terra

DISCOVERY
CREATIVITY
INNOVATION
Spring 2015

BRAVING BARRIERS

Women reach for equity in science fields

Oregon State UNIVERSITY

terra

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Oregon's leading public research university

FEATURES

DEPARTMENTS

In Eastern Oregon's expansive sagebrush country, hundreds of sensitive, threatened and endangered plant and animal species live among herds of cattle and wild horses. Oregon State climate scientist Dominique Bachelet (featured in "Anatomy of a Climate Tool," Page 30) captures the spare beauty of western rangelands with her watercolors. To see more of her paintings, visit http://bit.ly/1IgAjBY.

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Oregon State is Oregon's leading public research university with more than $285 million in research funding in FY2014. Classified by the Carnegie Foundation for the Advancement of Teaching in its top category (very high research activity), Oregon State is one of only two American universities to hold the Land-, Sea-, Sun- and Space-Grant designations. Oregon State comprises 11 academic colleges with strengths in Earth systems, health, entrepreneurship and the arts and sciences.

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On the cover: Six Oregon State University researchers are featured in "Elusive Equity," Page 6. (Photos: Chris Becerra)

Getting Along with the Neighbors

Walking my dog one night last fall, I glanced up into a sprawling maple tree to see the bright eyes of several raccoons reflected in my headlamp. As I pulled into a parking lot a few days later, I watched a half-dozen deer graze a suburban lawn. On the outskirts of town, I've seen coyotes stalk a blue heron in a pasture. I hear rumors of bobcats and cougars in the hills.

Despite the fact that we've carved up the landscape with roads, house lots and plowed fields, these and other animals remind us that we're part of a diverse community. If you take the long view, we're all related. Science writer Elizabeth Kolbert, who spoke at Oregon State in February, reminds us in her book, *The Sixth Extinction*, that our distant ancestors squeezed through cataclysms that wiped out many of the most successful species on the planet. Notwithstanding raccoons, coyotes and deer, we appear to be in the midst of another one.

If you doubt it, look to the oceans. In the animal kingdom, corals might be only remotely related to humans, but through geologic time, animals in the order *Scleractinia* have survived drastic alterations in ocean habitats. Scientists have traced their direct ancestors back about 237 million years to a time known as the Triassic.

Our understanding of corals' future revolves around several issues. How do corals interact with the microorganisms in the reefs? Are hard skeletons and reefs even necessary for corals to live? In a warming world, ocean acidification may make it difficult or impossible for corals to build these structures.

Oregon State marine biologist Rebecca Vega-Thurber and her colleagues ("Reefs Under Siege") are studying these and other questions. They are working to understand what these remarkable creatures need to survive the changes that are coming as surely as the next wave.

The prospects for animals on land look similarly dire. Bill Ripple and his colleagues at Oregon State and around the world have conducted reviews of the global status of large animals — charismatic carnivores and their prey. They conclude that habitat loss and hunting are threatening many species, particularly in developing countries. Effective solutions are needed to allow humans and animals to coexist.

The wildlife in our yards and neighborhoods may please or sometimes annoy us, but they connect us to a web of life that appears to be unraveling before our eyes. For many in the scientific community, learning about them and their cousins on land and at sea is driven by the desire to save them — and us.

Editor

Beyond Appearances

Diversity creates opportunities and challenges

BY RON ADAMS, INTERIM VICE PRESIDENT FOR RESEARCH

Oregon State's faculty have diverse origins. We come predominantly from the United States, but among us are people from practically every continent and many countries: Ethiopia, New Zealand, Germany, China, India, Colombia, El Salvador and Ireland. The list goes on.

We are extroverts and introverts; speakers of Hindi, Spanish, Polish, Mandarin and Russian as well as English; people who understand genetics or know their way around the surface of a computer chip; people who see the world through music, poetry or the visual arts. We are physically diverse. We are male, female and shades of both with varying sexual orientations. We are predominantly white but also Asian, Hispanic, black, Native American and all of the above.

Such diversity — and the varieties of experience it represents — is invaluable in a modern land grant university. It makes our research enterprise stronger. That's because different views of the nature of a problem and of potential solutions lead to results that are more creative than those developed through a narrow lens.

Nevertheless, diversity carries special challenges. Accurate communications, for example, can be difficult. Every discipline has its own vocabulary, which must be properly understood to make a multidisciplinary research team effective.

In a multicultural environment, the boundaries of behavior and appearance are wider than they are in a single culture. But they matter less than the content of ideas and the commitment to values.

The diversity of faculty families requires respect for the balance of work and personal life. I once met with a department head about a faculty member who was pregnant. The faculty member was on tenure track, and the question was this: Can we delay the tenure clock so that she can give birth without worrying about her career? The answer was a simple "yes." In reflecting on this experience, the fact that we even need to have such a conversation raises the need to review institutional policies. One of the considerations of the ADVANCE program, described in this issue of *Terra*, is to make such accommodations automatic, essentially opt-out rather than opt-in.

At Oregon State, the President's Cabinet, Provost Council and other leadership bodies have adopted an Ethos Statement to guide our interactions. It provides a foundation for building and maintaining a community in which all members are committed to the growth, development and well-being of every other member. Among other things, it calls on all of us to act ethically, to establish relationships of trust and integrity, to respect each person's identity and to eliminate the effects of biases.

These values are at the heart of an effective research community where every faculty member feels respected and has the opportunity to thrive.

Oregon State has a history of working toward such culture. A few years ago, a researcher suggested to me that we had a great story to tell. In her experience at that time, there were more female unit heads in the Oregon State College of Engineering than in any other such college in the country. I hadn't thought of that as a story. It's just the way it worked out because the people in those positions were the best leaders.

We know that we have more work to do to encourage women and minorities in science, technology, engineering and math, the STEM fields. We're continuing to make progress through programs like ADVANCE.

Discovering Our "Research-Impact" Identities

Transcending the academic rat race and remembering why we do science

BY JULIE RISIEN

Researchers are keenly aware that their work matters far beyond their achievements within the academy. Discoveries in Earth sciences, for example, allow us to predict dangerous weather events. Breakthroughs in engineering such as airbags help protect passengers in cars. Findings in medicine have slowed the spread of HIV. Agricultural researchers are working to sustain our food supply in a rapidly changing climate. These and countless other fields of study not only improve our lives, they very often save them.

Most researchers came to their chosen discipline full of curiosity and passion. But that passion, that inspiring spark, can be left behind in the publish-or-perish grind toward promotion and tenure. To weave that motivating mission into the fabric of academic evaluation, we need to add progressive mechanisms that consider the value researchers add to society through their discoveries, innovations, partnerships and public engagement. This is not a purely benevolent proposal. On the contrary. Charting the path from research impact to broader benefit would enhance the competitiveness of proposals and strengthen Oregon State's research enterprise in this time of ever-increasing scrutiny over public funding.

Early in their careers, faculty may get advice to avoid activities that could expose and expand the impact of their work, such as engaging underserved youth in the scientific process or bringing research to bear on public policy. Such activities may be viewed as distractions from publishing for peers and citation metrics, which count heavily in the tenure process — so much that a researcher may risk job loss if he or she has not demonstrated success on such narrowly conceived measures.

Here at Oregon State University, a land grant institution, we need to do more than research about things that matter to us. We are obligated to *make* research matter for society. Toward that end, we need to find ways not only to nurture researchers' love of discovery, but also to fuel their drive toward solutions to the world's most wicked problems. We need to meaningfully connect these solutions to the broader public. We need to ignite young minds with the sense of wonder that inspires scientific inquiry.

It's essential to help faculty transcend the rat race, to create something new, to grow research impacts from the set of underlying principles that burn in the heart of each researcher. We should encourage investigators to unveil their "impact identities" and establish career-long societally relevant goals. Let's commit to linking researchers to the web of partners who can assemble and deploy appropriate evidence-based tools to transform impact goals into realities.

Perhaps the most compelling reason to empower faculty to focus on passion and action in the world is the prospect of an awe-inspiring professoriate with an infectious love of discovery to shape the minds of students on their way to becoming the leaders of tomorrow.

Julie Risien is the associate director of the OSU Center for Research on Lifelong STEM Learning. She also serves as faculty lead for the new OSU Research Impacts Network. A graduate of the Oregon State College of Earth, Ocean, and Atmospheric Sciences, Risien is on the steering committee for the National Alliance for Broader Impacts funded by the National Science Foundation.

Electric Earth

Honors student looks at how the West was made

BY NICK HOUTMAN

Talk to L Roy Bonner about his research, and you'll hear phrases such as "plunging layer of marine sediment" and "rising magma." The world beneath his feet still vibrates with the ancient collisions that formed the West.

Through the science of geomagnetics, the Oregon State University senior from Beaverton is peering into the structure of the Earth's crust with an eye on how the continent is put together and what that might mean for our future.

As a student in physics and the University Honors College, Bonner worked with a team led by Adam Schultz, professor in the College of Earth, Ocean, and Atmospheric Sciences. Schultz also directs the National Geomagnetic Facility at Oregon State.

Bonner spent a month measuring electric and magnetic fields in an area between Mount Rainier and Mount St. Helens in Washington. His project is part of a larger analysis of the structure that underlies the region's volcanic history.

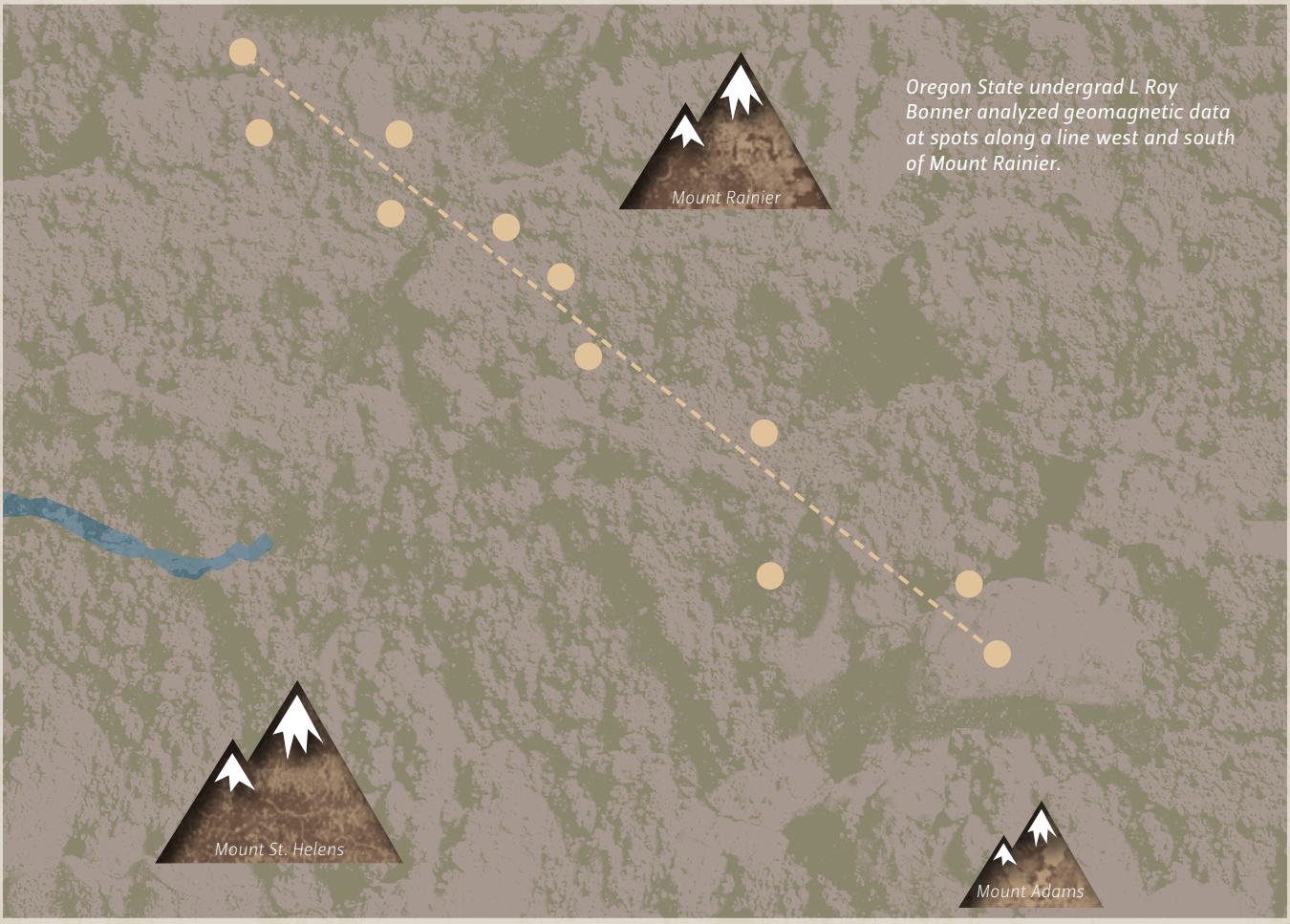
The signals that Bonner detected stem from thunderstorms, as well as from the interaction of the Earth's magnetic field with the solar wind, a stream of high-energy particles that constantly bombards the planet. "I've always been interested in electromagnetism, and the Earth is the largest system that I can study," says Bonner, who plans to graduate this spring.

Bonner likes to hike (the Opal Creek Wilderness and his dad's land near Clackamas are among his favorites) and found that he enjoyed doing fieldwork. "It was surprising to me that you could collect data like this and image everything. It's all about relating surface measurements of electric and magnetic fields and applying the principles of physics and mathematics to understand what's going on underground."

In general, electric currents flow more readily in areas that represent buried marine sediments or contain hot fluids such as magma. In one area near Mount Rainier, Bonner found evidence for both, an ancient part of the seafloor and magma that appears to feed Washington's largest volcano. "It's hard to tell the difference from geomagnetics alone," he says, but he was able to confirm that his observations matched the results of earlier seismic and geomagnetic studies.

"Scientists think a rift opened up (in the distant past), and all this marine sediment piled into it," says Bonner. "If you can actually identify these materials, you can figure out what happened. It's helpful for understanding geological processes."

Bonner plans to continue working with Schultz's team as a graduate student. He expects to study how electromagnetism in the Earth can affect the nation's power grid.



Oregon State undergrad L Roy Bonner analyzed geomagnetic data at spots along a line west and south of Mount Rainier.


Lisa Gaines


Catalina Segura


Margaret Burnett


Holly Swisher


Julie Greenwood


Kathleen Bogart

ELUSIVE EQUITY

Oregon State tackles the persistent bias inhibiting women in STEM fields

BY NICK HOUTMAN | PHOTOS BY CHRIS BECERRA

"It is not lack of talent, but unintentional biases and outmoded institutional structures that are hindering the access and advancement of women."
— Beyond Bias and Barriers, National Academy of Sciences

As a 25-year-old Ph.D. candidate at Harvard, Jane Lubchenco joined her classmates at the biology department's annual orientation meeting for incoming graduate students. A professor welcomed the group and asked them to look around the room. Take note, he told them, that equal numbers of men and women were present.

