Summer16
vol15no3

Washington State MAGAZINE

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Close encounters from outer space

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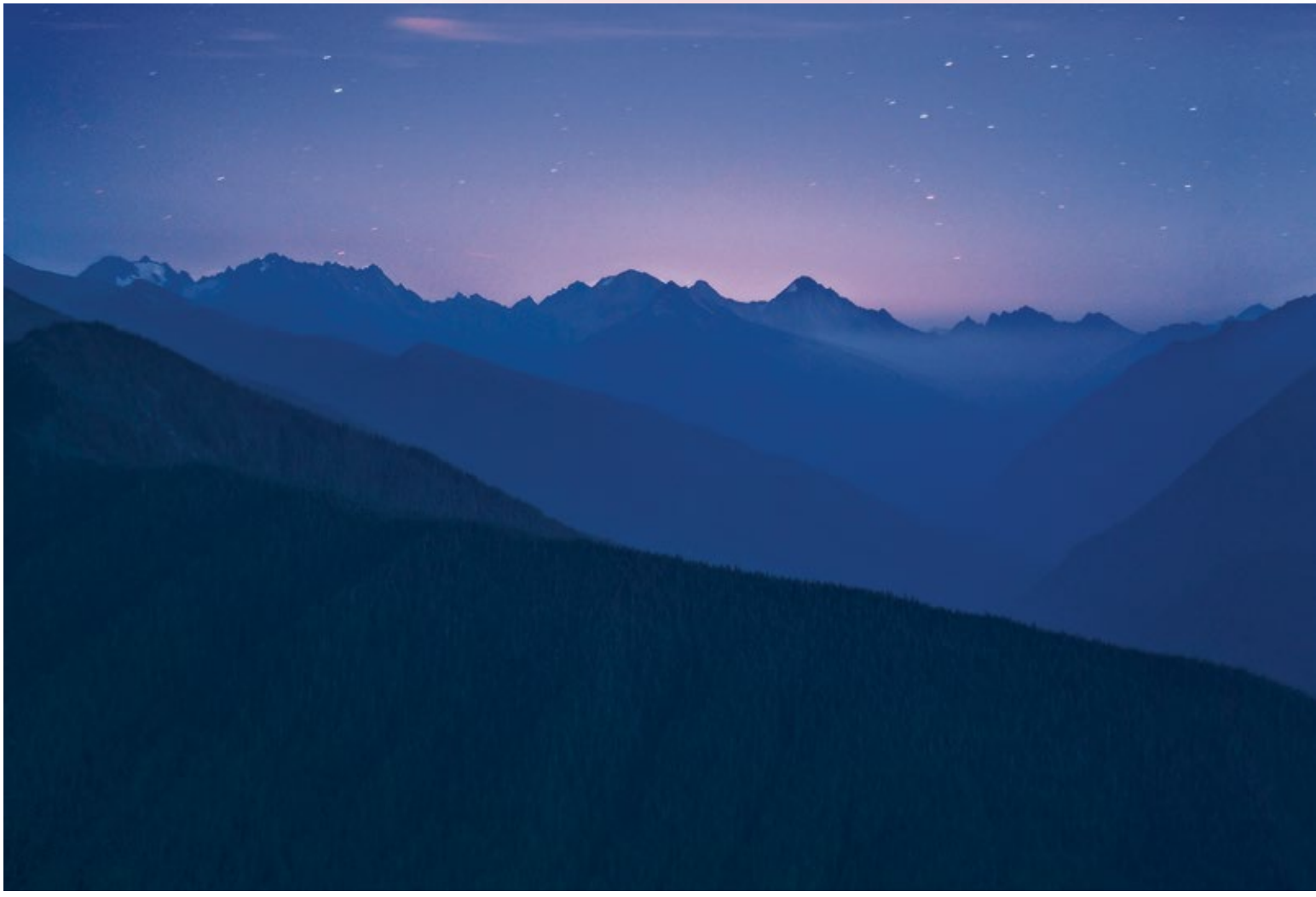
The pharmacist will see you now



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Meet the new **WSU** president

Washington State University's next president, Kirk H. Schulz,

sees his new role at WSU as a once-in-a-lifetime opportunity to lead a university poised to launch a medical school, continue its commitment to accessible higher education, and further its research mission.

Schulz will join WSU on June 13 from Kansas State University, where he has been president since 2009.

Schulz has a long commitment to land-grant universities and their historical mission to provide accessible, affordable higher education. He earned his degree in chemical engineering from Virginia Tech, a university similar to WSU with strong agriculture, veterinary medicine, and engineering components.

Virginia Tech, Kansas State, WSU, and Mississippi State—where Schulz worked as vice president for research and economic development and dean of their engineering college—adhere to the land-grant ideals, he says.

Schulz also notes the decision by the state to reduce tuition and then backfill the money as another reason he's joining WSU. "That showed me that the state of Washington is interested in keeping higher education as affordable as practically possible," he says.

The Elson S. Floyd College of Medicine gave Schulz another reason to get excited about the presidency of WSU. "It's highly intriguing to lead a land-grant university with the opportunity to start and build from scratch a publicly-funded medical school," he says.

Schulz brings his success in raising the research profile of Kansas State to WSU, which he sees as poised for even greater achievements.

Schulz is joined in Pullman by his wife Noel Schulz—an internationally recognized power systems expert and electrical engineer—who will join the faculty of the Voiland College of Engineering and Architecture.

Read our feature on President Schulz in the Fall issue.

PHOTO ROBERT HUBNER

Expecting?

Marriage, children, career move, grandchildren, retirement. Our lives are full of life-changing moments that make us stop and reflect on taking care of the people and causes that mean the most to us. Wherever life leads you, consider being a part of creating a bright future for Washington State University through your estate plans.

Call the WSU Foundation Gift Planning Office at 800-448-2978 or visit *foundation.wsu.edu/gift-planning* to create your legacy today.

WASHINGTON STATE UNIVERSITY FOUNDATION

As above, here below. Early science fiction authors tossed around the idea of mining the asteroids near Earth decades ago. Asimov, Heinlein, Pournelle, and other sci-fi luminaries wrote the concept into their stories of robots and space-bound pioneers since the 1940s. As with many of those authors' ideas, we're on the edge of fiction becoming reality.

Companies such as Redmond-based Planetary Resources plan to send robot harvesters up to the asteroids, likely within a decade, to extract water and rare minerals. CEO Chris Lewicki told me they are already in the prospecting phase, sending satellites to probe for likely mining candidates. The conference room where we met has a large window into a clean room, where their engineers prepare the next satellites.

"I think we are closer to extracting water off of an asteroid than we were to the launching of the iPhone," he said.

As Lewicki talks, he illustrates his discussion not with pictures, but with meteorites scattered on the Planetary Resources conference table. Rocks such as these have crashed all over Earth, like an almost 20-kilogram iron mass found a few miles from Pullman in 1993. They provide clues to what we might mine from asteroids.

One of the unassuming samples on the table is a dark slice of rock with light flecks. It's similar to the type of asteroid, a carbonaceous chondrite, that might provide ice—and thus oxygen and hydrogen for fueling rockets and water to keep people alive when the time comes for further human spaceflight.

Asteroid mining is just one aspect of the rapidly-developing private space industry. Rocket launches, space tourism, and space planes are already here—with Washington at the forefront. The Washington State Space Coalition is a recently-formed group of Washington companies that builds on the state's long history of aerospace innovation from Boeing and others.

Research at WSU on meteorites, propulsion systems, and other aspects of space exploration can help Washington move toward that future. Just as crucial, WSU trains engineers and others who will work in this growing field. Dozens of alumni already work for outer space companies such as Blue Origin, Planetary Resources, Aerojet Rocketdyne, and SpaceX. They're working not on sci-fi dreams, but real efforts with a universe of possibilities.

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TALKback

Police training

Congratulations for this important and excellent story [Spring 2016] that WSU grads are creating concerning the much needed training of first responders in handling potentially explosive and often tragic situations. It is of interest that the technology (smart phone cameras) that brought to the country's attention the several recent lethal police encounters with escalating situations, is also being used to assist the training (dash and body cams) to defuse contentious confrontations.

I am pleased to see that the researchers and trainers involved in this project are expertly fusing psychology, criminology, and technology into their training programs and that they take seriously the validation of their training procedures. Their success will likely save lives of otherwise disruptive suspects and mentally ill individuals. Here's hoping that the fruits of their research will spread across the country.

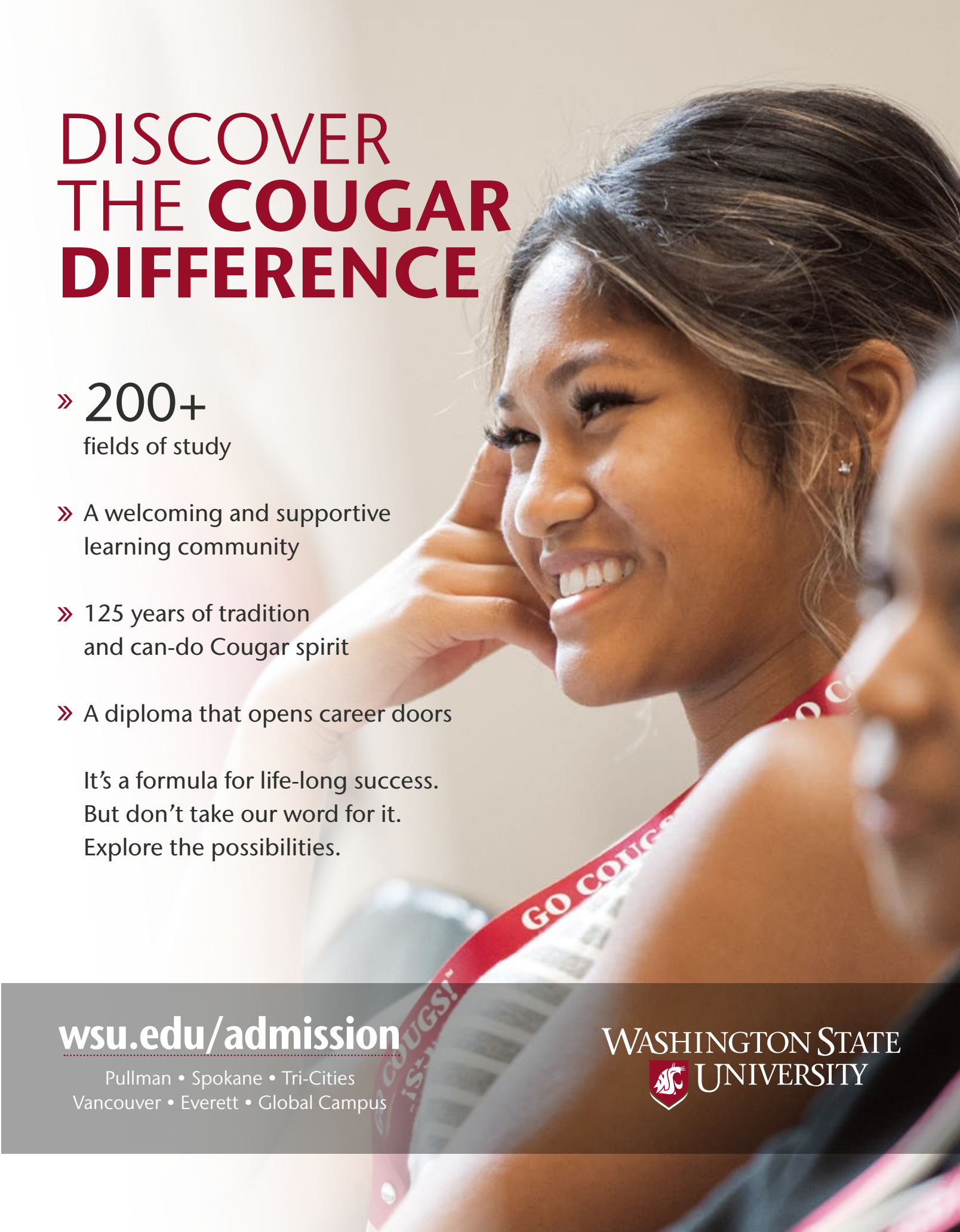
RONALD KLEINKNECHT, '64, '66 MS PSYCH., '69 PHD CLINICAL PSYCH. AND CRIMINOLOGY

Still thinking about Amelia

Whenever I see an article on Amelia, It takes me back to my time spent on Saipan during WWII. I was a ground crew chief on a B-29 Bomber, and every third day had 14 hours of free time to roam around the island. I became friends with a Chamorro fisherman. He spoke fairly good English, and during one of our conversations, told me about fishing at the docks one day (before the invasion). He said a boat came in that had a blond woman and a dark haired man aboard. He saw them taken away, both restrained, but never saw them again. I asked him if he had ever heard of Amelia, and he had not. Other than seeing the two, he had no further information. I have told this to many people, but not to anyone with interest.

