2017

Momentum: Research & Innovation for Fall 2017

University of Rhode Island

THE
UNIVERSITY
OF RHODE ISLAND
DIVISION OF RESEARCH
AND ECONOMIC
DEVELOPMENT

THINK BIG WE DO℠

Momentum:

Research & Innovation

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fall 2017

Momentum:

Research & Innovation

Welcome to the latest issue of *Momentum: Research and Innovation*, the research and scholarly activity magazine of the University of Rhode Island. We are proud to share with you the unique accomplishments of the faculty, students and staff in developing scholarship that will help to change the world. The responsibilities of a research institution such as the University of Rhode Island include teaching and the discovery of new information. Sharing that new information with others allows it to be applied, leading to improvement in our daily lives. *Momentum: Research and Innovation* is one of the ways we can share our new information and new scholarly activities with the world. We hope you will enjoy the adventures.

Sincerely,

Gerald Sonnenfeld, Ph.D.
Vice President for Research
and Economic Development

fall 2017

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The Sky is the Limit
for Wearable Technology

written by **ALLISON FARRELLY '16**

3D-Printed Robotized Hand, developed to help amputees.

Kunal Mankodiya, assistant professor of electrical, computer and biomedical engineering at the University of Rhode Island (URI), is creating textiles much different than the ones he helped his family sell as a child in India. Today, Mankodiya's textiles are "smart."

Through his medical technology research, Mankodiya strives to meet crucial problems in the health care industry – among them, long-term monitoring and data synthesis – with affordable, applicable solutions, his smart textiles.

Mankodiya's Wearable Biosensing Lab at URI is working to create wearable systems, such as smart clothes and socks, which can mimic the technology found in hospitals and patient homes. Discreetly woven with an array of sensors, the smart clothes can non-invasively track important patient metrics such as heart rate vital signs, physical activity, falling, walking or other movement difficulties in their daily life.

"There is a huge demand for doing data collection at home," Mankodiya says. "Hospital devices cannot translate to home because they're not made for home monitoring."

This day-to-day tracking is particularly important, Mankodiya says, for patients who had strokes or heart attacks. The textiles gather data on movements and analytics. Mankodiya's lab has also created gloves that can monitor symptoms of patients with Parkinson's disease, and socks that can monitor movement.

"The sky is the limit, but we want to design what will be appropriate," he says.

The devices would not only enable doctors to monitor patients' symptoms remotely, but also allow care to be given with a more in-depth understanding of the patient's history.

"The idea is we can use smart textiles to collect that data, and the data provides a window for medical professionals to see their patients progress," Mankodiya says. "It's important to look at their progress over time. Doctors are unable to see it on a daily basis, so we are trying to bridge this gap in health care."

Wearable Functional Near Infrared Spectroscopy (fNIRS) device is an optical brain monitoring system which uses a highly controlled near infrared light to illuminate the brain from the scalp skin and measure brain activity.

Smart Glove which can measure tremors and movement difficulties in Parkinson's disease patients. These gloves are woven with high-resolution motion and stretch sensors connected to an on-board computer with wireless connectivity.

NOT ONLY DOES THE TECHNOLOGY ALLOW HEALTHCARE PROVIDERS TO TRACK THE ONSET OF SYMPTOMS, BUT THE LONGEVITY OF THE DATA ALLOWS THEM TO TRACK BEHAVIOR PATTERNS.

Mankodiya's interest in the intersection of smart textiles and the internet led him to another of his substantial research projects: The Internet of Things (IoT).

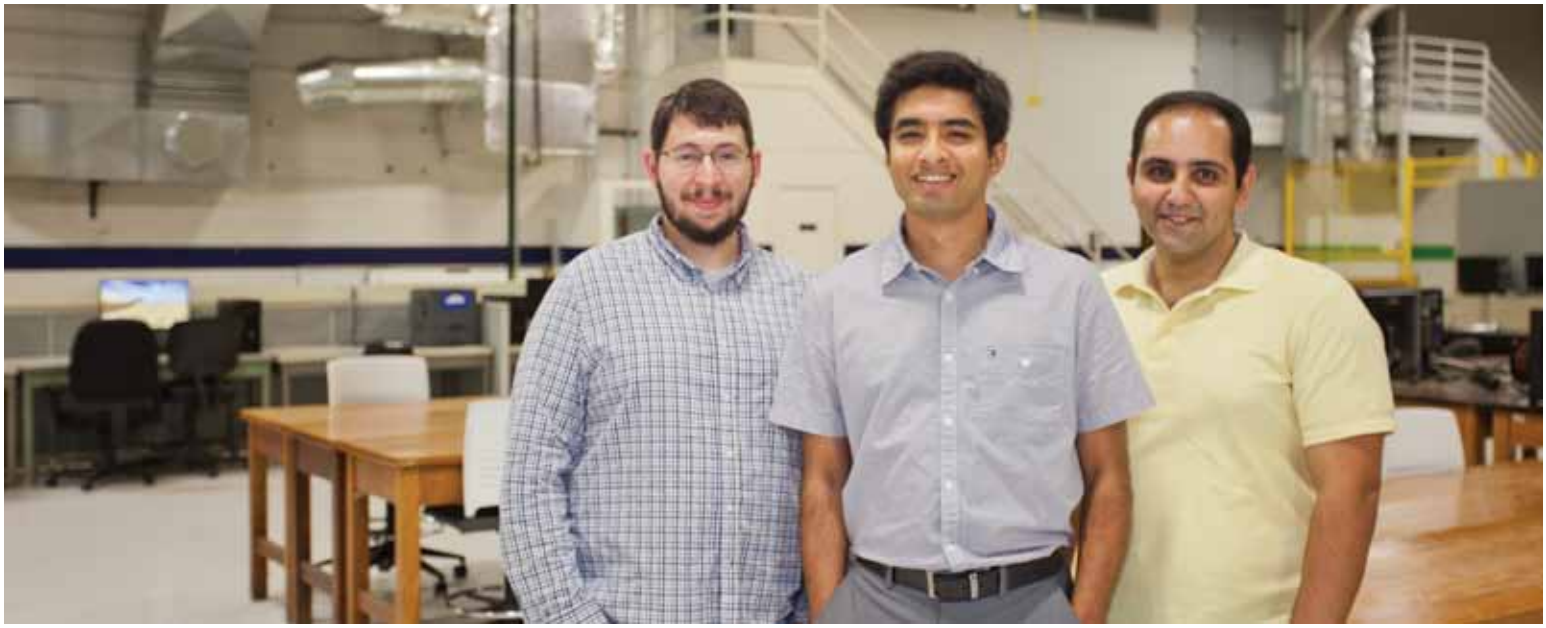
Lacking any means for home analysis of the data collected by smart textiles, patients still rely on visits to medical professionals to translate the information collected by their smart textile devices. However, with Mankodiya's IoT, data gathered by the smart textiles is sent to the cloud where it can be accessed for diagnostics by health care providers.

The IoT blends Mankodiya's smart textile technology with cloud computing to collect data that enables personalized, dynamic health care. One of the features he's most excited about? Some preliminary data analysis can even be done on a patient's mobile device.

One of Mankodiya's preliminary tests of the intersection of wearable technology and the Internet of Things was a research study done with Rhode Island Hospital. Smart watches were given to patients at risk of post traumatic stress disorder (PTSD), and used to track patient behavior over time. This project allows clinical experts to see how their patients are behaving before and after the behavioral treatments. The aim is to adjust the treatments on-the-go with a promise to reduce the time associated with trial-and-error.

Not only does the technology allow health care providers to track the onset of symptoms, but the longevity of the data allows them to track behavior patterns.

"We'll be able to track from the watch sensors why some episodes happen at a particular time of the day," Mankodiya says of PTSD episodes.



URI graduate students Joshua Gyllinsky (left,) and Mohammadreza Abtahi (right), with Mankodiya (center).

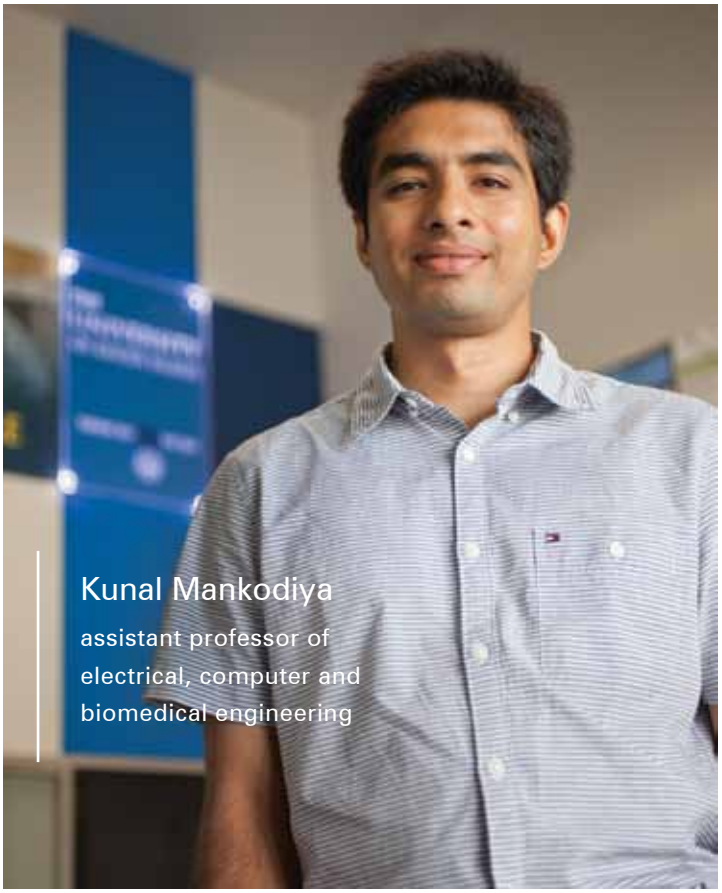
Mankodiya has been recognized locally and internationally for his work as a scientist. In 2017 he was awarded a National Science Foundation (NSF) CAREER award and a URI Early Career Faculty Research and Scholarship Excellence award. He was also named Future Textile Awards "Innovator of the Year" Frankfurt, Germany, and is one of the *Providence Business News* "40 under 40."

Since coming to the University, his research has been funded by three NSF grants, one National Institutes of Health grant, and 16 foundation or local grants. Mankodiya has been awarded close to $1.8 million that supports six Ph.D. students, three master's students, and several undergraduate students. His lab is a multi-cultural environment where diversity is a strong force for the innovation and development in cross-disciplinary domains.

In addition to his research, Mankodiya played a key role in establishing the Rhode Island Textile Innovation Network, a collaboration among the state, manufacturers and textile industry leaders that seeks to maximize use of the state's manufacturing infrastructure and foster innovation and growth in Rhode Island's textile industry.

The Rhode Island Textile Innovation Network is not the only professionally-diverse team Mankodiya works with. He has initiated many interdisciplinary research teams at URI to approach problems in health care from a broader breadth of knowledge.

"This diversity of perspective," he says, "creates innovation."



