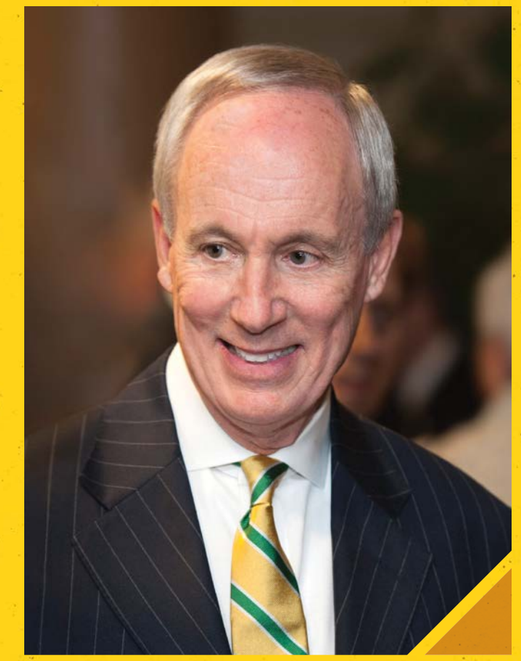
UVM

iNQUIRY

2018

RESEARCH, SCHOLARSHIP AND THE ARTS
AT THE UNIVERSITY OF VERMONT



Advancing Creativity and Possibilities

Ninety years ago, the groundbreaking educator, philosopher, and University of Vermont alumnus John Dewey wrote that "every great advance in science has issued from a new audacity of imagination." That spirit of boldness inspires not just scholars in the field of science, but in all areas of intellectual exploration and artistic creativity across the University.

This issue of ***UVM Inquiry*** displays, as always, just a sampling of the research, scholarship, and artistic work of the institution's 1,600 faculty members. As Vermont's land-grant institution of higher learning, the University is dedicated to its mission to "create, evaluate, share, and apply knowledge," and to impart that knowledge to its students and to the wider community. This creative mission is driven by our outstanding faculty, and the creative contribution of the University of Vermont extends across the wide range of human endeavor — from crafting solutions to the harrowing opioid addiction crisis, to building new molecular structures to improve chemical and mechanical processes, to giving new insight and inspiration through words and images.

All of this work must take place within the real world of infrastructure. This year has seen a blossoming of new facilities to support the growth of new knowledge and teaching at UVM. Work in the STEM fields has already been assisted by the opening this past year of Discovery Hall, and will be further improved when the adjacent Innovation Hall comes online later in the coming year. The Miller Center for Holocaust Studies, whose work is showcased in this publication, now occupies its new quarters in the renovated Billings Library, UVM's Richardson Romanesque architectural gem, which now also houses the Humanities Center, the Center for Research on Vermont, and UVM Libraries' Special Collections. The newly opened Ifshin Hall offers innovative new space in which the Grossman School of Business is expanding its programs. Also, the state-of-the-art collaborative studio, gallery, performance, and classroom space in the Cohen Hall for the Integrative Creative Arts — in the renovated former Elihu B. Taft School — has opened for our faculty-artists in the visual, digital, performing, and art history fields.

The creative work that takes place at the University is a key indicator of the institution's role as a full-fledged member of an intellectual community. ***UVM Inquiry*** highlights a few important examples of this vital connection, where the University, among other goals, is fostering the entrepreneurial spark to grow new industries and building new partnerships to expand knowledge and its applications.

More than 60 years after his passing, John Dewey rests now in a quiet corner on our campus next to Ira Allen Chapel. But, as this showcase of the work of the University demonstrates, his spirit of bold, assured inquiry lives on in the efforts of all the members of the UVM community. It drives their contributions to this institution and the world around it.

Tom Sullivan

TOM SULLIVAN
President
University of Vermont

UVM INQUIRY 2018

RESEARCH, SCHOLARSHIP AND THE ARTS AT THE UNIVERSITY OF VERMONT

SHORT TAKES:

UNIVERSITY OF VERMONT FACTS

THE MISSION OF THE UNIVERSITY OF VERMONT

To create, evaluate, share, and apply knowledge and to prepare students to be accountable leaders who will bring to their work dedication to the global community, a grasp of complexity, effective problem-solving and communication skills, and an enduring commitment to learning and ethical conduct.

HISTORY

The University was chartered in 1791, the same year that Vermont became the 14th state, and celebrated its 225th Anniversary in 2016. It was established as the fifth college in New England (after Harvard, Yale, Dartmouth and Brown).

Although it began as a private university, UVM attained quasi-public status in 1865, subsequent to the passage of the Morrill Land-Grant College Act and the addition of the State Agricultural College.

Today, the University blends the traditions of both a private and public university, drawing a portion of its general fund from the State of Vermont.

A TRADITION OF EQUALITY

Throughout its history, the University of Vermont has demonstrated its commitment to fairness and equality. It was the first American college or university with a charter plainly declaring that the "rules, regulations, and by-laws shall not tend to give preference to any religious sect or denomination whatsoever."

In addition, the University was an early advocate of both women's and African Americans' participation in higher education. Andrew Harris from the Class of 1838 was the first African American graduate of the University, and went on to be a powerful voice in the abolitionist movement. In 1871, UVM defied custom and admitted two women as students.

Four years later, it was the first American university to admit women to full membership into Phi Beta Kappa, the country's oldest collegiate academic honor society. Likewise, in 1877, it initiated the first African-American into the society.

FACULTY

1,646 FULL- AND PART-TIME FACULTY

TOTAL ENROLLMENT

10,513 UNDERGRADUATE

1,542 GRADUATE

461 MEDICAL

40% UVM UNDERGRADUATE PARTICIPATION IN RESEARCH

(BASED ON LATEST AVAILABLE NATIONAL SURVEY OF STUDENT ENGAGEMENT)

GRADUATE EDUCATION

50 MASTER'S DEGREE PROGRAMS

22 DOCTORAL PROGRAMS

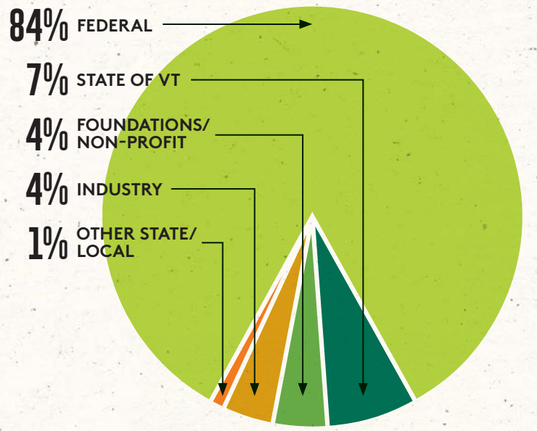
1 M.D. PROGRAM

8 INTERDISCIPLINARY GRADUATE PROGRAMS

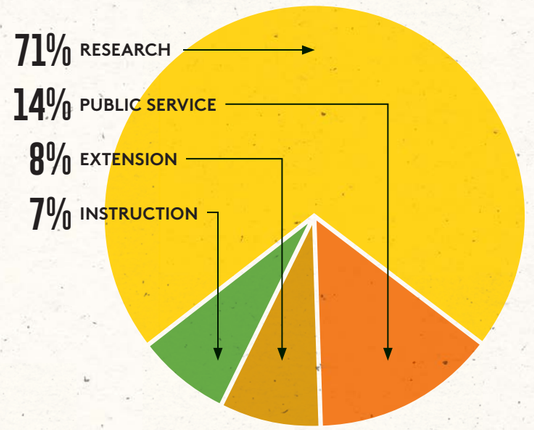
RESEARCH AWARDS

$136M EXTERNAL GRANT FUNDING

624 SPONSORED PROGRAM AWARDS



AWARDS BY SPONSOR (FY18)



AWARDS BY PURPOSE (FY18)

PHILANTHROPY

Thanks to gifts from more than 70,000 alumni, parents, community members, and friends, ***Move Mountains: The Campaign for the University of Vermont*** in August of 2018 crossed its $500 million fundraising goal eleven months ahead of schedule — and shows no signs of slowing down.

"This transformative accomplishment reflects the passion, generosity, and hard work of thousands of donors, volunteers, and staff members who have put their shoulders to the mountainside since the beginning of the campaign," said UVM President Tom Sullivan. "We owe the ongoing success of this campaign to them and are deeply grateful."

Launched in 2011, the *Move Mountains* campaign is a comprehensive fundraising effort to benefit the entire University, including its colleges and other academic units, as well as a wide range of extracurricular and athletics programs. The $500 million goal makes Move Mountains the most ambitious fundraising effort ever undertaken by UVM, and the campaign will continue through June 30, 2019.

$500,000,000

MOVE MOUNTAINS CAMPAIGN (TOTAL AS OF AUGUST 1, 2018)

$522M UVM ENDOWMENT (FY17)

$68.3M NEW FUNDRAISING COMMITMENTS TO UVM (FY2018)

70,000+ CAMPAIGN DONORS (AS OF JUNE 30, 2018)

moveMountains

The Campaign for The University of Vermont

NEW KNOWLEDGE

RESEARCH, SCHOLARSHIP, AND THE ARTS NEWS FOR 2018

EXPLORE MORE ABOUT THESE STORIES AT: **UVM.EDU/INQUIRY**

Genetic Limits Threaten a Globally Critical Food

The humble chickpea is a legume of life-and-death importance — especially in India, Pakistan, and Ethiopia where 1 in 5 people depend on them as their primary source of protein. The droughts, heat stress and insect pests that are the result of global climate change will create the need for new varieties of agricultural plants that can adapt to quickly changing conditions. Where could those novel traits come from? "The wild relatives of crop plants are the most promising reserves of genetic diversity," says **Eric Bishop von Wettberg, Ph.D.,** a UVM plant biologist who led a new research effort that discovered an extreme lack of genetic diversity and other threats to the future adaptability of domestic chickpeas. He and his team collected wild relatives of chickpeas in southeastern Turkey that hold "great promise," von Wettberg says, as a source of new genes for traits like drought-resistance, resistance to pod-boring beetles, and heat tolerance. The team's results were published in the journal *Nature Communications* — and have received international media attention, from *Reuters, Newsweek* and other venues.

Eric Bishop von Wettberg, Ph.D.

88%

Amount of coffee growing areas in Latin America that could be reduced by global warming by 2050, as found in a study published in the *Proceedings of the National Academy of Sciences* co-authored by **TAYLOR RICKETTS, PH.D.,** director of UVM's Gund Institute for Environment. While other research has explored climate-coffee scenarios, no other study has explored the coupled effects of climate change on coffee and bees at the national or continental scale. The study forecasts much greater losses of coffee regions than previous global assessments, with the largest declines projected in Nicaragua, Honduras and Venezuela.

LGBTQ Campus Climate in Doubt?

Jason Garvey, Ph.D., assistant professor of higher education and student affairs, co-authored a new study showing slow but consistent progress in the experiences of LGBTQ students on college campuses over the past 70 years, but is concerned that, for the first time since 1944, that trend may be reversing. The article in the *Journal of College Student Development* shows generational progress and improved perceptions of campus climate for LGBTQ undergraduates from 1944 through 2013, based on data form the National LGBT Alumni Survey. Garvey is concerned that recent policies — he cites the so-called "bathroom bill" to restrict the use of public restrooms by transgender people, and a filing by the Justice Department asserting lesbian, gay and bisexual people have no protections under Title VII of the Civil Rights of Act — coupled with a rise in anti-LGBTQ state-level proposals, are negatively impacting the overall climate for LGBTQ people on — and off — college campuses.

Jason Garvey, Ph.D.

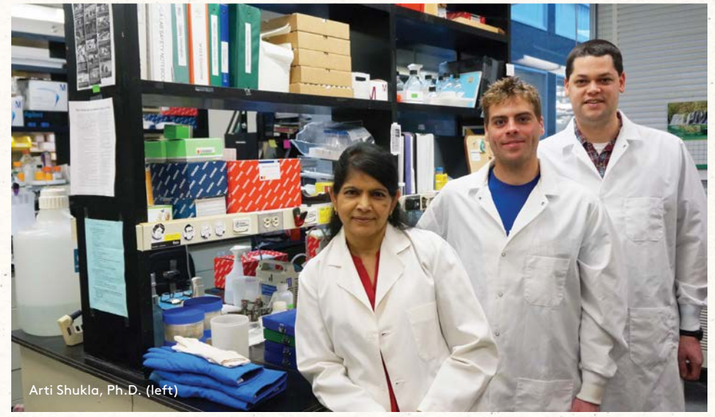
Red Spruce Recovers, Thanks to Clean Air Act

Since the 1960s, UVM scientists have been documenting the decline of red spruce trees, casualties of the damage caused by acid rain on northeastern forests. But now, surprising new research published in the journal *Science of the Total Environment* shows that red spruce are making a comeback — and that a combination of reduced pollution mandated by the 1990 Amendments to the Clean Air Act and changing climate are behind the resurgence. The new study was led by **Alexandra Kosiba, Ph.D.,** a staff scientist for the Forest Ecosystem Monitoring Cooperative at UVM, and co-authored by Paul Schaberg of the USDA Forest Service and UVM faculty members **Shelly Rayback, Ph.D.,** and **Gary Hawley, Ph.D.** The scientists examined data from 658 trees in 52 plots spanning five states — and found that more than 75 percent of red spruce trees and 90 percent of the plots exhibited increasing growth since 2001. "Our evidence suggests that the Clean Air Act is working to enhance conditions for red spruce," says Kosiba. "This is a surprising and positive story."

Alexandra Kosiba, Ph.D.

Highlighting How Asbestos Causes Mesothelioma

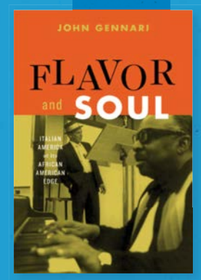
Asbestos exposure is widely known to cause human disease, including the deadly cancer mesothelioma — although researchers aren't sure why. While asbestos is inhaled into the lungs, mesothelioma develops in physically remote mesothelial cells. No successful methods exist for early detection of exposure to asbestos. But new research led by **Arti Shukla, Ph.D.,** at the UVM Larner College of Medicine published online in *The FASEB Journal,* may have unlocked the first piece of this puzzle. "Our findings suggest that cells in one region of the body are capable of sending messages to cells in a distant location, and can cause significant genetic changes," says Shukla, "This communication from injured or diseased cells to healthy cells has the potential to initiate changes that might lead to cancer or other diseases."



Arti Shukla, Ph.D. (left)

THE BOOKSHELF

When describing ethnic identity in America, **JOHN GENNARI, PH.D.,** suggests you picture a pinball machine. "We all say we come from somewhere, we have these family backgrounds. But then we mix it up. We're in a pinball machine, we're bouncing around. The balls are all scattering all over the place all the time." Gennari, an associate professor of English and critical race and ethnic studies at UVM, has spent decades researching and analyzing Italian American and African American cultures and practices separately, but he drops himself right into the middle of a whirling, swirling cultural pinball game in *Flavor and Soul: Italian America at Its African American Edge* (University of Chicago Press). Gennari's book explores the "cultural edge" between these two ethnic groups, a complicated place where identities overlap, intertwine, and clash throughout American history. He takes an energetic dance through connections in music, food, sports, and film, and examines ideas about gender and family, with a dash of his own experiences growing up in an Italian American household.



12x

The magnitude of mining-induced deforestation in the Amazon forest that occurs outside mine lease areas, as reported in an October 2017 *Nature Communications* article by UVM Gund Institute associates **LAURA SONTER, PH.D., GILLIAN GALFORD, PH.D.,** and **DIEGO HERRERA GARCIA, PH.D.** Their research showed mining-related forest loss caused roughly 10 percent of all Amazon deforestation between 2005 and 2015, much higher than previous estimates. "These results show that mining now ranks as a substantial cause of Amazon forest loss," says Sonter. "Previous estimates assumed mining caused maybe one or two percent of deforestation. Hitting the 10 percent threshold is alarming and warrants action."

Above: the Colorado potato beetle

Opening the Genome of a Major Pest

The Colorado potato beetle is notorious for its role as one of the first targets of the pesticide industry — and for its ability to resist the insecticides developed to stop it. Now a team of scientists co-led by UVM professor **Yolanda Chen, Ph.D.,** has for the first time sequenced and explored the whole genome of this major agricultural pest. The team expected to find clear genetic evidence of the beetle's amazing adaptability to insecticides. Instead, the study revealed that the genes of the Colorado potato beetle involved in insecticide resistance are similar to other species of beetles. This new data will help shed light on how this insect jumps to new plant hosts and handles toxins, and it will help researchers explore more ways to control the beetle. "What this genome will do is enable us to ask all sorts of new questions around insects," says Chen, "why they're pests and how they've evolved — and that's why we're excited about it."