FRANK SLAGLE '51
Redmond

We'd love to hear from you! Send us your letters or class notes, sign up for our monthly email newsletter, and connect with us on social media: **magazine.wsu.edu/connect**



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WASHINGTON STATE UNIVERSITY

COLLECTION OF ORANGUTAN NEST PHOTOS FROM SURVEY FLIGHTS (COURTESY CONSERVATION DRONES). **OPPOSITE:** AN AFRICAN PAINTED DOG (COURTESY PAINTED DOG RESEARCH TRUST)

BY REBECCA PHILLIPS

Looking over the endangered creatures

KEEPING A WATCHFUL EYE IN REMOTE ENVIRONMENTS WITH AERIAL DRONES

Stealing through the shadowed plantation, an orangutan stops to feed on the tender shoots of a palm sapling. An instant later, she crumples from a rifle shot, her baby crying out in fear. The infant is eventually rescued and spirited away to a rehabilitation center for release back into the wild.

"At one time there were 2,500 of these orphans in Borneo," says Chuck Pezeshki, a professor of mechanical and materials engineering at Washington State University. "It's an enormous tragedy and the apes are now on the endangered list."

Pezeshki says the native rainforest favored by orangutans is rapidly being cleared to make way for lucrative palm oil estates. Forced to become scavengers, the displaced primates creep into villages seeking food where they are often killed and the babies sold as pets or left behind. Orangutan numbers have consequently fallen to half their 1950 level.

In an effort to help restore these populations, Pezeshki and his senior students in the Industrial Design Clinic are developing a radio tracking system to monitor the survival rates of reintroduced apes. Working in collaboration with ConservationDrones.org and U.K. biologist Serge Wich, the tracking device will be deployed in Borneo using a commercial quadcopter and video camera.

The tracking system will also be adapted for use in aerial surveys of endangered African painted dogs in Zimbabwe.

Since 2012, design clinic students have undertaken challenging projects like these for nonprofit organizations free of charge. The clinic, which Pezeshki began teaching in 1994, typically asks a fee for projects with for-profit corporations like British Petroleum or Boeing. Over time, these projects generated a reserve fund which allowed Pezeshki to begin supporting nonprofits.

"The concept of us tithing and giving back is important," he says. It is also important to grant nonprofits the same customer standards they use for industry: In order to pass the class, students must create a product the client can actually use.

PEZESHKI'S FIRST NONPROFIT PROJECT was with Mobility Outreach International, a company that develops low-cost prosthetics for manufacture in Sierra Leone. "We made a prosthetic foot and ankle that could be built from recycled materials and repaired locally," he says.

Encouraged with the results, Pezeshki sought out ConservationDrones.org in an effort to help the orangutans. He soon signed on for a second project with Carrie Culp and the Painted Dog Research Trust USA in Seattle.

With large, spoon-shaped ears and showy calico coats, painted dogs were once a common sight throughout sub-Saharan Africa but today are threatened with extinction from relentless hunting, habitat loss, road kills, and disease.

Pezeshki says painted dogs are unique in caring for sick and elderly members of the pack. A "doctor" dog will even be assigned as caretaker, regurgitating food, licking wounds, and staying with an injured animal until it recovers. Unfortunately, if one dog is caught in a snare trap, the whole pack stops, providing easy prey for shotguns.

For several semesters, Pezeshki's students have labored over the construction of an unmanned airplane that will improve scientists' ability to track and protect painted dogs in Zimbabwe. They want to build a low-cost radio telemetry drone able to fly over 120 kilometers and detect signals from collared dogs within a 2-kilometer range. The first step was to make it fly.

On a bone-chilling, blustery day last December, the team drove their fiberglass plane to Lewiston, Idaho, for its eleventh attempted test flight. Despite strong winds that afternoon, great cheers of delight and relief filled the air as the drone performed flawlessly.

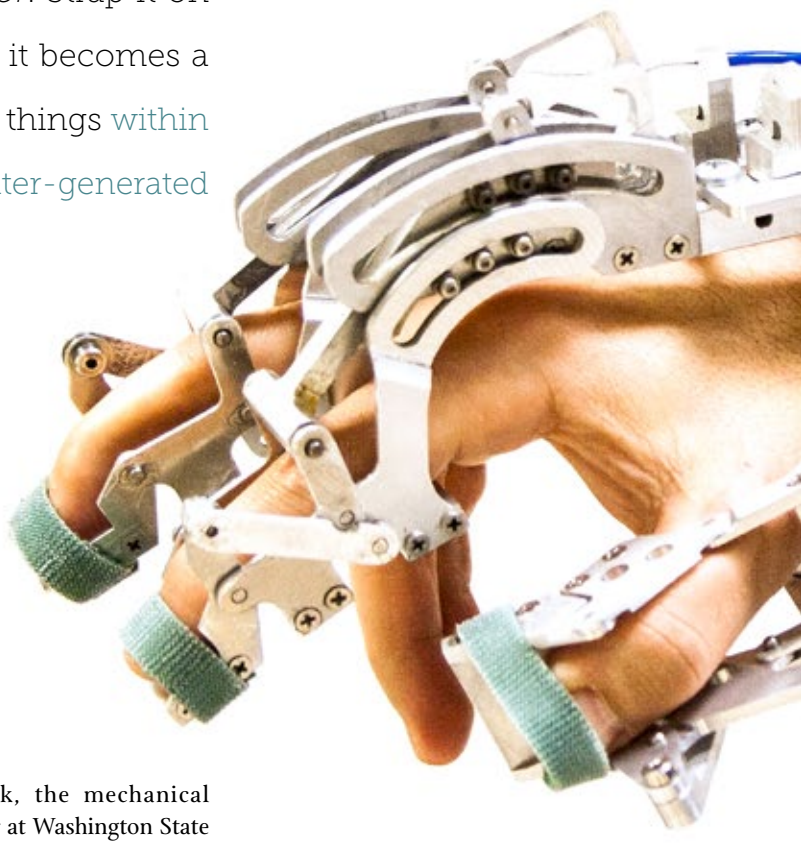
Pezeshki was impressed but says there is still work to be done. Although the drone is radio controlled for takeoff and landing, the flight path will be programmed through an automated Pixhawk system yet to be installed. He's confident they will ship a functional plane and tracking system by the end of the year. "The clock is running for these animals," he says. "So we persevere."

Putting feeling into the digital world

A NEW TOUCHSTONE FOR VIRTUAL REALITY

On its own, the gleaming silver skeletal hand looks like a disembodied limb from *The Terminator*. Strap it on a human and it becomes a glove to grasp things within virtual, computer-generated worlds.

BY LARRY CLARK



Hakan Gurocak, the mechanical engineering professor at Washington State University Vancouver who designed the glove with his former graduate student Randy Bullion, says the haptic interface can be used in conjunction with virtual reality headsets and position sensors to add a new sense of touch to the experience of being in a digital environment.

More than just immersive computer games or movies, virtual reality and the haptic glove could, for example, help physicians perform better diagnoses during robot-assisted surgery. Using information from robotic arms, the surgeon can push on tissue and determine if it's diseased or healthy, says Gurocak '93 PhD, who is also founding director of the WSU Vancouver School of Engineering and Computer Science and head of the robotics and automation laboratory.

Manufacturing companies could also virtually prototype products and test them, saving money on multiple iterations because they wouldn't have to make the physical items.

The haptic interface comes at a good time. Virtual reality is poised to take off,

+ other Gurocak inventions: magazine.wsu.edu/extra/haptic

with Oculus Rift, Samsung Gear, and other consumer VR devices on the market this year.

But the glove had a problem.

It works using actuators, small electronic brakes that apply resistance to the human hand to simulate holding or touching an object. The small size of the actuators is possible because they use magnetorheological (MR) fluid, with iron particles suspended in an oil. When activated magnetically, a change in viscosity causes the brakes to apply forces on fingers. The small MR-brakes were also developed in Gurocak's lab.

The problem involved "memory." MR fluid doesn't fully change to its prior state when deactivated, essentially because of stored magnetic memory in the brake. In other words, if you are holding a tennis ball in a virtual reality simulation and release the ball, it still sort of feels like you're holding it. The problem, hysteresis, is well-known.

"It feels like the ball is stuck to your hand and you can't get rid of it," says Gurocak.

So Gurocak and his graduate students set to work on the issue, and eventually found that tiny, inexpensive sensors placed in the MR-brake could cancel the hysteresis and return the resistance to the proper level.

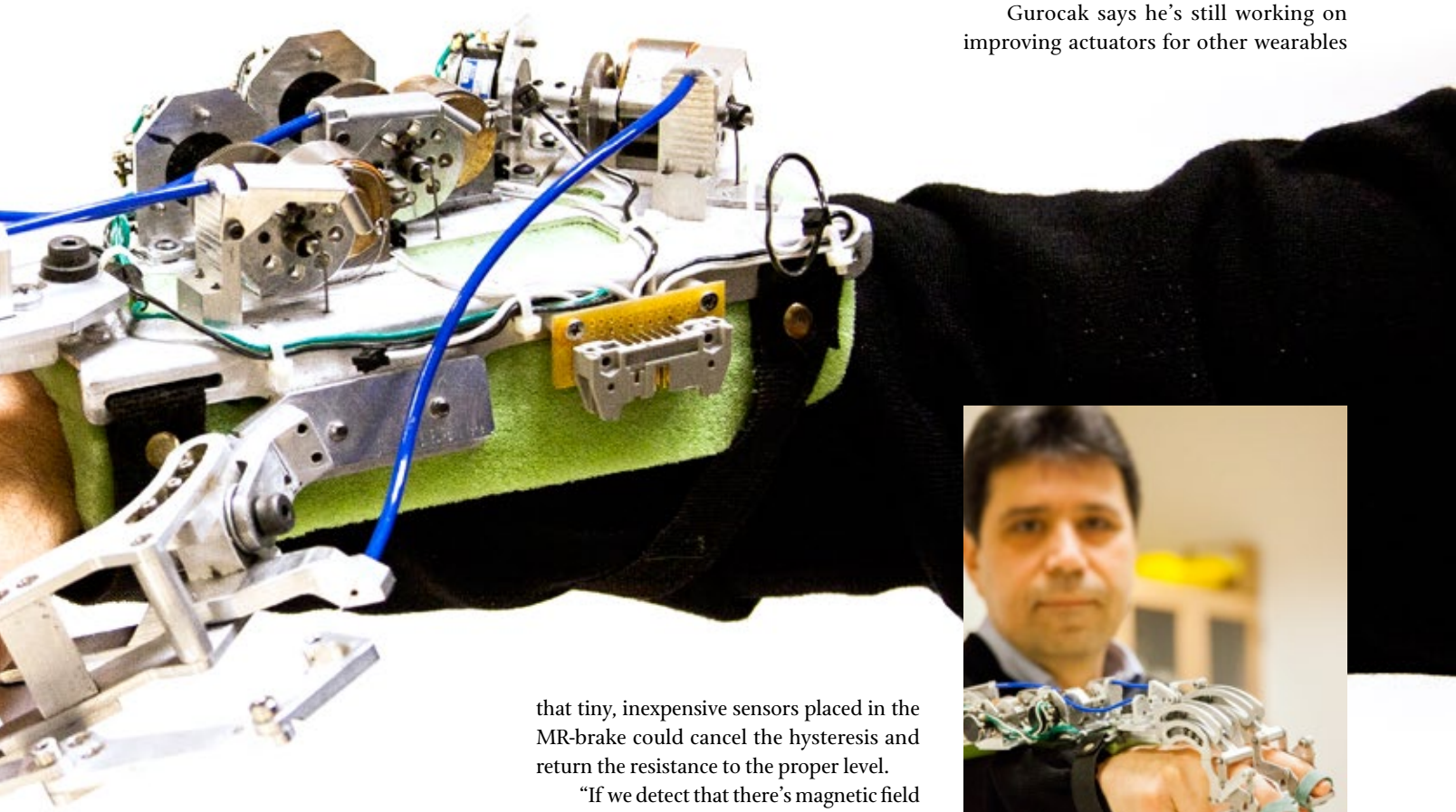
"If we detect that there's magnetic field remaining, we are able to polarize it, just enough to reverse it."