"He said, 'This is the first time in the history of the department that's been the case. And we think it's appropriate and remarkable, and I want you to understand why we have chosen to have this balance,'" Lubchenco recalls. "'We have learned from experience that the men graduate students are not happy if they do not have women around. So we have chosen to accept more women graduate students to satisfy that need, and we don't really expect all of you to finish.'"

Raised with her five sisters to be a competitive athlete and star pupil and to spare no effort in accomplishing her goals, Lubchenco took the comment as a challenge. "It motivated me to show him how wrong-headed his worldview was," she says. Not only did she finish, she became the president of the American Association for the Advancement of Science, the first female administrator of the National Oceanic and Atmospheric Administration, a member of the National Academy of Sciences, a MacArthur "genius" fellow, the winner of numerous other scientific awards and a Distinguished Professor of zoology at Oregon State.

But in 1972, the Harvard professor's attitude reflected a shared opinion that created a Berlin Wall for many women in higher education, barring them from jobs and opportunities for advancement. However capable or committed they were, women were often considered a "bad investment," wrote Donna Shalala, head of the National Academy of Sciences committee that in 2007 produced a report on gender discrimination, *Beyond Bias and Barriers*. Noting that women tend to be offered lower starting salaries and are poorly represented in leadership roles, that report called for a national effort to end systemic gender bias in science, technology, engineering and mathematics, the so-called STEM fields.

These leaders from some of the nation's top universities and think tanks advised academia to provide "equitable and unbiased evaluation of accomplishment, equitable allocations of support and resources, pay equity, and gender-equal family leave policies. Otherwise," it warned, "a large number of the people trained in and capable of doing the very best science and engineering will not participate as they should in scientific and engineering professions."

Well before this call to action, the alarm was heard at Oregon State. Against a backdrop of activities going back to the 1970s, a new initiative — known appropriately enough as ADVANCE — aims to create true equal opportunity for women in STEM and across the university.

Awakenings

In 1972, on the heels of the women's liberation movement of the '60s, Oregon State created the President's Commission on the Status of Women to promote the well-being and advancement of women in all walks of campus life.

Six years later, Oregon State reached a milestone in family-friendly work policies: Lubchenco

Jane Lubchenco

and her husband Bruce Menge — both marine biologists — were among the first couples hired to split a single tenure-track position at an American university. They had looked for an institution where they could grow professionally and share the day-to-day responsibilities of raising their children.

"We each loved teaching and doing research. Neither of us wanted to give that up," says Lubchenco. "Typically the guy would have the full-time job and the woman would be the caregiver. That's what all of our colleagues and friends from graduate school did at that time.

"We talked to many universities about this. Most of them were thinking of all the reasons they could not do it," she adds. "Oregon State was exceptionally visionary." Other science and engineering couples at Oregon State have followed in their wake.

Over time, a student scholarship to support women in science and changes in faculty recruitment policies added fuel to the fire for equity. In the 1980s, former College of Science dean Fred Horne set a high priority on recruiting women for tenure-track positions and promoting them to department chairs. And to support female students, he and his wife Clara Horne, head adviser in the College of Business, established The Clara & Fred Horne Scholarship for Women in Science. In the College of Engineering, search committees are encouraged to advance qualified women, minorities and veterans to the interview stage.

Mostly Male

Despite these and other measures — a nationally recognized program known as Difference, Power, and Discrimination; offices of Equity and Inclusion and Work/Life Balance; a dual-career hiring initiative and a spousal employment network known as the Greater Oregon Higher Education Recruitment Consortium — employment in STEM fields at Oregon State is still overwhelmingly male. In 2012, 21 percent of tenured and tenure-track STEM faculty were women. By comparison, women comprised 34 percent of tenure-track faculty in all fields and nearly 42 percent of faculty in the social and behavioral sciences.

Nationally, the picture is similar. According to *U.S. News and World Report*, women comprised about 18 percent of full professors in science and engineering in 2013.

Part of the difficulty, says Becky Warner, senior vice provost for Academic Affairs, can be traced to the expectations that greet all new STEM faculty and affect women in particular. "What many women find is that at the same time they're having a family, they are trying to develop their career and get tenure. That's not unique to STEM. What's unique to STEM is the rigidity of the science itself. Long hours in the lab and being in the field for weeks at a time are not conducive to having a full, flexible and balanced life."

Habitual attitudes also play a role, she adds. Women sometimes face "a lack of awareness among the men who have been in control of the disciplines that it's an issue."

Leadership in ADVANCE

SUSAN SHAW, director of the School of Language, Culture and Society

BECKY WARNER, senior vice provost for Academic Affairs

MICHELLE BOTHWELL, associate professor, College of Engineering

LISA GAINES, director of the Institute for Natural Resources

TUBA ÖZKAN-HALLER, professor, College of Earth, Ocean, and Atmospheric Sciences

DWAINE PLAZA, professor, College of Liberal Arts

DEBORAH JOHN, assistant professor, College of Public Health and Human Sciences

NANA OSEI-KOFI, director of the Difference, Power, and Discrimination Program

SARINA SATURN, assistant professor, College of Liberal Arts

A more equitable, family-friendly workplace is not just a women's issue. Some observers of faculty hiring note that male candidates often express a desire for family-friendly policies. As did Menge and others before them, they want a meaningful role in raising children and, in the case of dual-career couples, opportunities for a spouse.

Yigit Menguc, a new assistant professor of mechanical engineering, puts it this way: "Traditional modes of work-life balance would have me, as a man, emphasizing 'work' while my wife emphasizes 'life,' which is no balance at all. Furthermore, as faculty, I have a responsibility to make the next generation of engineers and scientists more plural in its diversity. Maintaining a good work-life balance can serve as a practical example for both men and women in my research lab and in my classroom."

"Our university will be an inclusive community that reflects and practices our belief in the educational value of diversity and equal opportunity."

— Strategic Plan 3.0, Oregon State University

Digging Deeper

With support from the NSF, Oregon State is launching a program to explore the cultural and structural factors that steer women away from tenure-track positions in STEM fields. Known as Oregon State University ADVANCE, the program aims to change institutional practice as well as personal behavior.

The principal investigator for ADVANCE is Susan Shaw, director of the School of Language, Culture and Society and a professor of women, gender and sexuality studies in the College of Liberal Arts. In addition to Warner, faculty from oceanography, bioengineering, sociology and natural resources are among the co-investigators (see Page 8 sidebar). Planning for the initiative took two years and meetings with more than 40 people at Oregon State.

"I was horrified by some of the stories I heard from our colleagues," says Shaw. Some examples of discrimination they heard were overt, but others comprised "micro-aggressions, the little stuff that, in and of itself, you might not think is a big deal when it happens, but when it's repeated, it starts to feel very aggressive."

For example, she says, faculty may refer to male students by name and to females by appearance. Or people make inaccurate assumptions, such as calling males "Dr." and females "Mrs." After a 28-year career as a professor in higher education, Shaw regularly gets emails and phone calls for "Mrs. Shaw."

Over the next five years, ADVANCE will conduct workshops, offer public lectures, publish an academic journal and evaluate the impact of these activities on campus culture and the hiring and retention of women in STEM fields. For a centerpiece, it will revise Oregon State's signature Difference, Power, and Discrimination (DPD) program for use in STEM fields. Through DPD, Oregon State faculty will study the theory and application of systems that perpetuate inequality.

Emphasis will also be put on the diversity of women's experiences. "We're not looking at women as a monolithic group, but we're paying attention to differences among women across age, ability, class, race and sexual identity," Shaw explains. "If we make things better across these differences, we make things better for everybody."

For scientists like Lubchenco — those who received the occasional egregious insult in their academic careers — ADVANCE is welcome. "It's a terribly exciting time to be a woman in science," Lubchenco says. "There are so many opportunities that are available that were much more difficult in earlier years. That said, there are major challenges, and we need to face up to them. I'm delighted with the sustained attention that OSU has paid to these issues of many years."

Natural Determination

Documenting women's fight for equity in wildlife biology

To be a wildlife biologist, it helps to have skills: to climb 30 feet up a tree to reach an eagle's nest, to monitor a tranquilized wolf before it wakes or to track a wolverine in the high country. And in years past, it would have helped to be a man.

For much of the 20th century, wildlife positions in universities, agencies and industry were all but closed to women. Pat Kennedy, Oregon State professor and wildlife biologist at the Eastern Oregon Agricultural Research Center in Union, is documenting the stories of women who persevered as volunteers, poorly paid assistants and part-time technicians to pursue their science.

Among her subjects are biologists in the United States, Canada and Australia. She is working with a publisher and expects to complete a draft in 2015.

PROFILES IN PERSISTENCE

Overcoming barriers to the practice of science

It takes more than skill and interest to succeed in STEM. These six female scholars discuss their own journeys through fields that have been, and in some cases still are, overwhelmingly male.

Kathleen Bogart

Assistant Professor
School of Psychological Sciences

Kathleen Bogart doesn't take communication for granted. Even as a child, she was aware that people responded to her differently. She was born with Moebius Syndrome, a condition that causes facial paralysis and difficulty in moving eyes from side to side. She had to work to make herself understood.

In college, Bogart found that Moebius had been largely ignored by science. So she set out to explore the consequences of facial paralysis that affect nearly 130,000 Americans annually. She is opening new ground in the psychology of disabilities and the impacts on social marginalization and emotional health.

Terra: What accomplishment are you most proud of?

"I succeeded in getting a National Institutes of Health grant while I was still a graduate student. The full title is a 'Pre-Doctoral Fellowship to Promote Diversity.' I thought the chances of getting this funded would be very low because there was no precedent at NIH to study facial paralysis and psychosocial consequences. I was given the run-around by several institutes because they didn't think it fit within their area. Well, that happens with gaps in research that no one has addressed. I thought it was especially important to apply and point out that there is no place for this.

"When I applied to the National Institute on Dental and Craniofacial Research, it was funded on the first try. So now there's a precedent. I created a precedent. I'm glad I persisted."

Terra: How have gender and diversity influenced your career?

"When I think about diversity, my experience as a person with disabilities overshadows my experience of being female. I'm young, so there's also a generational effect. I happen to be lucky in that things are getting better. When I entered academia, I benefited from the activism and politicking over the years.

"Disability can be conceptualized as a minority group because people with disability share the same marginalization as ethnic and racial minorities, such as health disparities or the stigma of prejudice. Very little work has been done on people with disabilities, even though it's a very similar phenomenon. People with disabilities is the largest minority group in the U.S., about 20 percent of the population.

"Having facial paralysis makes me unique in the research field, because there's no one else who has facial paralysis and is also studying it."

Kathleen Bogart *Margaret Burnett* *Lisa Gaines*

Margaret Burnett

Professor of Computer Science
School of Electrical Engineering and Computer Science

When Margaret Burnett was growing up in the 1960s, being a female with a gift for math led to one likely career: teaching. She didn't see herself in front of a classroom, but when a neighbor got a job with IBM after majoring in math in college, Burnett saw an opportunity. As an undergraduate at Miami University in Ohio, she would rush home to do her computer programming homework. "It was like a new puzzle. I loved it," she says.

Burnett broke a gender barrier in her first software-development job, as the first female ever hired into a management-level position in a sprawling Procter & Gamble manufacturing facility. In 1992, she broke another gender barrier: Burnett and Cherri Pancake were the first tenure-track female faculty hired in computer science at Oregon State.

Terra: What accomplishments are you most proud of, and how have gender and diversity influenced your career?

"For me, these are the same question. In research, I'm most proud of the gender aspects of a software project that Laura Beckwith (former Ph.D. student) and I started. It is the most important thing to ever come out of my lab. She and I put together this research question: Do some of the gender differences that have been reported in psychology, sociology and education have implications for the way people use software? We've been working on it for about 10 years, but it continues to climb. I think we're about to change the world with it.

"In education, I'm most proud of my student mentees, about half of whom have been female. It's been so exciting to take a student who is good, to lift them above whatever barriers they're not even thinking about and say, 'You're better than this,' and watch them soar. It's awesome."

Lisa Gaines

Director
Institute for Natural Resources

Lisa Gaines' grandmother made it a priority to educate her girls. "I will educate my daughters before I educate my sons," Gaines remembers her saying. Gaines' grandmother lived her entire life in the black community in St. Louis and saw that young men "always found a way of making it through, but women did not."

That ethic of female empowerment affected Gaines' life as well. As she was growing up in San Diego, the daughter of a U.S. Navy officer and a teacher, there was never any question that she would be going to college. The drive for education had a history on her father's side of the family. Her father's uncle was the plaintiff in a landmark U.S. Supreme Court case, Gaines v. Canada, which set precedent for Brown v. Board of Education.

Trained in international relations, natural resource economics and environmental sciences, Gaines sees herself as a facilitator of difficult conversations among people with diverse interests. "I'm able to talk to people and move things along," she says. "If people ask me if I'm a mover and a shaker, I say absolutely not. Not even close. But I can talk with individuals and get a point across. Despite the fact that I have a great respect for rivers, land and air, my main interface was always with people."

Terra: What accomplishment are you most proud of?

"It's this ability to talk to and be understood and trusted by multiple audiences. Faculty and natural resource decision-makers have come to me if they have issues about the science or the trajectory of a project and know that I will hold their concerns in confidence and help change the course or dynamics of a project overall. I end up being a mediator."

Terra: How have gender and diversity influenced your career?

"As a woman, when I participate in this area of natural resources science and policy, I'm seeing more women in the room, usually about 50-50. But I can think of only two times in Oregon in natural resource meetings when I have not been the only African-American person in the room. Let alone one of the few minorities.

"Why aren't minorities higher up in levels of thinking about natural resources, on the impact on their world in the urban environment or the rural environment? Why is this not a career trajectory?

"I was nominated by someone on my board to participate in the American Leadership Forum of Oregon. These are people from government, education, business, and part of its mission is to build on the strengths of diversity to train leaders to work collaboratively. My class was a widely diverse group in terms of race, gender, sexual orientation, political background, geography and religion. It was wonderful to be part of this group as we thought through issues that affect Oregon."

Julie Greenwood

Associate Dean for Academic and Student Affairs
College of Science

A video in Julie Greenwood's lab catches cancer cells in the act of invading the brain. They are glioblastoma cells, agents of the same disease that killed Senator Ted Kennedy. "Glioblastoma cells are very effective at invading the neighboring tissue of the brain," says Greenwood. "In many cases, these cells sprint." Although surgery is often a first step in treatment, it's nearly impossible to remove all of the tumor cells.

Greenwood leads a team of undergrads and graduate students delving into the biochemical cross-talk — how proteins affect cell movement, how cells respond — between cells and the environment. Their hope is to contribute to an effective treatment for the disease.

Greenwood joined the Oregon State Department of Biochemistry and Biophysics in 2000, presenting herself as a male, Jeff Greenwood. On the weekend before she started her job as associate dean, she came out in an email to her colleagues as a transgender woman.

Terra: What accomplishment are you most proud of?

"I always like to say my biggest accomplishment is my three boys. I like to emphasize that because in science we don't always say it. In my work, my biggest accomplishment is my students. They're the ones that make the research happen. I've had great graduate and fantastic undergraduate students. I love having them in the lab."

Terra: How have gender and diversity influenced your career?