No, It's Not Fair: Dieting Gets Hard When We're Not Hungry

When we're on a diet, we'll avoid cheeseburgers and ice cream and other foods we love, even though we're ravenous and hankering for them. Once off the diet, we'll often return to stuffing ourselves with goodies — even if we aren't hungry. We learn self-control while we're dieting. But a new study by UVM researchers suggests that control of consumption isn't simply a great act of will power but possibly is guided by the states of hunger and satiety. Context matters, explains **Mark Bouton, Ph.D.,** the psychology professor who co-authored the study in the journal *Psychological Science* with his Ph.D. student **Scott Schepers.** During a diet, hunger may become the context in which we learn to deny eating impulses. When we stop dieting and no longer feel hungry, the context vanishes, and we may lose the inclination to restrain our food intake. This could be an important reason why weight regain after a diet ends is so common.

Ethical Leadership Key to Employee Volunteerism

A study in the *Journal of Business Ethics* co-authored by **Kenneth De Roeck, Ph.D.,** assistant professor in the UVM Grossman School of Business showed that people who work for socially and environmentally responsible companies tend to identify more strongly with their employer, and as a result, increase their engagement in green and socially responsible behaviors like community volunteerism. That loyalty goes out the window, however, if employees don't perceive their immediate supervisor as ethical. "This isn't another story about how I can get my employees to work better to increase the bottom line, it's more about how I can get employees to create social good," says De Roeck.

Kenneth De Roeck, Ph.D.

THE BOOKSHELF

Among the dozens of novels by the 19th century writer Amantine Dupin — better known by her pen name, George Sand — one of the most beloved by her readers is *Le Petit Fadette,* published in 1848 and recounting the relationship between a mysterious waif and two identical twin brothers. UVM Professor of French **GRETCHEN VAN SLYKE, PH.D.,** published this new translation of Sand's novel in 2017, and followed it with her translation of Martine Reid's biography of Sand, both from Penn State University Press.

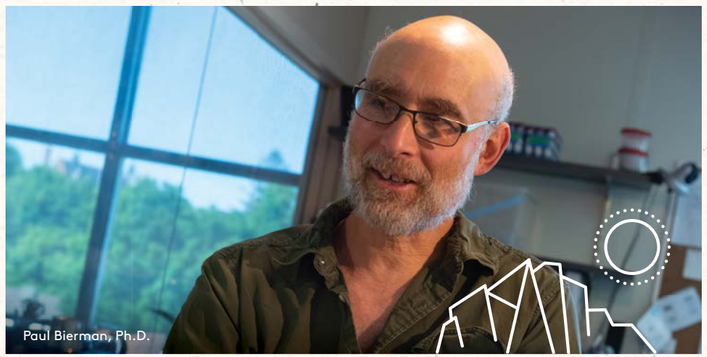
Elevating Entrepreneurs at the Base of the Pyramid

Growing up in southern India, **Srinivas Venugopal, Ph.D.,** witnessed people living in extreme poverty on a daily basis. He often marveled at their entrepreneurial abilities to meet basic consumption needs by selling tea or umbrellas or patching punctured bicycle tires on the streets of Chennai. "Growing up middle class with poverty all around makes you want to understand it," says Venugopal, who teaches courses on sustainable marketing. Since arriving at UVM in 2016, Venugopal has published widely on the intertwined nature of consumption and entrepreneurship in subsistence marketplaces. His bottom-up approach to research involves immersing himself in communities to better understand the lives of local entrepreneurs who live at what is termed the Base of the Pyramid, often living on a few dollars a day. It's an approach that was popularized by **Stuart Hart, Ph.D.,** UVM's Steven Grossman Endowed Chair in Sustainable Business.

Srinivas Venugopal, Ph.D. (left)

70%

The amount financial losses caused by hurricanes could increase by 2100, according to a study co-authored by **DAVID ROSOWSKY, PH.D.,** UVM provost and professor of civil and environmental engineering, in the journal *Sustainable and Resilient Infrastructure.*



Paul Bierman, Ph.D.

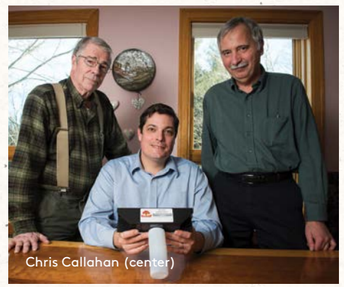
Nature Study Illuminates Antarctic History

Of all the world's icy places, the ice sheet covering East Antarctica has the largest potential to make sea levels rise as global temperatures increase. But efforts to predict the East Antarctic's role in future sea-level rise have been hindered by an absence of data about the ice sheet's response to warming periods in the past. Now, a team of researchers co-led by UVM Professor **Paul Bierman, Ph.D.,** using ultra-sensitive analytical measurements that have helped to reveal the history of other ice sheets, has found that the East Antarctic Ice Sheet did not retreat significantly over land during the warm Pliocene epoch, approximately 5.3 to 2.6 million years ago, when atmospheric carbon dioxide concentrations were similar to today's levels. The results were reported in the journal *Nature.* The findings suggest that some ice on the southern continent could be stable in a warming climate, but do not signal that Antarctica can somehow backstop the impact of climate change, the researchers caution. Ongoing emissions mean that atmospheric carbon dioxide levels will soon surpass the benchmark set during the Pliocene.

Report Finds Vermont Losing Many Acres of Forest Each Year

New England has been losing forestland to development at a rate of sixty-five acres per day — and Vermont is losing 1,500 acres of forest every year — according to a September 2017 report by Harvard Forest and a team of authors from across the region including two UVM scientists. "Over the last decade, Vermont lost about one percent of its forest cover due mostly to suburban and rural residential sprawl, reversing a 150-year trend of forest recovery and expansion," says co-author **Bill Keeton, Ph.D.,** professor of forestry and forest ecology and UVM Gund Fellow. Public funding for land protection has also been steadily declining in all six New England states and is now half what it was at its 2008 peak. Land conservation trends have followed suit. Conversion to development is the biggest near-term threat to forests, bigger even than climate change, the scientists report. "If our goal is to make sure our forests in Vermont are resilient and able to adapt to the changes that climate change and invasive species pose, then the first critical step is to keep those areas forested," says co-author **Tony D'Amato, Ph.D.,** an associate professor and director of UVM's Forestry Program. "That is often lost in our discussion of how to manage and conserve in the face of such future uncertainty."

Bill Keeton, Ph.D.



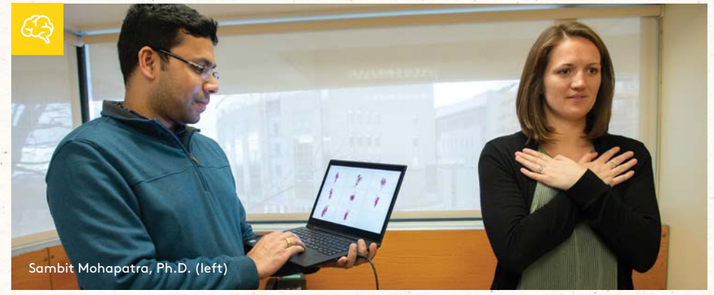
Chris Callahan (center)

Invention Could Save Food Producers Thousands Annually

A UVM Extension professor has invented a $300 device that could save Vermont's produce growers an average of $6,500 annually in improved storage conditions and its artisanal cheese and meat producers up to $10,000 a year in higher yields during processing. The device, called a DewRight, modernizes 250-year old technology to more accurately measure temperature and relative humidity. The savings come from reduced spoilage and increased yield, increased quality, improved recipe repeatability and labor savings, said its inventor, **Chris Callahan.** The new device delivers a 67 percent improvement over old technology.

Concussion's Effects

Many of the more than two million veterans who have taken advantage of the Post-9/11 GI Bill have struggled academically in college. Similarly, albeit for different reasons, so have many college athletes. Results of a new study focusing on the long-term effects of concussions or mild Traumatic Brain Injury (mTBI) in both populations offers new evidence for why they might not be making the grade. The *Scientific Reports* study, co-authored by **Sambit Mohapatra, Ph.D.,** UVM assistant professor in Rehabilitation and Movement Science, revealed slower visual and auditory reaction times by veterans and athletes to simple environmental stimuli years after experiencing mTBIs. Participants also struggled with significant reductions in eye-tracking accuracy and were plagued by intrusive saccadic eye movements, making it difficult to focus for more than a few minutes at a time. "Our main concern was with veterans who were getting deployed but still had concussive symptoms that were not getting picked by current protocols," says Mohapatra.



Sambit Mohapatra, Ph.D. (left)

THE BOOKSHELF

Now in its new fourth edition, *Bright Futures: Guidelines for Health Supervision of Infants, Children, and Adolescents,* this essential resource published by the American Academy of Pediatrics (AAP) was authored by UVM professors **JOSEPH HAGAN, M.D., JUDITH SHAW, PH.D.,** and the late **PAULA DUNCAN, M.D.** The Bright Futures program was begun under the AAP auspices nearly 25 years ago with the goal of supporting primary care practices in delivering the best well-child and adolescent care. Doody's Health Science review service called the publication "an excellent, overall review of the most up-to-date information for pediatricians."

Mandatory Labels Reduce GMO Food Fears

As the U.S. Department of Agriculture prepares guidelines for labeling products that contain genetically modified ingredients, a new study co-authored by a UVM faculty member reveals that a simple disclosure can improve consumer attitudes toward GMO food. Led by **Jane Kolodinsky, Ph.D.,** an applied economist in UVM's College of Agriculture and Life Sciences, the study compared levels of consumer opposition to GMO foods in Vermont — the only U.S. state to have implemented a mandatory labeling policy — with consumer attitudes in the rest of the U.S. The analysis showed opposition to GMO food fell by 19 percent in Vermont after the implementation of mandatory labels. The study in the June 2018 issue of *Science Advances* is the first to examine the real-world impact of consumer attitudes toward GMO foods in a state where consumers were exposed to mandatory GMO labels.

Examining Nicotine Reduction and Addiction

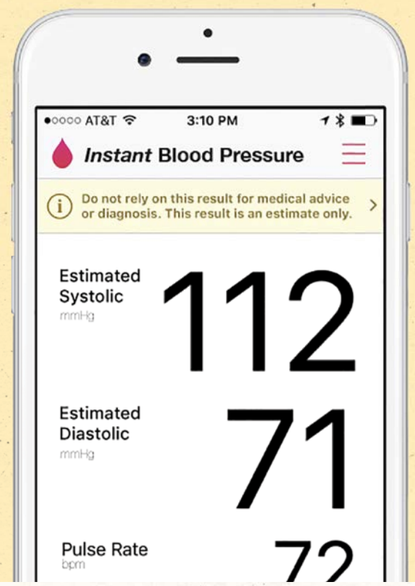
The FDA is right — when it comes to disease culprits, cigarette smoking tops the list. While recognized as the number-one cause of preventable disease and death, it's an incredibly tough habit to break due to the addictiveness of nicotine. New findings from researchers at UVM's Vermont Center on Behavior and Health (VCBH) and their colleagues suggests that reducing nicotine content in cigarettes may decrease their addiction potential in especially vulnerable populations (individuals with psychiatric disorders and socioeconomically disadvantaged women were the groups studied) and suggests how regulatory policies could shift preferences to less-harmful tobacco products. "This study provides a very encouraging indication that reducing the nicotine content of cigarettes would help vulnerable populations," says VCBH Director Professor **Stephen Higgins, Ph.D.** "We need more research, but this is highly encouraging news with tremendous potential to improve U.S. public health."

THE BOOKSHELF

UVM Associate Professor of Nutrition and Food Science **AMY TRUBEK, PH.D.,** who trained as both a cultural anthropologist and a chef, spent three years chronicling randomly selected people as they cooked for her latest book, *Making Modern Meals: How Americans Cook Today* (published by the University of California Press). Trubek asserts that cooking isn't a simple act of executing a recipe, of blending ingredients into a dish. Cooking involves a complex stew of personal relationships, knowledge, self-confidence, technique, tradition and cultural norms. And those ingredients change over time.

5 STARS

The mobile blood pressure app reading that UVM Assistant Professor of Medicine **TIMOTHY PLANTE, M.D.,** and his former colleagues at Johns Hopkins found may be wildly inaccurate (and possibly lead to dire consequences), in a June 2018 *Journal of the American Medical Informatics Association* article.



A NEW ANGLE ON GERRYMANDERS

In 1812, the governor of Massachusetts, Elbridge Gerry, approved a narrow and winding voting district for the state senate that curved from Marblehead around to Salisbury. It looked like a long-necked salamander, *Federalist* newspaper editors declared. They labeled the district "The Gerry-Mander," and the *Salem-Gazette* warned that it was a "monster brought forth to swallow and devour your Liberties and equal Rights." More than two centuries later, the fight over gerrymandering continues. Though there is general agreement that to gerrymander is intentionally drawing voting districts so as to advantage one group over another, the best ways to find and measure this problem are hotly contested. Now a UVM mathematician, **GREG WARRINGTON, PH.D.,** has developed a new tool, called "the declination," to help ferret out gerrymandered districts. Warrington's research was published March 2018 in the *Election Law Journal* and could become an important tool — for both courts and legislatures — in the wake of a pair of U.S. Supreme Court cases now being considered that might outlaw certain partisan gerrymanders.

Above: The original illustration of the "Gerry-mander" from the 1813 *Salem-Gazette*.

NEW KNOWLEDGE

Finding What Makes Strong Science Teachers

In an investigation of 9,500 middle school science teachers, **Tammy Kolbe, Ed.D.,** and **Simon Jorgenson, Ph.D.,** assistant professors in the College of Education and Social Services, found that a teacher's educational background in science was a key determinate of whether or not they used hands-on, inquiry-oriented instruction methods, offering new evidence for why U.S. students may lag behind their global peers in scientific literacy. Their study appeared in *The Elementary School Journal* in April 2018.

Tammy Kolbe, Ed.D.

170%

The amount of increased risk of developing a venous thromboembolism blood clot among those who reported they watch TV "very often" compared with those who watch TV "never or seldom" in a study reported by Professor of Medicine **MARY CUSHMAN, M.D., M.SC.,** at the 2017 American Heart Association Scientific Sessions.

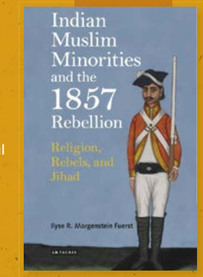
Algae Blooms, Human Health, and Community Action

UVM researchers have received a $598,000 grant from the U.S. Environmental Protection Agency to investigate links between harmful algal blooms and human well-being and to explore how a community along Lake Champlain works to take action based on scientific information about those links. In lakes and ponds worldwide, cyanobacteria blooms, also known as "blue-green algae," threaten water quality, ecosystem health and human well-being. "Science has demonstrated multiple links between cyanobacteria blooms and human health and well-being," says **Rachelle Gould, Ph.D.,** of UVM's Rubenstein School of Environment and Natural Resources, who is lead principal investigator in the study, with fellow PI **Jason Stockwell, Ph.D.** "This project explores links of emerging concern and then investigates how the community processes that information."

Updating the Image of the Vermont Farmer

Picture a Vermont farmer. Does a grizzled, seventh generation dairyman come to mind, Holsteins and silo in the background? A Challenge Grant from the National Endowment for the Humanities to a consortium that includes the University of Vermont and three partners aims to complicate that image. "We tend to use one brush to paint the picture of farming in Vermont," said **Linda Berlin, Ph.D.,** director of UVM's Center for Sustainable Agriculture, the grant's lead partner. "Historically that may have worked, but today it's more complex." While dairy farming remains an important part of the state's economy and landscape, contemporary Vermont farmers are an increasingly diverse lot, says UVM anthropology professor **Luis Vivanco, Ph.D.,** co-director of the University's Humanities Center, another partner on the grant. "Many are female; they vary in age, ethnicity and race; and they produce a wide range of agricultural products," he said. "The goal of the grant is to tell the story of this changing dynamic in an engaging way that brings people together." The other partners are the Vermont Historical Society, the Vermont Folklife Center and the Vermont Farm to School Network.

