc. in N.Y.C. in 1960, became a principal in 1973 and president in 1992, and retired in 1996. From 1980 to 2005 he was involved in the nonprofit International Road Federation and served as chairman of its world executive board. After moving to New Hampshire in 2012 he volunteered at the Upper Valley Haven. He was an avid hiker, completing the Appalachian Trail in his late 60s. Dana is survived by his wife, Anne, and children Richard '84, Christopher, and Virginia.

Joel D. Ash '56 Th'58 passed away at his home in Grantham, N.H., on September 10, 2020. He earned his MS in electrical engineering from Thayer School and married Marsha in 1958. He then started a long career that included extensive international travel as an executive with International Telephone and Telegraph. He then ran his own consulting firm. He is the author of two published works of poetic limericks. He retired to Connecticut and then moved to Grantham in 2002. Joel enjoyed membership in the Country Squires, fishing, magic, and travel. He was the '56 class secretary at his passing. He is survived by Marsha; sons Kevin '85 and Deron '88 and their wives; grandchildren Aaron, Braelin, Ben, Andrew, and Aiden; and brother Robert '52.

Richard D. Bugbee '57 Th'58 died at his home in Wilmington, Del., on September 2, 2020. He earned a master's in mechanical engineering from Thayer School. He attended Dartmouth on a Navy ROTC scholarship and served three years in the Navy on the destroyer USS *Manley*, achieving the rank of lieutenant. Dick's 35-year career with the Dupont Co. included many moves before headquarters assignments in Wilmington, where he specialized in photo products. Upon retirement he worked at Right Associates providing career transition support. Dick had always wanted to work in a hardware store and enjoyed working at Brandywine Ace Pet and Farm in West Chester, Penn., for more than 10 years. He was predeceased by Ann Lee, his wife of 59 years. He is survived by daughters Elizabeth and Sarah.

John T. Blunt '58 Tu'59 Th'59 died on July 19, 2020, at his home in Village of Golf, Fla. At Dartmouth he was a member of Zeta Psi, rowed crew, and participated in the Tuck-Thayer 3-2 program. John's 55-year career began when he joined the Northern Trust Co. in 1960. He held a number of positions during his 30 years there in tax, trust administration, family business, and strategic planning. He retired in 1989 as president of Northern Investment Management Co. He served as director of a number of corporations, including Schwinn Bicycle. He was involved with numerous charitable and social organizations, including the Northfield Community Fund and United Christian Community Services. John is survived by his wife of 60 years, Susan, and children John Jr. '82, Richard, Deborah '90, and Barbara and their families.

Paul W. Drenkow '64 Th'66 died of Parkinson's disease at his home in McKinney, Texas, on August 25, 2020. At Dartmouth he earned his AB and MS in engineering sciences. He went on to receive an MBA from the University of Washington. Paul began his career working for Boeing in Seattle, Wash., and in the early 1970s moved to Ann Arbor, Mich., to work for the Ford Motor Co. In the early 1990s he served as Ford's executive director of business planning for Asia Pacific and on the board of directors for Mazda Motor Co. Paul retired in 2001 and enjoyed traveling the world with his wife, Clarine, and frequent trips to the Hawaiian Islands with friends and family. Paul served on the board for Lutheran Social Services of Michigan. He is survived by Clarine and four children and their families.

Thomas M. Morton '65 Th'66 Th'67 of Santa Cruz, Calif., died on September 5, 2020, after a long illness. At Dartmouth he was a member of Beta, Sphinx, and Green Key. After earning his bachelor's and master's in engineering from Thayer School, Tom enjoyed a distinguished 37-

year career at Lockheed-Martin in Sunnyvale, Calif. He retired as vice president of the Fleet Ballistic Missile Program. He was involved in developing the Polaris, Poseidon, and Trident submarine missile systems, which he called "the nation's most effective system deterring nuclear war." He and his wife of 48 years, Karen, enjoyed worldwide travel. Karen survives, as do children Blake, Heather, Cheryl, and Kevin.

Fred Love "Pete" Krehbiel '87 died October 19, 2020, in Chicago, Ill. He spent his career with Molex Inc., a worldwide leading manufacturer of electronic, electrical, and fiber optic interconnection systems. After earning his AB in engineering sciences, Pete joined Molex as a design engineer in the company's America's region automotive division. In 1994 he was named to Molex's board of directors and earned the Molex Excellence in Product Design Award. When Molex acquired Cardell Automotive, Pete relocated to the new automotive division headquarters in Auburn Hills, Mich., and was named division president. In 2007 he was promoted to vice president of product development and commercialization for Molex's new global divisions and in 2009 he was named senior vice president of technology innovation. He is survived by siblings John '91 Th'92 and Margaret '94.