Gurocak received a U.S. patent for the method last July. He received another patent the following month for a linear MR-brake, in which the brake moves along a rod and can resist or stop at any point.

His MR actuator innovations have commercial applications beyond virtual reality. The automotive, aerospace, robotics, prosthetics, retail, computer game, and rehabilitation industries could use the compact and powerful devices.

Even after eliminating the hysteresis, Gurocak says haptics research is still in its infancy. "There are still huge challenges in making them lightweight and inexpensive. But I can think of many applications. Imagine if you could hold a shoe while online shopping."

Gurocak says he's still working on improving actuators for other wearables beyond gloves. He notes his former graduate students who helped with the inventions could contribute to the field, as they have moved on to medical technology and robotics research, as well as opening their own businesses.



A haptic glove can add touch to virtual reality. **Inset:** Hakan Gurocak. Photos Laura Dutelle

stretchable metal in action: magazine.wsu.edu/video

Smart couture

Wearable electronics are leaving the lab and hitting the runway

BY BRIAN CHARLES CLARK

From smart phones to FitBits, mobile electronics have been woven into the very fabric of our lives. But things are about to get a lot more literal as e-devices begin to be incorporated into the clothing we wear.

Imagine a "smart" shirt or other item of clothing that can monitor your biometrics and ping your doctor when something is out of the ordinary. Or, to manage diabetes, we'll use a contact lens or pair of glasses to monitor blood glucose levels—and leave behind forever the expensive and annoying finger prick test kit. But wearable electronics are not limited to health care: A truck driver might wear a baseball cap that monitors her alertness levels.

Rahul Panat, an associate professor of engineering in Washington State University's Voiland College since 2014, observes that it is consumers who are driving the move towards wearables.

"Consumer tastes started to shift in the late 2000s," he says. "People are no longer concerned about the speed of microprocessors. Rather, they started paying a lot more attention to function, size, and the coolness of software and devices. That put a lot of new challenges on materials engineers and computer scientists."

Whatever the application, wearables have a couple major hurdles to clear before they can well and truly be incorporated into our everyday lives.

One, they need circuitry that can bend and flex as vigorously as the clothes we wear. And two, these devices need power supplies that are both tiny and flexible. Therein lie the challenges for materials engineers.

Conductive metals are required to create any sort of power-consuming device. To get smart devices into our clothing where they can do us the most good requires flexible, bendable interconnects that move current from point A to B. And we need batteries that won't fail when stretched or bent.

Panat says that the current options are either too expensive or too bulky. Gold, while ductile enough to flex in wearable applications, is too expensive. "If someone finds a huge vein of gold on an asteroid, then maybe we can use it in everyday applications," he says.

Another route to get some flex in metal interconnects is a serpentine arrangement that allows the circuit to straighten without breaking when stretched. But that, Panat says, takes up a lot of real estate. "And the increased length of the conductor increases resistance." Increased resistance means higher power consumption and more heat, both undesirable with wearable devices.

Panat and fellow Voiland College professor Indranath Dutta, along with graduate student Yeasir Arafat, recently demonstrated a significant advance by showing that the metal indium, deposited as a thin film on a polymer substrate, can be stretched to twice its length without breaking—"a quantum improvement," Panat says, over current methods.

As part of a team at Arizona State University, Panat had shown that batteries designed with origami creases can fold, bend, and twist. Employing the Miura-Ori pattern of origami folding and using standard materials, the team wrote in *Nature Communications* that their "strategy … represents the fusion of the art of origami, materials science, and functional energy storage devices, and could provide a paradigm shift for architecture and design of flexible and curvilinear electronics with exceptional mechanical characteristics and functionalities."

The combination of deformable batteries and stretchable metal conductors opens the door to a wide array of wearable devices. You'll know you've stepped through that door when you put on a nightcap that enables you to sleep better or a smart bike helmet to guide your ride with heads-up GPS and proximity alerts.

PNEUMA DRESS FROM THE EMOTION PROJECT / UDK BERLIN

make your neigborhood walkable: magazine.wsu.edu/extra/walkable

It takes a (walkable) village

BY REBECCA PHILLIPS

They call it Tangletown—a Seattle neighborhood where streets and trolley tracks intersect like wayward skeins of yarn. In the 1930s, local residents routinely chose the trolley for trips to work, the market, or hardware store. They did that several times a day and it involved a lot of walking, says Glen Duncan, professor in the Elson S. Floyd College of Medicine and chair of nutrition and exercise physiology at WSU Spokane.

Duncan lived in Green Lake near Tangletown for a time, and says public transportation systems like trollies provided a level of physical activity that is all but lost in today's society.

"We're completely dependent on the automobile for daily life," he says. "Most people don't give a second thought to hopping in the car for a half-mile drive, when they could easily walk that distance." Duncan says the modern idea of physical activity—jogging, cycling, lifting weights—is greatly removed from our historical norm. It's a mindset he wants to change.

Duncan is an advocate for walkable communities. "We need to fundamentally rethink the way we live and how we construct our built environment," he says. Infrastructure in the United States has evolved around the automobile with busy streets and highways taking priority over walking paths and bike lanes. The result, Duncan says, is a society laden with sedentary citizens and high rates of chronic disease.

In contrast, a safe, well-lit community—with goods, services, and recreational opportunities located within walking distance from homes—promotes an active lifestyle. Traveling to the grocery, restaurant, or coffee shop on foot can benefit both physical and mental health.

Duncan says general physical activity is not the same as exercise, that very purposeful form of movement aimed at raising aerobic capacity or building muscle mass.

"In American society, we really have relegated our physical activity to leisure-time exercise," he says. "When most people hear 'physical activity,' they think of the gym and sweating on the machines for 30 minutes."

Since we rely so heavily on cars, elevators, and automated gadgets, the only thing left is that kind of dedicated exercise, he says. "And for the person who doesn't have the time, resources, or inclination for the exercise piece, the default option is to be sedentary."

It's a perception Duncan challenges. "People say they can't afford to buy equipment or don't have time to go to the gym, when in fact, they really have ordinary physical activity at their disposal."

Raking leaves, walking the dog, using a push mower, and taking the stairs can all improve health measures including aerobic fitness, a key factor for reducing all causes of disease and mortality, he says.

"And walking to your destination also reduces pollution, saves money on gas and car repair, and builds a sense of community. What could be better?"

Today, Duncan's former Green Lake neighborhood ranks as one of the more walkable communities in Seattle, scoring a 79 on Walkscore, a website that ranks neighborhood walkability from "car dependent to walker's paradise." Green Lake is considered "very walkable and most errands can be accomplished on foot."

In comparison, Pullman is car dependent with a 42 walk score. Spokane fares slightly better at 45—also car dependent. Tacoma averages 51— somewhat walkable. Richland comes in at 29 with most errands requiring a car. Check your community score at www.walkscore.com.

STAFF PHOTO/ILLUSTRATION FROM GOOGLE MAPS

BY TINA HILDING

Thin ice

Being put to the test at the ground zero of climate change

There's the day the polar bear mangled the meteorological instruments. Or when a massive storm smashed two humidity sensors. Days of howling winds, extremely limited visibility, and weather so cold that power cords snapped like twigs.

For Von P. Walden, a professor in Washington State University's Department of Civil and Environmental Engineering, the most exciting day as part of the Norwegian Young Sea ICE Cruise (N-ICE2015) team was last May when the thin layer of Arctic sea ice on which the researchers were working started breaking up.

Wearing a Regatta suit intended to keep him afloat in the event of a cold swim, Walden sank up to his knees in large puddles of water on the sea ice as he and his colleagues took down the experiment's meteorological tower. Feeling like he was walking on swiss cheese, he tried to convince himself that there was still plenty of ice underfoot. He tried not to think about the thousands of feet of ocean below.

LED BY THE NORWEGIAN POLAR INSTITUTE, N-ICE2015 researchers collected data on first-year sea ice for six months starting in January 2015 to understand the critical sea ice system that has changed dramatically over the past 30 years, and then model and predict the impact on the ecosystem, weather, and climate.

On a Norwegian research ship, the *Lance*, researchers headed into the Arctic Ocean north of Svalbard, a Norwegian archipelago halfway between mainland Norway and the North Pole. Locked into

the ice, the *Lance* drifted through the dark Arctic winter whichever way the winds blew it.

The interdisciplinary team from around the world collected a rare and comprehensive dataset of oceanographic, atmospheric, and biological conditions on Arctic ice during winter and spring. Walden made measurements of clouds as part of the research team and then spent five months in Norway, collaborating on data analysis as the Fulbright Distinguished U.S. Arctic Chair.

The conditions for the study were some of the harshest possible in one of the most inhospitable places on the planet. "It was difficult and dangerous work," says Walden. In fact, the last major interdisciplinary campaign to drift on the Arctic sea ice in winter occurred in 1998 off the coast of Alaska.

Since that time, the Arctic and its sea ice have changed dramatically.

MANY PEOPLE ARE AWARE that there is less sea ice as the Arctic has warmed. Sea ice acts as a natural refrigerator for the planet, keeping the Arctic cool and moderating the planet's climate. Satellites show the declining extent of sea ice, which has been happening for a generation. The most dramatic sea ice decline has occurred since 2000 with the lowest summertime extent ever recorded in 2012. The 2015 sea ice extent was the fourth lowest.

At the same time, though, the ice itself has changed. When Walden was in graduate school in the 1980s, Arctic sea ice was 9 or 10 feet thick in most places. Now, only a small part of the Arctic includes multiyear ice, or ice that exists for more than one year. Today, Arctic sea ice is more like a thin chocolate layer on a dipped ice cream cone—fragile and easily breaking into slabs.

"The ice is so thin and we saw that a whole ice floe can melt in a week," says Stephen Hudson, a former graduate student of Walden's and researcher at NPI who leads the atmospheric portion of the N-ICE2015 experiment. "We saw how quickly it can change and how little it takes to change it."

The big picture of Arctic sea ice has been well-known and predicted for decades, says Walden. Sea ice is very sensitive to increases in greenhouse gases and to global warming. But the details of what is happening are extremely complicated.