THE BOOKSHELF



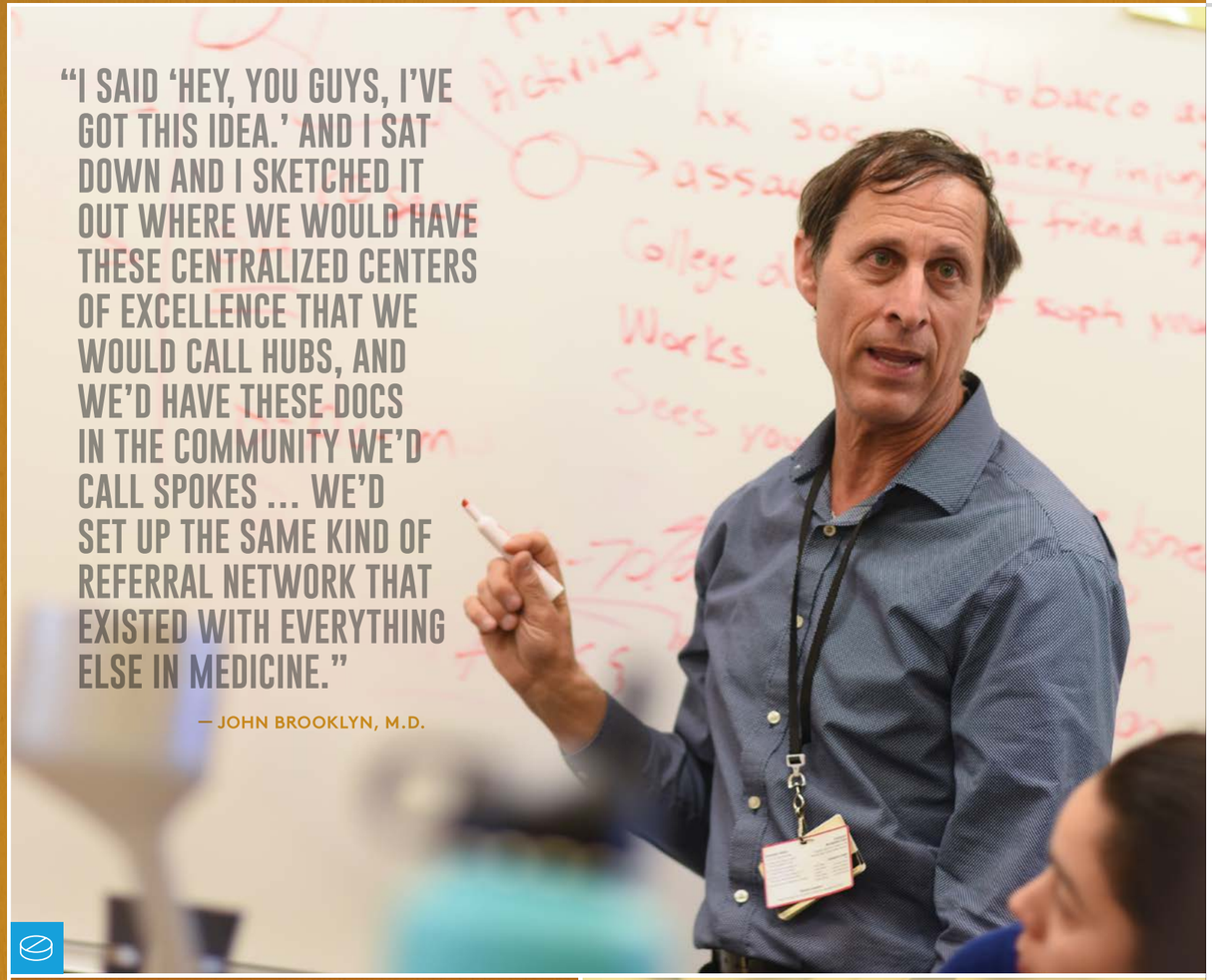
In a world in which "jihad" has come to be associated with modern acts of terror, looking back to earlier events that fit the term of "struggle" (the literal translation of the word) illuminates areas of Islam that have seen little examination and study. In *Indian Muslim Minorities and the 1857 Rebellion: Religion, Rebels, and Jihad* (from I.B. Tauris Publishers) **ILYSE MORGENSTEIN FUERST, PH.D.,** UVM assistant professor of religion and director of the Middle East Studies Program, examines the 1857 Rebellion (referred to by generations in Britain as the "Indian Mutiny") and its place in the history of jihad during the British Raj.

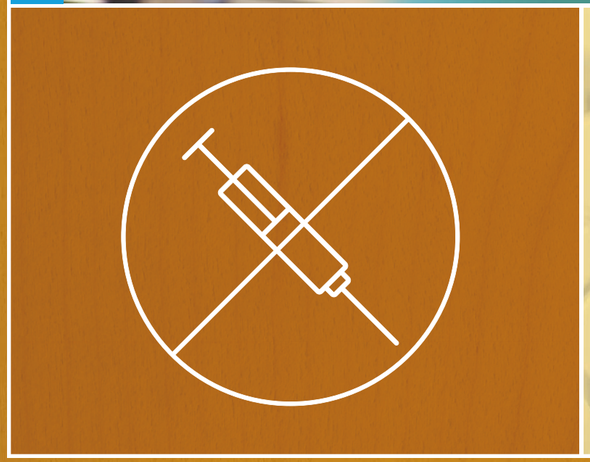
Everyday Conflict's Effect on Kids

It stands to reason that parents who physically or emotionally abuse their children do them lasting damage, in part by undermining their ability to trust others and accurately read their emotions. But what about the children of parents who experience simple, everyday conflict? Research published this spring in the *Journal of Personal and Social Relationships* shows that the emotional processing of these children, too, can be affected — potentially making them over-vigilant, anxious and vulnerable to distorting human interactions that are neutral in tone, throwing them off-balance interpersonally as adults. "The message is clear: even low-level adversity like parental conflict isn't good for kids," said **Alice Schermerhorn, Ph.D.,** an assistant professor in the UVM Department of Psychological Sciences and the lead author of the study of 99 nine-to-eleven-year-old children.

THE POETIC JOURNEY

University Distinguished Professor and Richard Dennis Green and Gold Professor **MAJOR JACKSON, M.F.A.,** has authored hundreds of poems and five books and has contributed to more than 40 published anthologies. His work has appeared in many online and print outlets, including the *New Yorker, American Poetry Review, Boston Review,* and the *New York Times,* and he is the poetry editor of the *Harvard Review*. Jackson's work has received critical attention in the *Boston Globe,* the *Christian Science Monitor,* the *Philadelphia Inquirer,* the *Washington Post,* and on National Public Radio. He is the recipient of some of America's most prestigious awards, including a Guggenheim Fellowship and a National Endowment for the Arts Artist Fellowship, and he received the 2016 Vermont Book Award. His latest poetry collection, *Roll Deep,* was hailed by the *New York Times* as "a remixed Odyssey… What it reminds us of, from its first poem to its last, is that the danger facing the black boy does not disappear when he becomes a black man. The black body is never safe, even when it journeys far from home."





Facing the Crisis

UVM RESEARCHERS LEAD THE WAY ON OPIOID ADDICTION TREATMENT.

BY ERIN POST

Vermont has made headlines in recent years for its residents’ struggles with opioids, a class of drug that includes prescription painkillers such as morphine, hyrocodone and oxycodone as well as illicit substances like heroin. From 2000 to 2014, Vermont saw a more than 770 percent increase in treatment for all opiates, indicating a rising tide of addiction. And it’s a deadly epidemic: Heroin-related fatalities were non-existent in the state in 2010. Five years later, 34 Vermonters died of a heroin overdose in a single year.

For a state that prides itself on its bucolic image — think general stores with creaky wooden floors, rolling fields of dairy cows, steam rising from the maple sugar shack — the epidemic rattled many Vermonters to their core. In 2014, then-Governor Peter Shumlin devoted almost his entire State of the State Address to what he called a health crisis that required quick and decisive action. He cited statistics as well as stories from Vermont families that painted a dire picture. Vermonters were suffering and needed help.

“What started as an OxyContin and prescription drug addiction problem in Vermont has now grown into a full-blown heroin crisis,” said Shumlin.

Over the past five years, Vermont has emerged as a national leader in treatment for opioid use disorder, thanks in large part to clinical innovations driven by UVM researchers — called the hub-and-spoke system — that incorporates addiction treatment into primary care in a comprehensive way not seen anywhere else in the country. A support network for community physicians administering medication assisted treatment has increased capacity at what are known as the spokes, while centers of excellence called hubs bring addiction specialists and wraparound services together to provide more intensive treatment for patients who need a higher level of support. Research on new treatments for addiction — long an area of excellence at UVM — benefits from a model that incorporates opioid use disorder as a chronic condition, fostering innovative thinking about ways to deliver that care.

UVM Professor of Psychiatry **Richard Rawson, Ph.D.,** a native Vermonter who returned to the state in 2015 after a storied career in addiction treatment research at UCLA, characterizes Vermont as the leader of a paradigm shift. In December of 2017 he completed a federally funded assessment of the hub-and-spoke system, conducting interviews with providers and patients over the course of one year.

“I was surprised and inspired by the treatment going on in primary care settings,” he says. “I think this new treatment paradigm will change the course of opioid addiction and recovery.”

In creating this new system, Vermont physicians and health policy leaders have altered public perception of addiction. Instead of shunting patients labeled as “addicts” into a category separate from other disease sufferers, they’re welcomed into an environment that supports them on the journey to recovery.

“I THINK THIS NEW TREATMENT PARADIGM WILL CHANGE THE COURSE OF OPIOID ADDICTION AND RECOVERY.”
— RICHARD RAWSON, PH.D.

Opposite: UVM Clinical Assistant Professor of Family Medicine John Brooklyn, M.D. Above, Professor of Psychiatry Richard Rawson, Ph.D.

Although challenges remain, the hub-and-spoke system represents a huge step forward in how opioid use disorder is treated and understood, and stands alone as a national model.

A NEW IDEA

UVM Clinical Assistant Professor of Family Medicine **John Brooklyn, M.D.,** received his undergraduate degree in elementary education from UVM in 1979, then went to medical school at Brown. After his residency, he started working at UVM's Human Behavioral Pharmacology Lab, directed at the time by a trio of renowned UVM researchers: **Stephen Higgins, Ph.D.,** now director of the Vermont Center on Behavior and Health; **John Hughes, M.D.,** a leader in nicotine research; and **Warren Bickel, Ph.D.,** now co-director of the Addiction Recovery Research Center at Virginia Tech. The lab was conducting studies of what was at the time a fairly new treatment for opioid addiction: buprenorphine. It showed promise as an alternative to methadone, an effective treatment backed by decades of research, although the medication is itself addictive. Buprenorphine, on the other hand, blocks the effects of opioids without the risk of addiction, allowing patients relief from cravings and withdrawal with less worry about medication diversion or overdose. UVM was one of the first institutions nationally to study buprenorphine's clinical applications.

When Vermont's first methadone clinic — called the Chittenden Clinic — opened in 2002 with Brooklyn as medical director, the waiting list quickly ballooned. In 2003, Vermont introduced buprenorphine as an office-based treatment, which in theory should have expanded treatment capacity. But concerns about managing complex patients without adequate support, the lack of social and mental health services for patients, and the possibility for medication diversion meant many primary care physicians only saw a handful of patients or less. So despite Vermont boasting a high number of office-based treatment providers per capita, many still lacked care. The wait list at the Chittenden Clinic extended to two years.

Brooklyn, who was also treating patients at the Community Health Centers of Burlington, saw the struggling primary care physicians, the at-capacity clinic, and the growing number of patients who desperately needed treatment, and he proposed a plan to Vermont Department of Health officials with the executive director of the Howard Center:

"One day I marched into the Department of Health with Bob Bick from the Howard Center and I said 'Hey, you guys, I've got this idea.' And I sat down and I sketched it out where we would have these centralized centers of excellence that we would call hubs, and we'd have these docs in the community we'd call spokes, and there would be a connection. We'd set up the same kind of referral network that existed with everything else in medicine."

The first hub opened in January of 2013 at the Chittenden Clinic in Burlington, and other hubs across Vermont soon followed. Spoke providers were recruited from the ranks of family medicine physicians, obstetricians and pediatricians at all types of practices, from group and solo practices to federally qualified health centers. These doctors received training that granted them a "waiver" to prescribe buprenorphine, giving patients access to medication assisted treatment in a medical home, a place where treatment is coordinated and delivered in a way that puts the patient first. The key to making it all work, says Brooklyn, is communication and support.

"Docs in the community need to know that we have their back," says Brooklyn. "Because if you're going to take on prescribing for people who are fairly complex, you need to know that there's a regional expert you can call at any time."

In addition to being able to consult their hub, spoke providers also have a team to call on to help manage patients. Called a Medication Assisted Treatment team, or MAT team, they include one registered nurse and behavioral health provider per 100 Medicaid patients receiving office-based treatment.

"WE'RE BREAKING DOWN SILOS AND PUTTING A LOT OF EMPHASIS ON PRIMARY CARE HOMES. FINANCIALLY, IT'S A VIABLE MODEL. A LOT OF PEOPLE ARE SAYING 'WOW YOU ARE TREATING EVERYBODY, AND SAVING MONEY, AND YOUR OVERDOSE RATE IS LOW.' HOW OFTEN IN MEDICINE DO YOU GET PRETTY GOOD EVIDENCE THAT SOMETHING IS WORKING LIKE THAT?"

— JOHN BROOKLYN, M.D.

CONTINUITY OF CARE

As the MAT teams and Learning Collaborative took shape, the focus became recruiting spoke providers to join the system. Other early conversations also fostered what was to become another key component of the hub-and-spoke: the Addiction Treatment Program (ATP), directed by **Sanchit Maruti, M.D.,** assistant professor of psychiatry at UVM. Conceived as a bridge between the intensive treatment in the hubs and the outpatient experience of the spokes, the program is designed to support primary care physicians and help patients move from one environment to the other.

"The goal is to have patients go to the ATP to be stabilized before going to the spoke," says Fisher. "And if they fall off the wagon, they can go back to the ATP. It's a way to manage the flow of patients."

This continuity of care is in part what makes the hub-and-spoke unique, says UVM Associate Dean for Primary Care **Charles MacLean, M.D.** Primary care doctors are embracing medication assisted treatment "like any other tool," he says, and the long-term relationships they are able to develop with patients are leading to positive outcomes.

FRONT LINES OF RESEARCH

As director of the Chittenden Clinic since 2004, **Stacey Sigmon, Ph.D.,** has been at the front lines of the opioid epidemic. She's seen the population seeking treatment shift, from long-time, IV heroin users in their 40s or 50s, to young people, many in their late teens or early 20s, some of whom started using heroin after first getting hooked on prescription drugs from friends, or their parents' medicine cabinet. As the crisis worsened, the clinic kept pace. The staff has expanded by a factor of four since Sigmon's arrival, and they now treat 1,000 patients with both methadone and buprenorphine, up from 50 when she first took the helm.

Sigmon's work in the clinic informs her research as an associate professor of psychiatry at UVM: She has built a national reputation for developing and testing innovative treatment options. One technological solution, called the Med-O-Wheel, shows promise. The small computerized device dispenses buprenorphine at set intervals, lessening the chance for medication diversion while increasing access. In one study published in the *New England Journal of Medicine* in 2016, use of the Med-O-Wheel combined with daily monitoring calls via an interactive voice response phone system had positive results for patients on a waitlist. At the 12-week mark, 68 percent of subjects screened negative for illicit opioids, compared to zero for a control group who received no treatment.

"There's no reason to think this wouldn't be effective beyond patients on a waitlist," says Sigmon, pointing to its potential usefulness in areas with few providers, or for patients who lack regular transportation. UVM has also been at the frontlines of testing long-lasting formulations of buprenorphine, including an implant that delivers the drug for up to six months. The device, approved by the FDA two years ago, has "huge potential for rural areas," says Sigmon.

Above: Associate Professor of Psychiatry Stacey Sigmon, Ph.D., researches new addiction treatment options, and directs the Chittenden Clinic.

The goal is to get treatment to patients who need it, in a way that's appropriate for their needs. In this, Vermont has set the stage for more innovation to come.

THE WAIT IS OVER

A watershed moment came in September of 2017 when Governor Phil Scott convened a press conference to announce that the wait list for medication assisted treatment in Chittenden County had been eliminated, and that patients in all 14 Vermont counties could receive immediate treatment for opioid addiction.