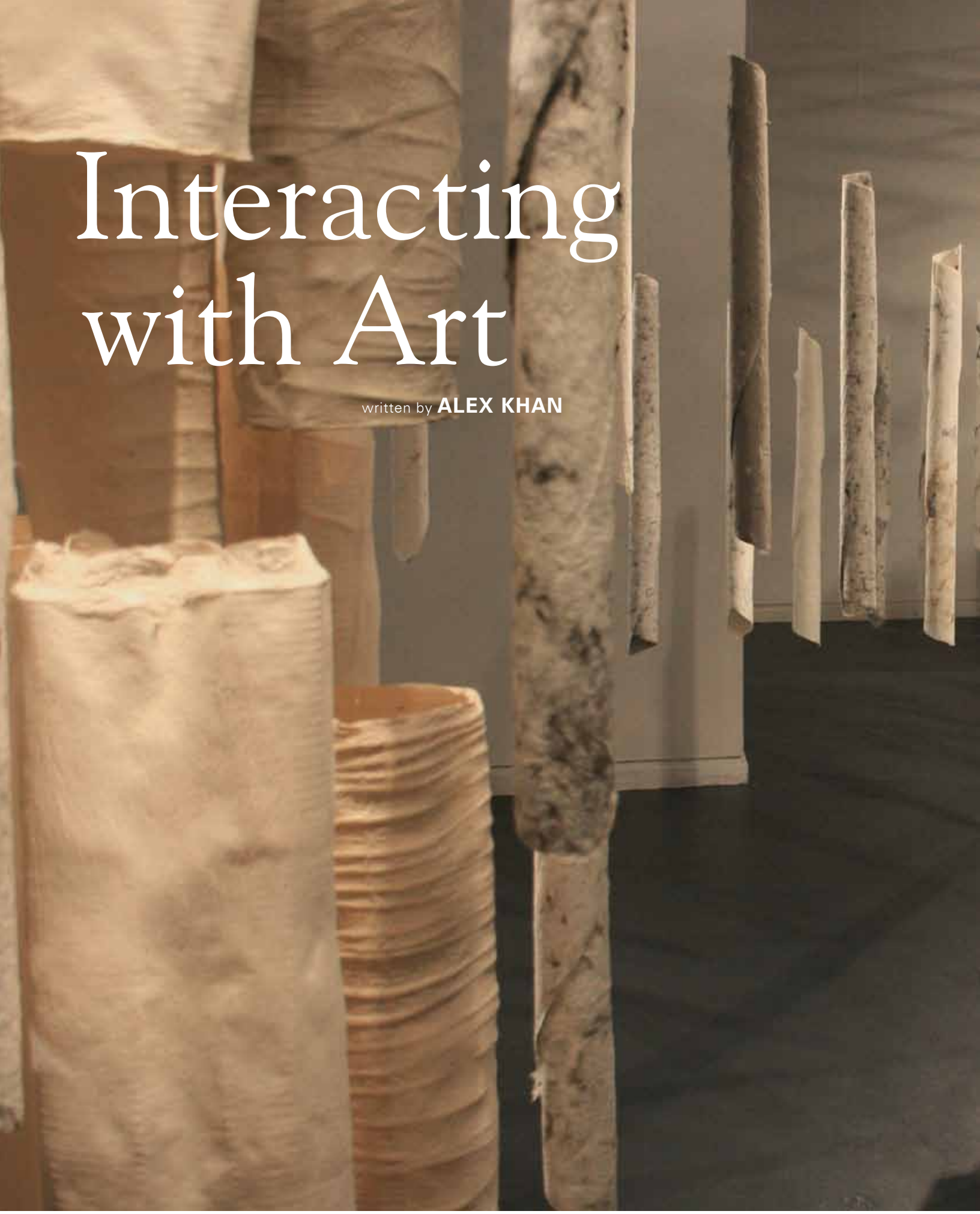
Kunal Mankodiya

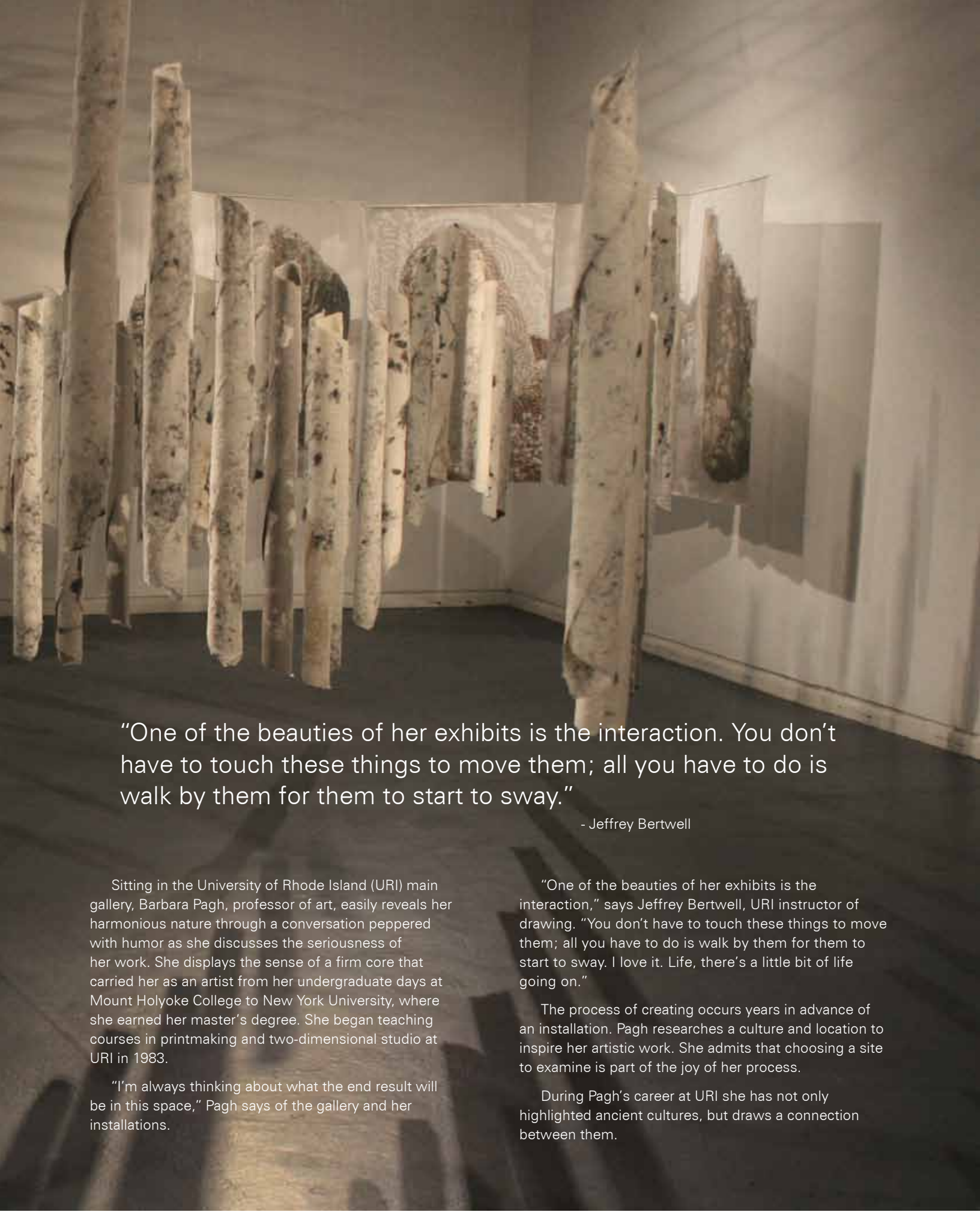
assistant professor of electrical, computer and biomedical engineering

The aim is to adjust the treatments on-the-go with a promise to reduce the time associated with trial-and-error.

Interacting with Art

written by **ALEX KHAN**





"One of the beauties of her exhibits is the interaction. You don't have to touch these things to move them; all you have to do is walk by them for them to start to sway."

- Jeffrey Bertwell

Sitting in the University of Rhode Island (URI) main gallery, Barbara Pagh, professor of art, easily reveals her harmonious nature through a conversation peppered with humor as she discusses the seriousness of her work. She displays the sense of a firm core that carried her as an artist from her undergraduate days at Mount Holyoke College to New York University, where she earned her master's degree. She began teaching courses in printmaking and two-dimensional studio at URI in 1983.

"I'm always thinking about what the end result will be in this space," Pagh says of the gallery and her installations.

"One of the beauties of her exhibits is the interaction," says Jeffrey Bertwell, URI instructor of drawing. "You don't have to touch these things to move them; all you have to do is walk by them for them to start to sway. I love it. Life, there's a little bit of life going on."

The process of creating occurs years in advance of an installation. Pagh researches a culture and location to inspire her artistic work. She admits that choosing a site to examine is part of the joy of her process.

During Pagh's career at URI she has not only highlighted ancient cultures, but draws a connection between them.

Alignments installation

Kermario alignments, Brittany

Handmade paper detail

Kerzerho giant menhir, Brittany

Alignments installation

Barbara Pagh
professor of art

In 2016, with her latest showing at the University's main gallery, *Alignments* Pagh capped off a trilogy of public exhibitions, which began in 2002 with her examination of Scotland's megalithic stone circle structures. What unites the pieces encompassing Scotland (*Stone Paper Circle)*, Ireland (*Passages)*, and Brittany (*Alignments)*, is a sense of a disparate shared culture, utilization of stone, and a sense of awe, demanding introspection and curiosity.

Megalithic construction in Brittany started between 5,000 and 2,000 BC with the most well-known sites found around the village of Carnac. Alignments are rows of standing stones (menhirs), ranging from one row of a few stones to several rows of hundreds of stones. In her installation *Alignments* Pagh uses the repetition of 100 handmade paper tubular forms hanging from the ceiling to create linear rows in the gallery that the viewer can pass through. At the end of the rows, digital images of large menhirs printed on cotton are hung in the form of a cromlech.

"My intention is not to be totally representational of what I am looking at, but to interpret it and try to capture the feeling of the space that I am in," Pagh says of her interpretations of these ancient sites.

The woven path a person went through of the installation *Stone Paper Circle,* led one art critic, Doug Norris in Art New England, to characterize the work as: "A passage symbolizing the journey of human life from awakening to awareness, past to present, this world to the next."

> "When structures alter the landscape and you're there, it's a feeling of connection to the people that made these structures and made these marks on the structures."
>
> - Barbara Pagh

Pagh was inspired to create her own paper for her exhibitions and prints. "I read an article in a magazine that said you could make paper in a blender, and that's what got me started."

Even though she was traditionally a printmaker, Pagh began working paper beyond its flat two-dimensional form. She began a three-dimensional exploration of her medium by making artistic bowls and expanded this

Vieux Moulin menhir, France

Handmade paper detail

"My intention is not to be totally representational of what I am looking at, but to interpret it and try to capture the feeling of the space that I am in."

- Barbara Pagh

approach to other forms over time.

For Pagh, while building and altering these structures, this feeling of connection begins a balancing act between communicating the experiential quality of a natural space while also highlighting the cultural realities and beliefs that each civilization maintained.

"When structures alter the landscape and you're there, it's a feeling of connection to the people that made these structures and made these marks on the structures," Pagh reflects. "And, how do you have somebody else who hasn't been there have a similar kind of experience?"

Pagh based her 2009 installation, *Passages*, on Ireland's Megalithic Passage Tombs in Newgrange, Knowth, and Dowth, which are large mounds of earth or stone with a narrow passage leading from outside into a central chamber or chambers. From that inspiration, Pagh carved out a space in which individuals could walk diagonally through the installation with an increasing light echoing the physical experience of passage tombs. While simultaneously maintaining a sense of one's life journey.

For Pagh, these elements are often deconstructed and implanted she says, "It's organic in itself, the hanging process."