Thin sea ice is different from multiyear ice, which matters to everything from zooplankton to the planet's energy budget, says Hudson. Young ice is rougher and saltier than older ice, and after the first year, the salt drains out. Those properties affect how much heat it absorbs, which affects how fast it melts. And, then there's the complicating factor of snow—how much and when it falls. Snow on the ice will reflect 80 to 85 percent of the sunlight, but bare ice only reflects 50 to 60 percent, absorbing more of the sun's warmth and causing it to melt faster.

Getting accurate measurements of snow, ice, atmospheric conditions, and radiation are critical and difficult.

For instance, the eddy covariance instrument measures little eddies of air—the energy that's being moved to and from the surface.

"It's relatively easy to measure radiation, but sensible and latent heat fluxes are tricky," says Walden. "The instrumentation and the software to analyze the data are complicated."

Or the radiation sensor. On the ship, the researchers had four of them with little fisheye domes looking up and looking down. You have to make sure you know exactly what you're measuring, he says.

"If the dome starts to frost, you're not measuring downwelling radiation. You're measuring the frost on your dome."

Walden has conducted numerous research studies in Antarctica, Canada, and on the top of the Greenland ice sheet. It is very easy to generate a number using a computer model, he says, but it is very difficult to acquire the real data to validate that number. And many times researchers have been too conservative, surprised by the rapid and dramatic change in polar regions, he adds.

To get the best information on the properties of young sea ice, the researchers collected as much data as they could as the ice floe melted beneath their feet.

"We're literally skating on thin ice—both in terms of our knowledge of the rapidly changing climate and in terms of trying to conduct experiments to prove the science," says Walden. "We're not getting enough data because it's changing so fast."

A Norwegian research ship, the *Lance,* ferried the international team of scientists to study conditions in the Arctic during winter and spring in 2015. Photos Mar Fernández-Méndez

WHEN TACKLING HUMANITY'S BIGGEST CHALLENGES of melting sea ice in a changing climate, "the overwhelming feeling is you're working a lot," says Hudson in an understated way.

Researchers on the N-ICE2015 team traveled from around the world—Korea, Norway, Russia, Germany, France, Sweden, Spain, Finland, Britain, and the United States—to Svalbard. All of the researchers received training on the two biggest hazards of the Arctic: falling into the cold ocean and dealing with polar bears.

All research on the ship was conducted with a full-time bear guard, armed with flares and a rifle for an emergency. The bears were a hazard, particularly, during the winter when 24 hours of darkness and blowing snow made it difficult to see them.

The other danger is shifting and dynamic sea ice. While the N-ICE2015 researchers lived on board the ship, they spent their days on the ice, measuring everything from atmospheric conditions to zooplankton. Sometimes they made transect measurements as far as a mile away from the ship.

"There are always problems and challenges you're facing. It's always interesting work," says Hudson.

Like when a polar bear mangles your instrument.

Bears wandered through the research site several times during the experiment, but one March night, one did its own little scientific investigation, grabbing and bending some weather instrumentation that had been carefully installed the day before.

"That really adds excitement to your day," says Lana Cohen, a postdoctoral researcher at NPI who spent a couple of months on the ship during the winter and got to deal with the bear's handiwork as well as the most challenging weather conditions.

But in harsh conditions, she says, "the whole point is to get good, accurate data."

There were occasional breaks in the work, like a soccer game played on the sea ice and a celebration of Norwegian Independence Day. Food on the ship was traditional Norwegian fare, including salted cod and potatoes, lutefisk, and whale meat.

For his part, Walden felt a sense of wonder on the ship, enjoying a different experience from his previous fieldwork. He learned about the world on the ice, seeing plankton grow in tiny cracks, watching water flood over ice, listening to crunching and cracking of a dynamic world, and learning the difference between a refrozen lead and an ice floe.

"I felt like a kid on the boat," he said. "It was incredible to be on such a thin veneer, knowing that the ice is only eight and a half inches thick, and then it's the Arctic Ocean beneath you."

Since returning to Norway, the researchers are "in heavy data analysis mode," says Cohen.

Later this year, the project will be featured in a special issue of the *Journal of Geophysical Research*. There are papers to write and follow-up proposals to draft. Many research questions remain unanswered, such as the effect of clouds on the sea ice and how fall weather conditions affect the sea ice growth.

Like many of us, worries about the future and a melting Arctic only occasionally make their way into the conversation.

Starting his research career in the Arctic in the early 2000s, Hudson, who has participated in several sea ice cruises, is sad that he never had the chance to see much of the multiyear ice—the thick and hearty ice that was, well, solid.

"I GET WORRIED FOR THE ARCTIC," he says.

Melting sea ice promises to impact the Arctic ecosystem, including polar bears, seals, and cod, as well as the people who have lived in the region for thousands of years and rely on that system, he says.

Cohen says she is usually too busy to consider the big picture when she's on the ship.

"Coming back is when I put it in context," she says. "It's happening whether we do something or not."

For his part, Walden says it's a daunting but exciting time to be a polar researcher.

"The Arctic is changing more rapidly than science can keep up with and can explain right now," he says. "Even though we have accurately predicted for decades that the Arctic would be one of the first places on Earth to observe climate change, we need to continue to make these difficult measurements to keep up with the rapid pace of change."

WSU engineering professor Von Walden trudges through Arctic sea ice to check instruments. Photo Marcel Nicolaus

wsu.edu

INSPIRING BOLDNESS

Washington State University scientist Jen McIntyre is pioneering new ways to protect the beautiful Puget Sound ecosystem.

An aquatic ecotoxicologist, McIntyre leads research at the WSU Puyallup Research and Extension Center designed to use soil to mitigate toxic stormwater runoff. Right now, the runoff is full of pollutants that can kill coho salmon in just a few hours.

McIntyre's research efforts are not only addressing local challenges, they're changing the way our leaders think about preserving our environment for future generations. Learn more at innovators.wsu.edu.

A bold approach? Definitely. But, after all, you've counted on us for creative solutions to the state's needs since 1890. And you always can.

125 YEARS, AND COUNTING.

WSU 125

EST 1890

Morels

Mysterious. Elusive. Delicious.

BY LARRY CLARK

The smell of rain-soaked earth permeated the logged-over clearing in the woods in mid-May as my friend Mike and I peered closely at the ground and walked slowly. We were hunting mushrooms.

Mike's more adept eyes spotted a cluster of light brown, honeycombed caps. He sliced the morel mushrooms with his knife. After a while we filled a small bucket, which we took back to Mike's mom. She battered and fried them and, as a teenager in northeast Washington years ago, I had my first taste of the rich flavor of the wild Northwest mushroom.

Mike and I had likely picked *Morchella snyderi*, a common morel species in the region, says Lori Carris, a mycologist in Washington State University's plant pathology department and an avid morel hunter. But for Carris, there's nothing common about morels.

"These are one of the most iconic of our wild edible mushrooms and yet we know virtually nothing about them," she says.

Morchella mushrooms, or morels, are one of the most coveted wild spring mushrooms for gourmands and chefs. Found in North America and Europe, they are traditionally divided into black morels, common or yellow morels, and half-free morels. They typically are found April through early June in woods and in burned over areas the year after a forest fire.

Even though the culinary pleasure of the delicious fungi has been known for centuries, Carris says the last few years have yielded research, both her own and others, about morels and shed some light on the mysterious mushrooms.

"The life cycle of morels isn't even fully understood," she says.

When Carris was leading a field excursion in the Idaho woods near Pullman in fall 2011, she stumbled on white fungal growth on moss. Since she couldn't identify it, Carris took a sample back to the lab and identified it under the microscope. To her surprise, she had become the first researcher to connect the asexual stage of morels in the wild to fruiting morels. DNA evidence later confirmed her analysis.

After she first presented her findings at a scientific conference, "it was like being a minor rock star in the mycological world," says Carris "I'd never had that happen. I usually work on smut fungi, which doesn't generate that much interest."

Outside of WSU research, Michael Kuo, an English professor at Eastern Illinois University and amateur mycologist, classified the taxonomy of morel species in North America in 2010. USDA mycologist Kerry O'Donnell in his 2010 study of morel biogeography and distribution found that the center of diversity in American morel species is the Pacific Northwest.

Another surprise for some is that morels don't just grow in the woods. Tobin Peever, also a WSU mycologist, teaches a graduate-level

LEFT: MORELS, PHOTO ED RESCHKE. **INSET:** PLANT PATHOLOGY PROFESSOR LORI CARRIS WORKS WITH STUDENTS IN THE FIELD TO IDENTIFY FUNGI, PHOTO ROBERT HUBNER

Safe Mushrooming 101: magazine.wsu.edu/extra/safe-rooms

class on fungal biology, primarily focusing on mushrooms. Graduate students in Peever and Carris's 2014 class researched urban and landscape morels for their class project.

They found flushes of morels in Pullman parks and even around WSU's buildings, including an unidentified and possibly new species. WSU graduate students Andrea Garfinkel, Sean McCotter, and Teresa Jardini found that a number of morel varieties thrive in nonforest settings. They published their research in mycology journal *Fungi* last fall.

Carris and Peever connect with morel experts all over the world on these new inquiries into morels—some of them hobbyists in completely different fields, such as Phillipe Clowez, a French pharmacist. In France, pharmacists are often called on to identify wild mushrooms.

Although they enjoy the research, Carris and Peever both started seeking morels in earnest when they moved to the Northwest over 20 years ago. Carris also teaches community classes on mushroom hunting. One thing she emphasizes for novices seeking any mushrooms: Learn from an expert, and don't eat fungi you don't know.

While most people like me, Carris, and Peever seek out morels for personal use, there are commercial morel foragers. Morel mushrooms can't be cultivated, with the exception of an unusual landscape morel first described from Mexico, *Morchella rufobrunnea*.

While it's free to collect some morels for personal use, permits are required in some national forests.

Competition is often fierce among commercial pickers, but recently wildfires and warmer temperatures have brought bumper crops of morels. In some years they fruited earlier and lasted longer than Carris can remember.