"I have embraced my identity, and I feel great. That does not mean there have not and there will not be significant challenges. But, the gorilla is off my back, and I am so happy. I have so much energy; my productivity has tripled.

"Sometimes I don't know if my interactions with others are affected more by my transition as a woman or by my transition to associate dean. For 14 years, I was in the locker room, so to speak. So I do hear things. I do feel that there is language, and there is attitude that individuals don't even realize. I know it's complicated.

"I've had occasions when I've entered into seminars and meetings, and at least twice, there was the assumption that I was the assistant. Not the associate dean, that's for sure. But even going to national meetings where no one knows me, it's so interesting, the gender segregation. In a meeting that is predominantly men, women cluster. There's a comfort.

"As a queer person, it's been very difficult. I went to a conference with people who are out in the STEM fields, and most of them say STEM is 'don't ask, don't tell' in terms of being queer. In Corvallis, we think we're so liberal, but on these issues, we're not so liberal."

Catalina Segura

Assistant Professor
Forest Engineering, Resources and Management

As the daughter of a physics professor and a lawyer, Catalina Segura set her sites on working in a university. Her father was "truly excited to use science to make a difference," she recalls. "He was very inspiring."

Julie Greenwood *Catalina Segura* *Holly Swisher*

But growing up in Bogotá, Colombia, which ranks among the world's 25 largest cities, Segura turned her concerns to ecology and sustainability. Deforestation has accelerated erosion and habitat loss in the country's rainforests. By studying forest hydrology — how water moves through forested watersheds — Segura decided to study forestry with the idea of helping reduce such impacts and conserve Colombia's diverse ecosystems.

She received her bachelor's from the Universidad Distrital in Bogotá where she was one of three females in a forest engineering program with 70 students. A Fulbright Scholarship enabled her to complete her master's at the University of Washington, and she went on to the University of Colorado for her Ph.D. She came to Oregon State in 2013.

Terra: What accomplishment are you most proud of?

"Just being at Oregon State still feels like an accomplishment. It's been a long journey to make it here. It's a new beginning, but it still feels like, 'Wow, I made it.'"

Terra: How have gender and diversity influenced your career?

"Where I grew up, there is a prescription for what a woman should do. And it's the same for men. They are also tied to it. The choices that I made when I was young about what I wanted to study, I had to defend. I became a strongly opinionated person because I had to defend them. While my cousins and friends were studying business and being very traditional, thinking about getting married, I wanted to be outside as a forest engineer. It was not a woman's job.

"I learned how to navigate that *machista* world, and when I came to the U.S., it was paradise. It was so much more relaxed. So it's taken me a while to develop a sensitivity because I was kind of numb. Where I came from, the gender roles are so much stronger, and here, it is so refreshing.

"The forest sector is very male dominated and still is. I'm one of the few females in the department. But it's so much more inclusive than where I came from. I don't feel that my gender has made a significant difference."

Holly Swisher

Associate Professor
Department of Mathematics

In her first year in college (Pacific Lutheran in Tacoma), music almost won out over mathematics for Holly Swisher's attention. During her high school years in Salem, she had played piano and bassoon in a youth symphony, sang in a choir and even played drums in the marching band.

But her love of math wouldn't play second fiddle. She transferred to the University of Oregon where she majored in the subject. Her journey included a Research Experience for Undergraduates (REU) program at Trinity University in Texas where she "sat in an office and did math all day, every day. And it was amazing. 'I love this,'" she recalls thinking.

At Oregon State, she teaches and organizes an REU program in mathematics. But what sparks her creativity is number theory. She investigates the properties of numbers, for example, that arise from partitions and the analysis of complex functions. She describes doing mathematics as "an art that is precise, beautiful and appealing."

Terra: What accomplishment are you most proud of?

"I've had doubts about research in my career, and I'm really proud of pushing through them. But what I'm most proud of is mentoring students. I feel like I have definitely helped people become successful, and that makes me really happy."

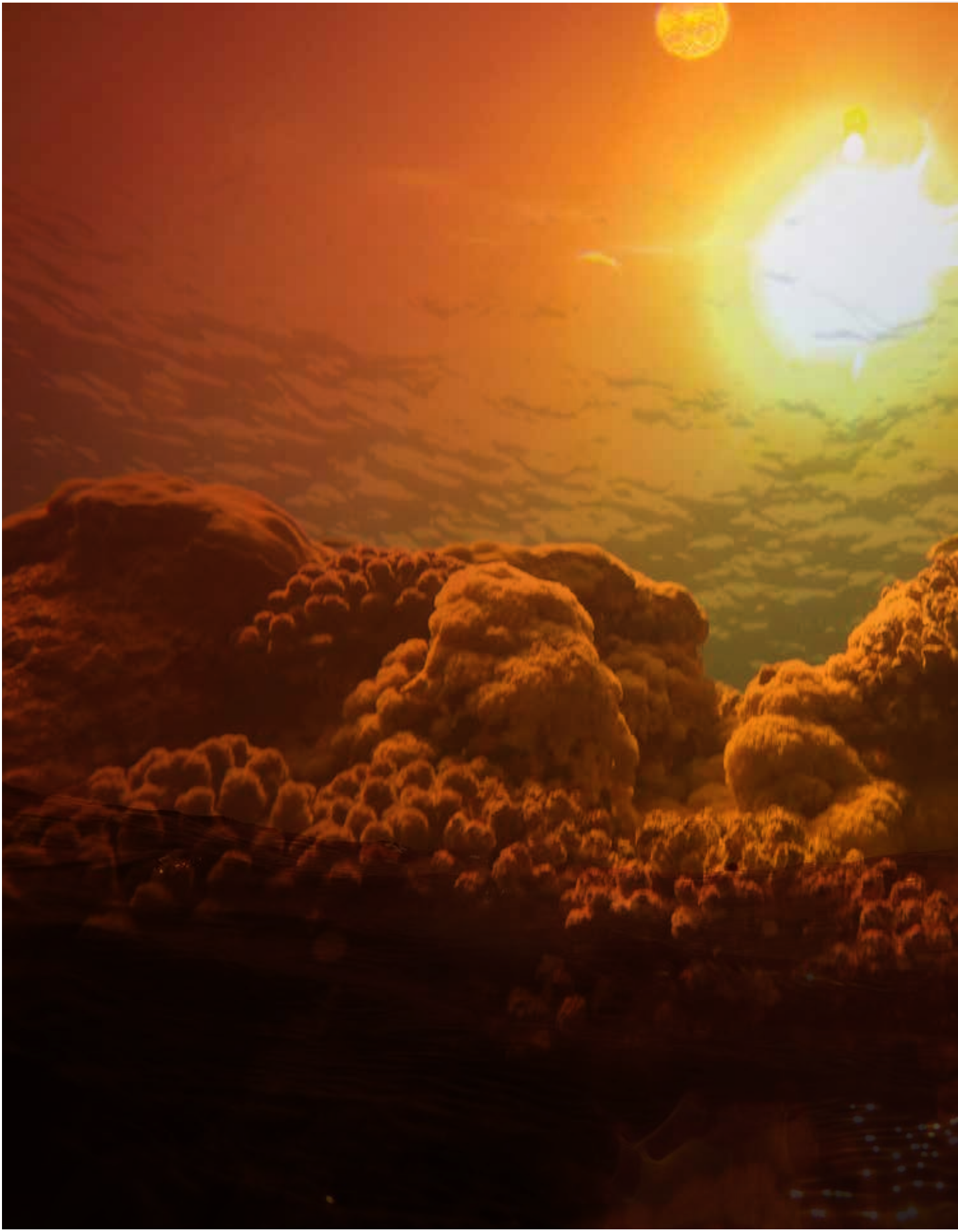
Terra: How have gender and diversity influenced your career?

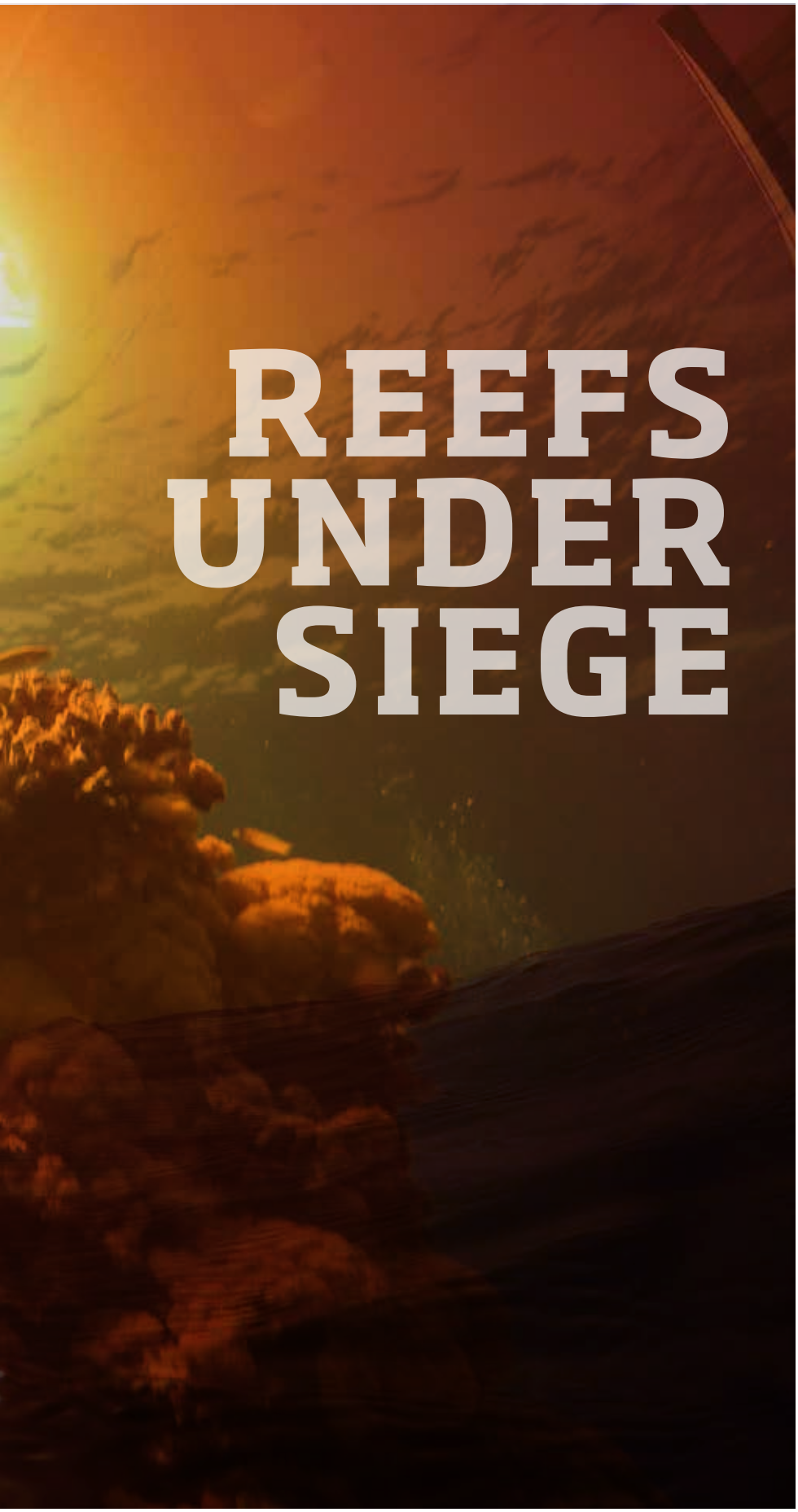
"I think people have a typical view of a mathematician as an older white male. When I started going to conferences, I dreaded flying because I'd have to have the conversation with the person next to me. 'Oh, you do math? Wow.' Or it would just get really awkward because they wouldn't expect it.

"I don't blame people, certainly. But I realized that every single time, they were telling me that I'm weird, or that I don't belong or that I picked something really weird to do.

"More upsetting were evaluations I got from two students in a large calculus class during my post-doc at Ohio State. They wrote that they had a hard time taking me seriously because I didn't dress like a professor but like a young woman. Since I was a 27-year-old woman at the time and a professor, this really threw me off. My young, casual-dressing male colleague received no such criticisms. I haven't had comments like that here.

"I've also had very positive experiences. For example, I am part of a community called Women in Numbers designed to build research collaborations between women in my field. It has created an amazingly strong network. It's been so productive. I say this literally saved my research career at a crucial time when I was in doubt." terra





REEFS UNDER SIEGE

Researchers search urgently for clues to coral decline

BY DAVID BAKER

The nose of the Boston Whaler dips into the trough of the wave for a stomach-dropping second. The crew and divers now face a wall of water topped by the frothing curl of a break. They ride up so steeply that the boat seems about to topple backward. The pilot, Mohammad, guns the throttle, charges over the top and slips down the other side.

Before they can catch their breath, he circles back to make another run at dropping anchor on the windward side of the stack of coral jutting from the ocean floor just below the surface. This reef called Shib Nazar is located off the Red Sea coast of Saudi Arabia, and it's the first structure these waves have met after rolling across hundreds of kilometers of open water. No wonder they're angry.

Mohammad somehow manages to anchor just short of where the waves pound the reef's outer wall. Four Oregon State University divers in back of the boat hurriedly strap on weight belts and hoist heavy tanks onto their shoulders. They eye each other nervously as the craft bucks over the swells.

"Very dangerous here," Mohammad says, gesturing toward the break, the words of caution slicing through the language barrier. He wants the team to enter quickly and not dally on the surface, where

waves threaten to toss them onto the shallow corals.

Ryan McMinds sits on the gunwale of the rocking boat. The Oregon State Ph.D. student is the youngest member of the team but also the most experienced diver. He calmly holds his facemask and regulator in place with one hand and tumbles backward into the water. He rights himself and signals to the boat that he's OK. On the opposite gunwale, Jesse Zaneveld, a post-doctoral researcher, follows suit.

A few more frantic moments pass as the rest of the team enters the water and gathers on the surface. But when they submerge beneath the crashing chaos, the surge becomes a smooth rocking and pushes them toward a massive wall of coral before it draws them gently away again. It takes only moments to adjust to the rhythm.

A baroque vista of colorful corals in every imaginable shape greets them. There are twisted fingers, tangled thickets, boulders and smooth patterned mounds that look like cartoon brains. This first glimpse of a coral reef inspires awe. But the scientists are already descending, zeroed in on an interesting cluster. These massive marine structures are built by colonies of tiny marine invertebrates, and the researchers work with their noses inches from these animals that look more like miniature flowers than the architects of marine ecosystems.

A Global Problem

McMinds and Zaneveld have traveled halfway around the world to gather coral samples. They chip small fragments from the colonies and use syringes to collect mucus. It's not the slime that interests them; it's the bacteria contained within the liquid. Back on the boat, they'll store the samples in a "dry shipper," a container filled with liquid nitrogen that instantly freezes the samples until they can be taken to the lab for gene sequencing.