As an artist she sees the need to roll with the unexpected when coming into an exhibition space. Such is the case with lighting during installations of hanging materials and unexpected patterns of shadows.

"That in a way is the exciting part, the work is not just totally mapped out," Pagh says.

While Pagh continues working with two-dimensional printmaking, it is her three-dimensional sculptures filled with life that one finds harmony between art and artist.

◈ ◈ ◈

Filling a cryogenic thermos with liquid nitrogen to trap volatile compounds during the synthesis of monomers and polymers.

QUESTIONING
the Science of Systems

written by **ALLISON FARRELLY '16**

Kiesewetter's team synthesizes new, biodegradable, monomers to replace existing materials - making new monomers - the yellow solution with the flask submerged in a heating bath of aluminum beads.

Plastics are both a tremendous benefit and burden for humanity. While these materials have revolutionized our daily lives, they are entering the ocean at an alarming rate, more than ten million metric tons in 2010. If current trends hold, by 2050 there will be a greater mass of plastic in the oceans than fish. For one Ocean State chemist – University of Rhode Island (URI)'s Assistant Professor of Chemistry Matthew Kiesewetter – the opportunities to lessen the burdens of plastic while increasing its benefits is a driving force.

Kiesewetter conducts fundamental and applied research on ring-opening polymerization using organic catalysts. A catalyst is a chemical compound that speeds up a chemical reaction, and most polymers (plastics) are made through processes that use catalysts.

"Catalysis is key," he says. "We can lessen the societal burden of plastics by developing catalysts that access current materials more efficiently or that access replacement materials that are environmentally friendly."

Given the vast amount the U.S. economy derives as a result of manufacturing and selling these materials, the development of efficient processes for polymer synthesis is of great importance. Kiesewetter aims to develop more efficient catalysts that function under mild reaction conditions and enable better control of the polymer structures.

"We can lessen the societal burden of plastics by developing catalysts that access current materials more efficiently or that access replacement materials that are environmentally friendly."

- Matthew Kiesewetter

Pouring liquid nitrogen into a vacuum jacketed flask to cool reactions and trap monomers to purify them.

Since arriving at URI in 2013 Kiesewetter has received more than $900,000 in funding from sources such as the American Chemical Society and the Rhode Island IDeA Network for Biomedical Research Excellence. He is currently working on a five-year National Science Foundation grant to conduct his research.

"One of our research goals is to build systems so people can make new materials," Kiesewetter says. "We were finding that the systems out there, they were fine, but it became an interesting problem for us to see if we could make them better."

Kiesewetter and his team are making catalysts that are more active than some of the most active catalysts known, and trying to keep them highly selective.

"Instead of days, you could make polymer in hours or minutes," Kiesewetter says. "When we began researching catalysts, 150 grams of then-state-of-the-art organic catalyst were needed to create one kilogram of polymer, which is a lot. We can do the same reaction, more quickly, with only 4 grams of our best catalyst."

This lessens the waste associated with plastic production.

Kiesewetter and his team are ultimately interested in making catalysts that can be applied to any application. Polymers are being called upon for diverse applications including conventional products like bottles, packaging and adhesives, but also cutting-edge applications like self-healing coatings, bone and tissue adhesives, and bio-delivery of chemotherapeutics. To create polymers for specialty applications, extremely selective and versatile catalyst systems are needed.

"It is one thing to make a catalyst that can generate plastic for a bottle or packaging material," Kiesewetter says. "But can we make a catalyst capable of producing a polymer that we have never even thought of?"

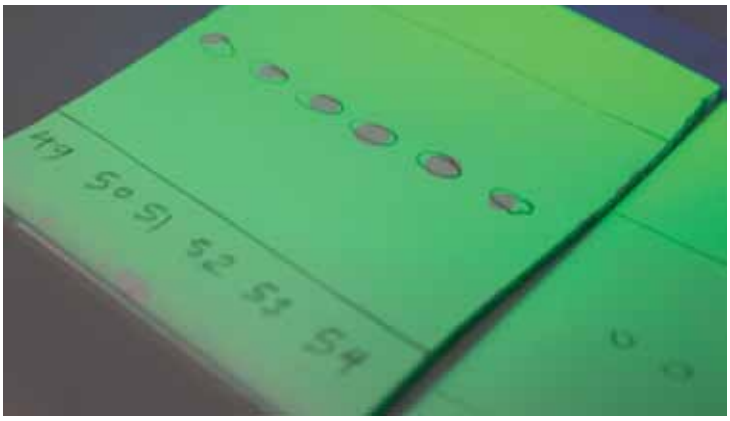
This is the chemistry equivalent of creating a hammer versus driving a single nail without one.

"What I hope our research shows is that fundamental investigation pays off," Kiesewetter says. "Research begins by asking simple questions about known catalysts, 'Why does this work?'"

Once he can find a possible answer, he says it is like grabbing a loose thread, that when you pull it the

Liquid nitrogen evaporating from a vacuum flask.

Synthesizing polymer in an air-free environment.



Removing organic solvent under reduced pressure.

Visualizing catalysts with UV light during purification by thin-layer chromatography.

whole story unravels. The story in this case is a detailed understanding of how molecules interacting with each other on a microscopic scale can produce huge amounts of useful material.

The job of a polymerization catalyst is to link thousands or millions of individual units (called monomers) together to make a polymer.

"Polymers," he says, "are like little data tapes that remember the story of how they were made. If we can understand how the story was written, then you can rewrite the story and make an entirely new material."

In Kiesewetter's line of exploratory research, the research application can often be a byproduct. His team recently asked a question: What happens when we replace one atom in our monomer for another? The result is a new type of polyester that behaves like rubber but is entirely biodegradable. Reducing the cost of these materials that society uses so extensively requires approaching the problem from every possible angle. That includes making catalysts that do not even want to form a polymer.

One of Kiesewetter's coworkers changed the way they were approaching their synthesis and found out that certain catalysts prefer to de-polymerize plastic.

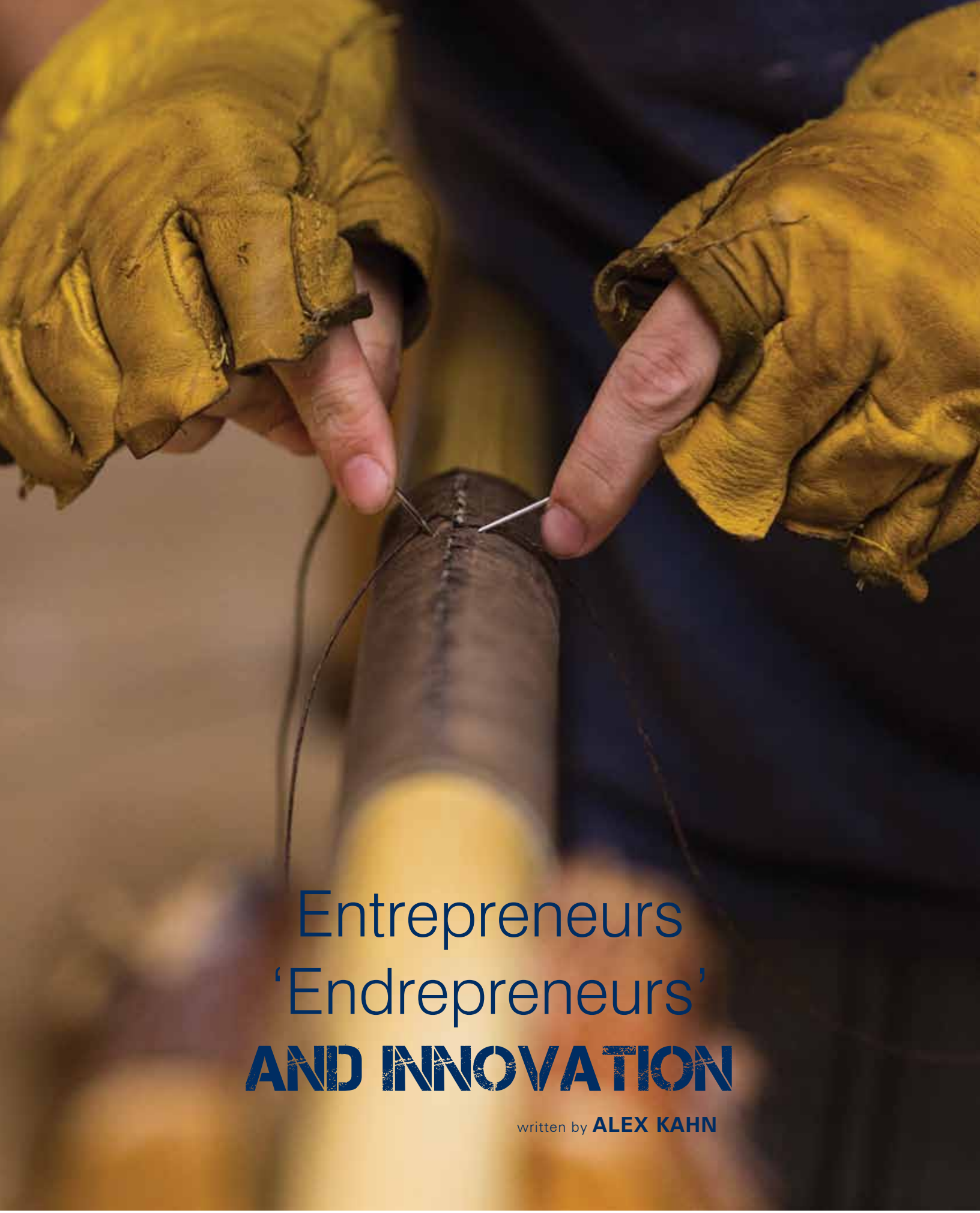
"This was very exciting for us," Kiesewetter says. "Besides discovering something people had not known before, imagine being able to use one catalyst one way to transform monomer to polymer and another way to take it back to starting material!"

Then, you can take bottles out of the ocean before they ever get there.

◈ ◈ ◈

Polymers are being called upon for diverse applications including conventional products like bottles, packaging and adhesives but also cutting-edge applications like self-healing coatings, bone and tissue adhesives.

URI graduate student Jinal Pothupitiya is filling a cryogenic thermos with liquid nitrogen, preparing to synthesize polymer.



Entrepreneurs ‘Endrepreneurs’ AND INNOVATION

written by **ALEX KAHN**

Nancy Forster-Holt

assistant professor,
Spachman professor of
entrepreneurship

"I am intrigued by the entrepreneurial ecosystem of Rhode Island."

- Nancy Forster-Holt

In 2011, Nancy Forster-Holt earned her Ph.D. from the University of Maine and was looking for an academic job located close to the manufacturing company she owns with her husband in Orono, Maine. She felt that her pragmatic resume – a 25-year career in accounting, banking and small business ownership, plus an MBA, Ph.D., and a certified management accountant license would add value to the right employer. She landed at Husson University, where her job was to start and teach an entrepreneurship program at undergraduate and graduate levels, and re-start the Family Business Center with Executive Development programming that was relevant to businesses across the state. Her career goal was to work eventually at a land-grant university in New England. In spring 2016, the College of Business Administration (CBA) at the University of Rhode Island (URI) presented the perfect opportunity.

"I am intrigued by the entrepreneurial ecosystem of Rhode Island," Forster-Holt says.