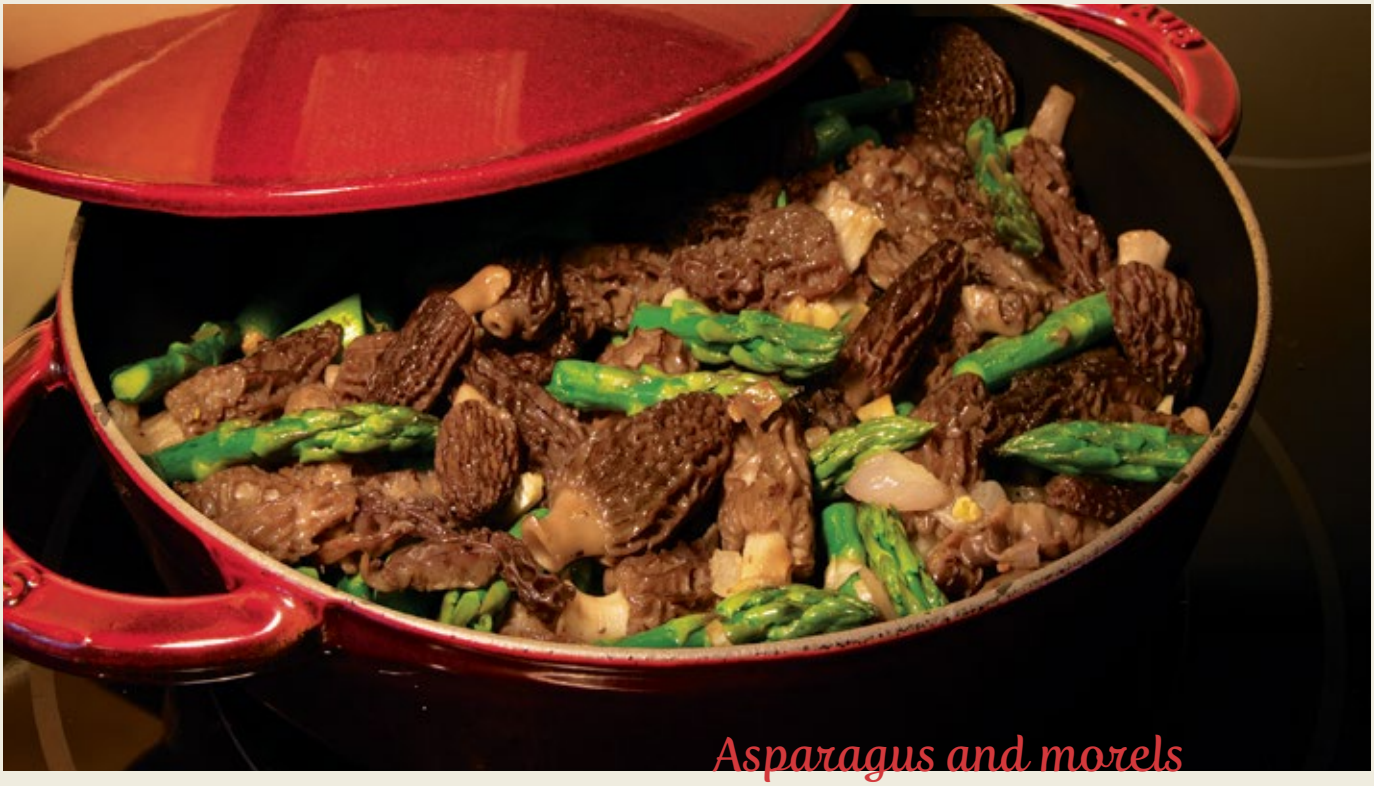
That's good news for morel fans. More morels means more ways to try out the unique and flavorful fungi.

Many people, including Peever and Carris, like to eat morels prepared simply, such as cooked with scrambled eggs, or like my friend's mom's tempura-like mushrooms. Just don't eat them raw.

Morels also taste delicious in light cream or wine sauce and served in pasta or on salmon. They can be stuffed with cheese, crab, or other ingredients.

Carris says dried morels retain excellent flavor even when rehydrated months later for soup or other dishes.

PHOTO BRUCE ANDRE



RECIPE FROM MUSHROOM-APPRECIATION.COM

Asparagus and morels

Morel recipes are often served with some sort of meat or animal product. Yet this is an easy creation that lets nonmeat eaters enjoy the fresh fungi as well. Replace the butter with olive oil for a truly vegan recipe.

- 2 tablespoons butter
- 1 shallot, chopped
- 2 cloves garlic, minced
- ½ lb fresh morels, sliced lengthwise
- 2 bunches asparagus, cut into one-inch pieces

Melt the butter in a skillet over medium heat. Add the shallot pieces, garlic, morels, and asparagus. Cook until the morels are browned and the asparagus is tender, usually 8 to 10 minutes.

Racing into history

The Olympic moment of WSU Hall of Famer Lee Orr

BY JASON KRUMP '93

As rain fell in Berlin's Olympic Stadium in 1936, Lee Orr, a Washington State College student not yet 20 years old, didn't realize the magnitude of the events surrounding him.

"I was pretty young and didn't know what was going on," he said.

It had been over seven decades since Orr raced against Jesse Owens at the '36 Olympic Games when, in 2008, the soft-spoken Orr recalled his Olympic experience in Germany.

A year after the interview, Orr passed away; however, the story he told lives in sports lore.

Owens's four gold medals and his historic achievement was recently depicted in the movie *Race*. In the movie an off-screen announcer names the 200-meter finalists, ending with: "Lee Orr. Canada."

Those who saw the movie witnessed Owens's accomplishments on the big screen. Orr saw them and interacted with Owens in real life.

"I warmed up with him on the track and talked with him as we were jogging around," Orr said. "He was a very nice gentleman."

Orr also was in close proximity to another historical figure.

Adolf Hitler.

"He had a place to sit and watch that was directly in front of where the noncompeting athletes sat," Orr remembered. "Hitler sat right in front of us."

The path to the 200-meter final began when Orr finished second in a first round heat, only behind Owens. In his quarterfinal, Orr ran an Olympic-record equaling time of 21.2 to advance to the semifinal round.

WSU ATHLETICS

Orr finished second in the semifinal to Mack Robinson, older brother of Jackie Robinson.

Orr was then assigned lane six for the final. It proved to be a disadvantageous position.

"In the final, I had an outside lane, but I couldn't hear the starter very well," Orr recalled. "I was bouncing around and got a poor start."

Orr finished fifth and Owens, in lane three, secured his third of four gold medals, clocking an Olympic record time of 20.7.

Orr also raced in the 100-meter and once again raced against Owens in the 4x100-meter relay, finishing fifth as Owens captured his fourth gold medal leading the United States to victory.

Orr's Olympic journey began at Washington State College.

Born in Saskatchewan, Canada in 1917, Orr moved to Monroe at the age of three. His track prowess at Monroe High School led to three state championships in the 220-yard dash.

His high school success continued as a WSC student athlete, where he ran varsity caliber times as a freshman. However, in 1936, freshmen were not allowed to compete at varsity level.

Still, Washington State coach Karl Schlademan believed Orr had a legitimate shot competing at Berlin.

"Coach decided that I could qualify, so I tried out for the Canadian team," Orr said.

Orr qualified for the Canadian Olympic Trials at Montreal, where he was selected to the team after his impressive performance.

After the Olympics, Orr returned to Washington State and his career earned him induction to the school's athletic hall of fame in 1978.

Orr said he had not considered the significance of the 1936 Olympics until late in life.

"I had a lot of natural ability and I enjoyed doing it, and I worked hard at it," he said. "I didn't know what I had accomplished until recent times."

COURTESY SUSAN RADEMACHER AND MARGOT SKIRPSTAS

Pete Rademacher

BY DAVID WASSON

Long before the 1980 U.S. Olympic hockey team's Miracle on Ice, there was Pete Rademacher '53.

The tenacious six-foot-one boxing heavyweight stunned the world during the 1956 summer games with his one-round knockout of previously undefeated Soviet champion Lev Moukhine for the gold medal.

The decisive, triple-knockdown bout in Melbourne, Australia transformed Rademacher into a Cold War hero and international inspiration. Hungarian athletes, still reeling from the Soviet invasion of Budapest just a few weeks earlier, joined the U.S. team in hoisting him onto their shoulders in celebration.

"It was very emotional," recalls Rademacher, 87, now a retired business executive living in Ohio and the first Cougar to bring home Olympic gold. "I bawled for probably half an hour."

Raised on a Yakima Valley farm, Rademacher was a junior college transfer to Washington State, where he played football and some baseball. He was ineligible to box at the collegiate level because of his Golden Gloves experience but continued to pile up other amateur titles.

He was serving in the U.S. Army when he won a spot on the 1956 Olympic boxing team and quickly dispatched his first two opponents, Czechoslovakia's Josef Nemec and then Daan Bekker of South Africa, to advance to the gold medal bout.

With the Cold War intensifying, interest in the heavyweight matchup between a Russian boxing champ with a 100-0 record and a U.S. Army lieutenant drew international attention.

The trash talk started as soon as the contenders got into the ring.

"He'd say to me, 'Rademacher I'm gonna knock your head off.' And I finally told him, 'How you gonna do that when you're on your butt counting to 10?'"

Rademacher spotted an opening moments into the fight and launched a straight left, sending Moukhine to the mat as the crowd erupted in cheers. The Russian got up but was floored again. Less than two minutes in, Rademacher sent Mouhkine sprawling onto the mat for a third time and the referee called the fight, raising the American's arm in victory.

Surrounded by an international swarm of cheering athletes, Rademacher tearfully accepted the gold medal and was selected by his teammates to carry the U.S. flag during the closing ceremonies.

He went on to fight professionally until 1962, retiring from boxing with a 17-6-1 pro record and went into business in his adopted home state of Ohio.

More than 50 of Washington State University's top athletes have made it to the Olympics since 1920. Here's a look at the eight who took home medals:

PAUL ENQUIST '77, ROWING; LOS ANGELES 1984, GOLD; USA. Part of the two-man double sculls team that edged out Belgium to become the first U.S. team in two decades to win gold in an Olympic rowing event.

MIKE KINKADE '96, BASEBALL; SYDNEY 2000, GOLD; USA. Played third base for Team USA which beat perennial powerhouse Cuba in a three-hit shutout for the gold medal.

PETER KOECH '86, 3,000-METER STEEPLECHASE; SEOUL 1988, SILVER; KENYA. Kenya nearly swept this event, taking gold and silver, and setting what was an Olympic record at the time.

JULIUS KORIR X'86, 3,000-METER STEEPLECHASE; LOS ANGELES 1984, GOLD; KENYA. Ran mostly with the pack before pulling out to pace and then slip past the leader heading into the final lap for a runaway win.

BERNARD LAGAT '01, 5,000-METER RUN, SYDNEY 2000, BRONZE; ATHENS 2004, SILVER; KENYA. Internationally acclaimed distance runner who also competed for the U.S. Olympic Team in 2008 and 2012.

KRISTI NORELIUS '76, ROWING; LOS ANGELES 1984, GOLD; USA. Part of the eight-member women's team that, after an unbalanced start, recovered to edge out Belgium for the gold medal.

PETE RADEMACHER '53, BOXING; MELBOURNE 1956, GOLD; USA. Beat the Russian heavyweight champion in under two minutes to snag the gold medal.

GABRIEL TIACOH '85, '91 MBA, 400-METER RUN; LOS ANGELES 1984, SILVER; IVORY COAST. Held on from outside lane to take the silver medal.

Find the full list of WSU athletes and alumni who have competed in the Olympic Games at magazine.wsu.edu/extra/olympians

ARTIST'S CONCEPT OF AN ASTEROID BELT IN THE VEGA SYSTEM—NASA/JPL-CALTECH

CLOSE ENCOUNTERS FROM OUTER SPACE

BY REBECCA PHILLIPS

The errant asteroid hurtled through space at 40,000 miles per hour. Tumbling in a wild orbit, it glinted with sunlight as it neared the Earth. At 65-feet wide, the potato-shaped object should have been easily detected but no one saw it coming.

On the morning of February 15, 2013 the asteroid exploded with the force of 500 kilotons of TNT about 15 miles above the city of Chelyabinsk in the Russian Ural Mountains. The fireball was reportedly 30 times brighter than the sun. The shockwave blew out windows in hundreds of buildings and injured more than 1,500 people.

It was Earth's most powerful meteor strike since 1908 according to NASA, and was the strongest ever detected by the Comprehensive Test Ban Treaty Organization whose infrasound sensors monitor nuclear explosions. By happenstance, they also pick up the low-frequency sound waves given off as meteors are torn apart by the atmosphere.

Both beautiful and terrible, meteors streak across the sky like admonitions. The world has taken note.

Scientists across the globe are scrambling to learn more about the behavior and composition of these flying rocks. Peering into the borderlands of space, they ask: What can we learn from asteroids? Can we stop one from hitting Earth? Can we mine them for precious resources?

In 2014, Europe sent the Rosetta probe to study Comet 67P, as it passed through the inner solar system, and successfully deployed a lander onto its rocky surface. In 2005, Japan's Hayabusa spacecraft crash-landed on the small, near-earth asteroid Itokawa, yet managed to convey dust samples back to Earth by 2010.

At Washington State University, astrobiologists, geologists, and astrophysicists are taking part in the effort, using meteorites to calculate the age of our planet, question how life first arrived on Earth, and propose that asteroids might one day help us find a new home in the galaxy.

