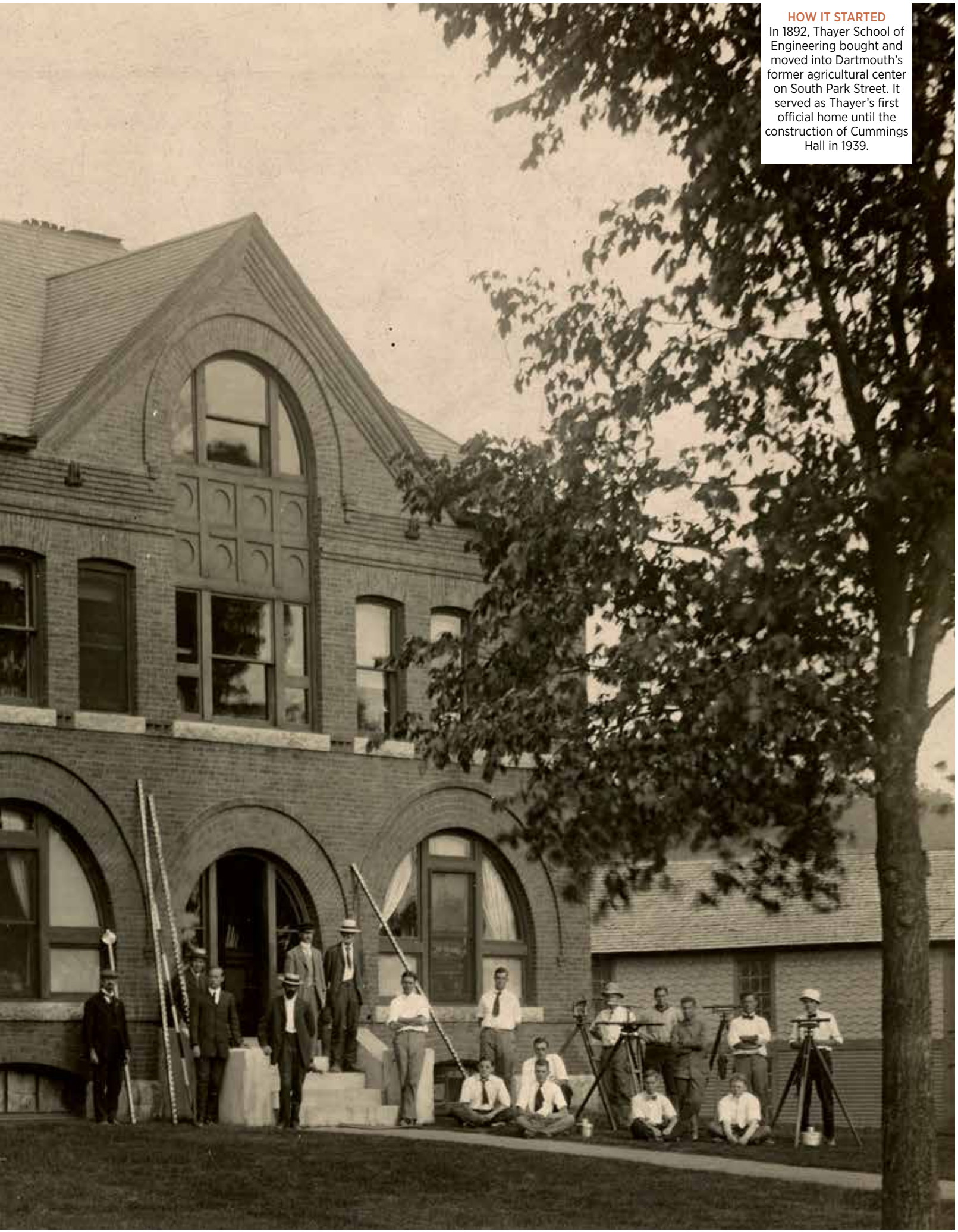
DARTMOUTH
Engineer
THAYER SCHOOL OF ENGINEERING | SPRING 2022

BUILDING ON INNOVATION

CLASS OF 1982 ENGINEERING AND COMPUTER SCIENCE CENTER TRANSFORMS WEST END INTO NEW HUB FOR HUMAN-CENTERED DISCOVERY.

inside

First Look



HOW IT STARTED

In 1892, Thayer School of Engineering bought and moved into Dartmouth's former agricultural center on South Park Street. It served as Thayer's first official home until the construction of Cummings Hall in 1939.

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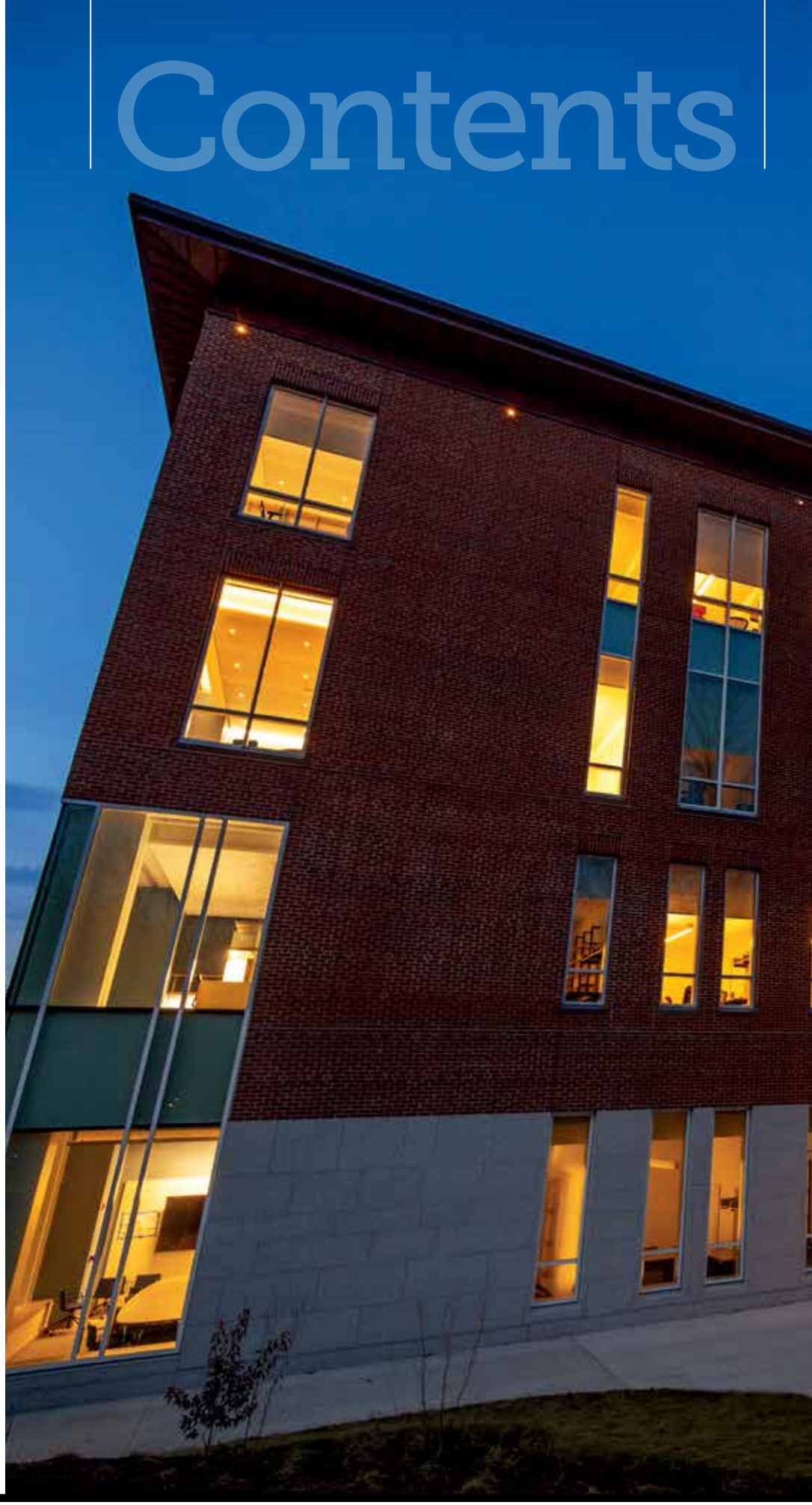

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DEPARTMENTS

"We're all really excited about how sharing space facilitates the sharing of expertise."

—PROFESSOR MARGIE ACKERMAN

Leading Thoughts

"A Rich Intellectual Climate"

Dean Alexis Abramson speaks with Professor Margie Ackerman about the potential of Thayer's newest building.

CAMPUS CONVERSATIONS

Dean Alexis Abramson (right) talks to Professor Margie Ackerman about her new lab home, inside the Atrium of the Class of 1982 Engineering and Computer Science Center.

ROB STRONG '04

The new Class of 1982 Engineering and Computer Science Center is doing more than transforming the look of the West End—it is expanding Dartmouth Engineering's capacity for innovative research and interdisciplinary learning. I spoke to Professor Margie Ackerman, program area lead for biological and chemical engineering, about her research and how the new building will enable further opportunities for human-centered impact.

First, can you elaborate on your current research?

ACKERMAN: My group, broadly speaking, works on the role of antibodies in protecting us from infectious disease. We work on understanding the human body's response to vaccines and learning what the principles of effective antibody-mediated interventions might be. Students in my lab do a lot of molecular biology, cutting and pasting pieces of DNA to make designer proteins that they'll then go on to test. We look for the not-so-obvious, where the quantity of antibodies present is not well-linked to the outcome of the disease.

You're working on potential cures and vaccines that could certainly impact society in so many ways.

ACKERMAN: The work that we are pushing hardest to translate is in the space of herpes simplex virus antibodies. About half the world is infected with HIV, and for neonates, it can be fatal or lead to long-term neurological consequences. We've been investigating the ability of antibodies to prevent long-term neurological deficits in mice exposed to HIV and are starting to collaborate with clinicians to design early-stage trials to investigate moving the antibodies proven effective into the clinic. HIV has been a tremendously difficult pathogen to address with vaccines. It was rewarding in the last year to see the people who have been working on it for decades pivot and transition to COVID-19 and apply a lot of technology developed from the HIV vaccine space.

Let's talk a little bit about the benefits of moving your lab into the new Engineering and Computer Science Center.

ACKERMAN: We're excited about hitting critical mass and being a better intellectually mixed system. We're all really excited about how sharing space facilitates the sharing of expertise. The open structure of the building will drive connections beyond biotech with biofuels or biomedical devices. Each lab moving into the new space has its own footprint, with personnel working side by side. Some of our people have been in buildings located in other parts of campus, so we're really excited about coming together. I'm looking forward to better integration at all levels.

Our educational model is designed to empower learning across disciplines. What are the benefits of this approach at the undergraduate and graduate level?

ACKERMAN: It encourages students to extend beyond their existing interests. They'll hear more from classmate peers or colleagues in the research labs and be more aware of other opportunities on and around campus. Even our graduate students have great flexibility to choose courses beyond their area of research. For our group, it's tremendous to be able to draw students from everything from chemistry to quantitative biological sciences to molecular and cell biology. We have students, equipped with different tools, working on addressing shared questions. It makes for a rich intellectual climate and is critical to our success to have such a diverse student base.

THE Great Hall

NEWS FROM AROUND THAYER SCHOOL

Rafe Steinhauer will build on the "Range and Radar" course that leveraged design thinking to help young alumni navigate some of life's big questions around work, family, and social justice.

HUMAN-CENTERED APPROACH

Designing Across Campus

FACULTY THROUGHOUT DARTMOUTH ARE harnessing the power of design thinking, engineering, and the liberal arts to bring new insights to their research and teaching through a series of new projects sponsored by the Design Initiative at Dartmouth (DIAD).

It's an effort grounded in human-centered design principles at the heart of Dartmouth's engineering education approach. DIAD, co-led by engineering professors Eugene Korsunskiy and Sol Diamond '97 Th'98, is providing funding and the tools to enable faculty from engineering to art history and film and media studies to infuse design thinking, critical thinking, and social awareness into their practice.

"These projects provide a glimpse into the diversity, creativity, and interdisciplinarity of scholarly work in design across the institution," says Diamond.

Engineering professor Rafe Steinhauer will build on the "Range and Radar" course he taught last summer that leveraged design thinking to help young

"It's exciting to see how faculty from across different disciplines are using the tools and mindsets of design to enhance their teaching."

