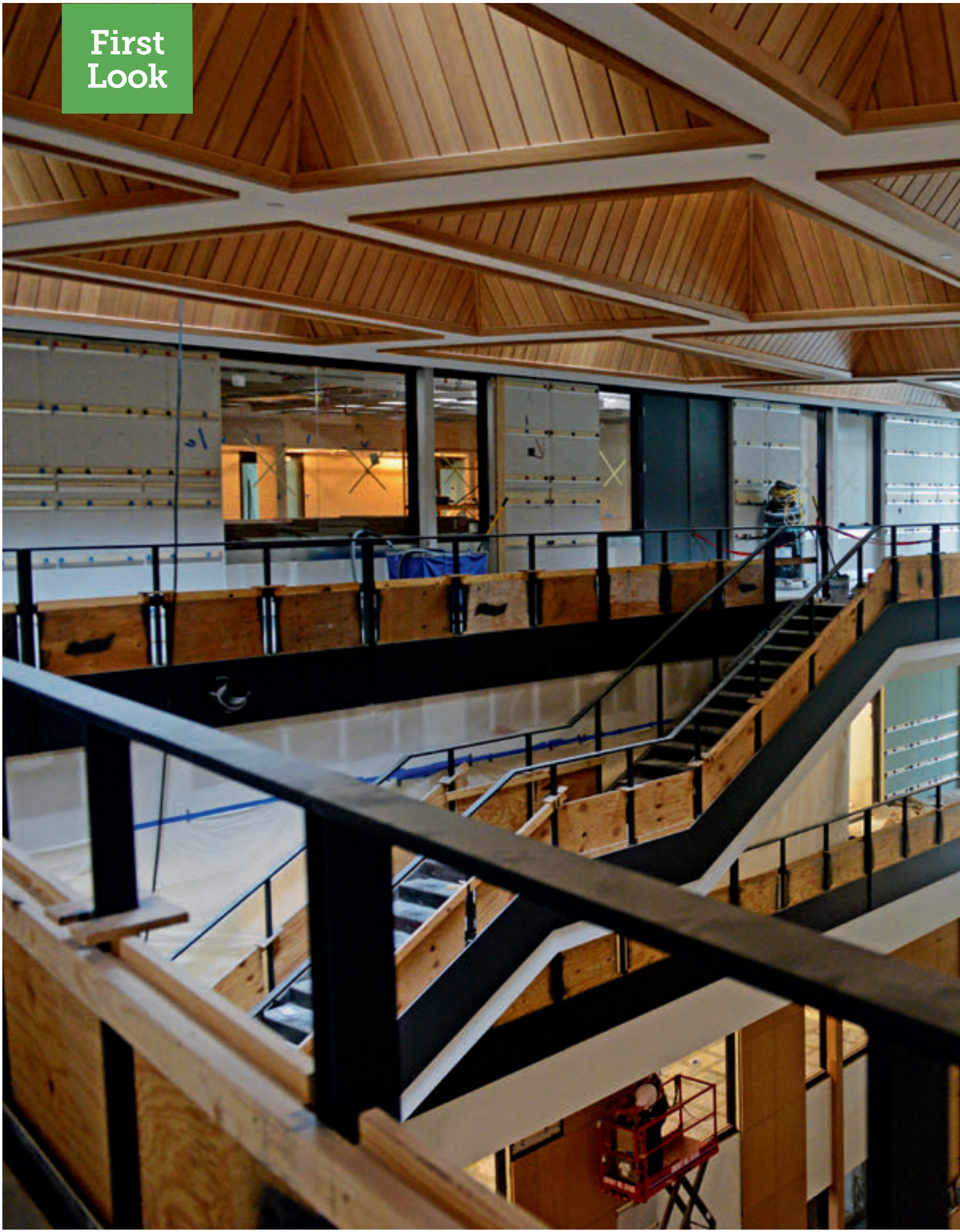
DARTMOUTH
Engineer
THAYER SCHOOL OF ENGINEERING | FALL 2021

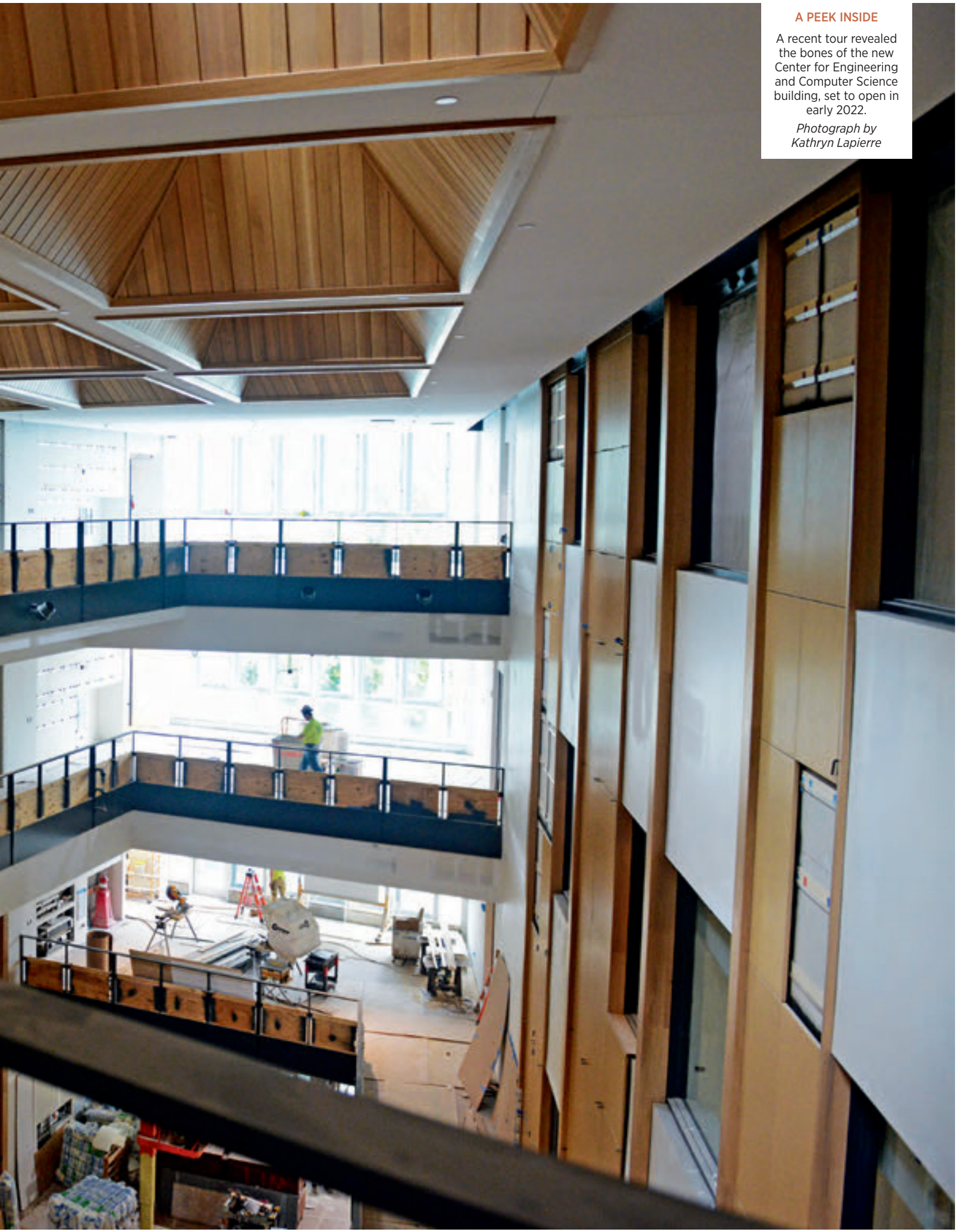
EVERY BREATH YOU TAKE

PHD CANDIDATE MARIA NYAMUKURU AND PROFESSOR KOFI ODAME USE "SMART" TECHNOLOGY AND MACHINE-LEARNING ALGORITHMS TO MONITOR RESPIRATORY DISEASES.

inside

First Look





A PEEK INSIDE

A recent tour revealed the bones of the new Center for Engineering and Computer Science building, set to open in early 2022.

Photograph by Kathryn Lapierre

Dartmouth Engineer
Volume 16 / Number 1

Contents

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

dartmouth.engineer@dartmouth.edu
Tel. 1+ (603) 646-0617
Fax: 1+ (603) 646-9133

Dartmouth Engineer Online
dartmouthengineer.com

Thayer School Website
engineering.dartmouth.edu

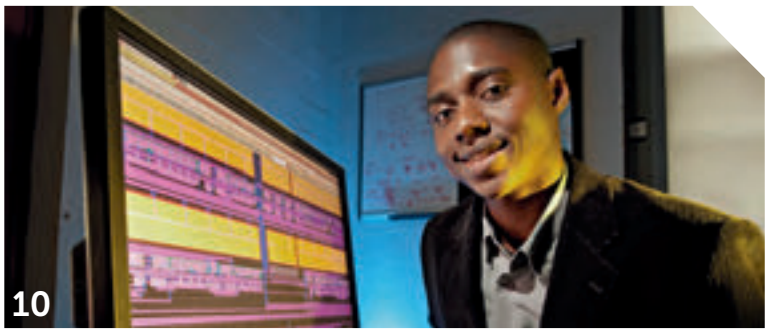
Report Address Changes
engineering.alumni.records@dartmouth.edu

DARTMOUTH ENGINEER
is published twice a year for the Thayer School of Engineering at Dartmouth community.

Printed by Villanti Printers

MIX
Paper from responsible sources
FSC® C013435

➤ For their "Engineering Design Methodology and Project Initiation Course" (ENGS 89/90), students connect a missing section of the Concord-Lake Sunapee Rail Trail with the natural environment.



DEPARTMENTS

COVER:
Photograph by Lars Blackmore

THE Great Hall

NEWS FROM AROUND THAYER SCHOOL

Leading Thoughts

Alexis Abramson | Dean

AT DARTMOUTH, OUR DISTINCTIVE HUMAN-CENTERED APPROACH TO engineering empowers students to learn, discover, and innovate with a singular purpose: improving lives and bettering our world. As dean, I have a unique vantage point to witness how we live out these values every day, both within Thayer and across Dartmouth. This new conversation series aims to amplify our community's voices and the human-centered work that drives the solutions to some of the world's most complex challenges. We're kicking off the series with Professors Sol Diamond and Eugene Korsunskiy, co-leaders of the new Design Initiative at Dartmouth who work to bring the power of design thinking and human-centered design to all corners of campus.

CAMPUS CONVERSATIONS

Dean Abramson (center) talks with professors Eugene Korsunskiy (left) and Sol Diamond (right).

What does "human-centered engineering" mean to you?

SOL DIAMOND: Human-centered engineering requires us to take a fresh look at the role of engineering in society and the profound impact of our work—beyond stakeholders to surrounding communities and to society at large. It brings in questions about morality, ethics, and justice in ways that engineering alone may neglect.

How does design fall under the umbrella of human-centered engineering?

EUGENE KORSUNSKIY: Everything around us, all our experiences, is designed. If everything we come into contact with is created by humans for humans, then we are agents. As agents, we have the power to engage in this critical examination and improve the lives and experiences of all creatures on the planet through engineering and the design process.

Can you think of recent examples where you've seen this human-centered design process play out?

DIAMOND: Students in ENGS 89/90 partnered with a company to design an optical sensor to monitor the effectiveness of ultraviolet light in sterilizing the air in HVAC systems. The team started with the technical specifications and then considered the broader impact, engaging in a different kind of conversation. What HVAC systems are suitable for outfitting or retrofitting with UV purification technology? Can it work on aging systems in underfunded communities? Who ultimately benefits? Who is left out? The students asked hard

questions. This process profoundly influenced their understanding of the role they play as engineers.

What's the most important thing you want students to take away?

KORSUNSKIY: I want students to walk away with a steadfast commitment to collaboration across disciplines. No matter how smart or deep an expert you are, your one brain is not going to be enough on its own. Engineers need anthropologists, marketing experts, doctors, and environmentalists. At these intersections, you generate new, exciting ideas.

DIAMOND: I want students to ask, "What is the role of this technology in society? What are the ramifications of our work? How do we make our world truly better for everyone?" As engineers, we follow a professional code of ethics, but human-centered engineering elevates this beyond mere compliance to deep reflection. I want students to start a habit of personal and professional reflection that carries through their careers.

