IMPACT

2020

RESEARCH AT BROWN

BATTLING ALZHEIMER'S

PAGE 22

STARTING OFF

In September 2019, Brown received its largest-ever federal grant, $53.4 million from the National Institutes of Health. Brown's School of Public Health is leading a national effort to improve health care and quality of life for people living with Alzheimer's disease and caregivers. Partnering with Hebrew Senior Life, our researchers are guiding colleagues at more than 30 large universities and hospitals around the country, and their projects will show us how to scale breakthroughs in treatment from laboratory to the real world.

True to Brown's breadth and its strength in collaborations, you'll find in our cover story that the University's work on Alzheimer's involves considerably more than this new grant. Through the Warren Alpert Medical School and its affiliate, Butler Hospital, researchers are running numerous clinical trials of potential dementia drugs, and neuroscientists at the Carney Institute for Brain Science are unlocking the genetic puzzle of Alzheimer's.

This issue of *Impact* showcases the many ways Brown is making a difference in the world, through both fundamental and translational research.

One of this year's other stories focuses on the exciting entrepreneurial work of our undergraduate students, and what Brown is doing to inspire this activity. Established in 2016 through the philanthropic generosity of an alumnus, the Nelson Center for Entrepreneurship has grown as an incubator for students creating new products and companies. The center moved into a beautiful new building last year, and the dynamic space is enabling development of ideas to improve people's lives. Brown students and recent alumni are winning many competitions, including two of the three top awards from the highly visible MassChallenge startup accelerator.

Our donor-funded Brown Biomedical Innovations to Impact (BBII) is another powerful example of how philanthropy and research can combine to fuel translational research. In 2019, BBII gave five awards of $100,000 to cutting-edge faculty biomedical projects with the potential to produce new drugs and treatments.

Research also connects with Brown's Open Curriculum, which this year marks its 50th anniversary. I believe that our unique approach to the student-faculty partnership in education has played an important role in Brown's research for societal benefit. I invite you to read about Jessica Meir '99, who at this writing is an astronaut on the International Space Station. She speaks about how her research at Brown, and the influence of two particular professors, boosted her goal of space exploration. In another story, Katie Wu '19, an engineering concentrator fascinated with Japanese language and culture, credits the Open Curriculum for the flexibility and advising that brought her many opportunities, including a Fulbright in Japan.

I hope you enjoy our stories this year, and that you share in my excitement about Brown's investments in research to support our commitment to solving the urgent problems of society.

Jill Pipher
Vice President for Research
Elisha Beniamin Andrews Professor of Mathematics

IMPACT
RESEARCH AT BROWN

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On the Cover: Human neurons are being studied for insights into how Alzheimer's disease can be detected and treated. (Lab of Professor Eric Morrow)

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NICK DENTAMARO/BROWN UNIVERSITY

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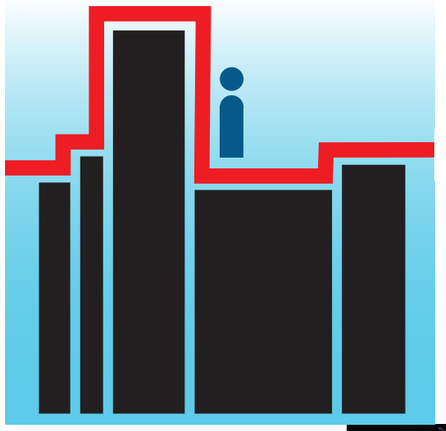
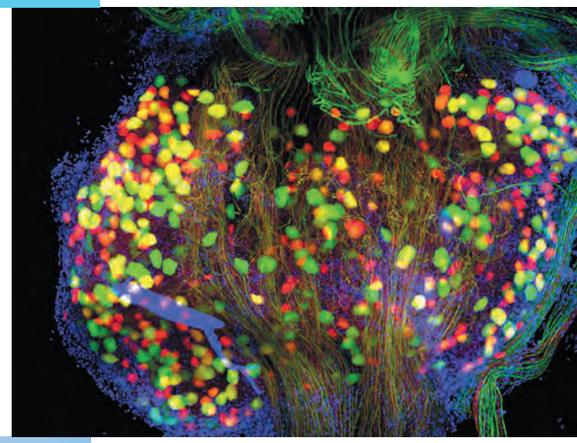




Finding the Frame

A visual art professor earns an Oscar nomination for his film study of "blackness."

"Research is a frame of mind," said RaMell Ross, an assistant professor of visual art at Brown, and his research earned him a 2019 Academy Award nomination for Best Documentary Feature.

As his faculty career began at Brown, Ross wrote, directed, filmed, and edited *Hale County This Morning, This Evening.* "A lot of my research is based on human interaction," he said. "I was researching the history of 'blackness,' what that means to me, how it has changed, and the role it plays in interpretation. So it was a good time to be in Hale County, because it is a predominantly black community."

Ross had moved in 2009 to Greensboro, Alabama, where he still lives for part of the year, and worked as a photography teacher and basketball coach. He took photographs there and began filming people he met. His introduction to Providence came when he pursued his MFA at RISD and started teaching at Brown, first as inaugural professor of the practice for the Brown Arts Initiative, then as a Mellon Gateway Fellow, and now in the visual art department.


RaMell Ross

Ross's film is an impressionistic rather than a formal narrative, confronting the legacies of racism in a pictorial, often dreamlike way. "The organization of the film is my understanding of looking at the community," Ross said. "You don't have to follow a trail of historical threads to do research. History is this actual moment. The archive is now."

Hale County was included on many critics' best-of-year lists. It won many film festival awards, including a special jury prize from the Sundance Film Festival, before receiving the Oscar nomination. Film critics have praised it for its poetry and the quality of its photography. Glenn Kenny of the *New York Times* wrote: "The particularity and power of the larger cinematic image he has created through a multiplicity of moments are impossible to adequately describe in critical prose." **—Noel Rubinton '77**

"Hale County This Morning, This Evening" was filmed in Alabama and Quincy Bryant (below) is one of the main characters.

MARK OSTOW; COPYRIGHT IDIOM FILM. COURTESY RAMELL ROSS & CINEMA GUILD

From Innovation to Impact

A new fund fosters faculty entrepreneurship and brings medical products to the market.

As part of efforts to translate and speed promising biomedical discoveries into commercial product opportunities, Brown Biomedical Innovations to Impact (BBII) awarded five Brown faculty research projects up to $100,000 each in 2019.

"BBII helps to bridge the gap between academic biomedical discoveries and new products by providing much-needed funding," said director Karen Bulock. The goal of BBII, launched by the University's Division of Biology and Medicine in collaboration with the Office of Industry Engagement and Commercial Venturing, is to make aid available when federal funding for research ends and before private investors are willing to invest.

Bulock said the aim is to benefit both patients and the economy by launching new products such as therapeutics, diagnostics, and medical devices. BBII, so far supported by more than $8 million in philanthropic gifts, is part of Brown's 2018 "Brown and the Innovation Economy" initiative to expand the University's impact on economic growth across Rhode Island.

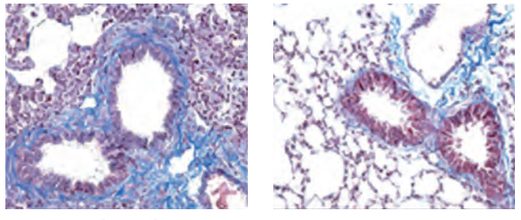
Jack A. Elias, senior vice president for health affairs and dean of medicine and biological sciences, said, "BBII is intended to foster faculty entrepreneurship, and to help bring products to patients who need them. It also has an educational component, as students at all levels have an opportunity to participate in the real-life experience of readying a discovery for market."

The 26 project proposals BBII received were evaluated by an external advisory committee of industry leaders, including pharmaceutical business developers and venture capitalists.

Professor Jeffrey Morgan is working to advance lab-grown, human-derived tissue to repair the heart.

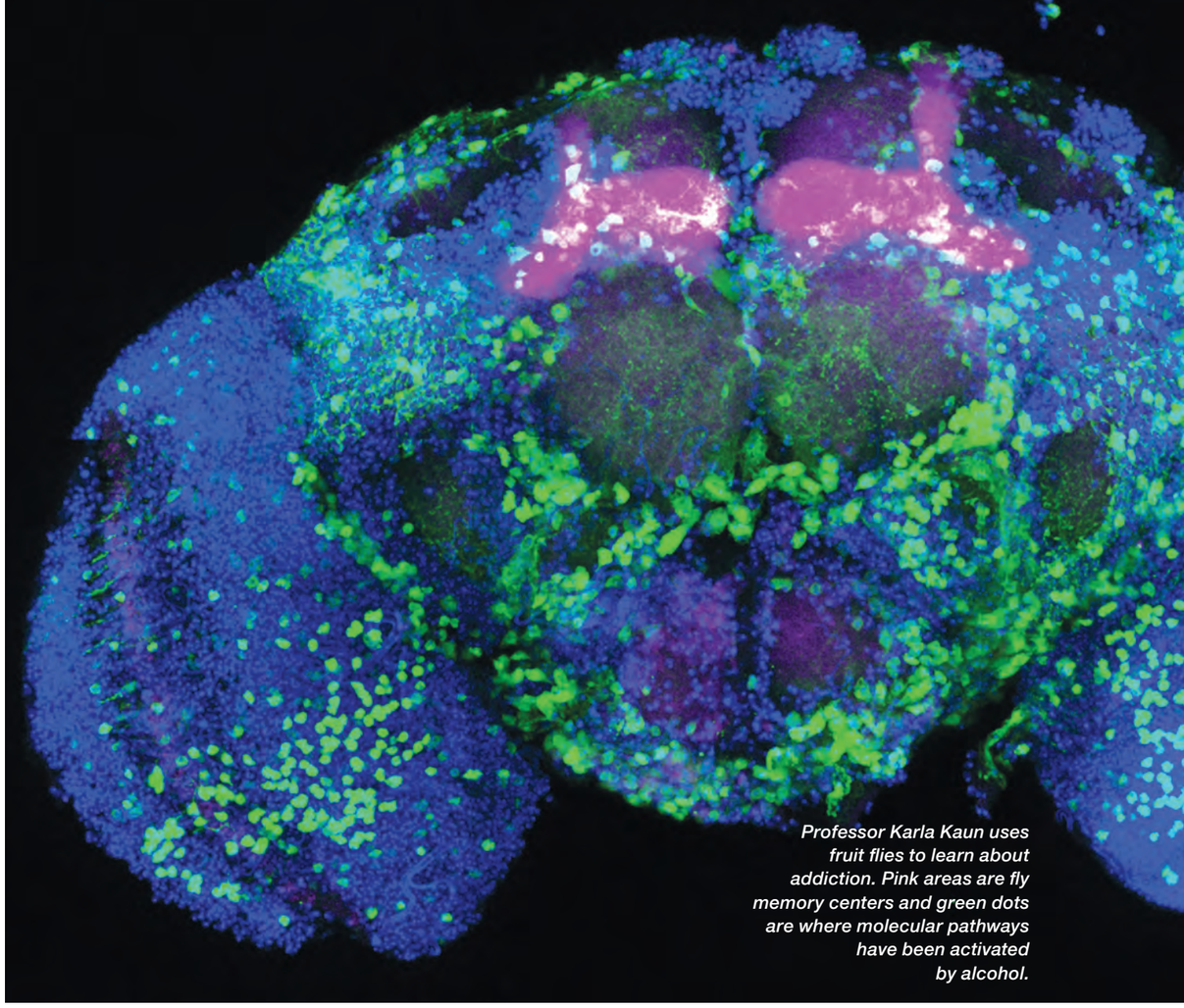
PROJECT AWARDEES ARE:

- **Brian Alverson,** professor of pediatrics and medical science, and **Ravi D'Cruz,** teaching fellow in the Warren Alpert Medical School department of pediatrics, to develop a positioning device for infants less than 60 days old who must undergo a lumbar puncture to test for meningitis;
- **Stephen Helfand,** professor of molecular biology, cell biology, and biochemistry, for work to discover new drugs treating metabolic disorders such as Type 2 diabetes;
- **Chun Geun Lee,** professor of molecular microbiology and immunology, to optimize a new drug to treat pulmonary fibrosis;
- **Jeffrey Morgan,** professor of molecular pharmacology, physiology, and biotechnology and engineering, and **Blanche Ip,** assistant professor of molecular pharmacology, physiology, and biotechnology, to advance lab-grown, human-derived tissue to repair the heart;
- **Carl Saab,** associate professor of neurosurgery and neuroscience, to develop an EEG-based test for diagnosing lower back pain.



Professor Chun Geun Lee is at work on a new fibrosis drug; these are views of mouse lung histology.

ADAM MASTOON, COURTESY LEE LAB



Professor Karla Kaun uses fruit flies to learn about addiction. Pink areas are fly memory centers and green dots are where molecular pathways have been activated by alcohol.

COURTESY KAUN LAB/BROWN UNIVERSITY

The Secrets of Cravings

A neuroscientist looks at how alcohol hijacks a memory pathway in the brain.

Just a few drinks can change how memories are formed. That's the conclusion of a recent study from Karla Kaun, assistant professor of neuroscience at Brown, and her lab team of undergraduates, technicians, and postdoctoral researchers.

Using fruit flies as their models, they found, in research published in the journal *Neuron*, that alcohol hijacks a memory pathway in the brain and forms cravings that fuel addiction.

"One of the things I want to understand is why drugs of abuse can produce really rewarding memories when they're actually neurotoxins," said Kaun, who is affiliated with Brown's Carney Institute for Brain Science and whose research was funded by the National Institutes of Health. "Why do we remember the good things about drugs and not the bad? My team is trying to understand on a molecular level what drugs of abuse are doing to memories and why they're causing cravings."

Once researchers understand what molecules are changing when cravings are formed, Kaun said, then they can figure out how to help people suffering from alcohol and substance use disorder by decreasing how long the craving memories last, or how intense they are.

"One of the important findings from this study is that scientists need to look not only at which genes are being turned on and off, but which forms of each gene are getting turned on and off," Kaun said. "We think these results are highly likely to translate to other forms of addiction, but nobody has investigated that yet."

"One of the things I want to understand is why drugs of abuse can produce really rewarding memories." —Karla Kaun

RESEARCH BRIEFS

Chemical Sleuth

For complicated environmental mysteries, this Brown epidemiologist is in high demand.

David Savitz led a group investigating contamination in Michigan, including the presence of chemicals such as perfluorooctanoic acid.

When the governor of Michigan needed a scientist to head a working group to investigate complicated toxic contamination, he turned to an epidemiologist who had done highly respected research around the world: Brown epidemiologist David Savitz.

At issue in Michigan were per- and polyfluoroalkyl substances (PFAS), chemicals that include byproducts from the use of fire-fighting foam and from manufacturing non-stick household goods and waterproof fabrics. Savitz's study group in Michigan examined the research on environmental health effects of PFAS and prepared a set of evidence-based recommendations for how to protect public health and the environment, and clean up the PFAS contamination.

"We found that the current guideline of 70 parts per trillion may not be adequate to protect human health," said Savitz, a professor at both the School of Public Health and the Warren Alpert Medical School. "We also encouraged the state to pursue research to increase understanding of pathways of exposure, the health impact of different chemicals, and technology to remove these chemicals from the environment." As a result of the report and subsequent assessments, Michigan could have some of the nation's toughest drinking water limits for PFAS.

Savitz said research on PFAS health effects is still developing. He said any health disorders are likely the result of a long period of exposure and that, to continue curbing PFAS pollution, more research is needed on potential sources of exposure besides drinking water.

Savitz has extensive experience in designing and analyzing environmental studies looking at the health effects of chemicals. Before the Michigan project, he served on a panel that studied, in West Virginia and Ohio, perfluorooctanoic acid (PFOA), a man-made chemical used in manufacturing products that people use regularly. Savitz also recently served as the chair of a National Academies of Sciences, Engineering, and Medicine committee that evaluated the potential health effects on U.S. veterans of toxic emissions from military burn pits. **—Noel Rubinton '77**

ALUMNI IMPACT

REBECCA BALLHAUS '13, WHITE HOUSE REPORTER FOR *THE WALL STREET JOURNAL* AND PART OF A TEAM THAT WON A 2019 PULITZER PRIZE, CONCENTRATED IN POLITICAL SCIENCE AND WAS MANAGING EDITOR OF *THE BROWN DAILY HERALD*.

"As a reporter, you need to be able to dig. That means being able to find facts quickly, reliably, and often in situations where people are trying to prevent them from coming out. My time at Brown studying political science and working for the Brown Daily Herald *taught me how to be accurate and dogged, and instilled in me the importance of approaching things from a different angle."*

BROWN UNIVERSITY

NASA astronaut Jessica Meir '99 inside the crew lock area of the International Space Station in October, just before her first spacewalk.

From College Hill to Space

An astronaut from Brown, Jessica Meir '99, tells how the University and its faculty inspired her.

Jessica Meir '99, a biology concentrator at Brown, is a NASA astronaut. She became an astronaut in 2013 and began her first trip on the International Space Station on September 25, 2019. She was interviewed by Eliza Cain '20.

Were you involved in research as an undergraduate at Brown?
I worked with Herman Vandenburgh [now professor emeritus of molecular pharmacology, physiology, and biotechnology]. We were making bio-artificial muscles and looking at things where we could express different genes. One of the things I did for my senior thesis project was evaluating a subculture unit that was being designed to be used in space. A lot of parallels, of course, to what I'm doing now. I was fortunate to be in that lab, where there were a lot of amazing scientists, other students, and postdocs that I learned from. That first research experience was really important for me in terms of developing that interest and that desire to explore further and pursue an advanced degree in science.