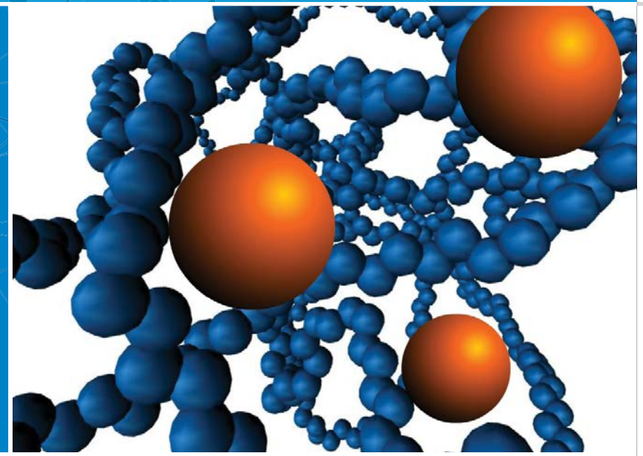
Now, the state boasts six hubs and over 75 spokes across the state. Capacity for treatment of opioid use disorder in Vermont is higher than anywhere else in the United States, with 13.8 patients potentially treated per 1,000 people, according to a 2017 paper in the *Journal of Addiction Medicine* authored by Brooklyn and Sigmon. As the first opioid treatment program in the U.S. to receive Medical Home status from the National Committee for Quality Assurance, the Chittenden Clinic leads the way for hubs. And UVM Medical Center residents in specialties including family medicine, internal medicine, obstetrics and gynecology and psychiatry are trained to prescribe buprenorphine, so that many of the state's newest physicians provide treatment from day one.

It's a model worthy of export, says Brooklyn. Over the past two years he has been to California, Colorado, and even Vietnam to consult on how to set up similar systems. At a presentation at the annual meeting of the Association of American Medical Colleges in November 2017, Brooklyn was asked, "So how long are your wait times for treatment in Vermont?" When he replied that there were no wait times, an audible gasp was heard from the audience.

"We're breaking down silos and putting a lot of emphasis on primary care homes," he says. "Financially, it's a viable model. A lot of people are saying 'wow you are treating everybody, and saving money, and your overdose rate is low.' How often in medicine do you get pretty good evidence that something is working like that?"

UNCOVERING THE SECRETS OF IMMUNE RESPONSE

Researchers have long known that glucose — or sugar — fuels cellular activity, including cells involved in immune response. While previous research focused on sugar stores external to the cell, Assistant Professor of Medical Laboratory and Radiation Science **EYAL AMIEL, PH.D.,** published a surprising new discovery in the journal *Cell Metabolism* that finds that dendritic cells — the messengers of the mammalian immune system — draw from sugar stores within the cell. This new knowledge could lead to targeted treatments to increase immune activity in cancer therapy, or suppress immune reactions in patients with multiple sclerosis.



Big Accomplishments from the Nanoworld

UVM COLLEGE OF ENGINEERING AND MATHEMATICAL SCIENCES DEAN LINDA SCHADLER, PH.D., BRINGS A PASSION FOR INNOVATION AND SCHOLARLY IMPACT.

BY SARAH ZOBEL

In a world of things we think of as “normal” size, **Linda Schadler, Ph.D.,** develops polymer nanocomposites, polymers mixed with fibers or particles so small that 10,000 of them would fit within the diameter of a human hair.

“If you think about technology, often it’s limited by materials,” says Schadler, the new dean of the University’s College of Engineering and Mathematical Sciences (CEMS). “We didn’t have a successful space shuttle program until we had heat shields that were made of special materials that allow the shuttle to return to earth and not burn up in the atmosphere. We didn’t have desktop computers until we had the solid-state transistor that allowed for shrinking of electronics. Polymer nanocomposites are also enabling new technologies: better batteries, better insulators, and more robust composites for aircraft and spacecraft.”

What, exactly, are nanocomposites? Polymers are plastics. Composites are a mixture of two materials that together create something with properties better than either material alone — like the fiberglass or carbon fiber embedded in plastic to make skis or a tennis racket. In skis, for example, the composite enables a balance of stiffness and flexibility that could not be attained with either component material by itself. Nanocomposites are composites with fibers or particles that are less than 100 nanometers in diameter. [As a point of comparison, a sheet of paper is roughly 100,000 nanometers thick]. To understand why nanocomposites are different from traditional composites, Schadler suggests imagining a tennis ball in one hand and several golf balls in the other. The same volume of golf balls will have a higher surface area than the tennis ball. So nanoparticles or nanofibers have much higher surface area than traditional fibers or fillers at the same volume fraction. When this high surface area comes in contact with a polymer chain — this is called the interface region — the properties of the polymer chain change. Because of the high surface area, almost the entire nanocomposite material is made up of interfaces. By controlling the nature of those interfaces, it is possible to tailor material properties to meet different needs. In addition, sometimes the fillers are so small that they do not scatter light, resulting in a transparent composite. If you use conductive fillers, for example, you can create stiff, conducting, transparent materials. Something not possible with traditional composites.

“The reason I find nanocomposites fascinating is that you can create unique combinations of properties that you can’t get with traditional composites,” says Schadler, adding that 80 percent of her research is done with some application in mind. “It’s surprising how a very subtle change in the chemistry of a particle will change how it’s organized in the polymer, whether each of the particles is separated or they form a blob or a string. Just subtle changes in this organization make big differences in the properties,” she says. She focuses on making nanocomposites with unique mechanical, optical, and electrical properties, work that can be translated into the development of insulators in high-voltage cable transmission applications and more efficient encapsulants for light-emitting diodes, among many other uses.

Schadler’s career in science and engineering seems almost preordained. Her mother was a biologist and the dean of undergraduate education at Union College in Schenectady, New York, who earned her Ph.D. when Schadler and her two siblings were pre-teens. Her father was the chief metallurgist at General

Opposite: Linda Schadler, Ph.D., Dean of the UVM College of Engineering and Mathematical Sciences.

Dean Linda Schadler, Ph.D., meets with a staff member in the Dean's Office in Votey Hall.

Electric and a member of the National Academy of Engineering. Family vacations — several of them cross-country drives — often included backpacking treks, fossil hunting, and ranger talks, though Schadler says no one's interest had to be forced: "They just wove the science into our everyday lives, so it didn't ever feel like class."

Schadler entered Cornell University intending to study chemical engineering. She soon realized it wasn't the right fit, but the fortuitous choice of an elective gave her the direction she needed. In that class, students were asked to make materials and then intentionally break them in order to figure out what makes a material strong, something Schadler says fascinated her. Switching to a major in materials science and engineering created plenty of career options, but another course set Schadler's trajectory. In that class, students were required to lecture to their classmates on a subject of their choosing. Schadler's topic was sol-gel chemistry, a method for creating ceramic materials at low temperatures. The positive response from her classmates — that would later be reinforced when she defended her Ph.D. thesis — left no doubt that she wanted to join the many members of her extended family who were passionate about teaching.

"I loved standing in front of the class and watching them learn as I spoke, and I loved figuring out how to communicate the message," Schadler says of that first experience teaching others. She went on to earn a Ph.D. in materials science and engineering at the University of Pennsylvania in 1990, and then spent two years at IBM getting some industrial experience before moving on to an assistant professorship at Drexel University. "Drexel was a fantastic place to start a career. I received wonderful mentoring in both teaching and research, says Schadler. But in 1995, pregnant with her first child, she wanted to live closer to the mountains she loved, be close to family, and work at a university with a better balance between teaching and research. Rensselaer Polytechnic Institute (RPI) offered that opportunity.

Schadler remained at RPI until this past July. She became RPI's associate dean of academic affairs in the school of engineering in 2009, was named the Russell Sage Professor in Materials Science and Engineering in 2012, and became the vice provost and dean of undergraduate education in 2014.

Her husband, Tom Feist, is also a material scientist with a love of the mountains. When Schadler began at RPI, he landed at General Electric's Global Research Center. After spending time in several of GE's units, he eventually led the global digital x-ray detector business, which included moving digital x-ray production from the research center into a major production facility. He recently retired from GE. Schadler and Feist are parents to a son, who is just starting work as a mechanical engineer at Lockheed Martin, and a daughter, a rising junior at Williams College with an interest in neuroscience.

Schadler has co-authored more than 160 refereed journal publications and ten book chapters (her *h*-index, a metric of the productivity and citation impact of a researcher's published work, is an impressive 55). She received more than $13 million in research funding as principal or co-principal investigator, has obtained 12 patents, and received a number of awards, including being named a fellow of the Materials Research Society and one of *Reuters*' Top 100 Materials Scientists in the Last Decade in 2011. Schadler says she continues to be passionate about both teaching and research.

UVM Provost David Rosowsky lauds Schadler's passion for innovation. "I look forward to working closely with Dr. Schadler to elevate the visibility and impact of the College, creating innovative new programs and opportunities for our students, and supporting the College faculty and their research. Linda is a proven leader and a steadfast advocate for academic quality and scholarly impact."

From the outset of her career, Schadler made it a point to help encourage women in the field, whether as personal mentor or through support of K–12 outreach or undergraduate programs focused on women in STEM. She was motivated by the low number of women in her program at Penn, and inspired by her own mother's example.

"I was passionate about [women in STEM] as soon as I got out of graduate school," she says, noting that although her undergraduate department was 50 percent women, the same was not true of her grad school class. "Looking back, I can see lots of places where my career was impacted because of being a woman in STEM. In some cases I had more opportunities and in others I had doors closed."

While at Drexel, Schadler traveled to middle schools to conduct outreach with young girls; at RPI, she served as a faculty coach, mentoring female junior faculty members. Her profile can be found among a handful on the NAE's "Engineer Girl" website, where she outlines her work ("I am most proud of my students who have gone on to make contributions to the field of materials science and engineering and of how I have worked to create an atmosphere at work that is encouraging and supportive of all."). While at Rensselaer, Schadler was the director of educational outreach at RPI's Nanoscale Science and Engineering Center (NSEC) for Directed Assembly of Nanostructures, one of six nanotechnology centers funded by the National Science Foundation. Schadler also spearheaded a summer research program and partnerships with historically black and women's colleges to provide a yearlong research experience for students.

An additional outgrowth of the NSEC program was RPI's Molecularium (www.molecularium.com), for which Schadler served as co-executive producer. It uses animated films and a planetarium-style format to make nanoscience accessible to elementary-age students. "Riding Snowflakes" has won awards and been translated into languages including Arabic, Korean, and Turkish, while "Molecules to the MAX!" has been shown in IMAX theaters around the world. "Nanospace" is a virtual interactive theme park that children can access from home.

Schadler's most recent project has been a collaboration on a materials resource for nanocomposites called Nanomine. It will allow researchers and others to quickly and easily access specific information related to materials genomics without having to wade through hundreds of papers and create their own databases. Schadler also sees it as her bridge to UVM.

"It's exciting, because CEMS is really well poised as the whole world is turning to more data-driven science and technology," she says. "The fact that UVM already has combined engineering, computer science, data analytics, and mathematics in one school shows real foresight in terms of where the technological world is moving. I think there are huge opportunities for CEMS to increase the impact of its research." To keep that forward-looking momentum going, Schadler plans to engage the CEMS community in a strategic planning process using a tool called scenario planning.

"In scenario planning, a diverse group of people get input into the process before you, as a group, decide how you're going to move forward. Nobody's ideas ever get quenched because they're all still out there on the table," she says. "It is a way to really build community around the process and the strategic plan that is produced."

An athlete — "a very amateur recreational triathlete" — who has completed several Olympic-length triathlons and two Half Ironman events, Schadler is excited as well about life in the Burlington area. She and her husband are skiers and count themselves among the "Adirondack 46ers" — those who have summitted all 46 of New York's highest peaks. Ahead of Schadler now lie new goals, both in the nanoworld of research and the broader environment of leadership.

> "THE FACT THAT UVM ALREADY HAS COMBINED ENGINEERING, COMPUTER SCIENCE, DATA ANALYTICS, AND MATHEMATICS IN ONE SCHOOL SHOWS REAL FORESIGHT IN TERMS OF WHERE THE TECHNOLOGICAL WORLD IS MOVING."
>
> — LINDA SCHADLER, PH.D.

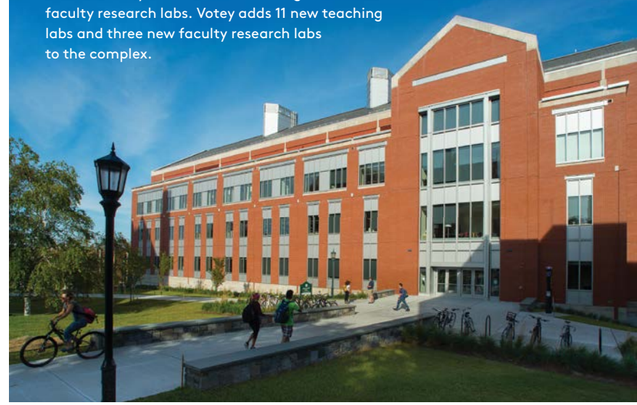
FACILITIES FOR THE LEADING EDGE

At the beginning of the 2017–2018 academic year, UVM celebrated the completion of Phase I of its new $104 million science, technology, engineering and mathematics, or STEM, complex, the largest construction project in the University's history, with tours of the two buildings most recently completed — Discovery Hall, which opened after 23 months of construction, and Votey Hall, which underwent an eight-month renovation. The third component of the complex, Innovation Hall, will be completed in May 2019. When finished, the STEM complex will house UVM's departments of Chemistry, Physics, Mathematics and Statistics, Computer Science, Civil and Environmental Engineering, Mechanical Engineering, and Electrical and Biomedical Engineering.

"We're thrilled that the new STEM complex is on schedule and on budget, and that a significant portion of the project is already online promoting just the kind of engaged student learning and interdisciplinary faculty innovation that we envisioned," said TOM SULLIVAN, UVM president.

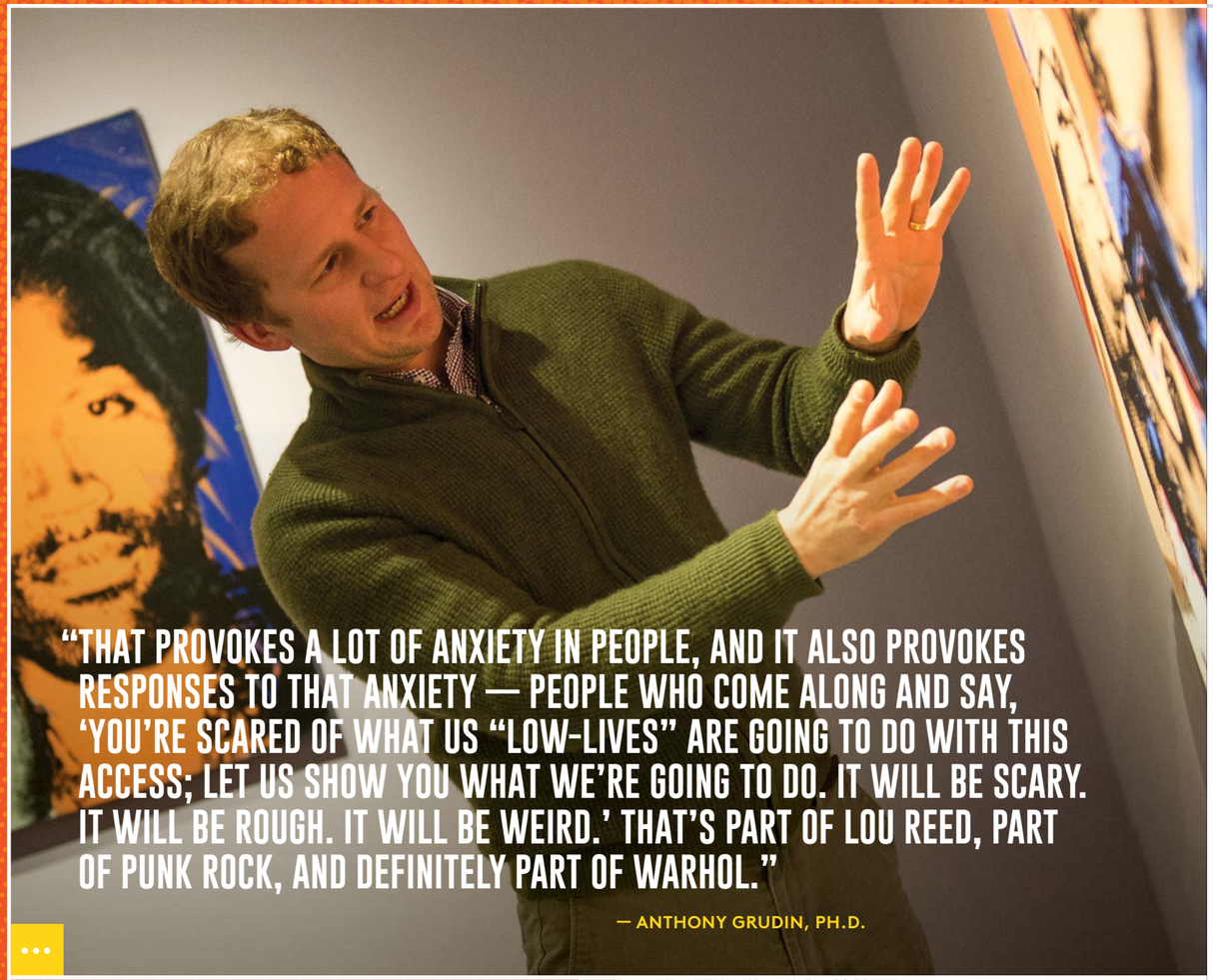
While Innovation Hall will contain predominantly faculty offices, lecture halls and classrooms, Discovery Hall and Votey Hall, home base for the university's College of Engineering and Mathematical Sciences, will house the majority of new teaching labs and faculty research labs in the STEM complex.