It's 2030. The Design Initiative at Dartmouth is wildly successful. What does that look like?

KORSUNSKIY: Every person at Dartmouth—students, faculty, staff—sees themself in this initiative. Dartmouth becomes a place where design thinking, engineering, and the liberal arts exist as a beautiful tripartite.

DIAMOND: Dartmouth is recognized as the leading brain trust for design, a full-solution space for society's complex challenges that leverages the sciences, arts, business, medicine, and the humanities.

OPPOSITE PAGE: KATHRYN LAPIERRE. THIS PAGE: ISTOCK

ASK THE EXPERT

Energy Transformation

AT THE ARTHUR L. IRVING INSTITUTE FOR ENERGY AND Society's inaugural "Investing in Our Energy Futures" conference this spring, Dean Alexis Abramson engaged leading energy experts and thought leaders in a conversation about emerging energy technologies and the path forward to a sustainable energy future. Below are highlights from the event, hosted by Irving and Thayer's "Great Issues in Energy" series.

On Emerging Technologies

Darren Peers '96, Analyst, Capital Group: "We're at an interesting intersection where technologies—on-shore wind and solar, nature-based offsets, carbon capture and sequestration, renewable fuels, renewable diesel from waste cooking oils, battery technology, off-shore wind, electric vehicles—are economical or very close to being so. And with government help, we can continue to bring down the cost curve. It will take a myriad of solutions to truly tackle emissions during the next number of decades."

On How Innovations Have Shaped Policymaking

Brad Plumer '03, Climate Reporter, *The New York Times*: "Fifteen years ago, when I started covering climate policy, the idea was that Congress would pass a climate plan, fund research, and technology would solve the problem. Those bills never passed. But through time—thanks to state and local efforts, engineers, and private companies and innovators—clean-energy technologies have emerged. Utilities pledge 70- to 80-percent emissions reduction even without government mandates, and states reach for 100-percent clean electricity. It has completely changed what companies set as goals and what policymakers are willing to talk about."

On Energy Equity

Abby Ross Hopper '93, President and CEO, Solar Energy Industries Association: "We have to ask, 'Who enjoys the benefits of clean energy? Who is creating wealth in this energy revolution? How do we center the communities impacted, but often not included, in these conversations?' That's a different way of setting policy priorities and engaging communities, empowering them, and seeing them as full partners. I see the opportunity to be intentional about how we share the benefits of this clean-energy job transition and make sure that the diversity of our energy workforce reflects the diversity of our country."

Peers: "A billion people in the world don't have electricity today, and another 3 billion have no access to clean fuels for basic things like cooking. As we go through these transitions, some clean-energy solutions will cost more, and this will continue to create tension and inequity. If we're not aware of this and the implications for those who are struggling just to pay the rent, we set ourselves up for failure. How do you split equitably the cost of this transition? These are complex issues, for sure, but an important policy debate and a huge challenge we have to tackle during the next decade."

On How We Get There

Peers: "There is tremendous capital being deployed into clean energy, both at an investment firm level and at a corporate level—billions of dollars into off-shore wind, hydrogen, biofuels, direct-air-capture technologies, and so forth. I'm optimistic that we will continue to reduce cost in all of these solutions."

Tom Kiernan '81, CEO, American Rivers: "And when we have a clearer, more definitive policy about where we're going, that will bring even more investors and even better returns. We also need societal evolution in how we site transmission. The process can take eight, 10, or 12 years, whether it's hydrogen, batteries, off-shore wind, or solar. It's not just about new technologies or finding better ways to use our existing grid. We need technology, yes, but also additional policies, incentives, and better strategies to deploy more transmission."

Hopper: "We need intentional investment in workforce. Folks are not just going to appear out of thin air to build tens of gigawatts of wind and solar and offshore wind. We have to train them, support them, and make sure our industry is diverse and equitable. At the local level this means supporting curriculum development, partnering with [historically Black colleges and universities], and making sure students know we need capable engineers in the clean-energy industry."

BIOFUELS GRANT

Energy Technologies

ENGINEERING PROFESSOR DANIEL Olson will lead new research funded by a $1.2-million, three-year grant from the U.S. Department of Energy (DOE) to investigate the use of biomass to produce next-generation fuels and chemicals.

The goal is to use *C. thermocellum*, a type of bacteria that is a promising candidate for cellulosic biofuel production, to better understand similar organisms and their potential as a platform for production of fuels and chemicals.

"Biofuels made from cellulose are one of the few options available for reducing greenhouse gas emissions in the heavy-duty transportation sector, which includes long-haul trucking, ocean shipping, and aviation. Bacteria that natively consume cellulose are good candidates for producing cellulosic biofuels, but in many cases their metabolism is poorly understood," says Olson.

"To better understand metabolism in these organisms, we are combining a relatively old-fashioned technique of enzyme assays with robotics, modern computer modeling, and advanced analytical chemistry techniques," he adds.

The grant, "Cell-free systems biology of an atypical glycolytic pathway," will also involve researchers from Pennsylvania State University, the National Renewable Energy Laboratory (NREL), and the University of Wisconsin. The funding is part of $45.5 million the DOE recently awarded to efforts across the country to better understand and harness nature's processes to produce clean biofuels and bioproducts, enhance America's energy security, and build its clean-energy economy.

"Biofuels that can power planes and ships and bioproducts made from renewable resources will play a critical role in decarbonizing our economy—and today's awardees will help us understand, predict, and even design them at the cellular level so we can unlock their full potential," says U.S. Secretary of Energy Jennifer Granholm about the awards. "Led by the unparalleled scientific capabilities at DOE's national labs and America's world-leading research universities, these projects will help us develop low-carbon products that drive economic growth while building a more sustainable world for our children and grandchildren."

—Julie Bonette

VIRTUAL COMPETITION

Formula Hybrid Adapts

IT HAS BEEN A TOUGH TWO YEARS FOR the Formula Hybrid Competition and its organizers. While the basic program hasn't changed—the competition features high-performance hybrid race cars built by teams of undergraduate and graduate engineering students—many events were modified due to COVID-19 restrictions.

"It's been very challenging," says Michael Chapman, director of the Formula Hybrid program. In March 2020, with the international teams in mind, the organizers made the decision to go virtual. "We went with a static-events-only format, which is usually declared by a team whose car isn't able to run in the dynamic events. We spent more than 70 hours on student Zoom calls, including virtual office hours, Q&A sessions, electric safety form reviews, and design and project management presentations."

They modified the competition as they went along. "It's like the old saying about changing the tires on a car going 60 miles an hour. But we were building the car going 100 miles an hour while we were building the road at the same time."

"Without the Zoom platform, we wouldn't have been able to pull it off."
—MICHAEL CHAPMAN

Their decisions in 2020 provided a good framework to modify the competition. "We added the Optimal Hybrid Challenge, where students designed the optimal hybrid car for a future competition without the usual cost constraints," says Chapman. "We also added the Virtual Racing Challenge using the sim iRacing platform, where students were challenged to set up a standard iRacing car and then have an expert driver from the New England Region Sports Car Club of America take timed hot laps around the virtual New Hampshire Motor Speedway course with south oval." The fastest laps scored the most points.

"Amazingly, I think we got to know the sponsors and the teams much better than during a normal competition. I think the experience taught us that we can add things to the competition before the cars get to the track that can really benefit the teams."

Organizers are now focusing on sponsor and team development for 2022. *—Kathryn Lapierre*

lab report

SERVICE TO SOCIETY

National Food Security

FOOD INSECURITY IS A MAJOR PROBLEM AND A persistent issue for much of the world's population, so much so that the United Nations has made achieving zero hunger one of its sustainability goals.

A recent analysis across 65 countries found that household income—more than any other factor, including land resources and production—consistently explains more discrepancy in food security. The Dartmouth Engineering study, "Cross-national analysis of food security drivers: comparing results based on the Food Insecurity Experience Scale and Global Food Security Index," was recently published by the peer-reviewed journal *Food Security*.

"We're trying to inform international development efforts. There's a long history of rich countries launching initiatives to help the developing world that aren't very effective," says Professor Lee Lynd. "If the real reason people are food insecure is that they're poor, the best thing you may be able to do for them is to give them a job."

"When we took a data-driven look at this, we found the amount of money households were spending on goods and services was by far the most important determinant of food security amongst the countries that we studied," says PhD candidate Andrew Allee.

The study concluded quantity and quality of a nation's agricultural land did not predict national food security; rather, the most effective strategies include measures to increase citizens' capacity for consumption. The researchers are quick to point out that no single metric can capture all dimensions of food security, but models consistently showed per-capita household spending was the single best predictor of food security—and an increase in income usually drives an increase in food security.

Allee and Lynd worked with Professor Vikrant Vaze on linear regression models that used country characteristics to predict food security from the Food Insecurity Experience Scale and the Global Food Security Index, two well-known indicators of food insecurity. The 65 countries studied represent 56 percent of the global population.

Allee's research was supported by the Henry J. McCarthy 1931 Fellowship and a National Science Foundation graduate research fellowship. He defended his PhD last spring and now works at the Rocky Mountain Institute, where he leads agriculture and energy work as part of its Africa Energy program.

Lynd's work is supported by the Center for Bioenergy Innovation, part of the Oak Ridge National Laboratory.

—Julie Bonette

Research Scientist Jacob Buffo

Space Ice

AN ENGINEERING LAB AT DARTMOUTH HAS BEEN AWARDED two grants totaling $1.25 million to conduct planetary science research relating to the geophysics and astrobiology of icy planets in our solar system. The research could lead to clues about the nature of the icy planets' inaccessible interiors and support future space travel to these planets.

"Given the importance of ice-ocean worlds in our search for life beyond Earth, understanding the geophysics of planetary ices is incredibly important in determining how these worlds work, how habitable they are, and how we will interpret measurements taken by future missions," says Jacob Buffo, a research scientist in Professor Colin Meyer's lab. "However, we currently have only a limited understanding of how compositionally diverse ices evolve and behave."

"The ubiquity of icy worlds in our solar system is becoming increasingly apparent," adds Meyer. "Understanding these systems is a top priority in the planetary science community, and our research will provide an invaluable tool to support this work."

A grant for $750,000 from the NASA Established Program to Stimulate Competitive Research will support research into the biogeochemistry of planetary ices, complex ice-brine-sediment systems, and ice interactions with spacecraft materials. An additional $500,000 grant from the NASA Solar System Workings program will fund a detailed geochemical investigation into ice cores grown from five distinct chemistries—representing potential icy world oceans—that can simulate the thermophysical and geochemical evolution of icy planetary systems.

Using terrestrial analog environments and laboratory experiments, the team will quantify the physical, chemical, and material properties of a suite of diverse planetary ice analogs, which will provide a novel catalogue valuable to the earth science and planetary science communities. In addition, the researchers will develop numerical models to predict the geophysical and astrobiological dynamics and evolution of ice-ocean worlds across the solar system.

"As an early career researcher, it is incredibly exciting to see your ideas for interesting scientific investigations become a reality," says Buffo. "I'm incredibly thankful for the teams of co-investigators on both grants, as these types of cross-disciplinary projects truly take a village to carry out."

—Julie Bonette

OPPOSITE PAGE: ISTOCK. THIS PAGE: ISTOCK (LEFT), COURTESY JACOB BUFFO (RIGHT)

NEW FACULTY

Welcome

XIAOYAO FAN joined Thayer in July as a research assistant professor of engineering. Her research interests focus on image guidance in neurosurgery, including open and minimally invasive procedures.

XIAOYAO FAN

HUI FANG joined Thayer in July as associate professor of engineering. His research concentrates on multifunctional materials and devices for large-scale soft microsystem development with an emphasis on neuroelectronics.

HUI FANG

DAVID GLADSTONE joined in July as a new professor of engineering. Previously, he served as an adjunct professor. His research interests include radiation therapy, biological gating of therapeutic X-ray beams, image-guided brachytherapy, Cherenkov emission during radiotherapy, and EPR dosimetry.

DAVID GLADSTONE

BRITT GOODS joined Thayer in June as assistant professor of engineering. Her research lies at the intersection of reproductive health, immunology, and biological engineering.