COURTESY NASA (2)

Jessica Meir '99

Did your research at Brown change what fields you were interested in?
I took the introductory biology course my first year at Brown, taught by Ken Miller ['70]. He's an eminent scientist, and he didn't need to teach basic biology, but he thought it was important to get those hooks in and get people inspired. I thought I wanted to major in biology, and I took his class, and after that I was sure I wanted to major in biology. Having a good professor and being inspired from the beginning was important.

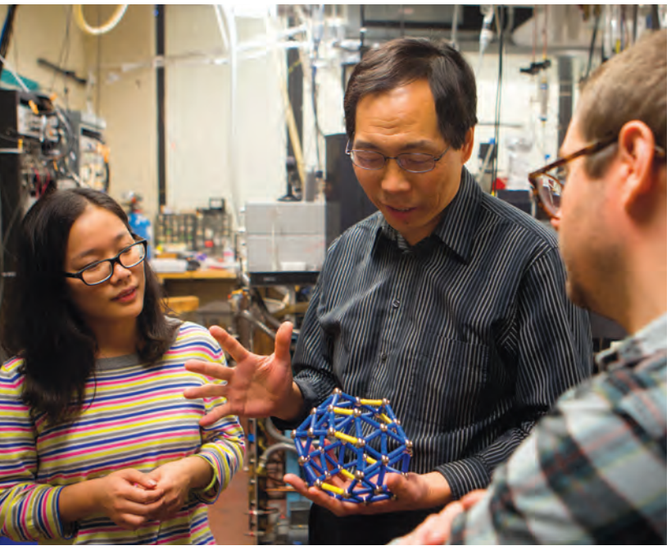
What lessons that you learned from doing research at Brown do you apply to your current job?
As they say, in college you learn how to learn. You learn how to study, you learn what's important, and then you can focus in on things later in life. The diverse and broad education at Brown allowed me to think open-mindedly and broadly. That's important in our lives as astronauts: to be able to approach a problem from multiple perspectives and integrate across disciplines.

"In college you learn how to learn." —Jessica Meir '99

What do you think is special about the research environment at Brown, as opposed to other universities?
It's really useful that Brown has this open-minded and liberal education and allows people to explore and discover classes outside of their concentration, to try to be more well-rounded. That's something that helped me be successful in life.

Research Honors

Six professors receive Brown's top research awards.



Chemistry Professor Lai-Sheng Wang and his research group have made significant discoveries in boron chemistry.

NICK DENTAMARO/BROWN UNIVERSITY

Honoring faculty from a wide variety of fields, Brown awarded Research Achievement Awards to six professors at its annual Celebration of Research in April 2019.

"Researchers at Brown are advancing knowledge and making a difference in the world through exceptional achievements and discoveries," said Jill Pipher, vice president for research and professor of mathematics. "These awards, now in their third year, are one of the important ways that the University recognizes the extraordinary research contributions of our faculty."

Provost Richard M. Locke, who gave keynote remarks at the awards ceremony, said, "Brown's faculty are central to the University's mission to make a difference in the world by collaborating across multiple disciplines to address society's most pressing challenges through critical research and inquiry." He added that faculty members' research accomplishments are closely entwined with their successes in teaching and mentoring students.

Nominations for the awards were sought in six categories and then reviewed by panels of Brown faculty. In addition to the awards, each winner received a $5,000 research stipend.

THE WINNERS OF THE 2019 DISTINGUISHED RESEARCH ACHIEVEMENT AWARDS ARE:

- **Elizabeth Brainerd** (biology and medical science), for developing X-ray Reconstruction of Moving Morphology (XROMM), a technology for visualizing bones and joints in motion, opening new research areas in comparative and orthopedic biomechanics.

- **James Green** (history and Portuguese and Brazilian studies, Watson Institute), cited as the leading scholar of gender and homosexuality in Brazil and prominent among experts on the 1964 to 1985 Brazilian dictatorship.

- **Lai-Sheng Wang** (chemistry), for contributions in areas of atomic clusters and multiply charged anions, helping to open new fields of physical chemistry research that could lead to design of novel nanomaterials.

THE WINNERS OF THE 2019 EARLY CAREER RESEARCH ACHIEVEMENTS AWARDS ARE:

- **Monica Muñoz Martinez** (American studies), for research focusing on immigration, histories of violence and policing, and public memory of history.

- **Andrew Peterson** (engineering), for work about understanding and controlling chemical reaction processes on solid surfaces, with primary applications for energy and environmental technologies such as solar fuel production and carbon dioxide capture and conversion.

- **Kali Thomas** (health services, policy and practice), for research identifying ways to improve the quality of life of older adults needing long-term services and support.

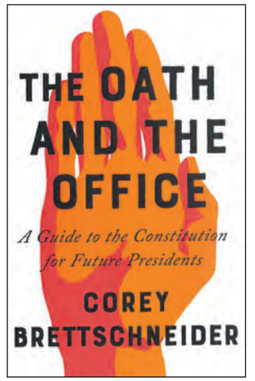
ALUMNI IMPACT

MYECHIA MINTER-JORDAN '94, MD '98, WAS RECENTLY NAMED EXECUTIVE VICE PRESIDENT AND CHIEF IMPACT OFFICER OF DENTAQUEST PARTNERSHIP FOR ORAL HEALTH ADVANCEMENT. SHE CONCENTRATED IN HEALTH AND SOCIETY AT BROWN.

"My time at Brown taught me that, at its core, research is about helping people. During my medical school training, we always focused on the patients and their experience. Now, as a physician leader in community health care, my work to expand access to health care for underserved populations reflects my beliefs in equitable access to innovative health and human services for all people."

What a President's Oath Really Means

A political scientist argues for a limited presidency, with true allegiance to the Constitution.



COURTESY W.W. NORTON & COMPANY

When Brown political science professor Corey Brettschneider wrote in 2016 an essay, "Trump vs. The Constitution: A Guide," for *Politico*, an influential publication about policy and politics, he intended to expand it into a book.

But a number of people urged him to first broaden the scope in order to teach citizens what they should expect from leaders and to help future presidents avoid misunderstanding the Constitution.

Brettschneider's resulting book, *The Oath and the Office: A Guide to the Constitution for Future Presidents*, has become the subject of wide discussion, including in Washington, D.C.

During 2018 confirmation hearings on Brett Kavanaugh for the U.S. Supreme Court, Sen. Chris Coons of Delaware submitted another of Brettschneider's *Politico* essays—"Brett Kavanaugh's Radical View of Executive Power"—into the official Congressional record.

To Brettschneider, "A president who wants to 'preserve, protect, and defend' constitutional principles must be willing to subject him or herself to investigation—just like all the other citizens he or she serves." Brettschneider said his book "is an argument for the limited presidency. It starts with a very simple point, that the president is required in Article II of the Constitution to say some very specific words—it's the only oath that's laid out in detail—namely that he or she will preserve, protect, and defend the Constitution of the United States."

> **"It's the only oath that's laid out in detail—namely that he or she will preserve, protect, and defend the Constitution."** —Corey Brettschneider

He wrote the book as "a compact, comprehensive tour of the Constitution," to give "all readers, voters, and future presidents the knowledge and confidence to read and understand one of our nation's most important founding documents." The final section is about how to stop a president who disregards the oath, with chapters on indictment and impeachment as responses to unconstitutional presidential actions.

Brettschneider did a national lecture tour on his research. He also gave 2018's Alexander Meiklejohn Lecture at Brown, named for the noted alumnus (class of 1893), civil libertarian, Brown dean, and Amherst College president. Brettschneider presented in conversation with two alumni, Chris Hayes '01, host of "All In with Chris Hayes" on MSNBC, and Kate Shaw '01, professor at Benjamin N. Cardozo School of Law. **—Noel Rubinton '77**

SHORT TAKES

Four teams of undergraduate and graduate students, working with faculty, were chosen as **winners of the Brown-Hyundai Visionary Challenge for smart mobility projects,** including aerial robotics and biometrics-based feedback.

A new National Institutes of Health **grant went to Brown medical school faculty testing a novel program that gives pharmacists more authority** and resources to care for people addicted to opioids.

Brown's Judaic Studies program was funded by the Andrew W. Mellon Foundation and National Endowment for the Humanities **to digitize 50 print volumes of its high-quality scholarship previously published only in print,** making it publicly accessible on multiple web platforms.

Literary Arts Professor Emeritus Forrest Gander won the Pulitzer Prize in poetry for *Be With*, a volume inspired by his wife and fellow poet and Brown faculty member, C.D Wright, who died unexpectedly in 2016.

With a $1 million Carnegie Corporation grant, **the Watson Institute is launching a military fellows program** that will bring military officers to study and work with Brown scholars.

A study by Haffenreffer Museum of Anthropology researchers, using a new method of radiocarbon dating, showed that textiles predated European contact and **overturned the long-held belief that Vikings introduced spinning and weaving to indigenous people.**

As the landing site for its new 2020 Mars rover, **NASA chose Jezero crater, a spot that Brown researchers have studied** and championed for more than a decade.

Katie Wu's interest in Japanese culture led her to earn a black belt in Aikido.

Thanks, Open Curriculum

A 2019 alum reflects on how Brown's opportunities changed her.

Over the course of a month last spring, Katie Wu '19 accepted an offer to Princeton's Mechanical and Aerospace Engineering PhD program, won a Fulbright to do research in Japan, and earned her black belt in Aikido.

She gives much credit to Brown's Open Curriculum—celebrating its 50th anniversary this year—for creating a culture where she felt comfortable and able to pursue her varied interests. "It's an environment where people have to think for themselves: what do I want to learn and how do I want to learn it?"

For Wu, a first-generation college student, that meant challenging herself in advanced math and computer science courses outside of her engineering requirements, as well as taking accelerated Japanese language classes. Wu said she benefited greatly from the flexibility of her professors, including Rashid Zia '01, now dean of the College, who let Wu take his computer programming class without having all the prerequisites.

"The philosophy that underpins Brown's Open Curriculum emphasizes the intellectual and personal development of individual students," Zia said. "This is why, as faculty, we provide personalized attention to help each and every student maximize opportunities for learning and growth."

As one of the 38 new Fulbright scholars from Brown, Wu is working in a mechatronics lab in Kyoto, combining her passions for Japanese and engineering while also preparing herself for her PhD program. "I thought it would be a great opportunity to experience what life is like in a different country," Wu said. "It's also a chance for me to try out a focused, independent research project for close to a year, which is the kind of thing I would be doing in graduate school."

Wu is part of a group of Fulbright scholars that marked the third year running that Brown was the nation's top Fulbright-producing university, including both undergraduates and graduate students. Christopher Carr, who oversees undergraduate fellowship programs at Brown, said the sustained year-to-year success of Brown students is a testament to their willingness, supported by the Open Curriculum, to step out of comfort zones academically and engage in teaching and research projects that forge deep connections across geographical, cultural, and linguistic borders. "Our winners rise to meet Fulbright's mission of promoting education through cross-cultural exchange," Carr said. **—Eliza Cain '20**

"It's an environment where people have to think for themselves." —Katie Wu '19

COURTESY WU

RESEARCH BRIEFS

Brown will offset most campus electricity use by buying power from a 50-megawatt solar facility in a former gravel pit in North Kingstown, R.I.

Brown Getting Greener

Collaborative science is leading an ambitious campaign to reduce campus greenhouse gas emissions.

In work with the Institute at Brown for Environment and Society, sociologist Leah VanWey and evolutionary biologist Stephen Porder have done extensive research on environmental change around the world.

The research focus of their recent assignment in coleading a key University effort was distinctly different: the Brown campus and figuring out how to reduce campus greenhouse gas emissions to net-zero by 2040. In February 2019 their work culminated in the Brown Corporation's approval of a phased plan to cut emissions by 75 percent below 2017–18 levels by 2025, and achieve net-zero no later than 2040.

"This was very much a collaborative science project," said Porder, who became the first assistant provost for sustainability in 2018. Many campus departments, as well as students, were involved in the research and planning.

"The goal was finding the right energy sources," Porder said, "We've carefully studied our buildings, our heating infrastructure, and our budget. We've looked at logistics on how best to maintain campus operations while infrastructure improvements are being made."

VanWey, who during the project was associate provost for academic space and is now dean of the School of Professional Studies, said, "Brown is a place where knowledge becomes action. We know that climate change is one of the primary challenges humanity faces, so it's critical for us to lead by example."

The plan's first phase involves creating a 50-megawatt solar facility in a former gravel pit in North Kingstown, R.I., to offset 70 percent of campus electricity use. The remaining 30 percent will be offset through a Texas-based wind farm.

"We've carefully studied our buildings, our heating infrastructure, and our budget." —Stephen Porder

The second phase, scheduled for 2022, will convert the central heating plant to post-consumer bio-oil as primary fuel. The project's third phase involves further upgrades to the University's central heating loop and buildings, and the final phase, scheduled for 2038, calls for conversion of Brown's heating plant to renewable electricity. Currently, the plan envisions air-source heat pumps as the heat-generation technology. **—Noel Rubinton '77**

Priority: Privacy

The goal is to make full use of data possible without compromising sensitive information.

When Seny Kamara thinks of an ideal world, he sees people enjoying the full advantages of data and computing, without any risk to their privacy.

Kamara, an associate professor of computer science who came to Brown after eight years at Microsoft Research, is a leader in the search for encryption solutions that protect data privacy while still supporting computation on the data without having to decrypt it first. This is a growing field, in which Brown is an important place for trials, and Kamara directs Brown's Encrypted Systems Lab.

One of the challenges that makes computing on encrypted data so difficult, Kamara said, is that the entire point of encryption is to make data unreadable and unusable. A specific challenge Kamara works on is how to search through encrypted data quickly. Since search algorithms are fundamental to almost every computer system, the solutions Kamara works on could have a major impact on digital privacy.

Kamara is working on designing a new generation of encryption algorithms that support search and analytics. "When good policy and advanced technology combine, the benefits of big data can be obtained without compromising sensitive information," he said.

Recently Kamara and Brown colleagues launched Pixek, a camera app for Android phones that aims to allow users to search their photos, yet be protected from data breaches and unwanted photo disclosures. It employs "structured encryption," designed so that, when you search your encrypted photo collection, the cloud only sees an encrypted query but is still able to return the relevant encrypted photos—all without ever being able to decrypt the queries or the photos.

In June 2019, Kamara was an organizer of experts from around the world who discussed encryption solutions at Brown's Institute for Computational and Experimental Research in Mathematics (ICERM). Kamara was a member of a National Academies of Sciences, Engineering, and Medicine committee that generated ideas for tradeoffs between data privacy, encryption, national security, and law enforcement. He has also been a technical advisor to U.S. senators drafting privacy legislation and to large software companies. **—Noel Rubinton '77**

Seny Kamara directs Brown's Encrypted Systems Lab.

STEPHEN CROCKER/BROWN UNIVERSITY

Managing Childhood Obesity

Overweight children suffer losses in cognitive development, making interventions key.

"The first few years of life are critical for cognitive development," said Nan Li of Brown's School of Public Health, and increasingly childhood obesity is seen as a significant obstacle to healthy brain development.

Nearly one in five children and adolescents in the United State is obese, with more at risk. Obesity and related health problems have become urgent public health issues, and Brown researchers are defining the population at risk, finding the root causes, and testing possible solutions.

"The first few years of life are critical." —Nan Li

Li, an assistant professor of epidemiology, was lead author of a study investigating how weight status affects how children learn, remember information, and manage attention and impulses.

Collaborating with Joseph Braun, associate professor of epidemiology, Li found obesity in early childhood associated with lower IQ, decreases in perceptual reasoning, and less working memory at school age. Their work, published in the journal *Obesity*, said further research should investigate whether obesity is connected with school performance, attention-deficit/hyperactivity disorder, and other learning disabilities.

Meanwhile, Elissa Jelalian, professor of psychiatry and pediatrics at Brown's Warren Alpert Medical School, is using a five-year, $2.45 million federal grant to adapt and evaluate a family-based intervention program for children with obesity who live in low-income settings.

Based at the Weight Control and Diabetes Research Center of the Miriam Hospital, an affiliate of the medical school, the program is evaluating the effectiveness of programs for children ages 6 to 12 years in the settings of housing authorities and physician offices designated "patient-centered medical homes."

Jelalian's research is part of the Healthy Weight Initiative of Brown's Hassenfeld Child Health Innovation Institute, which is linked to Brown's public health and medical schools and aims to improve dietary intake and physical activity to prevent excess weight gain in children. She said, "The most pressing need is in children from low-income settings, who are at greatest risk for obesity and least likely to have access to care … . This work extends our research on healthy weight, nutrition, and physical activity."

DANA SMITH; MINDY OSWALD

Shoot for the Moon

Students became the research team for a private Moon exploration company.

Professor Jim Head (r) arranged the class that let students do planning for a Moon landing.

NICK DENTAMARO/BROWN UNIVERSITY

When a space exploration company needed research help, it turned to a group of Brown undergraduate and graduate students.

Through a class called "The Origin and Evolution of the Moon" arranged by Brown planetary scientist James Head PhD '69, who has longtime ties to NASA and other space organizations, the students became a research team for ORBITBeyond, a private space firm developing a moon-landing vehicle and rover.

The students investigated a moon landing site in Mare Imbrium, developed rover routes and exploration strategies, and delivered their recommendations to ORBITBeyond. "Being involved at this stage in our careers with actual mission planning is an experience I don't think we could get elsewhere," said Ashley Palumbo, a PhD student and one of the leaders of the project, "It's just a great opportunity."