—PROFESSOR EUGENE KORSUNSKIY

alumni navigate some of life's big questions around work, family, and social justice. With this new project, Steinhauer will guide a team to develop a "Range and Radar" toolkit—including a card deck with prompts, activity workbook, and video series—alumni and students working with the Dartmouth Center for Social Impact can use.

Other projects by professors across the curriculum will draw in collaborators from the Hopkins Center, Data Experiences and Visualizations Studio, and Dartmouth Center for the Advancement of Learning (DCAL). Art history professor Nick Camerlenghi will develop an interactive, virtual reality experience for students and scholars of Rome's Basilica of St. Paul. Digital humanities and film and media studies professor Jacque Wernimont will explore how humans gain and share knowledge. Studio art professor Tricia Treacy will invite journalism, politics, music, visual arts, performance, literature, and electronic media experts to create content on specific topics.

The ongoing effort to integrate human-centered design with liberal arts can also be seen this winter and spring in new joint DIAD and DCAL-supported courses ranging from anthropology to sociology to Italian literature. Says Korsunskiy: "It's exciting to see how faculty from across different disciplines are using the tools and mindsets of design to enhance their teaching and bring their subjects to life for their students."

Catha Mayor Lamm contributed to this story.

ROB STRONG '04

"It was fun to share some aspects of everyday camera technology."

—PROFESSOR ERIC FOSSUM

Galápagos | Prof. Fossum Captures Evolution

FROM VOLCANIC SUMMITS TO THE WORLD'S LARGEST MARINE iguanas, the Galápagos Islands have much to explore. Those joining a recent Dartmouth alumni trip led by Professor Eric Fossum made particularly well-informed observations using technology invented by Fossum, the John H. Krehbiel Sr. Professor for Emerging Technologies at Dartmouth.

The voyage's faculty leader and expert, Fossum invented the CMOS active pixel image sensor, now an integral part of every modern digital camera and cell phone. "It was fun to share some aspects of everyday camera technology evolution, including my contributions from the past and those underway today in my lab at Dartmouth," he says. "It gave my wife, Susan, and me a chance to explore the curious evolutionary science of the Galápagos—from volcanoes to life at the intersection of lava and the sea—and to meet some fascinating Dartmouth alumni and experience the Galápagos with them." Fossum originally developed the technology while working at the NASA Jet Propulsion Laboratory at Caltech for the purpose of interplanetary spacecraft travel, not knowing that his invention would have such a broad impact on society.

From the *National Geographic Islander*, the group explored both land and sea. They climbed volcanic summits, went snorkeling and kayaking, and observed sea lions, whales, dolphins, flightless cormorants, giant tortoises, and other wildlife. "You definitely want to take memories from here. The special tool that we have been using to do this is digital cameras," says naturalist and National Geographic educator Gianna Haro. For that reason, she says, "it has been an honor to have Professor Fossum on board."

PROFESSORS

Welcome New Faculty

Dartmouth Engineering welcomed three new faculty during the fall and winter terms.

Assistant Professor **KATIE HIXON'S** research focuses on tissue engineering and regenerative medicine strategies to improve treatment and facilitate healing in patients with congenital and traumatic craniofacial anomalies. Hixon earned a PhD in biomedical engineering at Saint Louis University and completed a postdoctoral position in orthopedic surgery at the Washington University in St. Louis School of Medicine, where she studied bone healing through the NIH's Ruth L. Kirschstein National Research Service Award.

KLAUS KELLER, the Hodgson Distinguished Professor of Engineering, comes to Dartmouth from Penn State, where he was a professor of geosciences and directed the Center for Climate Risk Management. He was previously a research scientist at Princeton, where he earned a PhD in civil and environmental engineering. His research focuses understanding how past and ongoing changes to the earth's system to design sustainable, efficient, and ethical climate change mitigation strategies.

Assistant Professor **WESLEY J. MARRERO'S** research lies at the intersection of operations research and statistics. His work is applicable to substance use disorder, cardiovascular disease, and organ transplantation and he has ongoing collaborations with the University of Michigan Medical School, the University of Michigan's Medical School and the School of Public Health, and the U.S. Department of Veterans Affairs. He was previously a postdoctoral research fellow at the Massachusetts General Hospital Institute for Technology Assessment and Harvard Medical School.

KLAUS KELLER

WESLEY J. MARRERO

Hixon's research focuses on tissue engineering.

classroom

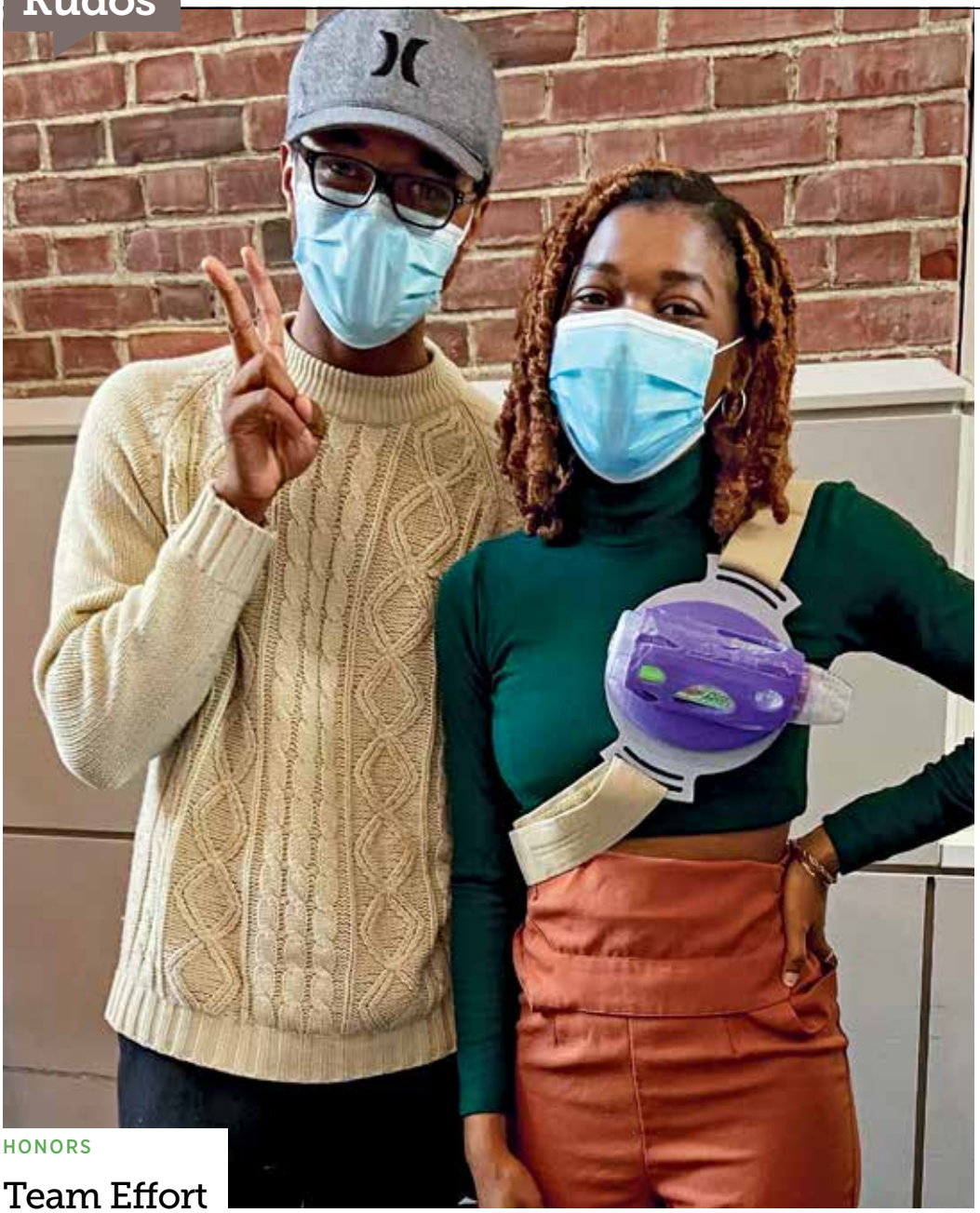
"I thought this course would be a great way to delve into a field that I know very little about."

—NINA HAM '22

ENGS 2: "INTEGRATED DESIGN: ENGINEERING, ARCHITECTURE, AND BUILDING TECHNOLOGY"

Nina Ham '22 tackles an assignment to design and build a full-size chair put of cardboard in Couch Project Design Lab. It's only one of several team challenges senior lecturer John Wilson gives his students in ENGS 2: "Integrated Design: Engineering, Architecture, and Building Technology." The course is an introduction to the integrated design of structures and the evolving role of architects and engineers. "I have always been really interested in architecture. I thought this course would be a great way to delve into a field that I know very little about and allow me to learn from one of Dartmouth's experts," says Ham, who is majoring in biology and economics. "There is a lot of history behind buildings, their construction, and their styles. I think it is valuable to understand the history and challenges behind how an everyday building came into existence."

MARK WASHBURN (4)



CATHA MAYOR LAMM

HONORS

Team Effort

NATHANIEL MENSAH '24 (LEFT) AND EZINNE ANOZIE '22 demonstrate Nouri-Me, a device that makes infant bottle-feeding easier during a recent prototype exhibition for ENGS 21: "Introduction to Engineering." Nouri-Me was designed by Mensah, Anozie, Evana Amok '23, and Elorm Coch '22 working with teaching assistant Nina Klee '23 to address challenges with existing products. "As we read online reviews, we noticed common complaints: [It] wasn't secure, did not stay in place on the body, and the bottle could not stay in an acceptable feeding position for some parents," says Amok. "We took these complaints to the drawing board…and looked at images of organic shapes to find something that would be comfortable for both the baby and an adult." The exhibition traditionally caps the "Introduction to Engineering" course and teams with innovative prototypes that demonstrate best overall performance earn the Phillip R. Jackson Award. Fall term winners—Emma Kallman '22, Mia Giallorenzi '23, Emily Lukas '23, and Ella Marden '23, with teaching assistant Gretchen Carpenter '23—developed Core Check, safety device that checks ropes for internal damage. Users slide a rope through the device to watch for any catching, stopping, or skipping that might indicate rope damage. "Team Core Check created many prototypes, finally settling on a simple but elegant prototype that consistently detects internal damage in climbing ropes," says Professor Vicki May. "They came up with a creative way to assess the accuracy of their device and solicited and incorporated user feedback throughout the term."

EDITED *High Entropy Alloys & Materials*, a journal recently launched by Springer to cover all properties of high-entropy materials, is led by **Professor Ian Baker** as co-editor-in-chief.

FUNDED The U.S. Air Force Office of Scientific Research Innovare 2021 Trusted AI Challenge Series has awarded **Professor Eugene Santos** $100,000 to demonstrate how beneficial a human-AI team can be when expectations align.

QUOTED **Professor Colin Meyer** and postdoc researcher **Jacob Buffo** spoke to *Planetary Radio*, a podcast of the Planetary Society, about their discovery of the makeup of the plumes from Saturn's moon Enceladus and what it means for finding life beyond Earth.

SELECTED PhD student **Congran "Billy" Jin Th'21** was one of two U.S. finalists—the other was from the Geisel School of Medicine—in the international Matariki Three Minute Thesis competition with an entry that centers around using the human body's natural processes to harvest energy.

PUBLISHED Research toward a better battery by engineers **Chuanlong Wang, Yiwen Zhang, Jianmin Luo, Xiaofei Hu, Edward Matios**, and **Weiyang (Fiona) Li** appeared in the *Proceedings of the National Academy of Sciences*.

