terra

A world of research & creativity at Oregon State University · Spring 2013

AQUATIC VIGIL

Looking after research fish day and night

OREGON 9.0
Getting ready for the Big One

OF TEXTS AND TEXTILES
Arras tapestries tell rich stories

CONNECTIVE TISSUE
Where philosophy meets science

Oregon State UNIVERSITY

terra

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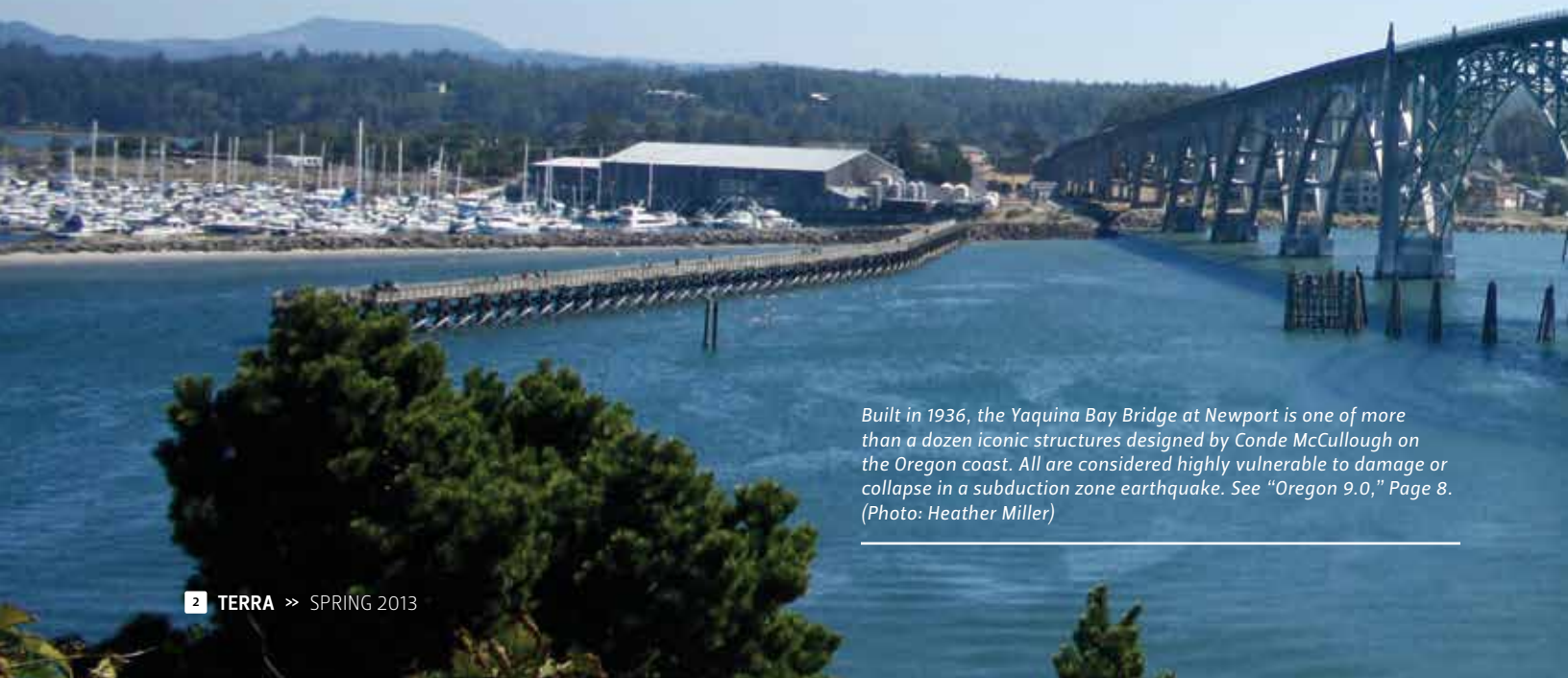
Oregon's leading public research university

FEATURES



Built in 1936, the Yaquina Bay Bridge at Newport is one of more than a dozen iconic structures designed by Conde McCullough on the Oregon coast. All are considered highly vulnerable to damage or collapse in a subduction zone earthquake. See "Oregon 9.0," Page 8. (Photo: Heather Miller)

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Oregon State is Oregon's leading public research university with more than $281 million in research funding in FY2012. Classified by the Carnegie Foundation for the Advancement of Teaching in its top category (very high research activity), OSU is one of only two American universities to hold the Land-, Sea-, Sun- and Space-Grant designations. OSU comprises 11 academic colleges with strengths in Earth systems, health, entrepreneurship and the arts and sciences.

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On the cover: Joseph O'Neil keeps tabs on steelhead eggs in a tank at the Oregon Fish Hatchery Research Center near Alsea. (Photo: Lynn Ketchum, Extension and Experiment Station Communications)

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Oregon State UNIVERSITY

BALANCING WORK AND FAMILY

Babies don't wait for you to get your master's degree. They arrive on their own schedules and change your life. Drew Arnold learned that lesson when he became a father. He also found that sleep comes in a distant third to family and education.

In 2010, he began a graduate program in mechanical engineering at Oregon State University. He wanted to work on innovative, high-risk projects that solve problems and push technology in new directions. So for his thesis, he aimed to reduce injury risk for chainsaw users. The problem is called "kickback" and happens when the tip of a fast-moving chain accidentally hits an object and lurches toward the user's face. Chainsaw injuries now send about 36,000 Americans to the emergency room every year, according to the Centers for Disease Control and Prevention. Arnold combined a miniature gyroscope with other sensors to create a brake that would stop the chain more rapidly than the mechanical devices used on most saws today.

When baby Claire entered the world, she shifted priorities for Drew and his wife Ashleigh. Education became more than progress toward a degree and an engineering career. It became a stepping stone toward a secure future for their daughter.

Personal and professional lives overlap. Take two other examples from this issue of Terra. Ruth Milston-Clements is on-call 24/7 for the care of laboratory fish. The phone might wake her from a deep sleep or interrupt dinner for her family. Scott Ashford, an earthquake engineer, understands what will happen when the next major quake hits the Northwest. He worries about the safety of his own family as well as the future of communities across the region.

Drew Arnold now works as a product engineer for one of Oregon's most respected manufacturers, Blount International in Portland. His job is demanding, but the Arnold family also enjoys company-sponsored Easter egg hunts, barbecues and other activities. Moreover, through the Oregon State University Advantage program (see Page 39), Blount maintains an edge through research with Oregon State engineers. Its long-term success rides on the shoulders of such partnerships and on the babies who are our future.

Nick Houtman

Editor

Flight Plan

UAV technology can create jobs, save money and lives

BY RICK SPINRAD, VICE RESIDENT FOR RESEARCH | ILLUSTRATION BY LESLIE HERMAN

Unmanned aerial vehicles (UAVs), sometimes referred to as "drones," have been the focus of recent international attention because of their military use. However, these systems also have many domestic uses that are practical and benign and should be embraced for their potential to save money and lives.

UAVs are an emerging industry that Oregon can help lead, and the state would be wise to support it. Oregon State University has formed a consortium with industry, government and others to develop the use of these aerial systems, a potential multi-billion dollar job growth engine that will also provide significant benefits to society.

Under a mandate from Congress, the Federal Aviation Administration will establish several test sites for UAVs by 2015, and one of those sites could be in Oregon. Our state offers a unique combination of research excellence, varied terrain, relevant industry and local applications in agriculture and forestry.

There's not much that UAVs can do that a pilot in a small plane couldn't do, but they can do it more safely and at much lower cost. UAVs can monitor and help manage wildfires or support a search and rescue mission. They can help forest-product industries plant trees to avoid wind or heat damage. They can monitor wildlife, improve irrigation, detect crop-disease outbreaks and gauge environmental health.

Decades of experience in remote sensing have drawn OSU to this venture. Our oceanographers use NASA satellites to monitor global phytoplankton productivity and identify harmful algal blooms. We use optical remote sensing to detect earthquake faults, assess wildfire impacts on forests and measure tsunami inundation patterns. We have instruments on the International Space Station to study shoals and ocean shores.

Natural Extension

We have already formed the OSU Unmanned Vehicle System Research Consortium to bring a national UAV test center to Oregon. The business and job potential is high. With more than 300 companies and nearly 7,000 employees, Oregon's aviation sector sees UAV technology as a natural extension of industry within our state that already is building helicopters, small aircraft and aviation components. OSU and industry partners n-Link and Prioria have conducted the state's first FAA-sanctioned mission – a UAV flight over McDonald Forest near Corvallis that provided live video of the research forest.

We recognize that the transition toward the civilian benefits of UAVs has raised privacy concerns. Protection from prying cameras where there is a reasonable expectation of privacy is a legitimate concern, legally protected by current law and the Fourth Amendment of the U.S. Constitution.

Every new technology raises some kind of social concern, and society figures out reasonable solutions. We urge that these solutions be pursued in parallel with the needed technical research as the FAA develops a comprehensive privacy policy.

This technology will be developed somewhere in the United States. Because of Oregon's comprehensive scientific and industry experience, and our state's ideal geography, we can choose to be a leader in this exciting venture. That choice would be good for Oregon business, industry, researchers, workers and our environment.

Comments Posted to Terra Online

Editor's note: These excerpts are taken from an online discussion of Robert Lackey's Perspectives column, "Normative Science," in the winter 2013 issue of *Terra*. See **oregonstate.edu/terra/2013/01/normative-science/** for the full text of 43 responses. We welcome comments and will run excerpts as space permits.

A Place for Wisdom

While it is important to present science with dispassionate realism (neither optimistic nor pessimistic, as Dr. Lackey suggests) there may be a time when scientists serve us best by shedding the scientific shield and speaking from a place of wisdom founded on sound logic. Science can provide data, information, and knowledge, but to what end if society doesn't apply wisdom?

Dan Phalen

Two Sides of One Fence

Bob Lackey and I climb down different sides of the same fence here. We both seem to support the pursuit of truth using the tools of science. I believe we would both agree that being disingenuous, surreptitious (stealthy) or misleading is contrary to that goal. I would go a step further, though, and say that once science has taken us as far as is feasible, an explicit and measured subjective statement of "better or worse" is appropriate for scientists. To not do so is relegating the final decision to lawyers, judges, businesses and politicians.

Lee Foote, University of Alberta

Stirring the Hornets' Nest

Scientists are often caught in a political trap. I have found myself in situations where I had to keep my mouth shut so that I would not harm my client politically. I know that if I put a stick in the hornets' nest I, and those around me, will get stung. So we walk a fine line and do our best to bring objectivity to a subjective world of politics.

Paul Fishman

Paul Hawken vs. Magister Ludi

When I use the word "advocacy," I'm talking about being Paul Hawken-like in getting out boiled-down scientific facts about the consequences of our actions on the environment/biosphere — making the connection between the state of the environment 10, 20 and 50 years from now and what it means for people's children and grandchildren in a blunt, in-your-face, hairy, black-and-white (science-based) realism kind of way. People can still choose urban sprawl, alfalfa fields and artificially watered ski resorts if they want to and, I would argue, will be more inclined to if scientists stay hidden in journal papers and other Magister Ludi-like environs, afraid that someone might accuse them of "advocating."

Clint Alexander

Spin Doctors and Urban Myths

Although I agree that sociocultural and political biases can creep into science, bias is much worse outside this field, particularly when political and/or religious pressures are high (notably in the spin-doctored, climate-change "debate"). Agency scientists often have to debunk urban myths, e.g., that dams can supposedly enhance Pacific salmon (not!), and there are a lot of case studies to demonstrate this (which is why dam-breaching is becoming more popular).

Robert L. Vadas Jr.

Who Are We To Believe?

The problem with normative science is that the general public doesn't know whom to believe — for instance, scientists who advocate that global warming has a deleterious affect on the planet versus petroleum scientists who advocate that global warming isn't happening or isn't caused by human activity. What is the non-science general population to do with competing advocacy positions? This is why scientists should stay neutral, present the results of their research and let policymakers decide what to do with the facts.

Erik Schwab, Oregon State University

Political Hanky-Panky

The public's appetite for unblemished science grows greater each day, as political hanky-panky, influence peddling and corruption are reported by the media. Science is seen by many as the rock in this sea of deceit. Indeed, science and technology are the cornerstones of modern society and well-being. Few appreciate that science, too, is vulnerable to the same degeneracies as politics, finance and other human affairs. In the same way the public is demanding better checks and balances on these dark sides of our society so, too, will they eventually demand the same from scientists.

Ed Hanna

Tweeting Science

When I started college in 1989, I assumed I would be out in the field without anyone bothering me. My biology curriculum did not include policy or social science classes. Now, our studies and data are on Facebook, YouTube and Twitter! Scientists have new responsibilities to declare the limits of their work and educate others — in this case, policymakers — about where the scientist's job ends and the policymaker's job begins.