"Being involved at this stage…with actual mission planning is an experience I don't think we could get elsewhere." —Ashley Palumbo

The collaboration drew praise from top NASA officials. Students had a chance to present their work to Thomas Zurbuchen, associate administrator for NASA's Science Mission Directorate, and Sarah Noble PhD '04, a program scientist in NASA's planetary sciences division.

Zurbuchen said, "Brown is a great example of training and research to support the objectives of this new exploration campaign, and especially to understand the interests of commercial exploration partners and to maximize science that can come from such a novel approach."

Ariel Deutsch, who co-led the project with fellow PhD student Palumbo, said, "Over the course of the semester, we discussed the current state of knowledge in lunar science. We outlined the questions that are still unanswered and then started thinking about how this mission might help answer them."

The students and ORBITBeyond engineers presented findings in March 2019 at the international 50th Lunar and Planetary Science Conference in Houston, Texas.

ALUMNI IMPACT

CHRISTOPHER SHARPE '90 WAS RECENTLY NAMED CHIEF INVESTMENT OFFICER AND PORTFOLIO MANAGER FOR NATIXIS ADVISORS, INTERNATIONAL INVESTMENT FIRM. APPLIED MATHEMATICS WAS HIS BROWN CONCENTRATION.

"I draw upon what I learned and how I learned at Brown almost every day in the math and quantitative nature of my career. Brown laid the foundation for it. These days, a chance to steal away for a few hours and really break down and think out a problem like I did when I was at Brown is necessary but somewhat of a guilty pleasure."

COURTESY SHARPE; ALEX SAFRON

Credit Where It's Due

An intricate analysis of academic journals moves toward giving women proper recognition.

Inspired by the 2016 movie *Hidden Figures* on unheralded black female mathematicians who played a large role in the early U.S. space program, Emilia Huerta-Sanchez, assistant professor in Brown's department of ecology and evolutionary biology, and her collaborators at San Francisco State University tackled what they thought was a similar situation in population genetics.

She and colleagues analyzed the contributions of women researchers in all studies published in an influential journal from 1970 to 1990, and their findings were striking: many female computer programmers had been denied proper credit for their work.

Emilia Huerta-Sanchez says she hopes to "change misperception of women's relative absence from STEM fields."

Many women, responsible for developing and running computational simulations to test hypotheses explaining genetic diversity within populations, were recognized only in papers' acknowledgements section rather than listed as authors. Of programmers mentioned in the acknowledgements, 43 percent were women, while only 7 percent of the study authors were women.

"Many women worked in research in computational biology in the 1970s and made significant contributions to papers but were not given authorship," said Huerta-Sanchez. "There are many stereotypes about women's ability for science, technology, engineering, and mathematics (STEM) fields because there aren't as many women role models. We hope that by shining a light on the contributions these women have made, it will change misperception of women's relative absence from STEM fields."

"I don't think there is anything specific about the journal *Theoretical Population Biology*," Huerta-Sanchez said of the journal studied. "In our interviews with researchers, it is apparent that it was common practice not to consider female programmers and numerical analysts for authorship." The findings were published in the February 2019 issue of the journal *Genetics*.

"We plan to do the analysis in other journals and conduct interviews with acknowledged female programmers to have a record of their type of contributions," Huerta-Sanchez said. "We want to make their contributions known."

Forward Fast

For this first-generation college student, a passion for research has taken hold.

William Jordan worked at Brown in the lab of biology professor Erica Larschan.

NICK DENTAMARO/BROWN UNIVERSITY

"I'm trying to help change the picture."
—William Jordan PhD '19

Since he discovered his passion for scientific research, William Jordan has looked like someone making up for lost time.

After starting to do research when he got to college at Virginia Tech, Jordan has moved forward at a fast pace. He came to Brown for its functional genomics track and enrolled in a doctoral program, connecting with the lab of Erica Larschan, associate professor of molecular biology, cell biology, and biochemistry.

Winning a Howard Hughes Medical Institute fellowship and a National Science Foundation Research Fellowship for his graduate training, Jordan went through at a highly accelerated pace, earning a master's degree in data science and a biology PhD within five years.

His key research, which won a Joukowsky Family Foundation Outstanding Dissertation Award and part of which has already been published in *Trends in Genetics*, focuses on how the three-dimensional structure of a chromosome influences gene activity. With the goal of more effectively treating disease, Jordan said, "I've always been a bit of a tinkerer, as well as interested in how all the cells that make up an organism work. I hope my work will contribute to the general understanding of how genes are regulated and how dysregulation that results in disease states may come about."

Jordan, who is African American and a first-generation college student, sees part of his role as breaking ground for others from groups underrepresented in the academic research worlds. "I'm trying to help change the picture and serve as the inspiration for someone younger who might see my work and be inspired to be a scientist," he said. "If they don't have anyone they can relate to in the sciences, it is a hard path." After graduating from Brown, he became a senior data scientist at Netrias, an artificial intelligence firm looking to apply machine learning in the life sciences.

Larschan said of Jordan, "His talent, hard work, and self-determination have allowed him to emerge as an outstanding biology PhD," and she called him "a strong leader who has excelled scientifically and as a mentor for younger graduate and undergraduate students." **—Noel Rubinton '77**

Chris Horvat studied the sea ice in the Nares Strait, only 500 miles from the North Pole.

COURTESY HORVAT (2)

On Thin Ice

By unconventional means, an Arctic explorer charts climate change.

Scientific research is usually communicated via studies and articles in journals. Chris Horvat, a mathematician and oceanographer who is a postdoctoral fellow at the Institute at Brown for Environment and Society, is publishing in the usual places but also contributing to climate change research through more unconventional means: a documentary film and a webcam that became an Internet sensation.

"My research interests are directed toward uncovering new ways of understanding climate while we still have time," said Horvat about his study of sea ice, oceans, and ecology.

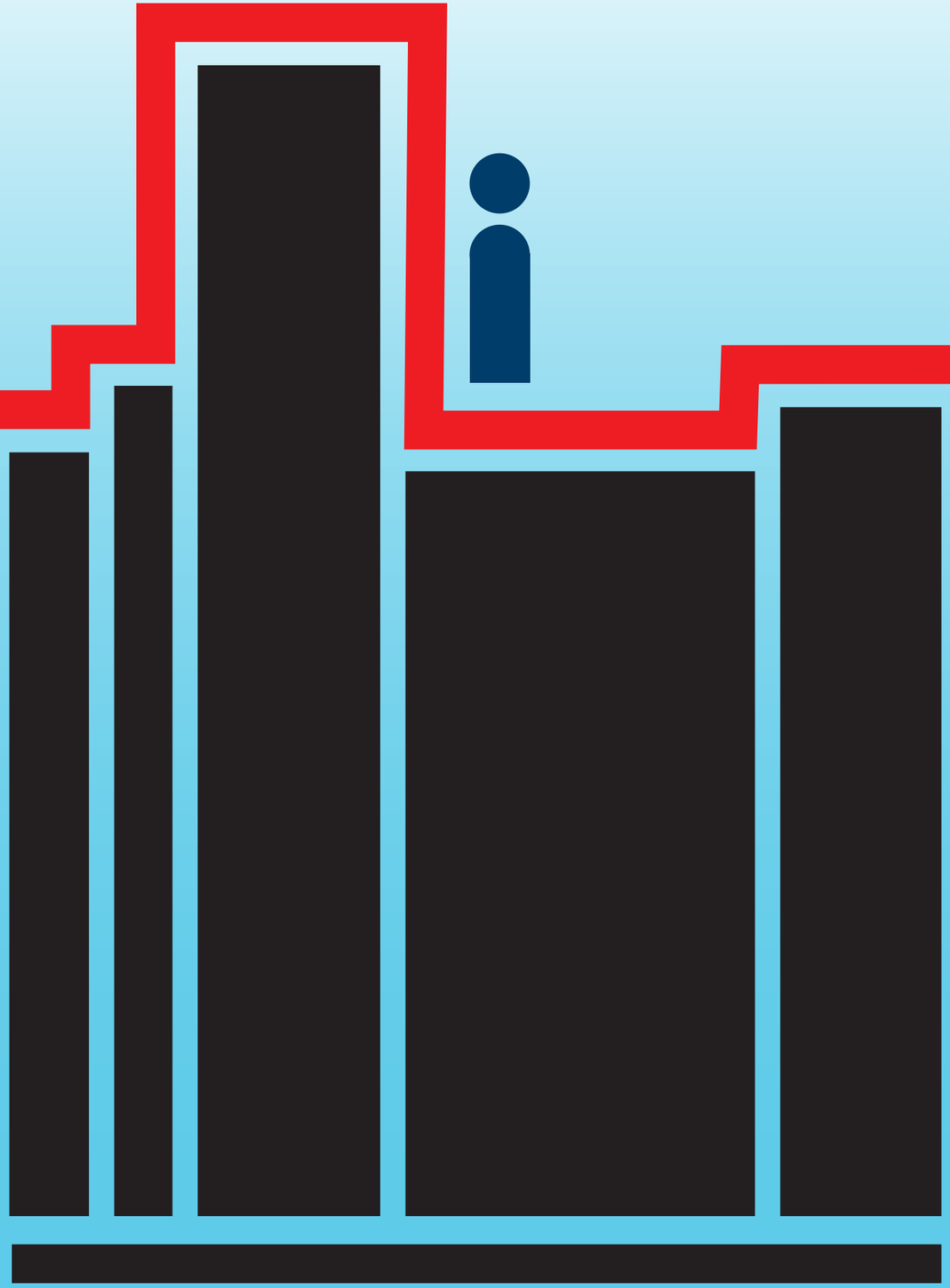
Chris Horvat

Horvat, after receiving his PhD from Harvard in applied mathematics, ventured to the far Artic, 500 miles from the North Pole. He went to study sea ice in the Nares Strait, and his trip was documented in a forthcoming film, *Enduring Ice*. Horvat and colleagues planned to kayak through the waters. But conditions complicated their journey, turning it into an exhausting illustration of the effects of climate change and demonstrating how the melting ice and ice reduction in polar oceans, even where ice has been predicted to last, is affecting the environment.

Far from the Arctic, in early 2019 Horvat found his work, which was funded by the National Oceanic and Atmospheric Administration, stalled by a federal government shutdown. Horvat was looking to keep his work going when he heard about a circular ice disk, hundreds of feet in diameter, spinning in the Presumpscot River in Westbrook, Maine.

For Horvat, it was a serendipitous research opportunity. "We're interested in seeing how individual pieces of sea ice, which are called floes, evolve," Horvat said. "With this ice disk, we don't have to get a ship up to the Arctic, we don't have to fly drones or any of that. It's right in the middle of a city."

Horvat worked quickly to set up a public webcam, and while the disc stayed in place there was publicity around the world as people watched it. He uses computer vision algorithms in studying how ice floes change over time. "Now we have images of a floe, updated minute by minute," Horvat said.



MINDY OSWALD

Faculty specializing in sophisticated analysis are propelling Brown's economics department to the top tier.

BY NOEL RUBINTON '77

DATA DRIVEN

Educational opportunity. Economic mobility. Global warming. Mortality risks and planning for the future. Political polarization and social media. Interest rates and bank lending. How cellphone use can help determine a person's creditworthiness.

These are just a few of the subjects of recent research from Brown's growing group of data-driven economists. "There is a revolution in data," said Brown economics department chair Anna Aizer.

The explosion of access to Big Data worldwide has profoundly affected research in many academic fields, economics included. "We have a faculty doing work that is on the frontier," Aizer said, and that work is helping raise the profile and impact of Brown's department. One professor, for instance, is studying the allocation of public housing and collaborating with housing councils in London to implement a better system; another is helping cities around the United States find ways to reduce income inequality.

Building on Brown's long-time strengths in economics—including development, growth, and game theory—the University has in the past six years recruited an enhanced cadre of faculty in applied microeconomics. That's the area most closely tied to data-intense research, and is a branch of economics that takes theories and methodologies and applies them to questions of individual behavior and societal outcomes. By examining topics with real-world relevance, Aizer said, "Many of these projects get at fundamental questions of opportunity and well-being. This research has the potential to change policy, both here and abroad, because the results reveal clear policy implications."

The department got a major boost in April 2019 with the announcement of a $25 million gift, its largest ever, from Orlando Bravo '92, a private equity investor. More than half of the gift from the Bravo Family Foundation, $15 million, will launch the Orlando Bravo Center for Economic Research so the department can expand and enhance its research and training, and the other $10 million will fund two new endowed chairs and spur faculty recruitment.

Brown president Christina H. Paxson, herself an economist and a member of the department, pointed to the power of economics in "improving human welfare" and said of Bravo's gift: "This incredibly generous gift will power years of scholarship that propels positive change—and it will enable our students to have a hand in conducting original economics research alongside internationally respected faculty."

"THIS INCREDIBLY GENEROUS GIFT WILL POWER YEARS OF SCHOLARSHIP THAT PROPELS POSITIVE CHANGE."
—Christina H. Paxson

'ALLOW US TO DO MORE'

Aizer said, "A gift like this will allow us to do more, and do it better. The creation of the Bravo Center will support the department by building on existing strengths of the department, advancing faculty research and student training."

The economics department and its research are seen as on the rise by a number of measures, including rankings of published papers and increased enrollments. Brown's place among U.S. economics departments in the widely used Research Papers in Economics rankings—highly dependent on the research output of faculty—has gone from being in the range of 16th to 19th in the country six years ago to now eighth.

Based on a recent external review of the department, plans have been made to increase the size of the faculty in the next few years from the current 30 to about 40, a move expected to have significant positive effects on both research and teaching.

Already, faculty recruiting is seen as making a large difference in research. Professor John Friedman is one example.

After earning undergraduate and doctoral economics degrees at Harvard University, a postdoctoral fellowship at University of California, Berkeley, teaching at Harvard's Kennedy School, and being a special assistant to the president for economic policy at the White House, Friedman was ready to find his long-term academic home in 2015. He came to Brown.

Economics chair Anna Aizer is studying intergenerational transmission of poverty, using a large data set she built.

ELLEN DESSLOCH BROWN UNIVERSITY

Friedman, whose research on education and economic opportunity using massive data sets has gotten national and international attention, said the decision "was really about the commitment Brown is making to empirical social science research." A large number of faculty was hired just before him, he joined with another sizeable group, and he's seen the commitment continue. Friedman credits his Brown colleagues for significantly helping elevate his research through dialogue and collaborations.

Friedman's research, like that of his Brown colleagues, involves enormous data sets, such as the CLIMB initiative, which looks at 30 million students nationally over time to look for ways to increase access and economic mobility. His Opportunity Atlas project is using millions of data records to see which U.S. neighborhoods offer children the best chance to rise out of poverty. At a 2019 public forum on the efforts to reduce Providence's income inequality and increase social mobility, Mayor Jorge Elorza praised Friedman's research and said it had already influenced city planning.

The surge in available data sets for economists has led to increased opportunities, and also greater costs. Accessing data almost always comes with expenses, often tens of thousands of dollars, and the Bravo research center will especially help graduate students and junior faculty who aren't as able to access large grants to pay for data. "Money at the right time can go a long way," Friedman said, and will help Brown "compete at the highest levels" for faculty members and research dollars.

FOCUS ON HIGH-VISIBILITY ISSUES

Many others in Brown's expanded applied microeconomics group are also focusing on high-visibility issues. Professors Justine Hastings and Jesse Shapiro have researched the shopping habits of recipients of the Supplemental Nutrition Assistance Program (SNAP, generally known as food stamps). They found, contrary to expected economic behavior, that SNAP benefits increase overall food spending by about 50 percent of the benefit's value. Shapiro has also shown that social media is overrated as the cause of rising political polarization.

Professor Emily Oster has studied how mortality risks influence people's choices about education and other future-oriented investments, and found people often choose not to learn about their health future. She has also recently published *Cribsheet*, a best-selling book that is a data-driven guide to parenting young children.

Daniel Bjorkegren, an assistant professor of economics, received wide attention for his study showing that patterns in phone usage can predict who will default on loans. Assistant Professor Bryce Steinberg studied water quality in the developing world and found that imperfect infrastructure burdens the poor in ways that go far beyond obvious health consequences.

Economics professor John Friedman (r) spoke on his social mobility research at a forum with Brown President Christina H. Paxson and Providence Mayor Jorge Elorza.

STEPHEN CROCKER/BROWN UNIVERSITY

One of the newest faculty members in applied microeconomics, Neil Thakral '13, came back to Brown in 2018 after getting his PhD at Harvard. Thakral's current research is focusing on the allocation of public housing, testing ways to avoid inefficiencies that have long plagued the tenant selection process. Housing choices are central to decisions people make determining their economic and social stability; he is using detailed data from Pittsburgh to analyze the choice process and is working with housing councils in London to design better allocation systems.

'PUT US ON THE MAP'

Thakral, an assistant professor of economics with a joint appointment at the Watson Institute for International and Public Affairs, said, like Friedman and others, that what made him want to teach and do research at Brown is the quality of the faculty, including those hired in recent years. "This group has propelled the Brown economics department to the forefront," he said, "It put us on the map."

Gauti Eggertsson came to Brown in 2013 after eight years of conducting research at the Federal Reserve Bank of New York. At the Federal Reserve, Eggertsson gave advice to the bank's president on setting interest rates and other policies. His research at Brown has centered on monetary policy, including analysis of the 2008 financial crisis and lessons to be learned.