He hands me the meteorite and I marvel at its smooth black surface, cupped with "thumb prints" from a tortuous journey through Earth's atmosphere. WSU professor emeritus of geology Nick Foit is smiling. "It's made of iron and nickel, from the core of one of the solar system's first tiny planets," he says. "It's about 5 billion years old."

Heavy, like a small hand weight, I lift it up into the 10th-floor window of the Webster Physical Science building overlooking the campus and snow-covered Palouse hills beyond. I feel like I'm in an iconic scene from the film *2001: A Space Odyssey*. Five billion years.

Foit has been collecting meteorites since his early college days and shows me impressive specimens from nearly every continent. Today, many countries protect meteorites as national treasures, he says, making it more difficult to acquire the rare rocks.

His interest began with a gift from his father—a fragment of the asteroid that formed Meteor Crater near Flagstaff, Arizona. The well-preserved impact crater, nearly a mile in diameter, was formed about 50,000 years ago during a collision with a 160-foot wide asteroid.

Evidence of similar strikes is scattered around the globe, says Foit, ranging from the massive and most ancient Vredefort crater in South Africa (2 billion years), to the infamous Chicxulub crater in Yucatan (65 million years) and the comparatively infant Lonar crater in India (0.5 million years.)

"We are lucky the Russian Chelyabinsk meteor hit Earth with a glancing blow," Foit says. "If it had come straight down it would've done a lot more damage. Its low trajectory also allowed it to spend a long time in the atmosphere creating one of the more spectacular shooting stars in recent memory," he says.

The evocative, supernatural aspect of shooting stars has troubled humanity for eons. Randomly plummeting from the sky like angry gods in shades of blue, green, or yellow depending on their mineral content, meteors have been revered and feared, as well as put to good use.

Spearheads and other tools were fashioned from meteorites by prehistoric Native Americans and indigenous peoples in Africa, says Foit. Impact glass, created when the intense heat of an asteroid melts surrounding sand, was called "the rock of god" by ancient Egyptians and was discovered in King Tutankhamun's scarab beetle pendant.

Determining which glass or stone fragment is actually a meteorite can be difficult. Millions of years of erosion can obscure the craters and other evidence. Foit says the presence of "shatter cones" is key. When a meteor slams into the ground, it produces tremendous shock waves that break the underlying bedrock into telltale fluted cones. "When you find one of these shatter cones, it's proof positive you've found a meteorite impact site," he says.

Besides leaving huge craters, asteroids have at times nearly abolished life itself. The devastating Chicxulub asteroid smashed into the coast of Mexico 65 million years ago, helping to eradicate the dinosaurs. Foit says the impact created a cloud of dust that cooled and darkened the entire planet, changing the climate. "It probably disrupted the weather for decades and caused one of the mass extinctions … it killed almost everything."

On the other hand, some speculate it was an asteroid that first brought life to Earth.

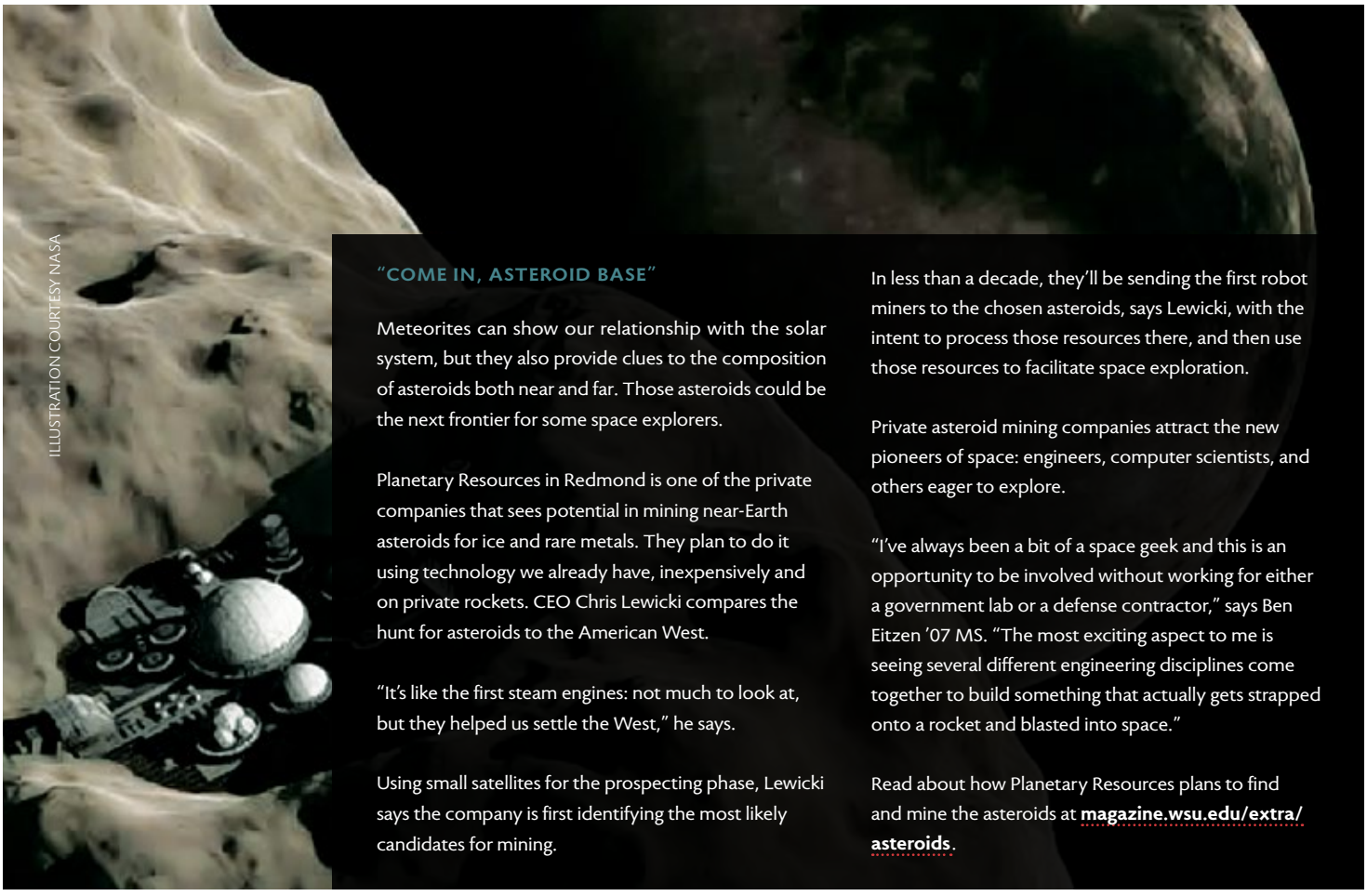


ILLUSTRATION COURTESY NASA

"COME IN, ASTEROID BASE"

Meteorites can show our relationship with the solar system, but they also provide clues to the composition of asteroids both near and far. Those asteroids could be the next frontier for some space explorers.

Planetary Resources in Redmond is one of the private companies that sees potential in mining near-Earth asteroids for ice and rare metals. They plan to do it using technology we already have, inexpensively and on private rockets. CEO Chris Lewicki compares the hunt for asteroids to the American West.

"It's like the first steam engines: not much to look at, but they helped us settle the West," he says.

Using small satellites for the prospecting phase, Lewicki says the company is first identifying the most likely candidates for mining.

In less than a decade, they'll be sending the first robot miners to the chosen asteroids, says Lewicki, with the intent to process those resources there, and then use those resources to facilitate space exploration.

Private asteroid mining companies attract the new pioneers of space: engineers, computer scientists, and others eager to explore.

"I've always been a bit of a space geek and this is an opportunity to be involved without working for either a government lab or a defense contractor," says Ben Eitzen '07 MS. "The most exciting aspect to me is seeing several different engineering disciplines come together to build something that actually gets strapped onto a rocket and blasted into space."

Read about how Planetary Resources plans to find and mine the asteroids at **magazine.wsu.edu/extra/asteroids**.

WSU astrobiologist Dirk Schulze-Makuch is in Germany, where he just took his children to the opening of the new Star Wars movie, *The Force Awakens*. I dial long distance and after a short pause, I'm speaking with him in Berlin. It's just before Christmas.

Schulze-Makuch, professor in the School of the Environment, is widely known for his investigations of extraterrestrial life and cosmic biology. He is a leader in the global astrobiology community and recently published a paper on the physical, chemical, and physiological limits of life.

He says scientists don't expect to find *X-Files* type aliens in our solar system, "but only tiny microorganisms similar to Earth's microbes." The biochemical makeup of these microbes would vary greatly depending upon their environment.

Life on Mars, for example, might be quite similar to water-based life on Earth, says Schulze-Makuch. But it would be very different on Saturn's largest moon, Titan, where the atmosphere is mostly nitrogen and methane forms the clouds, rain, rivers, and lakes.

I ask his opinion of a 2015 study led by Italian researcher Raffaele Saladino which hypothesizes that the organic building blocks for life arrived on Earth via carbon-rich chondrites, the oldest type of meteorite in the solar system.

"The findings are interesting," says Schulze-Makuch. "But organic molecules could also have developed on Earth or Mars. From there it's very complicated to actually make them into a working cell or organism. There are a lot of ideas about how life initially began, but no overarching theory. It remains our biggest puzzle."

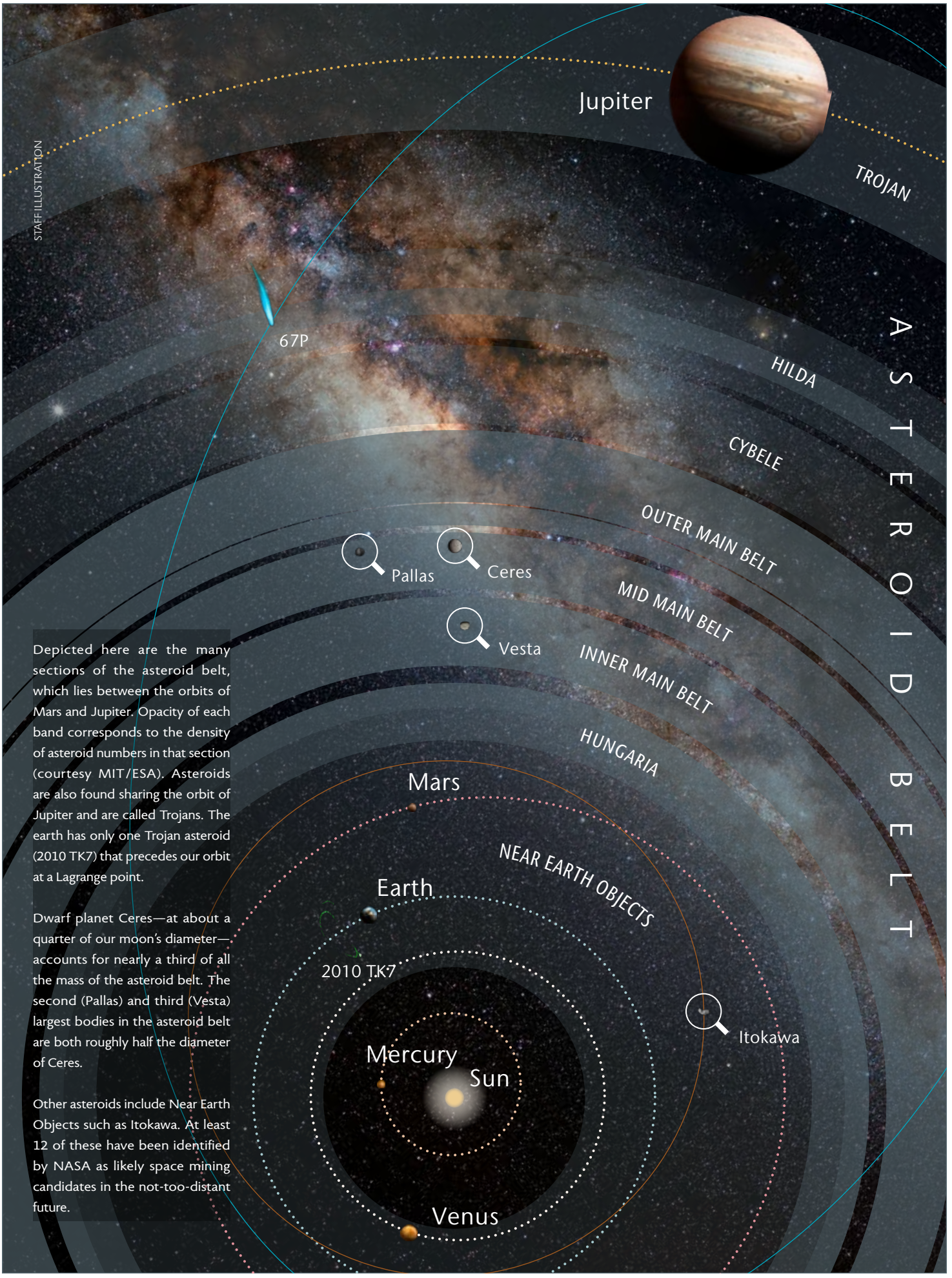
He does think, however, that life could travel to Earth inside a meteorite, just a few centimeters below the surface. He refers to the 1984 discovery of ALH84001 in Antarctica.