Amy Cook

Freedom of Access

The public deserves and needs access to scientific information

BY MICHAEL BOOCK, HEAD OF THE CENTER FOR DIGITAL SCHOLARSHIP/ASSOCIATE PROFESSOR, OSU LIBRARIES AND PRESS
ILLUSTRATION BY LESLIE HERMAN

The widespread availability of knowledge is a key element of Oregon State's land grant mission. Since 2006, OSU Libraries and Press has maintained a publicly available repository (ScholarsArchive@OSU) of scientific papers and student theses and dissertations. This archive — and ones like it at other universities — could be a cost-effective solution for a new federal initiative to make more research information available to the public.

Traditional channels of scholarly publication preclude access by the general public who, in the case of state and federally funded research, paid the bills. Journals that charge an annual subscription fee restrict information to those who are affiliated with institutions that can pay the fee. Costs vary widely but can be as much as $20,000 a year or more.

Recognizing the continued role of publishers and the need to facilitate public access, the White House Office of Science and Technology Policy (OSTP) issued a policy memorandum on February 22. It directs federal agencies with more than $100 million in annual research and development expenditures to work with stakeholders to make articles and research data associated with federally funded research freely available to the public within 12 months of publication.

The OSTP policy directive is a significant milestone for public access to scholarship. It benefits OSU researchers by increasing the readership and impact of their scholarship. It also provides accountability to the public by enhancing access to the scholarship they funded.

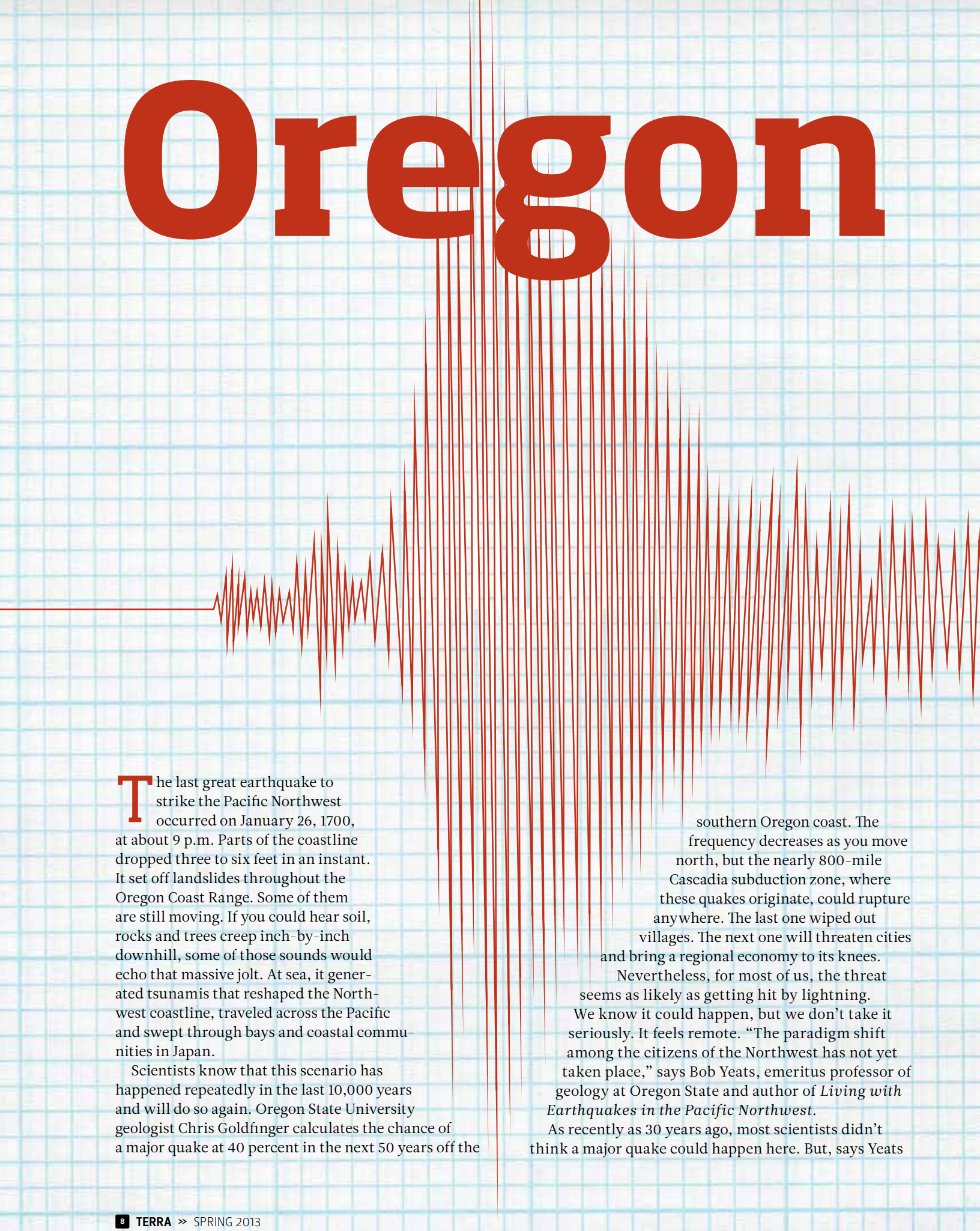
In fiscal year 2012, Oregon State researchers received more than $176 million in funding from federal agencies. What the OSTP directive means for these scientists will depend on agency requirements still in development, but the existing National Institutes of Health (NIH) public access policy may serve as a model to other agencies. The NIH requires articles that result from NIH funding to be available in the freely accessible PubMed Central database within 12 months of publication. While individual agencies are charged with developing policies, the memorandum does encourage interagency cooperation in order to make the processes and, potentially, the systems uniform.

ScholarsArchive@OSU already provides access to thousands of faculty and student articles and was recently ranked seventh among U.S. single institution repositories. The use of institutional repositories to preserve and make federally funded research available to the public has several benefits. It leverages infrastructure that is largely in place, and it enables institutions to monitor and ensure policy compliance for their own authors.

For scholars, access to the work of their peers is fundamental to the advancement of research. Making well-organized research data more widely available encourages reuse and supports inter- and intra-disciplinary collaboration. It also enables the private sector to leverage public research and invest in and develop new products and services.

Last year, the National Science Foundation began requiring the inclusion of data management plans as part of grant proposals. The Oregon State University Libraries and Press supports OSU faculty in meeting this and other federal data requirements. Our services are likely to evolve to support new agency requirements that result from the directive.

Oregon



The last great earthquake to strike the Pacific Northwest occurred on January 26, 1700, at about 9 p.m. Parts of the coastline dropped three to six feet in an instant. It set off landslides throughout the Oregon Coast Range. Some of them are still moving. If you could hear soil, rocks and trees creep inch-by-inch downhill, some of those sounds would echo that massive jolt. At sea, it generated tsunamis that reshaped the Northwest coastline, traveled across the Pacific and swept through bays and coastal communities in Japan.

Scientists know that this scenario has happened repeatedly in the last 10,000 years and will do so again. Oregon State University geologist Chris Goldfinger calculates the chance of a major quake at 40 percent in the next 50 years off the southern Oregon coast. The frequency decreases as you move north, but the nearly 800-mile Cascadia subduction zone, where these quakes originate, could rupture anywhere. The last one wiped out villages. The next one will threaten cities and bring a regional economy to its knees.

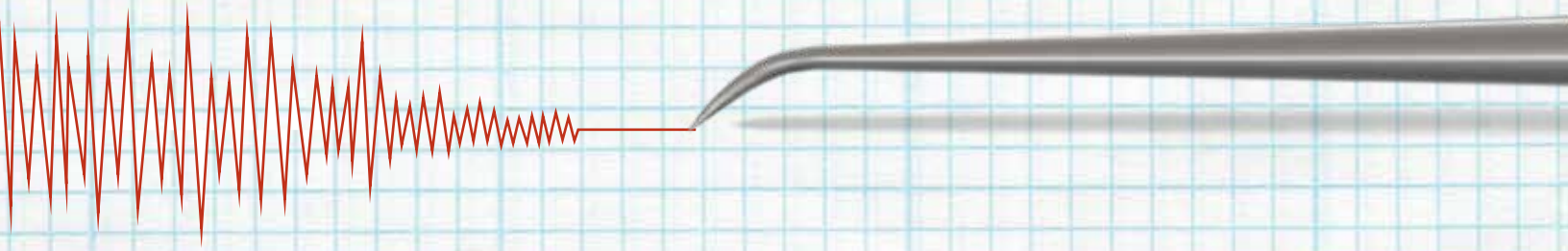
Nevertheless, for most of us, the threat seems as likely as getting hit by lightning. We know it could happen, but we don't take it seriously. It feels remote. "The paradigm shift among the citizens of the Northwest has not yet taken place," says Bob Yeats, emeritus professor of geology at Oregon State and author of *Living with Earthquakes in the Pacific Northwest.*

As recently as 30 years ago, most scientists didn't think a major quake could happen here. But, says Yeats

9.0

When the next Big One comes, will we be ready?

By Nick Houtman



in an upcoming book, evidence from coastal marshes, seafloor canyons, GPS monitoring stations and native traditions tell a compelling story: The western edge of North America is locked against another part of the Earth's crust, the Juan de Fuca Plate, which is diving beneath us. Like wrestlers in mortal combat, they occasionally break their hold on each other and lurch into a new position. Geologists have given such events a name right out of Saturday night wrestling — "megathrust." When it happens, the landscape vibrates like a bass drum. Seismic waves pulse through the crust for three minutes or more. Some types of soil liquefy and spread out. Bridge and building foundations get pushed out of alignment. Other soils could amplify the shaking from below, subjecting buildings, especially high-rises, to even more violent motion.

Lifelines

Scott Ashford has seen the consequences of these quakes in Chile, Japan and New Zealand: buildings and bridges tilted and broken like toys, beachfront tourist towns reduced to rubble, pipelines squeezed out of the ground like toothpaste out of a tube, businesses closed or forced to relocate.

The Oregon State Kearney Professor of Engineering is determined to soften the blow when Oregon's turn arrives. In 2010, after viewing damage from a megathrust quake in Chile, Ashford developed the idea for the Cascadia Lifelines Program, a consortium of Oregon businesses, government agencies and universities. The goal is to save lives and to shorten the time it will take for the state and the nation to recover.

"If you look at the effect on the people and at recovery, a key part of our resilience is lifelines," Ashford says. "Electric power, natural gas, transportation systems, telecommunications, drinking water, sewer. And critical facilities like the Port of Portland and the Portland International Airport. All of these lifeline providers have common challenges to prepare for this next earthquake. None by itself has the financial ability to fund the research

necessary. My vision is to pursue research of common interest to develop cost-effective solutions to mitigate the Cascadia earthquake."

Members of the consortium already include the Oregon Department of Transportation, Portland General Electric, NW Natural (Northwest Natural Gas), the Port of Portland, the Portland Water Bureau and the Bonneville Power Administration. Ashford is lining up others as well. Among their concerns are building standards, landslides, communications and recovery strategies. But first up on their research agenda is an Oregon State study of soil liquefaction, the phenomenon that compounds the damage caused by seismic shaking.

Soil Sleuths

Soils are often named for the places where they're found. California's state soil is called San Joaquin. In Washington, Tokul soil is named after a community in King County. Oregon's state soil is Jory, named for a hill in Marion County where a family of that name settled in 1852. For geotechnical engineers, another local soil poses a potential risk in a megathrust earthquake: Willamette silt.

With a texture midway between sand and clay, this remnant of the ancient Missoula Floods underlies much of the Willamette Valley. From McMinnville nearly to Eugene, bridge piers, roads (I-5, U.S. Highway 99) and pipelines run through or on top of Willamette silt. It carries railroad tracks and electric transmission lines. Large parts of Salem sit on it, as do Albany, Corvallis and Sweet Home. It is up to 130 feet deep in some places.

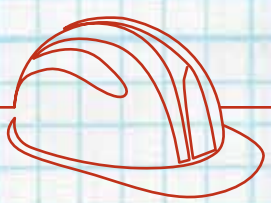
"We don't really know anything about how Willamette silt responds to earthquakes," says Ben Mason, an assistant professor of civil engineering at Oregon State. What he does know is that, as soils go, it doesn't take much water for it to change from being dry and crumbly to taking on the properties of a liquid. "It has a low plasticity index. What that means is that it can liquefy during an earthquake," he says. At least theoretically.

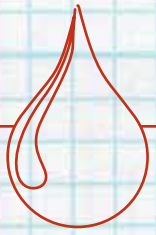
To find out for sure, Mason has collected Willamette silt from the Oregon State campus. Last winter, he and a colleague, Li Zheng from the Nanjing Hydraulic Research Institute in China (Li wants to know how earthen dams will perform during an earthquake), placed soil samples the size of hockey pucks in a device that simulates conditions deep underground. They subjected the samples to repeated, precisely controlled cycles of shaking. As a piston shook the sample, simulating seismic waves, sensors measured changes in volume and in water pressure inside the soil.