Part of what makes Brown economics distinctive is the department's willingness to embrace nontraditional areas of economic research. When she came to Brown in 2003, Aizer knew the choice of her first research area would be crucial. She wanted to explore domestic violence as a subject, but wondered what her colleagues' reaction would be. She was relieved when a senior colleague was extremely supportive, and she has continued to do work in this area for many years. More recently she has been studying the intergenerational transmission of poverty, including the impact of welfare on children's outcomes using a data set she built of 80,000 children whose mothers had applied for welfare. Other professors also have been encouraged in exploring areas not standard at other universities.

The department's high level of collaboration, inside and outside Brown, has shaped its success by bringing different dimensions to projects. The faculty have been active in many partnerships within Brown, including the Warren Alpert Medical School and School of Public Health, and at many Brown centers and institutes, such as the Watson Institute for International and Public Affairs and the Institute at Brown for Environment and Society. "Economics is a very collaborative discipline," Aizer said, and Brown is fertile ground.

Brown's economics department dates back to 1828 and is one of the University's oldest academic units, housed for more than a century now in the distinctive Venetian Gothic-style Robinson Hall. While the cluster of hires in recent years in the data-mining areas of applied microeconomics have been a significant boost to the department, Aizer said the department has also increased its strength in other areas, such as game theory, long-run growth, and more. Glenn Loury, for instance, is a prominent public intellectual and applied theorist who has published research on a number of subjects, including the importance of social capital.

Joining the department in 2019 was an economic theorist, Teddy Mekonnen, whose research focuses on information economics and mechanism design. An assistant professor of economics, he came to Brown after a postdoctoral fellowship at California Institute of Technology, where he worked on research showing that, against conventional wisdom, people newly enrolled in health insurance searching for primary care physicians achieved better outcomes if they randomly sampled the doctors available in their networks than if they screened doctors based on published rankings.

The success of the department's graduates is another indicator of its larger impact through research. "Scholars who earned their doctorates in the Brown economics department are found throughout the top ranks of university economics departments in the United States and abroad, as well as in the Federal Reserve system, World Bank, IMF, and the central banks of many foreign countries," said Professor David Weil '82, a former department chair.

ALUMNI WELL REPRESENTED

Distinguished undergraduate alumni of the department—including Janet Yellen '67, chair of the U.S. Federal Reserve from 2014 to 2018—are well represented in the top ranks of academia, finance, business, and public policy, Weil said.

While the department is expected to increase faculty by about eight in the next few years, it plans to preserve its essential tight-knit character, emphasizing integrated scholarship.

For the applied microeconomics group, that means that when its regular seminar convenes, everyone in that area joins in, including faculty and graduate students. In larger economics departments at other universities, there are separate microeconomics seminars broken out by subject area. At Brown, it's seen that unity is better, maximizing interaction between different specialties and leading to new insights and collaborations. Said Thakral, "You get to interact with a broader set of people." Friedman added, "Bringing together more people and ideas helps."

BATTLING ALZHEIMER'S

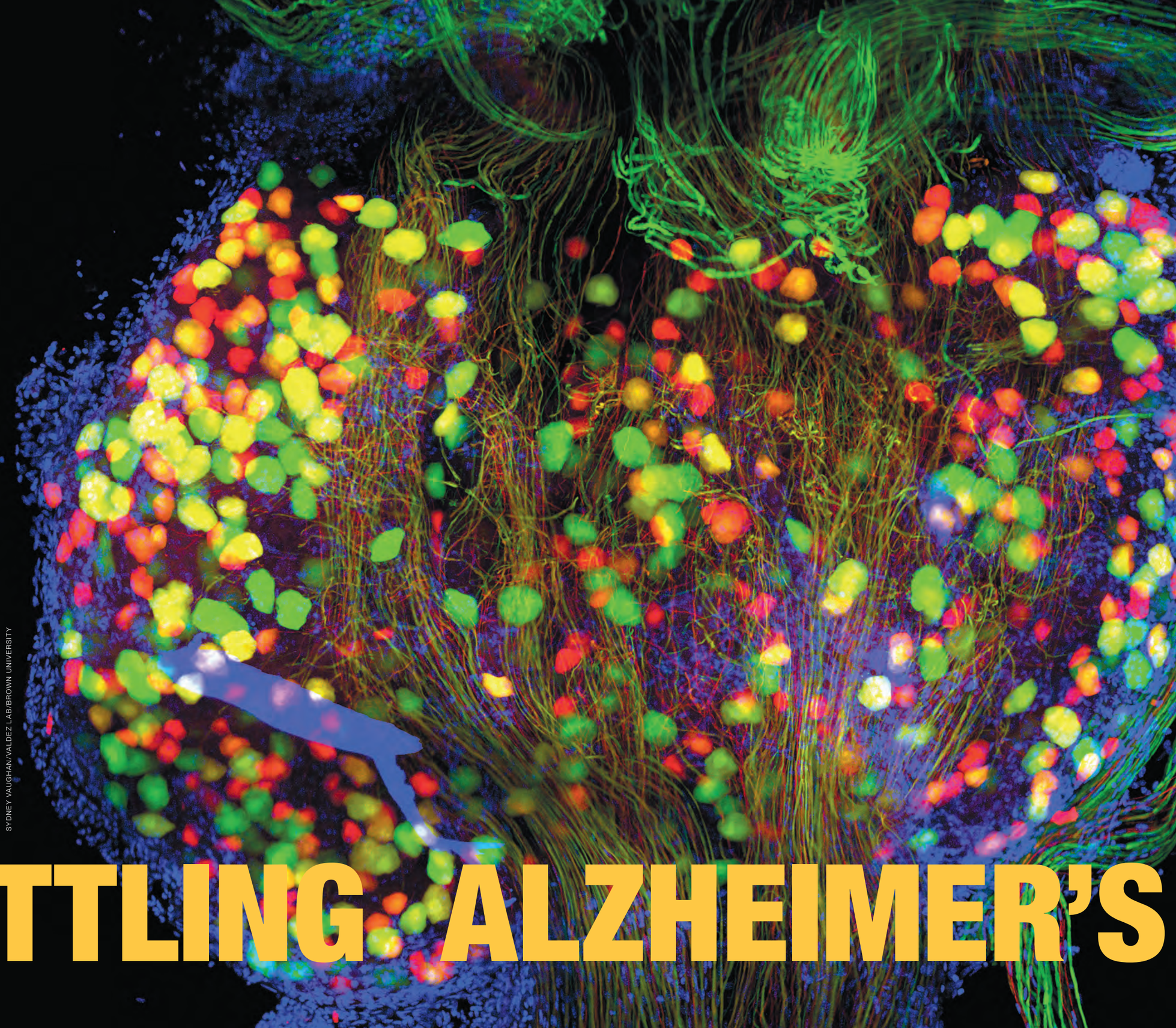
Brown researchers are leading a national effort to better understand dementia and provide improved treatment.

BY MAURA SULLIVAN HILL

Stephen Salloway still remembers the day his grandmother moved into his childhood bedroom. No longer able to live alone because of her increasing dementia symptoms, she needed full-time care. The only extra bed in the house was in his room, so he saw the impact of the disease up close, as his family became her primary caregivers and he became her roommate.

"I saw what dementia was like, and the effect it had on our family. There is a grandmother's story lurking in the background for many Alzheimer's researchers," said Salloway, now a neurologist and professor of psychiatry and human behavior at Brown's Warren Alpert Medical School.

With more than 5.6 million Americans aged 65 and older living with Alzheimer's and other forms of dementia, the impact of the disease is widespread, and the need for new interventions and treatment is urgent. Dementia is an umbrella term for diseases that cause a decline in



Different types of sensory neurons are being studied at Brown as a way to discover and test molecules to prevent neurodegenerative diseases, including Alzheimer's.

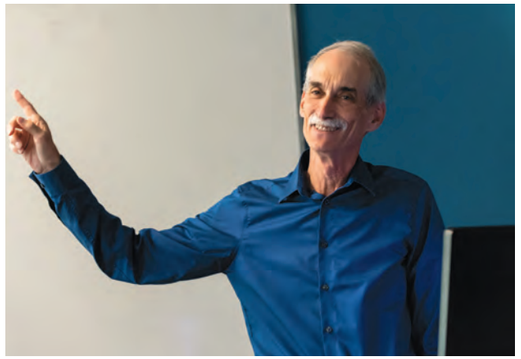
SYDNEY VAUGHAN/VALDEZ LAB/BROWN UNIVERSITY

mental ability, and Alzheimer's and the memory loss associated with it are the most common form of dementia. Alzheimer's disease, the sixth-leading cause of death in the United States, according to the Alzheimer's Association, is a progressive disease where the symptoms of memory loss, behavior changes, and disorientation worsen with age, due to changes in the brain.

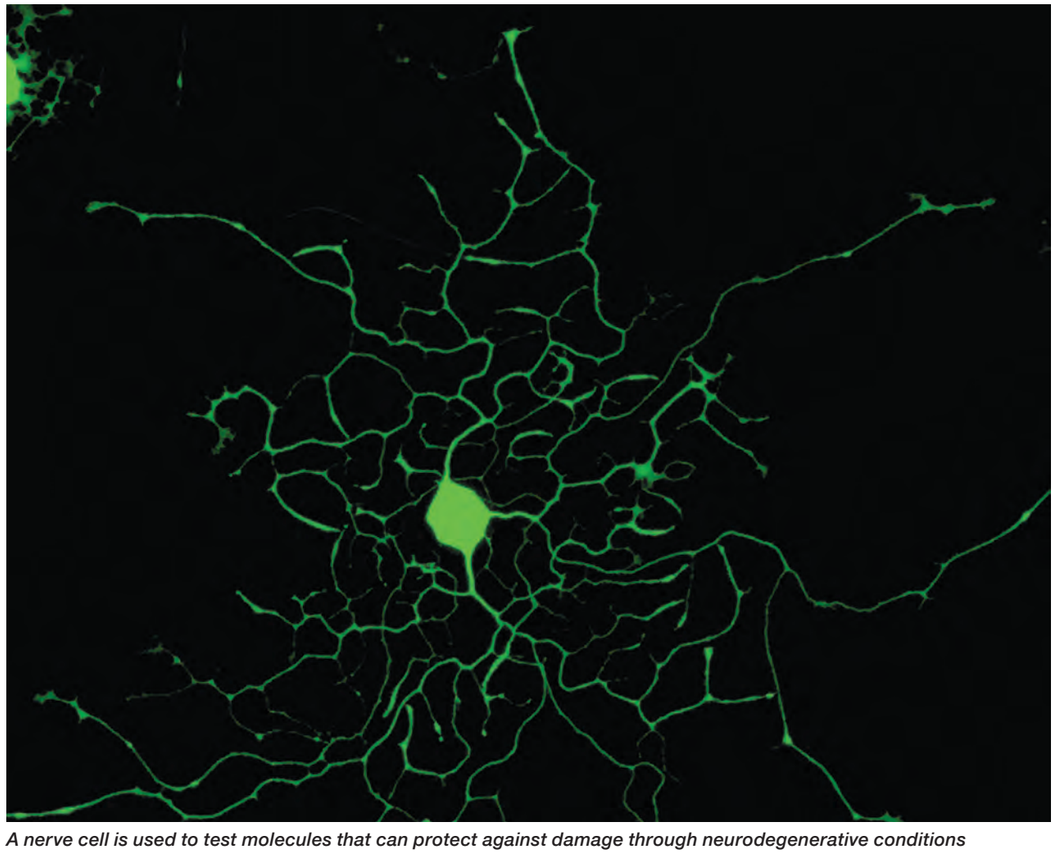
Although risk genes have been identified, there is no cure for Alzheimer's, and researchers have not yet discovered the cause of the disease.

Brown has emerged as a leader in the field of Alzheimer's research and prevention through intense activity in the School of Public Health, the Warren Alpert Medical School, the Carney Institute for Brain Science, and the new Center for Translational Neuroscience.

Researchers and clinicians across the university are engaged in multi-faceted, collaborative efforts to treat Alzheimer's disease and dementia: searching for the root causes of the disease, developing drugs to treat it, or creating interventions that could prevent or slow the progress of the disease.



Stephen Salloway said fear of Alzheimer's "can be paralyzing, but more research is synonymous with hope."



COURTESY BUTLER HOSPITAL; SYDNEY VAUGHAN/VALDEZ LAB/BROWN UNIVERSITY

A nerve cell is used to test molecules that can protect against damage through neurodegenerative conditions such as Alzheimer's.

"It is going to take more than one drug to treat or modify the course of Alzheimer's, so we are going to hopefully get one that works and then build on that or combine them. There are a lot of challenges, but more research is synonymous with hope," Salloway said.

LARGEST-EVER GRANT

In 2019, Brown received the largest federal grant in university history, a five-year $53.4 million award from the National Institute on Aging (NIA) to lead a nationwide effort to improve health care and quality of life for people living with Alzheimer's disease and related dementias, as well as their caregivers. Together with Boston-based Hebrew SeniorLife, a Harvard Medical School affiliate, researchers at Brown are creating a massive collaborative research incubator to develop clinical trials aimed at evaluating non-pharmacological interventions.

Vincent Mor said his grant will allow a powerful national network to grow.

"THIS IS NOT A PROBLEM THAT CAN BE SOLVED ONE LONE PROGRAM AT A TIME... WE HAVE TO GO TO SCALE." —Vincent Mor

Vincent Mor, coleader of the collaboration and a professor of health services, policy, and practice at Brown's School of Public Health, said this grant has the potential to revolutionize how care is delivered to patients, because it will speed up the process of bringing evidence-based interventions into health care systems.

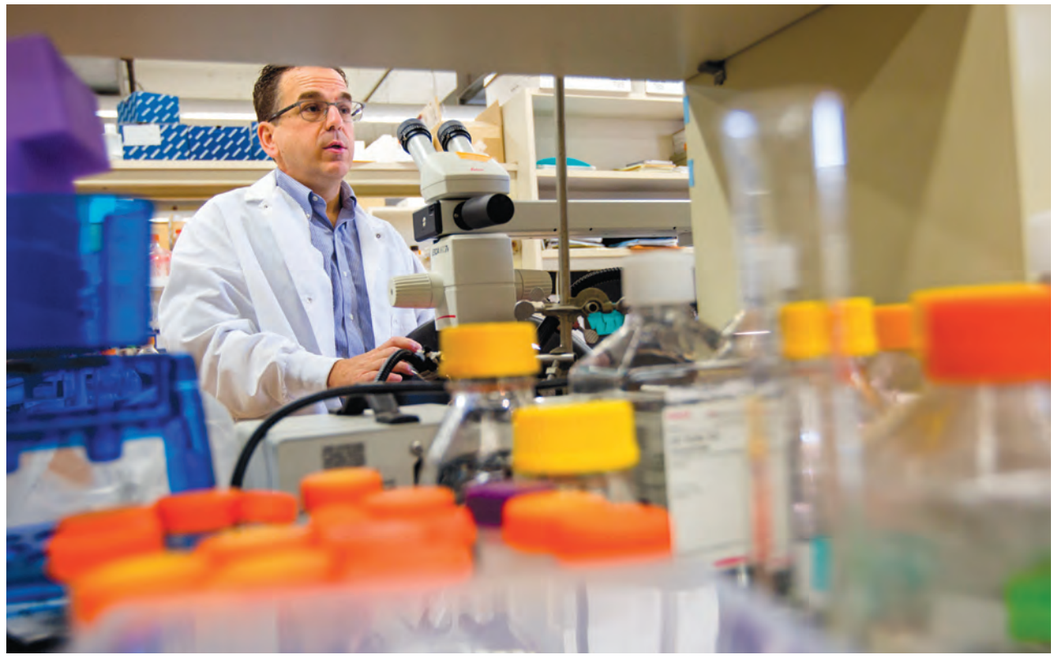
"Given how many people are going to be diagnosed with Alzheimer's and other dementias and the number of caregivers, this is not a problem that can be solved one lone program at a time. We need an industrial-strength program. We have to go to scale," Mor said. "And anytime you go to scale, that complicates matters dramatically, both scientifically as well as operationally, and from an organizational, human engineering perspective. The goal is to figure out how to take an idea that works when researchers do it, and to see if it works when real staff do it."

The program, dubbed the IMPACT Collaboratory, will fund up to 40 pilot projects in real-world health care systems beginning in 2020, generating the necessary data for even larger trials that will be supported with future federal funding. Researchers from more than two dozen universities around the country, including Harvard, New York University, University of Michigan, and Yale, will also be collaborating on the project.

BROWN UNIVERSITY

"There is a pressing need to improve care and support for people with dementia and their caregivers," said Richard J. Hodes, director of the NIA. "The IMPACT Collaboratory will enable more effective, efficient teamwork research on finding better solutions for the millions of Americans affected by these devastating diseases."

The collaboratory is searching for pilot projects much like Mor's successful Music and Memory project, which found that listening to a personalized music playlist can help reduce an Alzheimer's patient's behavioral symptoms and need for antipsychotic medications. They reached this finding with a small pilot study, and then received additional funding to implement the program in 81 nursing homes, gathering a larger research sample while simultaneously offering a new treatment option for patients. The IMPACT Collaboratory will offer that same opportunity to other studies that have proven successful in small trials, providing the funding and support to implement on a larger scale.



Eric Morrow is using genetics to better understand brain diseases like Alzheimer's.