BRITT GOODS

ERIN MAYFIELD joined Thayer in September as assistant professor of engineering. She studies human-environmental-engineered system transitions in the context of climate change.

ERIN MAYFIELD

HELENE SEROUSSI joined Thayer in August as associate professor of engineering. Her research interests include glaciology, ice sheet modeling and ice sheet contribution to sea level, ice-ocean interactions, climate science, and data assimilation and inverse modeling in geosciences.

HELENE SEROUSSI

RAFE STEINHAUER joined Thayer as instructional assistant professor of engineering in July. His interests center on design thinking, human-centered design, and education design.

RAFE STEINHAUER

Class of 2021

The Dartmouth Engineering 2021 Investiture ceremony on June 12 honored 174 recipients of BE and graduate degrees. The following morning, Dartmouth awarded 107 AB degrees in engineering sciences. At Thayer School's ceremony, Ernest J. Moniz, the former U.S. secretary of energy, was awarded The Robert Fletcher Award and gave the keynote address.

"The responsibility for our collective good, for our sense of community, falls on you and every other generation of graduates of this distinguished institution," said Moniz. "You have extraordinary capabilities for raising the level of discourse, and we need it…. Engineers solve problems. Engineers will address the full range of innovation challenges. Quite simply, we need you to face these challenges and capture these opportunities."

ENGINEERING GRADUATES

107
Bachelor of Arts

106
Bachelor of Engineering

4
Master of Engineering

46
Master of Engineering Management

18
Doctor of Philosophy

Kudos

HONORS

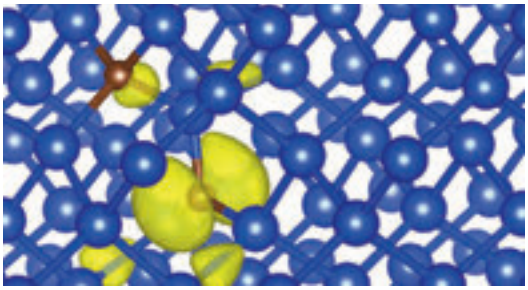
PhD Student Named NSF Graduate Fellow

PHD CANDIDATE Ayobami Ogunmolasuyi has won support from the National Science Foundation (NSF) Graduate Research Fellowship Program. "My research involves quantifying the mechanical and microstructural effects of impurities deposited from past volcanic events and fossil fuel combustion on polycrystalline-glacial ice," says Ogunmolasuyi, who previously received NSF fellowships for his involvement in the Joint Science Education Project and Data Science Infused into the Undergraduate STEM Curriculum. "My next steps will include incorporating machine-learning techniques to understand and predict the mass balance of ice sheets. It is exciting to work on cutting-edge climate research." He will receive a three-year annual stipend of $34,000, a $12,000 cost-of-education allowance, opportunities for international research and professional development, and the freedom to conduct his own research. "Ayobami is an outstanding student who is making excellent progress on his experimental study on the effects of impurities and stress state on the creep of ice. I expect great things from him," says faculty advisor and engineering professor Ian Baker.

"Ayobami is an outstanding student who is making excellent progress on his experimental study on the effects of impurities and stress state on the creep of ice."
—PROFESSOR IAN BAKER

HONORS

DOE Grant Awarded to Revolutionize Quantum Computing



FUNDED BY A $2.7-MILLION GRANT FROM THE U.S. Department of Energy (DOE), **Professor Geoffroy Hautier** will lead a three-year, multi-institutional effort to identify qbits, a basic unit of quantum information, in order to advance quantum computing. The team aims to build a database of viable qbits, which can store information in their spin, by analyzing defects in solids.

"This is an exciting time for quantum information science research. There has been compelling work in the last decade showing that defects in solids are viable qbits and could be the basic units for future quantum computers, but there is still not a perfect quantum defect. We are convinced that our approach will lead to important findings," says Hautier.

It has been shown that quantum computers will be significantly faster than current computers at solving certain complex problems. However, major breakthroughs are needed to scale up and revolutionize the field. And the field of quantum computing is still looking for a quantum defect with several desired attributes, such as the ability to retain a quantum state for a long period of time and being easy to control.

Previously, quantum defects were identified on a case-by-case basis, but with the DOE funding, the researchers will use high-throughput computing to accelerate the search for these defects, build a database, and then experiment with and test the most promising materials. As the database grows, the researchers intend to use machine learning to quicken the screening process.

Hautier will work with a graduate student and two postdoctoral engineers at Dartmouth, as well as researchers at the University of California, Berkeley, and the Lawrence Berkeley National Laboratory. "Tightly combining theoretical and experimental work is key for this project, and I am extremely excited to start to work soon with such a strong and complementary team," says Hautier. —*Julie Bonette*

AWARDED A $3-million grant from the National Science Foundation (NSF) will enable Thayer School and Guarini School to expand its PhD Innovation Programs by about 50 percent. "This program [emphasizes] the successful transfer of new technology to best benefit society," says **Professor Eric Fossum**, program director. Fossum also won an Emmy at the 72nd Annual Technology and Engineering Emmy Awards for inventing the intra-pixel charge transfer CMOS image sensor.

NAMED The Irving Institute for Energy and Society has named **Rose Mutiso '08 Th'08**, research director for the global Energy for Growth Hub, to its advisory board.

PUBLISHED Research on 3-D printing fluorescent material for biomedical imaging by **Professors Kimberley Samkoe** and **Brian Pogue**; PhD candidates **Alberto Ruiz, Samuel Streeter '13 Th'14 Th'21**, and **Mia K. Giallorenzi '23**; and **Ethan LaRochelle '20** was published in *Nature*.

APPOINTED Dartmouth trustees named **Laura Ray** the Myron Tribus Professor of Engineering Innovation and **Charlie Sullivan** the Sue and John Ballard '55 TT'56 Professor of Engineering.

WON The article "Digital Platforms and Antitrust," coauthored by **Professor Geoffrey Parker**, won the 2021 Antitrust Writing Award for best academic article in the digital category.

HONORED **Professor Ron Lasky** received the Technical Distinction Award from the Surface Mount Technology Association.

COAUTHORED **Professor Doug Van Citters '99 Th'03 Th'06** and PhD candidate **Hannah Grover Th'21** explained how to optimize manufacturing of joint implant materials in a recent article in the *Journal of Manufacturing Science and Engineering*.

SELECTED **Professor Lee Lynd** is founding director of the new Advanced Second Generation Biofuel Laboratory in Brazil.

NAMED **Professor Jifeng Liu** is now a fellow of the Optical Society, which recognizes members who advance optics and photonics.

AWARDED **Professor Colin Meyer** has been awarded $500,000 from the Heising-Simons Foundation to develop mathematical models for the motion of water from the surface to the bed of the Helheim Glacier in Greenland.

OPPOSITE PAGE: LARS BLACKMORE


"We want to monitor COPD using a smart watch."
—PHD CANDIDATE MARIA NYAMUKURU

PHOTOGRAPHS BY LARS BLACKMORE

EVERY BREATH YOU TAKE

Professor Kofi Odame and PhD candidate Maria Nyamukuru use "smart" monitoring and machine-learning algorithms to effectively measure

RESPIRATORY DISEASES.

BY KATHRYN LAPIERRE

Difficulty breathing, congestion, coughing, and wheezing—these are all-too-familiar symptoms in our current COVID-19 world. But long before the pandemic, respiratory illnesses have plagued millions across the globe, with chronic conditions such as chronic obstructive pulmonary disease (COPD) being among the deadliest—and most expensive—to treat.

"The problem with COPD is monitoring patients," explains Maria Nyamukuru, PhD candidate in Professor Kofi Odame's Analog Lab at Dartmouth. The group focuses on designing highly efficient analog and mixed signal integrated circuits for sensor interfaces in wearable biomedical devices.

"The most conventional way that COPD is monitored involves patients going into the hospital once or twice a year, depending on how severe their disease is, in order to get a spirometry test," says Odame. "They go into a lab and blow into this machine. The machine measures how forcefully they can blow out, which measures their lung capacity, pointing to how healthy their lungs are."

Repeated hospital visits can be time-consuming, inconvenient, and expensive, and experts are exploring the possibility of shifting how they can better monitor lung disease at home. This practice has already been in place for years for other conditions, including everything from pregnancy to diabetes to food sensitivity.

"In-home monitoring is a relatively new development," says Odame. "And two big reasons for it not being trusted by doctors is because, first, patients forget to do these tests; and second, even when they do remember, it's not done with the best level of accuracy."

This level of in-home testing can provide questionable results, Odame continues, which delivers a collection of bad data and leads to poor patient care and diagnosis. So Odame and Nyamukuru are seeking a solution that collects accurate data at home from patients through a more streamlined and passive process.

The pair is trying to leverage a ubiquitous modern device: the smart watch.

"The spirometry test requires a lot of human intervention to use it. We want to address the issues with the handheld spirometer by monitoring COPD using a smartwatch," says Nyamukuru.

Much of the population carries on their wrists everything they need to monitor their lung health—with a few advanced technical moderations, of course. "Smart watches, which are becoming more and more common, already have a way to measure your heart rate," says Odame. "One way of measuring heart rate is to use an electrocardiograph, or ECG, signal. The other way is to use photoplethysmography, or PPG, signals."

"We're trying to extract information about breathing from the heart signal and make broader inferences about lung health."

—PROFESSOR KOFI ODAME

Most smart watches can already measure heart rate, and measuring lung health is related. "There is a relationship between the heart signal that's measured—how fast your heart is beating and how hard—and your breathing pattern," he says. "We're trying to extract information about breathing from the heart signal and then take the information about breathing and make these broader inferences about lung health. We're trying to correlate that to what we would be measuring if the patients went into the hospital and did the gold standard conventional spirometry test."

In addition to the issues with monitoring COPD, patients also struggle with managing the disease and often succumb to exacerbations, which are acute events that worsen the disease. "It often ends with patients having to be rushed to the ER and sometimes hospitalized," says Odame. "That's not a pleasant experience for the patient or their family, and it's an expensive experience for the healthcare system. It turns out that often a few weeks or several days before such an acute event, there is this measurable drop in lung function and lung health. One potential use case would be this device identifying such a drop and alerting whomever, maybe the patients, maybe their caregivers, maybe the healthcare givers, and try to prevent that exacerbation that is eminent.

The algorithm they are delivering may do just that.

"A cool thing about this algorithm is that it takes advantage of the existing technology in the space. We'll just use these ECG signals to develop our algorithm," says Nyamukuru.

THIS PAGE: JOHN SHERMAN

It all sounds simple when you boil it down: Take an existing tool and adapt it to measure lung health. Problem solved. But, naturally, there is more to it.

"Developing the machine-learning algorithm and making sure it can fit and run on a smart watch device accurately is my main task," says Nyamukuru. "It's a resource-constrained device with limited memory and computation resources."

The Power of Neural Networks

Nyamukuru is currently leveraging the power of multitask neural networks to extract both respiratory rate and fractional inspiratory time (FIT)—or what percentage of a breath is characterized as "inspiring," or breathing in—from ECG signals.

"This is important because it's telling of lung and airway obstruction," she says. "For example, people with obstructed airways of-ten have a lower FIT, usually less than 20 percent, because it takes longer to exhale. Respiratory rate and FIT are measurements that we are looking at to infer COPD severity. Extracting these metrics from ECG signals would be great because that means we can take advantage of ubiquitous wearables with ECG sensing to monitor lung airways in real time."

"Most of the challenge is in developing the machine-learning algorithm that can extract some of these respiratory metrics from ECG signals. It has been really difficult to find an existing database that has clean enough data that's also collected in a way that's usable," Nyamukuru adds.

The team worked with a pulmonologist at the Dartmouth-Hitchcock Medical Center (DHMC) using a hospital-grade spirometer to collect respiratory signals and COPD metrics.

"I don't know if it's because of the size of the school or just the inherent culture, but this is a collaborative environment," says Odame. "I am not a biomedical engineer. I'm not a machine-learning scientist. My expertise is in circuit design, specifically analog integrated circuit design. That's a very specialized, narrow field. Coming to Thayer, and to Dartmouth in general, I was struck by just how accommodating the environment is to crossing these boundaries between traditional fields. The strong interaction between Thayer and DHMC was a huge attraction."

Nyamukuru came for similar reasons, noting that Dartmouth's collaborative approach and the freedom given to students to explore interests beyond traditional engineering made it an attractive place to learn and apply her knowledge in the real world.