It's all part of the Global Coral Microbiome Project, an ambi-

Ryan McMinds and Jesse Zaneveld search the dizzying diversity of this Red Sea reef for coral species so they can begin the collection process. (Photo: Justin Smith)



Coral reefs provide homes for a spectacular range of sea life; some of the most colorful inhabitants include a clown fish (left) and a nudibranch (center). (Photo: Justin Smith)

tious study funded by the National Science Foundation and led by Rebecca Vega-Thurber, assistant professor of microbiology at Oregon State. From labs in Corvallis to reef ecosystems in the Red Sea, the Caribbean and Great Barrier Reef off Australia, she and her team seek to understand how corals and other organisms — particularly the microbes they host — have co-evolved. The fish, the corals and algae that live inside of them all have a role to play, but ultimately the reefs reflect a balance between growth and decay.

When the balance tips, things go wrong. Disease may result as the proportion of good to bad bacteria slips, she says. Before the 1980s, diseases in corals were largely undescribed because they were so rare. Now diseases are rampant in regions like the Caribbean. When corals disappear, entire ecosystems collapse.

"Corals are the foundation species of tropical reefs; that is, they essentially build the infrastructure necessary for reefs to flourish and be so biodiverse," adds Vega-Thurber. Reefs have been called the rainforests of the oceans. It's estimated that 25 percent of all marine species depend on these habitats for food, shelter and nurseries to rear their young.

Reefs also provide benefits, so-called "ecosystem services," to humans. Half a billion people count on reef fish as their only source of daily protein. Reefs protect coastlines from waves and storms. Their molecular biodiversity has led to the discovery of life-changing pharmaceuticals. The list of what is lost as they disappear quickly becomes alarming.

Most of the causes of decline can be traced to human activity. Rising ocean temperatures related to climate change lead to events like coral bleaching, which weaken or kill corals en masse. More intense and extensive storms leave damaged reefs in their wake. And as oceans absorb increased levels of CO_2, acidity increases faster than species can adapt. Pollution and runoff add nutrients that upset the microbial balance of corals. Overfishing removes species that have specific roles to play in maintaining ecosystem balance. The litany of pressures is daunting.

Vega-Thurber hopes to find solutions that will help these habitats survive. "If we understand what microbes are doing and what their sensitivity is to those (stressors), then we can predict which corals might do well in the face of climate change."

Her collaborator in Saudi Arabia agrees. "Research provides a very important underpinning, because it provides the foundation to put items into action," says Christian Voolstra at his lab at KAUST, the King Abdullah University of Science and Technology near Jeddah.

Last winter, Voolstra's lab hosted McMinds and Zaneveld, providing them access to a full range of tools, from the latest gene-sequencing equipment to boats that carried the researchers out to Shib Nazar, one of KAUST's "house reefs." The university, barely five years old, is a vast collection of grand academic buildings and luxurious student residences still under construction, built on bare desert directly on the shore of the Red Sea. It provides an ideal scenario for studying corals. Samples can be collected in the morning and processed in a full-service facility in the afternoon.

When it comes to the global decline of corals, the entire Red Sea can be seen as a natural laboratory. "It's a very warm sea. It's a very young sea. We can essentially follow the evolutionary trajectory of what organisms did to survive here," Voolstra says of his home waters, which glint blue in the background through the monumental windows of his laboratory building. While climate change pushes ocean temperatures higher around the globe, healthy reefs still manage to thrive here. "In a way, you can relate to the Red Sea as a future ocean scenario."

Ph.D. student Ghaida Hadaidi didn't grasp the scale of the threats facing the precious resource lying just off her country's coastline until

taking Voolstra's class. She began to dig into research publications on corals. "I started to get interested in coral bleaching. I was fascinated. I didn't know anything about that," says Hadaidi, who discovered a whole new world just below the surface of the water. And it's worth saving, she says. "We just throw everything into the sea, and we don't care. This is actually wrong, and we should raise the awareness for everyone. There's amazing life down there."

McMinds, like Hadaidi and anyone who experiences tropical corals, is dazzled by their beauty and diversity. But their aesthetic value is not what he thinks of first when it comes to their decline. "If we lose these really diverse environments, we lose the microbes that go along with them. And the microbes themselves contain a lot more diversity than their hosts."

Over the long term, reefs will survive, McMinds believes. They will adapt. They may be different, but nature will find a way. His research partner agrees.

"Over hundreds of millions of years, coral reefs — or something just as spectacular — will bounce back," Zaneveld says, "but humans may not be around to see it." So he holds out hope that their work can help lead to conservation of these ecosystems for current and future generations. "We want to preserve these reefs for us and for our children. We want to experience that diversity and wonder."

Rebecca Vega-Thurber is leading the Global Coral Microbiome Project, an ambitious effort to understand coral bacteria. (Photo: Justin Smith)

A Cluster of Coral Knowledge

For Vega-Thurber, coral decline is a personal issue. Her father, an immigrant from the Dominican Republic, infected her with a fascination for marine habitats. A doctor by training and an intrepid conchologist by passion, he collected and hand-labeled shells, which she displays in a case in her office. The Caribbean reefs that inspired her father, and where she snorkeled as a child, have been decimated by coral decline. "If we don't, as a community and a society, try to fix what we've done to these areas, they certainly will be gone in the next generation," she says with a matter-of-fact tone that belies her emotional connection to these places.

Mementos of her travels adorn her office. A license plate from Florida stands beside a tiki idol carved for her by a colleague in Hawaii as a good-luck token. Next to the memorabilia from her field research, a photo of Flynn, her 2-year-old son, is a reminder of what she leaves behind when she goes into the field and why the work matters.

While she heads into the field as often as possible, Vega-Thurber's teaching schedule keeps her from covering the globe herself, so she relies on her team. Trusted field researchers like McMinds and Zaneveld are key to the project's success. She sends her tiki idol along with them. Even a scientific project can use a little luck.

And Vega-Thurber also counts her fellow faculty members as part of her good fortune: Many of her Oregon State colleagues are hard at work trying to figure out the causes and consequences of coral decline.

A Home for Algae

Virginia Weis, chair of Oregon State's Department of Integrative Biology, has been studying corals for a quarter century. She focuses on the relationship of corals to the photosynthetic algae that live inside their tissue. These algae feed the coral polyps and provide them with their brilliant colors. It's a partnership. The tiny marine invertebrates provide a home for the algae, which in turn provide nutrients and energy to their hosts. Over time, this symbiosis between coral and algae leads to the production of hard calcium carbonate skeletons that become the physical structure of the reefs.

"My interest is in how that partnership works," says Weis. "How they make decisions about who goes with whom, and of course in the context of reef pressures, what

Christian Voolstra of KAUST's Red Sea Research Center leads an international cohort of graduate students through the reefs near Al Lith, Saudi Arabia. (Photo: Justin Smith)

happens when things start to go wrong."

The breakdown in the balance between corals and algae can have serious impacts on reefs. Coral bleaching is just one example. It occurs when coral immune systems reject their algal symbionts. A vibrant reef turns into a ghostly boneyard of dead, starving and disease-ridden corals. Some reefs never recover.

Weis has visited reefs around the world, but she also studies bleaching and symbiosis in her lab. She uses a species of tropical sea anemone common on coral reefs. "Anemones engage in symbiosis like corals do, and with the same types of algae," Weis explains. She affectionately refers to "my animals" in tanks lining the bench and refrigerator shelves of her lab.

While the key to understanding coral bleaching will likely lie in powerful new gene-sequencing tools, it's the change she's seen in her students throughout her long career that gives her the most hope. "In young people, I'm hearing, 'I want to help. What can I do to make the world a better place?' I find it's a profound generational difference."

Weis finds this drive to solve problems in other young faculty and coral scientists on campus as well.

Assistant Professor Eli Meyer has found another way to study corals far from the tropics. He breeds them in his lab. In a former storage closet two floors below Weis's lab, he has rigged computer-controlled tanks with lights programmed to emulate the sun and moon.

The corals in the tanks have successfully spawned. To demonstrate, he takes a small square tile out of one of the tanks and points to a coral the size of a grain of rice. It's a year old. It takes patience to grow coral.

"I came into the coral world and was a little disappointed that everyone is going off into nature, doing one-off experiments and going back into the lab. There was no way to ever reproduce any experiments," Meyer says. His career path in marine biology was cemented in his mind from his first frigid snorkeling

Lizard Island Research Station is located directly on the northern reaches of the Great Barrier Reef. (Photo: David Baker)

experience in Maine at the age of 7, but a short diversion into the world of plant genetics gave him a new perspective on how to study these animals. "In the plant world, they don't take no for an answer when it comes to growing their organism. If you're a plant biologist, you're going to have a greenhouse and grow your plant in that greenhouse."

The question Meyer hopes to answer with his coral "greenhouse" is whether there's a genetic basis for variation in thermal tolerance of corals and their ability to survive events such as coral bleaching. If variation is genetic, then corals can potentially adapt to a warming ocean.

Kerry McPhail, associate professor in the Oregon State College of Pharmacy, studies coral microbes in the field. In a sense, she's an agent of "ecosystem services." A medicinal chemist, she looks to reefs as untapped sources of new drugs. "Microbes are the absolute best chemists out there. Their chemistry is unlike anything synthetic chemists can really think of without inspiration," says McPhail, after returning from a recent trip to a different stretch of Saudi Arabian reefs.

Drug discovery and coral reef diversity go hand-in-hand, and they provide a way to communicate the value of these habitats. McPhail's team found a promising molecule in Coiba National Park in Panama in an area threated by onshore development. "The discovery of that compound has helped to justify the preservation of that area," she says.

Shifting Baseline

In the heart of the Willamette Valley, Oregon State may seem like an odd place to find a concentration of coral experts, but the Lizard Island Research Station is not. This collection of breezy labs with interconnected walkways and aquaria fed by water pumped from a sandy beach lies in the shadow of Cook's Look, the tallest peak with a view over Australia's Great Barrier Reef.

In 1770, Captain James Cook climbed this island's summit and gazed out at the patchwork of pastel blues and greens that stretch to the horizon in all directions. His heart sank. The words he wrote in his journal hang in the research station's main breezeway:

"Sunday, 12th...when I immediately went upon the highest hill on the Island, where, to my Mortification, I discover'd a Reef of Rocks laying about 2 or 3 Leagues without the Island."

For Cook, the "Reef of Rocks" was a maze, a dangerous navigational

Ryan McMinds collects coral samples near Lizard Island on the Great Barrier Reef. He will bring them back to Oregon State University for further processing. (Photo: Katia Nicolet)

Virginia Weis studies coral bleaching in her lab at Oregon State University by working with tropical sea anemones that share a similar symbiotic relationship with algae. (Photo: David Baker)

nightmare that was frustrating his exploration of Terra Australis, still unknown to Europeans. But today we actually know what the native aboriginal peoples understood for tens of thousands of years: Those reefs are among the richest, most diverse ecosystems on the planet and a cornerstone of life in the ocean.

While visiting Lizard Island on a fellowship in 2014, Ryan McMinds helped establish the template for fieldwork on the Global Coral Microbiome Project. There he collected samples as a proof-of-concept for the project.

Situated on the world's largest barrier reef, Lizard Island is surrounded by coral diversity. The magnificent reefs are visible from shore. The shadows of turtles and sharks drift over them. From such a vantage point, it's hard to take a pessimistic view on the outlook of their survival. To Cook's dismay and our delight, Lizard Island seems rich in coral.

This scene underscores a problem with understanding coral habitats, or any ecosystem in decline, what ecologists call the shifting baseline. Here's the idea: What we accept today as normal overlooks the steady transformation that has taken place in the past. The reefs we see today are vastly different from what Cook saw in 1770, or what the native aboriginal people saw for thousands of years before that.

One scientist who has studied the reefs at Lizard Island long enough to witness the modern shift in the baseline is the station's director, Anne Hodgett. Efficient, no-nonsense, friendly and capable, she has been co-directing the station for 25 years with her husband, Lyle Vale. In that time, she's seen more than a thousand scientific papers published by visiting researchers.

Hodgett has also seen entire stretches of reefs damaged by storms, overtaken by algae and destroyed by ongoing infestations of crown-of-thorns sea stars. These animals prey upon corals, and the sea stars' population has exploded in recent years, decimating large portions of the Great Barrier Reef.

"If we lose it, it would be a tragedy, an absolute tragedy," Hodgett says. "And I'd like to think that it wouldn't happen on our watch: my generation or our children's generation. But I think it's going to."

Her comments echo concerns expressed in another community several hundred kilometers away, on another remote and stunning stretch of beach in Queensland. The Aboriginal Shire of Yarrabah is an impoverished community with few jobs and no businesses. Some of the young men have found employment in government-run crown-of-thorns sea star eradication programs, giving them a way to connect with the habitat that once provided their people with a livelihood.

Errol Neal, the mayor of Yarrabah, holds out hope for the economic prospects of his town. He plans to establish an ecotourism industry, and his vision includes cruise ships

and resorts. But for the moment the only vessels in the harbor are the rusted skeletons of wrecks.

Despite Neal's optimism that people will want to pay good money to visit this pristine coastline along the Great Barrier Reef, he's also witnessed a shift in the baseline. He recalls gathering the eggs of seabirds on nearby islands as a boy, when villagers would take only what they needed to subsist. The eggs are gone. There are also fewer turtles than he remembers.

"They say all good things don't last forever, but we managed to maintain that for thousands and thousands of years," says Neal. "And more recently, things have been really sad because the beauty of this land has been deteriorating — the reef, the natural wonders — simply because people don't regard aboriginal history serious enough."

When asked to share some traditional cultural stories about the reef, Neal initially demurs, saying it isn't his place. But at the end of an interview, he shares this: "In the old stories, they say when the Mother gets mad at us, then the seas will begin to boil." Did a 40,000-year-old culture understand the shifting baseline? Did their "Mother" warn us about climate change?

A Fighting Chance

Half a world away, while McMinds and Zaneveld scour KAUST's house reefs in search of new species and collections to bring back to Vega-Thurbers' lab at Oregon State, Ghaida Hadaidi studies genomics and marine biology and awaits her chance to explore the world that lies just beyond her country's coastline. The late King Abdullah created the institution as a "beacon of knowledge" and symbol of tolerance and learning in the heart of the Islamic world. Inside its walls, women have more freedoms than elsewhere in the country, and international scientific collaboration and progressive thought are encouraged.

While the Great Barrier Reef is among the most studied — it's a World Heritage site and a source of national pride with numerous research stations and universities devoted to its understanding — the Saudis are just learning about the rich diversity that lies off their longest coastline. Along with Oregon State, KAUST is at the forefront of a growing awareness that these precious marine resources need protection.

As a Saudi woman working her way toward a Ph.D., Hadaidi is fulfilling the promise of KAUST in a part of the world where women's education isn't always encouraged, where they're not even allowed to drive. It's not an easy path, but she impressed Voolstra with her persistence. He can choose from a global pool of qualified doctoral candidates. But as a master's student, Hadaidi showed up at his office door weekly until he agreed to take her on in one of his handful of Ph.D. slots.

Hadaidi has yet to dive in the spectacular KAUST reefs. In her culture, it's not an easy feat for women to explore the ocean. At the swimming beaches, you never find women in the water. At the most they'll hike their abayas and wet their feet along the shore. Now, there are even rumors circulating through KAUST that women won't be able to secure diving licenses under the new regime.