AIDING EARLY DETECTION

Much like the IMPACT Collaboratory, the Memory and Aging Program of Providence's Butler Hospital, with a team led by Salloway and as an affiliate of Brown's Warren Alpert Medical School, is focused on making treatments and preventions more widely available and accessible. A host of clinical trials are focused on early detection, studying people who possess risk genes for Alzheimer's to discover what contributes to the disease. As the causes are targeted, researchers are hopeful that possible prevention treatments can be developed for future generations. A key part of that effort is to get more people to participate in research studies and educate the public about potential risk genes for Alzheimer's.

"Everybody's afraid of Alzheimer's—the most feared disease of aging, more than cancer," Salloway said. "It can be paralyzing. Our volunteers who participate in these studies are valiant, dedicated, and courageous. We've developed tools now so that we can identify people at risk and try to modify the risk so they don't get the memory loss and the dementia."

The Memory and Aging program hosts what they have dubbed "swab parties"—events where the public is invited to assist in Alzheimer's research by participating in a cheek swab that tests for genetic risk for developing Alzheimer's. If a participant has one of the risk genes for Alzheimer's, known as APOE e4, the Butler team will reach out to them about opportunities to participate in studies, as well as counseling them through the process of learning about their potential risk for the disease. Salloway's team has offered swab parties in places aimed to broaden engagement, such as Brown's alumni reunions and WaterFire in Providence.

The program has also developed a disease prevention registry, and it matches willing volunteers with Alzheimer's studies in search of participants. After potential volunteers complete a secure and confidential online questionnaire, program representatives reach out to them about how to participate in a study. Previous studies done by the program have produced important results in the fight against Alzheimer's, including more advanced and accurate tests for the disease, like brain scans that can detect the brain plaques and tangles (or protein deposits) that lead to Alzheimer's before memory loss sets in, and new medications in clinical trial phase, like gene-targeted therapies that shut down the production of these toxic proteins.

In addition to the Butler Hospital team's clinical trials, John Sedivy, professor of biology and director of the Biology of Aging initiative at Brown, gained funding from the Alzheimer's Association for a new clinical drug trial. A drug initially developed to fight HIV appears to have the potential to treat Alzheimer's and other age-associated diseases because of how it targets inflammation. Sedivy's research showed that the drug reduced inflammation from age-related conditions in naturally aging mice, and now a team led by Sedivy and Salloway will test it on people with Alzheimer's.

"Many age-associated diseases are accompanied by increased inflammation. In fact, an elevated, chronic level of inflammation is one of the hallmarks of aging—normal healthy aging included," Sedivy said. "Alzheimer's in particular has been linked with pronounced neuro-inflammation. While it is by no means clear whether this neuro-inflammation is the cause of Alzheimer's, it is increasingly believed that it might be an important exacerbating factor. Hence, reducing or preventing neuro-inflammation might slow down the progression of the disease."

"REALLY UNDERSTANDING GENE CHANGES OFFERS A POWERFUL, FRESH, AND NEW APPROACH." —Eric Morrow

BROWN UNIVERSITY

UNTANGLING ALZHEIMER'S THROUGH GENETICS

While clinical trials search for drugs that could help treat Alzheimer's and other dementia patients, neuroscientists are still looking for the root causes of these diseases. When neuroscientists learn more about the gene mutations that contribute to Alzheimer's, researchers learn new targets for drug treatments. It all requires a collaborative process, which has led to Brown's new Center for Translational Neuroscience, which officially launched with the 2019–20 academic year.

"There have been major advances in human genetics. Really understanding gene changes offers a powerful, fresh, and new approach for dissecting complicated brain diseases like Alzheimer's disease. Genetics is the logic and glue that brings us together and orients our path," said Eric Morrow, a psychiatrist and professor of biology, neuroscience, and psychiatry at Brown, who leads the center alongside Brown neurologist Judy Liu, who also runs a molecular neuroscience lab. Both Morrow and Liu are physician-scientists.

The center's goal is to advance knowledge about how brain diseases develop and to translate this knowledge into improved clinical outcomes for families affected by brain disease. The center is paying special attention to Alzheimer's, with two new faculty members experienced in the field of Alzheimer's research: Alvin Huang, recruited from Stanford, and Gregorio Valdez, from Virginia Tech. Valdez has moved his established laboratory studying age-related neurological diseases to Brown, and Huang, who is also a physician-scientist and neurologist, is starting his laboratory at Brown as junior faculty focused on Alzheimer's disease.

They will also partner with Brown's Carney Institute for Brain Science, already a leader in research to identify therapies for neurodegenerative diseases, including Alzheimer's, ALS, and Parkinson's.

"We are tremendously excited about the new Center for Translational Neuroscience," said Diane Lipscombe, the director of the Carney Institute. "The most important ingredients for success are the people—Eric Morrow and Judy Liu are a phenomenal team; they are committed to building a community of scientists with a passion for patient-centered research. Eric and Judy lead through example, and their own research has given novel insight into disease origin. The first two recruits into the Center for Translational Neuroscience, Greg Valdez and Alvin Huang, focus on cellular and molecular processes disrupted in Alzheimer's disease, an area of great need."

COURTESY BUTLER HOSPITAL

At "swab parties," people assist in Alzheimer's research by participating in a cheek swab that tests for genetic risk for developing Alzheimer's.

SHARE KNOWLEDGE WIDELY

Researchers and clinicians at Brown continue to confront Alzheimer's disease on multiple fronts: through public health interventions, clinical trials and community education, and genetics research. On its current trajectory, Alzheimer's disease is estimated to afflict 14 million people by 2050, and the day-to-day reality of this work is grueling and challenging, so efforts are seen as urgent.

"I'm so excited that Brown is really getting behind Alzheimer's research," Salloway said. "It is setting the stage for some amazing work. It is an exciting time, the opportunity for collaboration across disciplines and to bring discoveries to people that need them."

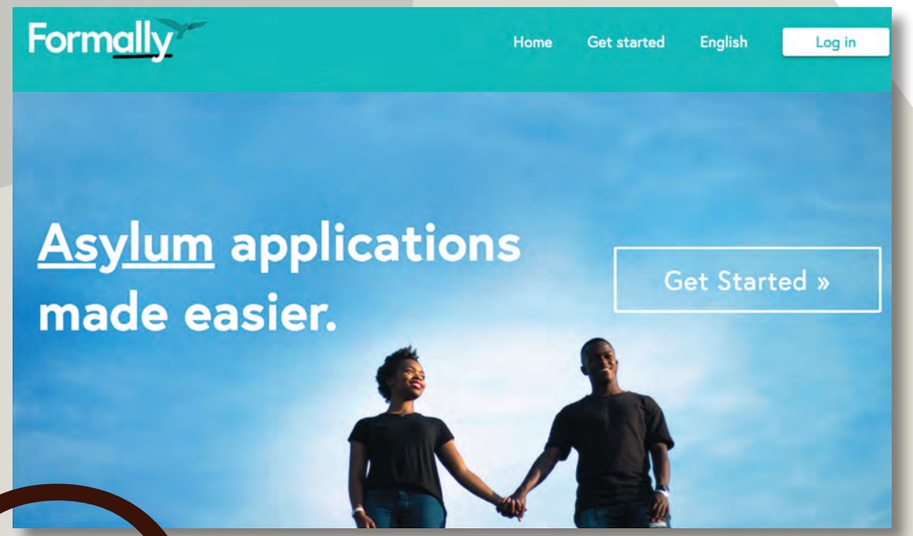
As different programs are tested and implemented, the goal is for them to be replicated in any kind of health care facility, including under-resourced ones. Mor, who is coleader of the IMPACT Collaboratory along with his frequent research partner, Susan Mitchell of Hebrew SeniorLife, points out that top-ranked medical centers, like Brown, have the resources to invest in research and clinical trials, and there is a responsibility to share this knowledge widely. "There are other places that are going to find it much more difficult. It is critical that we design programs that are going to be implemented and embraced," Mor said.

ENTERPRISING MINDS

Undergraduates are creating successful new products and companies as the Nelson Center for Entrepreneurship acts as incubator.

COURTESY VAVROVSKY

Amélie-Sophie Vavrovsky ’18 started Formally to fix a policy problem. Her company, through its website (r), helps people navigate immigration forms.



COURTESY VAVROVSKY

BY SARAH C. BALDWIN ’87

Growing up in Austria, Amélie-Sophie Vavrovsky ’18 witnessed firsthand the parallel rise of immigration and xenophobia across Europe. To counter the hatred, she began volunteering with refugees while learning all she could about immigration and refugee policies.

Pursuing those efforts at Brown, she was surprised to learn that in the United States, immigration forms themselves can constitute a barrier to asylum, as they are difficult to understand and available only in English. What’s more, applicants are not provided lawyers—despite a 1951 United Nations Convention protecting a person’s right to seek asylum. “That struck me as a gross human rights violation,” Vavrovsky said.

Armed with an idea that would tackle the situation, the international relations concentrator signed up for the annual 24-hour software-design marathon Hack@Brown. By the end of that weekend in 2018, she and her team of four had produced the prototype for Formally, a software program with an intuitive interface that translates legalese into simple English and other languages. It guides users through immigration forms and fills them out as they go.

This drive to solve a “consequential problem” typifies many would-be entrepreneurs at Brown, says Danny Warshay ’87, director of the Nelson Center

Danny Warshay (r), director of the Nelson Center for Entrepreneurship, teaches a course on "The Entrepreneurial Process: Innovation in Practice."

for Entrepreneurship. Established in 2016 with a $25 million gift from Jonathan M. Nelson '77, the center has in short order become a portal to all things entrepreneurial. While the entrepreneurial inclination is hardly new to Brown, including with the iconic ENGN9 class taught for decades by Professor Barrett Hazeltine, the center positions Brown to satisfy the growing appetite among students to create what Warshay called "solutions with impact."

Housed in a new, specially designed 10,000-square-foot building in the heart of campus, the center supports scholarly research while offering foundational courses, mentoring, grants, student-run groups, and a nonstop schedule of workshops and lectures; from fall 2016 to fall 2019, 750 students were enrolled in the center's selective programs, and events and office hours accounted for 5,000 visits to the center. In addition, the center partners with BrownConnect (which links students with alumni) to offer internships in Israel, Germany, Sweden, and elsewhere.

"We're not just motivating students to learn about entrepreneurship," Warshay said. "We're empowering them to *do* it."

The results are showing, as companies started by Brown undergraduates are dominating accelerator competitions that give credibility and needed funds—such as in the 2019 MassChallenge Awards, where two of the three top Rhode Island awards went to start-ups closely connected to Brown and the Nelson Center.

To help grow Formally into a full-fledged venture, in 2018 Vavrovsky applied to the center's Breakthrough Lab, an intensive summer accelerator program that supports students developing high-impact ventures. During B-Lab, as the program is known, she and her collaborators received a stipend of $4,000 each, worked alongside other founders, and were mentored by successful alumni entrepreneurs. In March 2019, the Formally team won first place and $25,000 in the center's Brown Venture Prize, a pitch competition designed to take advanced ventures to the next level and funded by two Brown alums who are cofounders of Casper mattress company, Neil Parikh '11 and Luke Sherwin '12.

The Breakthrough Lab is an intensive summer accelerator program that supports students developing high-impact ventures.

NICK DENTAMARO/BROWN UNIVERSITY (2)

WHAT'S YOUR PROBLEM?

Before applying to B-Lab, Vavrosky had taken Warshay's course, "The Entrepreneurial Process," whose title reflects the foundation of his approach. Rejecting terms like "entrepreneurial mind-set" or "entrepreneurial spirit," Warshay emphasized that entrepreneurship at Brown has all the rigor of any other academic discipline: "It is a structured process you can teach, learn, master, and apply."

Saron Mechale '19 (l), founder of goTeff, works in Ethiopia with Saron Fisseha '21 to test solar irrigation pumps along with farmers.

COURTESY GOTEFF

That process consists of three steps: identify an unmet need, devise a solution, and develop a scalable, sustainable model. Step one requires inquiry and observation—what Warshay referred to as "bottom-up research." Brian Demers '85, director of business development in the Office of Industry Engagement and Commercial Venturing, who helps transform research into successful ventures, agreed: "As Danny says, 'An entrepreneur is first and foremost an anthropologist.' You want to go in and … understand what people are doing on a daily basis, how they're addressing a problem—as opposed to going in with an answer and then asking them what they think about it."

"THE RESEARCH LEADS YOU TO THE PROBLEM…AND YOU TRY TO FIND THE SOLUTION." —Saron Mechale '19

Saron Mechale '19 always knew she wanted to have an impact in her native Ethiopia, a country "often perceived by the West as a place of poverty or lack of development." She wanted to change the narrative, but she didn't know how. In 2015, after her sophomore year, the social analysis and research concentrator took time off to spend two years back home, where she began learning about her country's agricultural industry—specifically, about the growing demand for the Ethiopian staple and global super-food, teff, that Ethiopian farmers have been cultivating for thousands of years.

When she returned to Brown and enrolled in Warshay's course, Mechale realized she had already done the bottom-up research he prescribes. That research—the two years she spent getting to know the Ethiopian ag scene—yielded the idea for goTeff, a company that would market teff-based food

products online and then reinvest the profits with the farmers who supply it. Mechale's venture would thus accomplish two goals: empowering Ethiopian farmers by connecting them to international markets, and telling the world "an authentic and contemporary story" about Ethiopia.

The idea quickly gained traction. Mechale received two venture-support grants from the Nelson Center; enrolled in Lean Launchpad, Brown's Wintersession course on building start-ups; participated in the 2018 B-Lab; and, in March 2019, won second place and $15,000 in the Brown Venture Prize competition. That same year, goTeff was a finalist for the Hult Prize, an international competition for student entrepreneurs. After more than 10 months of product development and testing, the firm officially launched online in September 2019, and a few weeks later was named one of the top three prizewinning start-ups in the Rhode Island program of MassChallenge, a global network of start-up accelerators. (Another of the top three companies, Intus Care, is also Brown-connected, founded by four current undergraduates and aiming to provide improved home health care at lower cost.)

"The research leads you to the problem … and then you try to find the solution," Mechale said. "This methodology helped me to pursue my interest in entrepreneurship at a deeper level than before."

"I WANT TO DO SOMETHING THAT WILL HAVE A FAR-REACHING IMPACT."
—Gian Christian Ignacio '18 MD'22

It's the same approach that led Jack Roswell and fellow engineering students Julian Vallyeason and Alex Zhuk to the idea for their venture, Cloud Agronomics. As first-years, they were doing independent research in plant physiology and remote sensing with John Mustard, professor of earth, environmental, and planetary sciences, and James Kellner, assistant professor of ecology and evolutionary biology. They were also designing and constructing a solar-powered drone they hoped would break the world record for the longest sustained flight of any unmanned aerial vehicle. After six months of work, the drone finally took flight—only to crash eight seconds later.

Brown students Alex Zhuk (l), Jack Roswell, and David Schurman are among the founders of Cloud Agronomics, which aims to help farmers detect crop disease early and limit its spread.

COURTESY MARTY LAROCQUE/CLOUD AGRONOMICS

Gian Christian Ignacio '18 MD'22 is part of a team seeking to help cardiac bypass surgery patients with a mesh (below) that more effectively filters debris.

Roswell said the crash placed the friends at a "serendipitous intersection" of backgrounds, passions, timing in the industry, and a breakthrough in their research. Working with their professors, they observed that it was possible to extract valuable insights about a plant's physiological processes from data collected via remote sensing, but those insights never left the lab. "So we decided to transition," he said, "from designing a cool engineering project to creating a company and having a bigger impact."

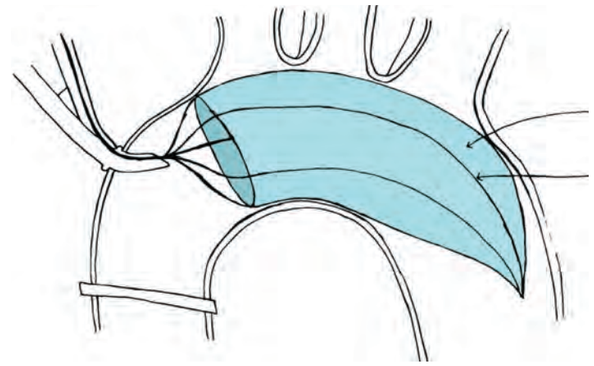
To maximize that impact, Roswell and Zhuk—who come from farming families in Michigan and Ukraine, respectively—spent weeks on the ground traveling to research laboratories and farms across the United States to determine the biggest problems the agriculture industry was facing, such as crop disease. Remote imaging provided a window inside each plant, while powerful analytics enabled them to identify disease weeks before any symptoms were available to the naked eye. For growers, that could mean minimum waste and maximum profits.

Today, Roswell, Zhuk, and David Schurman work full-time on the venture, which received support funding from the Nelson Center and took second place in the Brown Venture Prize competition in 2018. Since then, Cloud Agronomics has garnered not only millions of dollars in capital but recognition as well, including in the National Inventors Hall of Fame. In addition to working on carbon/sustainability initiatives with Microsoft AI for Earth, the company was named a breakthrough innovator for using agriculture to reverse the effects of climate change by Indigo Ag, itself a leading agtech company. In fact, Mark Tracy '95 left his position as vice president of Indigo Ag to become the Cloud Agronomics chief executive officer. (Kellner and computer science professor Donald Stanford serve as advisers).

COURTESY IGNACIO

Other students are devising ways to use technology to improve human health. When he walked into the required biomedical engineering capstone class, Gian Christian Ignacio '18 MD'22 wasn't thinking about medical devices or start-ups. But he had long planned to integrate entrepreneurship and medicine in his career: "I want to help patients on a day-to-day basis, but at the same time I want to do something that will have a far-reaching impact." So when cardiothoracic surgeon Neel Sodha, an assistant professor of surgery at Warren Alpert Medical School, presented the class with a real-life problem to solve, Ignacio took notice. Sodha explained that, after a patient undergoes cardiac bypass surgery, there's a risk of debris from the aorta, such as plaque, entering a patient's bloodstream and causing embolic stroke.