"Before I came to Thayer I was working in industry, mostly focusing on embedded systems, and I was exposed to a project that used machine learning that was really interesting. When I was applying for my PhD, I looked at machine learning, and hardware and embedded systems. Most of the programs seemed to be very constrained, except for Professor Odame's lab, which is why I was initially drawn to it."

The flexibility to work on projects such as these allowed Nyamukuru to explore multiple interests, and she relishes the chance to work side by side with researchers and doctors at DHMC as they collect data.

The COVID-19 pandemic temporarily put the work on hold. "We had to stop collecting data from the hospital, which has been a huge challenge," says Nyamukuru.

While data collection will resume in the coming months, the team is adapting the best they can. "We're trying to figure out ways to collect our own data down the road and make use of what we have right now and learn from it."

KATHRYN LAPIERRE is editor of *Dartmouth Engineer*.

DATA SCIENCE

AT DARTMOUTH

Students learn how to turn zeroes and ones into actionable information.

BY JULIE BONETTE

ISTOCK

The field of data science is exploding. The process of looking at data, creating hypotheses, running experiments, and analyzing results to leverage new understanding and informed decision-making is in high demand. Not just at Dartmouth, but around the globe, the need for data analysts who can sift through and interpret data is snowballing as fast as the amount of data itself.

Smart Devices Drive Demand

The demand for data scientists is partly driven by the increasing number of smart devices in the marketplace for both businesses and private individuals. Common, everyday devices now collect and transmit data—from refrigerators that keep track of expiration dates to traffic signal sensors that adjust brightness levels in response to ambient light.

"We just have a lot more data than we ever did before," says Geoffrey Parker, director of the Master of Engineering Management Program and professor of engineering. "We're awash in data, but it doesn't do much good if it's just a bunch of zeros and ones."

As a result, the field of data science has expanded exponentially, and businesses have realized they have to start making use of the data they collect in order to remain competitive.

A 2019 LinkedIn study found that data scientist is the most promising job in the country. According to the U.S. Bureau of Labor Statistics, data scientist is one of the fastest-growing occupations, with a 31-percent projected growth rate from 2019 to 2029.

"We now see tons of organizations grappling with the fact that they've got data, but they don't have the people or the systems to make use of it. They're trying to staff up," says Parker. "Data science matters because all that data is just zeroes and ones until you analyze it and turn it into actionable information. It's one thing to just bang away at a data set, but much more important is asking 'Why? What am I trying to figure out? What am I trying to solve for?' "

NSF Grant Expands the Pipeline

To answer these questions and meet the exploding demand for data scientists, Dartmouth has launched a new initiative to expand the pipeline across STEM disciplines. Thanks to a four-year, $2.8-million grant from the National Science Foundation (NSF), a team of engineering and computer science faculty, along with graduate and undergraduate students, is developing new data science for STEM courses. The Data Science Infused into the Undergraduate STEM Curriculum (DIFUSE) team has been working individually with faculty across the College since the fall of 2019 and has so far developed eight modules that can be integrated into current Dartmouth undergraduate course curricula, such as "Climate Extremes on a Warming Planet," "Statistical Methods in Engineering," and "Introductory Psychology."

The group is led by four principal investigators (PIs), including engineering professors Laura Ray and Petra Bonfert-Taylor; Lorie Loeb, faculty director at the Digital Applied Learning and Innovation (DALI) Lab; and math professor Scott Pauls. An initial team—including one PI, one graduate student, and one undergraduate student—meets with a course instructor to develop learning objectives that help tailor data science modules to fit course-specific needs. The entire DIFUSE team then develops the module in collaboration with the course instructor to ensure it meets the desired learning outcomes.

"It's one thing to just bang away at a data set, but much more important is asking 'Why? What am I trying to figure out?' "

—PROFESSOR GEOFFREY PARKER

"We work with instructors of introductory STEM classes who are interested in having a module developed for their class that introduces students to basic data science techniques and practices," says Bonfert-Taylor. "Each module we have developed so far is completely unique—no two are even close to similar."

Faculty response has been positive. "I really enjoyed working with the DIFUSE team to get more data science into my course," says Robert Hawley, chair and associate professor of earth sciences who worked with DIFUSE to develop a module for his "Environmental Change" class. "Using the additional data module from the DIFUSE team, my students were able to extend their analysis to the next level. As a result, nearly every student group connected the ideas that I'd hoped for in the project, where previously many groups still missed important components of the concept."

Biological science assistant professor Caitlin Hicks Pries agreed her ecology students benefitted from the newly incorporated module. "This data-exploration lab is one that I have been wanting to design, but I did not have the time or technical know-how to do it on my own," she says. "It was so much fun to work with two DIFUSE students who were so dedicated to the success of this project. From them I learned about translating my code to an interactive webpage, and, I hope, they learned a bit about carbon balance and eddy covariance from me."

Students Learn New Skills

By infusing data science into the STEM disciplines, DIFUSE seeks to enhance undergraduate students' expertise in data science and prepare them to enter the workforce. In addition, the dozen or so students on the DIFUSE team have gained experience building effective and engaging courses.

"We want students to feel motivated to learn R [a programming language for statistical computing], and we want this module to fit in seamlessly," says engineering major Sarah Korb '22, who helped students in "Statistical Methods in Engineering" use R for statistical analysis. "As a student who is normally on the receiving end, it is impressive to see how much thought goes into building a Dartmouth course."

DIFUSE students were also able to boost their own learning. James Busch, a PhD student studying earth science, has worked on two modules. For "Stars and the Milky Way," he completed a series of activities that enabled students to use Python libraries to learn about celestial objects in the galaxy. "I really enjoyed learning about the basics of astronomy and how we view objects in our very own galaxy while designing the exercises," he says.

An environmental studies module Busch worked on for "Environment and Society" was especially rewarding. After coming across research that linked increased COVID-19 mortality with race and regions of Louisiana, he helped create a web app to examine deaths, air pollution, and demographic data from the state. The app allowed students to investigate the relationships between the Louisiana communities with historic pollution and increased COVID-19 mortality.

"We built the application so students could get hands-on learning with important environmental social justice issues such as those that have occurred in 'Cancer Alley' and work with a highly relevant COVID-19 dataset that is currently being studied by researchers of all different fields in the United States," says Busch.

He enjoyed working on both modules. "I was very impressed by the PIs and the creative freedoms they gave the students in developing the modules—it made the experience that much more fun and gratifying."

Data Science for All

As DIFUSE was gearing up in the fall of 2019, another data science program sprang up on campus. Dartmouth Engineering launched an online program to offer a professional certificate in data science in partnership with online learning company Emeritus. The course, which is open to all, is based on Parker's popular "Data Analytics" engineering management class.

Students learn data science fundamentals and high-demand skills such as data visualization, machine learning, risk management, and predictive capabilities, with a focus on real-world concepts. Students work directly with industry mentors and complete a final portfolio demonstrating software, math, and engineering skills.

"At the end of the program you actually have the ability to solve practical data analytics problems within an organization," says Parker. "I think that there's a certain beauty in being able to visualize data and solve problems and saying, 'Aha! That's really neat, and I didn't know that before.' "

New six-month sessions launch every two months, and the only prerequisite is a knowledge of calculus, linear algebra, statistics, and probability. Student can expect to spend 10 to 15 hours each week on the course, which Parker recommends for those who want to pursue a career in data science.

The Next Digital Transformation

Dartmouth Engineering will launch an online program focused on digital transformation, this time in partnership with Coursera. While not exactly data science, participants will learn how to integrate artificial intelligence (AI) and machine-learning solutions to streamline business operations, lower costs, and respond to new market opportunities.

The program will include live-session classes and draw from the expertise of the MEM program at Dartmouth and will be taught by Parker and engineering professors Elizabeth Murnane and Vikrant Vaze.

Participants can expect to spend eight to 10 hours per week on the six-month program and earn a certificate in digital transformation. There are no formal prerequisites, but students are encouraged to have an interest in digital transformation and innovation, experience with college-level learning, and some familiarity with Python.

A Pioneering Role

As technologies continue to evolve, so will the field of data science. Parker predicts improved automation will decrease the time and effort required by humans to assemble and clean data sets, leading to a demand for different skills. "I think that technical aspects will get suppressed as they get absorbed into our cloud solutions," he says. "We could then shift the 70 or 80 percent of effort that's currently consumed by building data sets over to analyzing them. What will be left is understanding your problem and explaining results in a meaningful way."

In order to help the emerging workforce keep up with the field, the DIFUSE team will hold an online workshop next summer to share learned methodologies with faculty at other institutions. The workshop is being designed to spread the techniques developed for data science module creation, as well as the modules themselves, positioning the College as a true pioneer in the field.

"It's really neat to see this effort expanding at Dartmouth," says Parker.

JULIE BONETTE is contributing editor to *Dartmouth Engineer*.

PHOTOGRAPHS BY
KEONI OCALVEY '20 TH'21

NATURE AND

FOR THEIR CAPSTONE BE DESIGN SEQUENCE, STUDENTS WORKED TO COMPLETE A MISSING SECTION OF THE CONCORD-LAKE SUNAPEE RAIL TRAIL IN WARNER, NEW HAMPSHIRE. THEY CONSIDERED COST, FEASIBILITY, AND MITIGATION STRATEGIES TO CONNECT THE TRAIL WITH THE NATURAL ENVIRONMENT.

BY KATHRYN LAPIERRE

ENGINEERING

From left: Savannah Cochran '23, Camile Pauley '21, Tim Blagden from the Concord-Lake Sunapee Rail Trail, Lelia Mellen from the National Parks Service, and Chris Drake '20 Th'21 (not pictured: Keoni Ocalvey '20 Th'21, Evan Christo '21, Andres Rosales '20 Th'21)

The group relied on communication with sponsors and outside resources, including surveying community members about their needs. "The project was a testament to how Thayer prepares its engineers for the multidisciplinary nature of many engineering projects in the real world," says Ocalvey.

The rail trail runs 34 miles across New Hampshire, beginning in Concord and passing through Hopkinton, Warner, Sutton, and Bradford before ending in Newbury at Lake Sunapee.

➤ *Cochran, left, and Pauley record distances and slopes along a steep drop to I-89. The section "crosses under highways, navigating steep topography and traversing floodplains without rail grade," says Ocalvey. The group worked to make it wheelchair accessible and safely connect users with nature.*

➤ *"The goal was to establish a challenging connection point along the multiuse biking and walking trail," says Ocalvey. "It can also serve as a form of alternative transportation for local residents."*

Alumni News

FROM AROUND THE WORLD

spotlights

At the Pinnacle

Clemson University bioengineering professor **Renee Cottle '07 Th'09** has earned the 2021 Pinnacle Research Award to advance her study of therapies to treat liver disease. She leads a team working with CRISPR-Cas technology, a powerful tool that enables scientists to make alterations to the human genome for treatment of diseases. "My laboratory is devoted to developing nonviral approaches for delivering CRISPR components into hepatocytes for liver-directed therapies," she says. Cottle's lab—which includes four PhD, one MS, and 12 undergraduate students—is also developing point-of-care devices for patients. She created two research classes to further these efforts. "One course provides students an opportunity to design and validate gene-editing tools for treatment of genetic diseases affecting the liver," says Cottle. "My second course is focused on the development of an at-home monitoring device for patients with nonketotic hyperglycemia." Working with students in the lab is both inspiring and rewarding, she says. "They bring out the best in me as a researcher: I study hard and push the limits of science so I can teach new things to my students," says Cottle. "I also enjoy watching my students grow intellectually, become experts in the gene-editing field, and advance to great careers." That trajectory mirrors her own career. "I gained hands-on experience in bioengineering while working on my capstone design project to develop a sterilizer device for IV fluids and my honors thesis project mentored by Dr. Tillman Gerngross and Ronald Taylor investigating peptide mimics for vibrio cholerae LPS toward a vaccine for cholera," says Cottle. She credits that background with helping her land a National Science Foundation Graduate Research Fellowship before she entered the PhD program in biomedical engineering at Georgia Tech and Emory University.

"When a payload separates from the rocket, I feel a great sense of pride for my team and the effort we put into ensuring the satellite reaches its orbit."