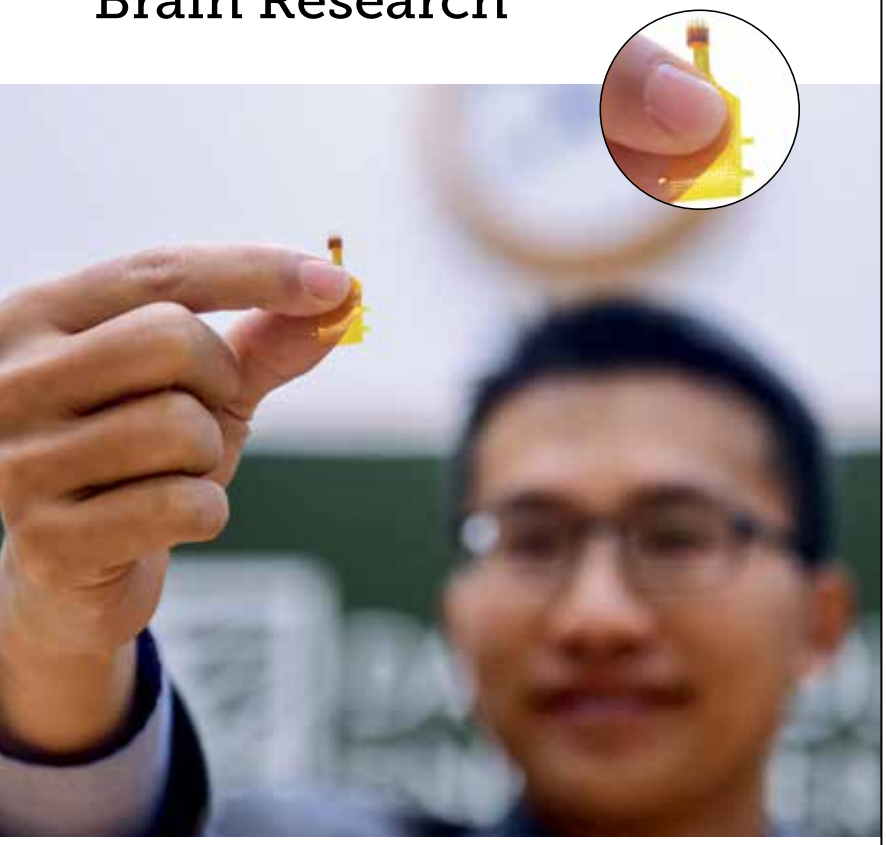
IDENTIFIED Research engineers **Barbara Currier** and the late **John Currier '79 Th'81** and **Professor Douglas Van Citters '99 Th'03 Th'06** identified primary determinants of artificial knee wear in research recently published in *The Bone & Joint Journal*.

NAMED The Breast Cancer Locator device developed by CairnSurgical—co-founded by **Professors Keith Paulsen** and **Venkat Krishnaswamy**—has been named the N.H. Tech Alliance 2021 Product of the Year.

LISTED **Professor Tillman Gerngross** has been named to the *N.H. Business Review*'s "New Hampshire 200" list of influential business leaders across major industries in the state.

NIH GRANT

Probe Revolutionizes Brain Research



DARTMOUTH ENGINEERING professor Hui Fang is developing next generation neural probes to revolutionize how researchers study the human brain. With a $2.8-million National Institutes of Health (NIH) grant, he's co-leading a team that includes students and postdoctoral researchers to create a high-density, flexible neural array dubbed Neuro-CROWN.

The four-year effort is part of the NIH's Brain Research Through Advancing Innovative Neurotechnologies (BRAIN) Initiative.

Traditionally, researchers study brain activity with electrodes that individually wire to a separate, remote recording device. The extensive wiring in a constrained space limits the amount of electrodes that researchers can use to about 100, often forcing a choice between a high-resolution reading focused on a small area of the brain or low-resolution readings over larger areas. Fang aims to sidestep this limitation by developing flexible CMOS electrode arrays that require a fraction of the wiring and increase the number of electrodes by a factor of 20. The Dartmouth team is also working on solutions to deliver the sought-after 3-D interface to replace typical flat electrode arrays placed over the brain.

Neuro-CROWN—which stands for CMOS-based, rollable, low-noise neuroelectronics—could house more than 2,000 electrodes spread three-dimensionally and use fewer than 20 external wire connections. "My lab has achieved a unique way to transform flexible devices from planar form—the dominant form of all electronics—to 3-D architecture," says Fang. "It is realized through a rather simple process, taking advantage of the device's flexibility."

His team believes this new technology will enable novel neuroscience research and the creation of enhanced neuro-prosthetic systems.

—Julie Bonette

RESEARCH

Team Transforms Specialized Ceramics

POLYMER-DERIVED CERAMICS (PDCS) HAVE ENABLED significant breakthroughs in biomedical implants and renewable energy storage devices, but PDCs are susceptible to wear and brittle fracture and can be hard to shape.

Professor Yan Li and research associate Chi Ma have developed a flexible, energy-efficient approach that may offer an ideal solution to fabricating a range of durable ceramic composites. Their computational framework accounts for the atomic structure evolution of PDCs while they undergo pyrolysis, a type of heat treatment, and their resulting transformation.

"These capabilities will greatly extend the use of ceramics in areas such as biomedical implants and renewable energy storage devices."
—PROFESSOR YAN LI

"The polymer-to-ceramic transition opens up exciting opportunities to produce a broad spectrum of PDCs with tailored mechanical, chemical, and physical properties," says Li. "Shaping at the polymer state can avoid problems related to tool wear and brittle fracture upon finishing the ceramic component."

The research, "Modeling of Phase Transition in Fabrication of Polymer-Derived Ceramics (PDCs)," was published last winter in *International Journal of Computational Materials Science and Engineering*. Li and Ma specifically investigated polymethylhydrosiloxane crosslinked by divinylbenzene, but the approach can be applied to other PDC fabrication systems.

"We found that heating rate, pyrolysis temperature, and pyrolysis time combine to affect the mechanical response of the pyrolyzed sample," says Li. "Certain phase composition maps can lead to improved material strength without sacrificing the ductility. These capabilities will greatly extend the use of ceramics in areas such as biomedical implants and renewable energy storage devices, where customer-specific geometry and functionality are in high demand."

The research was supported by the New Hampshire Center for Multiscale Modeling and Manufacturing of Biomaterials, a $20-million project funded by the National Science Foundation.

—Julie Bonette

LEFT: KATHRYN LAPIERRE; TOP: ELI BURAKIAN '00

3-D SENSOR Professor Petr Brůža holds a prototype of the fluorescence LiDAR camera.

RONGXIAO ZHANG

Surgical Camera Pinpoints Tumors

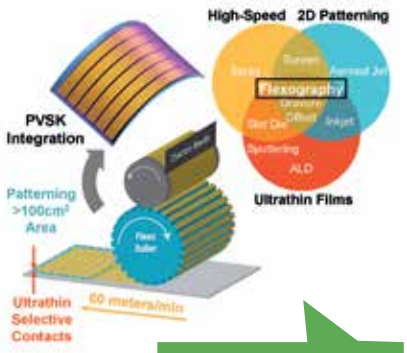
A NEW SURGICAL CAMERA DEVELOPED BY DARTMOUTH engineers and researchers at the Swiss Federal Institute of Technology Lausanne can image and measure the shape and location of deep-seated tumors—a great advancement on current operating room techniques.

Surgeons initially use computer tomography (CT) or magnetic resonance imaging (MRI) scans to gauge tumor locations and shapes, but during surgery typically rely on vision, touch, and training to remove tumors and leave healthy tissue intact. "We can use pulses of light to range the distance and position of cancerous cells in tissue, similar to how radar detects the position of planes in the air," says Professor Petr Brůža.

The concept of using a depth-sensing camera—leveraging 3-D imaging sensor and pulses of light to localize tumors—came to Brůža in 2020. He assembled a team of biomedical engineers, including Professor Kimberley Samkoe, one of the principal investigators of Dartmouth's fluorescence-guided surgery project, and Professor Edoardo Charbon in Switzerland, who provided an ultra-fast sensor for experimentation.

The team's research—"Single-photon avalanche diode imaging sensor for subsurface fluorescence LiDAR"—was featured on the cover of *Optica* last winter. Now, Dartmouth engineers are testing a novel fluorescing drug designed to bind to cancer and highlight affected areas when irradiated by red light. The camera is being integrated into a compact surgical microscope to assist surgeons in navigating through sensitive tissue to ensure no tumor is left behind.

—Julie Bonette



"The impact of solar energy depends critically on the cost of manufacturing solar cells."

—PROFESSOR WILLIAM SCHEIDELER

LAB REPORT

New Printing Process Helps Scale Solar Tech

DARTMOUTH ENGINEERS HAVE developed the quickest reliable printing method for the manufacturing of perovskite solar cells, which can be used to efficiently harness and convert solar energy. The method may help scale the use of efficient solar technology such as electric vehicles.

Metal halide perovskites—a new abundant absorber material with the most promise to increase global solar capacity—have slow production times that makes scaling difficult and increases manufacturing costs. The research team, led by Professor William Scheideler, has developed a method that can accelerate total processing time of solar charge transport layers (CTLs) by a factor of 60 while maintaining reliability.

"Our method prints the layers of the solar cell with the speed and efficiency of a commercial newspaper printing press," says Scheideler. "This directly translates to lower cost per kWh, which will ultimately make solar energy more affordable for a larger population."

The team's method pairs high-speed flexographic printing with rapidly annealed sol-gel inks. When compared to silicon photovoltaic production, this method is faster, more energy efficient, and requires less materials.

"An advantage of our process is that it can be used to print solar cell layers on flexible or rigid substrates, allowing for applications of solar energy that go beyond typical silicon solar panels," says PhD candidate Julia Huddy.

"Eliminating the Perovskite Solar Cell Manufacturing Bottleneck via High-Speed Flexography" by Huddy, research associate Youxiong Ye, and Scheideler was recently published in *Advanced Materials Technologies*. "The impact of solar energy and its penetration into the electrical grid depend critically on the cost of manufacturing solar cells," says Scheideler. "This is where innovation in the lab is still needed to accelerate the potential of renewable technologies."*—Julie Bonette*

BUILDING ON INNOVATION

PHOTOGRAPHS BY ROB STRONG '04

CLASS OF 1982 ENGINEERING AND COMPUTER SCIENCES CENTER HAS TRANSFORMED THE WEST END INTO NEW HUB FOR HUMAN-CENTERED DISCOVERY.

BY THERESA D'ORSI

If the soaring glass and brick exterior is any indication, there is something very cutting edge about the new Class of 1982 Engineering and Computer Science Center (ECSC) that has transformed Dartmouth's West End into a new hub for innovation. Step inside the light-filled Atrium and you'll notice open classrooms with movable walls, furniture on wheels, tech-enabled "smart" classrooms, wet and dry labs, and the Back of the Napkin Café, the grab-and-go eatery that opens to shared work benches and booths when inspiration strikes over coffee.

But it's what goes on among the faculty, staff, and students that's really important.

"Every aspect of the building is designed for how we teach and learn at Dartmouth," says Alexis Abramson, dean of Thayer School of Engineering at Dartmouth. "Everything—from the floors to the furniture and to the tools in every classroom—encourages connection, creativity, collaboration, and active learning."

Rising five stories above West Wheelock Street, ECSC is the first major Dartmouth building to welcome students, faculty, and visitors from across the Connecticut River to campus. The 160,000-square-foot facility, which connects via tunnels and bridges to MacLean Engineering Sciences Center and Cummings Hall, as well as to the new Arthur L. Irving Institute for Energy and Society, doubles Thayer's footprint and serves as the new home for the the department of computer science, Magnuson Center for Entrepreneurship, the electron microscopy suite, and the new Design Initiative at Dartmouth (DIAD). Fitted with high-performance energy conservation features, ECSC is expected to earn LEED Platinum certification from the U.S. Green Building Council.

Its open architecture facilitates Dartmouth's hallmark collaborative, interdisciplinary approach to education and research, Abramson says. "By bringing together engineering, computer science, energy, entrepreneurship, design, and business in the West End, we create the magic that only happens at the intersection of all these disciplines."

What began in 2013 as part of President Philip J. Hanlon '77's vision to significantly expand engineering at Dartmouth, the ECSC opened to students in March for the first day of spring term.

"I am excited by the new opportunities emerging for students to engage in the new center. Design offers a framework for collaboration across disciplines on research that addresses our world's complex human-social-technical problems," says Professor Sol Diamond '97 Th'98, whose lab is in the new space.

Kyra McLaughlin '23 agrees. She is working in Diamond's lab to develop an improved nasal CPAP interface for preemies. "Learning in such a creative environment will be a source of inspiration to all aspiring designers and engineers and strengthen the human-centered design community at Dartmouth," says Mclaughlin, who is studying engineering modified with studio art and minoring in human-centered design. "That's where you'll find me!"