As the shaking continued, "the water pressure builds up, builds up and builds up and eventually the soil will act like a liquid," says Mason. "And that's when we say liquefaction happens." In effect, he explains, soil structure breaks down, water oozes from pores where it had been bound and the soil turns into a mass with the consistency of pea soup.

We can see liquefaction in action when we walk on a beach, Mason adds. "If you run, you cause these minor liquefaction events. It's a very dynamic load hitting the sand." Water is forced out from between the grains and pools briefly on the surface. In contrast, water underground has nowhere to go. As Mason's experiments show, pressure rises. The question is: Will it get high enough to trigger liquefaction? If it does and the soil happens to be on a slope, it can spread out, jeopardizing any structure that is in the way, such as a bridge pier, building foundation or pipeline.

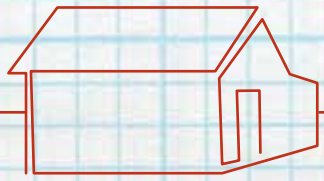
ENGINEERING PROFESSOR SCOTT ASHFORD IS GATHERING EARTHQUAKE RECOVERY LESSONS FROM CHILE, JAPAN AND NEW ZEALAND TO HELP OREGON PREPARE.





WHEN SOILS LIQUEFY, STRUCTURES CAN FAIL. DATA FROM THE OSU SOIL-TESTING LAB IS HELPING ENGINEERS TO ACCOUNT FOR LIQUEFACTION.

OREGON STATE RESEARCHERS BEND AND BREAK STRUCTURES MADE OF STEEL, CONCRETE AND WOOD TO UPDATE LIFE SAFETY STANDARDS.



Mason's experiments are the first to be supported by Cascadia Lifelines Program funding. His lab is one of the few on the West Coast with the ability to subject soils to a wide range of precisely controlled earthquakes. His "cyclic simple shear" device can be programmed to mimic seismic waves with varying duration and strength. With accurate information about Willamette silt, engineers will be able to design structures that can minimize the damage from the possibility of soil movement caused by liquefaction. Engineering firms are already contacting him to test soil samples for project design purposes.

Buildings and Bridges

Most schools, city halls, bridges, commercial buildings and other structures in Oregon were built before the possibility of big earthquakes was taken seriously. "We don't know how these buildings will perform (in an earthquake)," says Andre Barbosa, an Oregon State structural engineer. "We have a very rough idea. We know by year and type of construction, whether this or that building may behave well or not so well. But we don't really know."

Because seismic stresses were not even recognized in the state's building codes until 1974, our infrastructure and architectural heritage are highly vulnerable. According to the Oregon Resilience Plan, a report produced by the Oregon Seismic Safety Policy Advisory Commission (OSSPAC) in 2013, nearly half of 2,193 schools assessed in the state have a high to very high potential for collapse. More than a third of the 2,567 bridges in the state highway system were built with no seismic considerations. All nine of Portland's bridges over the Willamette were built before seismic codes were in force, although some have been strengthened.

"Many of Oregon's lifeline providers have shared research needs, whether it's to improve our ground motion predictions, to assess liquefaction potential of Oregon soils or to develop retrofit technologies for our legacy systems."

— Matthew L. Garrett, Director, Oregon Department of Transportation

But estimating vulnerability is only the start, says Barbosa, who specializes in structural performance in earthquakes. Engineers also need to evaluate strategies for retrofitting old structures and improving standards for new construction. Toward that end, Barbosa conducts experiments on building and bridge components in the Oregon State structures lab, which boasts the second-largest "strong floor" on the West Coast. It allows researchers to simulate earthquake forces up to 1 million pounds on frames up to two stories high. In a project for the Oregon Department of Transportation, Barbosa is evaluating the performance of high-strength reinforcing steel (aka "rebar") to resist long-duration shaking.

That fills an important need in the Northwest where subduction zone earthquakes are likely to last three to five minutes or more. In contrast, crustal earthquakes, such as those along the famed San Andreas Fault in California, typically last 30 seconds or less. The difference adds up

ALTHOUGH MOST OREGON BRIDGES WERE BUILT BEFORE EARTHQUAKE STANDARDS WERE IN PLACE, MANY ARE BEING REINFORCED.

to higher demands on buildings, especially where the frequency of the seismic waves matches a structure's internal characteristics.

"The main objective of our modern building codes is life safety," Barbosa adds. "We design structures so that people can evacuate in case of strong shaking. The structure can vibrate back and forth, but it is designed not to collapse. That's the life safety design approach."

In addition to living in earthquake country, Barbosa has a personal connection to such events. He grew up in Lisbon, Portugal, which suffered a cataclysmic earthquake and tsunami in 1755. Geologists now estimate that it approached the strength of the 1700 megathrust earthquake in the Pacific Northwest. Since then, Portugal and the Northwest have experienced thousands of smaller quakes centered in local faults, but there have been no large events of the kind seen recently in Chile and Japan. "The problems we have in Portugal are the same as we have here in Oregon," he says. "The return period for large earthquakes is very long. People just don't remember."

"We believe this is indeed the right approach, especially in the wake of a potential 9.0 mega-quake of the type that struck Japan."

— Bill Nicholson, Senior Vice President Portland General Electric

Nevertheless, Oregon is taking a leadership role in planning. Elsewhere, agencies and regions (the San Francisco Bay Area) have developed a holistic approach to resilience, but Oregon is the first to do so at the state level. "Through OSSPAC," says Barbosa, "Oregon is doing something that is amazing."

Sliding Slopes

When Michael Olsen pulls up a map of the Oregon Coast Range on his computer, he sees wide swaths of red dots. Each one represents landslide-prone areas identified through the highly accurate lens of a remote sensing technology known as LIDAR ("light detection and ranging"). The Oregon State civil engineer and Hoffman Faculty Scholar specializes in the emerging field of geomatics, which is land surveying on steroids. Geomatics practitioners analyze landscapes by combining remote sensing data (from the ground, the air or planetary orbit) and large spatial datasets for soils, vegetation, precipitation, streams and other features.

In the Coast Range, Olsen and his graduate students are assembling LIDAR data and layering it with what engineers know about the terrain. Working with the Oregon Department of Transportation, their goal is to estimate the likelihood of earthquake-triggered landslides near highways that link the I-5 corridor with coastal communities.

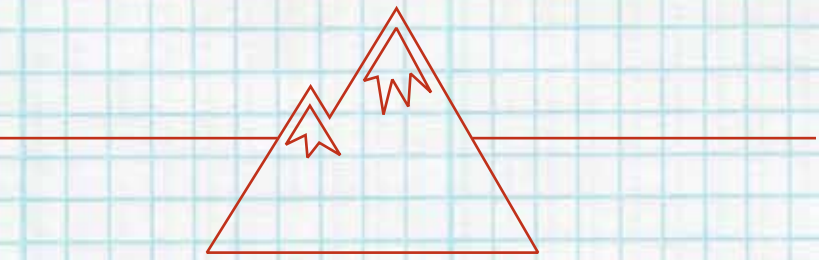
These mountains might be beautiful, but Olsen's picture isn't pretty. "The Coast Range consists of very loose soils that are of very poor quality. They don't have a lot of strength to them," he says. In an emergency, "barriers along these lifeline corridors would be a big problem. Even a small landslide can close down a road for a day or two."

And it doesn't take much to start Coast Range soils moving. Based on the locations of previous slides and knowledge of soil types, it appears that slopes as low as 10 to 15 percent are vulnerable to sliding. "That isn't that much. It's pretty scary that it's that low," Olsen says.

Landslides are hardly a new phenomenon in Oregon, but they are more common in some years than in others. The winter storms of 1996-97 generated an estimated 9,500 landslides, mostly in western Oregon. Scientists at the Oregon Department of Geology and Mineral Industries (DOGAMI) have calculated that, while economic losses exceed $10 million in a typical year, they exceeded $100 million that winter.

Although all Coast Range roads pass through slide-prone terrain, some may be less vulnerable and easier to re-open than others. Such information, says Olsen, will help ODOT prioritize roads for earthquake recovery purposes.

OSU LANDSLIDE STUDIES ARE HELPING THE OREGON DEPARTMENT OF TRANSPORTATION TO PRIORITIZE ROADS TO BE RE-OPENED AFTER A QUAKE.



A Statewide Effort

By coordinating these and other research investments, Cascadia Lifelines meets an important need for state agencies and utility companies and fills a critical niche in statewide preparedness efforts. Spurred by the state Legislature, scientists, utility companies and agencies are evaluating risks and identifying solutions to mitigate the most significant impacts of the next megathrust earthquake. Schools and other public buildings have been assessed, and retrofits have begun. Roadways are being ranked for vulnerability to landslides and bridge failures.

Researcher Profiles

Oregon State University's expertise in earthquake resilience ranges from engineering and geophysics to public health and community outreach. Here is a sampling.

SCOTT ASHFORD

As a geotechnical engineer and the Kearney Professor of Engineering, Ashford works to enhance public safety through interdisciplinary research on earthquakes and coastal hazards.

CHRIS GOLDFINGER

A geophysicist, Goldfinger studies the mechanics of subduction zone earthquakes and deformation of the seafloor and active continental margins.

ANDRE BARBOSA

Barbosa studies the behavior of structures in earthquakes. His research includes risk analysis and resilience of steel, reinforced-concrete and timber structures.

BEN MASON

A geotechnical engineer, Mason studies soil response to earthquakes and interactions between soils, structures and urban systems.

JEFF BETHEL

A disease epidemiologist, Bethel studies the relationship between population movement and vulnerability to natural disasters and other health risks.

MICHAEL OLSEN

For earthquake engineering purposes, the Eric H.I. and Janice Hoffman Faculty Scholar has developed new visualization and 3-D laser scanning techniques to characterize landscape instability and to map potential hazards.

PAT CORCORAN

A coastal hazards specialist with Oregon Sea Grant Extension, Corcoran helps communities to identify and address risks such as tsunamis, storms and shoreline erosion.

ROBERT YEATS

A book author and emeritus professor of geophysics, Yeats works to enhance public safety by raising awareness and understanding of earthquake risks.

DAN GILLINS

A specialist in geomatics, Gillins studies soil liquefaction hazards and develops maps to estimate the likelihood of ground failure in earthquakes.

SOLOMON YIM

Holder of the Glenn Willis Holcomb Structural Engineering Professorship, Yim leads an NSF Network for Earthquake Engineering Simulation and studies wave and earthquake impacts on structures.

On the coast, evacuation routes are being marked to help coastal residents and visitors escape the tsunami zone.

In 2011, Oregon's Earthquake Commission (aka the Oregon Seismic Safety Policy Advisory Commission or OSSPAC) assembled experts to lay out the risks and recommend a series of steps for the next 50 years. It released a final report — The Oregon Resilience Plan — last February. "The broad picture of what needs to be done is pretty straightforward," says Ian Madin, chief scientist for DOGAMI and an Oregon State alum who helped to lead the planning. "We need to strengthen our infrastructure so that it physically resists the effects of the earthquake, so that it is either undamaged or easily repairable."

Engineers know how to design earthquake-resilient structures, say Madin and Ashford. They can "harden" foundation soils to resist liquefaction and construct bridges and buildings that can survive shaking. Such measures carry a stiff price tag, but the return on investment can be positive. For example, says Ashford, after the earthquake in Christchurch, New Zealand, earthquake preparedness steps saved $10 for $1 spent.

Power to Recover

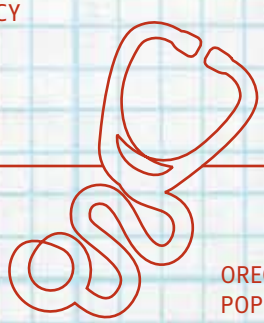
Ultimately, recovery is about more than engineering. It is about assistance for a traumatized citizenry, strategies for keeping small businesses afloat, security to prevent looting, radio systems that will work after cell-phone towers and land lines go down and policies that allow restoration projects to be fast-tracked. In Chile, Ashford adds, electricity was crucial for recovery efforts. Water pumps in rural areas, for example, couldn't even be tested until power was restored.

In New Zealand, homeowners insure against earthquakes as well as fire.

The government helped businesses get back on their feet by creating a temporary mall out of shipping containers. Grants kept paychecks flowing to employees who otherwise would have qualified for unemployment. Some businesses provided food and fuel to employees' families so that workers could focus on the job of rebuilding without worrying if their loved-ones were safe.

Individuals need to prepare as well. "I'm a big believer in personal responsibility," says Ashford. He has installed an electrical generator port on his home, keeps extra medication on hand and fills his truck's fuel tank when it hits half empty. "Every family needs to be prepared to be on their own for a few days. Every community needs to be prepared to be on its own. If you are expecting the government to come in immediately with assistance, it may take many days or weeks for that help to arrive." terra

PROTECTING PUBLIC HEALTH AFTER A QUAKE WILL REQUIRE EMERGENCY SUPPLIES OF FOOD AND WATER.