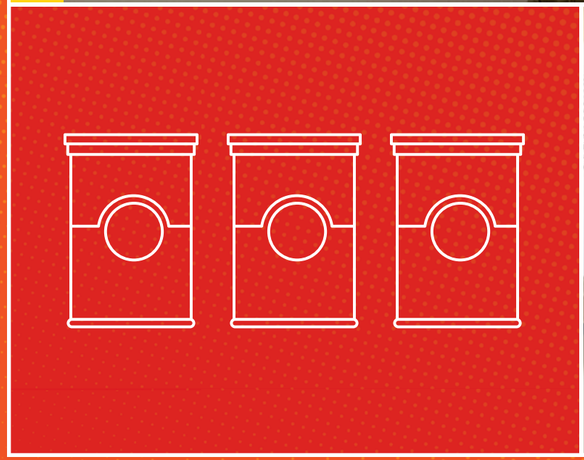
Discovery is home to 14 teaching labs and 22 faculty research labs. Votey adds 11 new teaching labs and three new faculty research labs to the complex.



RESEARCH TO HELP THE AT-RISK

When Associate Professor of Psychological Science **ANNIE MURRAY-CLOSE, PH.D.,** was named the 2018 recipient of the UVM Alumni Association's George V. Kidder Outstanding Faculty Award, one of her colleagues commented "Annie is a quiet leader but one that has impacted me greatly. She reminds me daily that teaching is about learning from others what works and what doesn't and that as educators, we have to share that knowledge." As the director of the UVM Social Development Laboratory, she leads research and has published widely on "relational aggression" — behaviors that harm others through the manipulation of interpersonal relationships.





Art for Everyone

UVM FACULTY EXAMINE AND CREATE ART AS A DEMOCRATIZING FORCE.

BY THOMAS WEAVER

What would the late Andy Warhol make of the social media age? Snapchat moments and Instagram pics direct from The Factory?

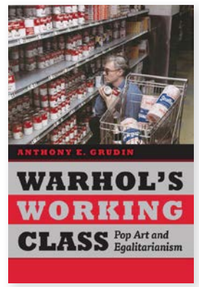
Daring to speculate on the vision of an 89-year-old Warhol armed with an iPhone, art historian and UVM Associate Professor **Anthony Grudin, Ph.D.,** says, “He would have been deeply excited by, enchanted by, mystified by all of these new possibilities.”

Apt terminology in this regard — “amateur cultural participation” — is a phrase the UVM associate professor of art history discusses early in his book *Warhol’s Working Class*, published in October 2017 by The University of Chicago Press. Today, that could describe the high school kid whose cell phone video of police brutality goes viral or a comedian who finds her first audience via YouTube.

Decades before this revolution, Warhol was carving a similar path.

“I think of him as one of the first people to really glimpse and get excited about this new possibility,” Grudin says. “I think that is at the core of his achievement and his importance as an artist. He sees the early stages of this opening through all of these relatively cheap reproductive technologies he loves to experiment with — Polaroids, tape recorders, video recorders, silk screens, even the personal computer.”

Warhol’s Working Class is an outgrowth of Grudin’s research at the University of California, Berkeley. Setting out to write a comparative discussion of minimalism and pop art, he became deeply intrigued by Warhol, particularly in regard to class issues. Warhol was one of very few modern artists from a working-class background, Grudin notes. His father worked construction; his mother cleaned houses; Warhol was born into “the abject poverty of a Pittsburgh ghetto.” But his achievement as an artist would vault him to a place among the glitterati, the rare millionaire artist and the rare individual who experienced life at both ends of the class spectrum.



Grudin breaks new ground with his discovery and examination of a marketing campaign by Macfadden Publications, an odd moment in early sixties consumer culture. It came at a time when national brands (like, say, Campbell’s Soup) were losing ground to generics and store brands. Macfadden, publisher of pulpy magazines such as “True Story,” argued that the future of national brands depended on the masses of working-class consumers who would remain loyal because of the perceived higher status of name brands. That same demographic defined Macfadden’s readership. Seeing an opportunity, they made their pitch to potential advertisers with tough-to-miss, full-page ads in the *New York Times, Wall Street Journal,* and *Chicago Tribune.*

The first Macfadden ad appeared Aug. 14, 1961. A few months later, Grudin notes, Andy Warhol began painting soup cans.

While it’s impossible to directly connect dots between those two events, they’re indicative of the times and the milieu around consumerism and class within which Warhol blazed his trail. And they add another dimension to a critical consideration of the artist’s life and work. While scholars have looked at performance of gender, sexuality, and race in regard to Warhol, this focus on the performance of class introduces a fresh perspective.

Grudin notes that a more egalitarian art world, allowing for expression across class lines, isn’t necessarily comfortable or welcome. He says, “That provokes a lot of anxiety in people, and it also provokes responses to that anxiety — people who come along and say, ‘you’re scared of what us “low-lives” are going to do with this access; let us show you what we’re going to do. It will be scary. It will be rough. It will be weird.’ That’s part of Lou Reed, part of punk rock, and definitely part of Warhol.”

Opposite top: Associate Professor Anthony Grudin, Ph.D., discusses an Andy Warhol work at the UVM Fleming Museum of Art. Bottom: “It Occurs to Me That I Am American” opened to Jane Kent’s work, titled “Blackout.”

Above: Audience members in UVM's Recital Hall listen to an interview with artist and author Art Spiegelman during the Pulp Culture Comic Arts Festival & Symposium.

SOME PULP — EXPLORING THE SERIOUSLY COMIC

Pulitzer Prizes, MacArthurs, Guggenheims, American Book Awards and numerous *New York Times* Best Sellers are just a sampling of the achievements collectively stacked up by the trio of artists/authors — **Art Spiegelman, Joe Sacco** and UVM James Marsh Professor-at-Large **Alison Bechdel** — who shared keynote honors at the October 2017 Pulp Culture Comic Arts Festival & Symposium. And, as if we need further confirmation of their cultural currency and cartoon cred, consider that Spiegelman and Bechdel have both appeared on "The Simpsons."

Hosted by UVM, which co-organized the festival with the Vermont Folklife Center, the three-day event drew hundreds of comic artists and fans of the medium. There are many portals into the work of the three celebrated artists and, more broadly, contemporary comic arts. Literature, visual arts, history, sociology, political science, anthropology, journalism and social activism to name a few. Evidence of that was found in the students and faculty from across a broad array of disciplines filling the music building's Recital Hall for Spiegelman's appearance on the festival's opening night event, sponsored by UVM's Carolyn and Leonard Miller Center for Holocaust Studies.

Early birds were fortunate to get a seat. Those who shaved it close to 7 p.m. perched on the stairs or stood in back when Spiegelman, blue glow of an e-cigarette in hand, and moderator **Dan Fogel, Ph.D.,** chair of the English Department, walked onto the stage and settled into a pair of arm chairs for a two-hour discussion of the author's diverse career and the evolution of comic arts.

Fogel, who currently teaches a course on graphic novels, shepherded the talk with the help of his laptop and a projector queued up with images encompassing the scope of Spiegelman's work. The arc of that career spanned from the childhood inspiration of *Mad magazine* to his years of work for Topps bubble gum/baseball cards ("my Medicis," Spiegelman quipped), from his covers for *The New Yorker* to his exploration of the Holocaust in the landmark *Maus,* which redefined the medium and received a Pulitzer Prize in 1992.

The next day, Spiegelman went from star on the stage to fan in the audience for fellow cartoonist Joe Sacco's talk. Credited in his own-right as a pioneer of graphic journalism and war reportage, Sacco's books, such as *Palestine* and *Footnotes in Gaza,* have further pushed the boundaries of cartooning.

Beyond the talks, comic arts took the spotlight many places on campus. A display in the Bailey/Howe Library showcased the work of the keynote speakers and also comic artists from Vermont and Quebec. On Friday evening, students in a service-learning-based Spanish course taught by **Rachael Montesano** delivered dramatic readings from *El Viaje Mas Caro,* cartooning stories created, through an initiative of the Vermont Folklife Center, by migrant dairy farm laborers.

Discussion panels throughout the day on Saturday led up to the closing keynote by local hero Alison Bechdel. Celebrated for her long-running strip "Dykes to Watch Out For" and her graphic memoir turned Broadway musical, *Fun Home,* Bechdel has been a UVM Marsh Professor-at-Large for the past several years. Professor **Jackie Weinstock, Ph.D.,** an associate professor in Human Development & Family Studies who includes LGBTQ relationships and communities among her scholarly interests, moderated the discussion.

Bechdel was informal and insightful, funny and frank. Reflecting on the unlikely success of *Fun Home,* she said, "At age 40, it saved my ass. I got to keep being a cartoonist." She traced a line back to Spiegelman. "The publication of *Maus* turned everything upside down. You could tell painful, complex, adult stories and people would read them."

For the event's masterminds — **Jonah Steinberg, Ph.D.,** associate professor of anthropology, and Andy Kolovos, director of archives and research at the Vermont Folklife Center — the event was the culmination of years of work that began with a "hey, what if?" moment between friends. On the Monday after, Steinberg enthused about the ways the event crossed disciplines in terms of support and participation. Particularly gratifying, seeing Spiegelman, Sacco and Bechdel connect, attending one another's talks and having dinner together each evening. "Here were the three greatest cartoonists of our time talking. There was collaboration and intersection that was incredible and unexpected — tremendous synergy," Steinberg said.

Isaac Cates, Ph.D., a lecturer in the Department of English who teaches classes in the comic arts, served as an advisor for the festival. He came to appreciate comic art from the perspective of poetry. "Poets must be attentive to every word, every detail," he says. "In the same way, every detail in every panel of a graphic novel is purposeful — nothing appears accidentally." Cates moderated a forum on comic art as a medium for autobiography. "I tell my students that comic authors are like filmmakers who happen to be the writer, producer, director, costume designer, set designer, editor and cinematographer," he says.

Another chance to get an up-close look at cartooning's cutting-edge occurred in spring 2018 when the Fleming Museum presented "Self-Confessed! The Inappropriately Intimate Comics of Alison Bechdel."

REDEFINING DEMOCRATIC IDEALS

Jane Kent is well-practiced in connecting her visual art with the written word. A printmaker, painter, and professor in UVM's Department of Art and Art History since 2004, Kent has also created artist's books, collaborating with writers Richard Ford, Susan Orlean, and currently focused on a work-in-progress with UVM English Department professor and poet **Major Jackson, M.F.A.**

Those projects involved taking a finished piece of writing and reacting to it independently with her own work. In the case of Susan Orlean's *The Orchid Thief,* that morphed into *The Orchid Thief Reimagined* — eight unbound screen-printed pages, combining Kent's art with Orlean's words, all nestled in a silk-covered box. An edition of thirty-five, number six of which is at home in UVM Library Special Collections, was co-published by Grenfell Press and the Rhode Island School of Design.

One of Kent's most recent projects is featured in a work that is more collective than collaborative, the 2018 book *It Occurs to Me That I Am America,* which brings together more than fifty contemporary writers and artists to consider "the fundamental ideals of a free, just, and compassionate democracy." Published in celebration and support of the American Civil Liberties Union, the book is fiercely relevant and timely as the headlines unfold a battle for our identity as a nation and as individual citizens.

The collection, published by Simon & Schuster imprint Touchstone, was conceived and edited by artist/writer Jonathan Santlofer. The impressive list of contributors includes Russell Banks, Eric Fischl, Louise Erdrich, Roz Chast, Neil Gaiman, Joyce Carol Oates, Art Spiegelman, Alice Walker, Marilyn Minter, and UVM alumna Bliss Broyard '88. It's a handsome publication with heft, both literal and moral. Picture your American civics text with a hip makeover, Jasper Johns' "Three Flags" on the cover.

When Santlofer, a longtime friend of Kent's, asked her to contribute to the project, she was quick to sign on. She was also quick to find the direction she wanted to take with her work for the book.

Kent had been working on making prints that blacked out text in documents, probing the concept of redaction. She says she was intrigued by the patterns of black and white and the visual examination of secrecy. "To me, the whole idea of redacting gets at, 'What does secrecy look like?' I'm always asking myself that question," Kent says. Until Santlofer came calling on this project, her explorations of redaction had gone back in a drawer in her studio. The concept had found its moment.

Kent's piece in *It Occurs to Me That I Am America,* titled "Blackout," is the first visual image in the book, placed midway through a short story by Russell Banks. Kent's rough rectangles of etching obscure many of the words in a reproduction of the United States Constitution.

Discussing the broad premise of the book, Kent says, "The whole point is what it is to make art and write in this contemporary moment — what it means to respond, to act, to do, and how important that actually is. To be able to do this in this small, quiet way is very, very gratifying."

Kevin Coburn also contributed to this story.

A HOME FOR ART INTEGRATION

Work has proceeded throughout 2018 on a project that has renovated and transformed the Elihu B. Taft School — located at the corner of South Williams and Pearl streets on the edge of campus — to become UVM's Cohen Hall for the Integrative Creative Arts. **MICHELE RESNICK COHEN, UVM '72,** and her husband Martin Cohen donated $5 million to fund the project.

The former elementary school, which served Burlington students from 1938 until 1980, will be a nexus for arts on campus that brings together multiple disciplines and fosters creative collaboration. Designed as a center for the arts, the space will include galleries, studios, classrooms, and exhibition and performance spaces that will encompass the disciplines of art, art history, dance, theatre, music, film and television studies, and more.

Michele Cohen is a member of the UVM Foundation board of directors, and she also is active in various education, nonprofit and arts-related boards in New York City where she and her husband reside. She is a long-time trustee at Alfred University, and serves as the chair of the board of trustees at the Museum of Arts and Design in New York City.

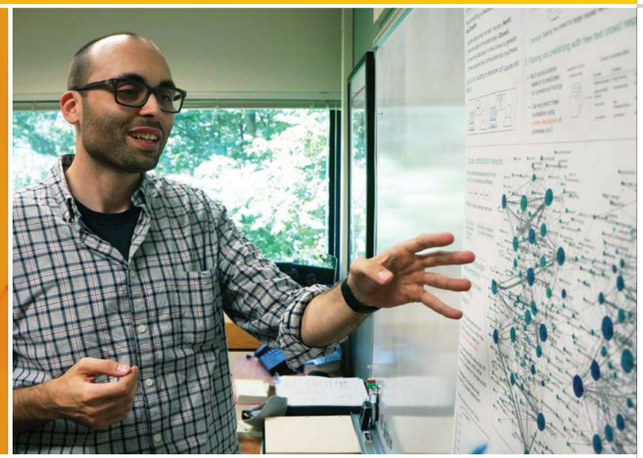
"We are so grateful to Michele and Marty for continuing our more than 225-year tradition of liberal arts education, integrating the humanities, the fine arts, business and the sciences to promote broad and deep learning for our students," said UVM President **TOM SULLIVAN.** "When we put heads, hearts and hands together to study the arts, creativity is unleashed in all aspects of the education process."