"The intersection of engineering and computer science is where the great discoveries lie."

—PROFESSOR KOFI ODAME

ENGINEERING WITHOUT BOUNDARIES

Faculty from different disciplines will be able to co-teach courses in a range of high-tech spaces. The Technology-Enhanced Active Learning (TEAL) Classrooms integrate computer science and engineering with a flexible "flipped classroom" that enables professors and students to cluster around coding projects or collaborate on design challenges. The Design Loft, home of the new Design Initiative at Dartmouth (DIAD), is instantly reconfigurable into arrangements for lectures, hands-on workshops, or casual conversation. "It will allow our multidisciplinary community to come together to inspire each other and create ideas," says Professor Eugene Korsunskiy, co-leader of DIAD.

THE CENTER OF IT ALL

The bright and open Atrium reflects the collaborative and cooperative spirit of Dartmouth's engineering and computer science community. It runs the height of the building and the garden level commons with a broad staircase that doubles as stadium seating during events.

"I'm excited to see how proximity will lead to new research collaborations and attract new professors, enriching the research portfolio of Dartmouth."

—MARIA NYAMUKURU TH'24

"Many of today's pressing questions require a convergent approach that brings together many academic disciplines. The new environment is ideally suited to support such an approach."

—PROFESSOR KLAUS KELLER

HANDS-ON LEARNING

Classrooms and offices are interspersed with project studios and labs that encourage students to learn by doing at every turn. Couch Project Lab II doubles the space for team-based learning and the Harold Edward Cable Makerspace is outfitted with beginner-friendly fabrication equipment and 3-D printers.

FOCUS ON IMPACT

The new center greatly expands Dartmouth's capacity to take ideas from the lab to the marketplace. From green energy technology to mobile devices that monitor health to intelligent systems that can improve everyday life, research here is tackled collaboratively by faculty and students from across engineering, computer science, and other disciplines. With Magnuson Center for Entrepreneurship located on the ground floor, faculty and students have ready access to resources to support their startup efforts. "We have a tangible emphasis on entrepreneurship. This provides more opportunities to connect, from bottom up, phenomenonal research with broader societal challenges and opportunities," says Professor Lee Lynd.

CLASS OF 1982 ENGINEERING AND COMPUTER SCIENCE CENTER

FLOOR BY FLOOR

LEVEL TWO

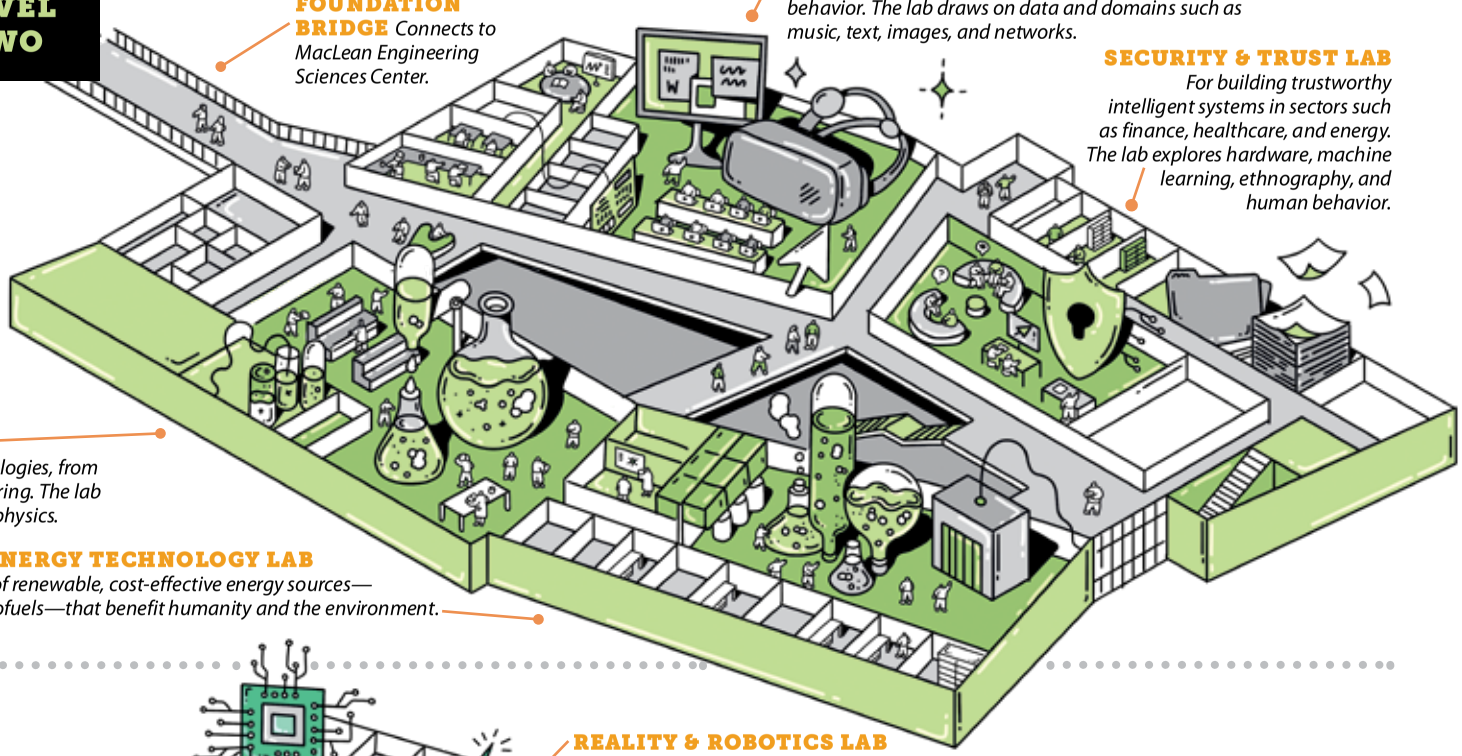
OPUS FOUNDATION BRIDGE *Connects to MacLean Engineering Sciences Center.*

MACHINE LEARNING LAB *For developing models to imitate and enhance intelligent human behavior. The lab draws on data and domains such as music, text, images, and networks.*

SECURITY & TRUST LAB
For building trustworthy intelligent systems in sectors such as finance, healthcare, and energy. The lab explores hardware, machine learning, ethnography, and human behavior.

ENGLES BIOTECHNOLOGY LAB
For the design and development of bio-inspired technologies, from quantum and nanoelectronic circuits to tissue engineering. The lab leverages expertise across engineering, medicine, and physics.

LORD FAMILY ENERGY TECHNOLOGY LAB
For the development of renewable, cost-effective energy sources—including cellulosic biofuels—that benefit humanity and the environment.



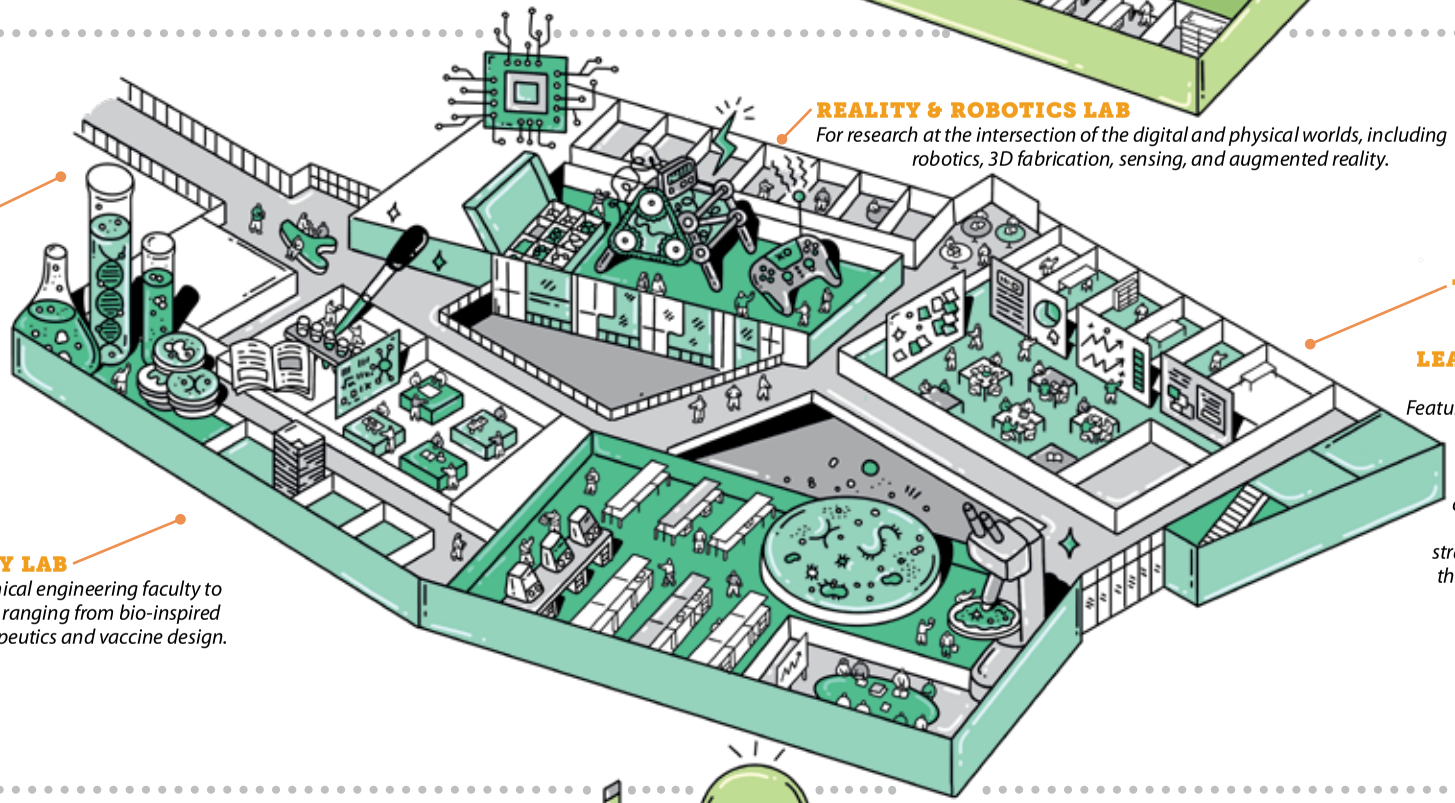
LEVEL ONE

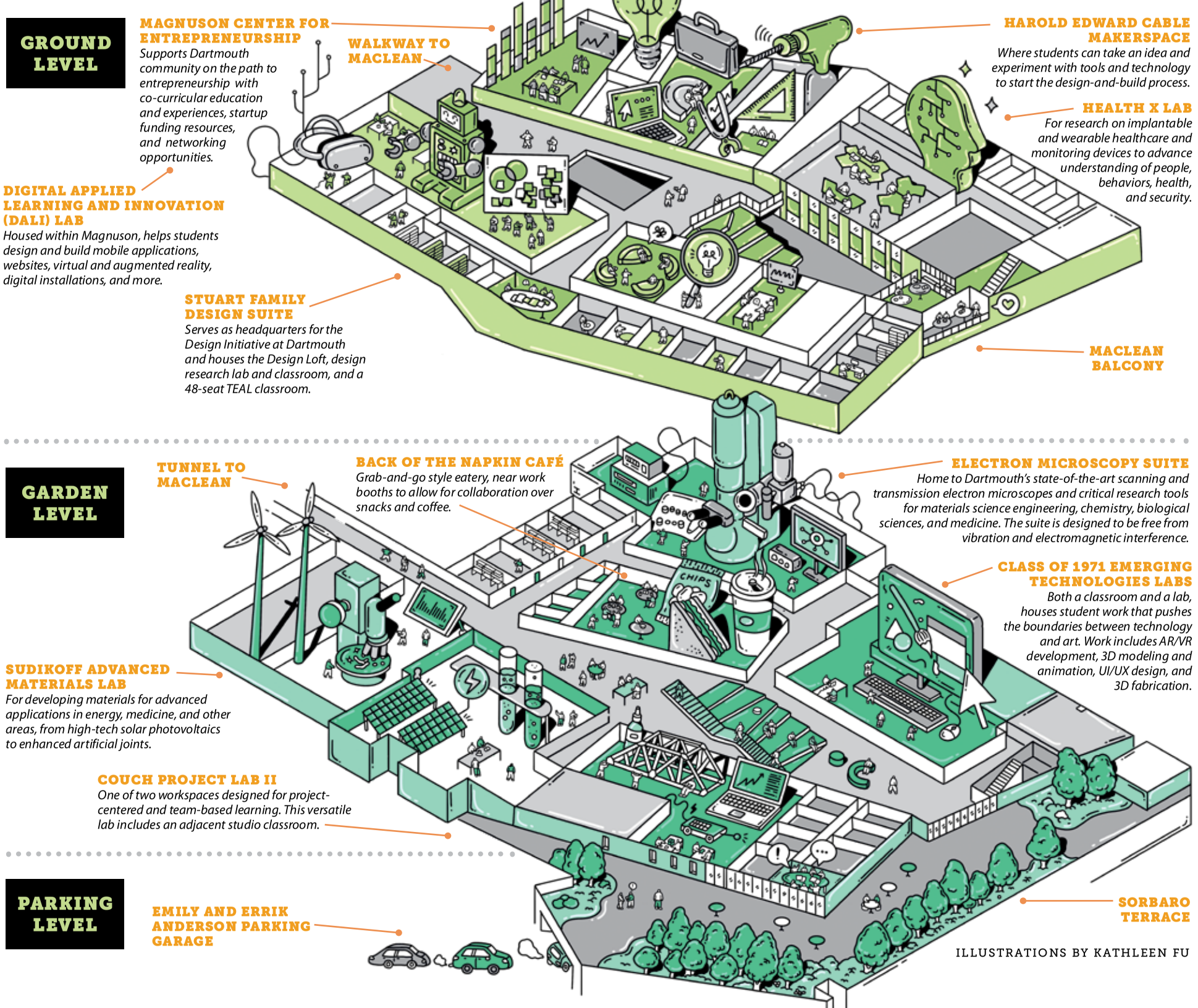
REALITY & ROBOTICS LAB
For research at the intersection of the digital and physical worlds, including robotics, 3D fabrication, sensing, and augmented reality.