OREGON STATE STUDIES OF VULNERABLE POPULATIONS ARE HELPING PUBLIC HEALTH AUTHORITIES TO SAVE LIVES AFTER NATURAL DISASTERS.

AFTER THE QUAKE

Saving lives is Everybody's job

As an epidemiologist, Jeff Bethel understands the vital role of public health in saving lives after a natural disaster. Most at risk, he says, are vulnerable populations — migrant laborers and people who live alone or have chronic illnesses.

"If you're in your little bubble, you're at higher risk," says the assistant professor in the College of Public Health and Human Sciences.

Bethel studies how prepared people are to survive on their own when the power and water go out and food supplies are disrupted. In partnership with the Marion County Public Health Department, he is surveying Latino residents and identifying subgroups such as the elderly or the chronically ill. The county will use Bethel's findings for publicity about disaster preparedness.

Epidemiologists can assist health-care professionals by providing up-to-date, population-based information, adds Michael Heumann, consulting epidemiologist with the Oregon Public Health Division. "In a disaster," says Heumann, "we all need to be able to do the minimum until help arrives. That means having food, water and medicine. And we need to have the skills sets — stop the bleeding, take care of people with broken bones. It's everybody's business: schools, civic organizations, churches, trade associations, businesses, public health agencies."

"Public health needs to be at the table in these conversations," Bethel says. "It's vital."

Ethical Evolution

The history of medicine owes much to animals

BY NICK HOUTMAN

Barely a century has passed since Louis Pasteur developed a vaccination for rabies. Since then, scientists have discovered treatments for some of the worst human scourges: smallpox, tuberculosis, polio and influenza. Much of their success can be traced to experiments on animals under circumstances that would shock us today.

Pasteur learned about rabies by infecting guinea pigs, rabbits and dogs with the invariably fatal disease. In the 20th century, the search for a polio vaccine took the lives of millions of monkeys (rhesus macaques). AIDS researchers still rely on monkeys to understand how the immune system responds to HIV and why some (sooty mangabeys) harbor the virus but never develop the disease.

In her book, Experimenting with Humans and Animals, From Galen to Animal Rights (Johns Hopkins University Press, 2003), Anita Guerrini tells the story of the scientists whose achievements transformed medical care and of the controversies that erupted around the use of animals for science. "It's about how this theme traces through the Western tradition and enters into the history of medicine," says Guerrini, a historian and Horning Professor in the Humanities at Oregon State University.

Everyday Cruelty

Advances in medical knowledge and the debate over human and animal rights go back to ancient Greece and Rome. They surface again in 17th century England, a time "when dancing bears, bears fighting with dogs, cockfighting and all manner of cat torture were commonplace, and everyday cruelty to animals was the rule rather than the exception," writes Guerrini.

Scientists such as William Harvey, Robert Boyle and Robert Hooke experimented on insects, rabbits, birds, fish, deer and dogs (Harvey even dissected the dead bodies of his wife's dearly loved parrot and his own father) in the name of science. Harvey's success in describing the circulatory system "brought animal experimentation into the forefront as a scientific method," Guerrini adds.

Guerrini traces the philosophical roots of arguments for and against vivisection (the cutting of live animals) and of the trade-off between suffering and knowledge. For example, Rene Descartes argued that animals lack souls and can't suffer in the way that humans can, but few accepted this argument.

England passed the first national law to regulate animal research in 1876. It took the United States 90 years to follow suit with the Animal Welfare Act. "Up to then, we had always trusted scientists to do the right thing," Guerrini says.

In 1985, universities and other organizations were required to establish institutional animal care and use committees (IACUC) to enforce higher standards of inspection and care. Those years also saw the rise of citizen activism through groups such as the Animal Liberation Front and People for the Ethical Treatment of Animals.

Before coming to Oregon State in 2008, Guerrini served on the IACUC at the University of California, Santa Barbara. She is now a member of OSU's IACUC.

In her own research, Guerrini is completing a book on anatomical research in pre-French Revolution Paris and looking at urban animals in pre-modern Paris and London.

AQUATIC VIGIL

Labs go to extraordinary lengths for fish and other water dwellers

BY LEE SHERMAN | PHOTOS BY LYNN KETCHUM

It was dinnertime at the Milston-Clements home. The hubbub of feeding a 6-month-old baby and a hungry toddler was at full clamor when a ringtone interrupted. Handing off the jar of creamed spinach to her husband, Ruth grabbed her cell phone.

"Hello?"

"Ruth, we have a broken pipe."

As manager of Oregon State's Salmon Disease Lab, Ruth Milston-Clements is on-call 24/7. With a network of alarms protecting the facility's 25,000 research fish from disasters both natural and human (power outages, floods, equipment malfunctions, vandalism), she's accustomed to running out the door at odd times. It happens once a month, on average.

So this dinnertime call seemed fairly routine. A researcher had accidentally backed her truck into a water pipe supplying 30 fiberglass tanks full of fingerlings, the caller reported. Quickly, an onsite technician cranked down the valve to stop the flow. He then rigged a fix that should hold till morning. However, the margin of error between life and death is, for a fish, as thin as a fin. "Without water flow or oxygen, the fish will suffocate in about 20 minutes," says Milston-Clements, a fish biologist who grew up in Lancaster, England. In her field, there's no such thing as an excess of caution. So, after tucking her little girls into bed, she spent the next few hours at the lab helping to construct a temporary backup system in case the quick fix failed before morning. It was after midnight when she finally flopped into bed.

The 3 a.m. ringtone blaring from her nightstand jolted her upright. "My heart started beating really loud, and I was hyperventilating," she recalls. The electronic message from the lab's security company read: Zone 1, low water. "This is the worst! This is what I've been dreading! Thousands of fish could die!" she moaned to her husband as she threw on her sweats and rubber boots and headed out once again.

In fact, no fish died that night. The second alarm turned out to be a minor malfunction unrelated to the burst pipe. But the adrenaline rush highlights what's at stake in a live-animal research facility.

The care and feeding of thousands of trout and salmon at OSU's Salmon Disease Lab are the solemn responsibility of fish biologist Ruth Milston-Clements (facing page). Brushes are disinfected after each tank is scrubbed to avoid cross-contamination (left).

Crabs Count, Too

Of the 600,000 animals used in Oregon State's research and teaching programs, 80 percent are aquatic species. Most of these half-million water dwellers are housed in fiberglass tanks on and around the Corvallis campus or at a research hatchery in the Alsea River Basin. Some live in simulated streams or raceways. Still others are on display in touch tanks or seawater aquariums at the Hatfield Marine Science Center in Newport. They come in outrageous colors and preposterous designs: pouty, big-eyed rockfish in shimmery golds and coppers; pincushion-like sea urchins bristling with purple spines; a giant Pacific octopus, its suction-cupped arms undulating around a bulbous orange body. The charismatic Chinook salmon, the elusive black prickleback, the tendrilled basket star, the diminutive zebrafish — more than 400 species in total — all are members of Oregon State's aquatic animal community.

The vertebrates among them are subject to the rigorous protocols of humane treatment laid out by the AAALAC (Association for Assessment and Accreditation of Laboratory Animal Care International) and overseen by OSU's Institutional Animal Care and Use Committee (see *Terra*, "The Ethic of Care," Fall 2012; and "Caring for Cows," Winter 2013). But the ethical distinction between the spined and the spineless has blurred in recent years. In the same way that the animal-care ethos for rodents and livestock has evolved, so have sensibilities for aquatic animals of all kinds. Just ask Tim Miller-Morgan. In his two-decade career, OSU's aquatic veterinarian has witnessed an ethical sea change.

Take the case of the ailing crustaceans, for example. Miller-Morgan was moonlighting at the Oregon Aquarium a few years back when he noticed that the spider crabs were lethargic and droopy-mouthed. In the old days, he says, a sick crab would have been euthanized. "The attitude was, 'It's only an invertebrate; let's just get another one.'" But instead of discarding the crabs, he drew their blood and discovered a bacterial infection. He treated the animals with antibiotic injections and medicated feed. "Typically, this wasn't something that was done," says Miller-Morgan, who also serves as backup veterinarian for OSU Attending Veterinarian Helen Diggs. "But now we understand that we shouldn't look at these animals as disposable. We brought them into captivity, and we have an obligation to keep them as long as we can, as close to their natural lifespan as possible — or even longer."

It's today's students, he says, who are driving the new morality. In the aquatic-medicine classes he teaches at OSU's College of Veterinary Medicine, questions about animal welfare are top-of-mind among the Millennials, also known as Gen Y. "Eight or nine years ago, students started telling me, 'We'd like to hear information on what we know about fish welfare, how we assess welfare, what do we know about pain?' That was a new thing."

Oxygen is pumped into a bag to prepare a rainbow trout for safe shipping.

In green-lidded tanks designed to minimize algae growth, transparent zebrafish are fed juvenile brine shrimp from a squeeze bottle.

He hears the same kinds of queries from students enrolled in the aquarium science program he helped develop at Oregon Coast Community College. It boils down to a centuries-old debate among philosophers, scientists, veterinarians, farmers, ranchers, aquarists, and pet owners: What is our obligation to captive animals?

For researcher David Noakes, the answer is crystal clear. "We have an inordinate responsibility," says Noakes, who directs the Oregon Hatchery Research Center run jointly by Oregon State and the Oregon Department of Fish and Wildlife (ODFW). "We need to go to extraordinary lengths."

It's the Water

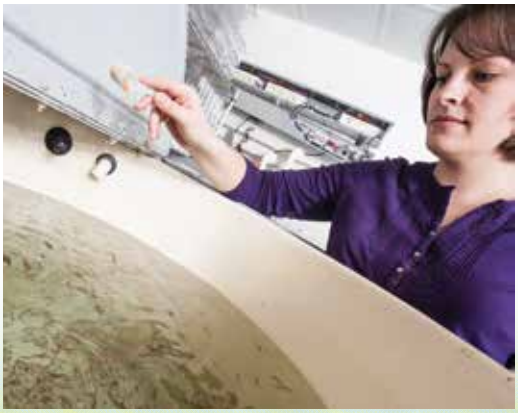
Because of the extraordinary lengths taken by Noakes and his staff, international scientists flock to the research center on Fall Creek, a tributary of the Alsea River, which ripples prettily through a mixed woodland of fir, aspens and big-leaf maple. From faraway nations like Japan, China, Iceland and South Korea, they come to conduct studies on the secrets of salmon navigation, the impact of temperature on sexual maturity, the ability of steelhead to negotiate woody debris, and other hot topics in fish biology. "This is the only place on the planet that has everything in one location for salmonid research," explains Joseph O'Neil, a senior ODFW technician who lives onsite at the hatchery. "It's the No. 1 destination in the world."

If O'Neil were to tell you that water is the most critical component for fish husbandry, you might be tempted to say "duh." But "water" doesn't come close to conveying the complexity of the systems that support research fish. When O'Neil says, "Fish need water," he's not talking about any old water. Whether it fills a 50-gallon fiberglass tank full of Coho smolts, a 40,000-gallon simulated stream stocked with brook trout, or racks of incubation trays, flushing a million salmon eggs at a rate of five gallons per minute, the water O'Neil is talking about is some of the world's most pampered. Pumped mainly from Fall Creek, this water may be treated with UV sterilization, carbon filtration or aeration so it's free of viruses and bacteria. O'Neil's also talking about precise temperature regulation matched to each species' native environment and each animal's stage of life. Eight miles of underground pipe circulate up to 2,500 gallons of freshwater a minute and return it to Fall Creek.

Out here in the Siuslaw National Forest, where the nearest town is picturesque Alsea, population 1,153, things do indeed go wrong. The power fails when gale-force winds howl through the hills; the property floods when biblical rains push the creeks beyond their banks; outdoor tanks crack and pipes rupture when branches crash to the ground. The staff takes pride in being able to improvise a solution or jury-rig a repair for just about any piece of equipment, even amidst the wildest squall, wettest deluge or blackest night.

How to Ship a Fish

In Oregon State fish circles, they're known as "The Two Carries." The self-described "guard dogs" of OSU's zebrafish lab, Cari Buchner and Carrie Barton make a solemn commitment each morning when they punch in their pass codes at the high-security building across the river from downtown Corvallis.



Cari Buchner, co-manager of OSU's Sinnhuber Aquatic Research Laboratory, feeds adult fish in a large stock tank.

Tens of thousands of lives hinge on the skill and vigilance of these fish-husbandry professionals.

Barton and Buchner are co-managers of OSU's Sinnhuber Aquatic Research Laboratory. The species they oversee — a type of minnow that has been dubbed the "new lab rat" for its growing popularity among biomedical researchers — multiplies fast, matures quickly, shares important disease processes with humans, and rapidly regenerates certain body parts and organs. Best of all, it's transparent during development. Researchers can see what's happening inside, literally. For these reasons, zebrafish make great animal models for medical and environmental research.