Along with three other biomedical engineering students and Emily Holtzman, a Rhode Island School of Design student earning her BFA in textiles, Ignacio was inspired by the problem-based approach. They shadowed Sodha, even observing a heart surgery, and pooled their research, expertise, and ideas. The result: a medical-grade mesh that more effectively filters embolic debris. EmboNet, as the group's capstone project is called, took first place in the Advanced Health Systems category of the 2018 Johns Hopkins Healthcare Design Competition. The team went on to place third in the 2019 Brown Venture Prize competition, and the $10,000 prize enabled them to continue working on EmboNet in that summer's B-Lab.



▲ **Nantucket Nectars** beverage company, *est. 1989*
Tom Scott ’90,
Tom First ’89

UPSTARTS

Barrett Hazeltine, professor emeritus of engineering, recalls the time a reporter from *Fast Company* magazine showed up in his office and asked, “How come the entrepreneurs I know in New York all came from Brown? What’s in the water in Providence?”

“I don’t know what’s in the water,” Hazeltine says now, “but I suspect the extraordinary number of entrepreneurs comes from exceptional students attracted by a culture and curriculum that prize autonomy. The promise of the early years has been fulfilled by a virtuous cycle of independent thinking, curiosity, and respect for student and alumni entrepreneurship.”

Here are just a few of the many ventures started by Brunonians (listing only the Brown alumni among the company founders). Many of these companies have become household names, while others have been incubated in Brown’s entrepreneurial ecosystem more recently.

EMILY SANDOR

305 Fitness

▲ **305 Fitness** workout classes, *est. 2011*
Sadie Kurzban ’11

▼ **Casper** sleep products, *est. 2014*
Gabriel Flateman ’12,
Neil Parikh ’11,
Luke Sherwin ’12

Dear Kate underwear (orig. Sexy Period), *est. 2008*
Julie Sygiel ’09,
Eunice Png ’09

▼ **Dogfish Head Craft Brewery,** *est. 1995*
Mariah Calagione ’93

Koi Prosthetics, *est. 2017*
Matthew Lo ’18,
Alexander Lo ’18,
Luke Morales ’18 MS’19,
Justin Lee ’18,
Matthew Borges ’19,
Claire Sise ’18

▼ **Motley Fool,** financial advisor, *est. 1993*
Tom Gardner ’90

Fool.com™
The Motley Fool®

Penta low-cost prosthetics, *est. 2016*
Trang Duong ’18

Premama prenatal nutritional supplements, *est. 2012*
Robert Aziz ’11,
William Do ’13

▲ **Rip Van Wafels** snack company, *est. 2010*
Rip Pruisken ’10,
Marco De Leon ’12

RUNA clean energy drinks, *est. 2008*
Dan MacCombie ’08.5,
Tyler Gage ’08

ShapeUp corporate wellness, *est. 2006*
Rajiv Kumar ’05 MD’11,
Brad Weinberg ’03 MD’11
(purchased by Virgin Pulse in 2016)

TextUp software for nonprofits and government-funded agencies, *est. 2013*
Michelle Petersen ’18,
Eric Bai ’15.5 MD’22

Uprook plant-based milk dispenser, *est. 2018*
Kevin Eve ’18

▼ **Warby Parker** eyewear, *est. 2010*
Andrew Hunt ’04

—**Sarah C. Baldwin ’87**

Casper

Ignacio believes being a student adds value to the problem-solving step. “We had the chance to hear about big problems that surgeons look at every day,” he said. “They’ve got years of experience and wisdom. We’re new. So instead of being stressed thinking about the problem, we brought fresh pairs of eyes to look at it in a different way.”

PROBLEM SOLVING WITH PURPOSE

Like its culture and curriculum, Brown’s brand of entrepreneurship transcends engineering, its historical home, and is decidedly interdisciplinary. The center works with many partners across campus, such as the Carney Institute for Brain Science, which is now literally across Thayer Street from it, and the Institute at Brown for Environmental Sciences. Its course recommendations draw on a range of programs, including sociology, computer science, public policy, music, and the visual arts. Warshay embraces the “accidental collisions” that come from such mixing. During B-Lab, he said, “we don’t have the social entrepreneur sit on the third floor and the capitalist on the second floor. Cross-pollinating leads to more effective solutions.” Demers said that rooting entrepreneurship in a research university with

“IT’S A UNIQUE TIME IN YOUR LIFE WHERE YOU CAN MOVE QUICKLY, BE AGILE.”
—Jack Roswell

a strong liberal arts foundation in its undergraduate curriculum makes it different from what MIT or Stanford offers: “All the cool stuff happens at the intersections.”

“I always thought that entrepreneurship was about people just trying to make money,” textile designer Holtzman said. “But the amazing thing about Brown is that, because there’s no business school, everyone’s coming to entrepreneurship from their own concentration [and] personal interests, so they have a huge passion for whatever their business is. They actually *care* about their project.”

That’s important to students who are impatient to solve the problems they uncover through research. “There are so many important debates about the future, but little to no representation of people our age who have the maturity and the hunger to make a difference,” said Roswell. “Also, it’s a unique time in your life where you can move quickly, be agile.”

Vavrovsky, who sees Formally not just as a business but also as a policy fix, agreed: “I study international relations, and what we get really good at is identifying policy problems. To find solutions, we need the smartest, most creative, most interdisciplinary, most diverse group of people working on these issues. And entrepreneurship is one of the ways to do that.” ■

FOCUS

A CLOSER LOOK AT RESEARCHERS AND PROJECTS GAINING WIDER INFLUENCE

The Search for Dark Matter

Brown physicists are in the forefront of efforts to identify the mysterious material.

BY KEVIN STACEY

ISTOCK PHOTO

Scientists are looking deep into the cosmos to study dark matter.

NICK DEMENTARO/BROWN UNIVERSITY

Researchers at Brown assembled in a special cleanroom an array of powerful light sensors to keep watch on the LUX-ZEPLIN dark matter detector in South Dakota.

In the mid-1960s, an astronomer named Vera Rubin found something very strange about the way galaxies rotate.

Stars near the outer edges of galaxies orbited the center much faster than expected—so fast, in fact, that they should just fly off into space. The finding suggested that gravity from some enormous yet unseen mass is holding these galaxies together.

Rubin's results were eventually confirmed, and the quest to understand the missing mass of the universe—dark matter—began in earnest. The quest goes on today, with Brown physicists playing key roles in solving what many see as the greatest mystery in modern physics.

Scientists think dark matter is the dominant form of mass in the universe, though no one is quite sure what the stuff actually is. The current consensus is that it's some kind of particle, the leading candidate being the WIMP, or weakly interacting massive particle. WIMPs, according to theory, should have a mass of somewhere between 10 and 1,000 times the mass of a proton, as well as a snobbish tendency to avoid any interaction with normal matter (hence "weakly interacting"). And so they waft ghostlike through space, ubiquitous yet unseen.

"You and I and all the stuff we can touch and see, that's just flotsam and jetsam in a vast sea of dark matter," said Rick Gaitskell, a professor at Brown and a leading dark matter hunter. "Yet, because the particles are so weakly interacting, they pass right through us all the time and we never know they're there."

Currently, the only way to study dark matter is through indirect observation deep in the cosmos. Though dark matter doesn't emit or reflect light, its gravity can warp the fabric of space, causing the path taken by light to bend. A technique called gravitational lensing measures light bending as it travels, and Brown physicist Ian Dell'Antonio is part of a much-anticipated lensing experiment, the Large Synoptic Survey Telescope, which will measure the light of billions of galaxies.

In the process, the telescope is expected to turn up lots of new dwarf galaxies, which are thought to be rich in dark matter. Telescope data can also be used to measure how "clumpy" dark matter is and the extent to which dark matter may interact with itself, a key characteristic for understanding the nature of particles.

JiJi Fan, an assistant professor of physics, is working with data collected by the European Space Agency's Gaia Satellite, which marks the position of more than a billion stars in our galaxy with unprecedented precision.

"Although the Gaia telescope doesn't measure dark matter directly, the motions of visible stars are mostly determined by the invisible dark matter through gravity," Fan said. "Thus, Gaia data does provide a highly powerful indirect probe to infer the distribution of dark matter." She and her students used the data to put new constraints on the possibility of a "dark disk"—dark matter aligned with the visible galactic disk of the Milky Way.

While the hunt for WIMPs goes on, Savvas Koushiappas, associate professor of physics, has been studying a different dark matter candidate: primordial black holes. Collapsing stars can form black holes, but renowned physicist Stephen Hawking predicted another type of black hole formed before stars existed, during the first moments after the Big Bang. These primordial black holes might contribute to the matter density of the universe, yet so far there's no experimental evidence that they exist. Koushiappas has calculated the earliest time stellar black holes could have formed—about 65 million years after the Big Bang. If gravitational wave experiments, which detect ripples in space-time resulting from black hole mergers, detect merger events before that cut-off time, it would be strong evidence that primordial black holes do exist and may constitute part of the dark matter.

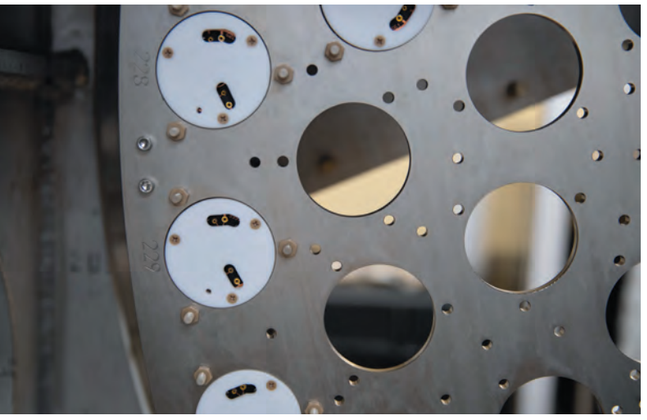
> *"There is every prospect for the direct discovery of the nature of the dominant mass in the universe."*
> —Rick Gaitskell

While indirect observations are important for understanding the nature of dark matter, Gaitskell and other physicists are hard at work trying to directly detect it on Earth. Gaitskell built his first dark matter detector more than 30 years ago; it weighed about 10 grams and was about the size of a fingertip. "It was an en-

tirely credible dark matter detector at the time," Gaitskell said.

Since then, things have scaled up considerably. Today, Gaitskell and scientists from around the world are building a 10-ton detector at the Sanford Underground Research Facility in South Dakota. That massive detector, called LUX-ZEPLIN or LZ, consists of a tub of liquid xenon festooned with powerful light sensors designed to capture the tiny flashes of light produced on the rare occasions when a WIMP smacks into the nucleus of a xenon atom.

To protect the detector from cosmic rays and other radiation that could drown out a WIMP signal, it's being built a mile below ground in a goldmine turned science lab. When



Students and faculty did assembly work on detector parts in a cleanroom to keep equipment as dust-free as possible.

complete, it will be the most sensitive dark matter detector ever built.

LZ is the successor to LUX detector, an experiment Gaitskell co-led that previously held the "most sensitive" distinction, and lessons from LUX informed the new detector. Gaitskell and his students designed and built key parts of the new LZ detector—two large arrays of photomultiplier tubes—in cleanrooms at Brown. The arrays are light sensors powerful enough to detect just a handful of photons coming from the xenon tank. The devices will be first to see the tiny flashes of light associated with a dark matter interaction.

The equipment was trucked from Providence to South Dakota in late 2018. Detector construction is now nearly complete, and soon it will switch on.

"Our team is very excited to see the first results of the operation of this detector in 2020," Gaitskell said. "It will be probing entirely new models of dark matter, and so there is every prospect for the direct discovery of the nature of the dominant mass in the universe".

This Is Her Lane

A physician advocates for a research and public-health-driven approach to curb gun violence.

BY NOEL RUBINTON '77

Just two weeks after the shooting deaths of 17 students and staff at a Parkland, Fla., high school in 2018, Megan Ranney's long-simmering frustration boiled over.

As a professor at Brown's Warren Alpert Medical School who had founded the school's Emergency Digital Health Innovation Program, and an emergency physician at Rhode Island Hospital, Ranney had reached an intense moment of exasperation in her efforts to find research-based solutions to the country's epidemic of gun violence.

An active social media user, Ranney tried a new approach, tweeting out the harrowing accounts of gun violence across the nation that she'd gathered, under the label #docs4gunsense. Her messages got enormous immediate notice, and within days there were hundreds of doctors posting stories of loss and anger under the hashtag she coined.

Less than nine months later, Ranney found herself in the lead of another high-wattage situation played out in social media. In response to a paper on firearm injuries and deals published by the American College of Physicians, the National Rifle Association sent out a tweet telling "self-important anti-gun doctors to stay in their lane." Ranney said she was stunned, yet quickly moved to the forefront of those organizing a rebuttal campaign as #ThisIsOurLane. Fueled further by another mass shooting just a few hours later in Thousand Oaks, Calif., the physicians' hashtag flooded Twitter with tens of thousands of messages.

For Ranney, who also earned an MPH degree from Brown, her interest in gun safety issues and research grew from her emergency department experiences. Over and over, she saw how firearms cases were unusual, particularly how so many were fatal. She was shocked at how many involved suicides, where the presence of an unmonitored gun in a house was connected to a spontaneous act that caused death. She calls the large number of suicide deaths in the United States by guns a "silent epidemic."

Early in her career, Ranney, a former Peace Corps volunteer in Africa, found herself drawn to firearm safety research. She was discouraged from going into the field and quickly found one of the main reasons: an act of Congress in 1996—a still-in-place rider known as the Dickey Amendment—had almost completely choked off all federal funds for gun safety research.

In the last few years, Ranney has led national efforts to conduct gun safety research with money that is available, simultaneously pushing to increase federal and state funding to a much higher level. Based on injury statistics, she estimates that research funds on gun violence should be 50 times greater in order to be responsive.

"This is the health crisis of our time," she said about gun safety issues. More research would identify and test more potential solutions; it would also address the lack of data, such as on firearm ownership, that makes current violence harder to stop, she said.

Ranney is also one of the founders and chief research officer for the American Foundation for Firearm Injury Reduction in Medicine (AFFIRM), a nonprofit group of health care providers and researchers looking to find solutions to firearm violence.

"We have not applied the public health approach to guns," Ranney said, comparing gun deaths to other causes of deaths, such as car crashes and AIDS. In the case of both autos and AIDS, she said, research led to significant innovations and ultimately lowered the number of deaths. For guns, the state of science has not advanced much since 1996, she said.

Responding to the concerns of many gun owners, Ranney said she doesn't think research-based solutions are about confiscation of guns. While recognizing that most guns are used safely, she said other changes, such as more accurate identification of people at risk of firearm injury, improved education about safer storage, and community-based prevention programs, could save lives.

In 2018, when the National Institutes of Health awarded a $5 million grant to the University of Michigan for a new Firearm Safety Among Children and Teens Consortium (FACTS), it was the largest grant from the agency for firearm injury reduction in 20 years. Brown is one of 12 universities and health systems across the country included, with Ranney in charge of Brown's part of the study.

"This is the health crisis of our time." —Megan Ranney

THERESA JOHNSON HERLIHY

Megan Ranney speaks around the country on ways to better understand and reduce gun violence

NICK DEMENTARO/BROWN UNIVERSITY

Also in 2018, Ranney served as the cochair of a 43-member gun safety working group for Rhode Island, appointed by Governor Gina Raimondo and delivering to her more than 30 recommendations for reforms.

She has published many papers on gun violence and other violent injuries, and frequently speaks on the subject.

Despite setbacks, Ranney said, "I see hope. We are close to a tipping point within this nation of recognizing that, when we address gun violence as a health epidemic, we have the potential to fix it, just like we made progress with HIV-AIDS and car crashes."

Last August was another inflection point for gun issues after the El Paso and Dayton mass shootings. Ranney was again one of the most prominent activists and researchers, writing articles and appearing on many radio and television programs. "I'm following a passion and doing something that needs to be done," she said.

Specimens of History

The Herbarium brought the long-lost "Cat Swamp" back to life.

BY NOEL RUBINTON '77

As director of Brown's Herbarium, the home of about 100,000 plant specimens where some date back to the 1800s, Tim Whitfeld kept running across a mysterious location name: Cat Swamp.

It took more sleuthing, including working with the Rhode Island Historical Society, to figure out more about where the plant samples were from, which turned out to be several blocks of the East Side of Providence, still rural in the 1800s. The marshy area was seen as too difficult and expensive to develop until 1915, when engineers and builders started draining the swamp and constructing many one-family homes in the area.

By the time Whitfeld came upon the specimens, there was no one alive who had seen Cat Swamp, and virtually nobody had ever heard of it. Without records and specimens from the Herbarium, Cat Swamp, with all its distinctive character and plant diversity, would have been lost to history. Instead, in collaboration with the historical society and the Brown Library, Whitfeld brought the swamp back into public view through "Entwined: Botany, Art and the Lost Cat Swamp Habitat," an exhibition that attracted several thousand visitors at the John Hay Library in the winter and spring of 2019.

The Brown Herbarium, started in the 1870s, "is a record of plant diversity at a given place at a given time in history," said Whitfeld. With its collection mostly fully digitized, largely through work by undergraduates, the Herbarium is more accessible than ever to researchers everywhere, and original specimens are safely preserved and available for further study in a modern facility in Brown's BioMed Center.