Lance G. Brackee '93 Th'94 of Chaska, Minn., passed unexpectedly from a heart attack on August 19, 2020. At Dartmouth he was a three-year starter at offensive tackle, helping claim the Ivy League title each year and setting numerous scoring, rushing, and passing records. In 2005 Lance was named to Dartmouth's All-Time football team. He was also involved in student workshops and Theta Delta Chi. After graduating from Dartmouth and Thayer with degrees in engineering, Lance returned to his native Minnesota. He embarked on a successful career as a software engineer and platform manager for several companies. Lance also had a stint playing semi-professional football and was an avid outdoorsman who enjoyed hunting, fishing, and trapping. Lance is survived by his wife, Melissa, and children Hunter, Logan, and Megan.

OPPOSITE PAGE: ELIZABETH TOBIASSON. THIS PAGE: THAYER SCHOOL ARCHIVES

| in memoriam |

VICTOR SURPRENANT
— 1932-2019 —

Research engineer was "an exquisitely good problem-solver."

Longtime Thayer research engineer Victor Surprenant died on October 3, 2020. Born and raised in Norwich, Conn., Surprenant served in the U.S. Air Force after high school. He then earned a geology degree from the University of Connecticut and began his career at the United Aircraft Research Labs in West Hartford, Conn. There he met Thayer professor George Colligan, who urged Surprenant to join him in Hanover.

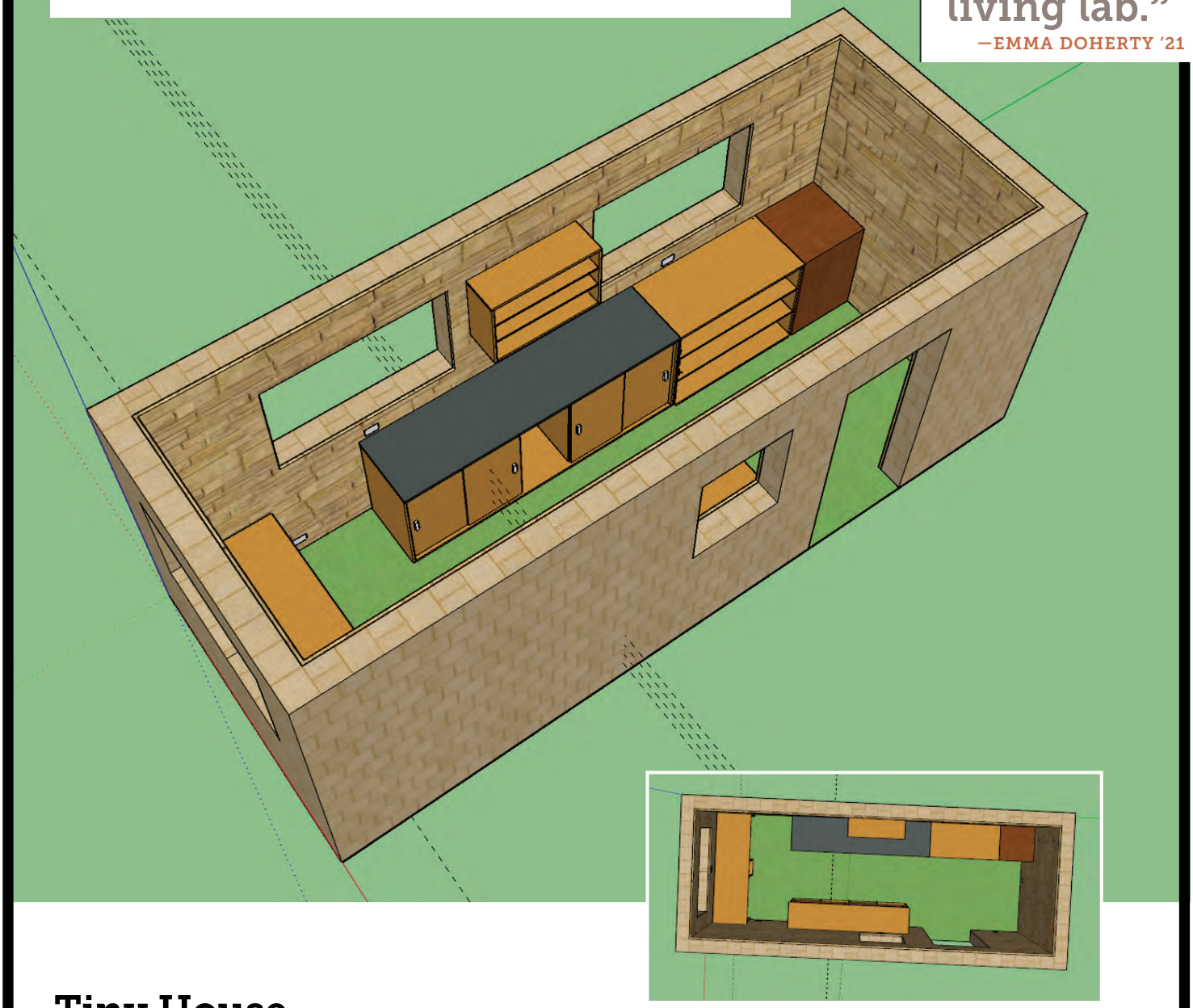
Surprenant moved to the Upper Valley and began teaching the labs for metallurgy and X-ray crystallography and X-ray diffraction. He conducted research in the metallurgy lab with Colligan and most recently worked in the biomaterials lab with Professor John Collier '72 Th'75 Th'77. "He was an exquisitely good problem-solver," says Collier. "We were studying how to improve the fixation of implants to bone, and he was involved in every aspect of developing and testing a porous coating that enabled bone to grow into the implant."