"The water here is probably cleaner than most people drink at home," Buchner attests. That level of purity applies even to water flowing into the staff restrooms, toilets included. If you are granted a visit to Sinnhuber, expect this email in your inbox: "Due to our biosecurity protocols we need to ask that you refrain from any contact with other aquatic species, labs, water sources — especially home aquariums, pet stores and outdoor fish habitats — for 24 hours prior to your visit." Once you arrive, anticipate being asked to sanitize your hands and slip sterile booties over your shoes.

No one here is taking any chances of jeopardizing the lab's highly specialized, technically sophisticated, razor-edged enterprise: raising fish that are free of the pathogen *Pseudoloma neurophilia*, rampant in the commercial aquarium trade and common in many research facilities. "Every fish in this room will be tested for that specific pathogen," says Buchner. Newly arriving fish are raised, spawned and rigorously tested in a quarantine chamber before their offspring can join the general population.

These uniquely healthy zebrafish are in demand not only at Oregon State but also at other labs. So a couple of years ago, Sinnhuber decided to sell them on its website at a nominal cost. But safely shipping live fish is as tricky as it sounds. The package has to be double-bagged, foam insulated, heat controlled and hand-delivered on the tarmac for transfer to the airplane. For months, Barton and Buchner worked with FedEx, testing various containers and running multiple mock shipments, climaxing with a battery of bumping, shaking, dropping, crushing and tumbling trials.

"The container has to be 100 percent secure," Barton explains. "It has to hold up even when someone says, 'Oops, that box fell off the forklift.'" (All this TLC comes at a price, ranging from $50 to $500 for U.S. shipments to $1,700 for international deliveries.)

Soon after becoming a Certified Research Fish Shipper, the lab passed a harrowing real-life test when a container of fish en route to Australia got held up in customs during the hottest part of the summer.

Cari Buchner checks water-flow rates to ensure correct settings.

Despite an extra five days of travel, the fish arrived in perfect health and were spawning within a fortnight.

Fish Food a la Carte

A "happy tank" is the gold standard in a fish lab. When Ruth Milston-Clements lifts the lid of a tank and sees the sleek, silvery smolts schooling round and round in vigorous uniformity, she can rest easy. But if the fish are "dancing" or "flashing" or "looking a bit itchy," she immediately calls in the lab pathologist. The telltale signs of trouble recently showed up among some rainbow trout. A scale swipe revealed a parasite called *Gyrodactalus*. She treated the tank with a hydrogen peroxide solution and monitored the fishes' behavior every 10 minutes for an hour. They revived. Happy tank.

Fish like it when someone lifts the lid on their tank. That's because it usually means mealtime. Over at Sinnhuber, the two Carries show off their brand-new commercial-grade kitchen where they concoct customized diets to researchers' specs. The proteins, carbs, oils, vitamins and minerals are tightly calibrated for optimal animal health. For many studies, researchers order special formulas. One of those researchers had a terrifying jolt a week before Christmas when he discovered his supply of custom fish food wasn't going to last through his experiment. So while most people were baking gingerbread cookies and fig puddings, Barton was down at the lab whipping up an emergency ration of experimental fish food. "I went into my superhero mode," Barton says with a satisfied grin. She saved the day — and the study.

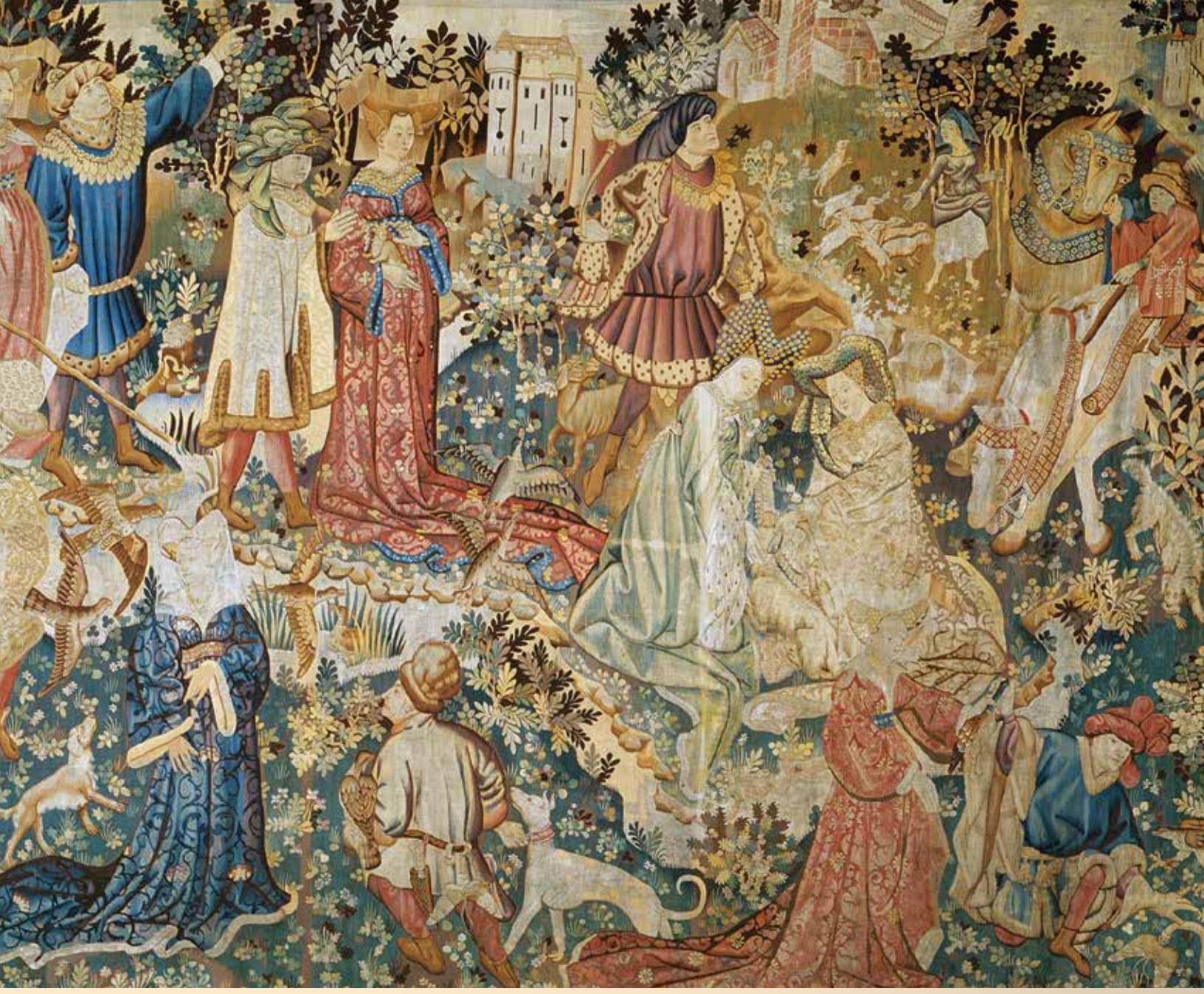
"Basic care for aquatic animals is much more intricate than it is for most mammals," she observes. "It's really a science unto itself." terra

Carrie Barton, co-manager of the Sinnhuber lab, feeds Artemia nauplii, *a juvenile form of brine fish, to zebrafish schooling in a stock tank.*

Of Texts and Textiles

Tapestries loom large in Renaissance literature and modern metaphor

BY LEE SHERMAN



The 15th-century tapestry, "Falconry," probably belonged to the Countess of Shrewsbury, known as Bess of Hardwick. (©Victoria & Albert Museum, London)

Why would binoculars be an essential tool for a scholar of Renaissance literature during a study tour of Europe? What does crawling around on a castle floor have to do with researching the writings of Shakespeare and Spenser? Why would a professor of 15th- and 16th-century poetry and drama desperately need a therapeutic massage after a day of intense investigation? The answer is tapestries.

Massive, intricate, otherworldly weavings called "arras" were commissioned by European royals and nobles to adorn the walls of their palaces and estates. Peopled with life-sized figures depicting scripture, myth and legend as well as hunting, falconry and winemaking, they brought color and life to drab, drafty halls. But adornment was only part of the purpose of these colossal works of art, says Rebecca Olson, who has spent more than a decade studying their role in literature and, by extension, in Renaissance society. They also reinforced power and inspired loyalty by evoking tradition and royal status.

"These tapestries were everywhere," says Olson, an assistant professor in the Oregon State University School of Writing, Literature and Film. "Besides the magnificent large-scale hangings, there were smaller, cheaper versions adorning humbler settings. They were as ubiquitous as TV is today. They had practical uses, educational uses, political uses. You can't really understand Renaissance literature unless you understand how they were used and how people thought about them."

Crafted of wool and threaded with strands of silk, gold and silver, the most impressive tapestries sometimes unfurled 30 feet long and soared 15 feet high, all the better to awe, educate and even intimidate the viewer. Studying them can be a workout. Olson once slid herself along the cold stones of Hampton Court Palace to view the underside of an arras laid out on a rack for repairs. To examine details at the top, she often resorts to peering upward through a pair of binoculars. After days of scrutinizing every last detail, she can wind up with a serious crick.

"Just to look at them is very physical," says Olson. "You're moving because you can't take them all in at once, so you're craning your neck, you're bending down, you're walking up to look closely, you're stepping back. My neck often hurts quite a bit."

Stories from the Past

The first arras hangings she saw with her own eyes were in the banquet hall of England's Hampton Court Palace. Even as frayed and faded as the massive tapestries were, she found them enchanting, particularly the heroic scenes depicting the labors of Hercules. The 500-year-old weavings felt like silent emissaries from

Shakespeare's era. As she gazed on them — realizing that the Bard's contemporaries had sat among these very hangings eating, drinking and watching live actors perform — her arms prickled with goose bumps.

In the years since, she has discovered a rich — and largely overlooked — literary and historical presence for the arras, which she documents in her upcoming book, *Arras Hanging: The Textile that Determined Modern Literature and Drama* (University of Delaware Press, in press). The arras was, for instance, central to one of Shakespeare's most dramatic scenes: Hamlet's stabbing of Polonius. In Act III when Lord Polonius plots with Hamlet's mother and stepfather to hide behind a tapestry to eavesdrop ("Behind the arras I'll convey myself"), he makes a fatal mistake. Hamlet, hearing the hidden voice, thrusts his sword through the arras (translated as a "curtain" in some editions), killing Polonius.

"The idea of a prince damaging one of these very expensive tapestries really makes us wonder about Hamlet's sanity in that scene," Olson says. Modern audiences, she adds, would fail to grasp the import of

As she gazed on them — realizing that the Bard's contemporaries had sat among these very hangings eating, drinking, and watching live actors perform — her arms prickled with goose bumps.

On the facing page and above, hunting in the Middle Ages was an integral part of court etiquette, as depicted in details of a wool tapestry called "Boar and Bear Hunt." (©Victoria & Albert Museum, London)

For the rich and the royal, arras hangings were status symbols. They depicted ancient stories of valor and virtue. Often designed to inspire viewers to be braver and better, they also were instruments of political propaganda and puffery.

his action without the historical context. "It's like when a rock star smashes his expensive guitar. It has real shock value."

In Book III of Edmund Spenser's epic poem *The Faerie Queen*, one of the great classics of Renaissance literature, the writer devotes 18 stanzas to the virgin warrior Britomart's night in a room draped floor to ceiling with arras tapestries ("For round about, the wals yclothed were With goodly arras of great majesty, Wouen with gold and silke…"). On the tapestries were bawdy scenes of debauchery and sensuality, which Spenser introduced to contrast with Britomart's chastity.

Inspired to Reverence

For the rich and the royal, arras hangings were status symbols. They depicted ancient stories of valor and virtue. Often designed to inspire viewers to be braver and better, they also were instruments of political propaganda and puffery. King Henry VIII favored images of King David in an attempt to associate himself with the great biblical figure. Queen Elizabeth I lined her outer chambers with woven figures of small size, yet as the visitor proceeded toward her inner chambers, the figures got bigger and bigger. "They were supposed to make you feel smaller and smaller, so by the time you got to the queen you just felt tiny," says Olson.

Olson's research has taken her to the Tower of London and to the National Archives of the United Kingdom, where she scoured ancient ledgers and inventories for clues to ownership and transport of arras hangings. She also has found evidence that tapestries were used to teach a young prince about the Battle of Troy, and that queens gave birth in chambers swathed in weavings.

As important as the woven images is the literary symbolism embedded in the act of weaving. Olson points out that the words "text" and "textile" derive from the same Latin roots *texo* and *texere* — "weaving" or "to weave." Even though the loom has largely disappeared from daily life, the metaphor (to weave a story, spin a tale, follow a narrative thread) has survived all these centuries, cropping up in our most advanced communications lingo (the Web, the Net, an email thread). Just as many moderns cling nostalgically to bound books of paper and ink, Olson notes, medieval Europeans would have felt attached to stories told upon the tactile surface of a weaving, even as the printing press was beginning to push the technology.