But Hadaidi is not deterred. She has signed up for a scientific dive course and eventually hopes to have a chance to experience a Red Sea environment that few of her countrywomen have ever seen.

The human spirit, like nature, will find a way. terra

Editor's note: David Baker and Justin Smith of Oregon State's Interactive Communications Department have been following the work of Rebecca Vega-Thurber and her team in Australia, the Red Sea, French Polynesia and the Caribbean. Learn more about their upcoming film, Saving Atlantis, *below.*

Dive Deeper

Voices from the front lines of coral reef conservation

Head to the Web (oregonstate.edu/terra) to experience coral reef habitats in videos produced by Oregon State University. See the Great Barrier Reef, a bird's-eye view of Lizard Island or the coral canyons in the Red Sea off Saudi Arabia. You can also hear the mayor of the Yarrabah Aboriginal Shire, Errol Neal (pictured below) in his own words and watch a preview of *Saving Atlantis*, a feature documentary currently in production at Oregon State and scheduled for completion in 2016. Learn more about the film at **coralreefmovie.org**.

Errol Neal is mayor of Yarrabah, an aboriginal town on the coast of Queensland, Australia. His people have a historic relationship with the nearby reefs. (Photo: David Baker)


Faux
SNAKE

SKIN and Power Suits

From sweatshops to high-fashion runways, contradictions abound in the apparel industry

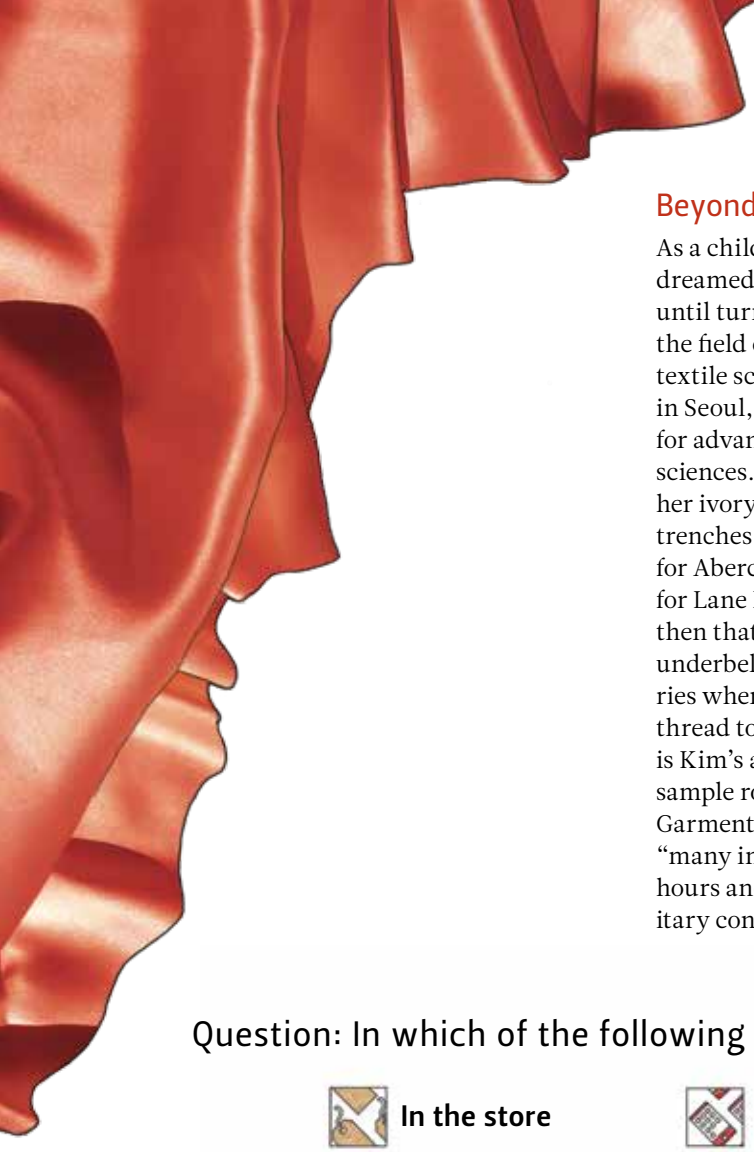
BY LEE SHERMAN
PHOTO BY CHRIS BECERRA
ILLUSTRATIONS BY HEATHER MILLER

In her tailored navy-blue blouse and dark pinstriped trousers, Minjeong Kim looks all business — muted, buttoned-down. But then you notice her shoes. Sitting at her desk in Milam Hall, she lifts her foot to show off the wedged sneaker with its hidden 2 ½-inch heel. "These," she says, "are from Nike's 'Sky Hi' line."

Her conservative outfit accessorized with edgy footwear nicely captures the complexity and contradictions in the world of apparel, a world Kim inhabits as a researcher in the School of Design and Human Environment at Oregon State University. In her closet at home, for example, hangs a pair of flame-red, faux-snakeskin pants (relics from her 20s that she keeps for nostalgia) right alongside the smart power suits she favors in her role as an associate dean in Oregon State's College of Business.

"I enjoy the multidimensionality of apparel — a hot-night look, a career look, a casual look," she says. "There are different meanings attached to clothes. They're rich with culture, symbolism, memory and sensory experience."

Researcher Minjeong Kim in her iconic high-heel sneakers.



Beyond the Ivory Tower

As a child in South Korea, Kim dreamed of being a cartoonist until turning her artistic eye to the field of fashion. After studying textile science and clothing design in Seoul, she headed to Ohio State for advanced degrees in consumer sciences. Meanwhile, she solidified her ivory-tower education in the trenches — doing technical design for Abercrombie & Fitch and later for Lane Bryant and Express. It was then that she first saw the industry's underbelly — the hot, grimy factories where workers put needle and thread to a designer's vision. "Scary" is Kim's adjective for the frenzied sample rooms of New York City's Garment District, where she saw "many immigrants" sewing for long hours and "small money" in "unsanitary conditions."

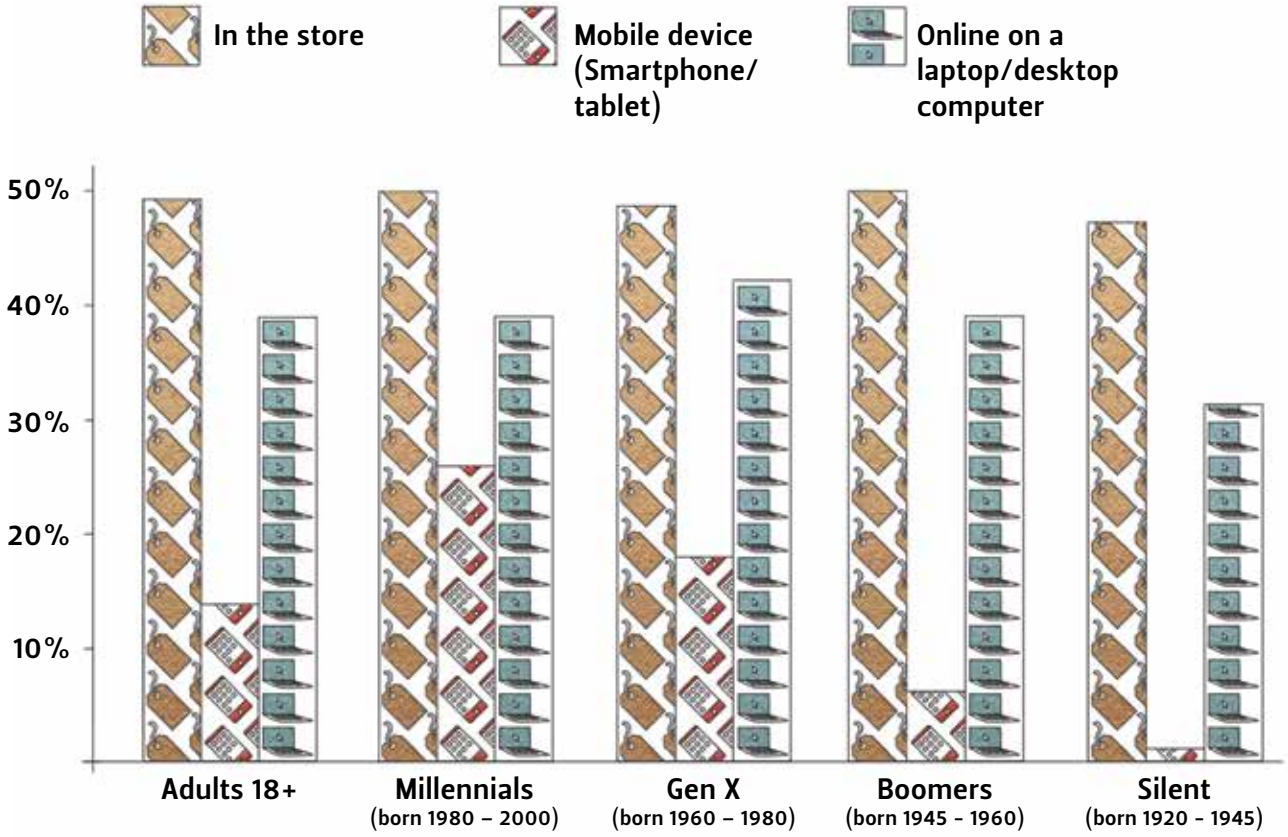
Today, Kim's hands-on experience guides her scholarly research into the mysteries of consumer behavior, from solitary online shopping to the all-too-common mob antics at Black Friday "door-buster" sales, when customers push, pepper-spray and even trample each other to save a few dollars on an advertised item. Her insider's view is a boon to her teaching, too. For students who aspire to careers as fashion designers, buyers, marketers or creative directors, Kim's professional knowledge and network are golden.

"Staying relevant to the industry is so critical," she notes.

Reading Is Believing

Understanding why people buy, especially online, is what drives much of Kim's current research. She tries to get inside shoppers' minds as

Question: In which of the following ways do you research apparel before purchasing?



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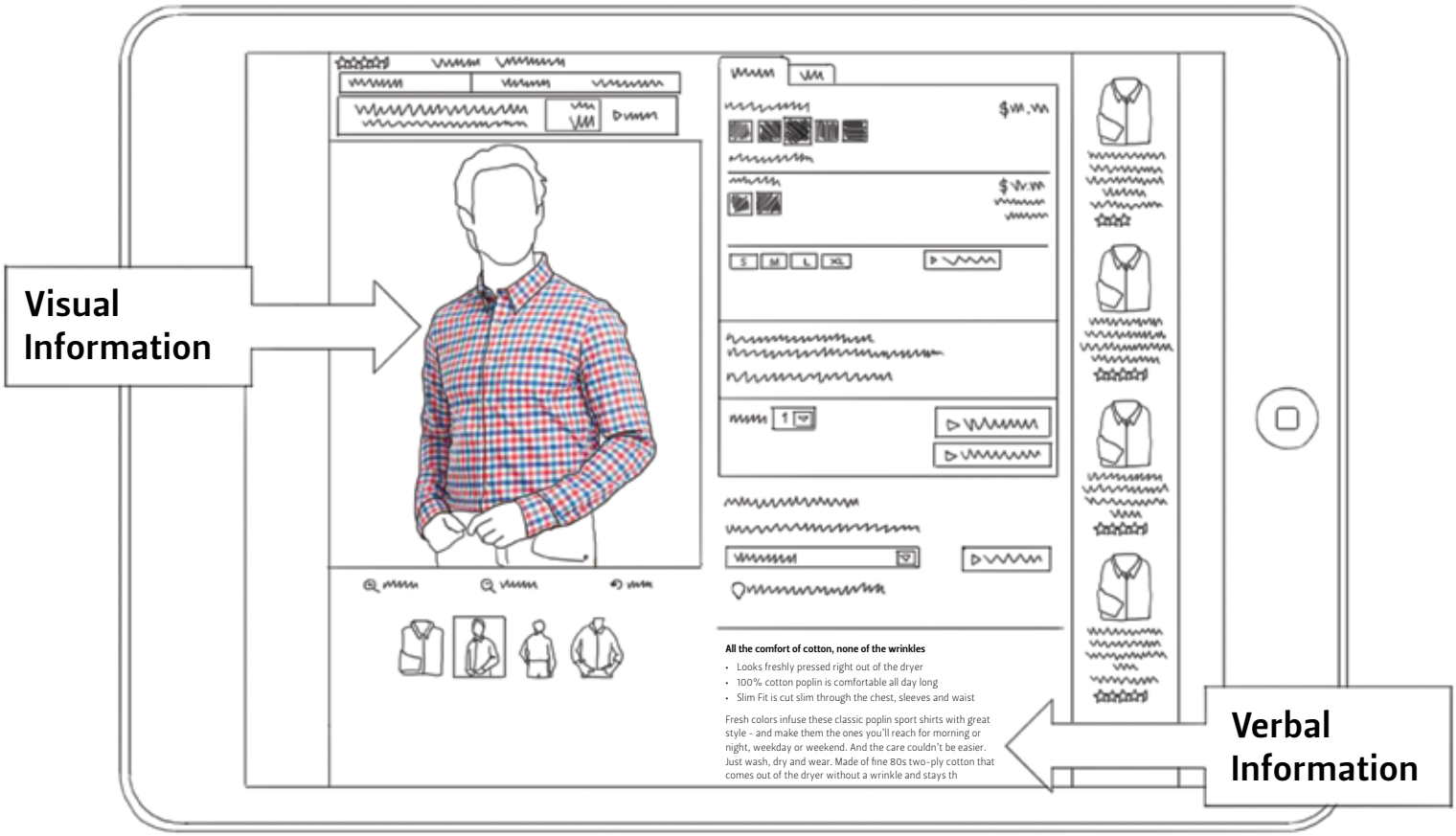


According to Kim, verbal — not just visual — information in online shopping websites has a significant role in turning an online browser into a buyer.

they browse a corporate website for a warm winter jacket or a special-occasion dress.

"My work is about how people process information to drive decision-making," she explains. "It has a twofold goal: to make a contribution to understanding human psychology, and to help retailers build websites that meet the needs of consumers and facilitate decision-making."

When clothing retailers first ventured into Internet sales in the 1990s, Kim was skeptical. "I was not convinced people would buy apparel online," she admits. "How do they make a decision without touching, without trying on? A brick-and-mortar store is sensory. Consumers can explore, collect information. It's a learning process. Being online is a completely different way of experiencing shopping. It felt impossible to me."

Her initial skepticism led to a series of research questions. "I wanted to figure out what makes people buy online. What facilitates decision-making? How should apparel be presented?"

Her findings have upset certain longstanding beliefs in the industry. Take, for instance, the relative importance of visual versus verbal information in consumer attitudes and behavior online. Earlier consumer studies minimized the role of written text in buying decisions. But Kim and her research collaborator, Sharron Lennon from Indiana University, found that verbal information has a significant role in turning an online browser into a buyer. It was a critical discovery for Internet retailers frustrated by high rates of "shopping-cart abandonment" (when a customer changes her mind and doesn't proceed to checkout) in virtual stores, where only about 3 percent of shoppers actually plunk down their credit cards.