Surprenant also enjoyed making up the labs—a significant portion of Thayer's material science courses—and they were always challenging. "We met at Thayer School in the 1970s when I was an undergrad in a material science course where he taught the labs," says Collier. "Vic took great joy in teaching students with hands-on experimentation. He was eager to help students figure out how to think better and solve problems." That focus also made Surprenant an ideal reviewer for more than two decades in Collier's Intro to Engineering course. "He would always ask the questions the students would have to think about and go back and do more research to get the answers to." After 35 years of teaching and research, Surprenant retired in 1997 with emeritus status.

He is survived by his wife, Helene, and their four children and their families. *—Theresa D'Orsi*

Collaborations

"It will be a living lab."
—EMMA DOHERTY '21



Tiny House

The original plan was to have a group of faculty and students design and build a tiny house at the Dartmouth Organic Farm, where it would serve as a learning and living space. But when budgets, permit issues, and COVID-19 postponed construction, the team switched gears.

Instead, the tiny house will provide research space for Dartmouth ecologists in the Second College Grant. A local builder created the shell on a trailer, then stored it in a warehouse.

Enter Professor Vicki May, who incorporated the project into the ENGS 89/90 capstone engineering design courses. A team of students got to work. "The interior design was heavily influenced by ecology researchers who will be using the space: no running water, a freezer for soil and samples, storage space, and plenty of outlets for laptops and microscopes," says team leader Emma Doherty '21.

Through the fall the team designed the interior, envelope, and electrical, heating, and energy systems. "It would have been a lot easier to be able to meet in person and begin certain parts of construction," she says, "but everyone has been great about sharing and completing work—and having fun while doing so."

Students plan to complete construction during winter term—then enjoy the space. "The building will have multiple monitors, such as temperature, humidity, electricity use," says Doherty. "It will be a living lab, where students can experiment with the building itself."

Six engineering professors have also expressed interest in incorporating the tiny house into their curriculums. *—Kathryn Lapierre*

SOON-YOUNG SHIMIZU TH'21 AND ANDREW MOURA TH'21

@thayerschool

A team of @Dartmouth, @DartmouthHitch, and @CancerDartmouth researchers developed a method of delivering #radiation therapy that reduces damage to healthy tissue while maintaining its efficacy against tumors.

@thayerschool

Don't mind us as we brag about #DartmouthEngineer magazine winning a bronze award from @CASEdistI for a recent feature!

@thayerschool

Prof Jifeng Liu has been named a fellow of the @OpticalSociety for his work with photonics!

@thayerschool

#DartmouthEngineering Dean @AbramsonAlexis knows it's more important than ever for schools to retain hands-on learning amid #COVID19. Check out her list of tips for #STEM schools in @insidehighered

@thayerschool

This week, the Dartmouth engineering student team gave their final presentation for @NASA's BIG Idea Challenge for innovations to explore the #Moon.

The Final Clock

ENGS 146 Computed Aided Design Chronometer Final Project

Students were challenged to build the most accurate, 3-D-printed, marine chronometer, or sea clock.

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@Dart_Humanitarian_ Engineering (DHE) students are safely starting work on their newest assistive technologies project in conjunction with a Romanian partner organization. Stay tuned!

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I'm an Engineer and an Olympian

"Making the team is still pretty surreal to me, and this is the first time that a Puerto Rican women's basketball team has made it to the Olympics. We made history. It's kind of hard to believe. What I relate to most with engineering and basketball is the team aspect. It's been a wild ride. The Olympic process is a long one and definitely the hardest thing I've done in my life."

—Isalys Quiñones '19 Th'20

WATCH QUIÑONES AND OTHER STUDENTS IN THAYER'S "I'M AN ENGINEER AND..." VIDEO SERIES AT YOUTUBE.COM/THAYERSCHOOL.

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