OPUS FOUNDATION BRIDGE
Connects to MacLean Engineering Sciences Center.

80-SEAT TECHNOLOGY-ENHANCED ACTIVE LEARNING (TEAL) CLASSROOM
Features smart technology and flexible room configurations ideal for the "flipped classroom" approach and other learning strategies that optimize the in-class experience.

BIOTECHNOLOGY LAB
For biological and chemical engineering faculty to collaborate on research ranging from bio-inspired systems to cancer therapeutics and vaccine design.





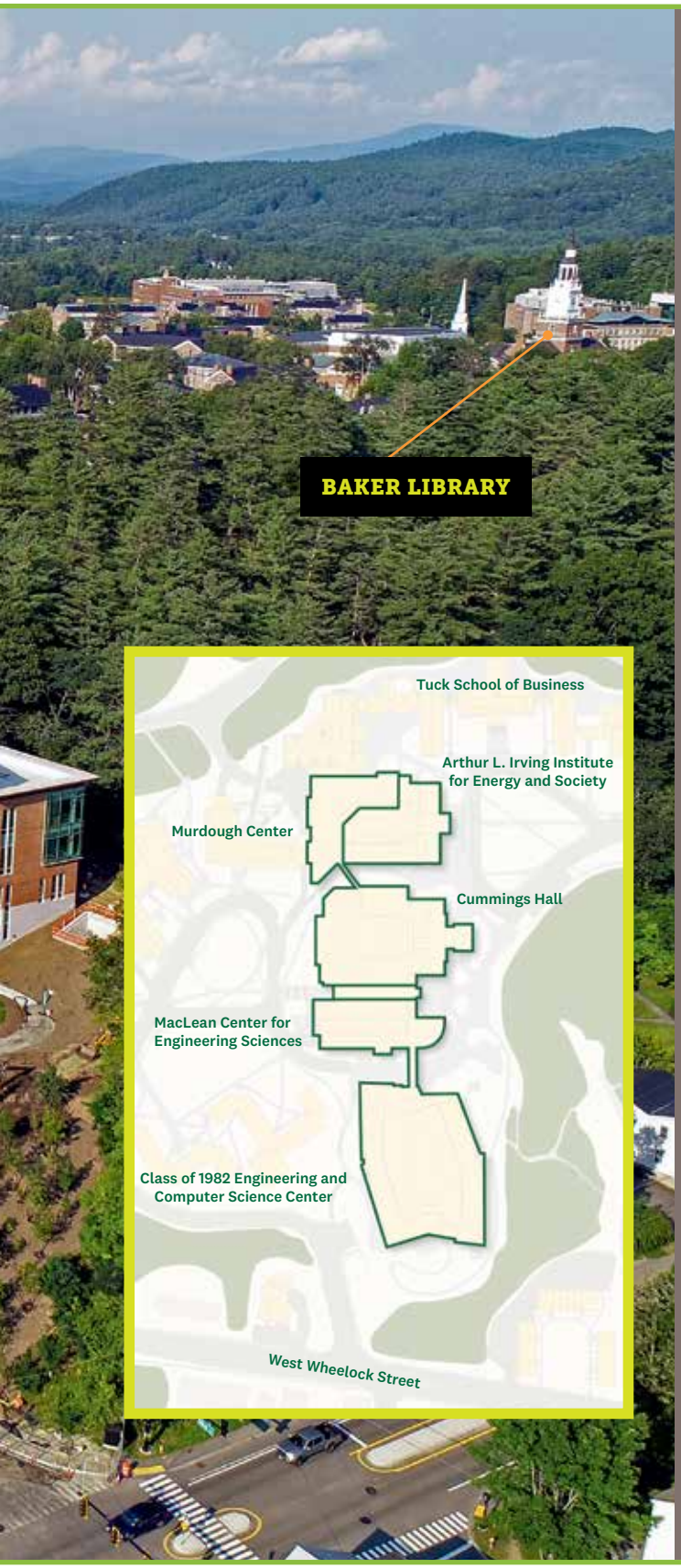
ILLUSTRATIONS BY KATHLEEN FU

TRANSFORMING THE

INTO A CREATIVE, COLLABORATIVE HUB

BACKGROUND PHOTO: JARED BENEDICT, IRVING: COURTNEY CANIA, ECSC: ROB STRONG '04, TUCK: COURTESY TUCK SCHOOL

WEST END OF CAMPUS



Dartmouth's new West End drives collaboration across disciplines and serves as the epicenter of technological and entrepreneurial innovation on campus.

CLASS OF 1982 ENGINEERING AND COMPUTER SCIENCE CENTER:
Home to Thayer School of Engineering, the computer science department, and Magnuson Center for Entrepreneurship, ECSC facilitates integration across disciplines by bringing together key drivers of human-centered impact—research, experiential learning, and tech-transfer support. At every level, the building connects to Thayer's MacLean Engineering Sciences Center and Cummings Hall. Every classroom is made for hands-on design, fabrication, and problem-solving, giving students from across Dartmouth an unsurpassed environment for learning by doing.

ARTHUR L. IRVING INSTITUTE FOR ENERGY AND SOCIETY:
The Irving Institute is situated between Thayer School of Engineering and Tuck School of Business, creating a point of convergence for faculty and students engaged in issues related to energy and society to drive innovation in the production, supply, and use of energy. The institute's new headquarters is also home to engineering faculty whose research centers on climate change mitigation and adaptation, the Dartmouth Sustainability Office, and the Revers Center for Energy, Sustainability, and Innovation.

MURDOUGH CENTER:
Murdough is home to Feldberg Business and Engineering Library, a two-story, interdisciplinary library for Thayer and Tuck, as well as their joint programs, including the master of engineering management (MEM) program. Murdough connects directly to Irving a via light-filled atrium.

TUCK SCHOOL OF BUSINESS:
Dartmouth's top-ranked business school, which connects directly to Irving and Murdough, infuses the West End with management, entrepreneurship, and technology transfer expertise. Tuck faculty collaborate closely with engineering faculty for the MEM program and interdisciplinary coursework in product design, marketing courses, and data science and transformation.

Alumni News

FROM AROUND THE WORLD

spotlights

"Elevate the Experience"

Fran Wang '12 Th'13 recently described her path to senior mechanical engineer at the renowned design firm frog on *The Context Podcast*. Joking that she dabbled in nine different majors at Dartmouth, Wang tells of earning her BE and following her interest in unmanned aerial vehicles to a position at SkyCatch in San Francisco. "There, I met ex-frog engineers and hearing them tap into their previous experiences and immense library of knowledge, it was a cool way to learn," she says. She moved on to New Deal Design as a product development engineer—"my first immersion into a design space"—before joining frog in 2017. "My appreciation for design is still growing," she says. "The most beautiful work comes out when people appreciate other disciplines and can both empathize with the challenges but also pick up on those moments of, 'Well, if you can do that, then that enables or unlocks these other things for me.'" Her work at frog includes conception and architecture, design and engineering, and manufacturing and assembly for industries ranging from consumer electronics to healthcare. For the San Francisco Museum of Modern Art's Magritte show in 2018, she helped frog develop interactive walls with depth-sensing cameras and motion-tracking technology. "We didn't want to hide the technology," she says. "We wanted to integrate it in a way that would elevate the experience." She finds the tech energy around San Francisco exhilarating—and familiar. "The way that they approach engineer thinking [at Thayer] is very much aligned with design thinking in the Bay Area, so it set me up to make it to where I am now," says Wang. "It feels like an extension of Couch, so there's this sense of entering a playground." You can hear her discuss "An Engineer's Life" at anchor.fm/advanced-design.

"The most beautiful work comes out when people appreciate other disciplines."

—FRAN WANG '12 TH'13

Actionable Insights

As the new academic director for doctoral education at NYU Stern School of Business, Associate Professor of Marketing **Bryan Bollinger '03 Th'03** encourages students to ask—and then answer—questions that will have widespread impact. A key challenge, he says, "is making sure that the work we do offers real value so that we can push the boundaries of academic study while offering actionable insights for the real world." He credits Thayer's capstone design sequence with his interest in how studies translate into solutions. "I saw that an incredible technology was not in itself a guarantee of consumer adoption," he says. "When I was making my decision to go back to graduate school—at Stanford for an MA in economics in 2010 and a PhD in marketing in 2011—I decided to focus on this second aspect, the drivers of consumer decisions that might facilitate or impede new product adoption." His research centers on the causal effects of policymakers' decisions and interdependent reactions by consumers and firms in such areas as solar adoption and pricing, the role of home-automation and dynamic pricing on demand response, and the effect of nutritional labeling. "Thayer's focus on systems-thinking has, in particular, been valuable for me as a researcher. I also still leverage relationships founded at Dartmouth. For example, **Jonathan Cedar '03** of BioLite has been a guest speaker multiple times in the Marketing and Sustainability class I developed."

Chuck Rosenwasser '06 ▶

Design at Play

It's not all fun and games for Wonder Workshop VP of hardware **Chuck Rosenwasser '06**. He is responsible for delivering the next generation of engaging and educational robots for the maker of Dash, Dot, and Cue. Rosenwasser, who studied mechanical engineering and fine arts at Dartmouth and product architecture and engineering at Stevens Institute of Technology, points to three phases of any development plan. "In the nascent stages, product definition is the central

TOP: JOHN SHERMAN; BOTTOM: MELANIE ROSENWASSER

On the Job

MAX FAGIN TH'11 | SPACE STATION ENGINEER

"I'm ultimately here because I want to put people in space and eventually join them."

COURTESY MAX FAGIN

Fagin's trajectory in space exploration has taken him from space vehicle design at NASA Ames and SpaceX to on-orbit satellite manufacturing at Made In Space and now to Blue Origin. There, he working as an aerospace systems engineer on Orbital Reef, a commercial space station designed for launch to low Earth orbit.

What are some of the skills you need to succeed in such a tremendous undertaking?
You need at least a passing familiarity with everything that goes into building a crewed spacecraft—not enough to be an expert in everything, but at least enough to know the right questions to ask the right people. Thayer was the perfect place to get that "bit of everything" engineering background. I eventually specialized in astrodynamics and spacecraft trajectories in grad school, but most of my day-to-day work is still more conventional engineering, just applied to spacecraft—design trades, materials, power budgets, spreadsheets—the nuts-and-bolts kind of stuff that I learned in the machine shop or in the CAD lab at Thayer.