Estimated to be 4 billion years old, ALH84001 is the oldest meteorite ever determined to have come from Mars. The rock is thought to have been blasted off Mars by an asteroid strike and later landed on Earth. ALH84001 caused excitement when it was discovered to contain carbonate globules associated with water. Inside the globules are large organic molecules that look like fossilized bacteria.

Schulze-Makuch says the idea that there was life in the meteorite is still being debated but one thing is certain: its interior was only heated to about 40 degrees Celsius. "So, if there were living organisms inside, they could've survived. They could've just gone dormant. Life can survive space travel," he says.

The speculation among some of his colleagues is that life originated on Mars and was seeded onto Earth by an asteroid strike.

Schulze-Makuch points out that early on, conditions for life were much more favorable on Mars than Earth. "Mars had oceans—or at least liquid water and an atmosphere," he says. Earth was recovering from "a collision with a huge object that tore off a piece of the planet and formed the moon." He says Earth was also probably covered with magma at the time, prohibiting the establishment of any kind of life.



Depicted here are the many sections of the asteroid belt, which lies between the orbits of Mars and Jupiter. Opacity of each band corresponds to the density of asteroid numbers in that section (courtesy MIT/ESA). Asteroids are also found sharing the orbit of Jupiter and are called Trojans. The earth has only one Trojan asteroid (2010 TK7) that precedes our orbit at a Lagrange point.

Dwarf planet Ceres—at about a quarter of our moon's diameter—accounts for nearly a third of all the mass of the asteroid belt. The second (Pallas) and third (Vesta) largest bodies in the asteroid belt are both roughly half the diameter of Ceres.

Other asteroids include Near Earth Objects such as Itokawa. At least 12 of these have been identified by NASA as likely space mining candidates in the not-too-distant future.

WSU professor of geology Jeffrey Vervoort doubts some of those ideas. Indeed, scientific theories, hypotheses, and speculation vary widely among those studying the new frontiers of space. But Vervoort has faith in this: He's pinpointed the age of the solar system at 4.567 billion years using the most common type of meteorites, the stony chondrites.

I walk across campus one cold blustery afternoon to talk with him in his Webster office next door to Nick Foit.

Vervoort is a soft-spoken historian of the solar system. He is also a type of cosmochemist, in that he uses chemistry to study objects from space. It turns out that it's easier to calculate the age of the solar system than it is our own planet Earth.

"Earth is such a dynamic planet with volcanoes and tectonic plates moving across its surface," he says. "The whole planet has been processed and melted—there are no vestiges of the original materials left to study. There is nothing we can put our hands on to directly determine the age of the Earth."

"This is the closest we can come," Vervoort says as he retrieves a pink, quartz-like rock that came from Australia. Shimmering slightly, the stone is full of minute zircons, whose tiny forms have been dated to 4.4 billion years, the oldest known minerals on the planet. But the surrounding rock is much younger.

"We need another way to age the Earth," he says. "That's where the meteorites come in."

Vervoort explains that our solar system was born from a cloud of interstellar dust and hydrogen gas that collapsed and began rotating as the result of a nearby supernova. Gravity eventually swept most of the material into the center to form the sun. The outer material gave rise to the different planets, moons, and asteroids. The rocky terrestrial planets—Mercury, Venus, Earth, and Mars—formed closest to the sun while the more volatile gas and ice giants—Saturn, Jupiter, Uranus, and Neptune—formed farther away.

A ring of leftover remnants orbiting between Mars and Jupiter became known as the Main Asteroid Belt. A second ring beyond Neptune, the Kuiper Belt, contains the dwarf planet Pluto as well as asteroids of highly elliptical orbits that cut across the solar system. And, in the outermost reaches of the solar system lies the spherical Oort Cloud, home to potentially trillions of icy objects including the comets that periodically pass near Earth.

Vervoort says that most of the iron and stony meteorites that fall to Earth come from the Main Belt and are representative of the terrestrial planets. These meteorites vary widely in composition but for his research, Vervoort focuses on a class of stony chondrites.

"They are really quite interesting," he says. "The most primitive ones appear almost fluffy and you can nearly break them apart with your hands even though they've been flying around the solar system for 4.5 billion years."

To determine the age of the chondrites, Vervoort and graduate student Audrey Bouvier analyzed the radioactive decay of uranium into lead for different components of the meteorites.

"Uranium is naturally occurring in all meteorites and in virtually all rocks," he says. "We know that it decays down to certain isotopes of lead with very precise half lives. So we measure the ratio of uranium to lead and can determine the specific age of a rock; in this case, the oldest components of chondrites are 4.567 billion years.

"So, we know the Earth is younger than 4.567 billion years and older than 4.4 billion years," Vervoort says. Using indirect evidence plus data from other researchers, he estimates our blue planet was largely formed between 4.53 and 4.52 billion years ago.

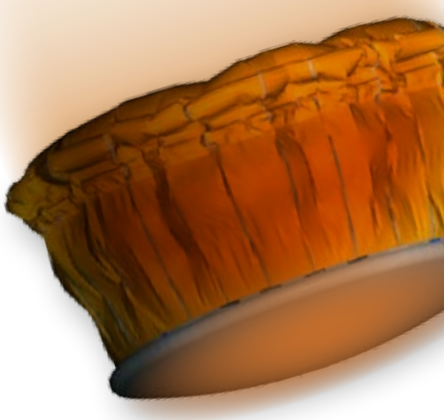
"Trying to understand how the Earth and solar system formed is one of the most fascinating things in all of human knowledge," says Vervoort. "Our solar system is but one among billions of galaxies each with millions of solar systems. We don't often think about how absolutely enormous the known universe is."

We don't often think about how **absolutely enormous** the known universe is.

WSU astrophysicist Guy Worthey has spent a lifetime dreaming about it.

An associate professor in the department of physics and astronomy, Worthey reaches beyond the solar system to study galaxies and the origin of chemical elements like carbon. He can also tell you a lot about red giant and cool dwarf stars.

This gray January day, I'm waiting as he attends to a whistling tea pot in the other room. Gregarious with a wry sense of humor, Worthey admits to a fascination with menacing tales of asteroids, and especially likes the story of Ann Hodges from Sylacauga, Alabama. On November 30, 1954, Hodges was napping on her couch when an 8-pound meteorite crashed through her roof, bounced off a radio, and slammed into her hip, causing



CLOCKWISE, FROM UPPER LEFT: NICK FOIT HOLDING METEORITE, STAFF PHOTO. CHELYABINSK METEOR TRACE, PHOTO ALEX ALISHEVSKIKH/WIKIMEDIA COMMONS. COMPUTER MODEL OF A SUPERSONIC DECELERATION SYSTEM DEVELOPED BY AIRBORNE SYSTEMS, COURTESY AIRBORNE SYSTEMS. DIRK SCHULZE-MAKUCH, PHOTO ROBERT HUBNER. JEFFREY VERVOORT, COURTESY JEFFREY VERVOORT. GUY WORTHEY, PHOTO ROBERT HUBNER

+ planning and planting for life on Mars: magazine.wsu.edu/extra/Mars-life

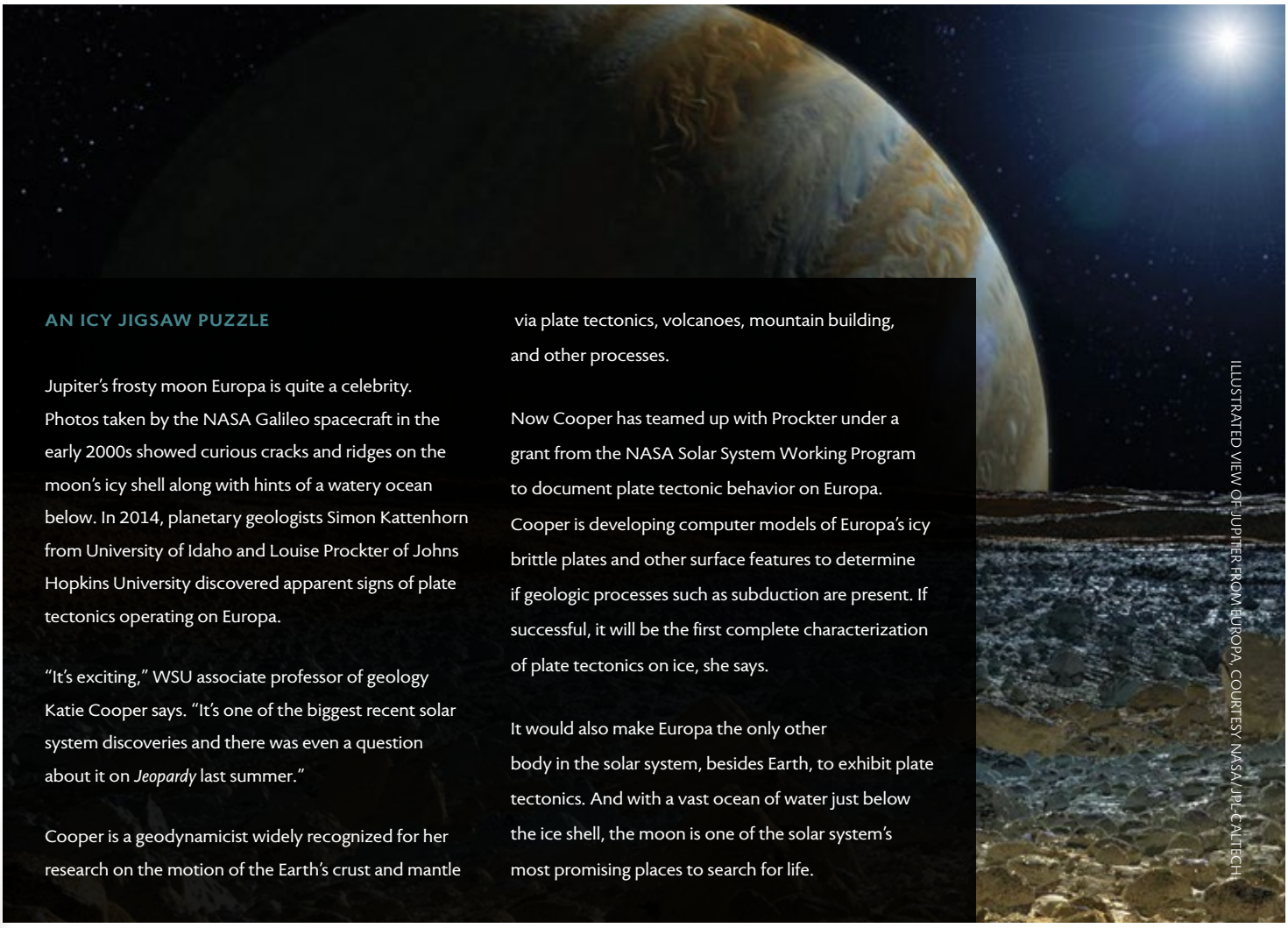
severe bruising. It was the first documented meteorite to hit a U.S. citizen and drew extensive publicity.