"I use the analogy of Kindles and e-readers and how they retain some of the elements of an actual book," she says. terra

"Boar and Bear Hunt" (detail) shows the fashions of the early 1430s: women in high-waisted gowns, men with drooping sleeves and low-slung belts. (©Victoria & Albert Museum, London)

Cub Kahn, center, leads Oregon State faculty in the development of hybrid courses. Participants in the spring Learning Community included Kathy Greaves, left, who teaches family development and human sexuality, and Margie Haak, who teaches chemistry. (Photo: Jeff Basinger)

Online and Face-to-Face

Active learning combines technology and teamwork

BY NICK HOUTMAN

If your memory of college includes trying to stay awake in large lecture halls, Cub Kahn has news for you. When he thinks about the future of higher education, he sees hybrids. Forget the cars that combine gas engines and electric motors. These hybrids are the latest in college courses. They enable students to learn via computer with online videos and activities that can be done at home or in the library or coffee shop.

Hybrids meet less often in actual classrooms, but when they do, their sessions resemble hands-on workshops where students solve problems and apply their knowledge. Done well, hybrids can improve learning and help students get more mileage out of education.

Nationally, college faculty have been experimenting with hybrid courses for many years, but they are only now gaining traction in standard curricula, says Kahn, an instructional designer for Oregon State University's Extended Campus and the Center for Teaching and Learning. Test scores and grades show they are at least as effective as traditional classrooms. Moreover, they appear to help students prepare more effectively for class.

"If you walk into classrooms today, you're likely to see someone reading PowerPoint slides to students. In 10 years, if you walk around the hallways, you'll see something substantially different," says Kahn. "Nobody will be talking about hybrid courses. They will be the norm."

Teaching in this fashion requires a sea change in academia. The hallowed "sage on the stage" tradition — an instructor who lectures uninterrupted for 50 minutes or more, students who sit passively and take notes — is giving way to a more interactive process leavened by Wi-Fi and the Web. The shift pushes against centuries of ingrained pedagogical practice, so Kahn leads OSU faculty members in their own course of study. Through collaborations that he calls Learning Communities, instructors are creating hybrid courses that fit their teaching styles and disciplines.

> *"Think of education as a whole — what is it? Is it just the transfer of information? If that's the case, then Harvard has a problem, and all other universities have a problem too."*
>
> **— Eric Mazur, physicist, Harvard Magazine,**

The move to hybrids is only one example of a broader trend at Oregon State. As one-way information delivery moves online, face-to-face classes are getting recharged. Students are engaging in debates, creating videos, building three-dimensional models, visualizing ideas and even reviewing each other's exams. Instructors roam the room and vary the pace by challenging students to solve problems or address questions in small groups.

To advance this vision, a new classroom building is on the drawing boards, one that will offer unusual room arrangements and a hub for faculty who want to conduct research on new teaching methods (see "Flexibility to Learn" sidebar).

Activist Students

Jon Dorbolo directs Oregon State's Technology Across the Curriculum program and was recognized by the Center for Digital Education (an educational research institute in Folsom, California) last fall as one of 50 Top Innovators in Education. He works with faculty members on methods for stimulating student engagement. "Ultimately what we work for academically," he says, "is for our students to see themselves as scholars. Not as passive recipients of information but as active scholars, researchers."

Teaching, he adds, is an example of the scientific method in action. "Every lecture is a hypothesis. An instructor goes in there saying, 'I'm going to communicate in this fashion, with the expectation that what I'm doing — the examples I'm giving, the analogies I'm using, what I'm drawing on the board, the questions I ask — is going to have an effect on the learner. If they (the students) pay attention and follow along with me, by the end of this, they ought to be different than they were before.'"

Measuring student learning is typically done through exams, which Dorbolo calls "this blunt and unsatisfying instrument." Ultimately, evidence of teaching effectiveness, faculty members say, lies in the ability of students to think creatively and apply new knowledge.

The foundation for this new approach comes down to how people learn. "We have to allow the integration of knowledge," says Kay Sagmiller, director of the OSU Center for Teaching and Learning. That requires active engagement in an environment in which students feel welcome, safe and confident. "Our challenge is to figure out how to open up the hearts and minds of those in the classroom to integrate what we offer into their existing knowledge," she adds.

"Many faculty members don't want to talk to a sea of faces. They prefer to engage with each person," adds Dedra Demaree, assistant professor of physics who studies instructional methods in introductory courses. In her research, she has focused on how her own teaching affects student engagement. "My general philosophy is that I want to be able to quantify things so I can measure outcomes. But," she says, "there are a lot of deep things you can't get to by measurement."

Classroom as Studio

While Demaree teaches first- and second-year students in lecture halls, she has also designed a classroom — a "physics studio" — that invites student participation. Instead of facing forward in rows, students work together at round tables. They get out of their seats to demonstrate concepts on electronic displays positioned around the room. A low-friction floor enables them to experiment with phenomena such as momentum and inertia.

With her graduate student team, Demaree analyzes videos of activity in class to understand what students actually do as she leads a discussion. She wants to know if they are disconnected or partially or fully engaged and how they are engaging in and interpreting discourse in the classroom. The team complements those analyses with interviews of students to delve deeply into the learning process.

Demaree's group has shown that even small unintentional cues from the instructor can make a big difference for students. For example, in two separate sections of a class, Demaree gave two different messages about her expectations. "I told one section, 'Remember this course is for everyone, even if you've never had physics before. We should all be able to reason through the process.'" To the other group, she said, "We started this on Friday and you should already know the answer." Her explanation stimulated engagement in the first group and depressed it in the second. "The difference in engagement was phenomenal," she says.

Pushing this educational shift, adds Kahn, is communication technology that students already know and trust. From laptops to smart phones to tablets, students have many opportunities to get information and exercise their brains. "Students are quite adept at accessing information. They're going to use these devices no matter what. Why not try to get them to use those tools to accomplish the learning outcomes of the course? For better or worse," he says, "they're going to educate themselves."

"In general," says Sagmiller, "we underestimate how complex teaching and learning and assessment are. It's exceedingly complex. It's hard. Anybody who thinks it's easy should stand up in a classroom of 600 undergraduates and give it a go and see how that feels. Or be held captive in a classroom with 35 kindergartners." terra

Engagement Across the Curriculum

Many Oregon State faculty members are challenging their students in new ways. Here are a few examples from across campus.

APPLETS FOR ALGEBRA

Scott Peterson wants students to think mathematically, not just to memorize formulas. He teaches introductory algebra, a fundamental course for most students. Online, he provides applets, software that allows students to visually perform mathematical tasks. Two of three weekly classes are spent in active exploration of algebraic concepts. In weekly lectures, he prompts students to discuss problems. He monitors conversations and tracks solutions through a rapid response system known as a clicker. He uses the results as a springboard for deeper discussion. About 2,000 OSU students take introductory algebra every year. Next fall, all sections are scheduled to adopt Peterson's methods.

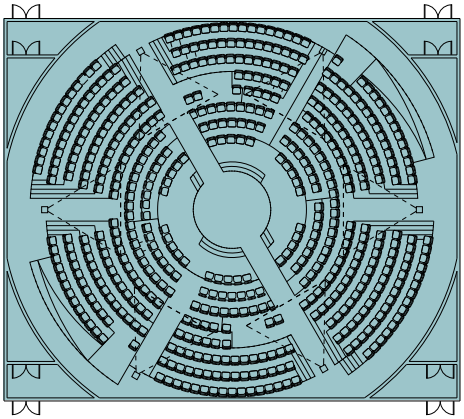
ROAMING WITH AN IPAD

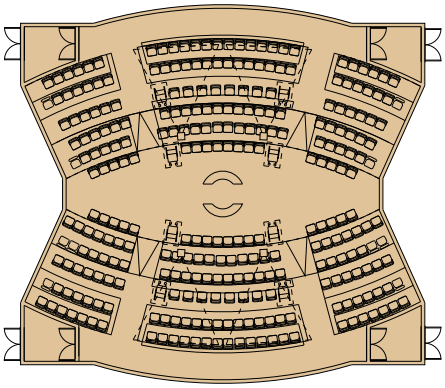
Devon Quick typically has 500 to 600 students in her introduction to human anatomy and physiology class. Like Peterson, she uses clickers, and she posts her lectures and other materials online for students to review. During class, she roams the room with an iPad. Using software from Doceri.com, she draws and manipulates images on a screen at the front of the room. She may hand the iPad to a student to demonstrate a concept. In surveys, 88 percent of her students have indicated that they like her use of the iPad and feel it makes the class more interactive.

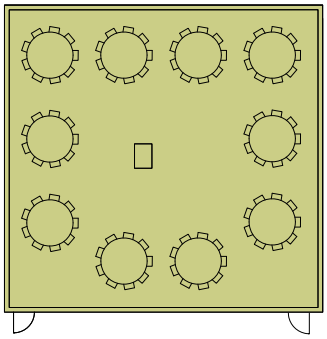
Flexibility to Learn

Pending approval by the State Legislature, Oregon State plans to create an inspiring teaching laboratory and promote active learning in a new classroom building. Planned by Boora Architects in Portland, the new facility has been designed with faculty input and includes:

- A 600-seat arena classroom in the round
- A parliamentary-style room where students face each other across an aisle
- Lecture halls in which teachers can easily reach every seat
- Flexible seating arrangements that allow students to work in groups
- Space for three programs that develop and support new learning strategies — the Center for Teaching and Learning, Technology Across the Curriculum and Media Services — and room to demonstrate new concepts for student engagement







HYBRID VERSUS TRADITIONAL

In two sections of Introduction to Psychology (300 or more students), Kathy Becker-Blease compared a hybrid to a traditional teaching approach. Each section used the same classroom, time of day, learning objectives, textbook and exam questions. Through quizzes, exams and homework scores, Becker-Blease found that student learning was equivalent. She also works with textbook publishers who offer online "diagnostic quizzing." Students get immediate feedback as they answer questions, and instructors see how individuals and the class as a whole perform. Becker-Blease says students come to class better prepared. She is planning research to analyze the effectiveness of this approach.

COLLABORATIVE TESTING

Tests need not be a cause for jitters. Engineering professor John Selker's high-tech secret: two pens with different colors. After students complete their tests with one pen, he hands out the second and has them work in groups to identify mistakes and come up with the right answers. Students get full credit for their initial work in the first color and partial credit for writing corrections in the second color. By working out solutions with their peers, students fill in knowledge gaps and strengthen peer relationships. "At last," says Selker, "the smartest student is also the most popular!"

VIDEO DEMONSTRATIONS

An engineering course, Strength of Materials, focuses on the forces that push, pull, bend and break everything from steel to carbon fiber. To help his 230 students master the mathematics and the concepts, Joseph Zaworski created 35 short online videos. Playable on any device from desktop computer to mobile phone, they allow students to pause and review as often as necessary. Between classes, students review videos and read the textbook. Class meetings include quizzes and team-based problem solving. Zaworski uses software from TopHatMonacle.com to monitor student responses and address common concerns.

Connective Tissue

Finding hope where facts and values intersect

BY LEE SHERMAN

Environmental philosopher Michael P. Nelson gamely copes with "ginormous" mosquitoes and gobs of "moose grease" as he necropsies a moose on Isle Royale in Lake Superior. (Photo: John A. Vucetich)

When Michael P. Nelson talks about his work, he mentions carcasses and cadavers to a startling degree — startling because Nelson is not a physician or a veterinarian or even a biologist. He's a philosopher. So at first glance, necropsy seems an odd topic of discourse. But it starts to make sense when you notice that Nelson's office is in Oregon State's College of Forestry, not the College of Liberal Arts where universities typically house their philosophers. And, as the only philosopher ever hired to lead one of the National Science Foundation's 27 Long-Term Ecological Research (LTER) sites — in this case, OSU's H.J. Andrews Experimental Forest — Nelson again defies tradition.

"We started the search assuming we'd end up with some sort of ecologist, hydrologist or biophysical scientist," recounts John Bliss, the associate dean of forestry who led the hiring process. "I knew we'd turned a corner when the ecologists on the committee stopped me in the hall to say things like, 'Maybe a philosopher is what we need!'"

With *-ologists* already well represented, they opted instead for Nelson's novel viewpoint. "Michael brings a philosopher's logic to complex problems, unencumbered by disciplinary straitjackets," Bliss says.

Mind Over Matter

To understand these discrepancies, you have to go back to Nelson's hometown of Janesville, Wisconsin, where, in a high school anatomy class, he saw a dead body laid out on a steel slab. "I thought that cadaver was the coolest thing in the world," he recalls. But once he got to college, the study of biology struck him as tedious. Too many equations to solve, too many chemical reactions to memorize. In contrast, he found himself relishing his philosophy classes. Ideas like the moral imperative and the inherent nature of being quickened his imagination. He soon switched majors and began to ponder the world on a cerebral rather than cellular level.