What aspects of your position engage you?
I'm exhilarated to be working on human spaceflight again! The past five years I'd been working on satellites and un-crewed spacecraft. I learned a lot about the industry and really appreciated the work, but I'm ultimately here because I want to put people in space and eventually join them. It's great to be on a project where humans are a part of the equation again instead of just robots and machines.

Has there been anything unexpected as you've advanced through the industry?
I've been continually surprised at how everyone working everywhere in human spaceflight—be it government or private sector, big company or small—has the same passion for the mission. Even between groups that are nominally in competition, there is still a camaraderie and a sense that a win for one is a win for all. That's even true across national borders.

What do you see on the horizon?
A continuing trend toward private companies taking over the task of living and working in space, opening up markets and industries in space that didn't exist before, and freeing up NASA to focus on the horizon pushing exploration activities beyond Earth orbit again.

effort," he says. At part of an effort to understand potential markets and users, he brings in testers—usually kids ages 6 to 12—to get their hands on initial designs. In the next phase, Rosenwasser's team zeroes in on prototypes, "that more faithfully represent the eventual product in one or more aspects ('looks-like' or 'works-like'), while keeping a close eye on constraints such as design for manufacturability and cost." In the last step, production, he draws on his experience designing housewares and tools for OXO and then eight years advancing at Wonder Workshop. "I have been fortunate in my career to work with exceptional contract manufacturers who can move mountains to realize the aspirations set in the earlier phases." This hands-on approach has defined Rosenwasser's role at the San Mateo-Calif.-based firm. "When I first joined the company, we were frenetically pursuing the launch of our flagship robot, Dash," says Rosenwasser. "Those days were consumed with front-end design work, prototyping, and user testing followed by long stints in Asia to put the robots coming off the line through their paces. Nothing compares to the satisfaction of shipping a product in which you were intimately involved." He continues to advance the company mission to foster STEM education—now in more than 20,000 schools worldwide—and has jumped into new efforts beyond hardware design and manufacture. "The seismic impact to the global supply chain and the emergence of remote learning revealed opportunities in the edtech space to which we were previously unattuned," he says. "I've been able to throw myself into projects such as our robot simulator and robotics competition."

Wide Worldview

Industrial engineer **Sreevalli Sreenivasan Th'17** has a talent for moving with ease between countries, disciplines, and humanitarian efforts. Born and raised in Bangalore, India, she earned her undergraduate degree there before coming to Dartmouth for her MEM.

◀ **Tricia Mangan '19** (top), **A.J. Hurt '23** (bottom)

Outside the classroom, she served as a UN volunteer with NGO Tanzania Development Trust, which works to prevent female genital mutilation. "I helped them with open street mapping, looking at satellite images to identify roads and buildings to create maps for volunteers on the ground or for women who have to walk long distances to work or for water or anything else." As part of her Thayer studies, Sreenivasan interned at wind energy firm Vestas, which led to a role at Norwich Solar Technologies after graduation. Her passion for humanitarian work drew her back to India, where she and friend laid the groundwork for an NGO—Nourish—focused on the issue of malnutrition among young children and pregnant women. "India has a large young population and one of the highest malnutrition rates, with an estimated 25 percent of the world's population of hungry people," says Sreenivasan, who is taking a systems approach to the problem. "We want to make sure we meet the World Health Organization's guidelines for nutrition by setting up a network of volunteers and medical teams to assess the need for supplements, medicines, and care in free medical camps." Not surprisingly, she is also pursuing skills that will enable her to do even more. She recently enrolled in Thayer's PhD program to study the issue from an operations perspective with Professor Geoff Parker. "He says you can take multiple different tracks and see which one you lean toward," says Sreenivasan. "That gives me flexibility for what to focus on, which is fantastic because I have so many different interests."

—Catha Mayor Lamm

"Biology and engineering are coming together in profound ways."

—DREW ENDY TH'98

Olympic Glory

Two engineering majors—**A.J. Hurt '23** and **Tricia Mangan '19**—were among only 11 women who competed for the United States in alpine skiing at the Winter Olympics in February. Mangan, who graduated with a degree in biomedical engineering in 2021, was a two-time first-team All-American for the Big Green in the giant slalom. In Beijing, China, she was the top U.S. finisher in the women's alpine combined downhill, moving to 11th overall after finishing eighth in the slalom and 20th in the downhill run. First-time Olympian Hurt came into the Games as Ski Racing Media's 2019 and 2021 Female Junior of the Year. She placed 34th in a field that saw 38 of the 88 skiers fail to finish both runs for women's slalom, and says she likes to push herself to the edge: "If you're in control, you're not going fast enough."

Saved by Synthetic Biology

Stanford bioengineering professor **Drew Endy Th'98** believes organisms can be redesigned for useful purposes. A star in the emerging field of synthetic biology, Endy is focused on using the transformational technology to feed the planet, combat pollution, and conquer disease. Case in point: Synthetic biology was used to accelerate the production of Covid-19 vaccines. Endy's optimism stems from the advances in the underlying technologies for synthetic biology—gene sequencing and DNA synthesis. As

GETTY IMAGES

in computing, biological information is coded in DNA, so it can be programmed. By taking an engineering approach—with reusable parts and automation—Endy aims to make such programming and production faster, cheaper, and more reliable. "Biology and engineering are coming together in profound ways," he tells *The New York Times*. "The potential is for civilization-scale flourishing, a world of abundance not scarcity, supporting a growing global population without destroying the planet." And he points to the money flowing into the field. "For the first time ever, synthetic biology companies are on the verge of making money instead of consuming money," says Endy. *The Times* reports synthetic biology companies raised $9 billion from venture capitalists and initial public offerings worldwide in the first half of 2021, more than the amount raised in 2020. Rather than a new industry, synthetic biology may be a sweeping force that can reshape the sciences, society, and culture. "It's an expression of human intention in partnership with nature," he says. "We're speaking with life."

Coding Crusader

Named one of *MIT Technology Review*'s "35 Innovators Under 35" for 2021, **George Boateng '16 Th'17** is on a mission to democratize science and technology education across Africa using smartphones and artificial intelligence. His latest venture, SuaCode.ai, emerged largely by accident. In 2013, as an undergraduate at Dartmouth, Boateng teamed up with friends to launch an ENGS 21-like innovation boot camp for high school students in their native Ghana. When the donated laptops they'd gotten for the course broke down, they were in a fix: Only a quarter of the students had laptops of their own. All the students, however, had smartphones—so Boateng and his colleagues redesigned the coding module to fit a 5-inch screen. The experience went so well that it hatched a spinoff. In 2018, Boateng and cofounder Victor Kumbol ran the first pilot of SuaCode, an eight-week smartphone-based course that teaches Processing, a Java-based language. The course now has more than 1,000 graduates from two dozen countries. Boateng, a PhD candidate at ETH Zurich, Switzerland, continues to advocate for early exposure to STEM fields and recently released the smartphone-based coding app on Google Play Store. This spring, he is a visiting researcher at the University of Cambridge working on issues around health and remote education. "I'm leveraging computer science and engineering to solve real-world problems," he says. "It's not just about publishing papers—it's about impacting people."

▼ George Boateng '16 Th'17

RAENG/GGIMAGES/FRANCIS KOKOROKO

On the Job

HANNAH MURNEN '06 TH'07 | MANAGING DIRECTOR

Murnen is leading Activate Anywhere's nationwide effort to enable science entrepreneurs to bring innovative research to market. The nonprofit provides fellows—such as **Grayson Zulauf '12 Th'13**, who cofounded Resonant Link with Professor Charles Sullivan—with salaries, R&D funding, and mentors to help them launch startups to address global challenges. It's an effort Murnen believes could change the world.

What was the impetus behind Activate?
It's really hard to reach commercialization in hard technology—whether it's chemicals, materials, hardware, etc. There's a gap between the science and commercial readiness that makes it hard to obtain capital—it's a long, risky road. Activate invests in people and helping them take their science or technology to commercial reality.

What qualities do you look for in your fellows?
There are a number of factors. Certainly, there is the technical feasibility and potential impact—we want to fund things that are world-changing—and whether they are able to make that transition from scientist to entrepreneur. Are they somebody who's thoughtful about how to build a team? Are they able to understand the techno-economics around taking a technology to commercial application? Are they coachable? Finally, a big part of selection is whether they can be a good community member. A lot of what Activate does is bring fellows together to support one another, so they have to buy into the idea that they're there for each other.

What is your vision five years out?
This first set of eight to 10 fellows I'm bringing in now will be well on their way. They'll be scaling up, sending out commercial systems, and IPO-ing and getting bought, and be wildly successful in changing the world. The other piece I find exciting is making this ecosystem more accessible. I'm hoping we'll have made this support available to a much broader set of science entrepreneurs and created a road map for building companies across the country.

Pushing Beauty Boundaries

Esi Eggleston Bracey '91 created Febreze, provided new direction to CoverGirl, and now oversees iconic brands such as Dove, TRESemmé, and Suave in North America for Unilever. But the engineering sciences major was more into math than makeup while growing up. She undertook engineering internships with Motorola Solutions Inc. and Argonne National Laboratory before a recruiter from Procter & Gamble (P&G) introduced her to a consumer products career requiring problem solving, leading teams, and understanding what makes people tick. "It was like a lightbulb went off," Bracey tells *The Wall Street Journal*. "I thought: 'Wow I am quite interested in this.'" During the course of 25 years, Bracey advanced to senior VP and general manager of global cosmetics for such brands as CoverGirl and Max Factor. When Coty bought P&G's beauty division in 2016, Bracey served two years as president of consumer beauty at the $3.5-billion global cosmetics firm, then became the first Black female head of beauty and personal care for Unilever North America. She also embraced the opportunity for activism, helping advance the CROWN (Create a Respectful and Open Workplace for Natural Hair) Act, which has passed in several states and has been introduced in the U.S. Congress. "There has also been a significant expansion in the brands and entrepreneurs that are participating and succeeding in the beauty—in particular from Black, brown, and female founders," she tells *The Suite Sheet*. "It's good to see the progress, but there still is a long way to go for beauty industry to reflect the full spectrum of beauty and diversity that we see in America."

On the Job

PATRICK MCCARTHY '04 TH'06 | TELEHEALTH SERVICES

As assistant vice president of telehealth services for Northwell Health in New York City, McCarthy had to adjust quickly when the pandemic drove exponential growth in ambulatory telehealth. He also found a silver lining: "It showed patients and providers that not everything requires an in-person visit and we can provide a blend of in-person and remote care."

What type of growth have you seen in telehealth in the past year?
We went from a couple hundred visits a month to a peak of more than 4,000 a day. We have leveled out and are now seeing about 1,000 a day, which is somewhere between 5 to 15 percent of our ambulatory visits on any given day. We don't use telehealth to bring in new patients, but it may help attract patients to the system as a way of receiving ongoing care. Most of the growth was driven by COVID, in that it reduced a lot of the restrictions around reimbursement and coverage for telehealth visits.

How have you adapted to meet this demand?
Luckily, we had been building for this and have an integrated solution with our core systems. We had also worked with our telehealth vendor to create a lightweight version that allowed us to scale quickly to meet the immediate spike in demand as we moved all practices to the integrated solution. There are a lot of challenges still related to telehealth—universal access to broadband and internet connectivity, patient and provider adoption, reimbursement may still be a challenge moving forward, and on and on. That said, there is definitely patient demand for this service, and it just makes sense to push through and provide this type of care.

How do you anticipate telehealth will change the landscape moving forward?
I think it will be a portion of our ongoing care, but I don't see telehealth replacing all in-person visits. Maybe 10 to 20 percent of ambulatory volume could and should be done via telehealth. We are going through and examining what makes sense clinically to continue to do via telehealth and which visits really should always be done in person.

COURTESY PATRICK MCCARTHY

I GIVE TO THAYER BECAUSE

"I want to support the next generation of students in cultivating the curiosity and confidence to pursue meaningful careers and develop innovative technologies that have a positive impact on society."