This text-based boost to sales runs counter to common wisdom, Kim says. Consumer studies from the 1980s "generally supported the idea that visual information is superior to verbal information" in shaping consumers' attitudes and, by extension, their purchasing decisions, she and Lennon write in the journal *Psychology & Marketing*. Yet their study, a simulated online shopping experiment, found that "despite evidence from previous literature supporting picture superiority," the amount of verbal information significantly influenced not only attitudes but also buying decisions among the test subjects.

"Construction details and style information provide concrete information about apparel products," the researchers note. They offer these examples from their experimental website: *The pointed collar and barrel cuffs, pearl buttons for front closure, rounded shirt bottom, and single chest pocket; two layers of silk with a sheer top, a pattern of slender roses with delicate, thorny stems in deep brown and green, transparent seed and bugle beads across the upper layer.*

"The online experience should help you engage in mental imagery," Kim says. "It should help you picture how the item will mix and match with your wardrobe at home. If you're shopping for a special occasion or a vacation, it should help you imagine wearing it at a party or on the beach.

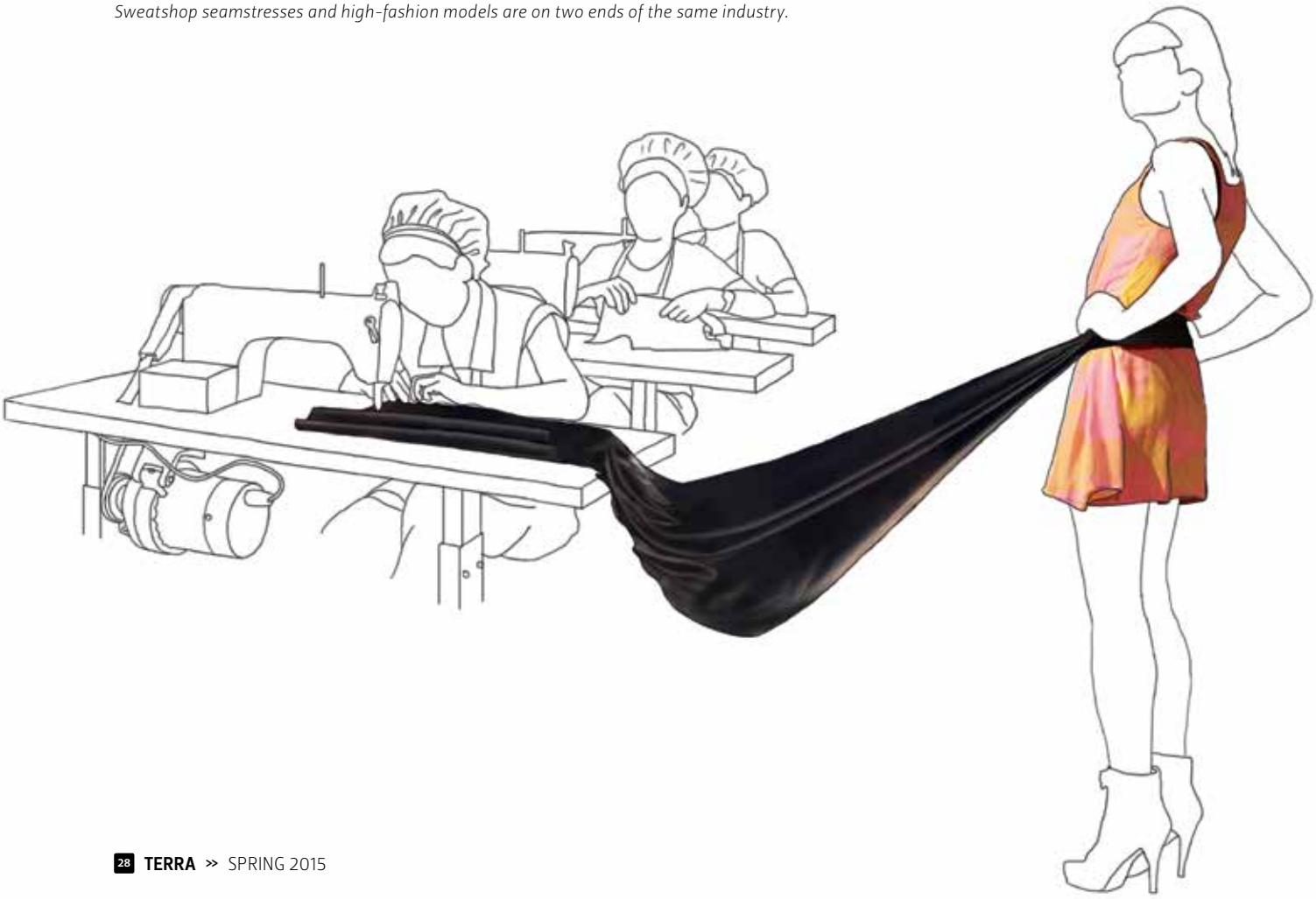
"Having more concrete description helps you to better imagine the product, giving you more confidence to buy," she says. "Shoppers perceive less risk when they feel more knowledgeable about the product."

Other findings from Kim's investigations tell us that Internet retailers who run out of stock risk not only losing immediate sales but also alienating buyers forever, especially if the shopper has chosen the item before discovering it's gone. Black Friday shoppers, too, have defied predictions in Kim's studies. Excessive crowding doesn't anger these bargain hunters and sidewalk campers, as she first posited; on the contrary, most post-Thanksgiving Day shoppers relish the festival atmosphere. It's when they feel misled by bait-and-switch ads that they go from being "happy as larks" to "mad as hornets." These and other findings have appeared in scholarly journals such as *Journal of Business Research, Computers in Human Behavior, Psychology & Marketing,* and *The Service Industries Journal* among many others.

Glitz and Grit

By its very nature, clothing is laden with contradictions. Superficial at first glance, clothes can hold deep significance for the wearer, Kim observes. What we wear (to a wedding, a wake, a game, a pub, a protest, a trial, a concert, a christening, a blind date) is personal but also carries rich cultural content. Functional on an everyday level (it keeps us warm and dry and covered), it also encodes meaning for the wearer's identity, expressing our

Sweatshop seamstresses and high-fashion models are on two ends of the same industry.



taste, values, even politics. Clothing has, in fact, garnered First Amendment protection as a form of free speech and personal expression.

The apparel industry — a $1.7 billion global behemoth that designs, sews, markets, distributes and sells our clothes — is an amalgam of glitz and grit, Kim has discovered during her years in the field. The bone-thin girls modeling the latest styles on high-fashion runways might seem unconnected from the bone-thin girls sewing garments in grimy sweatshops. But they are two ends of the same industry, one that employs 75 million people worldwide.

Kim is painfully aware of these polarities. She saw her first sweatshop as a technical designer of knit dresses made in the Philippines. "The workers were just kids, girls who were still in their mid-teens," she says. "One day I noticed that no one was eating lunch during their half-hour break. They had their heads down on the tables beside their sewing machines. I asked the factory manager about it. He said, 'They don't have money to buy lunch.' It was heartbreaking."

Being part of an industry with a mixed record on worker rights requires a kind of stereovision, the ability to see simultaneously the good and the not-so-good. Like a parent who loves a wayward child, Kim holds out hope for reform. For her, it's a question of business ethics. She once worked with a talented buyer whose credentials included luxury department stores in major U.S. cities. "He had a great eye for fashion, for what sells," she says. "But he didn't see the big picture, the connectedness of everything, because he didn't have an understanding of the production side of the industry. He wasn't aware of how corporate-level decisions would impact someone's life on the other end of the industry spectrum."

In the sweatshops of Southeast Asia during the 1990s, Kim saw firsthand the wretched conditions that have stirred protests among human-rights activists and spurred consumer boycotts. "The apparel industry gives a lot of opportunities to women, especially in developing countries," she notes. "It's labor-intensive, so it creates jobs. But there's a vicious cycle of poverty that most of the workers will never get out of. They are barely surviving."

Inside the Gray Matter

After a lot of soul-searching buttressed by extensive reading (including *Banker to the Poor* about social entrepreneurship and micro-lending by Nobel laureate Muhammad Yunus), Kim has resolved to turn her heartbreak to action for the young Filipino workers and others around the world. "In the long run, I want to use the skills, knowledge and network I have to help women in developing countries," she says. "There are 10 million people out there in poverty. If they have a little support, they can have a different quality of life. I want to contribute to closing the gap."

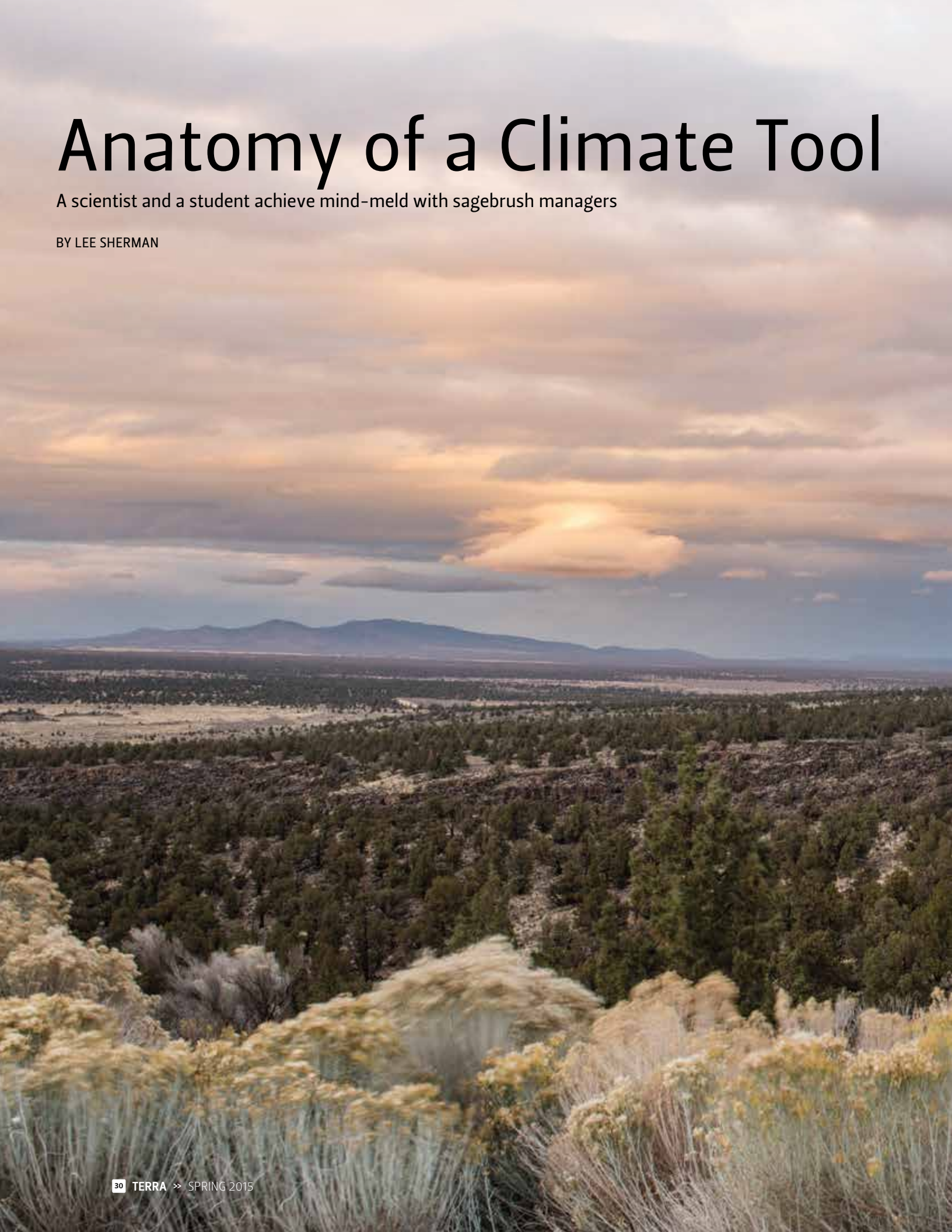
As for her consumer research, the next step is to move from indirect studies of shopper psychology (inferring attitudes, feelings and behaviors via surveys and controlled experiments) to direct studies (using fMRI technology to scan the brains of subjects while they shop, browse and buy). Inspired by books such as *The Shallows: What the Internet Is Doing to Our Brains* by technology writer Nicholas Carr and by earlier findings that brand loyalty and religion light up the same areas of our brains, Kim is eager to get down to the gray matter.

"Humans' brains are changing how they function," she says. "As people use the Internet more, it's harder for them to engage in linear thinking. Now it's more of a spiral." terra

Anatomy of a Climate Tool

A scientist and a student achieve mind-meld with sagebrush managers

BY LEE SHERMAN



Climate-change projections can help land managers think strategically about the future. But when range ecologists, wildlife biologists and weed coordinators in Eastern Oregon consider their own agency's swath of sagebrush, how can they be confident of their management decisions as conditions change? How can climate modelers build better tools to guide them in their work? What future climate-change information would be most relevant to their decision-making?

These are the questions driving an investigation by Oregon State University researcher Dominique Bachelet and undergraduate student Melanie Brown. Bachelet, an associate professor of bioengineering and senior climate-change scientist at Corvallis-based Conservation Biology Institute (CBI), and Brown, a natural resource management major in the College of Forestry, surveyed land managers in sagebrush country to create a blueprint for a practical, nimble, accessible computer tool for helping manage fires, protect wildlife, reseed vegetation and control invasives in a shifting landscape. A grant from the Bureau of Land Management (BLM) funded the work. *Terra's* Lee Sherman sat down with them recently to talk about the project.

Gray rabbitbrush (foreground) grows alongside sagebrush and western juniper on the rangelands of Eastern Oregon near Burns. (Photo: Stephen Ward)

TERRA: How did your project get off the ground?

DOMINIQUE BACHELET: It all started at the Oregon Climate Change Research Institute conference last year in Portland. I was sitting next to Louisa Evers from the BLM. And she was saying, "Presentations and publications are great, but sagebrush managers can't really use this." And I said, "Well, what is it that they could use?" And she answered, "Well, why don't you ask them." So I went back to Corvallis and said to Melanie: "Compile a bibliography and build your knowledge of the sagebrush issues. Once you're comfortable with that knowledge, you can contact managers and ask them questions to help design better tools for them."

MELANIE BROWN: I'm from the East Coast, so I had never dealt with sagebrush in my life. It was a huge learning curve, reviewing the literature on sagebrush and all the species in the sagebrush ecosystem, including the sage grouse, which is an obligate species — it can't live anywhere else. I learned about a multitude of threats, like invasive weeds that increase fine-fuel loads and feed the fire regimes we've been seeing east of the Cascades. It was summer when I was doing the literature review. The whole time, the news was flashing huge wildfires. So I was sitting at Valley Library or at CBI, reading, and there was a haze of smoke in the air. I was starting to really make the connection between the sagebrush and the wildfires that are ever-expanding because of cheat grass and medusahead and ventenata. Then I drove out to Boise for the Public Lands Foundation annual conference, and it was smoke everywhere. While we were there, we were on a tour bus with some fire-management specialists when all of a sudden, they were on their walkie-talkies because they saw a fire off in the distance, smoke rising over the hill. They were telling us, "There's no fire season anymore; the fires are just year-round."