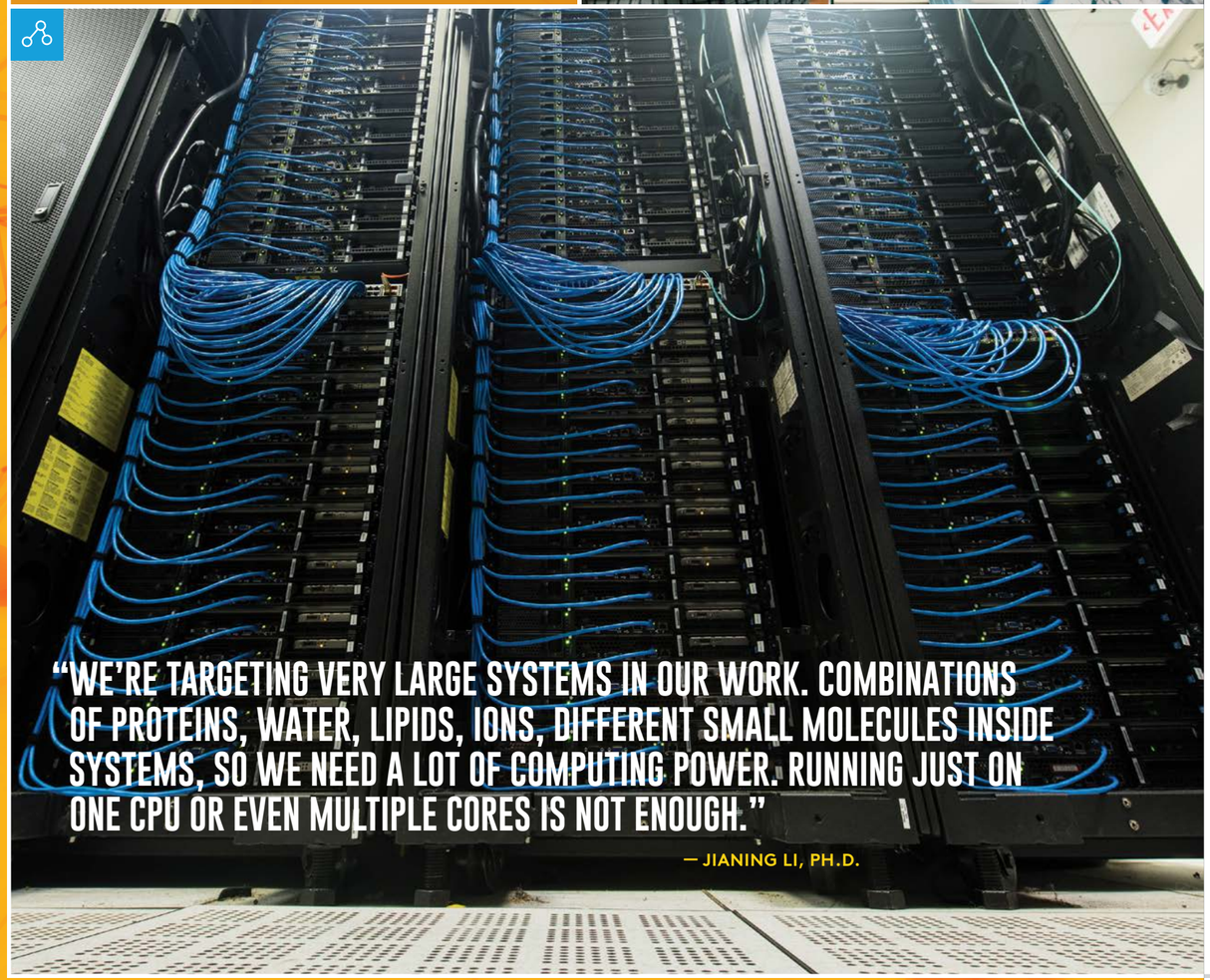
Cohen Hall for the Integrative Creative Arts

"This transformative gift will not only create a hub of collaboration and creativity; it will give us the opportunity we have been longing for, to rightly place the Arts at the forefront of the College, as a public face of UVM commensurate with the quality of the scholarship and teaching, and mirroring one of the essential qualities of Vermont, a commitment to and strength in the arts," said **BILL FALLS,** dean of the College of Arts and Sciences.

LGBTQ RIGHTS, MEXICO VS. U.S.

Associate Professor of Political Science **CAROLINE BEER, PH.D.,** has spent her career researching comparative data between Latin American countries and the United States that often debunks false stereotypes. Her latest study, published in the journal *State Politics and Policy Quarterly,* shows Mexico as more progressive than the U.S. when it comes to LGBTQ rights, especially in the recognition of same-sex relationships. Beer's research measures the effects of religion, LGBTQ organizations and left-leaning governors on LGBTQ rights in both countries, and her results show that religion suppresses the extension of LGBTQ rights in the U.S., but not in Mexico, where 80 percent of the population identifies as Catholic.





Data for Good

UVM RESEARCHERS USE THE VERMONT ADVANCED COMPUTING CORE TO EXPLORE A WIDE RANGE OF ADVANCES IN HUMAN UNDERSTANDING.

BY EDWARD NEUERT

In 1845, Charles Babbage, the British philosopher and mechanical engineer who invented the concept of the programmable digital computer, wrote “At each increase of knowledge, as well as on the contrivance of every new tool, human labour becomes abridged.” One-hundred-eighty years later, his words are proving true every day for scholars across the University of Vermont as they make use of a tool few universities of UVM’s size can offer — the high-performance computing capability of the Vermont Advanced Computing Core (VACC).

Hosted in the University of Vermont’s datacenter in South Burlington, and professionally managed by University IT staff from the Enterprise Technology Services (ETS) department, the VACC cluster is cooled by a multiply redundant air conditioning system (heat being the worst enemy of large-scale computer hardware). The VACC is a kind of “server farm” of super capacity computing cores, clustered together, that combine to handle massive amounts of data — far more than what ordinary desktop computer users would attempt on an average day. The current VACC hardware, nicknamed the “Bluemoon cluster,” delivers computing power that’s hard for the lay person to fully imagine. “For most types of computation, the VACC Bluemoon cluster is approximately 2,000 to 2,200 times faster than a new high-end laptop computer,” according to **Mike Austin,** Director of ETS Systems Architecture & Administration.

The VACC got started in 2003, with support from NASA and Vermont EPSCoR, and funding secured by Vermont Senator Patrick Leahy. Over the last 14 years, with support from the National Science Foundation and UVM leadership, the facility has undergone substantial upgrading, with more on the way in the coming year. It currently has over 300 active users at UVM or affiliated agencies, and those users are housed in 22 academic disciplines. “In 2017, the VACC generated over 15 million computational hours for UVM research,” says VACC Associate Director **Andrea Elledge.**

The common gift VACC offers to researchers, as Babbage alluded to in the 1840s, is time. Academic careers can only span so many years, so immensely complex research needs a tool like VACC to fit within the timeframe of the human researcher. As VACC Director **Josh Bongard, Ph.D.,** notes: “Our research group reported an experiment in the Proceedings of the National Academy of Sciences. It required a month of computation on the VACC, but it would have taken over 100 years to do on a standard workstation. Needless to say, we would never have got our experiment into print without the VACC.”

It’s a feeling echoed by many current VACC users.

“I usually introduce myself as the only chemist in the department who doesn’t do experiments.” Assistant Professor of Chemistry **Jianing Li, Ph.D.,** laughs as she says this, sitting at a conference table just outside her current office on the third floor of UVM’s Discovery Hall. And indeed, her office, where most of her scientific work takes place, might be mistaken to the casual observer for the workplace of a busy humanities professor. There’s nary a beaker or bubbling flask to be seen. What there are in abundance are large flatscreen computer monitors — the setting for a new and valuable kind of chemistry.

“THE VACC CULTURE IS VERY OPEN. THIS GIVES A RESEARCHER MORE FREEDOM, AND IT MAKES FOR MORE FLEXIBLE EXPERIMENTATION.”
— JAMES BAGROW, PH.D.

Opposite top: Associate Professor James Bagrow, Ph.D. Bottom: part of the Bluemoon supercluster at the VACC facility.

"I'm a theoretical chemist," Li explains. "So all my work is based on the computer. I don't have a wet lab, and all my students sit in the office and work on computers." Chemical synthesis, Li explains, is a very expensive and time-consuming process, involving multiple combinations of chemicals and conditions in the attempt to synthesize a desired compound. "But with a supercomputer like the VACC," she explains, "you can basically design things before you do the actual lab work. We can predict the properties, predict the stability, before we go into the lab and spend lots of human effort and money and time to synthesize something. By building a complex model we'll already know in detail what we want to synthesize."

Li and her colleagues, who have lately become some of the largest users of VACC computing time, build these complex models for use in three different areas of research. One relates to the actual approaches to the design of chemical models in order to reduce their complexity. Even the most impressive computers have limitations. As chemical models are designed to mimic the actions of millions of atoms together, the models become slower and less accurate predictors. "We don't have unlimited time," Li says. "We need to publish, students need to graduate — we understand that time limitation, so we want to move the frontier toward larger capacities that can simulate larger systems with more realistic setups." They are working to do this using improved software and computational theory to attempt to simulate the workings of a whole cell. A lay person may think of a cell as tiny, but it is actually the setting for immensely complex chemical interactions.

"Nowadays we can simulate a protein, or a protein sitting in a membrane. But we're talking about modeling thousands or even millions of proteins so we can see how molecules interact within the physical conditions of a cell. We can do this if we can improve our algorithm and make our technology work," Li says.

Besides guiding the synthesis of new materials, Li's work is focused on designing new molecular mechanisms for improved targeted drug delivery in the human body and, working with colleagues in the College of Arts and Sciences and the Larner College of Medicine, improved drug design.

"None of this kind of large-scale modelling could take place without the VACC," says Li. "Modeling takes power, and the VACC gives us that. This allows us to be productive, to move our research and patent applications along. And it's not just that hardware the VACC offers, it's also support. The VACC staff makes student training much easier. They make it faster not only to produce data, but to transfer and archive it. All grants today require a data management plan, and the VACC makes this easy for us. The VACC's value lies not just in research, but also in education and sustainable development."

Above top: Jianing Li, Ph.D. Bottom: Matt Mahoney, Ph.D.

The use of supercomputing has enabled a scientist like Assistant Professor of Neurological Sciences **Matt Mahoney, Ph.D.,** trained as a mathematician, to become a biomedical researcher.

"I'm a systems biologist," he explains. "I'm interested in how different units of biological entities interact with one another to create physiological outcomes." The magnitude of the data involved in those interactions makes the VACC a crucial tool for Mahoney's work.

Before coming to UVM as a postdoctoral researcher in 2013, Mahoney did genetics work at Dartmouth, focusing on gene expression related to the autoimmune disease scleroderma, a condition that causes progressive changes to skin, blood vessel, and organ tissue that can ultimately be fatal.

At UVM, Mahoney is currently working on two projects that make use of the VACC. The first is a cognition study. Working with a rodent model, he's comparing rats with an abnormal development of both their prefrontal cerebral cortex, the largest region of the brain, and the hippocampus, the brain's executive function and memory center. "We've posited that they would have working memory deficits because of these diffused abnormalities," he says.

Mahoney's collaborators use extremely fine probes to collect data about faint bits of electrical activity in these brains, and then process them into "action potentials" — which are signals sent by individual neurons. "In this way we can, in effect, 'listen in' on scores of neurons at a time, and we can study how each transmitted signal changes the probability of other neurons firing of an action potential. We're looking at how these neurons are coordinated in time, to encode information, and how this can go awry in disease, by building statistical models of their firing on the VACC." The results of this work have broad implications for understanding memory deficits in diseases like epilepsy that often have underlying brain malfunctions.

In other work, Mahoney uses the VACC resources to develop machine learning models to computationally "read" histological images of diseased tissues, such as scleroderma tissue. Using artificial neural networks — programming that replicates the way humans learn — he is developing diagnostic tools to mine images for subtle features that distinguish health from disease and predict clinical outcomes.

For all of Mahoney's research, supercomputing is absolutely vital. "I'm working with tremendous amounts of data," he says. "In our cognition study, for instance, we have recorded data from about 800 neurons for an hour, with information on action potentials for every thousandth of a second. This is nowhere near something you'd want to attempt on a desktop computer. It would take months to process. The VACC makes this all possible."

Assistant Professor of Mathematics and Statistics **James Bagrow, Ph.D.,** on his UVM website, describes his work as studying the underlying rules and organizing principles of complex physical and social systems. "But you could say that lately my work has tended a little more to the social side," he says. "I study a lot of networks — network science and network algorithms — and a lot of networks spring from data, so this brings my work into the realms of data science and machine learning. I try to be very broad in what I study."

That broad outlook has led Bagrow to explore in his research both the communication of humans, and the interaction of some of the smallest components of their cellular makeup. "It could be social media, or it could be systems biology work, where I look at proteins and protein interaction networks," he says.

"What I try to understand is what matters in networks, and what doesn't matter, and how does 'noise' or mismeasurement affect these structures." Experiments that are conducted for measuring interacting proteins, he explains, are fairly coarse-grained — they happen in model organisms, not in an actual cell, so there could be false positives or negatives occurring. In the same vein, in an interview to describe a social network, Person A might say they're Person B's friend, but Person B might disagree with that. "So you can get 'noise' in your measurements and sampling effects, where you only capture 5 or 10 percent of the real network. You're trying to draw conclusions about the network, but how robust are those conclusions, given that you're only really seeing this small portion? Researchers study this a lot in the physical sciences and engineering as part of error analysis. Engineers love the term 'uncertainty qualification' — and it's not used as much in other fields. So when I'm working with data in particular I'm very interested in getting a handle on that."

This summer Bagrow published a social media examination in *Chaos: An Interdisciplinary Journal of Nonlinear Science.* "In this piece we proposed (his co-author was Lewis Mitchell, Ph.D., from the University of Adelaide) a toy model for how people might talk to each other — whether or not they're really listening to each other," he says. But even toy models like this can require a lot of computing to study all the different possible versions of the model. "I can do that analysis very slowly on a laptop; but with the VACC I can set up all those different models at the same time and the model can run in parallel, and I'll get those results back pretty quickly."

Bagrow also cites the VACC "helpful culture" as a major plus. "I've done work at other places that have a supercomputer, and I had to write lengthy, time-consuming proposals in order to get on the cluster. That's not always worth it for small to medium scale simulations. The VACC culture is very open. This gives a researcher more freedom, and it makes for more flexible experimentation."

The VACC's computing resources are managed by a small team of IT professionals from UVM's central IT department, Enterprise Technology Services, who serve as the VACC's IT staff. Andy Evans, Jim Lawson, and Mike Austin's technical expertise in high performance computing are key to the success of the VACC cluster's ability to meet the needs of UVM researchers. Combined, the three have over 80 years of expertise in providing research computing services.

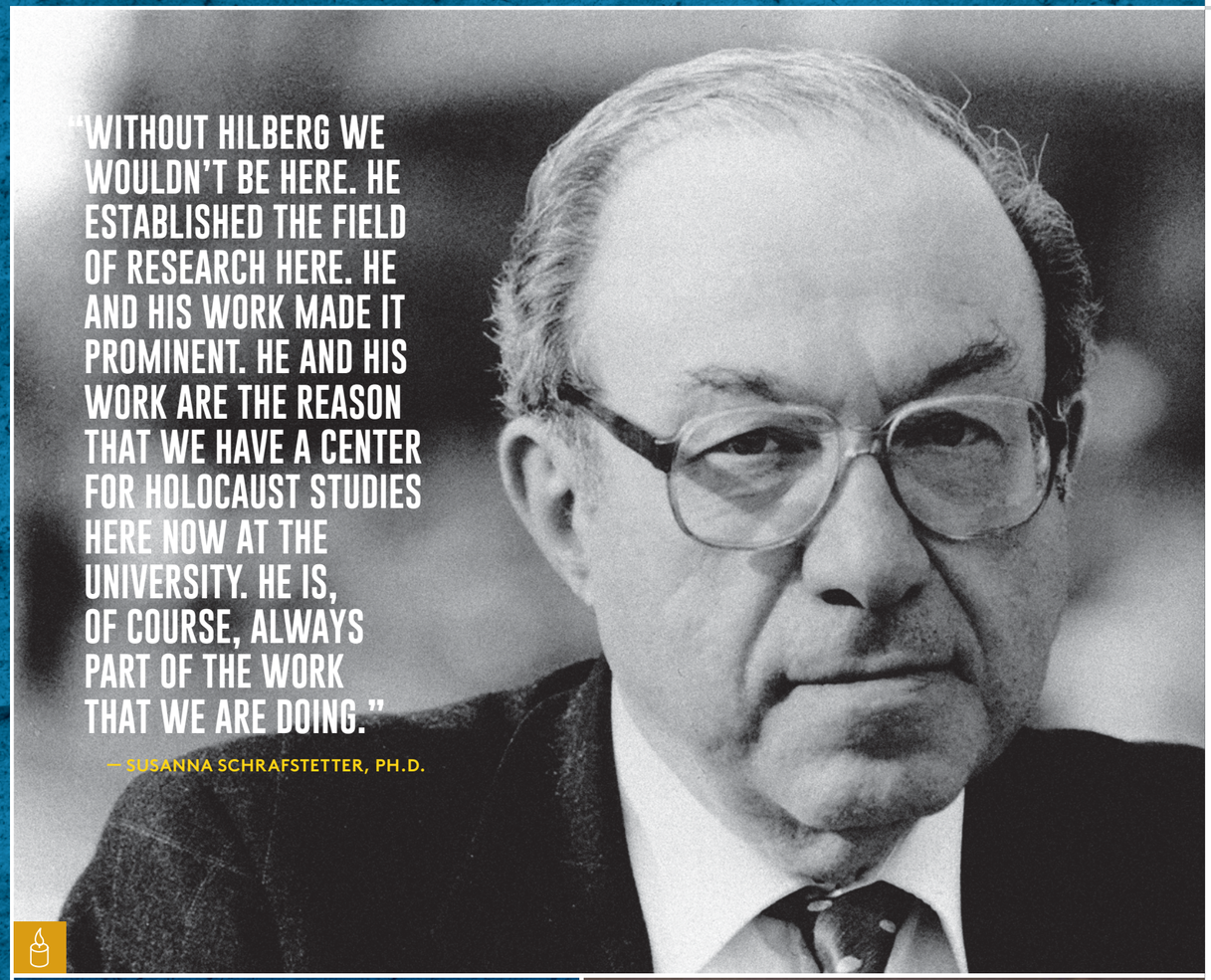
No one's computer is ever really powerful enough. This holds true for both a desktop, and a super-cluster. With that in mind, University and VACC leadership have worked constantly over the years to secure the most up-to-date upgrades for the VACC. Those efforts paid off most recently with the announcement in late August that the National Science Foundation (NSF) has awarded funding that will allow a whole new level of improvement to the VACC. Under the NSF Major Research Instrumentation Program, the VACC will be transformed by the addition of a large-scale graphics processing unit (GPU) cluster already nicknamed "DeepGreen." This will augment the existing central processing unit "Bluemoon" cluster. GPUs, developed originally for 3D game rendering, will be combined to make a cluster that is massively more powerful than the current VACC.