—SHAUN SENGUPTA '17 Th'18

Rocket Man

Launch engineer **Shaun Sengupta '17 Th'18** likes it when things come apart. "When a payload separates from the rocket, I feel a great sense of pride for my team and the effort we put into ensuring the satellite reaches its orbit," he says. As part of SpaceX's payload integration team, Sengupta is responsible for streamlining systems on the launch site at Cape Canaveral, Fla., and ensuring the reliability of flight hardware. Much of his work centers on launches of SpaceX's Falcon 9 and the reusable Falcon Heavy, the world's most powerful rocket. His SpaceX adventures are on the rise. "This summer I had the opportunity to work on the new Starship and Super Heavy vehicles that will soon take humanity to Mars," says Sengupta. "I was absolutely stunned at the massive scale of that rocket and the pace of the production facility. When fully stacked, the Starship-Super Heavy vehicle is about 400 feet tall, which I couldn't appreciate until I saw it up close. With about 30 Raptor engines, I can't even imagine how loud it will be during ascent!"

Renee Cottle '07 Th'09 ▶

Vermont Engineer of the Year

Vermont Technical College Professor **Scott Sabol '88 Th'88** is known for taking his motorcycle out in the summer to search for buildings and bridges he can talk about in class. A licensed structural engineer who has taught architectural and building engineering technology for more than 20 years, Sabol has been named Vermont's 2021 Engineer of the Year. He has also earned the college's highest faculty awards and helped Norwich University develop an online master's program in civil engineering. His professional engineering work included research for the Federal Highway Administration and development of a national strategic plan for integrating fiber-reinforced polymers into the transportation infrastructure. The Vermont native's current activities include volunteering with the

On the Job

BRIAN MASON '03 TH'05 | PRODUCT LEADER

In 15 years at design firm IDEO and medical device startup Willow, Mason was involved in more than 50 medical and consumer products, from early-stage research to the manufacturing floor. Now the mechanical engineer is bringing his experience in innovation to audio products developer Sonos in Boston.

Is there a favorite phase of development?
I love to see a team making progress together. My time at IDEO taught me how important (and fun) early research, ideation, and prototyping is to the design process—when we take an early, ambiguous idea or conflicting feedback from the field and are able to eventually converge on the best product for users. At the same time, I love spending time on the factory floor working with the technicians and manufacturing experts to troubleshoot and balance trade-offs leading up to high volume production. There is nothing like seeing an early idea make it all the way through the process and then be made in the hundreds of thousands and, I hope, millions.

How has Dartmouth Engineering informed your approach?
Thayer allowed me to go deep in both design and engineering. Professor Peter Robbie and John Collier's design classes gave me a deep appreciation for research, brainstorming, and rough prototyping. Always ask why. Never get married to a concept. And build to learn whenever possible.

What energizes you?
I feed off of a team moving a concept forward. There is nothing like a team gathering around a prototype or sharing concepts with prospective users.

What are your current challenges?
I am working to find new tools to energize teams. Being a team lead over Zoom is limiting: The go-to's of late nights in the lab, traveling with teammates, or laughing over lunch are all on pause right now in our work-from-home world. In addition, there is a constant challenge of too much to do in a day and too many good ideas to work on. Our team is being diligent to prioritize and focus so together we can deliver.

—Interview by Theresa D'Orsi

spotlights

Equity Alliance, a nonprofit focused on attracting a diverse workforce to the Green Mountain state.

Less is More

Companies are launching smaller satellites into space in larger quantities. Phase Four chief technology officer **Umair Siddiqui '10** is using his background in plasma physics to shrink the technology while scaling up production. Instead of the cathodes required by traditional plasma thrusters, "we've developed a new kind of engine that uses AC radio frequency waves to accelerate the plasma," Siddiqui explains. "In doing so we've shrunk the electronics more than 50 percent over traditional thrusters, which vastly simplifies the manufacturing and reduces the lead time." At less than 6 kilograms, Phase Four's first-generation Maxwell engine, Maxwell Block 1, is the smallest 400-watt plasma thruster in orbit. But that small package delivers big returns: The engines are designed to extend the lifespan of the satellites by allowing them to move in orbit for several years. Capella Space satellites launched in January provided the first evidence that Phase Four's technology worked in orbit as designed. "It was the first electrodeless thruster ever to operate successfully in space," Siddiqui told *SpaceNews*. His focus now is on production. The Los Angeles, Calif.-based company is building a manufacturing line to cut the time from order to delivery by 75 percent—a mere four months.

Thinking Inside the Box

When a friend's 7-year-old daughter, Coco, was diagnosed with leukemia last summer, **Casey Conway Tulloch '13** created a special care package to lift the child's spirits while she was hospitalized. So began Coco's Adventure Box (kcsadventureboxes.com), a collection of goodie bags designed around a story called *Captain Coco's Sea Adventure*. "It's a reimagined care package designed to help little girls facing long hospital stays build resilience," says Tulloch. "The gifts inside encourage these children to play along with a story that reframes many of the challenges encountered during treatment." The six chapters address issues girls ages 6 to 11 might face and offer costumes and activities to ease their way—such as a message-in-a-bottle from the family dog asking them to write back or a mermaid wig for when they lose their hair to chemo. Each goodie bag has a surprise—glow-in-the-dark stars, a cloud guide, a puzzle, or even a kaleidoscope—with a note about "its ability to look at something in a new and beautiful way," says Tulloch. She has been testing the adventure boxes with children at a hospital in Charleston, S.C., and hopes to build a network of participating hospitals and offer boxes for sale in 2022.

◀ Casey Conway Tulloch '13

Taking Care of Business

Chair of the Kenya Private Sector Alliance (KEPSA), **Nicholas Nesbitt '85 Th'86 Th'87**, knows how to bring business and government leaders together. His ability to navigate the challenges of a tumultuous year have earned him the No. 4 spot among 2021's "Top 25 Most Influential Chairs of Board Impacting Business." According to *Business Monthly*, "One of his hallmark achievements has been to lead the private-sector engagement with government that resulted in the improvement of Kenya's Ease of Doing Business ranking and the rationalization and easing of the tax burden to mitigate the adverse effects of the COVID-19 pandemic." A general manager of IBM Eastern Africa from 2013 to 2020, Nesbitt was also awarded the Order of the Grand Warrior by the president of Kenya in recognition of his "pioneering spirit."

Kelp is on the Way

Marty Odlin '04 Th'07 and his Portland, Me,-based company, Running Tide, are trying a new way to reverse climate change and the decline of marine life: growing kelp to pull carbon dioxide from the atmosphere and bury it on the ocean floor. "What we have to do is run the oil industry in reverse," the CEO recently told National Public Radio. He imagines kelp micro-farms floating on biodegradable buoys hundreds of miles offshore, over the deepest parts of the world's oceans. The kelp soaks up carbon, via photosynthesis, and grows. After about seven months, the mature blades get too heavy for their buoys, and sink. "Once it goes down below 1,000 meters, it's not coming back up, because the pressures are so great," Odlin told *Fast Company*. "So you can get at least 1,000 years of sequestration. More likely, it will turn into oil or sediment and be sequestered on the geologic timescale—millions of years." At large scale, kelp farming could make a major impact. A 2019 study calculated that growing and sinking macroalgae in just a fraction of federal waters off the California coast could fully offset emissions from the state's enormous agriculture industry.

Five New Thayer Advisors

The Dartmouth Engineering Board of Advisors welcomed five new members for three-year terms. They include **Vijay Kumar**, the Nemirovsky Family Dean of Penn Engineering and a mechanical engineering professor at the University of Pennsylvania since 1987; **Jian Lu Th'93**, corporate vice president of LinkedIn and president of LinkedIn China, overseeing the company's research and development; **Christopher McKenna '88**, co-founder and managing partner of Carleton McKenna & Co, an investment bank serving specialty manufacturing, service, and technology companies; **Tracey Pettengill**

Turner '93, founder and executive chair of Copia Global, which is bringing mobile commerce to East Africa; and **Katherine Osborne Valdez '94 Th'95**, board president of the Powell Foundation, which focuses on K-12 public education grantmaking in Texas, and a former foreign service officer with the U.S. Agency for International Development.

In Recognition

The Dartmouth Engineering Board of Advisors has named **Carol Muller '77** a 2020 Sylvanus Thayer Fellow in recognition of her service to and support of Thayer School. Muller came to the school as assistant dean in 1987 with administrative experience in higher education and a PhD in administration and policy analysis from Stanford. She also had the benefit of coming of age during the 1970s "and the wild, woolly, and weird gendered experiences of being in the second coeducational class at Dartmouth," she says. In her early days of working at Thayer, the faculty was all male, and only a few of the students were female. "Nowhere in my job description were 'diversity' or 'inclusion,'" she says. "But as a feminist with a passion for equal opportunity and concern about occupational segregation, I couldn't support that gendered status quo." In 1990, with the backing of Dartmouth Engineering Dean Charles Hutchinson '68A, Muller joined with chemistry professor Karen Wetterhahn, then associate dean of the arts and sciences, to design and implement the Women in Science Project (WISP). Muller stressed the need for women in the sciences—including engineering—to have role models, mentoring, and a sense of community. Wetterhahn added hands-on, active engagement in lab work—the research internships that became a cornerstone of the project. Muller engaged faculty, senior leaders, admissions and career services staff, and obtained funding from the College and the National Science Foundation and the Sloan Foundation. "It takes not only ideas for change, but the right timing and salience to muster the support for launching something like WISP," she says. Three decades later, the project has become a major part of the Dartmouth experience. "WISP is a brand," says Muller. In 1996 Muller returned to Stanford, where she founded an online global nonprofit mentoring network—MentorNet—for diversity in engineering and science. She then served as operating manager for Stanford's 70-member electrical engineering department and led WISE Ventures, which focused on campus-wide equity in STEM. After a career devoted to helping countless students succeed in science and engineering, Muller retired last spring.

The Board of Advisors also named **Ralph Crump '66A** a Sylvanus Thayer Fellow posthumously. Crump, who died March 16, 2020, at age 96, invented technologies that transformed everything from the processes of removing cataracts and purifying water to the development of bar coding and 3-D printing. In the 1960s Dean Myron Tribus tapped him to help guide Thayer's entrepreneurial activities. Crump served on the Board of Advisors for 24 years, and he and his wife, Marjorie, established the Myron Tribus Chair in Engineering and funded the PhD Innovation Program. In 1979 he received the school's highest honor, the Robert Fletcher Award.

◀ Carol Muller '77

On the Job

KARA PODKAMINER TH'11 | TECHNOLOGY AND POLICY ANALYST

"As technologists, we want to invent a technology—but that's only half of it."

Podkaminer's holistic approach to developing a clean-energy economy is a natural extension of her research as a PhD candidate at Thayer and a postdoc research fellow at the National Renewable Energy Laboratory's Biosciences Center. Before joining the U.S. Department of Energy (DOE), Podkaminer engineered organisms, tested enzyme activity, and analyzed bioreactor systems to develop low-carbon cellulosic biofuels. Her focus now is developing the tools to support a range of clean technologies.

What does your role entail?
I work at the DOE's Office of Energy Efficiency and Renewable Energy. We work with researchers at the national labs to develop and run analyses to inform decision-making—trying to understand how quickly we can transition to a clean-energy system and the challenges we need to overcome to get there—so that we can invest in the right technologies, support decision-makers, and help accelerate deployment. As technologists, we want to invent a technology—but that's only half of it. Understanding how to deploy it, how to have the supporting infrastructure, and how to overcome the inertia of the status quo is really hard. It keeps us all busy!

What element of your work keeps you engaged?
I love doing work that is impactful. Working for the federal government, trying to help understand the pathways that enable a clean-energy economy and help prevent the worst of climate change keeps me engaged.

What is your office dynamic?
I work in a cross-cutting office. I love the diversity of topics and bringing together experts in each of these areas. A clean-energy economy is inherently more interconnected, so understanding how these technologies work together is essential. I'm excited to work on the transition to electric vehicles as well as low-carbon renewable fuels. We're going to need all of these to meet our targets.

—Interview by Theresa D'Orsi

just one question

Q. If you were asked to give the Investiture address at Thayer, what would be your core message?

Didn't Sylvanus Thayer say something about engineering education that is memorable? In the absence of that, I tend to be guided by a variety of "Think Thayer Virtual Event" announcements. For example: "The importance of engineers and scientists informing the legislative process, and the impact it has on tackling the world's most pressing problems" or "Dartmouth is redefining how technology education can be a fundamental component of the liberal arts experience" or "Building solutions for a better world through human-centered engineering and design."