—JULIE ANN HALDEMAN '14 TH'14
THAYER SCHOOL ANNUAL FUND SUPPORTER

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SAVE THE DATE

DARTMOUTH REUNIONS AT THAYER:

- **JUNE 10, 2022**
  50TH RECEPTION WITH THE CLASS OF 1972
- **JUNE 14, 2022**
  CLASS OF 1962 BREAKFAST
  REUNION RECEPTION WITH THE CLASS OF 1971
- **JUNE 17, 2022**
  RECEPTION WITH THE CLASSES OF 1976, 1977, 1978, 1992, 1997, 2006, 2007, 2008, AND 2017

THAYER SCHOOL OF ENGINEERING INVESTITURE:

- **JUNE 11, 2022**

CELEBRATING THE CLASS OF 2020:

- **AUGUST 5-7, 2022**

DARTMOUTH HOMECOMING:

- **OCTOBER 28-29, 2022**

Gallery

1. John Kunz '65 Th'66 works with a former student on startup Alice Technologies.
2. Scott Lacy '13 Th'13 races for the U.S. national biathlon team.
3. Richa Karve Th'19 married Himanshu Damle, a veterinarian surgeon working for the Indian Army.
4. Now that he's retired, Mark Bunker '82 Th'83 enjoys spending more time with grandson Michael.

thayer notes

| 1940s |

Kendrick Kelly '47 Th'48: I'm 95 now, and I look back fondly at an interesting and exciting career working as a civil engineer on interesting and exciting large construction projects all around the United States and Europe. One of my kids was born in Rome and one in London. A few interesting jobs I worked on as a project manager included a 41-floor office building for IBM in New York City. Building a large structure always presents some problems—and building one in the middle of a large city certainly adds more! In my career I was also assigned to build a large petroleum storage facility on the coast of Greece near Athens. Greece had been through a world war and a civil war and was not in good shape. Getting permits, steel for the tanks, and the special valves and equipment that was needed was quite a problem. Another assignment sent me to the Scottish Highlands to construct a huge antenna system. Our site was not far from a mountain stream, into which we had to make sure we didn't leak anything because it was the source of water for a scotch distillery south of our site. The role of project manager was interesting, because in addition to dealing with engineers, architects, and contractors, I had to interact with lawyers, financial folks, government entities, and others. It was like putting together a giant puzzle—with a lot of money involved. Something I liked about Thayer School was that, in addition to having excellent professors, the faculty were usually available to meet and discuss any technical problem I was having.

| 1950s |

Jerry Allyn '59 Th'60: My career as a practicing, wage-earning engineer ceased as of January 1, 2003. My final years before this were spent primarily on personnel and technical business management issues, and I became burned out. One thing I could have used in my Thayer School education was more research findings in this complicated field of management. There's no question that graduates of Dartmouth and Thayer School soon are placed in management positions because of their broad education. I prize my Thayer School education, along with my exposure to liberal arts in my Dartmouth College courses. I continue to believe that well-rounded engineers are worth their weight in gold. Typically, they can write well, express themselves well, and embrace complicated topics. They become effective spokespersons for their organizations. However, in such positions they are asked to deal with situations that often don't have resolutions that are embraced by all members of their organizations and resistance can occur. How to continue effective management in the face of such resistance is a challenge. Reinforcement by upper management isn't necessarily a given. I'll bet that Thayer could come up with some courses that could prepare graduates for their eventual and likely introduction to the realities of management. This is important. Life after January 2003 has been busy with family, church, music (singing), outdoor sports including sailing, and property management of my 10-acre plot of home, yard, and woodlands. I am 84 years old and enjoying life. Periodically, I have found myself back in the engineering field. One example was the repair and rebuild of the roof supporting trusses in our 1835 brick church in Colchester, Vt. Two of the trusses had begun to fail and couldn't be easily fixed. I worked with a licensed civil engineer who had expertise in old buildings and explained our proposed rebuild—and cost—to our congregation. The project obtained approval, and the result is two rebuilt trusses and six new steel lintel supports for our big stained glass windows, plus a new raised seam steel alloy roof. The repairs and improvements have been very successful, and the church is now good for another 100 years or so.

| 1960s |

John Kunz '65 Th'66: I serve on the board of Alice Technologies, a start-up that has developed an artificial

intelligence-based tool that creates schedules for building projects that minimize cost, schedule, and other risks. The tool is now used in the United States, European Union, and Asia. The founder is a former student of mine from Stanford, where most of the courses I taught covered computer and social methods of modeling and collaboration for building design and management. I challenged lots of civil engineering students to look at a project being built, count the number of workers they saw, and compare that number with the number of occupants the project will have when complete. (Construction projects are mostly empty.) One student took the question seriously, measured utilization of workspaces on two projects, and observed that the hourly workspace asset utilization was about 7 percent! My next question was whether anybody cared about that low asset utilization. This question led to his using AI to generate schedule options—and found Alice. We are now working to get another round of investment, and I have been leading the planning of broad goals and specific objectives for the company. The work is challenging and fascinating as we work to bring highly specialized recommendations to practitioners who, by longstanding tradition, follow a judgment-based practice in this field, which is inherently and appropriately risk averse.

Mark Tuttle '65 Th'66 Th'68: For the first time in my life, I am officially aligned with, and supporting, an artificial intelligence (AI) effort—specifically on the scientific program committee as a reviewer of the submissions—for the American Medical Information Association's 2022 Artificial Intelligence Evaluation Showcase. I am not aware of any systematic, scalable, formal "evaluation" efforts for artificial intelligence, and certainly not in healthcare. Under this program, one doesn't get to present work on AI in healthcare and biomedical research this fall at the national meeting without an evaluation. The key is the focus on evaluation—in this case, the actual influence on patient care. This is both novel and important—and the reason that I accepted an invitation to be on the review committee. Throughout my education and professional life, I've been in too many contexts where AI consumed all the oxygen in the room, while the rest of us were trying to do what I call "real work." At the time, as one colleague put it, AI was "wishful thinking." With clarity of hindsight, non-AI work was focused on data—the growing amounts of it—and increasing access to computing resources. After decades, data proved to be the key to success. AI was started in a meeting at Dartmouth in the summer of 1956. By the mid-1960s, ripples hit Thayer School. I got to work on printed digit recognition, which was successful (sort of), and on spoken digit recognition, which was not even close to being successful. These projects and the study of statistics, information theory, and decision analysis enabled me to understand what would be easy or hard going forward with information processing tasks. Later, in graduate school at Harvard and MIT, I got to see various academic "wars" regarding AI research and development. Much later, quietly but suddenly, efforts began to leverage huge online data sources and heretofore inconceivable amounts of computing resources to make dramatic progress. All of a sudden, AI was being built on a foundation of data science. Today, most AI is machine learning, and most machine learning is "deep learning." These insights and lessons have been slow to penetrate healthcare and biomedical research, but with the Artificial Intelligence Evaluation Showcase, it's now happening.

1970s

Steve Askey '76 Th'77: I retired in 2015, for the second time, after 38 years in the upstream oil and gas industry and living and working in various parts of the world. A different path to be sure, but quite a ride. I currently live in Ormond Beach, Fla. Since retirement, I've been playing lead guitar in a classic rock bar band in the Daytona Beach area. I also play with an acoustic trio occasionally. I wanted to send a shout out to Wayne Ballantyne '77 Th'78 after reading his notes in the Fall 2021 issue. Wayne and I were both from south Florida. I had a 1966 Mustang, and he would occasionally ride down to Florida with me during breaks. It was always an adventure, and we were never sure if the car would make it. Finally, I also noted the obituary of Professor Stratton in that issue. While there were many brilliant professors at Dartmouth and Thayer at the time, Professor Stratton may have been the best of my entire Dartmouth experience. His ability to make the material clearly understandable, the classes and labs fun, and have me looking forward to the next class was truly motivating, as I was not the best of students. The fact that he seemed to do it effortlessly was certainly a testament to his expertise as an engineer and, perhaps more importantly, as a teacher. Those of us who had the opportunity to attend his class were fortunate indeed.

Michael Geilich '79 Th'81 Th'82: When COVID hit, I tried to retire, but it didn't quite work out. Today, I'm splitting my time writing software remotely for Edare in Lebanon, N.H., and playing music with friends.

1980s

Laurie Komornik Hartman '80 Th'80: I retired after 17 years of pastoral care ministry at a large church in the Indianapolis, Ind., area. The problem-solving skills I learned at Thayer translated quite well into working with people—especially those with complex trauma. I still volunteer in this area. My husband, Mark '78, and I celebrated our 42nd wedding anniversary. We enjoy travel, our three married children, and our five grandchildren.

Herbert "Buddy" Livingstone '81 Th'84: Winter break from college can mean only one thing: some field work with my twin sons, Ryan and Dylan, to study snow-snowboard friction properties at altitude, not to mention the effect of temperature on board stiffness and camber.

Mark Bunker '82 Th'83: I retired from corporate life last July after worked at Fidelity Investments in Boston for 25 years. I held a number of positions in technology management. On retiring, I was head of data security for the chief information security officer. The position I was most proud of was my three years previously as head of digital security when my team and I safely transitioned Fidelity data and applications into the public cloud. I managed an international team of cyber-security experts and developers charged with designing, coding and deploying automation to constantly check the security status of Fidelity applications and customers in the cloud. Our automation would flag or autonomously correct misconfigurations or weak protections in real time. This is the only way to thwart never-ceasing and ever-evolving cyber-security threats across such a large digital footprint (thousands of applications, millions of customers, and several trillion dollars in personal and corporate assets). Our team also was charged with protecting billions worth of cryptocurrency held by institutional clients. We developed elaborate operational procedures (similar to rules for operating nuclear power plants) for moving crypto assets in and out of digital vaults. The engineering involved was complex: human factors engineering, triple-backup procedures, software coding using blockchain technology, and automated cyber forensics. Dartmouth and Thayer School prepared me how to tackle such complex problems, breaking them down and solving them through deep investigation, learning, subject mastery, collaboration and teamwork, and being open to new ideas and course correction when needed. These days, my wife and I are spending lots of time with family, enjoying our first grandchild (born last May), and preparing for our son's spring 2022 wedding. I've started volunteering in the Boston Public Schools as a math mentor and tutor and for the Mount Washington Observatory as a fundraiser and part-time official weather observer for North Conway, N.H. More free time has also allowed me to spend more time playing, composing, and performing music—something that really brings me joy.

| 1990s |

Brian Stenger Th'97: I currently live in Ann Arbor, Mich., with my wife, Cathleen. We have been married for 20 years and have two amazing kids, Peter (18) and Anna (15). I recently changed careers, moving into real estate investing, primarily purchasing, renovating, and renting our single-family and multi-family homes in the metro Detroit area. Previously, I worked at TIAA as a senior director of strategic sourcing in Davidson, N.C. We moved up to Ann Arbor three years ago to be closer to family after my father was diagnosed with pancreatic cancer. During these three years, I actively invested in Detroit, purchasing, renovating, and renting out 10 homes in about a year and a half. It seemed to be going well. In the early stages of the pandemic, my employer offered all employees a package to reduce headcount, which became the impetus to take that package and start my own business. In January 2021, I took the leap of faith and went into it full time with the support of my wife. The goal is to have 50 rentals in five years, so about three years after my first purchase, I'm about one-third of the way there and hoping to grow by another 10 by the end of the year if all goes well.

| 2000s |

Brian Mason '03 Th'04 Th'05: Jocelyn '05 and I continue to make Lexington, Mass., our home—and we are trying to get outside a lot in the winter. Just recently we were up at Wildcat in New Hampshire and had views of Tuckerman's Ravine in the distance. It made us think back 20 years ago to when Jocelyn and I first met and skied Tuckerman's. I continue to be in the same job, leading new product development at Sonos. We look forward to getting up to Hanover soon. Our kids believe that Molly's is the best restaurant in the entire world!

| 2010s |

Umair Siddiqui '10: I have had a very busy year! Our company Phase Four, which is developing a new propulsion system for satellites, has delivered its first units to customers, which have been launched into space on SpaceX missions. We now have six propulsion systems orbiting the earth on our customers' satellites, with several more launching in the first half of the year. As Tech Crunch reported: "Phase Four aims to roll out its next-gen plasma thruster in the first half of 2022." Our investors include Green D Ventures.

Scott Lacy '13 Th'13: I am currently racing again full time and finally qualified to race for the U.S. national biathlon team for the winter in Europe. It has been absolutely wonderful. So far, we have raced in Norway, Germany, Slovakia, and the Czech Republic and will be continuing on to Austria, Italy, and Switzerland to finish the season out. Then I'll take some much needed at home time this spring before summer training begins.