The Herbarium has become a key research site for many biologists, students, and others on campus and around the world. And as DNA extraction and analysis techniques continue to become more sophisticated, the Herbarium's specimens have become even more valuable assets.

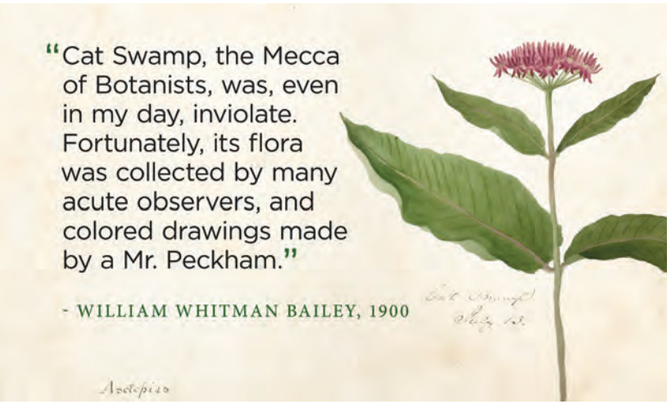
Caltha Palustis, or marsh marigold, taken from Cat Swamp.

JOHN HAY LIBRARY/BROWN UNIVERSITY

Several years ago, the Herbarium launched an ambitious effort to resume collecting current Rhode Island plant specimens. Whitfeld and students collected several hundred new specimens, and, now that Whitfeld has moved to the Bell Museum at the University of Minnesota, the new Herbarium director, Rebecca Kartzinel, is continuing the collecting. The Herbarium collection has grown through its nearly 150 years, and Kartzinel's Rhode Island Flora students will help finish the comprehensive collection of Rhode Island's estimated 1,700 current plant species.

"Scientific collections are super-important for documenting biodiversity," said Kartzinel, assistant professor of ecology and evolutionary biology. "In this era of climate change and invasive species," she said, the Herbarium is an important way to measure what grew when and where, and it increases understanding of environmental trends.

The Herbarium also is used as a research tool to better understand development and pollution locally. Comparing plant specimens at three sites in Providence from 1846 to 1916 to the same sites in 2015, Whitfeld, Sofia Rudin '17, and David Murray, a lecturer in Brown's Department of Earth, Environmental, and Planetary Sciences, were able to measure heavy metal pollution and changes over time and publish their work in the *Applications in Plant Sciences* journal.



While digitized images are making the Herbarium specimens more valuable to researchers outside of Brown, the collection of specimens carefully organized and preserved in climate-controlled cabinets will always be important, Kartzinel said. "You can't get DNA out of a photo," she said. DNA extraction from plants—done by grinding up parts of leaves and then going through filtering steps—has been growing more useful in research, including working to document new species. Kartzinel, whose research focuses on plant population and ecological genetics, plans to expand the use of DNA analysis in the Herbarium, developing a DNA digital database and aiming to add a DNA barcode to specimens to help in identification of species and in cross-referencing that helps determine what was grown in a particular location.

The Herbarium dates to the 1870s, when local businessman Stephen Thayer Olney donated his plant collection to the university. At the same time, William Whitman Bailey became the first botany professor at Brown, and he took over the fledgling Herbarium. He led the collection of many specimens, by himself and by students. Cat Swamp became a favorite location for field trips, as he and students would go there often, and Bailey's notebooks documenting the visits were part of the John Hay exhibition. Whitfeld said Bailey thought Cat Swamp "was noteworthy in the increasingly urban environment," and "it was an interesting local hot spot, easy to get to."

Kartzinel lives on the edge of what was once Cat Swamp. "To walk down there and think there was a swamp there is amazing," she said. The Herbarium "is tied to ecological history," she said, and is also well positioned to provide a window on the environment into the future. ■

Cat Swamp covered several blocks of Providence's East Side until the early 1900s.

Spreading Better Health

Rhode Island's clinical and translational research center, based at Brown, has already funded over 60 projects.

BY GABRIELLE STRANIERI AND PHOEBE HALL

Anyone who has ever spent time in Rhode Island knows that Lil Rhody—as it's affectionately called—often feels like one big small town. It's a statewide community of just over a million people, 70 percent of whom never relocate out of state.

Rhode Island's small size and stability was an advantage in Advance Clinical and Translational Research (Advance-CTR) being established at Brown in 2016. A $19.5 million statewide award was secured in a competitive process from the National Institute of General Medical Sciences. "Rhode Island is an excellent test-bed for research," said Neil Sarkar, director of Advance-CTR's biomedical informatics core.

With involvement from Brown, Advance-CTR's partners at the University of Rhode Island, and affiliated hospitals across the state, the program is already proving to be a change-maker. Its impact spans dozens of projects for big data research, community engagement, medtech discoveries, and more.

"We've created a centralized hub of resources for all health-focused researchers in Rhode Island," said James Padbury, program director of Advance-CTR and professor of pediatrics at Brown's Warren Alpert Medical School. "In our first three years, we funded 66 investigators and provided research support and training that were previously unavailable on a statewide level. This fills a crucial need, while putting major resources toward studies that tackle the health priorities of our local communities."

Here are three of Advance-CTR's projects so far:

PILOT STATE

Rhode Island is not just the Ocean State—it's also a pilot state. That's what Sarkar along with others had in mind when they brokered a deal with the state to leverage Rhode Island's All-Payer Claims Database for unprecedented big data health research.

The all-payer information is a powerful dataset that houses nearly all medical and pharmacy bills for the state's residents in one place. With this access, Sarkar said researchers can now track—with patient confidentiality and data security safeguards in place—every person who has had a heart attack

or shoulder surgery instead of having to select from a sample of patients. Thanks to Rhode Island's high resident retention, researchers can track patients over the long term.

"This data is a gamechanger," said Brett Owens, a professor of orthopaedics at Brown's medical school and one of five investigators at Brown and URI who are leveraging the data so far. Owens is studying the differences in outcomes among patients who seek treatment for shoulder injuries: "There's a huge care disparity in our state, but being able to track patients' outcomes, and map it to demographic factors, gives us the opportunity to fix the cracks in healthcare delivery in our communities."

FOOD IS LIFE

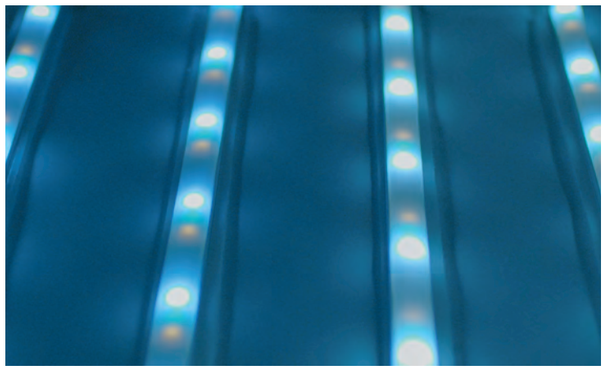
When Marcella Thompson, assistant professor of nursing at URI, and Elizabeth Hoover, associate professor of American studies at Brown, learned contaminants were found in fish at the Narragansett Indian Tribe's reservation in Charlestown, R.I., they wanted to help.

They teamed up with Dinalyn Spears, the Narragansett's director of community planning and natural resources, and secured funding from Advance-CTR to develop a survey. They wanted to understand how much fish tribal members eat from local ponds, and work with the community to make informed decisions about what to do next.

It's a complex issue to navigate, Thompson explained, as fishing is not just sustenance to the Narragansetts—it's a cherished practice that connects them to their ancestry, traditions, and culture.

"They are a sovereign nation," Thompson said. "Some of them have said, regardless, because it's so important to them, they're going to continue to eat the fish from these ponds."

URI nursing professor Marcella Thompson (second from left) is working with Narragansett Indian tribe members on food safety issues.



A Newport startup company is helping people improve sleep patterns, including through lighting systems.

That understanding is at the heart of the project. Spears said initial resistance is common until members have a full understanding of the risks and tribal government sets healthy fish and shellfish consumption levels. When the researchers bring the results to Narragansett tribal leadership, they and tribe members will discuss what to do next.

FROM SCIENCE TO STARTUP

Eliza Van Reen and Gustavo Fernandes were working at Brown on a "smart" lighting system to help sleep-deprived teenagers perform better in school. The multi-disciplinary pair—she an assistant professor of psychiatry and human behavior, and he an engineering researcher—saw an opportunity to aid people whose lives don't match up with internal clocks, like shift workers and security guards.

They received funding from Advance-CTR to establish proof-of-concept and wrote a patent application. The idea of taking their software out of the lab and into the market began to feel achievable.

Two years after Van Reen and Fernandes founded Circadian Positioning Systems in Newport, she said the business is doing well.

"We're developing a wearable that tracks sleep and wake, that's been validated against the laboratory-based gold standard measures," Van Reen said. "We're excited to expand our offerings in health care and operational settings and, eventually, maybe even to consumers."

Van Reen and Fernandes are Advance-CTR's first awardees to make the jump from academia to industry, and program leadership expects more. "By staying in Rhode Island, they're translating their findings back into the communities they serve, which is our goal for all our awardees," said Edward Hawrot, program coordinator and senior associate dean for Brown's program in biology. "Our goal is to improve health in Rhode Island."

Advance-CTR is in the fourth year of its five-year award. Padbury said they'll apply for another five years of funding in fall 2020, and continue with their goal to "lay the infrastructure for a sustainable, collaborative, and statewide research environment." ■

Portions of this article were previously published in Medicine@Brown.

NEWFANGLED STUDIOS; BEAU JONES

Making Music

A professor has moved into the leading rank of new classical composers.

BY ALLIE REED '21

On a September night in 2019, Eric Nathan received a standing ovation as he stood on the stage of Boston's Symphony Hall. The Boston Symphony Orchestra had just played the world premiere of his *Concerto for Orchestra*.

For many months preceding the performance, Nathan, an assistant professor of music at Brown, had been developing his latest commission from the BSO (the third in the past five years), researching and building the piece. The roots of his concerto actually went back much further: the first score Nathan ever bought was Bartok's *Concerto for Orchestra*, and his fascination with the concerto form came together when, as a teenager, he saw the BSO perform the Bartok at Tanglewood.

Nathan's creative world advanced as he started taking violin, piano, and trumpet lessons at an early age. He discovered that, while he loved to perform, he hated to practice. Yet composition, he found, was something he could do "all day long." And he wrote his first composition, *Proclamation for Trumpet and Piano*, while in high school.

Eric Nathan took a bow after the Boston Symphony Orchestra played the world premiere of his concerto.

"I'm experimenting, I'm failing, I'm learning and meeting these musical elements anew each time I write." *—Eric Nathan*

When Nathan composes, his studio may look similar to that of a historian writing a book. The room is covered with scores by other composers, which he uses to research how they dealt with similar issues. He also listens to music and fills notebooks with ideas before writing.

"When I'm writing," he said, "I'll have ideas of the larger-range picture or gestures," usually sketching them out by hand, sometimes using words to describe what he is going for. "Then I hone in on rhythms, pitches, and creating motives. Once I've composed a motive, I find that it usually then starts to take on its own life and presents new questions and ideas that can help lead me forward."

He uses many methods to "coax out ideas." Sometimes this means looking at pictures of conductors or performers. Other times, as with his Emily Dickinson song cycle that premiered in Dallas in January 2019, he finds inspiration from on-the-scene research. "There is something powerful about a sense of place that can help one feel connection to the past," Nathan said. Another piece, *the space of a door*, a 2016 Boston Symphony commission, was based on his emotional experience visiting the Providence Athenaeum for the first time.

Nathan, who joined the Brown faculty in 2015, said he's found techniques to work around roadblocks, like listening to his composition in a new space, with others, or while lying down or walking around: "If I invite someone in to listen with me, I listen completely differently than when I listen alone." Nathan thinks of his method of composing as a dialogue between what he wants on a conscious level and what the piece wants on a subconscious one.

For instance, after immersing himself in Dickinson's world by experiencing the sense of her house and standing in the room where she wrote her poetry, Nathan wrote a song cycle based on Dickinson's Civil War-time correspondence with Thomas Wentworth Higginson. He used their letters to "tell a story through music, about Dickinson's struggles as a woman poet and Higginson's struggles for the abolition of slavery." The 45-minute piece had a series of premiere performances in 2019, culminating in going "home" to near the Dickinson Museum in Amherst.

Another piece of Nathan's commissioned by the orchestra,* the space of a door*, is on a new CD.

KEITH KIRCHOFF

Robert Kirzinger, associate director of program publications for the Boston Symphony Orchestra, said he is "continually impressed with Eric's ability to unlock the personalities of the instruments and ensembles he's writing for," expressing a wide range of emotions in his work, from humor to grief.

Nathan said it took him time to let go of the idea of the "genius composer," whose ideas flow seamlessly from head to page all at once. Instead, he said, "I'm experimenting, I'm failing, I'm learning and meeting these musical elements anew each time I write."

Nathan is known in the music world for his adventurous spirit. *As Above, So Below*, commissioned by the New York Philharmonic in 2014, is a duet for a solo trombonist that Nathan describes as "a dialogue between two sides of the same instrument." The performer physically removes one of the trombone's tuning slides, to "project the sound forwards out of the trombone's bell, or backwards from the opened tuning slide." The result is two distinct characters that can be put into conversation with each other, despite the voices coming from just one performer.

A fellow composer praised Nathan for his teaching as well as his writing of music.

Nathan's *Missing Words* series pays homage to Ben Schott's book *Schottenfreude*, which is a collection of German words created for the modern world. Each piece is based off a word, which Nathan uses as a lens to find new sounds.

The critical response to Nathan's latest concerto was positive; *Boston Globe* critic Zoe Madonna wrote, "I'd happily have heard it over again as soon as it ended." The BSO's Chamber Players will reprise Nathan's *Why Old Places Matter* (2014) in March 2020. John Harbison, a Pulitzer- and MacArthur Fellowship–winning composer and professor of music composition at the Massachusetts Institute of Technology, said he believes Nathan will be "an important American composer for many years to come." He also praised Nathan's teaching for inspiring students to make a mark in the "fascinating and competitive world of new concert music."

New Ways to Fight Infection

An "obsession" leads to progress, using novel materials.

BY ALLIE REED '21

At a young age, Anita Shukla thought she wanted to be a doctor.

"But of course, as many engineers say, I also liked the math and all the basic sciences," Shukla recalled, and, by double majoring in chemical and biomedical engineering as an undergraduate at Carnegie Mellon, she gained perspective about health problems she could solve with engineering expertise.

Today Shukla is using her knowledge and her "obsession with infection" to take on the challenge of reducing infections and combatting drug-resistant diseases. As an assistant professor of engineering and of molecular pharmacology, physiology, and biotechnology at Brown, she is designing practical biomaterials for life-threatening problems.

Part of that work is a focus on hospital-acquired infections, which are among the most significant dangers, accounting for as many as 99,000 deaths each year in the United States. Shukla is targeting catheter-related bloodstream infections, which are the most common type of hospital-acquired infection. They are a "major burden for hospitals, health care providers, and most of all patients," she said, with infections that have mortality rates as high as 12 to 25 percent. They can prolong hospital stays by 10 to 20 days, and increase the cost of care from $4,000 to $56,000 per patient.

Shukla's Lab for Designer Biomaterials is collaborating with Rhode Island Hospital to develop a new antibacterial coating for intravascular catheters that aims to combat burdensome, costly, and sometimes deadly infections.

"We wanted to develop a coating that could both kill planktonic [free-floating] bacteria and prevent colonization of bacteria on surfaces," Shukla said. In their paper published in *Frontiers in Cellular and Infection Microbiology*, Shukla and her colleagues show that when their polyurethane coating is applied and a drug called auranofin is gradually released, it can kill methicillin-resistant Staphylococcus aureus (MRSA) bacteria for nearly a month in lab tests. "The initial data that we gathered for this paper shows that we have something really promising," she said.

Shukla's coating is unique in its use of auranofin. While the drug was originally developed to treat arthritis, it is being found to be also highly effective at killing MRSA and other dangerous microbes. Additionally, unlike a more traditional antibiotic, auranofin works in ways that make it hard for bacteria to evolve a natural resistance.

Research has shown that the coatings had no adverse effects on human blood or liver cells, but more testing is required before the coating is ready to be used on patients. Shukla said, "We're hopeful that the initial results we show here will soon translate to the clinic."

Although she got her PhD in chemical engineering at Massachusetts Institute of Technology just nine years ago and joined the Brown faculty in 2013, Shukla is already accumulating awards as a researcher, teacher, and mentor. In July 2019, she was one of just 314 scholars in the United States to win a Presidential Early Career Award for Scientists and Engineers (PECASE), the nation's highest award for scientists and engineers in the early stages of their research careers. She is also the recipient of a Director of Research Early Career Grant from the Office of Naval Research, the office that later nominated Shukla for the PECASE. "It was a huge honor to be recognized," Shukla said, adding that the Office of Naval Research "really believes in our work."

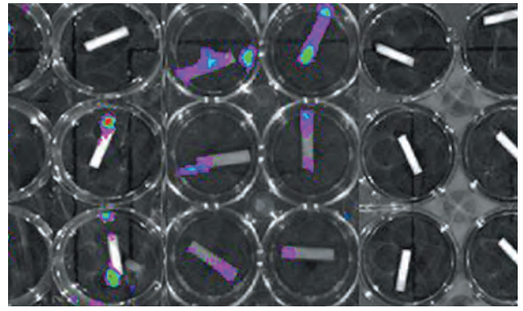
Anita Shukla said hospital-acquired infections are a "major burden" for patients and health care providers, prompting her lab's efforts to reduce them.