—Sam Florman '46 Th'73

Listen.

—Charles Queenan '52 Tu'53 Th'53

Now that you have completed your endeavors and learning experiences at Dartmouth and Thayer it is appropriate for you to ask, "Why did I come here in the first place?" It certainly was to learn new skills and gain new knowledge, but perhaps the single most important reason was to learn about yourself. By now you should know what turns you on. The key to your life and future success will lie in pursuing your passion. To be passionate about what you do with your life will be the best motivator you will ever find and ultimately lead to real satisfaction. If you can find a career that allows you to pursue your passion, you can almost be assured of your success and happiness.

—Ron Read '57 Th'58

Thayer and Dartmouth together provide an excellent mixed education of liberal arts and technical-engineering education. The engineer of today is called upon to do far more than just be technically excellent. He or she must be able to relate to the public at large in order to obtain encouragement and understanding for what they would like to do.

—Jerry Allyn '59 Th'60

Today is indeed a day for celebration. It is a time for commemorating your achievement and also for looking ahead. You have probably heard about William McRaven's advice in his 2014 University of Texas commencement address to "make your bed every day" and you may be familiar with Holocaust survivor Viktor Frankl's identification of the need for a goal. You will do well to practice both. Today, however, I'd like to stress the importance of gratitude. None of us got to where we are on our own. It not only takes a village to raise a child, it also takes a village to create an engineering graduate. Family, friends, teachers, and even institutions have had a part in preparing you for this day. Your debt of gratitude to all of these contributors is something that you can repay going forward. You can do this one step at a time: Catch a subordinate or peer, spouse, child, or supervisor something good and compliment them. Both of you will feel better for the action. At the end of each day, think of something you are thankful for; you will sleep better.

—Harris McKee '61 Th'63

Take the systems thinking you learned at Thayer with you when you leave. Apply it vigorously to both your professional and personal lives. We live in a complex and interconnected world. Actions and decisions focused on a particular problem or goal, like ripples in a pond, often affect seemingly unrelated aspects of our lives and the lives of others. Rarely can one component of a system be changed without triggering consequences downstream in the system. It is very worthwhile to invest effort and resources to anticipate those consequences. Usually when those consequences are negative, they cannot be reversed. Consider the actions of an executive who decides that the structure of the organization he or she manages must be changed to keep up with industry changes and improve performance. Without testing reorganization options with stakeholders who will be impacted, employees and customers might be lost because important, but not highly visible, relationships might be disrupted. On the brighter side, a carefully pre-tested reorganization plan might ignite people and teams to attempt new ways of improving performance. Similarly, if the plan to clean up a contaminated waste site focused not only on the contaminants to be removed, but also on the possibility to restore the ecosystem that once thrived on the site, the result might be additional community green space, not just a reduced eyesore. I would say systems thinking is the most important learning I received at Thayer.

—Neil Drobny '62 Th'64

My pitch would be don't worry so much about what engineering field to choose. Pick one that's interesting to you and pay close attention to the process of engineering design in that field. I retired from the Navy 25 years ago, and in retirement I have had the good fortune to meet and talk with hundreds of up-and-coming engineers from industry, academia, and the national labs. One question I ask of all of them is "Have you always worked in your field?" Surprising to me at first (but no longer) is that more than 50 percent of the rising stars in industry no longer work in the field of their graduate studies. A common theme in their responses is "Engineering at my level in our company is solving hard problems. My graduate degree in (whatever) has not been as important as learning the process I was taught for solving those problems."

—Bill Hayden '66

My topic would be why infrastructure cybersecurity needs to be embraced by the private sector. I worked briefly as a contractor with the U.S. Department of Energy's Idaho National Lab on consequence-driven, cyber-informed engineering (CCE). CCE is a methodology focused on securing the nation's critical infrastructure systems. It's a very impressive approach, but unsurprisingly federally focused. My previous energy experience was with the private sector. These folks can't turn on cyber command's offensive tools as easily as can the U.S. government. It's a serious challenge, as the recent Colonial Pipeline incident demonstrated. CCE begins with the assumption that critical infrastructure targeted by a skilled and determined adversary can and will be sabotaged. What's the solution? Develop a private-sector corporation mirroring the Idaho National Lab CyberCore Integration Center to conduct CCE engagement with private-sector industries.

—Jeff Zimmerman '67

Although I am an architect rather than an engineer, I would urge the new engineers to remember and live the words of 17th-century architectural critic Henry Wooten. He said that to be truly good, even extraordinary architecture, it must include "firmness, commodity, and delight": firmness to be structurally sound and of good long-lasting materials; commodity to enclose and accommodate whatever activities it is designed for; delight to please the senses with light, color, and harmony. Engineering should, in its own way, meet these goals. Let your Dartmouth education of engineering infused in the liberal arts prepare you to bring firmness, commodity, and delight to everything you do.

—David Peck '68

Your education process does not end at graduating from Thayer. You must pursue your engineering education throughout your career.

—Harvey Welker '68

The Dartmouth experience cultivates a special foundation that fosters a unique approach to applied sciences that is often missing from other technical experiences. We need

to take advantage of this unusual perspective, especially as it applies to many worldwide problems that cry for multidisciplinary attention.

—Peter Areson '72 Th'73

I would pass along the advice I received from Professor Russ Stearns when I asked if there was a future in civil engineering: "There is always a future full of opportunities for the best."

—Eric Kankainen '72 Th'73

An engineering education in a liberal arts environment is a distinct advantage! You have unique capabilities beyond nuts-and-bolts engineering skills to solve global problems with a contextual perspective on doing the right thing for the good of mankind.

—David von Loesecke '74 Th'76 Tu'83

"Impossible is not a fact. It's an opinion. Impossible is not a declaration. It's a dare. Impossible is potential," said Muhammad Ali. That's Thayer School to me. When I first heard this quote, I thought of the time when I told my thesis advisor, John Strohbehn, that I had hit a brick wall in my project. He said, "It just seems that you need to do something clever." There were so many clever things going on at Thayer at the time that it didn't seem like an impossibility. I finally worked through the problem. Through the years this advice has been a thing to focus on through many of my engineering challenges.

—Hal Greeley Th'77

Your achievement is significant. Today, breathe it in, be present with it, and consider what it means to you.

—Paul Krupka '79 Th'80

Speed, simplicity, and self-confidence. Fail quickly and recover. Keep messages simple to assure alignment. Have the self-confidence to innovate.

—Rich Kehl '81

Every human endeavor should be focused on climate change. Engineering is a key component to creating a sustainable future and is defined by the challenges of climate change. We are late in addressing this most critical issue.

—Jay Mead '82

"Have irrational self-belief and persistence —your voice, unique experiences, and world perspectives are superpowers."

—ATRI RAYCHOWDHURY TH'17

Life is about relationships, and if the last year taught us anything, it is that life also is short, fragile, and unpredictable. Cherish, nurture, and invest in your relationships with your family, friends, classmates, coworkers, and, for that matter, the gentleman sweeping the floor and the gentlewoman serving your coffee. Be truly present in the moment. Pocket your phone. Look up. Make eye contact. Smile. Listen. Empathize. Forty years on from my arrival on campus I can say with some perspective that academic and career success can certainly be rewarding, but there is no substitute for having close and enduring friendships and raising a family. These take focused time and attention, just as your schoolwork did and your career work will. Do not assume that the friend sitting next to you, with whom you have shared so much in the last few years, will be there in 10, 20, or 40 years—time that will go by in the blink of an eye. One day you will wish to be back at this day to relive the last 40 years with new eyes and attention to your relationships. So do the work to maintain and build the relationships in your life, because adversity and success cannot be tackled or enjoyed without friends and family. Grief shared is divided, and joy shared is multiplied. Good luck and God bless you!

—Doug Kingsley '84 Th'85

Technology has become more complex and more pervasive, invisibly weaving its way into every corner of our lives and work. More than ever, engineers need the moral compass to design in responsible ways and the communication skills to explain technology to consumers, users, and policymakers. Dartmouth may be uniquely poised to deliver these engineers of the future.

—Robert Mazzarese '87 Th'97 Th'98

Find your purpose and use it as your North Star!

—John Replogle '88

Use your education to adapt to the changes that must come and to resist the changes that should not.

—Scott Sabol '88 Th'88

Oh my goodness! Take it all in and take advantage of as much as you can!

—Maureen Hahn '92 Th'93 Th'94

Engineering education trains you to think, to use facts, data, and information to draw conclusions and solve problems. It forces you to hone in on what is important and discard what is not to get to the heart of the matter. Use that in your career and your everyday life to navigate these tumultuous and divisive times.

—Brett Buatti '92 Th'94

When engineering makes headlines, it is often because engineers fail. With the recent collapse of the Champlain Tower apartment complex in Florida, an overtop failure of the Edenville Dam in Michigan, and the failure of three tailings dams in the last 10 years, engineers must rebalance their professional obligations to the community and their financial obligations to engineering firms and clients. It does not save anyone money to take unnecessary risks on engineering features that are necessary to protect human or environmental health. In each of the cases listed above doing necessary maintenance, monitoring, or repairs were delayed, deferred, or canceled so that a client, stakeholder, or owner could do what was cheap. It's time for engineers to get brave again. We need to be telling the painful truth to our clients. It is obvious that our hard honesty is far easier to tolerate than our failures.

—Larry Breckenridge '95

Technology doesn't exist for itself. It exists for those who are creative enough to leverage it to make their lives better, as I heard Charles Hutchinson say many times.

—Keith Lenden '95 Th'95

For the first time in human history we can make things totally awesome. Engineers working with everyone can enable all of us (10 billion people) to flourish in partnership with Earth. The only thing holding us back is the articulation and pursuit of our collective dreams.

—Drew Endy Th'98

As you embark upon a journey solving real-life problems and achieving great successes in your respective careers, don't forget to invest time in cultivating your inner happiness and health. If the pandemic has made us realize something, it is to take a pause once in a while from the external world and draw closer to things and people that truly make us happy. Keep that perspective always and don't let the externalities eclipse the real you.

—Mayank Agrawal Th'08

I actually gave the first Thayer student Investiture address in 2014 (youtube.com/watch?v=u-3O5uOGtg4). I would probably give the same speech with the same points. First, you are infinitely invaluable and, second, holding this truth allows you to fulfill the mission of Thayer and be "the most capable and faithful [with] the most responsible positions and the most difficult service." Third, you give a Dartmouth degree value, so make the most of it.

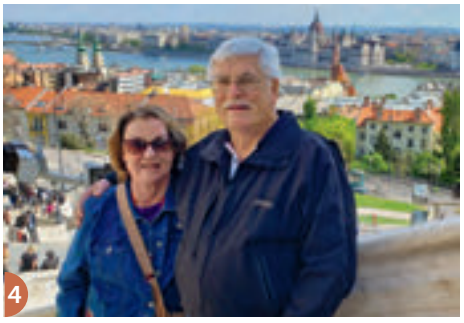
—Drew Wong '12 Th'14

Have irrational self-belief and persistence in this ever-changing world—your voice, unique experiences, and world perspectives are superpowers.

—Atri Raychowdhury Th'17

Reach out to the alumni family for advice and to pass on the help you received to other students or alums.

—Wanfang Wu Th'19



Gallery

1. Varsha Eluri Th'11 and her husband, Michael, recently welcomed son Aariv.
2. Jocelyn (Woolworth) Mason '05 and Brian Mason '03 Th'04 Th'05 and their three children explored the Pemigewasset River in New Hampshire.
3. Eric Fisher '82 and partner Bea Spolidoro practiced architecture from Lake Como, Italy.
4. Doug Boike Th'78 and his wife, Dorena, traveled to Budapest, Hungary, as part of a Danube cruise in May 2019.

thayer notes

1950s

Charles Queenan '52 Tu'53 Th'53: I am a retired attorney who specialized in the areas of tax, corporate, international, and transactional law. I serve as senior counsel and chairman emeritus to the law firm of K&L Gates LLP, having served previously as a partner and chairman of the management committee. I am a life member of the American Law Institute, a member of the Pennsylvania and Allegheny County bar associations (and their tax sections), the fellows of the American Bar Foundation, the Federalist Society, and the Dartmouth Society of Engineers. I have also served as chair of the Pittsburgh Tax Club and the annual Penn State Tax Conference. I lectured on a wide variety of topics, including in the areas of tax, international, merger, sensitive payments, and Foreign Corrupt Practices Act. *The American Lawyer* magazine honored me with its 2014 Lifetime Achievement Award. The award recognized my early growth strategy for the firm as "foundational to the expansion and success of what is now K&L Gates" and that I was "a backbone of numerous local cultural and civic institutions."