Rhode Island's metrics mirror those across the U.S., in that small companies comprise 96 percent of businesses and 54 percent of employment. Still, behind those numbers are stories that Forster-Holt wants to uncover. For example, she was given the green light for a proposal by the Rhode Island Research Collaborative to study her topic of the demographic trends of aging business owners and declining numbers of young people in the state, and the impact on business investments. This summer, she began a new research project on the outcomes of state-based innovation grant programs. Forster-Holt has become equally intrigued by startups and by business acquisitions.

"With the numbers of small employers and business so high in every state, the chances are good that students will work for, advise, start, acquire, or supply a small company," she says. "Plus, family-owned business is a big player in Rhode Island. Succession planning that includes innovation can keep that next generation intrigued."

Forster-Holt has created the term "endrepreneurship" or, the end of an entrepreneur's career, which she defines as the risks borne along the path of an owner toward retirement from the company they built. It will likely be an owner's one and only exit.

Forster-Holt's company, the 159-year old Shaw & Tenney's paddles were just named one of Maine's 10 most iconic products, by *Mainebiz* magazine.

URI student Justin Bristol, owner, designer, and builder of the SolarCart Café. In front of his towable food cart, which runs almost entirely on solar power.

"Employers tell us they want students who can innovate within an existing company," Forster-Holt says. "Students tell us they want to either start something themselves or else work for innovative companies. Skills like design thinking, lean startup, business planning, and small firm finance add value to a URI degree that matches the realities of the modern business world. Events like the Risica lecture reinforce these concepts."

The average age that someone starts a business is mid-30s. Therefore thinking of her students, she thought of the phrase "take a job/make a job" either within a company or by creating a company. It is at the core of the entrepreneurial and innovative landscape she hopes to cement at URI. Forster-Holt worked with a small team of business faculty and leveraged the support of the Dean's office, as well as contacts across campus that included the College of Engineering and the College of the Environment and Life Sciences, to create an interdisciplinary entrepreneurship and innovation program. As the first step of the CBA minor, six courses were added that targeted underclassmen. Prior to this initiative, the CBA offered two courses, Entrepreneurship and Small Business Management, typically taken during

Forster-Holt moderating the Risica lecture featuring URI alumni Tom Chisholm '68 and Brett Chisholm '94, NeuraFlash co-founders.

a student's senior year. This academic year, Forster-Holt will initiate the process of building the innovation major as well as three certificate programs at the University in innovation, entrepreneurship and social entrepreneurship.

Academic programs like these support the University's Start-Up Program/Accelerator/Resource Center (SPARC) initiative, to which Forster-Holt's work is closely tied as a professor and business mentor. SPARC aggregates all URI resources that support small business and entrepreneurship. SPARC also supports interrelations and interfaces among external and internal stakeholders through a network of mentoring, coaching and consulting. Recently, Forster-Holt worked with the Rhode Island Small Business Development Center, to develop projects for her courses that will give students a chance to apply lean startup methods to Rhode Island businesses. Forster-Holt also started the Guppy Tank on campus, a play on the Shark Tank theme. Staffed with a team of coaches from URI the Guppies train students to refine their business plan pitches for external competitions.

"Our teams did really well, taking the top spots including prize money, incubation and advising, at the events that they trained for," she says.

Forster-Holt has created the term "endrepreneurship" or, the end of an entrepreneur's career, which she defines as the risks borne along the path of an owner toward retirement from the company they built. It will likely be an owner's one and only exit. She has published on this topic and presented her research to national and international audiences.

"Every state in New England is an aging state, we bought our company, the manufacturing firm Shaw &

Recently, Forster-Holt worked with the Rhode Island Small Business Development Center, to develop projects for her courses that will give students a chance to apply lean startup methods to Rhode Island businesses.

Tenney in Maine, from a retiring business owner, and it really galvanized me," Forster-Holt recalls. "I could finally articulate what I studied for my Ph.D., which was the exit of small business owners, and leverage my life experience into teaching and research."

Forster-Holt began a two-year extraction of her family from Maine, setting off a series of discussions about the direction of the company, with family, employees and advisors.

"My husband calls this "me" search, since it has been unfolding for us over the years," She says. "How do we add value to this iconic Maine brand? Who would likely acquire our firm? What will an acquirer look for? Do our children, who have worked there since 2005, have any interest in succession?"

This is history in the making, and has been shared as case studies in her CBA classes and of course, provides her with more topics for her "me" search.

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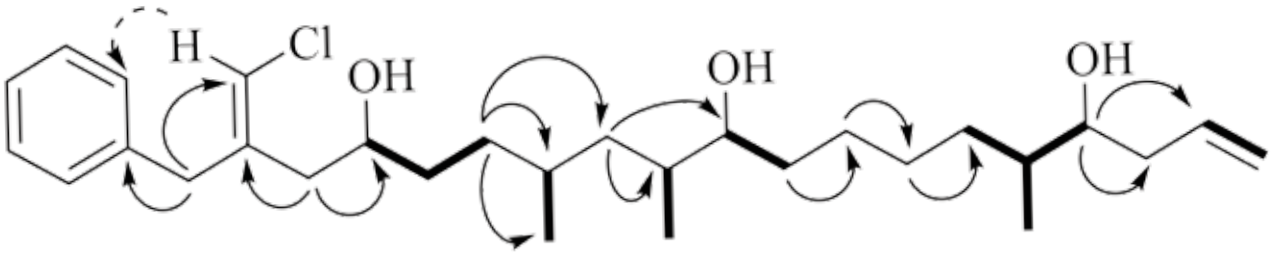
Seeking THERAPEUTICS from a 'Bucket of Muck'

written by **TODD MCLEISH**

Matthew Bertin

assistant professor of biomedical and pharmaceutical sciences



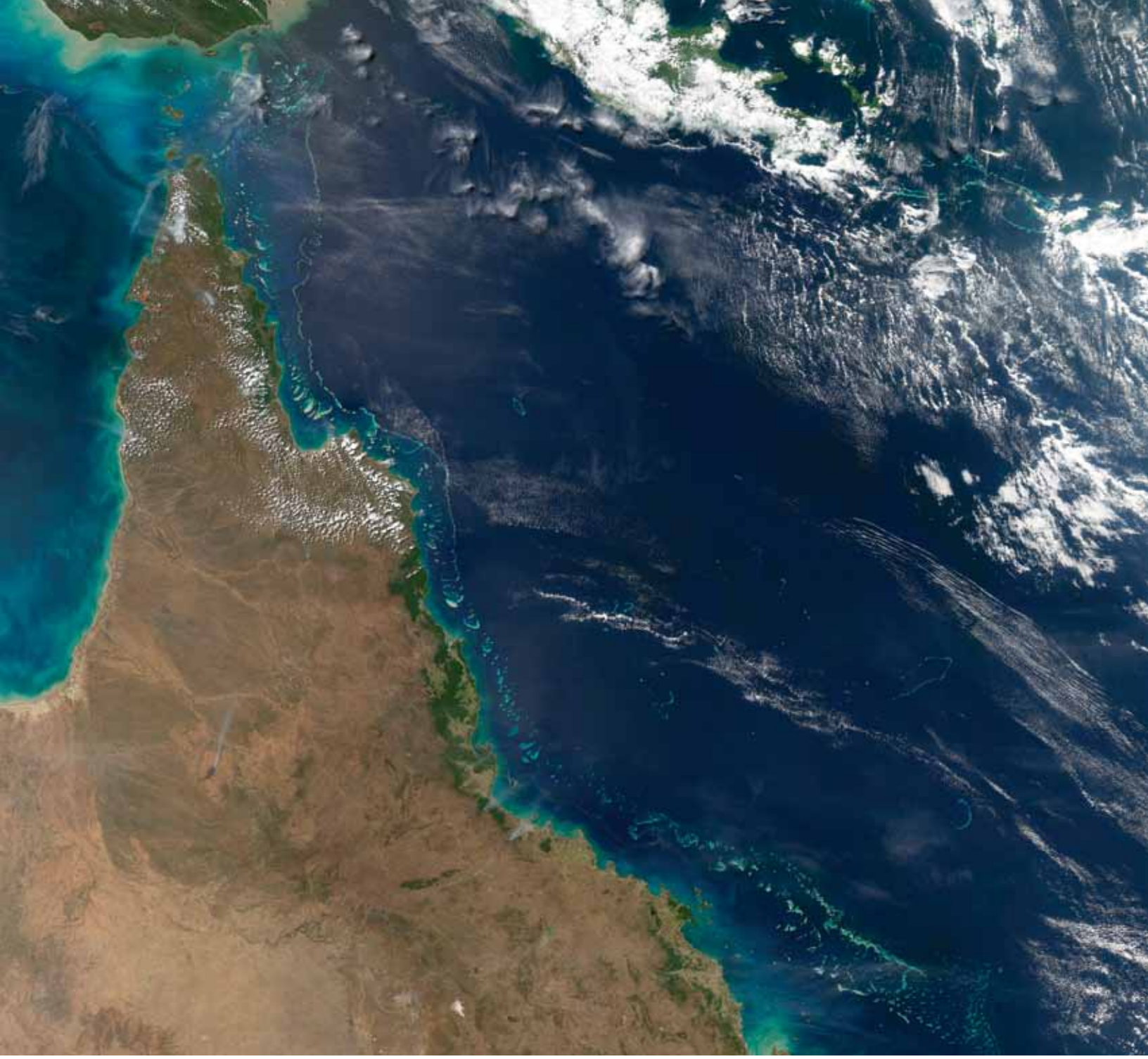
Structure of the new polyketide molecule trichophycin A with 2 dimensional NMR correlations detailed.

As a coral reef photographer for the state of Florida soon after graduating from college, Matthew Bertin enjoyed scuba diving about 200 times each year around the Florida Keys, the Dry Tortugas and other areas of the state. Nearly every time he dove below the water's surface, he became more and more intrigued by the chemical ecology of the reef systems and how marine microbes caused diseases that would stress and kill the corals.

It inspired Bertin, now an assistant professor of biomedical and pharmaceutical sciences at the University of Rhode Island (URI), to study the toxins and other compounds produced by blooms of marine cyanobacteria – the mats of blue-green algae that evolved about 3.5 billion years ago are among the most ancient organisms on Earth.

"The compounds are thought not to be made for growth or reproduction but instead for defense, to ward off grazers or other competitors," says Bertin, who joined the URI faculty a year ago. "And because marine cyanobacteria are so old, they've had a long time to have their genes mutated and duplicated and diverge, so they make all of these interesting molecules. They are prolific producers of secondary metabolites, or what we call natural products."

Bertin aims to isolate new molecules from blooms of cyanobacteria and test them for potential use as therapeutics against a wide range of diseases.



Satellite image of phytoplankton bloom off the coast of Eastern Australia.

"This is the very forefront of drug discovery," he says. "We're very far away from creating an actual therapeutic, but natural products have a long history of being effective therapeutics – they generally represent about 75 percent of all the therapeutics you find – so we're optimistic."

He starts by collecting what he calls "a bucket of muck." Off the coast of Texas, for instance, he and colleagues from Texas A&M University and the National Oceanic and Atmospheric Administration collected buckets full of blooming algae – most of it cyanobacteria – for examination in his URI laboratory.

"Natural products have a long history of being effective therapeutics – they generally represent about 75 percent of all the therapeutics you find."

- Matthew Bertin

Bertin and the undergraduate research students in his laboratory already identified 22 new molecules and are testing some of them against two cancer cell lines.

HPLC vials ready for analysis.