BACHELET: And, of course, there is the political issue of the sage grouse being considered for the endangered-species list. If it were listed, restrictions on land use would be dramatic. BLM also sells grazing and resource extraction leases, which are sources of revenue. Limiting those would affect funding for land-management activities. So pressures on land managers are amazingly complicated.

BROWN: After the literature review, we sent an online survey to 15 BLM weed coordinators — people who deal with invasive plant species. The response rate was pretty sobering. I tried email, but nobody got back to me. So I started making phone calls. And everybody was just so willing to talk. The survey expanded to 30 managers, from weed coordinators to biologists, range ecologists, ESR managers (Emergency Stabilization and Rehabilitation), people who work on REAs (Rapid Ecological Assessments) and monitoring plans. The interviews were all anonymous, so the subjects could speak freely. They all know that climate change is something they need to be dealing with. But they don't have access to useful tools. Sometimes it's because existing models don't match their needs. Often, their Internet browser, such as Internet Explorer, doesn't support all the tools' capabilities. Many managers told me they couldn't even open some of the tools I showed them.

BACHELET: CBI has developed a mapping and analysis platform called databasin.org that includes hundreds of spatial datasets. For the project, we set up a special group for the sagebrush managers where they could explore datasets and give feedback. Is the information adequate or incomplete? Is it current or does it need updating?

BROWN: We had them look at eight existing climate tools and pick them apart, everything from color to scale to axis increment size to the climate models used within the tool itself — the historical timescale versus the projected timescale.

TERRA: Climate scientists are always asking: How can we convey our findings in a way that people can digest them and use them, make the science practical? What did you learn about that?

BACHELET: Melanie's surveys indicate that 30-year average projections of potential change aren't that useful to people working in the field who need short-term information. Most land managers have a healthy dose of skepticism about the reliability of projections, anyway, which is good because uncertainty is high and model projections are probably conservative. There are some who do use climate projections to write plans and design triage for restoration or land use. But most of them want information that falls somewhere between weather forecasts and climate projections, which makes sense. They depend on annual and seasonal variations for seeding and planting just like farmers do. Tools for forecasting the best times for planting, seeding, harvesting and irrigating do exist for farmers, but the managers we talked to do not seem to use them.

A western juniper tree (right foreground) overlooks a sagebrush rangeland that transitions to juniper woodland in the distance. "Many of the juniper in the photo are less than about 140 years old," says Dustin Johnson of OSU Extension in Burns. "The historical landscape would have looked much different, with fewer trees and a far greater expanse of sagebrush on the landscape." (Photo: Stephen Ward)

TERRA: So what's needed to fill the tool gap?

BACHELET: At CBI, Tim Sheehan, who is also a Ph.D. student at Oregon State, is working on a decision-support tool that overlays spatial datasets. You can add a set of rules that weight each and every one of them in order of importance. Here's the sagebrush extent. Here are the different soil types — this soil's really tough and hard, this soil can hold a lot of moisture. Here's topography. Here's grazing intensity. And then by association, he creates polygons that describe the landscape with unique combinations of these interacting factors. So one can actually start looking at the landscape and see that some areas are in such dire straits that they might be sacrificed for resource extraction. Other places may have the highest density of intact sage grouse habitat. Let's protect it. Let's consider giving incentives to the landowner, if it's privately owned, so that they protect this area.

BROWN: Pretty much all the managers I talk to do seeding for restoration, whether it be to combat invasives or to reseed the sagebrush after a fire or to do emergency stabilization. For the long term, it comes down to this: What kinds of seeds do they want to plant? What species do they want to choose? Do they want to choose drought-resistant species because the climate is getting warmer and drier and summers getting longer? Do they want to forget species adapted to cool weather, like C3 perennial ryegrass species, those that need the snow and a cool growing period? The people who make the decisions need to feel confident that the climate tool they have access to is reliable at the temporal and spatial scale at which they work.

BACHELET: One thing is certain: Managers are more interested in impacts than absolute change. This is a key finding of our study. Information on impacts — drought, flooding, fire, plant migration, habitat shifts, carbon sequestration potential, water quality — has not been as widely available and centralized as climate projections have been, providing carbon-emission levels, temperature change, rising sea levels, or precipitation patterns. Climate-impacts scientists need to coordinate

"What Will the Impacts Be?"

Sagebrush managers voice climate-change concerns

Climate scientist Dominique Bachelet says climate-change projections can help land managers design plans and, above all, understand and anticipate impacts on the lands they manage. "They want to know the impacts on their system of concern, to be able to prioritize, to triage," says Bachelet. "We can build 'decision-support tools' specifically for these managers."

Here are a few of the comments and insights from sagebrush managers who participated in a Bureau of Land Management-funded project to design better modeling tools:

PLANT PATTERNS. "When you start talking about climate change, I start thinking about how climate change is going to impact the current vegetation that we have on site. What's the climate pattern going to be? Is it going to be hotter and drier? Cooler and wetter? Are we going to see shifts in when we start getting our precipitation? Will this shift from a springtime event to a monsoonal summer event? And how is that going to impact our current vegetation state? Will we start seeing our vegetation moving in a northern pattern? Will we start getting changes in vegetation from what we've historically seen, such as invasives?"

WILD WEATHER. "One thing that is a challenge for me observing the weather over the last few years is the day-to-day variability. We've been seeing very strange day-to-day temperature swings. For instance, last November we had a cold snap with record-breaking lows for almost a week right after we received a record-breaking snowfall. And then it got warm up to about 60 degrees maybe two weeks later. It would be helpful if there is any way for us to understand when we'll be seeing these wild temperature swings in the future."

LOOKING LONG-TERM. "From a planning standpoint we have an RMP (resource management plan) large-scale land use planning document. It's our larger document that we base all of our other documents off of. That would be where some of these tools could be useful because it's a long-term plan. Some of the projects we're looking at go 10 to 20 years, and recently we have needed to analyze climate. These longer projections would be helpful for the longer-term projects."

POLITICAL PRESSURE. "To me the problem is that some of this stuff is still a guess. It's still not 100 percent sure that this will be the scenario that we will see. But it's the best guess. It's the information and best science that you have available to work with at the time. We get a lot of political pressure to do or not to do. There are political opinions that make it challenging and our NEPA (National Environmental

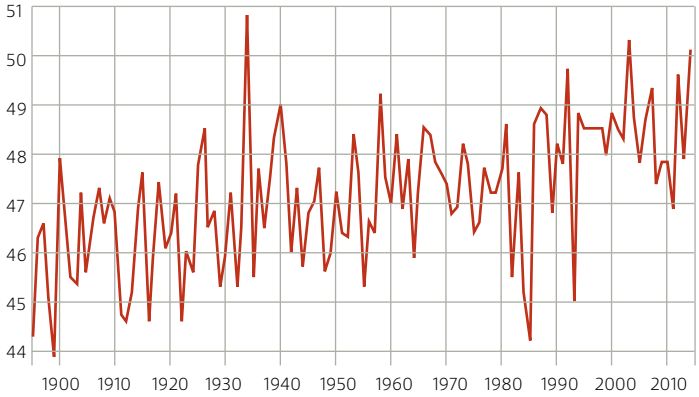
and produce the same packaged range of projections that climate modelers have done for the last 25 years. Effective tools to deliver the results from impact models have not been built yet.

TERRA: What sets your emerging tool apart from other tools out there?

BACHELET: Transparency. You can see how an answer is obtained. We tried to put as much documentation in the decision support as we could. You can see exactly the spatial layers we are using to answer a particular question. And flexibility. If something doesn't make sense or something is not useful to whomever it is asking the question, we can change it.

BROWN: And tailored. I think especially for these land managers, these new tools we are working on designing are going to be specifically tailored toward land managers, if not specifically sagebrush land managers, with a temporal and spatial scale relevant to them and with specific variables that land managers can use. terra

Average Temperature



Average temperatures in Southeast Oregon (Oregon Climate Division 9) have increased over the past 100 years, according to this graph from the National Oceanic and Atmospheric Administration.

Policy Act) has become messy and stagnant because of this. So instead of having a short, concise document we end up with long and messy, multiple-alternative-scenario documents. We try to use these kinds of tools to show that what we're trying to do on the ground is supported by the best information we have available."

TOO MANY TOOLS. "We're supposed to be looking at climate change when we do our NEPA analysis for any projects. We never know what climate models to use because there are so many of them. Even if we know which ones to use we don't have the data in-house, and then we don't have a consolidated place that tells us how the climate variables are going to affect our resources of concern."

IMPACT INSIGHTS. "A main concern or question I have is about the final impacts. What are they going to be? What will be the seasonality and the amounts of moisture? What's going to happen and how are climate variables going to impact the communities that existed historically? Where is the climate headed, and what is the plant community response to it going to be?"

SELECTING FOR SURVIVAL. "We would need to know if we're in an area where plants may not exist because the climate's getting hotter and drier. This is where a tool could be useful to predict what the climate change would be for a specific area. This would help us identify areas where we might have more durable treatments on the ground or help us make selections for different types of plant cultivars that would be adapted to drought, so that they can survive in those areas."

JUNIPER JUDGMENTS. "Understanding what climate conditions promote the invasion or spreading of juniper would be really helpful. At what elevation would this spreading be worse? Is it elevation, is it aspect, is it general climate trend?"

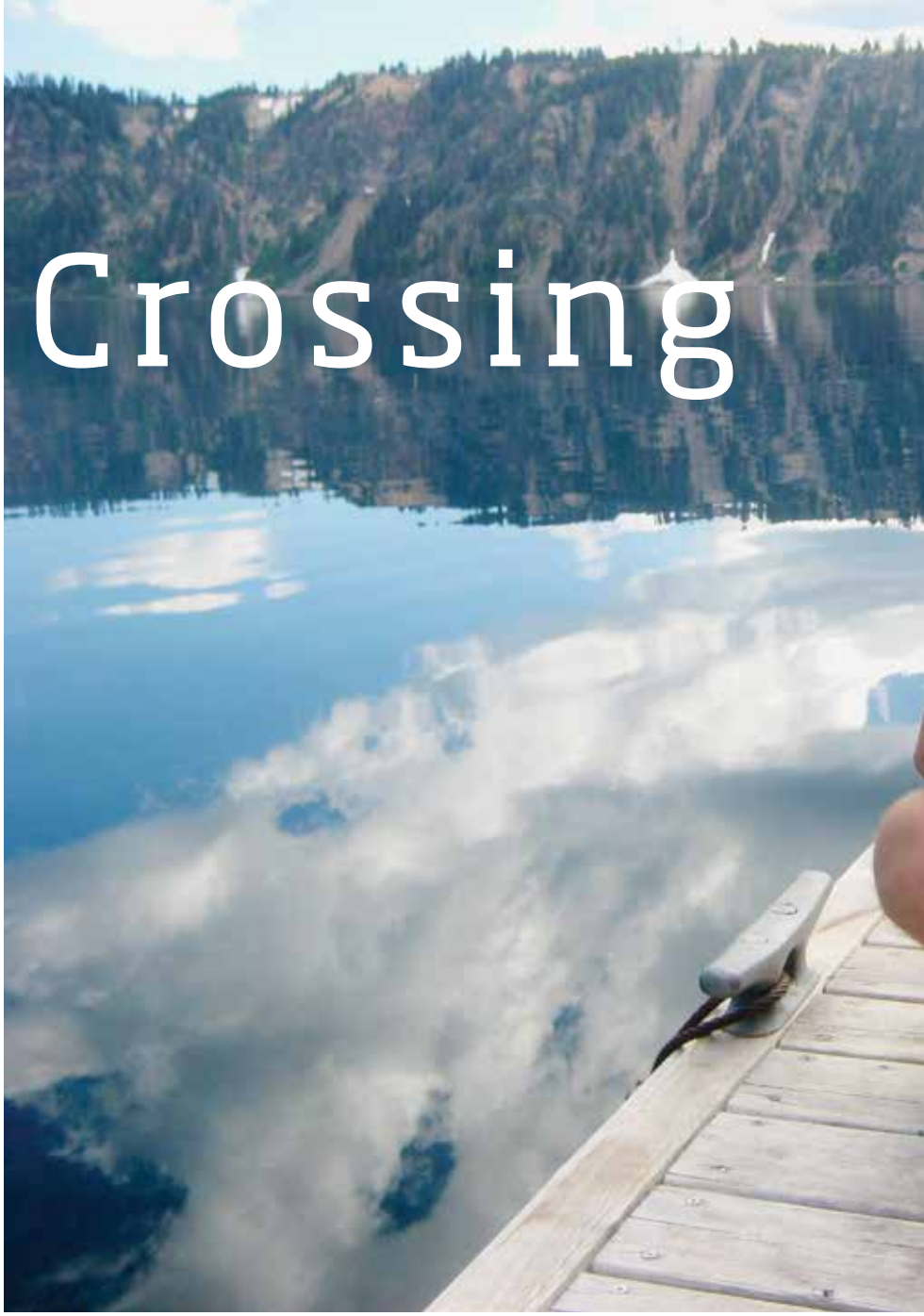
COMPARE AND CORRELATE. "The vegetation class (in the model) is quite interesting. It's hard to tell how accurate it is, but the trend itself is interesting. It's interesting to look at the past dates and then see where the shrubs have dropped off. It is interesting to compare across all the graphs (temperature max and min, and precipitation). Makes me feel better about what I'm seeing in the field and then correlate it back to the graphs in the tool."

INTERESTING INVOLVEMENT. "I appreciate being involved, and I think some of these climate tools are interesting. I can see good use in some of them. Thanks for pointing me to them."

The Crossing

A scholar resides comfortably astride the sciences-humanities divide

BY LEE SHERMAN



Toss an encyclopedia into an Osterizer and press "blend." That's how it feels to spend an hour with Raymond Malewitz.

The assistant professor in the School of Writing, Literature and Film at Oregon State University will take you on an intellectual romp that careens from crime-scene forensics to IKEA hackers, from the Sokal hoax to mad-cow disease, from "salvagepunks" to the *Adventures of Tintin*. In one breath he's talking about MacGyver, and in the next, he's making a point about Margaret Atwood's *Oryx and Crake*. One minute he's analyzing the gray wolf's role in Cormac McCarthy's Border Trilogy, while the next he's describing what happens when you drop a zinc-and-copper penny into hydrochloric acid.

"I'm a dabbler," he says with an apologetic grin. "I like to jump nimbly from thing to thing."

Especially, he likes to leap the traditional chasms between the sciences and the humanities on American campuses. While his propensity to break out of disciplinary silos makes him a rarity in academia, he's not entirely alone.

Ray Malewitz, shown here at Crater Lake, describes his first impression of the Pacific Northwest as "blindingly green." (Photo courtesy of Ray Malewitz)

There is, after all, his doppelganger. Giving his listener a quizzical look that says, "I know, it's hard to believe, right?" he waxes befuddled about Jason Coats, an undergraduate classmate at the University of Michigan who had signed up for the identical, improbable double major, biochemistry and literature. "It was the weirdest thing," he says, still shaking his head in disbelief nearly two decades later. "There was this other guy who took the very same, very strange double major."