Evan Landau '15: I have updates on some projects I've been working on as a freelance industrial designer. The first is a product designed in collaboration with Ryan Lisann '15, now a dentist and avid outdoorsman. The Packbrush is a dental hygiene multitool developed specifically for campers and backpackers, but it is a more sustainable way to take care of your teeth with its re-threadable flosser and replaceable brush heads. The product is patent pending, and we're seeking out investors/financial backers to help tool and manufacture a first production run. The other project I'm working on is with a carbon-capture research and development group called OpenAir. I'm using my experience with 3-D printing, design, and sustainable materials and manufacturing to help experiment with adding air-sourced carbon to different plastics and creating products with them. The purpose of this is to develop materials suited for mass manufacturing that can be a scalable endpoint to sequester atmospheric CO2 within—keeping it out of the air and doing a small part in removing the gigaton of carbon necessary to have a real impact on climate change. The ultimate goal of the research is to explore additional manufacturing materials that carbon can be realistically sequestered within to broaden the variety of carbon-storing products beyond plastics, concrete, and fuel.

Kate French '19 Th'20: I am currently a first-year medical student at the Larner College of Medicine at the University of Vermont in Burlington, Vt. While I am very busy, I still try to ski any chance I get!

Richa Karve Th'19: I studied electrical engineering as an undergraduate in India and interned at a couple of power plants. Those internships drew me to the power industry at large. Post-undergrad, I worked with an energy consulting firm, which directed me toward Dartmouth's MEM program. MEM allowed me to stick with engineering/quant while expanding my skills in management. Professor [Ronald] Lasky's Optimization course and Professor [Vikrant] Vaze's Operations Research course turned out to be some of my favorite and foundational courses during MEM. They shaped my internship with Tabors Caramanis Rudkevich in Boston. I spent a lot of time working on economic dispatch models that represent, simulate, and forecast the power grid. The entire process from inputs to application of model outputs is quite fascinating! After completing my MEM, I moved to Denver in early 2019 and worked with an energy consulting firm, Filsinger Energy Partners (FEP), where my primary role was modeling and forecasting of the U.S. power market. After working at FEP for almost three years, I've recently moved back to India and will be staying and working near our capital city of New Delhi. I haven't figured out my job in India yet—all I can say is I'm very much looking to continue in the power industry and hoping to leverage my Dartmouth and U.S. education in the market here. I hope I'll be able to continue modeling.

Kayla Wormsbecher '21 Th'21: I have moved to Huntsville, Ala., and am working for IDEX Corp. as a mechanical engineer. After playing hockey at Dartmouth, I am now volunteering with the local minor hockey association to show both girls and boys that hockey is more than just a game—and in fact, develops character and provides opportunity for growth.

obits

Joseph A. Baute '52 Th'54 died at his home in Surry, N.H., on September 6, 2021. Baute came to Dartmouth from the U.S. Marine Corps, having enlisted after high school and serving two years. He was discharged with the rank of sergeant in 1948. Baute began his undergraduate studies but was called back into the Marine Corps to serve during the Korean War. He was stationed at the Great Lakes Naval Training Station and at the San Diego Marine Corps Recruit Depot until discharged as a staff sergeant. He returned to Dartmouth to earn his AB in engineering sciences and master's in mechanical engineering. Baute then moved to Keene, N.H., where he began a 39-year career at Markem Corp., starting as an engineer and retiring as Markem's chairman and CEO in 1993.

W. George Krall '53 Th'55 passed away on October 31, 2021, in Hilton Head, S.C. After earning his AB in engineering sciences and master's in mechanical engineering at Thayer, Krall began a 35-year career at General Electric. He joined the company's manufacturing management program in 1955 and eventually moved to the aircraft engine group (now GE Aviation) in Cincinnati, Ohio. He was appointed vice president and general manager of aircraft engine manufacturing in 1980, a position he held until his retirement in 1991. He oversaw nine manufacturing plants, 21,000 employees, and the production of thousands of jet engines for a wide range of commercial and military aircraft. George was a director of the Advanced Manufacturing Sciences Institute and was elected to GE's Propulsion Hall of Fame in 1996.

William B. Macurdy '55 Th'57 of Falmouth, Mass., passed away August 18, 2021. In Hanover, he competed on the men's ski team, received the Charles F. and Ruth D. Goodrich Prize for high academic achievement at Thayer, and earned his AB in engineering sciences and his master's in electrical engineering. He went on to receive another master's in electrical engineering from New York University and a PhD from the Massachusetts Institute

of Technology in 1963. He began his career with Bell Laboratories in Holmdel, N.J., as an engineer and rose to become a senior executive for the company, worked as a vice president at AT&T in 1988, and retired as a vice president of software company Alcatel-Lucent in 1991.

Louis Coburn Turner '55 Th'56 of Falmouth, Mass., died on December 29, 2021. At Dartmouth he captained the football team and excelled academically, graduating Phi Beta Kappa with an AB in engineering sciences, earning the Barrett All-Round Achievement Cup, and receiving his MS from Thayer. Turner spent time as a counselor and director at Camp Becket in the Berkshires, an experience that inspired his 43-year career as an educator. He taught at Mount Hermon School, Athens College in Greece, and Western Reserve Academy. At the academy, Turner mentored many students and colleagues as a physics and astronomy teacher, supervised the design and construction of the Frost Observatory, and helped develop the physics curriculum.

Philip E. Coyle '56 Th'57, a senior science fellow at the Center for Arms Control and Non-Proliferation in Washington, DC, died on September 2, 2021. Coyle spent more than three decades working on nuclear weapons at the Lawrence Livermore National Laboratory in California, rising to associate director and deputy to the director of the lab by the time he left in 1993. He then spent seven years in the Pentagon as director of operational test and evaluation, an internal watchdog that oversees the testing programs of major military systems. Other career highlights included stints as associate director for national security and international affairs in the U.S. Office of Science and Technology Policy and as senior advisor to the president of the Center for Defense Information.

Ralph Fosdick Spencer Jr. '61 Th'62 of Salem, N.H., died August 23, 2021. He entered Dartmouth intending to study premed and shifted his career focus to electrical engineering, earning his BE from Thayer and a master's and PhD from the University of Pennsylvania. Spencer and his young family then moved to Dallas, Texas, so he could begin his career in the emerging computer industry. The family relocated several years later to Massachusetts, where Spencer spent the remainder of his career with Digital Equipment Corp. (DEC), which ultimately was acquired by Compaq Computer and then Hewlett Packard. Spencer semi-retired from his career with DEC in 2003 and continued to work as a consultant with Hamilton Technologies Inc.

William D. Gamble '62 Th'63 died of lung cancer at his home in Havelock, N.C., on December 11, 2021. He earned his AB with honors in engineering sciences with honors and a BE in electrical engineering, then served five years as a U.S. Air Force officer at the Rocket Propulsion Laboratory on Edwards Air Force Base. He worked as an instrumentation engineer on rocket engines with cryogenic and exotic fuels and monitored the electrical and electronic aspects of a military construction project for a new high thrust test facility. After retiring from the Air Force, Gamble spent 30 years in the spectrum management field with the U.S. government. He retired in 1997 as deputy associate administrator of the National Telecommunications and Information Administration's Office of Spectrum Management.

William W. Hale '80 Th'93 died November 28, 2021, at his home in Oxford, Mich. At Dartmouth, Hale was active in the Dartmouth Society of Engineers and earned an AB in engineering sciences. Hale worked on Wall Street and in London as a convertible bond trader for several years before returning to Dartmouth to earn his master's in engineering. He then moved to Oxford to begin a career in the automotive industry. In 2003 he again furthered his studies, this time pursuing a PhD in industrial engineering from the University of Minnesota. He was employed as a powertrain industrial engineering specialist at Stellantis (formerly FCA Group/Chrysler) at the time of his death.

DOUG FRASER

| in memoriam |

JOHN CURRIER '79 TH'81

— 1957-2021 —

Orthopedics work impacted millions of patients.

Currier, a longtime research engineer at Thayer School, died of cancer November 15, 2021, at the age of 64. At Dartmouth he competed on the cross-country and track-and-field teams, participated in student workshops, and earned his AB in engineering sciences and BE and MS in engineering, studying ice properties under Professor Erland Schulson.

Currier worked for 12 years in research and project planning for a petroleum company before returning to Dartmouth in 1994 to join the Dartmouth Biomedical Engineering Center for Orthopaedics. There, he studied polyethylene bearings in hip and knee prostheses, work that has helped improve the lives of millions of artificial joint patients.

But Currier may be most well-known for his role in the development of Mobile Virtual Player (MVP), the revolutionary virtual tackling dummy that has helped make football safer. In 2016 he cofounded what became MVP Robotics with Dartmouth football coach Buddy Teevens '79 and two former engineering students. The MVP, memorably featured on The Late Show with Stephen Colbert, is now used widely by teams across the NFL and college football and in the military.

"A central ethic of Thayer is that our value should be measured by the number of lives we've touched," says Professor Douglas Van Citters '99 Th'03 Th'06. "Consider this wisdom in the context of John's 25-plus years of selfless work with many hundreds of engineering students … family and friends." Dean Alexis Abramson echoes that thought: "For those of us who worked with him, John was more than a colleague. He was a beloved friend."

Currier—who is survived by Barbara, a senior research engineer at Thayer, and children Zachary Th'12 and Katherine—had recently returned to his childhood home in Danville, Vt. "We have moved to the family farm, where I grew up …. Life's a circle, after all. I still work at Thayer School and also at MVP Robotics. Now I get to add farming. Better to burn out than rust out!"

Collaborations

"Professor Lutz is adamant about student researchers taking an active part."

—EMMA HAZARD '22

Hazard (right) is helping minimize the impact of the emerald ash borer on forests in Corinth, Vt.

ELI BURAKIAN '00

Sensing the Ecosystem

Engineering and studio arts major Emma Hazard '22 has helped program, install, and maintain a network of sensors in a Dartmouth-owned forest in Corinth, Vt. Her work takes her to the computer, the workbench, and the woodland itself, which is under threat from the invasive emerald ash borer.

The 700-acre ash-heavy forest offers a rare opportunity to study the trees and surrounding habitat while they're still intact, says project leader David Lutz, a research assistant professor and lecturer in environmental studies. "Getting this far ahead of an invasive species and planning an experimental design well in advance is very novel."

Hazard, with Lutz's team, is exploring the ecological role white ash plays in forests and testing strategies for minimizing the impact of the emerald ash borer. It's complex work that requires an understanding of engineering, computing, environmental science, and ecology, which might scare off any number of seasoned researchers, says Lutz. "You have to be comfortable being stuck and finding solutions."

Hazard is learning new programming languages and building an app to collect, transmit, and filter environmental data from remote areas in real time. While some researchers love to put on hiking boots and bug spray, Hazard prefers the technical aspects. Nonetheless, she says, "It's always fun to be out there and definitely worthwhile."

The work draws expertise from a variety of research partners, including Cornell Lab of Ornithology, the University of Florida, the University of Vermont, and the US Forest Service, as well as Kevin Evans, Dartmouth's director of woodland operations. "Ecosystems are complex places … and casting a wide net is the key to success," says Lutz.

—Aimee Minbiole

@AbramsonAlexis

Thank you @BillGates for virtually dropping in on our Energy Sustainability course @Dartmouth @thayerschool today. You inspired our students to deliver on a shared responsibility to address climate change. As global citizens, they accept the challenge to be part of the solution!

@thayerschool

#DartmouthEngineering Professor @lizmurnane was interviewed by @XRDS_ ACM about integrating people-centered and planet-centered design. "As a human-centered technologist, having social impact comes before technical impact in my priority list," she said.

@thayerschool

Thayer grad students spent several months on the The Multi-disciplinary drifting Observation for the Study of Arctic Climate (MOSAIC) expedition.

#arcticstudies

@thayerschool

Dartmouth Engineering is among five STEM programs to earn a $100,000 grant from the Association of American Universities to create better models for evaluating under-graduate teaching.

#STEMeducation

@thayerschool

The Design Initiative at Dartmouth (DIAD) spon-sored a field trip to Boston for students interetsted in the intersection of design and social justice.

#socialjusticeeducation

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"Every aspect of the building is designed for how we teach and learn at Dartmouth. Everything—from the floors to the furniture and to the tools in every classroom—encourages connection, creativity, collaboration, and active learning."

DEAN ALEXIS ABRAMSON