"We try to capture this *in situ* chemical warfare that's happening in the environment, where the cyanobacteria blooms produce chemicals to ward off grazers, and other strains of marine bacteria are also producing chemicals to stop the growth of the cyanobacteria or to ward off their own grazers," Bertin says. "We're trying to capture the cyanobacteria bloom chemical space – all the different types of molecules made during these blooms. From that, we think we can isolate an extremely diverse panel of new compounds."

Using high-performance liquid chromatography to separate out the chemicals, and nuclear magnetic resonance spectroscopy to cross reference their molecular structure against databases of known molecules, Bertin and the undergraduate research students in his laboratory already identified 22 new molecules and are testing some of them against two cancer cell lines.

Bertin is also collecting additional buckets of muck from the same sites each year to compare how similar the chemicals are from bloom to bloom. He is half finished analyzing the bloom collected in the Gulf of Mexico in 2015, and he already found the compounds to be very different from an earlier collection.

"We hope that the third bloom, collected in 2017, will inform us whether each bloom is totally different or if it looks like one of the previous blooms," Bertin says. "We want to understand the underlying reason for it. Is it because of a difference in the biological community, or is it because certain environmental parameters are changing?"

In another project, Bertin is examining the genetic architecture that ultimately creates the chemical compounds to gain a better understanding of how the cyanobacteria produce them.

"The genes that are in the bacteria produce proteins and enzymes that construct the secondary metabolites like they're in an assembly line, like something Henry Ford would be proud of," he says. "When you look at some of the molecules we've isolated from the bloom, they have the same general carbon backbone, the same core structure, but then they have little deviations. I'm fascinated by what's controlling it, and I'm quite certain it's genetically controlled."

The architecture of the molecules could help Bertin move his research into the realm of genetic engineering, enabling scientists to stitch together uniquely structured genes to build entirely new compounds with inherent flexibility that could be used as a therapy for a variety of diseases.

Freeze dried sample of the acyanobacterium *Trichodesmium thiebautii*.

Funding for his research has come primarily from URI and the Rhode Island IDeA Network for Biomedical Research Excellence, though he recently was awarded a grant from the American Society of Pharmacognosy to fund his next trip to collect samples in the field.

Bertin plans to collect cyanobacteria samples from the Gulf of Mexico every year to create a database of compounds found in the blooms, while also collecting bloom material from the Red Sea, Australia, and other areas where cyanobacteria bloom regularly.

"The ultimate goal is to build a library of pure compounds and then try to get them into as many biological assays as possible to see where they might be therapeutically relevant."

- Matthew Bertin

Hooked on Reading

The importance of Vocabulary Intervention in the Early Stages of Education Development

written by **BRUCE MASON**

The significance of reading in achieving success in both school and in life is essential. Without a strong reading ability, many areas of life can be hindered. One University of Rhode Island professor developed a better way to learn vocabulary, a foundation of reading.

Susan Rattan, associate professor of psychology, focuses her research on developing and evaluating methods of vocabulary instruction for young students at risk of experiencing language and literacy difficulties.

Rattan found her calling after graduating from Siena College in Loudonville, New York. As a member of AmeriCorps in Austin, Texas, she helped provide extra reading instruction to children in first and second grade who were struggling.

She explains that her work typically identifies students as being "at-risk" when they score below the 30th percentile on a general receptive vocabulary test. Children who are most likely to be identified as being at-risk tend to come from low-income communities. Children learning English as a second language comprise another group more likely to need early intervention in vocabulary.

"Seeing the trouble kids had learning to read motivated me to do the best I could to help them gain this very important life skill," she says.

For more than a decade, Rattan has been involved in projects evaluating the effectiveness of interventions that involve storybook readings and interactive activities that engage students with vocabulary words and meanings. From 2011 to 2016, she worked with her colleague and mentor Michael Coyne, professor of special education at the University of Connecticut, on a large multi-site, multi-year project that looked at the long-term effectiveness of vocabulary intervention. Project Early Vocabulary Intervention was funded by the

> "Seeing the trouble kids had learning to read motivated me to do the best I could to help them gain this very important life skill."
>
> - Susan Rattan

U.S. Department of Education for $4 million.

The project spanned 284 classrooms across 48 schools in Rhode Island, Connecticut and Oregon, where students participated in vocabulary instruction led by teachers for 20 minutes a day, five days per week, for 22 weeks. A published curriculum called Elements of Reading-Vocabulary by Beck and McKeown (2004) was used for the classroom-based instruction. Some students who were at-risk received an additional small-group intervention that was developed by the research team. Currently, the researchers are analyzing the data and preparing manuscripts for publication. One exciting finding, Rattan notes, is that the gains made were maintained at first and second grade follow-up sessions.

"This is encouraging because the goal is to be able to affect the students' level of general vocabulary knowledge and to do this the children need what they learned to have long-lasting effects," she says.

Central to Rattan's research is that early vocabulary intervention is an immensely vital initiative in the beginning stages of education. The National Reading Panel identified vocabulary as one of the five main components of reading, however, there is little evidence of any direct, systematic instruction occurring in early elementary grades. Often, children enter school with varying levels of vocabulary based on the amount and type of language they have been exposed to at home.

"Our goal is to identify students who are starting off with low levels of vocabulary and are at-risk for reading difficulty." Rattan explains, "We provide them with intervention right away to try and begin to lessen the gap between them and their average achieving peers before that gap grows any wider."

In the past, Rattan worked primarily with children in grades pre-k and kindergarten, however, her next study will entail working with students in first grade.

"My work with early elementary-age children is particularly important because of the achievement gap that exists before schooling even begins," she says. "Another reason this group is particularly important is that most of the focus on reading instruction in the early grades is on decoding, or learning how to access the words on the page, and little time is spent on meaning-based instruction. It is important to focus on both code-based and meaning-based instruction early on in schooling. This is particularly important for preventing those at-risk students from falling further behind."

One of the primary challenges schools face today stems from teachers and administrators not having enough time in the school day to address the various academic needs of students who need help with reading. Rattan explains that when following up with some of the teachers who use her vocabulary program

teachers who really like the program were not implementing it regularly.

Exploring different ways to help implement reading intervention continues to be a challenge. Rattan plans to conduct a small study in a Rhode Island school this year with approximately 40 first grade students where she will incorporate technology into more traditional vocabulary lessons.

The technology, called InferCabulary by CommApptitude, will be delivered on tablets as a part of the study. It is a web-based, visual vocabulary and reasoning program that teaches word meanings. She hopes this will allow students to do some of the work more independently.

"I am grateful that I am able to continue to do this research that I believe can make a difference in young children's lives," Rattan says.

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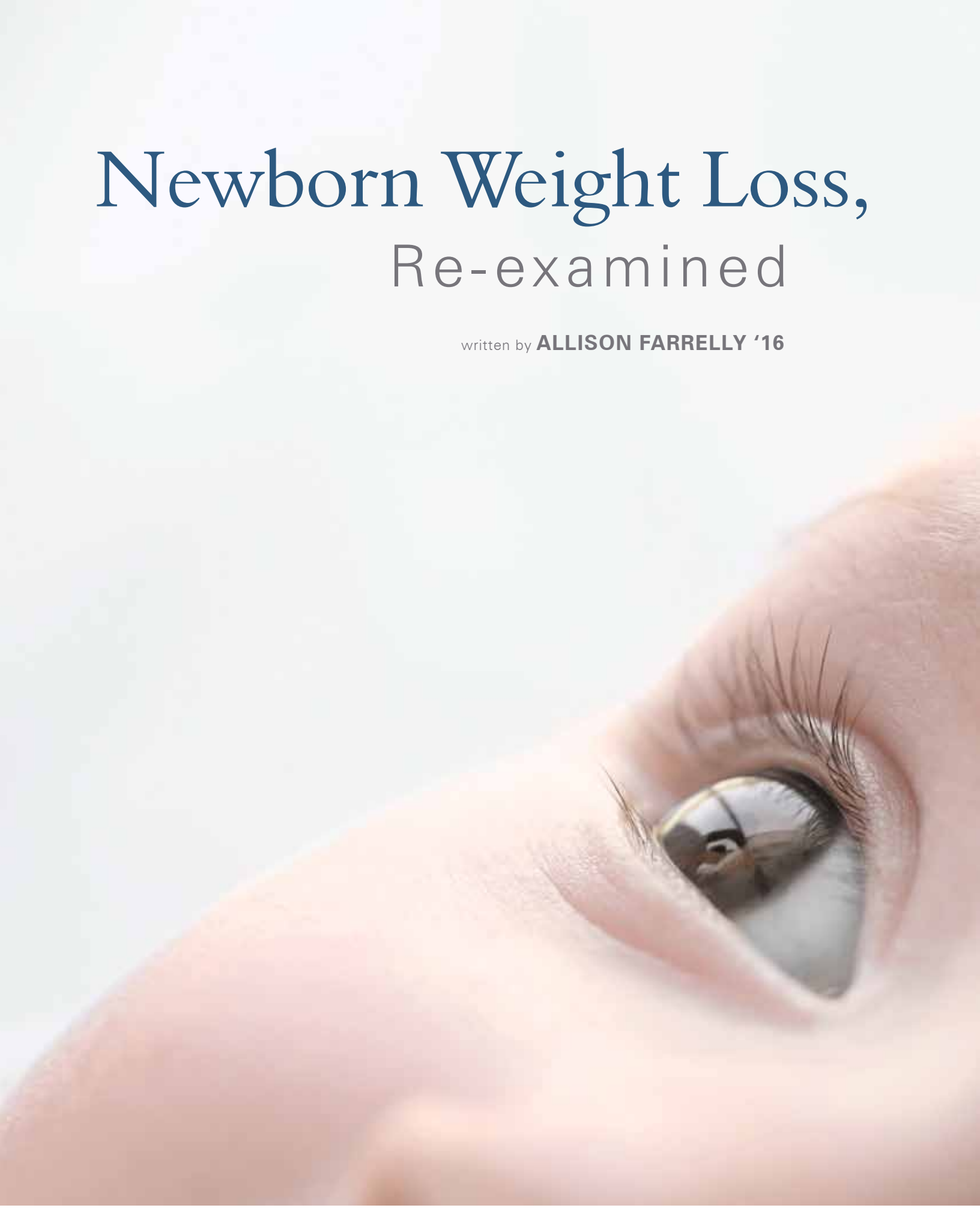
Susan Rattan
associate professor of psychology

Newborn Weight Loss, Re-examined

written by **ALLISON FARRELLY '16**



As a nurse of more than 25 years and lactation consultant, University of Rhode Island (URI) Assistant Professor of Nursing Diane DiTomasso sees new parents worry about newborn weight loss. But her research is questioning whether the long-held weight loss standard leading to such worry requires an update.

All newborn babies lose weight in the early days after birth. However, when breastfed babies lose more than seven percent of their birth weight, a standard set by the American Academy of Pediatrics, calls for health care providers to recommend formula as a supplement to breast milk. Based on her experience, DiTomasso began questioning the accuracy of that benchmark.

"I saw babies losing way more than seven percent and it made me question where that seven percent number comes from, and is it accurate?" DiTomasso says.

Though formula helps babies gain weight, DiTomasso says the substitute for a mother's milk often means an earlier end to breast feeding. And although formula can be essential for some infants, her research indicates that the option might be recommended too liberally as a supplement to breastfeeding.

"I am not against medically indicated formula supplementation – it can be vital for some babies," she says. "But when formula is given simply because babies have lost seven percent, that's where we have a concern."