His fascination with biological systems, however, never went away. Eventually, this man whose mental petri dish was awash in syllogisms

instead of cell divisions circled back to where he started — to that raw, physical nexus of life and death that is a carcass. It happened about a decade after he earned his Ph.D. at England's Lancaster University, the cradle of environmental philosophy. By then, Nelson was teaching at Michigan State University, where he met John A. Vucetich, co-director of a long-term, multidisciplinary study of predator-prey dynamics. Vucetich invited Nelson to visit the study site: a wild, isolated, mist-wrapped island in Lake Superior. Nelson was enchanted. Soon he became the "resident philosopher" for his project, the Wolves and Moose of Isle Royale.

Which is how, in 2005, he came to be kneeling beside a pile of bones and sinews where wolves had devoured a moose. Every summer, Nelson participates in collecting biological samples, including scat and skulls, for DNA analysis and pathology studies. Now in its 55th year, the project has tracked the dynamics between wolves and moose over a timespan unprecedented in the annals of predator-prey studies. Surprising insights into island biogeography and wildlife management are emerging from the mists.

"What I really like about my work," Nelson notes, "is that it exists at the edges of disciplines."

Sting Like a Bee

In front of a crowd, Nelson moves nimbly, like a boxer, on the balls of his feet. An aura of great energy emanates from his face and hands. It's clear that he's in a hurry to push his thoughts outward. Planet Earth is, after all, poised on the cliff of calamity, he says during a joint presentation on ethics and climate change with OSU conservation philosopher Kathleen Dean Moore. He and Moore challenge the scientists in the audience to couple their facts (climate models, data sets, statistical analyses) to their values (as parents, as community members, as global citizens). It's time to kick the advocacy taboo to the curb, the two philosophers exhort, arguing that meaningful action arises only when facts ("what is") are welded to values ("what ought to be").

To drive home the urgency of curbing fossil fuel use, Nelson cites sources as diverse as Genesis and Dr. Seuss. At last year's meeting of LTER scientists nationwide he did a riff inspired by *The Lorax*. This scholar of striking contrasts can recite playful couplets one moment and the next, dare scientists to rethink the most basic assumptions of their careers.

"Look, we don't know how to create careers in science that fully empower scientists," Nelson tells a roomful of researchers. "What we do know is this: Everything has changed. You have taught us that. You should ask yourself some questions: Are the old forms of scientific practice working? Or do you need to create another path? What does it mean to be a scientist now? You are studying systems, ecosystems; you know about the necessity of connections. Live what you know. That's integrity." terra

What It's Like to Necropsy a Moose

BY MICHAEL P. NELSON

It's physical and sensual. It's not an exercise in hypothetical counterfactuals or wonderings about brains in vats or the playing of a clever devil's advocate. It's hot and uncomfortable and smelly. You flail in vain at ginormous mosquitos with your forearms and shoulders (because your hands are covered in rubber gloves which are covered in moose grease and hold a sharp knife); you record information on a necropsy card; you walk ever-widening circles in search of bones dragged off and chewed on under a balsam fir tree; you cut the tendons between metatarsus and femur, and find the skull and the lower mandible; you tag, and bag, and carry them home.

But unless you have no soul or imagination it's also stunning and humbling. Someone who was intelligent and sensitive and brave, who had no interest in being killed and eaten, fought very hard but died here. And others, who were also intelligent and sensitive and brave, who also fought very hard, were fed here. And the breeze picks up. Little lonely ghosts of an adrenalin-drenched drama linger in this place – you can feel them. And it's appropriate to breathe in and to be deeply silenced by this truth.

Nomads No More

Anthropology student listens to the vanishing voices of Mongolian herders

BY CELENE CARILLO

Tom Conte has found that as the nomads of Inner Mongolia lose a way of life, the grasslands give way to desert. (Photo: Jeff Basinger)

In tune with nature's seasonal shadings, nomads once roamed across the grasslands of Inner Mongolia on China's northern frontier. For generations, bands of herders moved across the landscape — matching the dietary needs of livestock to the cycles of plants, striking an ecological and cultural balance.

But that ancient pattern is teetering, warns Oregon State graduate anthropology student Tom Conte, who lived with a group of herders while he studied their changing way of life. Pressure from encroaching modernization is threatening traditional patterns of migration and collaboration, he concludes. The grasslands that stretch forever under an endless sky are also stressed. The longtime symbiosis between grazing and growing, which mutually benefited lifeways, livestock and landscapes, is badly frayed.

Less Grass, More Sand

Bumping along a dirt track, it takes 45 minutes to reach houses outside the tiny village of Dashimo, where Conte stayed while interviewing herders for his master's thesis. The sparsely populated landscape gives the impression of boundless space, a foreign sensation to a guy of Italian ancestry raised in the Bronx. "There've been times in history when an Italian has met with Mongolians — Marco Polo and Kublai Khan, for example," he jokes. "This is more Joe Pesci than Marco Polo."

The ground that surrounds Dashimo reveals a troubling ecological process that's stripping vegetation from arid lands in Inner Mongolia and elsewhere around the world: desertification. Dashimo's once-lush sea of grass is giving way to sand. A symptom of land privatization — a land-use policy implemented by the

Chinese government in the 1970s — desert encroachment is undermining the livelihoods and traditions of herders, according to Conte.

"It's important to study these things because they're disappearing," he says."Studies show the desert expands more than 10,000 square kilometers a year in China."

The issues surrounding grassland degradation are complex in this remote region, home mainly to ethnic Mongolians and a minority of Han Chinese (As a whole, Han Chinese comprise about 80 percent of Inner Mongolia's population of almost 25 million.) The herders are being pushed aside to make way for industrialization, mining and privatization, Conte explains.

"Originally the land was managed collectively, until the Chinese government decided to privatize," he says. "Privatization worked really well in terms of agriculture. But pastoralism is different. Privately managed land has led to widespread degradation of the grassland. Animals eat everything, and the desert expands."

It's a tense issue in China. In 2011, a herder was killed by a coal truck as he was trying to stop a mining convoy that was driving across prairie land. His death sparked the biggest wave of demonstrations Inner Mongolia had seen in decades. The region is China's largest coal producer. It's also the largest supplier of rare-earth metals in the world — materials that end up in products consumed in the West, like smart phones, solar panels and wind turbines.

Many herders began settling about 20 years ago as the government forced them onto single plots of land that fail to meet all their animals' needs. Families that once cooperated are now living separately. While some rent additional land where they can move their animals, the land policy, overall, spurs dangerous overgrazing, Conte says. "If you stay in one place, you exhaust the resources."

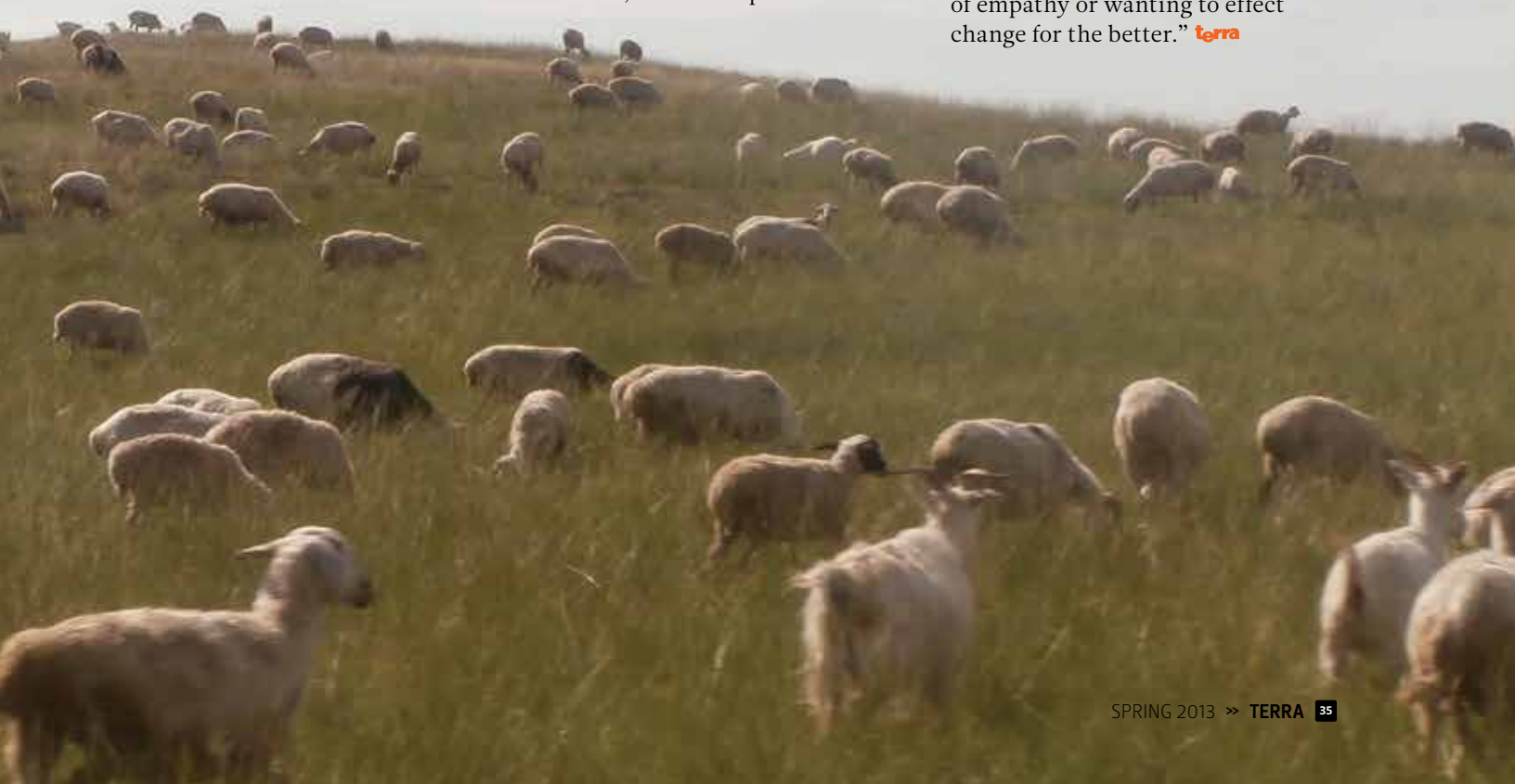
But overgrazing is just one outcome of settlement. Another is the loss of traditional kin-based ties that bound herders and enabled cooperation in moving livestock to prime forage, a problem Conte is addressing in his research. "Herders believe that ecological degradation has increased and cooperation has decreased," he sums up.

Lessons from America

The danger to the herders' culture, as well as to the land, mirrors our own history, argues Bryan Tilt, Conte's thesis adviser and an associate professor of anthropology. "The situation of minority populations in China is not unlike the American Indian story," Tilt says. "Only in folks of this region, the changes are much more recent. There is an element of culture loss that's happening."

"We know a lot of people think the nomadic lifestyle is romantic because herders are tied to the land," Conte says. "But it's not just romantic. There are concrete data showing that the ways the people manage land is sustainable. And better. Different animals — goats, sheep, camels, horses, yaks — have different water and plant species preferences given the season. A lot of traditional ecological knowledge went into the decision of where to move and when."

All of the herders Conte interviewed — those who have settled as well as those who still migrate — are feeling the strain in an altered landscape. "You can't work with people and not have a sense of empathy or wanting to effect change for the better." terra



Grape Crush

Food scientists find new uses for pulpy winery leftovers

As you sip your favorite Oregon pinot noir, do you ever wonder what happened to the discarded remains of those luscious grapes? Typically, the seeds, skins and stems from the nation's 4 million tons of wine grapes have been tossed out — until now.

The pulpy leftovers of juicing and crushing, called "pomace," are finding their way into products as diverse as gluten-free muffins, biodegradable flowerpots and edible food wrappings, thanks to Oregon State Extension researcher Yanyun Zhao and cereal chemist Andrew Ross. Loaded with antioxidants and dietary fiber, pomace also controls bacteria and preserves fats, making it versatile as well as nutritious. "We now know that pomace can be a sustainable source of material for a wide range of goods," says Zhao.

Sea Trio

Oregon State will lead design and construction of coastal research vessels

During the next 10 years, OSU will be at the forefront of a ship building project that will "revitalize and transform" coastal-ocean science in the United States, says oceanographer and former U.S. Navy and NOAA administrator Rick Spinrad, the university's vice president of research. Oregon State has been designated as the lead institution for the design, building and launching of as many as three state-of-the-art research vessels funded by the National Science Foundation.

Officials expect the vessels to be positioned on the East Coast, the West Coast and the Gulf Coast, depending on research needs and available funds. The 175-foot vessels will be "floating, multi-use laboratories" that are "more seaworthy and environmentally green" than previous research vessels, says Mark Abbott, dean of the College of Earth, Ocean, and Atmospheric Sciences. The first ship will hit the water in 2019 or 2020.