Robert Simpson '53 Tu'54 Th'54: I am fully retired, just passed age 90, and living with my wonderful wife in a retirement community called Shannondell near Valley Forge in Pennsylvania.

1960s

Neil Drobny '62 Th'64: Since retiring to Kalamazoo, Mich., about a year ago, I have gotten itchy to get back into the classroom. Starting this fall I will be an adjunct instructor in the Haworth College of Business at Western Michigan University. I will be mentoring students working on sustainability projects for corporate sponsors. Personal time has been spent enjoying the local lakes and trails and working, in support of a contractor, on a major house renovation.

1970s

Wayne Ballantyne '77 Th'78: After graduation from the Thayer BE program in 1978, I worked at Mitre Corp. for about nine months, then took an electrical engineer position at Motorola in south Florida, very near where I grew up. At Motorola I worked in pager and two-way public safety FM radio development up until around 1995, when we became the primary development site for iDEN Nextel radios, a long and profitable run lasting almost 20 years and helped greatly by the fact we were sole source. My role was lead architect for development of baseband modem integrated circuits, integrated GPS internet protocols, and complex power management integrated circuits. Later, as Nextel started winding down, we developed WiMax and LTE smartphones for Sprint. When Google acquired Motorola Mobility in 2012, we also delivered the Nexus 6 to them. Alas, all good things come to an end, and after Google sold us to Lenovo in 2014, our site was closed in August 2015. Fortunately, I was blessed to be able to leverage my ex-Motorola contacts out west and land a position in February 2016 at Intel in Chandler, Arizona, where I have been working on 5G transceiver development ever since. I dearly remember my Thayer experience and colleagues **Kelly Carter '77 Th'78, Bob Fleming '78, Steve Askey '76 Th'77**, and **Jack Maney '77**.

Doug Boike Th'78: I have recently wrapped up my engineering and management consulting career—final years were largely focused on the aerospace industry. It was a wonderful experience, but the travel and time commitments are not missed. I have stayed very active in investment and civic roles and continue to serve as the chair of Oak Ridge Financial Services, a successful community bank in the Greensboro, North Carolina, region. I am now also serving as the board chair of the Greensboro Symphony Orchestra and the North Carolina Brass Band, two wonderful professional organizations. I have enjoyed living in the Piedmont Triad region of North Carolina for 24 years now.

1980s

Eric Fisher '82: Fisher ARChitecture is now practicing for a couple months from our second office above Lake

Como, Italy. Bea Spolidoro and I are looking forward to returning home from this remarkable country filled with ideas and thoughts that will inform our designs through the coming year. I got to tell you: Running a progressive architecture firm, or any business for that matter, takes lots of time and effort. You start early and end late. You sit a lot and stare at a screen. Yet, as I learned from my Thayer classes, you can't output more from a system than what you put into it. So after a while, you get stale. You need fresh input. The Milan museums are spectacular. And it seems that every time you turn a corner in that magnificent world center you come upon an architectural classic. Some of the work is rooted so much in its time you can only admire it, but much of the more recent stuff speaks directly to the challenges of our current time. I know my batteries are re-charging when I see a building and want to adopt its ideas and motifs into my own work! We will return home mid-September to Pittsburgh, the small-but-mighty regional center where we live in the United States. Will our architecture suddenly sprout arches, thick walls, and olive trees like third arms and legs? Certainly not. But will something of the poetry of Italy's incredible natural landscape and architecture inflect our work in subtle unexpected ways? I certainly hope so!

Robert Mazzarese '87 Th'97 Th'98: COVID-19 has been kind to the Mazzareses, both professionally and personally. Perhaps most importantly, it gave us a chance to crouch together as a family before we start launching our three teenage boys off to college.

| 1990s |

Vishal Gupta Th'94: I joined Lexmark, an imaging giant, in early 2021 as its chief investment officer (CIO) and chief technology officer (CTO) and am energized to drive the transformation of Lexmark to exciting areas, including Internet of Things and becoming much more relevant in artificial intelligence and data analytics. I was fortunate to win the CIO 100 Award at Lexmark for innovations in digital thread and was also recognized as the top 100 CIO/CTO globally by the National Diversity Forum. My daughter is headed to College in August and was accepted to a seven-year accelerated integrated program for BS-MD and we will be missing her.

| 2000s |

Brian Mason '03 Th'04 Th'05: It has been two years since my family and I moved back from the Bay Area to Lexington, Mass. We are settling in and loving the seasons, being closer to family, and enjoying hiking and skiing in the White Mountains. I work at Sonos leading a new category of product development, and Jocelyn is a reading specialist. One of the unanticipated highlights of the past year has been walking my three children to school (one of the benefits of being work from home). Just this past week the five of us ventured up to the White Mountains to go camping on the Pemigewasset River. We hiked to Franconia Falls and played on the rocks all day long. Twenty years ago, Jocelyn '05 and I met on Dartmouth trips and went to the falls. It was amazing to be back!

Mayank Agrawal Th'08: I completed my MEM from Thayer in December 2007. I have been in the biotech/pharma space ever since. I am passionate about bringing important treatments to patients fighting debilitating diseases. I currently work at Takeda Pharmaceuticals as director of global marketing in oncology. I get up every day energized knowing that we at Takeda fight tough diseases and the work we do helps serve patients throughout the world. I am particularly proud of helping launch an innovative, targeted cancer therapy for treatment of non-small cell lung cancer across key markets. What has helped me advance professionally is to not be afraid to work outside my comfort zone and gain a diversity of experiences.

| 2010s |

Saryah Azmat '11 Th'11: I have been promoted to chief business officer of Turnstone Biologics Corp., a clinical-stage biotechnology company focused on the development of cancer immunotherapies. Turnstone Biologics, a privately held clinical stage biotech company, is developing breakthrough cancer immunotherapies by advancing two leading and complementary platforms that drive innate and adaptive tumor immunity, to provide benefit to the millions of cancer patients underserved by current treatment options.

Varsha Eluri Th'11: I recently accepted a role as associate partner at Ipsos, starting in August. I'll be building and leading Ipsos' digital strategy capability for the healthcare clients. More importantly, my husband and I (not-so) recently welcomed a baby boy, Aariv Eluri-Maddock, who is now almost 9 months old. We are navigating being new parents in this crazy pandemic and are really enjoying all the time we're getting to spend with our son, which would't have been possible if we weren't working remotely.

Prateek Reddy Th'11: I'm working as a risk strategist at Stripe. It's a lot of analytical problem solving, so the core engineering skills are at play all day, every day. There is a lot of skills overlap with credit risk research and investments (most of my professional background after Dartmouth). Managing risk at a very product-centric financial tech firm such as Stripe means I need to understand the intricacies of the technical products being built and analyze all possible vectors of risk, score different users of our products, and come up with strategies to mitigate the various vectors of risk.

Michael Henson Th'14: I'm currently an engineering manager at a tech startup classed Grayshift (grayshift.com). I manage a team working on a mobile forensics tool used by law enforcement and other agencies around the world to solve crimes. Our innovative solutions help law enforcement ensure public safety lawfully. I was employee No. 16 and now we have well over 100 employees.

Benjamin Nollet '14 Th'14: For the last several years I was down in Houston, Texas, working at the Johnson Space Center on NASA's Volatiles Investigating Polar Exploration Rover (VIPER) mobile robot project as a design engineer. Thayer alum **Jeffrey Loo '18 Th'20** is still working down there. I very recently relocated to Connecticut to be closer to family and will be working at General Dynamics on submarine propulsion systems.

Atri Raychowdhury Th'17: I've always been passionate about using technology to empower musicians. I'm leveraging my Thayer (MEM) skills at Sony Music as a senior product manager on the data strategy group, where I launched a portfolio of business intelligence platforms used daily by our artists, management teams, labels, and executives globally to help make informed business decisions and scale Sony's artists into superstars faster.

Ebrahim Najam Th'19: I'm currently working as an application and electrical engineer at SemiNex, a laser diode manufacturer near Boston. My job entails providing electrical support to customers and designing pulse testing for laser diodes. SemiNex is a small company of around 12 people, which means each of us wears many hats. I have to work with the production engineer to ensure our vendors are on time and make application notes on new technology, such as triple-junction lasers. I'm based in the greater Boston area and still keep in touch with Thayer friends. In fact, I'm applying for the ME program at Thayer this fall. Fingers crossed.

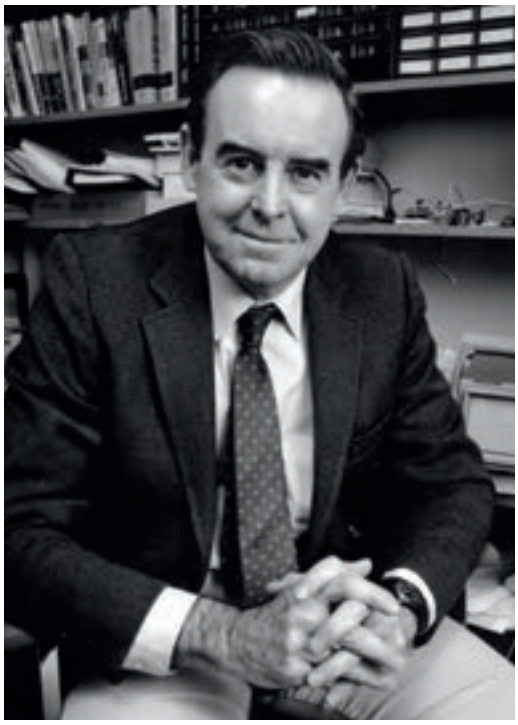
Wanfang Wu Th'19: I am transitioning from engineering into marketing. Specifically, I took a product marketing co-op after one and a half years as an engineer. I was a quality engineer at Abbott Vascular on stents and guidewires. Basically, I was at the corporate level supporting and managing quality engineers at the factories with projects that affect all factories. Product marketing does all the marketing related to a product (whereas other marketers focus on brand or company or the entire set of customers in general) and helps create the resources that sales and other teams use when they need to pitch the product. My current project is to help write web content to redefine our web presence to look much bigger than we actually are.

in memoriam

WILLIAM DAVID STRATTON

— 1934-2020 —

"Life-changing" professor inspired engineers.



Professor William David Stratton died on April 19, 2020, in his home of 45 years in Orange, N.H. After completing his undergraduate work at Wesleyan College, Stratton earned a master's in engineering from MIT, where he met his future wife, Shirley Anne Bentley, a graduate student in the architectural program. He then served in the Navy before returning to MIT to complete a PhD in electrical engineering.

In the early 1970s, Stratton joined Dartmouth's Thayer School of Engineering faculty, where he would teach electrical engineering for 31 years and form long-lasting relationships with many of his students. "Professor Stratton was simply life-changing. He cared intensely about his students [and] was one of the most comprehensible profs ever," recalled Peter Heymann '81 Tu'83 Th'83. "The labs were fun, the class was dynamic, and quite a few of us became engineers (and concentrated in electronics) because of his leadership and dedication to teaching," added Kimberley Quirk '82 Th'83.

Stratton also consulted in electronics for various companies and worked with several medical doctors on biomedical innovations. Outside of the classroom he enjoyed climbing the Presidential peaks, collecting stamps, woodworking, restoring WW II guns, flying, playing tennis, and repairing his tractor.

He was predeceased by Shirley in 1982, and he is survived by his brother, Geoffrey, and his family.

obits

Robert A. Closser Jr. '51 Tu'52 Th'52 died on March 17, 2021. At Dartmouth he earned his AB in engineering and was active in the Canoe Club, Dartmouth Outing Club, Tabard, and the track team. During the Korean War he served in the U.S. Coast Guard as a deck officer and became a lieutenant commander. His entire career from working in the plant to upper management was with Sherwood Solvents and later Union Oil of California. Upon retirement he was active in the travel business for 27 years. He was an Eagle Scout and later a scout leader, a Sigma Chi, a director of Native Sons and Daughters of Kansas City, Mo., and a member of the Vanguard Club. He is survived by his wife of 67 years, Ann, and children Robert, David, and Mary Ann and their families.