DiTomasso says once women begin using formula to supplement breastfeeding, it is difficult to stop. The factors behind a formula-instigated end to breastfeeding are emotional and physiological.

"It shakes a woman's confidence to be told her baby is losing too much weight," DiTomasso says. "Emotionally, it's very upsetting for a new mom to hear that."

Physiologically, formula use interferes with the lactation process. Babies fed formula get less breast milk, so the mother's bodies begins to produce less milk. Research also indicates that when it is possible, breastfeeding is advantageous to formula supplementation. Research shows that benefits to breastfed infants include stronger immune systems, fewer ear infections, lower rates of obesity, heart disease, diabetes, and fewer respiratory and gastrointestinal problems.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In her studies, DiTomasso found that more than half of healthy term breastfed newborns lost more than the conventional seven percent and that when weight loss was over seven percent, the use of supplemental formula increased markedly. Many babies in her study lost up to ten percent of their birth weight.

"So if it is normal for babies to lose up to ten percent, we should not be derailing breastfeeding by giving formula when weight loss reaches seven percent," DiTomasso says. "The lifelong health benefits that these babies may lose because of this early introduction of formula are just too important."

DiTomasso's first study, conducted at Women & Infants Hospital of Rhode Island and published in the Journal of Obstetric, Gynecologic and Neonatal Nursing, was a retrospective analysis of 272 babies.

DiTomasso is applying for grants that will enable a continuation of her research. Parents of 151 infants born at South County Hospital were lent scales and asked to record their baby's weight daily for the first two weeks after their birth.

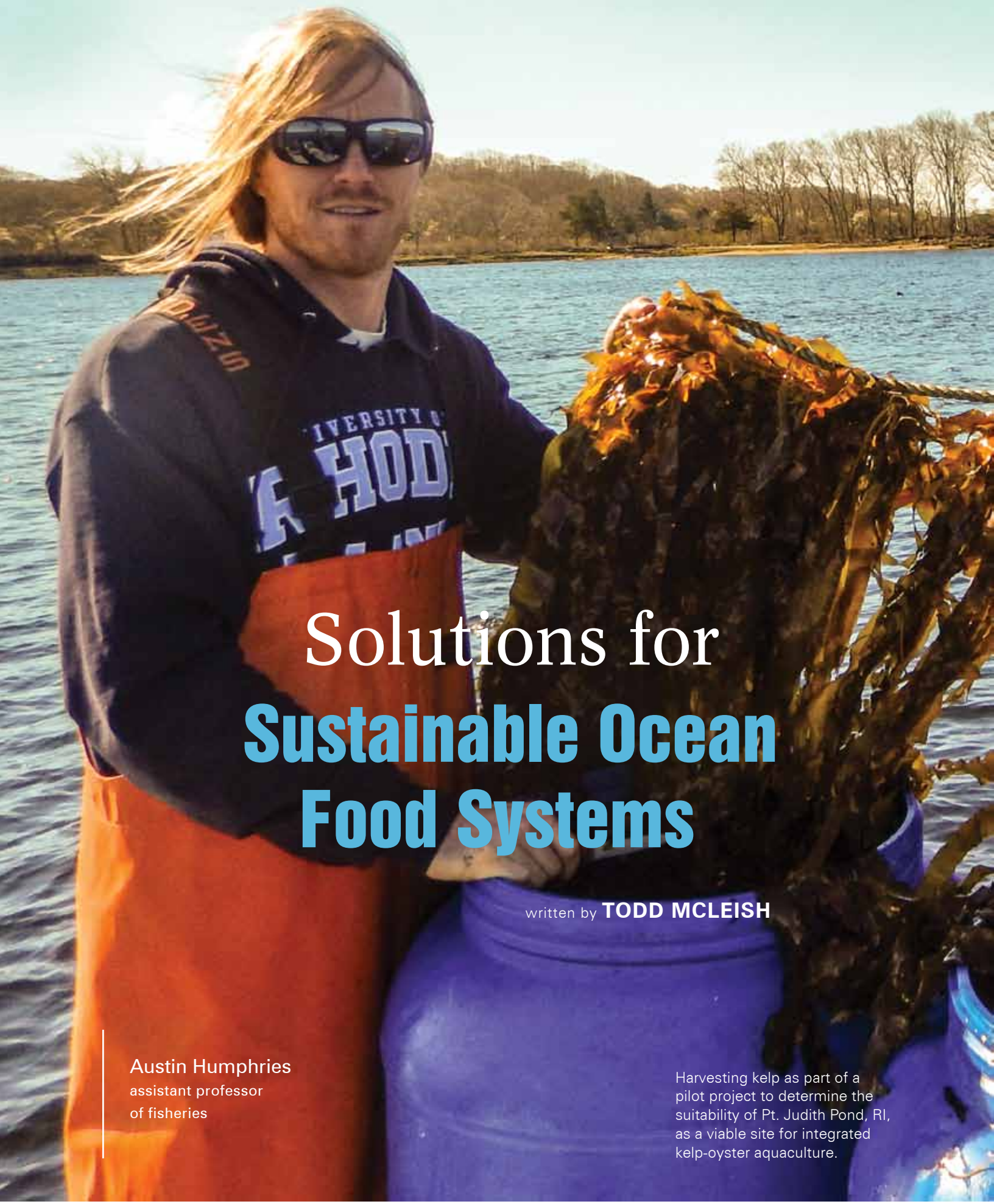
"What was novel about this was the amount of days the study captured the weight," DiTomasso says of the research, which has been since published by the Journal for Human Lactation.

"If it is normal for babies to lose up to ten percent, we should not be derailing breastfeeding by giving formula when weight loss reaches seven percent. The lifelong health benefits that these babies may lose because of this early introduction of formula are just too important."

- Diane DiTomasso

Previous studies recorded baby's weight for just two or three days after birth.

DiTomasso hopes to expand this research to create weekly growth charts for infants that reflect their weight changes for the first eight weeks of life. She believes comprehensive growth charts could guide health care providers when advising breastfeeding mothers. And it might mean far less unnecessary worry for new parents and, ultimately, healthier babies.



Solutions for Sustainable Ocean Food Systems

written by **TODD MCLEISH**

Austin Humphries
assistant professor
of fisheries

Harvesting kelp as part of a pilot project to determine the suitability of Pt. Judith Pond, RI, as a viable site for integrated kelp-oyster aquaculture.

Humphries surveying reefs in remote Indonesia during the 2016 El Niño coral bleaching event.

> "How can we as humans interact with the ocean in ways that may benefit both nature and people?"
>
> - Austin Humphries

Some of Austin Humphries' most vivid childhood memories are of fishing for bass in the rivers of southwest Virginia near where he grew up. His early fascination with fish evolved into an interest in sustainable fishing practices, partly as a result of his work in 2006 as a fisherman in Alaska, and his graduate studies of marine conservation in Kenya from 2010 to 2013.

"Broadly speaking, I'm most interested in the connections between people and marine ecosystems," says Humphries, an assistant professor of fisheries who joined the University of Rhode Island (URI) faculty in 2014. "How can we as humans interact with the ocean in ways that may benefit both nature and people? At its core, that leads to questions about sustainability, be it fish population and ecological sustainability, or fish catch and socio-cultural and economic sustainability."

These questions are especially important in developing nations like Indonesia, where food security is a serious concern and where delicate coral reefs provide fish and livelihoods for more than 3 million people. Fishery management in the region is in need of improvement as many catches are declining and fisheries are being over exploited.

That's where Humphries comes in. He was awarded a $3 million grant by the U.S. Agency for International Development in April 2017 to study and test fisheries management strategies that maintain and protect the ecosystem while also ensuring that fish are available for consumption.

"Many Indonesian communities are dependent on coral reefs for food and other ecosystem services," he says. "As these reef fisheries are feeling the heat from global stressors like coral bleaching, declines in fish catch are a major issue. Identifying the most urgent problems and testing fishery management solutions is becoming more and more important to ensure long-term sustainability."

According to Humphries, Indonesia has the most biodiverse coral reefs in the world, and half of the world's small-scale fishermen are there. The country's government is trying to implement an ecosystem-based fishery management system that will consider the impacts of fisheries on fish populations, habitats and species interactions, while also incorporating the social and economic context in which the fisheries operate.

"Indonesia is one of the first countries in the world that's taking steps toward formalizing a holistic management plan for coral reef fisheries that considers multiple ecosystem trade-offs," he says. "My project will provide the government with vital information for that initiative."

This isn't the only sustainable fisheries project Humphries is undertaking in Indonesia. He is also working with anthropologists and social scientists to evaluate how coral reef restoration affects the wellbeing of local fishing communities. Humphries is also working with The Nature Conservancy to implement an automated system of data collection on fishing vessels to improve management of the country's commercial fisheries for grouper and snapper.

But sustainable fishing practices are not just a concern in the developing world. This year the Rhode Island Science and Technology Advisory Council funded a new $85,000 project in which Humphries will collaborate with the Rhode Island Department of Environmental Management and Providence-based company FarSounder Inc. to use the company's three-dimensional sonar to provide more accurate counts of pelagic schools of fish in Rhode Island waters.

"Menhaden catches in the U.S. are greater than all other fish species combined," Humphries says. "We want to improve our methods of assessing the biomass of menhaden in Rhode Island so we can manage them with more certainty. If menhaden populations decline, the effects will ripple throughout the marine food chain

Scuba diving off Lombok Island, Indonesia, counting coral reef fish to determine the effectiveness of a Marine Protected Area in increasing fish abundance and biomass available for fisheries.

and negatively impact a great deal of other commercial fisheries that depend on these small fish. This will be bad for many Rhode Islanders who depend on fisheries for livelihood and those of us who enjoy eating fresh, locally-caught fish."

Fisheries are not the only renewable food production system in the ocean. Humphries is also working with oyster farmers in the state to help them diversify their aquaculture operations. Since oysters grow primarily in the summer months, many farmers have little income in the winter. Humphries believes that they may benefit from also growing kelp to sell to restaurants in Providence, New York City and elsewhere.

Kelp needs sunlight and nutrients to grow, so with a $300,000 grant from the National Oceanic and Atmospheric Administration this August, Humpries is creating a series of experiments around Narragansett Bay and the coastal salt ponds to assess where the best conditions are for growing kelp.

"Since kelp is a relatively new market in the U.S., we're assuming that few people are going to blindly start a kelp farm in the region. So, we're looking at where the best kelp growing conditions overlap with existing shellfish leases," he explains. "If a farm has the right combination of environmental parameters for seaweed, then they could add it to their existing system and have a year-round crop without much additional effort."

While these various projects all sound quite different they span multiple geographies and sub-disciplines, Humphries says they all link the ocean and food production systems with people, cultures, communities, and economies.

"They all have this overarching question of how people interact with the environment and vice versa, and my research focuses on how we enable that relationship to be sustainable," he concludes. "It's all about trade-offs and how to use the ocean without using it up."