AMY SIMMONS/BROWN UNIVERSITY

Dean of the School of Engineering at Brown Lawrence Larson called the work of Shukla and her lab "unique and innovative" because it applies concepts from a wide range of fields to develop "biomaterials for critical unmet needs in the areas of drug delivery and regenerative medicine."

Shukla won a 2017 Dean's Award for Excellence in Teaching. Students appreciate the fact that she is always "exceedingly well-prepared and pushes students to think beyond the course material," said Sarah Cowles '17, a chemical and biochemical engineering concentrator. Shukla said her favorite class to teach at the University is ENGN 1110: Biotransport and Transport Processes because of the chance to work with both chemical engineering and biomedical engineering concentrators, mirroring her undergraduate majors.

While they await the results of further testing on the antibacterial coating, Shukla and her lab are working on several other projects. One centers on fungal infections, a type of infection she thinks does not get enough attention from researchers; her lab is designing a gel-like bandage material made to limit both toxicity and drug resistance. When the bandage is applied to a wound that might contain fungi, if the gel detects the presence of fungi, it releases an antifungal substance into the body. Shukla said this bandage could aid military personnel in the field who cannot be tested for fungus on location.



In catheters on the right with coating from Shukla's lab, there are no signs of bacteria.

NICK DEMENTARO/BROWN UNIVERSITY

In addition to her research and teaching, Shukla is an active mentor of students, with a particular focus on advising other women in STEM. "There really aren't enough women in engineering and science," she said. "By being one of those people, and letting others see that I can be successful—that I'm teaching people and acting as a leader—that's critical. It makes people feel like they can do this too."

BROWN RESEARCH INDEX

With more than 700 regular faculty and hundreds more in clinical and other categories, Brown produces an enormous range and volume of research. The Brown Research Index captures some of this through faculty books published and selected faculty honors.

By the Book

In 2018, Brown professors published 105 books, spanning many disciplines and subjects.

Africana Studies
FRANCOISE HAMLIN
- These Truly Are the Brave: An Anthology of African American Writings on War and Citizenship (*Editor*)

BRIAN MEEKS
- The Coup Clock Clicks
- Beyond Westminster in the Caribbean (*Editor*)

American Studies
LETICIA ALVARADO
- Abject Performances: Aesthetic Strategies in Latino Cultural Production

MONICA MUÑOZ MARTINEZ
- The Injustice Never Leaves You: Anti-Mexican Violence in Texas

DIXA RAMIREZ
- Colonial Phantoms: Belonging and Refusal in the Dominican Americas, from the 19th Century to the Present

RALPH RODRIGUEZ
- Latinx Literature Unbound: Undoing Ethnic Expectation

Anthropology
MATTHEW GUTMANN
- The Romance of Democracy (*Chinese Edition*)

STEPHEN HOUSTON
- The Gifted Passage: Young Men in Classic Maya Art and Text

DAVID KERTZER
- The Pope Who Would Be King: The Exile of Pius IX and the Emergence of Modern Europe

ANDREW SCHERER
- Smoke, Flames, and the Human Body in Mesoamerican Ritual Practice (*Editor*)

BHRIGUPATI SINGH
- Anthropology and Life Itself (*Editor*)

Applied Mathematics
CAROLINE KLIVANS
- The Mathematics of Chip-Firing

Biology
KENNETH MILLER
- The Human Instinct: How We Evolved to Have Reason, Consciousness, and Free Will
- Biology by Miller & Levine

Bio Med
ELI ADASHI
- The Ovary, Third Edition (*Editor*)

SUZANNE COLBY
- Brief Interventions for Adolescent Alcohol and Substance Abuse (*Editor*)

KARA LYNNE LEONARD
- Biostatistics for Oncologists

WILLIAM OH
- Nephrology and Fluid/Electrolyte Physiology: Neonatology Questions and Controversies, Third Edition

RANNA ROSENFELD
- The PICU Handbook

DAVID WAZER
- Perez & Brady's Principles and Practice of Radiation Oncology, Seventh Edition

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YANNIS HAMILAKIS
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ANDREW LAIRD
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JOSEPH REED
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ADELE SCAFURO
- The Oxford Handbook of Greek and Roman Comedy (*Editor*)

Cognitive, Linguistic, and Psychological Sciences
JOACHIM KRUEGER
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AMITAI SHENHAV
- Goal-Directed Decision Making: Computations and Neural Circuits (*Editor*)

STEVEN SLOMAN
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- Modern Language Notes, special issue on Inheriting the Frankfurt School (*Editor*)

PETER SZENDY
- All Ears: The Aesthetics of Espionage (*Spanish Edition*)
- Of Stigmatology: Punctuation as Experience

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SENY KAMARA
- Decrypting the Encryption Debate: A Framework for Decision Makers

ROBERTO TAMASSIA
- Proceedings of the 26th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems (*Editor*)

Earth, Environmental and Planetary Sciences
AMANDA LYNCH
- Urgency in the Anthropocene

East Asian Studies
HYE-SOOK WANG
- Master Korean 4 (*Translator*)

Economics
ROBERTO SERRANO
- A Short Course in Intermediate Microeconomics with Calculus, Second Edition

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KENNETH WONG
- Federalism and Education: Ongoing Challenges and Policy Strategies in Ten Countries (*Editor*)

Egyptology and Assyriology
JOHN STEELE
- The Babylonian Astronomical Compendium MUL.APIN: Scientific Writings from the Ancient and Medieval World
- The Cuneiform Uranology Texts: Drawing the Constellations

BROWN RESEARCH

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- Jacques Edwards: Metamorfosis (*Editor*)
- Adiós, Ayacucho, Reprint Edition

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- All That Is Evident Is Suspect: Readings from the Oulipo 1963–2018 (*Translator*)
- Atlas Inutilis (*Translator*)
- Now, Now, Louison (*Translator*)

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BRENDAN HASSETT
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Theatre Arts and Performance Studies

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- The Baroque Night

REBECCA SCHNEIDER
- The Drama Review, special issue on Performance and Reproduction (*Editor*)

—Compiled by Eliza Cain '20

Selected Faculty Research Honors

During the 2018–19 academic year, faculty won dozens of research honors from national and international organizations.

ELI Y. ADASHI
Professor of Medical Science
- Inaugural Lifetime Achievement Award, American Society of Reproductive Medicine
- Honorary Member, European Society of Human Reproduction and Embryology

JASJIT AHLUWALIA
Professor of Behavioral and Social Sciences, Professor of Medicine
- Fellow of the Society for Research on Nicotine and Tobacco

STEPHON ALEXANDER
Professor of Physics
- President-elect, National Society of Black Physicists

RUBEN ALVERO
Adjunct Professor of Obstetrics and Gynecology
- President, International Gynecologic Society

AMANDA ANDERSON
Andrew W. Mellon Professor of Humanities and English, Director of the Cogut Institute for the Humanities
- Fellow, American Academy in Berlin

YURI BAZILEVES
E. Paul Sorensen Professor of Engineering
- Walter L. Huber Civil Engineering Prize, American Society of Civil Engineers

SARA BECKER
Associate Professor of Behavioral and Social Sciences
- Dissemination and Implementation Science Special Interest Group's Early Career Achievement Award

MARK BLYTH
William R. Rhodes '57 Professor of International Economics, Director of the William R. Rhodes Center for International Economics and Finance
- Open Society Fellow

GHADA BOURJEILY
Professor of Medicine
- Medalist Award, American College of Chest Physicians

ELIZABETH BRAINERD
Professor of Biology and Medical Science
- Brown Distinguished Research Achievement Award

MARIA L. BUCKLEY
Clinical Associate Professor of Psychiatry and Human Behavior
- Distinguished Service Award, American Association of Cardiovascular and Pulmonary Rehabilitation

HOLLY CASE
Associate Professor of History
- Imre Kertész Kolleg Fellowship

COLIN CHANNER
Associate Professor of Literary Arts
- Henry Merritt Wriston Fellowship

ROSS CHEIT
Professor of International and Public Affairs, Professor of Political Science
- Elizabeth Hurlock Beckman Trust Award

KAIJUN CHEN
Assistant Professor of East Asian Studies
- Henry Luce Foundation Fellowship, American Council of Learned Societies

TAMARA CHIN
Associate Professor of Comparative Literature, Associate Professor of East Asian Studies
- Frederick Burkhardt Residential Fellowship, American Council of Learned Societies

PATRICIA CIOE
Assistant Professor of Behavioral and Social Sciences
- Association of Nurses in AIDS Care Researcher of the Year

SUZANNE COLBY
Professor of Psychiatry and Human Behavior, Professor of Behavioral and Social Sciences
- President-elect of the Society for Research on Nicotine and Tobacco

LORIN CRAWFORD
Assistant Professor of Biostatistics
- Alfred P. Sloan Foundation Fellow 2019
- Forbes 30 Under 30: Science

BATHSHEBA DEMUTH
Assistant Professor of History and Environmental Society
- Henry Merritt Wriston Fellowship

PHYLLIS A. DENNERY
Sylvia Kay Hassenfeld Professor of Pediatrics, Chair, Department of Pediatrics
- President, Society for Redox Biology and Medicine
- Distinguished Physician Award, Infectious Diseases Society

BESHARA DOUMANI
Joukowsky Family Distinguished Professor of Modern Middle Eastern History, Professor of History
- Member, School of Social Science, Institute for Advanced Study

EMILY DRUSTA
Assistant Professor of Comparative Literature
- National Endowment for the Humanities Postdoctoral Fellowship

PAJA FAUDREE
Associate Professor of Anthropology
- Fulbright Senior Scholar Award

ORIEL FELDMANHALL
Assistant Professor of Cognitive, Linguistic, and Psychological Sciences
- Henry Merritt Wriston Fellowship

PATRICIA FLANAGAN
Professor of Pediatrics, Vice Chair, Department of Pediatrics
- Calvin C. J. Sia Community Pediatrics Medical Home Leadership
- Advocacy Award, American Academy of Pediatrics

FORREST GANDER
Adele Kellenberg Seaver '49 Professor Emeritus of Creative Writing, Professor Emeritus of Literary Arts, Professor Emeritus of Comparative Literature
- Pulitzer Prize in Poetry

HUAJIAN GAO
Walter H. Annenberg Professor of Engineering
- Fellow, American Academy of Arts and Sciences

CONSTANTINE GATSONIS
Professor of Biostatistics
- The Boston Chapter of the American Statistical Association 2019 Mosteller Statistician of the Year Award

STEFAN GRAVENSTEIN
Professor of Health Services, Policy, and Practice, Professor of Medicine
- Fellow of the Gerontological Society of America

JAMES N. GREEN
Carlos Manuel de Cespedes Professor of Modern Latin American History
- Brown Distinguished Research Achievement Award

GREG HIRTH
Professor of Earth, Environmental, and Planetary Sciences
- George P. Woollard Award, The Geological Society of America

BROWN RESEARCH

INDEX

JEFFREY HOFFSTEIN
Professor of Mathematics
■ Fellow, American Mathematical Society

ELIZABETH HOOVER
Manning Assistant Professor of American Studies
■ Stanford Humanities Center Fellowship

MARGARET HOWARD
Professor of Psychiatry and Human Behavior, Clinician Educator, Professor of Medicine, Clinician Educator
■ Committee on Women in Psychology Leadership Award, American Psychological Association

EVELYN HU-DEHART
Professor of History, Professor of American Studies
■ American Council of Learned Societies Fellowship

NANCY JACOBS
Professor of History
■ Rachel Carson Center for Environment and Society Fellow

GEORGE KARNIADAKIS
Charles Pitts Robinson and John Palmer Barstow Professor of Applied Mathematics
■ Elected Fellow, American Association for the Advancement of Science

TYLER KARTZINEL
Assistant Professor, Ecology and Evolutionary Biology
■ Early Career Fellow, Ecological Society of America

MICHAEL L. LITTMAN
Professor of Computer Science, Codirector, Humanity Centered Robotics Initiative
■ Presidential Faculty Award, Spring 2019

AMANDA H. LYNCH
Director, Institute at Brown for Environment and Society, Sloan Lindemann and George Lindemann Jr. Distinguished Professor of Environmental Studies
■ Presidential Faculty Award, Fall 2018

KATHRYN MANN
Manning Assistant Professor of Mathematics
■ Fellow, Alfred P. Sloan Foundation

BRANDON MARSHALL
Associate Professor of Epidemiology
■ ASPPH Early Career Public Health Research Award

MONICA MUÑOZ MARTINEZ
Stanley J. Bernstein '65 P'02 Assistant Professor of American Studies
■ Brown Early Career Research Achievement Award

KRISTEN MATTESON
Associate Professor of Obstetrics and Gynecology
■ Faculty Award, Society of Academic Specialists in General Obstetrics and Gynecology

F. DENNIS MCCOOL
Professor of Medicine
■ Distinguished Scientist in Cardiopulmonary Physiology Award, American College of Chest Physicians

GOVIND MENON
Professor of Applied Mathematics
■ Member, School of Mathematics, Institute of Advanced Studies
■ Simons Fellow in Mathematics

JENNIFER MERILL
Assistant Professor of Behavioral and Social Sciences
■ Distinguished Scientific Early Career Contribution Award, Society of Addiction Psychology

PASCAL MICHAILLAT
Assistant Professor of Economics
■ Member, School of Social Science, Institute for Advanced Study

DANIEL MITTLEMAN
Professor of Engineering
■ Alexander von Humboldt Research Award

PETER MONTI
Professor of Behavioral and Social Sciences
■ Jack Mendelson Award, National Institutes on Alcohol Abuse and Alcoholism

ELEFTHERIOS E. MYLONAKIS
Charles C. J. Carpenter, MD, Professor of Infectious Diseases, Professor of Medicine
■ Elected, Association of American Physicians
■ Fellow, American Academy of Microbiology

DIETRICH NEUMANN
Professor of History of Art and Architecture
■ Society of Architectural Historians Fellow

LINDI NICI
Professor of Medicine
■ Thomas L. Petty Distinguished Pulmonary Scholar Award, American Association of Cardiovascular and Pulmonary Rehabilitation

EFSTRATIOS PAPAIOANNOU
Professor of Classics
■ Guggenheim Fellowship

MARC PERLMAN
Associate Professor of Music
■ National Endowment for the Humanities Fellowship

ANDREW PETERSON
Associate Professor of Engineering
■ Brown Early Career Research Achievement Award

MAUREEN PHIPPS
Chace-Joukowsky Professor of Obstetrics and Gynecology, Chair, Department of Obstetrics and Gynecology, Professor of Epidemiology Assistant Dean for Teaching and Research on Women's Health
■ President-elect, American Gynecological and Obstetrical Society

JONATHAN POBER
Assistant Professor of Physics
■ Henry Merritt Wriston Fellowship

KAVITA RAMANAN
Roland George Dwight Richardson University Professor of Applied Mathematics
■ Simons Fellow in Mathematics

LOUIS B. RICE
Joukowsky Family Professor of Medicine, Chair, Department of Medicine
■ Elected, Association of American Physicians

JOSIAH RICH
Professor of Medicine, Professor of Epidemiology
■ Member, National Academy of Medicine

PHILIP R. RIZZUTO
Clinical Professor of Surgery (Ophthalmology)
■ Secretariat Award, American Academy of Ophthalmology

SHARON I.S. ROUNDS
Associate Dean for Clinical Affairs, Professor of Medicine
■ Fellow, American Association for the Advancement of Science
■ Grover Prize from the American Thoracic Society

BRENDA RUBENSTEIN
Assistant Professor of Chemistry
■ Fellow, Alfred P. Sloan Foundation

AMITAI SHENHAV
Assistant Professor of Cognitive, Linguistic, and Psychological Sciences
■ Fellow, Alfred P. Sloan Foundation

ELENA SHIH
Assistant Professor of American Studies
■ Fellowship, Henry Luce Foundation, American Council of Learned Societies Program in China Studies

PRERNA SINGH
Mahatma Gandhi Associate Professor of Political Science and International and Public Affairs
■ Fellow, American Academy in Berlin

MARCUS SPRADLIN
Professor of Physics
■ American Physical Society Fellow

KALI THOMAS
Associate Professor of Health Services, Policy, and Practice
■ Brown Early Career Research Achievement Award

ALLAN R. TUNKEL
Senior Associate Dean for Medical Education, Professor of Medicine
■ Clinical Teacher Award, Infectious Diseases Society of America

ANDRIES VAN DAM
Thomas J. Watson Jr. University Professor of Technology and Education, Professor of Computer Science
■ ACM SIGGRAPH Academy Inaugural Class

LAI-SHENG WANG
Jesse H. and Louisa D. Sharp Metcalf Professor of Chemistry
■ Brown Distinguished Research Achievement Award

ARNOLD-PETER C. WEISS
Professor of Orthopaedics
■ Weiland Medal for Lifetime Outstanding Research in Hand Surgery, American Society for Surgery of the Hand

THERESE ZINK
Clinical Professor of Family Medicine
■ Fulbright Scholarship

Source: *Brown University Dean of the Faculty's Office, School of Public Health, Division of Biology and Medicine, as reported in the 2019 Commencement program.* ■

BROWN

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AMY SIMMONS/BROWN UNIVERSITY

ENGINEERING TIME: *For the first time, undergraduates designed a piece of permanent public art at Brown. Students, spanning engineering, computer science, and humanities, devised "Infinite Possibility," a noon-mark sundial in the shape of a Mobius strip, installed outside the Engineering Research Center.*