"At 7.8 teraflops per V100 GPU, DeepGreen puts us on the order of a petaflop of computing power," says Associate Professor of Physics and VACC Associate Director **Adrian Del Maestro, Ph.D.** (A petaflop is a computing speed equal to one million billion [that's 10^{15}] floating-point operations per second.) With this huge upgrade, Del Maestro notes, the VACC could nudge into the top 500 most powerful computers in the world.

For researchers like Jianing Li, having this kind of power at hand could not come soon enough. "We're targeting very large systems in our work," she says. "Combinations of proteins, water, lipids, ions, different small molecules inside systems, so we need a lot of computing power. Running just on one CPU or even multiple cores is not enough. We, and others, need a multiple computing unit, and the GPU will give us that, and allow us to do even more complicated work in the years ahead."

COMPOSIING STORIES

A jazz flutist, Professor **PATRICIA JULIEN, PH.D.,** has been part of the Department of Music and Dance at UVM since 2002. She teaches courses in jazz composition and arranging, jazz harmony, classical music theory, and jazz history. In addition to writing works for mixed-voice choral ensembles, solo voice and piano, orchestra, contemporary chamber ensembles, small jazz combos, and big band, Julien composes original music for dance and theatrical productions (including a 2015 musical, *O, Caligula! A Mvsical*). In 2018 her orchestral work, *Among the Hidden,* was released on Navona Records. The piece was recorded by the Czech Republic's Moravian Philharmonic Orchestra. Julien also delivered the spring 2018 College of Arts and Sciences Dean's Lecture, "Stories About Composing," on the process of composing a work of new music when the work also involves words.



Following the Facts

MILLER CENTER FOR HOLOCAUST STUDIES SCHOLARS BUILD ON THE LEGACY OF RAUL HILBERG.

BY THOMAS WEAVER

In her Wheeler House office, one wall lined with books on the Holocaust and twentieth-century German history, another with a panoramic map of the Alps from the perspective of her native Munich, **Susanna Schrafstetter, Ph.D.,** considers the University of Vermont legacy of the late Professor Emeritus **Raul Hilberg.**

"It means a lot to all of us; without Hilberg we wouldn't be here," the associate professor of history and faculty member in UVM's Carolyn and Leonard Miller Center for Holocaust Studies says. "He established the field of research here. He and his work made it prominent. He and his work are the reason that we have a center for holocaust studies here now at the university. He is, of course, always part of the work that we are doing."

Alan Steinweis, Ph.D., professor of history and outgoing director of the Miller Center, notes the fundamental challenge that Hilberg, professor at UVM from 1956 to 1991, undertook when, as a graduate student, he launched his research on the Holocaust. Citing Hilberg's memoir, *Politics of History,* Steinweis shares Hilberg's recollection of his Columbia doctoral dissertation advisor telling him that the subject would be his professional death. "It's not that people were in denial about what happened to the Jews in Nazi Germany in World War II," Steinweis says. "But for a long time, it wasn't really considered to be… Everybody knew that it had happened and it was a terrible thing, but it was more the subject of moral condemnation than serious intellectual research."

That all changed in 1961 with Hilberg's publication of *The Destruction of the European Jews,* a foundational work exhaustively documenting the Holocaust with a rigor and authenticity never before approached.

A measure of the global impact of the career that followed is found in an October 2017 conference in Berlin, co-sponsored by UVM's Miller Center, that brought together many of the world's top historians and Holocaust scholars to consider Hilberg's transformative work on the tenth anniversary of his death.

At UVM today, Steinweis calls Hilberg's impact "palpable," with a professorship, lecture, and research collection named in his honor. But the greatest tribute to his influence is found in the work of the current generation of Holocaust scholars at UVM. Academic focuses vary — history, political science, religion, German, sociology — but faculty are united by an approach to their scholarship that follows in Hilberg's footsteps, Steinweis notes.

"THE KIND OF WORK THAT WE REALLY EMPHASIZE IS EMPIRICAL HISTORICAL WORK BASED ON DOCUMENTS. WE ACTUALLY OPERATE IN HILBERG'S INTELLECTUAL TRADITION.
— FRANK NICOSIA, PH.D.

History professor emeritus **Frank Nicosia, Ph.D.,** is among the prominent Holocaust scholars who have continued to carry the torch at UVM. Nicosia, who retired in spring 2018, held the endowed professorship named in Hilberg's honor and early in his career received inspiration and encouragement from the fabled scholar.

"The kind of work that we really emphasize is empirical historical work based on documents," Steinweis says. "We actually operate in Hilberg's intellectual tradition."

Earlier this year, Steinweis and Schrafstetter, a married couple who came to UVM in 2009 from the University of Nebraska, received prestigious research fellowships from the Jack, Joseph and Morton Mandel Center for Advanced Holocaust Studies of the U.S. Holocaust Memorial Museum. The honor gives them the opportunity to spend the fall 2018 semester in Washington, D.C., writing and using the museum's archive for research.

Opposite: Raul Hilberg, Ph.D., pioneer of the field of Holocaust Studies and the founder of UVM's Miller Center for Holocaust Studies.

A HISTORIC HOME REBORN

Academic year 2018–19 holds milestones for the University's Carolyn and Leonard Miller Center for Holocaust Studies. After nine years as director, Professor **ALAN STEINWEIS, PH.D.,** steps down from leadership as **JONATHAN HUENER, PH.D.,** associate professor of history, takes on the directorship for the next year. Steinweis credits his successor for being an anchor for Holocaust Studies at UVM across the past twenty years, another link in the chain of distinguished scholarship in the field.

In May, as Huener discusses the Miller Center's future, he pauses to search among stacks of papers and volumes that help inform a book manuscript, an in-depth examination of the Polish Catholic Church under German occupation, that he'll be focused on writing over the summer. But Huener doesn't have his author's hat on at that moment; instead, he's in center-director mode when he finds what he's seeking, a blueprint of the renovated Billings Library space where Holocaust Studies will be headquartered, joining the Humanities Center, the Center for Research on Vermont, and the library's Silver Special Collections.

As blueprint becomes reality, Huener sees opportunity. "The center is going to have an actual home on the campus instead of functioning as a sort of virtual center among various offices," he says. "And it's only appropriate that its home is in Billings. Leonard Miller had fond memories of the building as a student and was eager to see it function as a library."

With a director's office, library/research space, a seminar room, an office for potential visiting scholars, and event space in the gracious common areas of the 1885 Billings Library, Huener hopes that this hub becomes a very busy place — for students, faculty, and the Vermont community.

Huener takes the reins as director with deep appreciation for what Holocaust Studies at UVM has become, building upon Raul Hilberg's seminal scholarship though Professor Emeritus David Scrase's foundational work as the Center's first director and continuing with Alan Steinweis's leadership as the Miller Center developed. Studying the Holocaust at UVM, students are mentored via the strong teacher-scholar ethos of the faculty and also enjoy rare access to the cadre of international scholars who visit campus for lectures and symposia.

> "THE CENTER IS GOING TO HAVE AN ACTUAL HOME ON THE CAMPUS… AND IT'S ONLY APPROPRIATE THAT ITS HOME IS IN BILLINGS. LEONARD MILLER HAD FOND MEMORIES OF THE BUILDING AS A STUDENT AND WAS EAGER TO SEE IT FUNCTION AS A LIBRARY."
>
> — JONATHAN HUENER, PH.D.

"Especially at the undergraduate level, you'd be hard-pressed to find another institution that has the curricular offerings and the programming available to students that we do," Huener says.

"I know I'm tooting our own horn," he adds with a hint of apology, "but it's remarkable."

Above (L–R): Alan Steinweis, Ph.D., Susanna Schrafstetter, Ph.D., Frank Nicosia, Ph.D., and Jonathan Huener, Ph.D.

Susanna Schrafstetter's main focus at the Mandel Center, as the Judith B. and Burton P. Resnick Invitational Scholar for the Study of Anti-Semitism, is work on her project "Seeking Survival in the South: German-Jewish Refugees in Italy, 1933–1950." Her research explores the lives of the thousands of Jews from Germany who fled from National Socialist persecution between 1933 and 1940 to Fascist Italy. For the majority of these individuals Italy served as a temporary refuge, but a substantial number of Jewish refugees from Germany and other European countries remained in the country until the end of the Second World War. Following the Italian entry into WWII in 1940, they experienced internment, and, after the German occupation of Italy in September of 1943, they faced arrest and deportation to Auschwitz. Schrafstetter notes that exploring why Jews would seek refuge in Fascist Italy, of all places, is a central question. "I'm looking at how do Jews from Germany live in Italy in the late 1930s, how do they make a living?" she says. "The idea is to very much examine this from their perspective through their writings to the extent that we have them."

That work is rooted in document deep dives in places such as the national archives in Rome, the Jewish Documentation Center in Milan, and regional archives in key cities that include Trieste, Turin, and Vicenza. And the Mandel Center fellowship at the U.S. Holocaust Museum opens more avenues. Materials from the International Tracing Service contain details on the fate of those sent to Nazi death camps. Film and video of survivor testimony, widely known as the "Spielberg Collection," includes the experience of German-Jewish refugees in Italy.

As research turns to writing turns to publication, Schrafstetter anticipates bringing this work back to the classroom, with ideas beginning to coalesce around a new UVM history seminar course on Italy and the Holocaust.

Alan Steinweis, the Ina Levine Invitational Senior Fellow during his semester in residence at the Holocaust Museum's Mandel Center, will concentrate on completing a book manuscript on the history of Nazi Germany for Cambridge University Press. Part of a series called New Interpretations in European History, the book is designed to be a foundational text for college courses, highly readable but solidly grounded in scholarship. "It's a small book about a big subject," Steinweis says, "which might make it even harder to write."

> "[HILBERG] AND HIS WORK ARE THE REASON WE HAVE A CENTER… HE IS, OF COURSE, ALWAYS PART OF THE WORK WE ARE DOING."
>
> — ALAN STEINWEIS, PH.D.

As that broadly framed project comes to a close, Steinweis will also be setting out on the early stages of his work on a lesser-known chapter in the history of the Nazi regime. Steinweis is intrigued by the story of Georg Elser, a German cabinetmaker who came close to assassinating Hitler with a bomb hidden in a Munich beer hall in November 1939. Elser's action has received much less attention than the failed attempt on Hitler's life by German military officers in July 1944.

"We probably know as much about Elser and his acts as we can, as we ever will, research has really exhausted the sources," Steinweis says. "I think his story deserves to be told in a more extensive way in English than it has."

In particular, Steinweis sees an opportunity for greater examination of the after-life of Elser's act and why it has remained relatively obscure while the Stauffenberg assassination attempt of 1944 is celebrated, the stuff of Hollywood movies. Reasons range, Steinweis suggests, from the timing of the two assassination attempts to post-war German politics. East Germans were reluctant to claim Elser because he wasn't a communist; but for West Germans, he was too far to the left for embrace — a would-be hero lost in a no man's land between ideologies.

FINDING THE BROADER EFFECTS OF BULLYING

School officials focused exclusively on bullying prevention efforts should consider the findings of a study by Associate Professor of Education **BERNICE GARNETT, SC.D.,** showing the highly damaging effects of multiple forms of victimization on school climate. The research, published in the *Journal of Child & Adolescent Trauma* in 2017, measured the impact of polyvictimization — exposure to multiple forms of victimization — on school climate at the middle and high school levels. Results show that bullying, cyberbullying and harassment were significantly associated with decreases in perceptions of school safety, connection, and equity. Garnett is a public health prevention scientist whose areas of expertise focus on school and community strategies to prevent bullying and the intersection with discrimination and harassment among youth. In 2018 she was named the inaugural Adam and Abigail Burack Green and Gold Professor of Education.

People-Places-Capital Mantra Takes VCET — and Vermont Entrepreneurs — Far

With its superhero-themed art, retro furniture, random ping pong table and open floor plan, the Vermont Center for Emerging Technologies' eye-catching co-working space — a little bit of Palo Alto plunked into Burlington's FairPoint Technology Hub — is a fitting symbol for the dynamic contribution the economic development organization is making to Vermont's start-up culture.

But an everyday suite of offices in Winooski may tell the VCET story just as compellingly. The 5,000-square-foot space, tucked into an office park off East Allen Street, is home to SemiProbe, a fast-growing tech firm that, but for VCET, to borrow the developer's phrase, might still be a gleam in the eyes of its founders.

In 2007 VCET contributed space to the fledgling start-up, in the form of its Farrell Hall incubator on the UVM campus. Seed financing from VCET followed several years later, which spurred significant additional investment. Eighteen months ago, VCET helped recruit the company's CEO, **Doug Merrill.** Today SemiProbe, which designs and manufactures equipment for quality-testing semiconductor components, has clients ranging from United Technologies to Sandia National Laboratories, 11 employees, two hires in the works and the potential to add significantly more staff in the future. "We had a really strong year," Merrill says, "and we're looking at long term, multi-year growth."

Those words are music to the ears of VCET president and UVM alum **David Bradbury** (a UVM Business Administration graduate from the Class of 1988) and confirmation that the approach VCET takes to launching and scaling start-up companies is on target.

"Our goal is to create a density for innovation," Bradbury says, consisting of three components he repeats like a mantra, all of which SemiProbe tapped into: people, VCET's expansive network; places, the three physical spaces VCET runs, including Farrell Hall, the Burlington facility and an incubator at Middlebury College; and capital, VCET's $5.1 million seed fund, which, it uses to expertly leverage additional investment.

SemiProbe is hardly the only success story that tri-partite approach has yielded. Since 2008, VCET's 50 "portfolio companies" — those it provided seed capital to — have raised over $172 million total in capital. In turn, those companies have lifetime sales of $133 million and a payroll of $112 million. VCET's stellar track record prompted the Stockholm-based University Business Incubator Index to rank it the eleventh best university and college-orientated business incubator in the world and fifth best in the U.S.

VCET's reach extends far beyond Chittenden County to the 1,630 start-ups it has worked with around the state — Northern Reliability in Waterbury, for instance. When start-up costs caused cash flow impacts for the firm, which creates batteries and other systems for storing renewable energy, VCET stepped in with bridge financing that prompted more investment and a team of advisors that helped reposition the company's business plan. Last year it had record sales.

It's not easy being an economic development catalyst in the 21st century, as the start-up environment grows more competitive each year and entrepreneurs more sophisticated.

Recently the organization has put emphasis on creating original content — in the form of a podcast called *Start Here* and networking events spotlighting female entrepreneurs. The Female Founders Series, created and managed by Bradbury's VCET colleague, **Sam Roach-Gerber,** has taken the start-up community by storm, with nine sold out events over the last year and a half.