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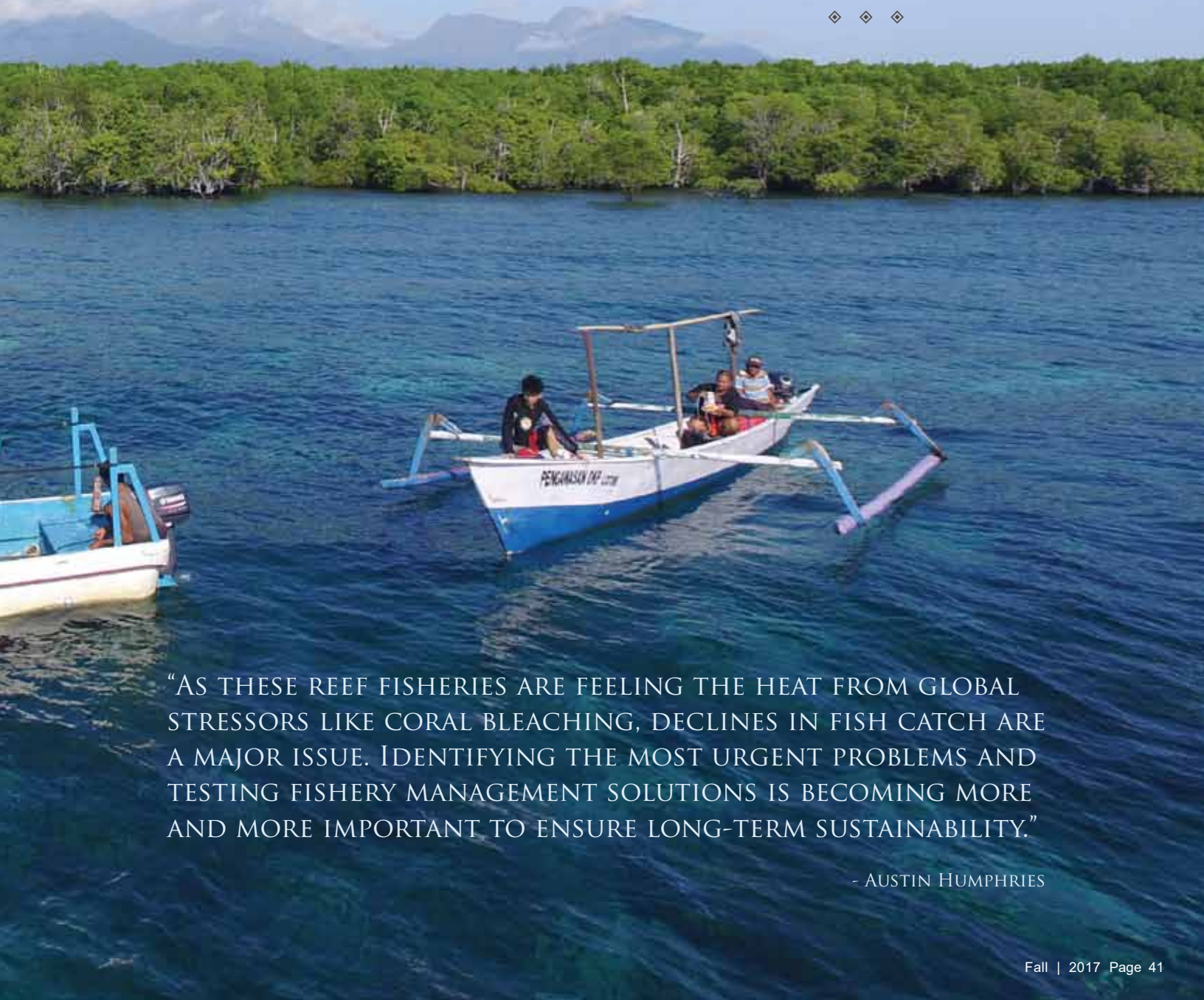

"As these reef fisheries are feeling the heat from global stressors like coral bleaching, declines in fish catch are a major issue. Identifying the most urgent problems and testing fishery management solutions is becoming more and more important to ensure long-term sustainability."

- Austin Humphries

Influencing Factors
ON FASHION CONSUMER BEHAVIOR

written by **EMMA GAUTHIER '18**

"One issue in particular is child labor. Some people believe it should be outlawed because it exploits children."

- Ji Hye Kang

People decide to buy certain products based on many aspects such as color, price, fabric, or fit. Noticing discrepancies in consumers' reactions to business practices in the global fashion market, Ji Hye Kang, assistant professor of textiles, fashion merchandising and design in the University of Rhode Island, College of Business Administration, decided to investigate one group of factors: cross-cultural consumer and business issues at work in the global fashion industry.

"Globalization is one of the most powerful forces in the fashion market," Kang says.

Kang brought her culture and research into the classroom to create what she calls a cross-cultural teaching experience. She partnered with Yonsei University, South Korea where classes had the same assignments and shared students work via an online meeting system – to follow consumer behavior with global brands. One team of students in the U.S. and one team of students in Korea followed Nike, and compared how the branding strategies and consumer behavior toward the product are similar or different in each country. Both groups of students learned about each other's cultures, as well as how branded products are consumed around the world.

"It's not study abroad; it's cost-effective," Kang says. "The course allowed students to have a little taste of international experiences, and get more information about international consumer markets."

Recently, Kang expanded her consumer research on sustainability. Using data from 164 U.S. respondents and 217 Korean respondents, Kang examined how mass media and education influence each group of consumers' emotions and cognition – their understanding, perception or experience. She looked at how these factors influenced a person's purchase of apparel manufactured in socially sustainable ways. Interestingly, the research found that knowledge of sustainability is a strong influence on the purchasing decisions of U.S. consumers. Kang found that the positive emotions Korean consumers feel when they buy the socially sustainable apparel products was of greater influence on them than cognition. Consumer decision-making processes are influenced by differences in an individual's cultural and social environment.

"Sustainability is an important issue," she says. "Especially in the apparel and textile industry."

Apparel is a commodity that takes up quantities of resources such as labor, water, chemicals and materials. Kang found that consumer consideration of the benefits stemming from ethical consumption can serve as a factor in leading retailers to employ more environmentally-sustainable manufacturing processes.

"One issue in particular is child labor. Some people believe it should be outlawed because it exploits children," she says.

Kang has been researching the impact of morals on Korean female consumers' purchasing behavior since 2013. She also researches organic and naturally dyed fashion products, and found what she calls "culturally sound situational involvement."

In 2013, the data of 372 Korean responses in online surveys was analyzed, revealing that interest in environmental issues increased. Responders consider the environment to be a public well-being issue, and believe social and individuals efforts should bring positive outcomes, such as reducing pollution.

"As ethic-related decisions are known to vary across culture, tradition, products, an investigation of culturally different consumers on specific products

will contribute to a richer understanding of ethical consumption," Kang says.

But what makes consumers purchase fashion products online? Online consumer behavior ties into another aspect of her research: big data. Kang especially interested in consumer-generated data such as comments posted online.

Kang analyzed fashion products sold at Macy's and Amazon through customer reviews, including numerical data and text data. She and her colleagues in computer engineering and marketing collected consumer reviews on 39 fashion items, including designer handbags, jeans, and shoes posted from 2005 to 2017. They analyzed 116,773 reviews, the team found that different consumer expectations directly related to the retailers. Amazon expanded its business to fashion in 2009. It accelerated by launching seven private brands in 2016 (Business Insider 2016). Amazon's clothing and accessory sales are expected to grow nearly 30% next year, to $28 billion. By comparison, Macy's apparel sales are expected to drop by 4%, to $22 billion during the same period (Business Insider 2017).

"If people have certain expectations, retailers need to review the product descriptions to promote and appeal to their own consumers," Kang suggests. "Manufacturers should also have ideas as to how they can promote ideas to different retailers."

Kang says stores use two primary methods to collect online customer feedback: surveys prompting customers from the website and customers' voluntary reviews. The reviews customers take are one of the most effective ways to get accurate responses from customers about their experiences. She analyzed the retail reviews directly.

Ji Hye Kang

assistant professor of textiles, fashion merchandising and design

"When consumers are participating in the survey, sometimes they adjust their responses to be nice or they do not exactly know how to answer the questions. For example, it could be hard for consumers to answer how much money they are willing to pay for an ethically manufactured item," Kang says. "When we analyze their review, we can see the outcomes about their reactions to the product."

Kang draws from her experience in the fashion marketing industry, where she worked as a consultant and a merchandiser prior to joining academia. She says that these insights from customers are exactly what businesses should capitalize on. By analyzing a variety of data and buyers' decision making processes, retailers can improve their services to benefiting not only the customer, but the profitability and marker reach of the global fashion industry.

In the future, Kang hopes to expand her research to include more cultures and clusters of people for a deeper understanding of consumers behavior.

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Online consumer behavior ties into another aspect of her research: big data.

Walking on Thin Ice

written by **TODD MCLEISH**

Measuring chunks of ice to determine the sea ice thickness.

Brice Loose is a geochemist with a preoccupation for the polar oceans, so he makes regular trips to the Arctic and Antarctic to investigate how methane, carbon dioxide and other chemical compounds move between the air, ice, ocean and back again.

"Nowhere else on Earth is the atmosphere more directly connected to the deep ocean as at the poles," says Loose, an assistant professor of oceanography at the University of Rhode Island (URI). "The exchange that happens there is really important, in part because of the fact that ice is in the way."

He is trying to gain a better understanding of how heat and mass move into and out of the deep ocean and the role that ice plays in both processes. It is an especially important question at a time when the climate is changing rapidly, since the ocean absorbs 25 to 35 percent of the carbon dioxide humans produce.

"In a world where we may need to carry out detailed carbon accounting to determine whether the climate treaty emissions reductions are having the desired effect, we have to know the natural carbon cycle very precisely. This includes carbon that moves through the ocean."

PIPERS science team collecting measurements of sea ice.

The results of Loose's research will eventually lead to better estimates of the total volume of sea ice production, the identification of ice production hotspots, and a better understanding of the effects of ice on the massive rivers of deep ocean circulation that begin and end around Antarctica.

Brice Loose taking a sea ice core sample in the period of 24 hour darkness that defines polar fall and winter.

PIPERS science team on the Terra Nova Bay Polynya.

Water sampling for ocean properties using a 24 bottle CTD rosette.

Brice Loose

assistant professor
of oceanography

In June, Loose returned from his longest expedition yet, a 66-day trip to the Ross Sea near Antarctica, where he and 27 colleagues from around the world investigated winter processes in openings in the sea ice called polynyas. But the weather conditions made the work extremely difficult.

"These were the coldest, darkest conditions we had worked in, where the ambient temperature is minus 25 degrees Celsius and the wind chill made it minus 60 or 70 degrees Celsius," he says. "It was quite a challenge to get anything done. At that temperature, everything mechanical stops working – the cranes and winches we use to move gear all seized up. We had hurricane force winds, so all the water that blew on deck froze to the side of the ship, making it unsafe to be outside."

Yet Loose, URI graduate student Sam Gartzman and the entire PIPERS (Polynyas, Ice Production, and Evolution in the Ross Sea) research team persisted. The team, from eight countries and 14 institutions, deployed instrumentation to determine what kind of ice is produced in such extreme conditions, how it accumulates, and what it does to the ocean as it freezes.

"Initially we were shocked to find that the ocean surface will not freeze solid if even a little wind is stirring it," he says. "Instead, the ocean becomes super-cooled below the freezing point and small 'frazile' ice crystals can be found in the top 50 feet or more of the ocean surface. These observations will eventually coalesce to produce a more complete picture of what goes on down there in winter."

The results of Loose's research will eventually lead to better estimates of the total volume of sea ice production, the identification of ice production hotspots, and a better understanding of the effects of ice on the massive rivers of deep ocean circulation that begin and end around Antarctica. All of this information will help to improve climate models that are currently incapable of reproducing these phenomena.