Samuel H. Daniell '52 Tu'53 Th'53 passed away January 22, 2021, due to complications related to COVID-19. Sam earned his AB in engineering sciences and then master's degrees in the Tuck-Thayer program. In Hanover he was active in Alpha Theta, Casque & Gauntlet, Green Key, men's track and cross country, and Navy ROTC. He served in the Navy as an officer for three years following his graduation. Sam spent his career as an executive with two manufacturing companies, the Bryant Chucking Grinder Co. and the Nashua Corp., from which he retired in 1994. He was predeceased by his wife, Zandra. He is survived by brothers Warren '48 Th'50 and Jere '55 and children Christopher '76, Stephen '79, Zia '91, Brian, and Mark and their families, including 12 grandchildren.

Ralph Allen "Skip" Adams '53 Th'54 died August 5, 2021, in his hometown of Houston, Texas. "Skip" earned his master's at Thayer School and served two years in the U.S. Army Corps of Engineers, earning an honorable discharge as a first lieutenant and platoon leader. He then spent eight years in heavy construction in the Boston area. Among his major projects were dormitories at Brandeis University, the Massachusetts Turnpike extension, and the Callahan Tunnel. In 1964 he assisted in the Amistad Dam construction on the Rio Grande in Texas, a career-making project that led to stints in Houston as a civil estimator and supervisor, including with Parsons-Gilbane in petrochemical construction. He is survived by his wife of 48 years, Bobbie; sons Robert, Russell, and Troy; four grandchildren; and seven great-grandchildren.

Clinton R. Gaylord '54 Tu'55 Th'55 died on May 14, 2021, in Tucson, Ariz. At Dartmouth he played four years of football, was a brother of Beta Theta Pi, and graduated from the Tuck-Thayer program. Clint enrolled in the Navy's officer candidate school and trained in explosive ordinance disposal, becoming a qualified diver and explosive expert. Upon leaving the Navy in 1958, Clint's IBM career began in Endicott, N.Y. He moved many times for job changes and promotions, finally arriving in Boulder, Colo., where he met and married Donna and combined their two families. In 1979 he moved the family to a new IBM plant in Tucson, where he retired in 1991. Clint is survived by Donna; children Beth, Judy, Bill, and Mike and their spouses; stepchildren Kirsten and Andrea and their spouses; and 10 grandchildren.

Alan A. Staley '54 Th'55 passed away on July 13, 2021, in Lexington, Va. Alan came to Dartmouth from Scarsdale (N.Y.) High School, where he played basketball and was co-captain of the football team. At Dartmouth he was a member of Theta Delta Chi and Dragon. After graduating from Thayer School with a master's in electrical engineering, Alan spent most of his working life in computer systems. He worked for IBM and Sperry Rand Corp. and spent some years as an independent consultant. His career carried him and his wife, Helen, a computer software specialist for A.C. Nielsen and Grumman Aerospace, to Australia and Hong Kong. Alan and Helen both retired to Virginia after "boat bumming" in the Caribbean. He is survived by Helen.

William B. Macurdy '55 Th'57 of Falmouth, Mass., passed away August 18, 2021. After earning his bachelor's and master's in electrical engineering at Thayer, Bill earned a second master's in electrical engineering from New York University and completed his education with a PhD from MIT in 1963. He began his career as an engineer at Bell Laboratories, eventually becoming a senior executive.

Bill retired as a vice president from AT&T in 1988. He was predeceased by son Allan. He is survived by children Anne and James and their spouses, six grandchildren, and five great-grandchildren.

Jack M. Wells '59 Th'60 died on March 16, 2021. At Dartmouth he earned an AB and MS in electrical engineering and was involved in the International Relations Club, Air Force ROTC, Zeta Psi, and the ski team. His 30-year career with the Air Force included installing the hot line to the Kremlin in the White House during the Kennedy presidency; launching spy satellites in the Atlas Agena program; working in the Minuteman and Peacekeeper nuclear missile programs; and as air attaché at the U.S. embassy in Kuala Lumpur, Malaysia. He finished his career as a commander of the Site Alteration Task Force at Warren Air Force Base, retiring as a full colonel. Jack is survived by his wife of 44 years, Mary Gay; sons Kenneth, Kevin, Brian, and Mark; stepchildren Elise, Tom, Steve, and Tara; 20 grandchildren; and nine great-grandchildren.

Robert M. Daly '61 Th'62 of Westford, Mass., passed away on April 19, 2021. At Dartmouth he was a brother of Sigma Chi, Interfraternity Council, and Air Force ROTC. He earned a degree in electrical engineering from Thayer and served in the Air Force. Bob began his career in Honeywell's computer division as a logic designer and rose to become director of systems engineering and was involved in the formative stages of AI research. In 1984 Bob joined Lexi-Data Corp. as vice president of engineering and then moved to Apollo/Hewlett-Packard. He was a corporate-level program manager with HP at his retirement in 2004. He leaves his wife, Judith, children Kristen '89 and David, their spouses, and six grandchildren.

Ralph F. Spencer Jr. '61 Th'62 died on August 23, 2021. "Dick" entered Dartmouth as a premed and was involved in crew, the Dartmouth Outing Club, and Sigma Phi Epsilon. He shifted his focus to electrical engineering and graduated with a bachelor's from Thayer and then a master's and PhD from the University of Pennsylvania. Dick moved his family to Dallas, Texas, to start a career in the emerging computer industry. He later relocated to Massachusetts to work for Digital Equipment Corp., which was eventually acquired by Compaq and then Hewlett Packard. He then spent a few years as a consultant with Hamilton Technologies Inc. before retiring. Dick was predeceased by his second wife, Nancy. He is survived by sons Brad and Jeff, siblings Sandra and John, four grandchildren, and his first wife, Prudence.

Ephraim N. Aniebona '64 Th'65 passed away on January 1, 2021, surrounded by family in his home country of Nigeria. He was a pioneer at Dartmouth as the first African to be enrolled in the African Scholarship Program to American Universities. Ephraim earned his bachelor's in electrical engineering from Thayer School and then an MS and PhD at New York University. He began his career as a research engineer at Bell Laboratories. In 1976 he returned to Nigeria and became a professor, rising in 2007 to head the physical sciences department at Novena University. He published extensively in scientific journals and invented several patentable devices related to the collection and application of solar energy. He is survived by his wife, Patricia; children Anwuli, Uju, Emeka, Ikechukwu, and Ibe; and four grandchildren.

Patrick K. Nutor '90 Th'90, a longtime board member of Ashesi University, died of COVID-19 on January 11, 2021. After earning his engineering degrees at Thayer School, Patrick worked as a senior field engineer at Schlumberger Wire Line Services and then founded Accu-Computers and Accu-Works in Accra, Ghana. He was involved in the founding of Ashesi—whose mission is to educate ethical and entrepreneurial leaders in Africa—and assisted the team from the UC Berkeley Haas School of Business that traveled to Ghana in 1998 to conduct a feasibility study on the university project. The Ashesi board of directors has named the university's research building the Patrick K. Nutor Hall in honor of his service. "He was a bridge between pragmatic realism and Ashesi's finest dreams," said one trustee.

Find more obituaries:
dartmouthengineer.com.

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

| in memoriam |

B. STUART TREMBLY TH'83

— 1953-2021 —

Inventor brought "a high level of rigor" to the classroom.

Longtime engineering Professor B. Stuart Trembly died unexpectedly on July 18, 2021, after suffering a stroke. Born in New Haven, Conn., he earned a BS in electrical engineering at Yale before coming to Hanover to earn a PhD and join the Dartmouth Engineering faculty as an assistant professor. For nearly four decades, Trembly challenged and engaged his students. "He was an exemplary teacher and scholar who provided a high level of rigor in his courses and was always available for his students," says Thayer School of Engineering Dean Alexis Abramson.

His research focused on therapeutic heating and properties of the tissue as well as the development of various biomedical techniques to treat disease. He developed a microwave thermokeratoplasty technique to correct nearsightedness and was working to thermally treat lung cancer using minimally invasive ablation techniques. A holder of numerous patents, Trembly founded and co-founded several successful biomedical technology startups.

In 2019, he was honored with the Dartmouth Technology Innovation and Commercialization Award at the Dartmouth Entrepreneurs Forum. In 2020, he was elected as a senior member of the National Academy of Inventors, which recognizes scientists who have demonstrated remarkable innovation-producing technologies that have delivered or have the potential to create significant impact on society.

He is survived by his mother, Grevilda, and brother Mark and his family.

Collaborations

Thayer team earns first innovation accelerator award.

Curtis, Lee, and Shin at work in the Lee Lab.

MARK WASHBURN

Targeting Cancer

Professor Jiwon Lee and his team are working to ensure cancer patients have access to the best treatment possible. In collaboration with Dartmouth-Hitchcock's Norris Cotton Cancer Center, Lee and his team are developing new cancer drug screen technology that connects patients to safer, more effective treatment—quickly.

Lee's group, including postdoctoral fellow Seungmin Shin and PhD candidate and NSF graduate fellow Nicholas Curtis, was one of three teams to receive the first awards from the Dartmouth Innovations Accelerator for Cancer last year. The accelerator, a philanthropy-funded initiative launched in 2020 by Norris Cotton and the Magnuson Center for Entrepreneurship, aims to fund the rapid translation of exciting discoveries into life-changing treatments. The program will provide researchers across Dartmouth with the support, entrepreneurial guidance, and infrastructure needed to translate innovations into the marketplace.

With the $50,000 Quinn Scholar Award, Lee and his team will develop Barcoded-Antibody Library for In-Vitro Engineering (B-ALIVE), a technology platform to enable more accurate, high-throughput screening of new cancer drugs, specifically monoclonal antibodies.

In addition to the award, the team participated in a 10-week course in drug and medical device product development with instructors from local biomedical firms Simbex and Celdara Medical. Lessons focused on biomedical entrepreneurship and regulatory requirements and the team created a step-by-step, multi-year plan for the development of B-ALIVE. *—Kathryn Lapierre*

@thayerschool

#DartmouthEngineer has joined the search for the world's oldest #ice as a collaborator on the new @NSF-funded Center for Oldest Ice Exploration (@COLDEX_STC).

@thayerschool

A @CancerDartmouth team that includes #DartmouthEngineering faculty and a PhD candidate will share promising #RadiationOncology findings at the American Society for Radiation Oncology later this month.

@thayerschool

@dartmouth was thrilled to host Professor Amro Nour from Kuwait this summer! His research with #DartmouthEngineering Professor Fridon Shubitidze could save lives.

@doescience

"Nothing borrowed or blue (as far as we know), but this experiment uses something old and something new. Researchers @thayerschool will be combining well-known techniques with robotics and computer modeling to research bacteria that could make biofuels.

@hopkinscenter

Alice Sheppard works at the intersection of disability, art, and design. In a recent workshop, Sheppard and Professor Eugene Korsunskiy explored the overlooked role of embodiment in design, interweaving ideas from disability aesthetics, design justice, and dance.

Professor Ryan Halter

Ryan Halter, associate professor of engineering and adjunct associate professor of surgery at Dartmouth, discusses his research developing medical imaging devices and systems for monitoring, diagnosing, and treating patients with clinical needs.

@wiid_chi

Fran Wang '12 Th'13 is co-founder of Yona, "an experience design concept that reimagines the pelvic exam for a patient-centered perspective."

DARTMOUTH ENGINEERING

THAYER SCHOOL OF ENGINEERING AT DARTMOUTH
14 ENGINEERING DRIVE
HANOVER, NH 03755

NON-PROFIT
U.S. POSTAGE
PAID
DARTMOUTH COLLEGE

I'm an Engineer and a Future Automotive Designer

"Automotive design is a perfect intersection for me since I love creating art and enjoy the technical aspects of engineering. During orientation, there was a presentation on the Dartmouth Formula Racing Team, and I remember being amazed at how students could create this amazing art and feat of engineering. What I want to do is work on cars, and I get to do that here at Thayer, which is awesome."

—Harrison Munden '23

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