VCET president David Bradbury and Sam Roach-Gerber, director of innovation, at the organization's co-working space in Burlington

> "ALL YOU HAD TO DO WAS WALK INTO A COFFEE SHOP AND SEE HOW MANY PEOPLE WERE BY THEMSELVES FOR SIX HOURS, TYPING AWAY AND DRINKING COFFEE AND NOT TALKING TO ANYBODY. I REMEMBER THINKING, 'I WANT TO KNOW WHAT YOU'RE DOING. HOW CAN I HELP YOU? HOW CAN YOU HELP ME?'"
>
> — DAVID BRADBURY '88
> VCET PRESIDENT

While VCET has always been autonomous, it was born on the UVM campus, in part as a way to spur commercialization of faculty research. VCET launched in 2005 as an independent 501(c)3 in Farrell Hall with funding from the university, Senator Patrick Leahy and the Vermont Technology Council. UVM is still a funder and remains closely connected through its faculty entrepreneurs, six of whom are in residence at one of the VCET facilities, and its students. Fully one third of VCET's 188 members are student entrepreneurs and interns, many from UVM.

That composition is attractive to UVM provost **David Rosowsky, Ph.D.,** a new member of the VCET board, who would like to see even more students involved. VCET, Rosowsky says, "can create a platform for interested students to become engaged in innovation and entrepreneurship, be part of startup culture and maybe even launch a startup."

As new companies form and grow, "that will create pathways and opportunities for students that could convince them to stay in Vermont," contributing much needed youth to the state's aging workforce and helping "drive a sustainable, prosperous and compelling future for the state," one of UVM's overarching goals as the state's land grant university, Rosowsky says.

ON EVERY MUNICIPALITY'S RADAR

Digging a hole in most major cities — for new construction or infrastructure repair — is no minor undertaking. With a dozen or more separate utilities required to inspect the ground under the dig site for a welter of obstructions like water, sewer and gas pipes, electric lines and electric generators — some so old they don't appear on city maps — the permitting process can take 18 months or more.

Transformational new technology, which uses "cognitive" ground-penetrating radar, is being developed jointly by the University of Vermont and the University of Tennessee at Chattanooga could reduce the inspection process to an afternoon's work. This ongoing research project, "Underground Infrastructure Sensing," won a Smart 50 Award in 2018 from a coalition that includes Smart Cities Connect, the Smart Cities Connect Foundation and US Ignite, honoring the 50 "most transformative smart projects each year."

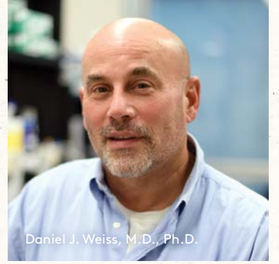
UVM Professor of Mechanical Engineering **DRYVER HUSTON, PH.D.,** is the project's principal investigator, with main collaborator, Professor **TIAN XIA, PH.D.** When the technology is fully developed, "a person with augmented reality goggles or a specially equipped smart phone or tablet will be able to walk over the area that needs to be inspected, look into the device and see in detail what's underground six to 12 feet down," Huston says.

"UVM's work on underground infrastructure sensing is truly remarkable, and a great example of how Vermont can lead the way on developing 21st century digital innovations," says **DENNIS MOYNIHAN,** executive director of BTV Ignite, Burlington's digital city initiative.

Above (L–R): Professor of Mechanical Engineering Dryver Huston, Ph.D., and Associate Professor of Electrical and Computer Engineering Tian Xia, Ph.D.

UVM Joins High Profile Regenerative Medicine Consortium


Jeff Spees, Ph.D.


Daniel J. Weiss, M.D., Ph.D.

The University of Vermont has joined the Advanced Regenerative Manufacturing Institute (ARMI) through its BioFabUSA program. ARMI is a non-profit, federally sponsored consortium dedicated to making the large-scale manufacture of engineered tissues and tissue-related technologies practical, to benefit existing industries and grow new ones.

ARMI is one of 14 sites under the federal umbrella of Manufacturing USA and the Department of Defense focused on catalyzing specific and promising advanced manufacturing technology areas. Located in Manchester, N.H., ARMI/BioFabUSA is composed of leading higher education institutions and corporations, ranging from large multi-nationals to start-ups.

Regenerative medicine translates fundamental knowledge in biology, chemistry and physics into materials, devices, systems and a variety of therapeutic strategies that augment, repair, replace or regenerate organs and tissues. While great strides have been made in research, practical, large scale manufacturing in regenerative medicine has lagged.

"Regenerative medicine as a field is on the verge of transforming the treatment of disease and disability, as the research breakthroughs of the past decade move into the world of practical medicine," said **Richard Galbraith, M.D., Ph.D.,** vice president for research at UVM. "Our membership in ARMI/BioFabUSA both recognizes UVM as a leader in this rapidly emerging area and provides an opportunity for the university to advance even further."

"The academic and commercial R&D community has done a tremendous job driving innovation in the field of regenerative medicine," said Gray Chynoweth, chief membership officer at ARMI/BioFabUSA. "Now it is time to move from bench and clinical scale to commercial scale manufacturing. New and different types of talent and expertise are needed for this transition to succeed. We are thrilled that UVM will be joining forces with us to support this transition and develop this talent pipeline."

Universities are eligible to join ARMI/BioFabUSA if their research and teaching programs make them a good fit for the organization, Galbraith said.

UVM has strength in regenerative medicine, where the university is developing a multi-disciplinary program focused on basic science, commercialization, entrepreneurship and biotechnology training under the leadership of **Daniel J. Weiss, M.D., Ph.D.,** and **Jeff Spees, Ph.D.** The university also has a robust biomedical engineering program. An undergraduate degree program in that discipline, under the leadership of **Jason Bates, Ph.D.,** and **Jeff Frolik, Ph.D.,** recently joined existing masters and doctoral degree programs.

A key element of the ARMI/BioFabUSA mission is to support basic and applied research in regenerative medicine through an ongoing grant program members are eligible to apply for. The organization has $80 million in funding it will disperse to consortium members over seven years.

In addition to research, ARMI/BioFabUSA is also focused on workforce development designed to create a new generation of employees to fill skilled, high paying jobs in regenerative medicine that barely exist today. For the universities that are part of ARMI/BioFabUSA, Galbraith said, that represents a rare opportunity for students.

"The ARMI/BioFabUSA ecosystem of companies will give our students exceptional networking, internship and employment opportunities," he said. "And the connections our faculty make with corporations in the consortium will provide us an early-stage understanding of market needs that has the potential to translate to new curriculum and give UVM graduates a significant competitive edge in the marketplace."

MASSMUTUAL PARTNERS WITH UVM IN GROUNDBREAKING DATA SCIENCE INITIATIVE

Seeking to expand the applications of computational, social and data science, Massachusetts Mutual Life Insurance Company has provided the University of Vermont with a $500,000 grant to fund an innovative pilot program within the University's Vermont Complex Systems Center.

The partnership with UVM focuses on three specific initiatives:

- Funding for a newly created MassMutual Ph.D. Fellowship. This four-year fellowship provides funding for a Ph.D. student working in data science and complex systems at UVM. The MassMutual fellow will explore research at the intersection of human health and well-being, data science, and complex systems.
- Supporting faculty collaboration. Through a named research fund, MassMutual supports exploratory questions related to wellness, human behavior and networks with a team of interdisciplinary faculty in UVM's Vermont Complex Systems Center.
- Hiring a visual data artist-in-residence. Visual data is an essential tool that communicates complex information clearly, creatively and effectively. The MassMutual Visual Data Artist-in-Residence partners with Complex Systems Center students and faculty and with MassMutual's data science team to create visualizations that allow people to easily understand and interact with complex data.

"We are excited to be working with the Vermont Complex Systems Center, and the world class research talent it brings to our strategic initiative of blending and applying academic and industrial capabilities to many fundamental issues," said **SEARS MERRITT,** MassMutual's head of data science. "Our partnership with UVM aims to enable the development of novel quantitative methods, as well as uncover new insights related to changes and patterns in human behavior and the determinants of social well-being."

The Vermont Complex Systems Center supports data science and complex systems education through interdisciplinary learning, and the Center's master's and Ph.D. level graduates have gone on to work for leading data science teams in the private sector at major U.S. and international companies. The data science initiative with MassMutual represents the largest single corporate collaboration with the Center since its inception in 2009.

UVM Spinoff's Small Packets Are a Big Deal for Energy Industry

So far, 2018 has been a whirlwind of developments for Packetized Energy, the energy sector start-up spun off from a large Department of Energy project in 2016 by three UVM electrical engineering faculty, **Paul Hines, Ph.D., Jeff Frolik, Ph.D.** and **Mads Almassalkhi, Ph.D.**

After completing a pilot with Burlington Electric Department at the end of 2017, the company launched ambitious demonstration projects in January with Green Mountain Power and the Vermont Electric Cooperative that put its innovative technology to the test under real market conditions.

That same month **Scott Johnstone,** former CEO at the Vermont Energy Investment Corporation and a global leader in the energy efficiency field, took the helm at the company. Later in the spring, Packetized Energy added a software engineer, hardware engineer and business project manager to its roster. In March, the three faculty completed a month-long stint at the new energy accelerator, Accel-VT, rubbing shoulders with some of the top energy entrepreneurs in the country and earning the company acclaim as one of the most promising firms in its cohort.

In April, UVM licensed the founder's technology to the company, a critical step in the commercialization process.

And in a fitting symbol that capped its momentum, in May the company left the co-working Inspire space at Green Mountain Power's headquarters it has occupied for the past year-and-a-half and moved into its very own offices in Burlington's trendy Chace Mill.

What's behind the impressive series of breakout moves?

Packetized Energy, it turns out, is the hottest of hot commodities in electric utility circles, the creator of a set of clever algorithms with products to match that could go a long way toward addressing the great challenge facing the energy sector and the planet: how to harness the increasingly abundant, but fickle, power of renewables like wind and solar when the sun doesn't shine and the wind doesn't blow.

If the company delivers on its promise, it could be a very big deal indeed, says private equity guru and serial entrepreneur **Bob Zulkoski,** chairman of the Vermont-focused investment firm Vermont Works, an early investor in Packetized Energy.

As the founder of a successful company "also in the energy resource field, I'm very familiar with this space," he says. "Packetized is one of the few companies I've seen in Vermont that could become what's called a unicorn," a company whose assets are valued at $1 billion or more. "They are in the right place at the right time with a very innovative approach."

Packetized produces smart controllers for the big energy hogs in the home: hot water heaters, batteries (both for charging electric vehicles and for power back-ups like the Tesla Powerwall) and HVAC systems.

The controllers sidestep the complexity of trying to predict consumer behavior by asking a simple question: How much energy does my device need right now? If the water in the water heater is too cool, for instance, it asks Packetized's cloud-based server if it can have a small "packet" of energy from the grid to warm the water.

By heating hot water, for example, in short bursts spread throughout the day and by staggering consumers' mini-power requests so they don't happen all at once — a similar process applies to energy requests from HVAC, batteries, and electric vehicle chargers — Packetized Energy helps power consumers and power producers achieve a Zen-like state of balance.

Academic articles and industry consultants have guessed at how much money utilities would save if they used renewable energy more consistently and avoided paying top dollar for supplementary power when demand exceeds supply. But the Packetized trial will be the first to get a real-world data on cost-savings. "We'll be seeing what the real financial benefit is to the utility of installing our devices in the field and interacting with the grid in this new way," Frolik says.

If the project is successful, and utilities save up to what the company projects, about $150 per water heater, it's easy to imagine the level of interest. "I would say about half the utilities in the country know who we are," says Almassalkhi. There would be keen interest, to say the least, he says, if the demonstration project pays off.

"They're hitting the market at the right time with an innovative product," says **Corine Farewell,** director of UVM's Office of Technology Commercialization, which has worked closely with Packetized's faculty founders as the company got off the ground. "They have a strong team, including a very strong CEO in Scott Johnstone. They have great partners in GMP and VEC. And they have customers. They're hitting all the right notes."

Johnstone couldn't be happier about his new digs. "If we're going to have clean, affordable and easy-to-use energy, the real focus of the next wave is dealing with demand-side management and optimizing the grid," he says. "That's what Packetized Energy is here to do and create, and that's what is so exciting about the work we're doing. When you consider all the grid-edge devices that will be interacting with the grid as the Internet of Things comes online, the potential of this company is really limitless."

> "PACKETIZED IS ONE OF THE FEW COMPANIES I'VE SEEN IN VERMONT THAT COULD BECOME WHAT'S CALLED A UNICORN. THEY ARE IN THE RIGHT PLACE AT THE RIGHT TIME WITH A VERY INNOVATIVE APPROACH."
>
> — BOB ZULKOSKI, CHAIRMAN, VERMONT WORKS


Surrounded by full- and part-time staff in the company's new offices in Chace Mill are (left to right) faculty founders Mads Almassalkhi, Ph.D., Jeff Frolik, Ph.D., Paul Hines, Ph.D., and new company CEO Scott Johnstone.

Deans of the University of Vermont

COLLEGE OF AGRICULTURE AND LIFE SCIENCES

DEAN THOMAS C. VOGELMANN, PH.D.

COLLEGE OF ARTS AND SCIENCES

DEAN WILLIAM FALLS, PH.D.

COLLEGE OF EDUCATION AND SOCIAL SERVICES

DEAN SCOTT THOMAS, PH.D.

COLLEGE OF ENGINEERING AND MATHEMATICAL SCIENCES

DEAN LINDA SCHADLER, PH.D.

GROSSMAN SCHOOL OF BUSINESS

DEAN SANJAY SHARMA, M.B.A., PH.D.

LARNER COLLEGE OF MEDICINE

DEAN RICHARD L. PAGE, M.D.

COLLEGE OF NURSING AND HEALTH SCIENCES

DEAN PATRICIA A. PRELOCK, PH.D.

RUBENSTEIN SCHOOL OF ENVIRONMENT AND NATURAL RESOURCES

DEAN NANCY MATTHEWS, PH.D.

CONTINUING AND DISTANCE EDUCATION

DEAN CYNTHIA BELLIVEAU, ED.D.

GRADUATE COLLEGE

DEAN CYNTHIA FOREHAND, PH.D.

HONORS COLLEGE

INTERIM DEAN LISA SCHNELL, PH.D.

UNIVERSITY LIBRARIES

DEAN MARA SAULE, M.L.I.S.

UVM Inquiry 2018— Research, Scholarship and the Arts at the University of Vermont is a publication of the Office of the Provost and the Office of the Vice President for Research

DAVID V. ROSOWSKY, PH.D.
Provost and Senior Vice President

RICHARD GALBRAITH, M.D., PH.D.
Vice President for Research

EDITORS

EDWARD NEUERT
Editorial and Creative Director, Medical Communications

CAROLE WHITAKER
Assistant Dean for Medical Communications

Special thanks to **THOMAS WEAVER** for his editorial contribution.

ART DIRECTOR

STEVE WETHERBY
Wetherby Design

EDITORIAL COMMITTEE

ANDREA ELLEDGE
RICHARD GALBRAITH, M.D., PH.D.
JERALYN HARALDSEN, PH.D.
DAN HARVEY
EDWARD NEUERT
AMANDA WAITE
JEFFREY WAKEFIELD
THOMAS WEAVER
CAROLE WHITAKER

WEB EDITOR

KERIME TOKSU

CONTRIBUTING WRITERS

JOSHUA BROWN
KEVIN COBURN
SARAH TUFF DUNN
SHARI HALIK
ALEXANDRA KOSIBA
JENNIFER NACHBUR
EDWARD NEUERT
ERIN POST
JON REIDEL
CAROLYN SHAPIRO
AMANDA WAITE
JEFFREY WAKEFIELD
BASIL WAUGH
THOMAS WEAVER
SARAH ZOBEL

CONTRIBUTING PHOTOGRAPHERS

JOSHUA BROWN
RAJ CHAWLA
JEFF CLARKE
ANDY DUBACK
IAN THOMAS JANSEN-LONNQUIST
BRIAN JENKINS
SALLY MCCAY
ERIN POST
DAVID SEAVER
SRINIVAS VENUGOPAL

PRINTING: Printed by Villanti Printers, Environmentally certified to the Forest Stewardship Council® Standards.

PAPER: Printed on paper manufactured using 100% post-consumer recycled fiber, Processed Chlorine-Free, and certified by the Rainforest Alliance to the Forest Stewardship Council Standards.

The University of Vermont

UVM.EDU/INQUIRY