Underwater mass spectrometer used to measure water properties in the freezing ocean.

Hurricane force katabatic winds blow off the Antarctic continent, pushing the ice away from land and opening a polynya.

At the opposite end of the world, Loose is examining how the warming climate is releasing methane – a more powerful greenhouse gas than carbon dioxide – from permafrost and from beneath the seafloor in the Arctic, a process that will speed up the warming of the climate. He is interested in how methane-eating microbes might slow the release of methane to the atmosphere.

"Once we have had the chance to synthesize and interpret our data, we'll be able to estimate how much ice is produced in polynyas, something that models have been underestimating," he says. "Even when other parts of the icepack are melting, polynyas are still producing ice because of the wind and the extreme heat loss coming from the open water."

At the opposite end of the world, Loose is examining how the warming climate is releasing methane – a more powerful greenhouse gas than carbon dioxide – from permafrost and from beneath the seafloor in the Arctic, a process that will speed up the warming of the climate. He is interested in how methane-eating microbes might slow the release of methane into the atmosphere.

"The ocean is full of bacteria, which have adapted to consume whatever food source is available, and some consider methane to be food,"

Brice Loose and URI Ph.D. student Jeffrey Mei hoisted on the man basket to sample properties of thin ice.

he explains. "We want to know how much methane they can eat and under what circumstances. When you combine that with the fact that the sea ice is slowing the ocean-atmosphere exchange, we wonder whether the bacteria in the ocean are doing us a favor by degrading methane before it escapes to the atmosphere."

Loose and postdoctoral fellow Cristiane Uhlig from the Alfred Wegener Institute, Germany spent three weeks in Barrow, Alaska, in spring 2016 drilling holes in the sea ice to collect water samples, putting that water in incubation chambers, and adding methane to calculate how much methane the microbes in the water consume.

"We did the same thing in Narragansett Bay and got completely different results," he says. "All sea water is not created equal. Water in the Arctic has special bacteria that are adapted to cold and ice conditions, and they're much more adapted to the presence of methane.

"We want to know how does the methane cycle work in the Arctic and what is the risk of liberating that methane into the water and into the atmosphere," Loose adds. "Is methane going to create a positive feedback on climate change? Bacteria in the ocean are a big part of the story."

Despite his frequent trips to the poles and the valuable discoveries he is making, Loose sometimes wishes he were researching something in the tropics instead.

"At the time that I got on this path, I was so excited about ice that it became all-consuming, and I didn't consider that I would spend nine months of every year in winter-like conditions," he jokes. "If that had dawned on me, I might have chosen to study something warmer, like coral reefs, instead."

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A RANGE OF 'MUSICAL' POSSIBILITIES

written by **CHRIS BARRET '08**

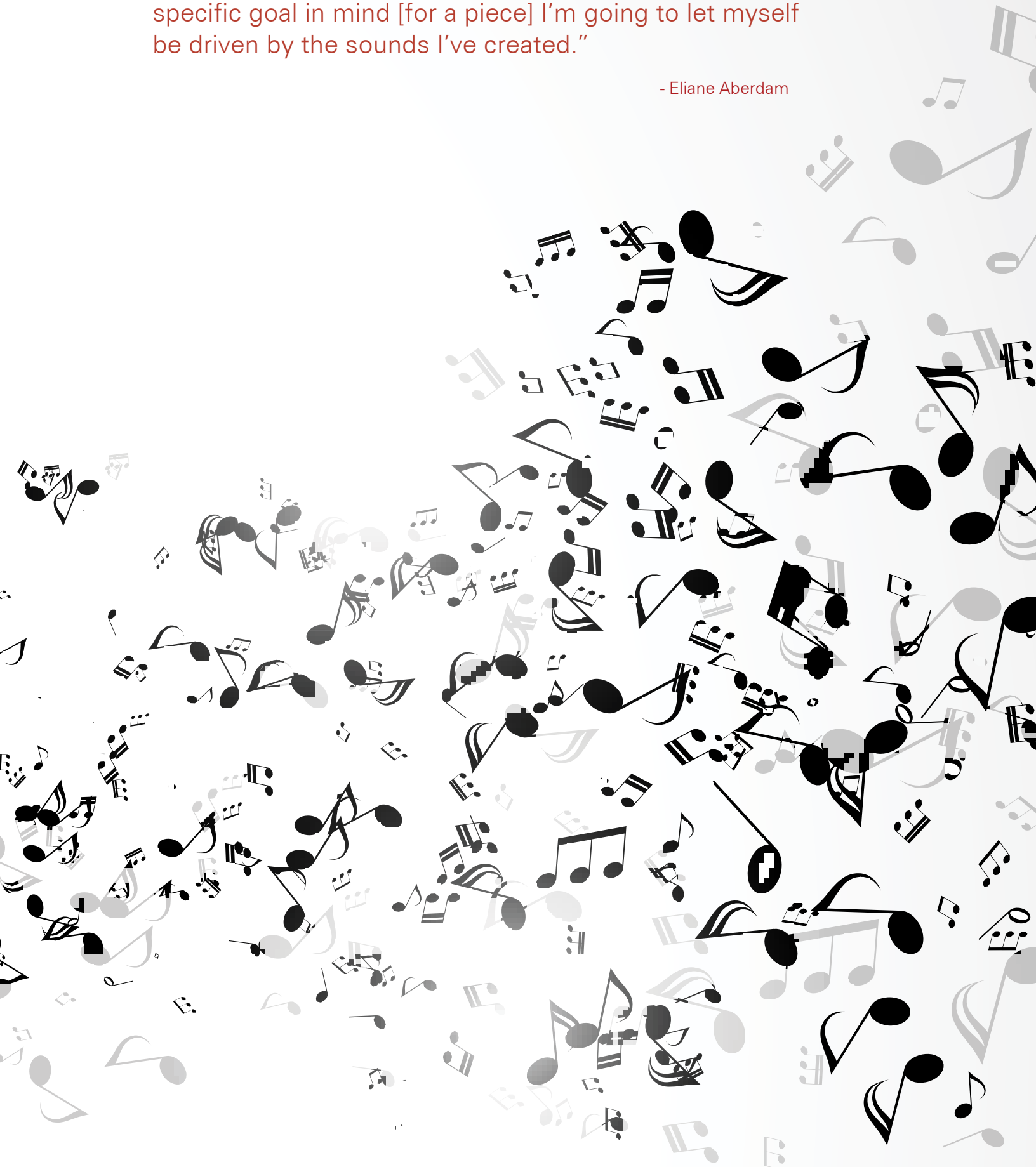
When Eliane Aberdam took the stage to present her musical composition, conspicuously absent were the singers, musicians and instruments. A computer sat center stage to play her piece no musical instruments produce.

The University of Rhode Island (URI) music professor invents sounds found nowhere on Earth. With the assistance of computer software, Aberdam builds sounds and assembles them into full-length pieces. But this is no ordinarily synthesizer. A typical synthesizer produces sounds from oscillators and uses samples of real instruments Aberdam creates one-of-a-kind sounds like the pluck of a 6-foot-long violin bow or a gong's ring that resonates an improbable 20 minutes.

"The sounds themselves are unique because you get hybrid sounds between, say, a sound of a bell that ends

"Instead of being inspired by something and having a specific goal in mind [for a piece] I'm going to let myself be driven by the sounds I've created."

- Eliane Aberdam



up sounding like a string when it resonates," Aberdam says. "You can have infinite combinations."

The software utilizes algorithms to reproduce the acoustic and harmonic characteristics of instruments. The program physically models the instrument to consider the physical characteristics of the virtual instrument such as its size, form and material, including thickness, stiffness and elasticity. It can also model the exciters such a virtual bow, a plectrum or a mallet that cause the sound.

Without the constraints of the typical array of instruments – piano, drums, guitar, etc. – or the musicians required to play them, Aberdam holds an unlimited orchestra at her fingertips. Indeed, the normal rules do not apply.

Traditionally composers place notes neatly on the staff on lines or spaces. Musicians around the world understand this universal language but the defined intervals limit the number of possible notes. Software eliminates the boundaries and the human factor. Microtones, as Aberdam likes to call them, allow much more fine-tuned sounds. These virtually infinite sound possibilities allow Aberdam to flip the classical approach to composition on its head.

"Instead of being inspired by something and having a specific goal in mind [for a piece] I'm going to let myself be driven by the sounds I've created," she says.

Ultimately, Aberdam's compositions sound slightly unnatural, a little unnerving because normal analogies do not apply. How does one describe, exactly, a cello that sounds like an oboe? The thought alone leaves some classically trained composers scratching their heads and others charging blasphemy.

The tension is not lost on the classically trained, piano-playing Aberdam whose parents sent her to a grammar school tailored for musicians. (The school took its charge so seriously that potential students sat for a hearing test to ensure they could detect subtle differences in pitch.)

"There's something for both sides," Aberdam says. "The tension can exist between purist-you-need-an-instrument and people relying on synthesizer sounds."

Aberdam, who grew up listening to Bach on LP vinyl records in France, says humans play a vital role in music composition. Humans may rely on computers to generate sounds – or even generate an entire piece – but machines lack the discretion and backstory humanity so strongly desires.

For example, a computer may produce a sound all on its own. But ask it to identify the segment most captivating or unique to a human ear and it will likely stumble. Plus, in a world where humans love stories what becomes of a computer and its personality-less software?

"I think there's a certain way we organize elements in life, whether it's the ingredients in a recipe or ingredients in music, that are intrinsically human, not robotic," Aberdam says. "You want to say something and there's a perception you want to transmit and to be perceived by an audience or diner…There's a story behind the music or food, even if it's not fully organized or conscious."

Humans crave meaning. Part of what attracts listeners to music is the belief that the piece represents something: perhaps a personal loss, conquest, political belief or life milestone. Live performances draw crowds hoping to connect with the singer, conductor or musician. Try connecting with a bland laptop that Aberdam shunts between home and her office. To humanize the process, Aberdam offers an explanation of the software, her approach and her rationale before presentations.

Her composition process starts weeks or months before a presentation with Aberdam experimenting, fiddling and exacting hundreds of sounds in the Genesis software. Appearing a bit like CAD models on the screen, her cursor can form different shapes with specified masses to create objects that emit tones on an infinite scale. No piano, pencil or paper required. Her graduate students are floored.

"I think they like the idea of the novelty of it," she says. "I'm not even thinking of a composition that's going to be fast or soft or exciting. I'm actually going to have sounds and lay them for their own sake and see how they are making sense in relation to each other."

Eliane Aberdam
professor of music

"The sounds themselves are unique because you get hybrid sounds between, say, a sound of a bell that ends up sounding like a string when it resonates. You can have infinite combinations."

- Eliane Aberdam

Incidentally, it was her time as a college student that inspired Aberdam write music rather than perform pieces written by others. Upon arrival at the Rubin Academy of Music and Dance in Jerusalem, Aberdam found administrators accidentally placed her in the music composition track rather than the piano and music performance concentration. Yet Aberdam excelled during the imagination exercises in music theory classes and found composition suited her.

After earning a master's degree at University of Pennsylvania and a doctorate at University of California at Berkeley, Aberdam arrived at URI in 2001. And despite the years of training and practice, she bristles at the implication she's done learning to compose.

"I always strive to try something new in my music: different ensembles, different sources of inspiration, different literatures from over the world, different topics," she says. "I do not think of myself as being a composer. I am becoming a composer each time I write a new piece."

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