The doppelganger aside, Malewitz's simultaneous embrace of the humanities and the sciences did set him apart from his peers. "My chemistry friends were deeply suspicious of my English friends, and my English friends were kind of puzzled by my chemistry friends," he reports, a sly snicker signaling his enjoyment of confounding his pals.

Speculative Scenarios

As an undergrad, Malewitz figured the only way to connect science and literature professionally was through the science fiction genre — that is, fiction about the future. But he had scant interest in what he calls "speculative scenarios." It was the real practice of science, "the day-to-day interactions between laboratory people and laboratory objects," that pulled him in. Unsure about his professional direction after graduation, he took a job doing smokestack purification research for an environmental engineering company in Cologne, Germany.

Once back in the states, he taught chemistry and biology at a private international high school for oil-industry kids in Houston. He loved teaching. But as he looked toward grad school, he remained torn between the sciences and the arts.

"I struggled with it a lot," he confesses. "But over the course of working in various chemistry labs, I discovered that as a chemist, you have to specialize rather quickly. And that's the thing you do for your life. You're the 'mass-spec' guy. I didn't want to be the mass-spec guy."

Meanwhile, a new field was taking hold in literature departments — literature and science, which he defines broadly as "fictional explorations of scientific achievements and problems," which are often "combined with attempts to accurately represent modern science as a kind of culture." He thought to himself: "Whoa, this is something I can do. I can combine these two interests and talk about things I love from the literary perspective, which I couldn't do from the other way."

So he went back to school for a Ph.D. in English literature at the University of Virginia. Summers, he wore his science hat to teach a course in the science of crime-scene investi-

gations at Cambridge. His doctorate completed, he taught writing as a lecturer at Yale for several years. But he never abandoned the scientific alter ego that had been with him since childhood.

Roots on a Rock

It was in the mid-1970s when a retired Catholic priest living near the shores of Lake Huron fell in love with a young elementary school teacher. The unlikely pair married and lived for two years on one of the lake's thousands of small islands, a "2 ½-acre rock pile" without electricity or running water. No TV, no phone. Great slabs of ice crashed and rolled in the lake during spring thaw, making travel to mainland Ontario impossible. So when the couple's first child, Raymond's older sister, came along, they moved back to town. But they spent summers on the island.

During those long, light-filled days, Ray learned to catch, fillet and panfry fresh pike and perch. He gathered wild blueberries in a tin bucket. He pumped water at an old hand pump and, when he was big enough, hauled it to the cabin. With his younger brother, he salvaged fort-building materials from a couple of moldering old skiffs. Beaver and deer swam in the cold, clear water that lapped the shores. At night, he listened to his father's adventure stories of canoeing in the Yukon, paddling Great Bear Lake and Great Slave Lake above the Arctic Circle.

And he read. The teetering stacks of library books he carried back to the island after weekly boat trips to the mainland were an eclectic selection, from graphic novels to presidential biographies to Hindu scripture. A particular favorite was Hemingway, who "wrote about areas in Michigan that I knew and that I had fished," Malewitz says. "The authors I typically read were either European or focused on one of the two American coasts, so I tended to associate 'important' art with those regions. Hemingway taught me that my own region was worthy of the same thinking."

"Whoa, this is something I can do. I can combine these two interests and talk about things I love from the literary perspective, which I couldn't do from the other way."

Animal Agency

Summers on a primitive island where the only parental rule was, "Don't die," gave Malewitz room to know Earth on its own terms. The human bent toward domination and domestication of wild places and wild things became a central theme in Malewitz's scholarship. For a recent OSU Humanities Center fellowship, for instance, he explored the question, Can literary animals have agency? His analysis centered on Cormac McCarthy's searing story of adolescent Billy Parham's paradoxical relationship with a captive gray wolf in *The Crossing*, the second novel in the Border Trilogy. This quarter, he's co-teaching a course called The Art, Science and Literature of Fly Fishing, described in the syllabus as "a cross-linked, multidisciplinary class that uses fly fishing as a window into the larger world of science, art and conservation."

Zoonotic diseases — ones that pass between animals and humans — are another of Malewitz's current interests. "These zoonotic viruses — Ebola, mad cow, HIV, West Nile — are really dangerous in our popular imagination," he says. "They have an additional horror associated with them because it suggests that we are like the animals, that the divides we set up between human bodies and animal bodies are illusory, right?"

He also delves into "material culture studies," an interdisciplinary field that originated in anthropology but has veered toward contemporary themes such as anti-consumerism, waste reduction, self-sufficiency and DIY (do-it-yourself) — ideas Malewitz tackles in his first book, *The Practice of Misuse: Rugged Consumerism in Contemporary American Culture* (2014, Stanford University Press).

Malewitz voices impatience with what he calls the "artificial war" between the sciences and the humanities. He concedes that when scholars in the arts, sciences and social sciences toss their divergent ideas into one bubbling cauldron, there's a danger of creating some "monstrous Chimera — you know, like part human, part lion, part horse.

"Sometimes that looks pretty ugly," he says, pondering the oddity of such a multi-species beast. "Sometimes, though, it's beautiful." terra

The Oh! Zone • Far-out findings from science

Of Mice, Astronauts and the Elderly

Studying bone loss on the International Space Station

When the privately owned aerospace company SpaceX launches a supply ship to the International Space Station next fall, researchers in the Oregon State University Skeletal Biology Lab will be keeping their fingers crossed. The cargo will include a shipment of laboratory mice destined to help the Oregon State scientists shed light on, among things, the consequences of bone and muscle loss in astronauts and elderly adults.

NASA has known for years that astronauts lose bone mass during space flight. Russell Turner, the Oregon State lab's director, has been collaborating with the agency on this problem since the late 1970s. "The rate of bone loss in astronauts is three to four times the rate for post-menopausal women," he says.

Space agencies have addressed the issue by tweaking exercise and diet regimes, but success has been elusive. Now, with funding from NASA, Turner and his team — Associate Professor Urszula Iwaniec and Ph.D. student Jessica Keune — are looking at how mice expend energy under weightless conditions. Specifically, they want to know if the manner in which animals regulate body temperature affects bone loss.

While Turner aims to help NASA keep astronauts healthy during a journey to Mars and back, he sees benefits for aging adults on Earth. "The level of mortality after a bone break is really shocking," Turner says. "This is an exquisite model for looking at the effects of skeletal disuse. If we can come up with ways that would effectively prevent muscle wasting and bone loss in an aged individual after a fracture, that will have a giant effect on quality of life."

Student-Built Solar Car to the Middle East

Oregon State's *Phoenix* runs in Abu Dhabi's first solar race

At last winter's Abu Dhabi Solar Challenge, residents of the Persian Gulf emirate would pull alongside competitors on the highway, lean out and take photos of the solar-powered vehicles. Solar cars are as much a novelty there as in the United States, says John Ren, a member of the solar car team at Oregon State University, which took part in the 1,250-kilometer race.

Such events spur Ren and his peers to push the boundaries of solar vehicle technology. "Efficiency is the most important thing for us," says the sophomore in industrial engineering from Portland. "We do everything we can to reduce drag and even power loss in the wiring."

Named the *Phoenix*, the three-wheeled Oregon State solar car was built by students from the ground up, starting with its titanium frame. Silicon solar cells in a plastic-laminated array blanket the car's surface, but the students have their eyes on emerging Oregon State photovoltaic technologies. Also under study is an anti-reflective solar-cell coating developed by team co-founder Kat Han, who received her Ph.D. in chemical engineering in 2014. The coating could help increase the car's power output.

Lack of Vitamin E May Threaten Brain Health

Micronutrient could be an Alzheimer's risk factor

It may not wake you up like caffeine or improve your Sudoku score, but new research suggests that vitamin E plays a critical role in brain function.

Working with zebrafish, a team led by Maret Traber has shown that this micronutrient contributes to adequate levels of DHA-PC, a chemical that is part of the membrane of every brain cell. Fish deficient in vitamin E had lower levels of another compound that helps to shepherd DHA-PC into neurons and to repair cell membranes.

The 1-year-old zebrafish used in this study, and the deficient levels of vitamin E they were given, are equivalent to humans eating a low-vitamin-E diet for a lifetime. In the United States, 96 percent of adult women and 90 percent of men do not receive adequate levels of vitamin E in their diet.

"This research showed that vitamin E is needed to prevent a dramatic loss of a critically important molecule in the brain and helps explain why vitamin E is needed for brain health," says Traber, who is the Helen P. Rumbel Professor for Micronutrient Research in the College of Public Health and Human Sciences at Oregon State. She is also affiliated with the Linus Pauling Institute at Oregon State.

The research was supported by the National Institutes of Health and reported in the *Journal of Lipid Research*.

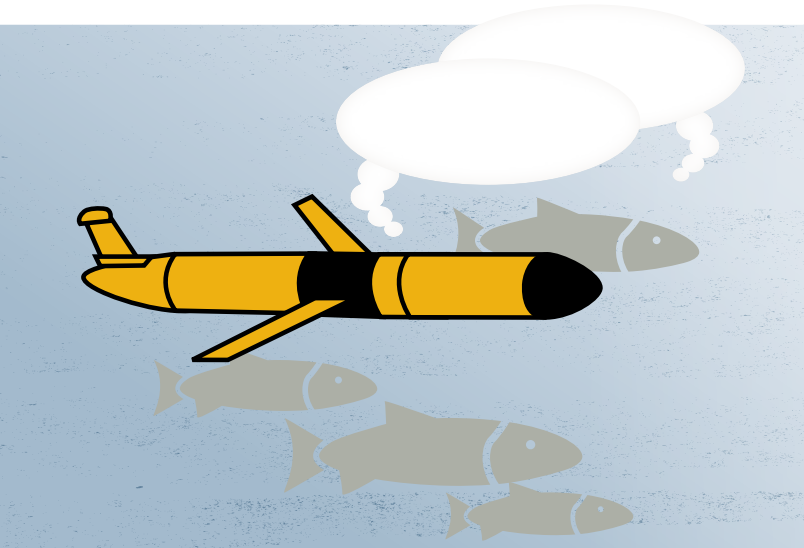
Undersea Gliders Think Like a Fish

Sensors will shed light on ocean ecology

By equipping underwater gliders with acoustic sensors and computer software, Oregon State oceanographers are teaching the autonomous vehicles to identify biological hot spots in the oceans.

"We want to get a better handle on what kind of marine animals are out there, how many there are, where they are distributed and how they respond to phytoplankton blooms, schools of baitfish or oceanic features," says Jack Barth, a professor in the College of Earth, Ocean, and Atmospheric Sciences at Oregon State. In other words, they want the glider to "think like a fish."

Barth is working with Kelly Benoit-Bird, professor and marine ecologist in CEOAS, and with Geoff Hollinger, assistant professor in the College of Engineering's robotics program. They received support from a $1 million grant from the W.M. Keck Foundation



Computing Resilience

University consortium targets community infrastructure

Earthquakes, tsunamis, tornadoes and other natural disasters strike with little or no warning. By developing new computer tools to evaluate buildings, utility networks and other infrastructure, Oregon State is helping communities to reduce damage and speed recovery.

Oregon State is part of the Community Resilience Center of Excellence located at Colorado State University, which has received support from a five-year, $20 million U.S. Department of Commerce grant.

"Engineering plays a big role in how resilient the built environment is in response to a variety of hazards," says Daniel Cox, professor in the Oregon State School of Civil and Construction Engineering and associate director for the center.

Oregon State leads the Cascadia Lifeline Program, a research initiative with government and private industry to help improve critical infrastructure performance during a major Cascadia subduction zone earthquake. Oregon State faculty have also contributed to the Oregon Resilience Plan, an initiative to mitigate damage from that earthquake and the resulting tsunami.

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Wood Panel Promise

Rapid construction, quake-resistant performance

In 2004, when Lech Muszynski first heard about cross-laminated timber (CLT) construction, he thought it was a terrible idea. Massive timbers glued together to form the elements of a structure seemed to grate against the trend toward thin, light, resilient structures.

However, his opinion was about to change. The associate professor of wood science at Oregon State University saw how fast complex structures could be built with CLT panels. He learned that a full-sized, seven-story CLT building survived nearly unscathed after being shaken on the world's largest earthquake table in Kobe, Japan.

Not since the development of plywood, he says, has a material innovation so thoroughly changed the construction process. "It's an entirely new technology," he adds. "It revolutionizes the way we build with wood."

A decade later, Muszynski coordinates a team of Oregon State researchers in the colleges of Forestry and Engineering that, with funding from Oregon BEST ($150,000) and the U.S. Department of Agriculture ($725,000), is working with the forest products industry to turn CLT into a boost for rural economies. He's also collaborating with the DR Johnson Lumber Co. of Riddle, Oregon, to test and certify the first U.S.-made CLT panels for the construction industry.

"Currently, in the U.S, it's kind of a chicken-and-egg situation with CLT," Valerie Johnson, president of DR Johnson, told the *Portland Business Journal* last fall. "There is significant and rapidly growing interest in using CLT, but the cost to import panels from Canada or Europe for construction is not cost competitive."

Among the topics that Muszynski and his colleagues are investigating are the integrity of wood-adhesive bonds, the use of Oregon wood varieties, the performance of CLT panels in seismic tests and the potential for using lumber from small logs harvested in forest restoration operations.

In 2010, a team composed of Arijit Sinha, Anthony Kramer and Andre Barbosa in the colleges of Forestry and Engineering produced CLT prototype panels made of hybrid poplar. "Poplar CLT was substantially lighter but still made minimum specifications for structural CLT," they reported.

Demand for CLT far exceeds global production, which currently stands at about 1 million cubic meters annually in Europe and Canada. Projected demand in the United States alone is 2 to 6 million cubic meters, based on a 5 to 10 percent penetration rate into residential and non-residential building markets, according to FP Innovations, a nonprofit forest research firm.

During a sabbatical in 2011, Muszynski visited CLT manufacturing plants in Austria, Italy and Switzerland. Although they were located in an area about the size of Oregon, he found that they were all successful in serving construction markets on the Continent. "By the European model, we should be able to have at least five plants just in Oregon," Muszynski says. "There is enormous interest among engineers and architects to use CLT."

Before coming to Oregon State in 2004, Muszynski was a post-doctoral researcher and assistant scientist with the Advanced Structures and Composites Center at the University of Maine.

CLT panels can be customized for specific applications. This one, manufactured by Smartlam, is being tested in Oregon State's wood science lab. (Photo courtesy of Lech Muszynski)

To discover what the **Oregon State University Advantage** and the **Advantage Partnerships program** can do for your business, contact Brian Wall, Assistant Vice President for Research, Commercialization and Industry Partnering, 541-737-9058. **oregonstate.edu/advantage**

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The genus of this Red Sea Acropora *coral includes species that also build reefs in the Caribbean, the western Pacific and other locations. Researchers in Rebecca Vega-Thurber's lab are collecting microbes from coral to understand threats to reefs, which have declined about 40 percent globally. See "Reefs Under Siege," Page 14. (Photo: David Baker)*