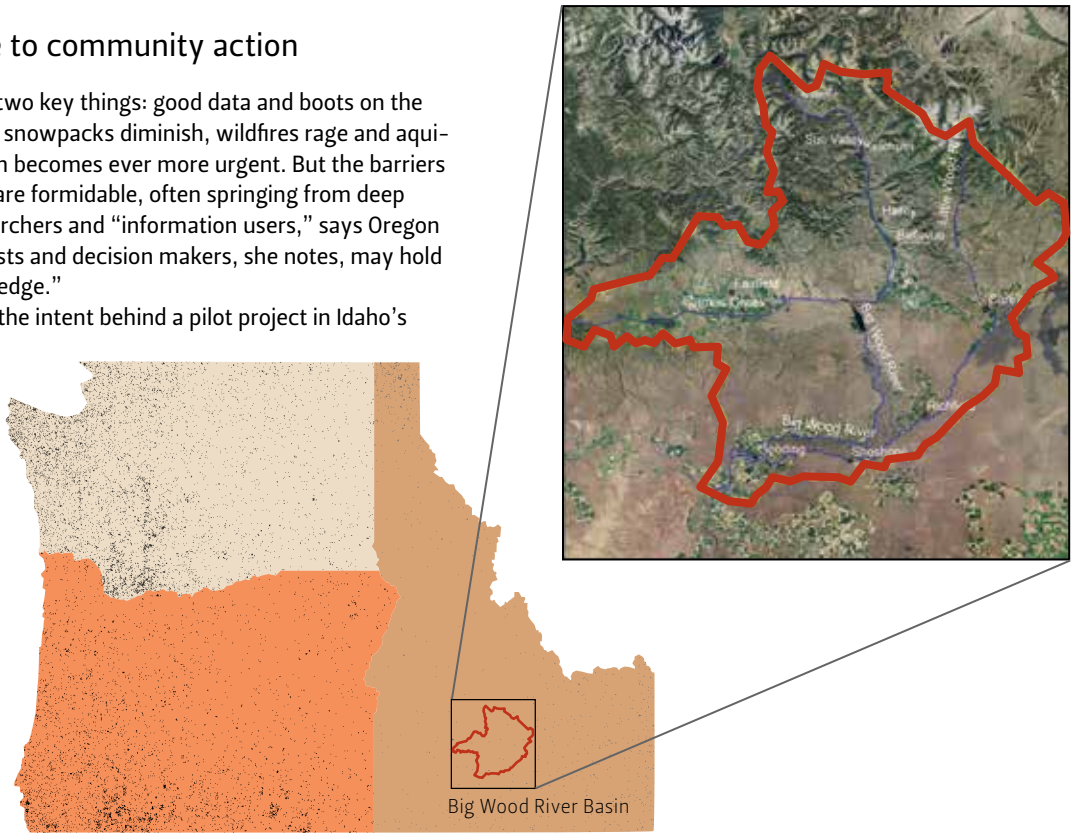
Conceptual drawings below are by Seattle-based Glosten Associates, a marine engineering firm.

From Data to Doing

Converting climate science to community action

Adapting to climate change requires two key things: good data and boots on the ground. As oceans rise, icecaps melt, snowpacks diminish, wildfires rage and aquifers dry up, coupling science to action becomes ever more urgent. But the barriers to linking science to practical action are formidable, often springing from deep disparities in worldview among researchers and "information users," says Oregon State sociologist Denise Lach. Scientists and decision makers, she notes, may hold "different notions of truth and knowledge."

Breaking through these barriers is the intent behind a pilot project in Idaho's Big Wood River Basin, where a diverse group of local stakeholders has been meeting regularly with OSU climate and social scientists to talk about and plan for climate-driven changes in water quality and availability. Convening and hosting this "knowledge-to-action network" is the Climate Impacts Research Consortium (CIRC) based at Oregon State. By fall, the network will have developed and analyzed alternative scenarios based on climate models, land-use practices and population growth.



BITS & PIECES • News Briefs from Oregon State

A BOOST UP. Kids being raised by a grandmother, sister, foster parent or other non-parental figure face extra risks that can hinder school success. Head Start gives these kids an important boost, says Shannon Lipscomb, a researcher at OSU-Cascades. They are readier for kindergarten, have better relationships with teachers, and show fewer behavior problems than kids from non-parental homes who don't attend a Head Start program, Lipscomb found in a recent study.

THE ACTIVE LIFE. Don't have time to go to the gym? Hate sweating through a Zumba class? That's OK, as long as you're up and moving around, OSU researchers Brad Cardinal and Paul Loprinzi found. Even short bouts of activity — climbing the stairs at your office, raking the leaves in your driveway, changing the linens on your bed — can improve cholesterol, blood pressure and other health indicators, as long as those bouts add up to 30 minutes a day. So ditch the leaf blower and grab a rake!

PREVENTION FOR PENNIES. Can a penny a day save your life? It might, says OSU researcher Balz Frei. Men who took a multivitamin daily for 13 years had significantly fewer cancers compared to men who did not, a study from Harvard Medical School and Bingham and Women's Hospital showed. "Quite simply, at around a penny a day, a multivitamin is the cheapest health insurance a person will ever buy," notes Frei, who directs OSU's Linus Pauling Institute.

ANIMAL MAGNETISM. Salmon navigation is a longstanding mystery in the biological community. Now, scientists have found a new clue. The fishes' "biological toolkit" of navigation aids — smell, sunlight, isotopic fingerprints, "infrasound" of breaking waves — also includes changes in the geomagnetic field, OSU researcher Nathan Putman found in a study supported by Oregon Sea Grant and the National Science Foundation.

Seeing the Light

New window technology will save energy and money

In the green-construction field, there's a window technology called "Low-E," the user-friendly term for "low emissivity." Now Oregon scientists and startups have joined forces to create the next generation of Low-E — an anti-reflective, thin-film coating for glass that will block infrared heat (keeping heat inside during winter's cold and outside during summer's sizzle) and allow more visible light to penetrate year-round.

This "new recipe" for advanced, energy-efficient window coatings got a big push toward the marketplace in March, when Oregon BEST (Built Environment & Sustainable Technologies Center) awarded a commercialization grant to an industry-university team to support research, testing and product development. Oregon State's Chih-hung Chang and University of Oregon's G.Z. "Charlie" Brown will be working with startup companies CSD Nano of Corvallis and Indow Windows of Portland.

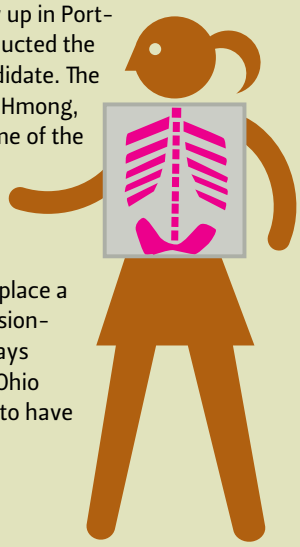
The saved energy and reduced costs could be gigantic, says Paul Ahrens, CEO of the OSU spinout company CSD Nano. "If you were to put the coating we're developing on all the architectural glass out there, you would save hundreds of millions of dollars in electricity currently used for lighting," says Ahrens.

Hmong Health Study Defies Expectations

More cancer screening, less male influence found

Hmong women in Oregon are not as wary of Western medicine as some national studies of Hmong communities have suggested. A study of Hmong adults living in Portland and Salem found much higher rates of breast and cervical cancer screenings than the researchers expected, says Oregon State public health professor Sheryl Thorburn, lead author.

Screenings may have been underreported in part because Hmong women typically keep health decisions private. And while many Hmong have indeed been screened, those screenings tend to be one-time or occasional events rather than regular routines. "It is not enough to have been screened once," says Jennifer Kue, who grew up in Portland's Hmong community and conducted the study with Thorburn as a Ph.D. candidate. The risks are especially high among the Hmong, whose cervical cancer rates are some of the nation's highest.



Another surprising finding: Hmong women make many health decisions independently of their husbands. "In our culture, we place a heavy emphasis on communal decision-making and it's male-dominant," says Kue, now an assistant professor at Ohio State. "I would have expected men to have more influence."

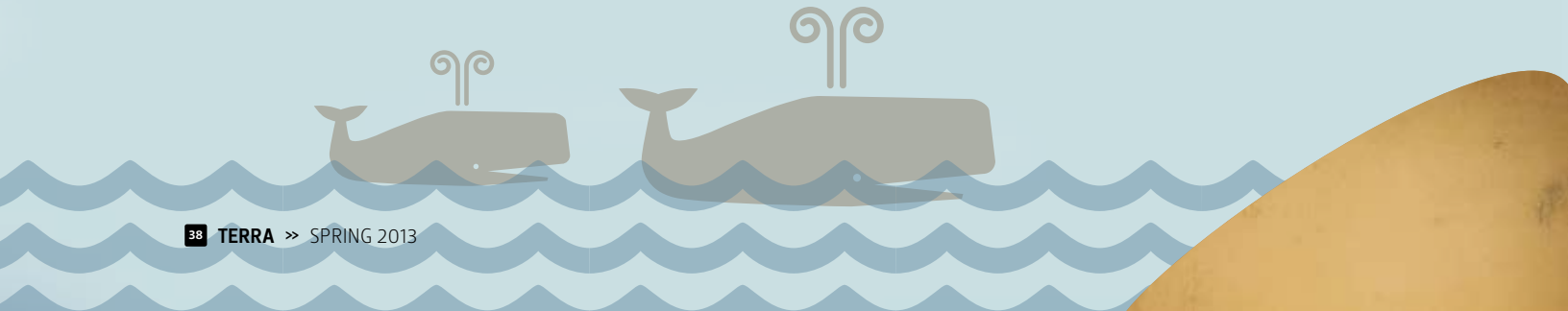
On the Beach

Stranded whales are not always related

Haunting images of whales strewn across beaches turn up all too often in the news. So far, scientists have little hard data to solve the enigma of mass whale strandings, although hypotheses abound.

One of those hypotheses — that family bonds play into the stranding phenomenon — is now subject to question, based on genetic analysis of hundreds of beached whales in New Zealand and Australia. The mothers of beached calves, for instance, often were missing entirely from the beach, says cetacean researcher Scott Baker, associate director of the Marine Mammal Institute at Oregon State. Given whales' strong kinship bonds, this familial separation could signal some disruption prior to the stranding — a disruption that could, in fact, play a role in triggering the event.

"Rescue efforts aimed at 'refloating' stranded whales often focus on placing stranded calves with the nearest mature female" on the assumption she's the mother, Baker says. "Our results suggest that rescuers should be cautious when making difficult welfare decisions ... based on this assumption alone."



Sustainable Semis

Partnership with Daimler Trucks North America produces carbon-fiber prototype

BY ANNIE ATHON HECK | ILLUSTRATION BY LESLIE HERMAN

Like the auto industry, trucking companies are looking for new ways to cut fuel consumption and greenhouse gas emissions. A partnership between Oregon State University and Daimler Trucks North America is making inroads by developing an 18-wheeler that combines high strength for heavy payloads and increased fuel efficiency for sustainable performance.

Part of the Super Truck program funded by the U.S. Department of Energy and Daimler, this effort already has yielded promising early results: a prototype carbon-fiber chassis rail and an innovative design for cruise control. The partnership began in 2009 when Daimler contacted John Parmigiani, a research assistant professor in Oregon State's School of Mechanical, Industrial and Manufacturing Engineering (MIME), seeking ideas. Daimler is the leading commercial truck manufacturer in North America.

Parmigiani led a research project to replace the rails, key chassis components that run from front to back, with lighter materials. By using carbon fiber — the same material used for rocket nose cones — instead of steel, Daimler achieved significant weight reduction.

"Carbon fiber is a great material to use," Parmigiani says. "The weight difference is amazing."

The partnership with Oregon State was a positive experience, says Derek Rotz, a senior manager in advanced engineering for Daimler — so positive, in fact, that the company hired Brian Benson, one of the graduate students who worked on the project.

"We learned a lot about the design," Rotz adds. "There still needs to be more work done before we put the carbon fiber rails into mass production, because they are more expensive."

The next step will be to integrate the rails into a production prototype. Headquartered in Portland, Daimler Trucks North America manufactured 141,000 vehicles in 2012. Its brands include Freightliner, Western Star, Freightliner Custom Chassis, Thomas Built Buses and Detroit.

In a separate project, MIME professor Kagan Tumer used "intelligent systems" to create an adaptive cruise control that improves fuel efficiency.

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At the Port of Ishikari on Japan's Hokkaido Island in 2007, Scott Ashford and colleagues from the Port and Airport Research Institute developed cost-effective liquefaction mitigation measures for airport runways. Their efforts helped to minimize airport damage in the 2011 Japan earthquake. Here, they are conducting scans with a LIDAR (Light Detection and Ranging) system to monitor soil liquefaction induced by controlled explosions. Support came from the National Science Foundation and the U.S. Geological Survey. See "Oregon 9.0," Page 8. (Photo: Rob Kayen, U.S. Geological Survey)