Though that rock was relatively small, Worthey says it's inevitable one of the much larger near-Earth asteroids will eventually hit our planet unless we do something to stop it. NASA's Asteroid Redirect Mission (ARM) is a step in that direction. ARM is a part of the broader Asteroid Initiative which seeks to identify potentially dangerous asteroids and prevent them from striking Earth. The goal of ARM is to capture an asteroid and bring it back to the moon.

When the initial call for ideas went out, California-based aerospace company Airborne Systems responded with a proposal to "snag a free-floating asteroid, haul it back toward Earth, and put it into orbit around the moon," says Gilbert Dodgen '74, '77 MA Music.

Dodgen, a software engineer with Airborne Systems, designs computer models of various spacecraft systems, including the asteroid-capturing device. For that project, he modeled cylindrical fabric beams that are extremely durable when inflated. He says the finished beams were bound into a hand-like contraption that could "grab" a suitable asteroid.

"The idea was that a spacecraft would go out and deploy the air beams with a bag attached. It would slowly come up to the asteroid, pass the bag around it, then deflate the beams to hold it in place. The spacecraft would then tow the asteroid back to the lunar orbit where it would remain permanently for astronauts to study," he says.



ILLUSTRATED VIEW OF JUPITER FROM EUROPA, COURTESY NASA/JPL-CALTECH

AN ICY JIGSAW PUZZLE

Jupiter's frosty moon Europa is quite a celebrity. Photos taken by the NASA Galileo spacecraft in the early 2000s showed curious cracks and ridges on the moon's icy shell along with hints of a watery ocean below. In 2014, planetary geologists Simon Kattenhorn from University of Idaho and Louise Prockter of Johns Hopkins University discovered apparent signs of plate tectonics operating on Europa.

"It's exciting," WSU associate professor of geology Katie Cooper says. "It's one of the biggest recent solar system discoveries and there was even a question about it on *Jeopardy* last summer."

Cooper is a geodynamicist widely recognized for her research on the motion of the Earth's crust and mantle via plate tectonics, volcanoes, mountain building, and other processes.

Now Cooper has teamed up with Prockter under a grant from the NASA Solar System Working Program to document plate tectonic behavior on Europa. Cooper is developing computer models of Europa's icy brittle plates and other surface features to determine if geologic processes such as subduction are present. If successful, it will be the first complete characterization of plate tectonics on ice, she says.

It would also make Europa the only other body in the solar system, besides Earth, to exhibit plate tectonics. And with a vast ocean of water just below the ice shell, the moon is one of the solar system's most promising places to search for life.

But NASA had a second option—a rival company proposed sending a probe to pluck a small asteroid off the surface of a large asteroid, and in 2015, NASA chose that plan.

Ultimately, these projects play into the larger goal of developing technologies for a human mission to Mars. Today Dodgen is part of a team devising inflatable deceleration systems to help spacecraft land safely on the red planet. The thin atmosphere on Mars requires rockets to brake more quickly than when entering Earth's atmosphere or risk a crash. His current designs include a supersonic jellyfish-like parachute.

Worthey would jump at the chance to travel to another planet and suggests, in the long run, that we terraform both Mars and the moon. Terraforming is the process of turning barren, hostile environments into habitable ones.

For starters, Worthey says there are many comets, Kuiper Belt objects, and little moons like Europa and Ganymede in the outer solar system that are full of water. They also have low gravitational fields making them accessible for water mining. Since today's chemical rockets use the ingredients for water—liquid oxygen and hydrogen —he proposes we use some of these bodies for fuel as well as terraforming.

He envisions sending robot-operated rockets to capture an icy moonlet and jet it back to our own moon. As the ice disintegrated, it would create lunar water and a thick atmosphere. "Eventually, we could move in," he says.

"This is technically feasible now," Worthey says. "We don't need fusion or antimatter; we just need the willpower. It's possible to send robots to places like a comet, icy asteroid, or maybe some of Saturn's ring system particles where they could mine water. Then as the rocket thrusts its way back through the solar system it could consume some of that water as fuel."

No longer confined to the realm of science fiction, terraforming has become a vibrant area of research especially as it applies to Mars. But before scientists can terraform the red planet, they must determine what drove Mars into its current desolate state. To that end, NASA's Mars Exploration rovers are on the ground, busily searching for clues of past geological processes and water activity.

There are also plans to terraform the moon. The concept, says NASA, is to place mobile robotic mirrors, called TransFormers, at the rim of a freezing lunar crater. The mirrors would be angled to reflect sunlight down into the crater, providing light, warmth, and solar energy for robots and eventually human explorers.

Full of optimism, Worthey says, "I would love to see us on a green moon and green Mars exploring nearby stars. In the Milky Way galaxy there are at least three billion habitable planets—basically Earth twins in the same place in their solar systems as Earth is. When fusion is physically possible, it will pan out. If we have the willpower it will happen quickly." ✳

WITH HOMAGE PAID TO NORMAN ROCKWELL'S
SATURDAY EVENING POST COVER *PHARMACIST*, 1939.
ILLUSTRATION BY DEREK MUELLER

125 years of pharmacy at WSU: magazine.wsu.edu/extra/Rx125

The Pharmacist will see you now.

BY DAVID WASSON

Shelves full of informational brochures, health aids, and other over-the-counter remedies. Pharmacists filling and checking prescriptions, tending to paperwork, and meeting with customers.

Tucked into a portion of a busy Fred Meyer retail store, it looks like a typical community pharmacy.

Except there's a difference. A big one that could help transform how and where many routine health care services are delivered.

Located in the Vancouver suburb of Mill Plain, it's among the first wave of enhanced pharmacies where customers not only can fill prescriptions but receive direct medical care for a range of common ailments that would otherwise require a trip to a doctor's office.

"The more people learn about how much pharmacists can do, they're realizing that a pharmacy really can be much more," says Matt McCarty, who manages the Mill Plain pharmacy. "Our ultimate goal is taking care of the patient."

Retail pharmacies are expanding to take on greater primary care roles.

From a clinical room alongside a separate waiting area, McCarty and his pharmacists are treating urinary tract infections, swimmer's ear, and nearly two dozen other common ailments as part of a pilot project with Washington State University's College of Pharmacy. They're also able to treat burns, yeast infections, dog bites, strep throat, and severe headaches, including migraines. And, they administer a range of vaccines and shots, while providing emergency prescription refills for a variety of conditions.

Think of it as a cross between a traditional neighborhood drug store and a window into the future.

As physician shortages worsen, pharmacists and other health science professionals are preparing to take on greater primary care roles. Some medical organizations already are

TOP: PHARMACY MANAGER MATT MCCARTY CONFERRING WITH EMA BOTEZ '13 DPH, PHOTO BILL WAGNER

CENTER, FROM LEFT: ASSISTANT PHARMACY PROFESSOR JULIE AKERS '99 DPH AND ASSOCIATE DEAN LINDA GARRELTS MACLEAN '78 DPH, PHOTOS LORI J. MARICLE. INTERPROFESSIONAL EDUCATION AND RESEARCH PROGRAM DIRECTOR BARB RICHARDSON '10 PHD, PHOTO CORI MEDEIROS

BOTTOM: PHARMACY STUDENTS ATTENDING THE 2016 LEGISLATIVE DAY IN OLYMPIA WITH STATE SENATOR LINDA EVANS PARLETTE, R-WENATCHEE, A '67 WSU PHARMACY GRADUATE, COURTESY WASHINGTON STATE LEGISLATIVE SUPPORT SERVICES

transitioning pharmacists onto patient care teams, and at WSU all health and medical science students now train collaboratively in an effort to enhance overall care.

"You have these highly trained, highly under-utilized health professionals," says Julie Akers '99 DPH, an assistant pharmacy professor at WSU who researches health care access issues. "People may see their physicians maybe once a year but many see their pharmacists at least once a month."

Additionally, pharmacies are as much a part of American neighborhoods as the local grocer. As of 2012, according to an industry study, 93 percent of Americans live within five miles of a retail pharmacy, many of which are open 12 to 16 hours a day, seven days a week.

Akers and Linda Garrelts MacLean '78, associate dean for advancement at WSU's College of Pharmacy, are studying the effectiveness of pharmacy-based treatment as part of a four-year research grant from the National Association of Chain Drug Stores Foundation. The goal is to develop baseline data that can be used to measure how enhanced pharmacy services are affecting health care quality and access.

Although they suspect the study will find the cost and quality is comparable to the same type of treatments provided at doctor's offices, urgent care centers, and hospital emergency departments, Akers and MacLean stress it can't replace a family physician.

"A key priority for the research team was to design the care protocol to ensure the patient's primary care physician was included in the process," Akers explains. "We also have a physician advisory group to periodically review our protocol and be our sounding board."

Making it possible is Washington's generally progressive approach to pharmacy practice. It's among a handful of states that extend broad treatment authority and in 1979 became the first in the nation to grant prescriptive authority to pharmacists who enter into working agreements with local physicians.

"There's so much potential for what can happen," says Akers. "This could really help in rural settings, obviously, but even in urban areas you can still have access and availability issues that pharmacies are well positioned to help with."

Fred Meyer already was moving toward enhanced operations at its pharmacies in southwest Washington.

Previously, for example, it had developed working protocols with local physicians to provide pharmacy-based smoking cessation services. Its pharmacists also are available for international travel consultations and able to administer required or recommended vaccines as well as prescribe motion sickness remedies for those embarking on ocean cruises, for example.

"Pharmacists have strong backgrounds in health sciences," says Crystal Bryan '10,'12 DPH, who is director of clinical services at Fred Meyer Stores. "Getting people working at the top of their license would free up some of those wait times to see a physician."

The pilot project launched in September, and some of the company's Vancouver-area pharmacies already are seeing customers from across the Columbia River in Oregon who've heard how quickly they can get treated for certain conditions in Washington.

Other retailers, including Bartell Drugs, Costco, Rosauers Supermarkets, and Yoke's Fresh Markets, are also working with WSU to introduce enhanced pharmacy operations.

Getting to this point has taken a combination of educational advancements, professional development, and legislative intervention.

It largely began in the late 1990s, when pharmacy education underwent dramatic changes. Bachelor programs were discontinued as pharmacy colleges transitioned to doctoral degrees that put greater emphasis on overall health science.

Then, pharmacists took on greater therapeutic counseling roles, working directly with their patients to help them understand how best to use prescribed medicines and evaluating dosage levels and medicinal interactions. About the same time, many states expanded the authority of pharmacists to directly administer vaccines and other shots.

The expansion into clinical treatment has long been seen as the next logical step, but the reluctance of insurance companies to reimburse pharmacists for services beyond the cost of dispensed medications has been a stumbling block.

In Washington, state law requires insurance companies to reimburse licensed health professionals for authorized services they deliver. It's how medical centers and clinics are able to get reimbursed for services provided by nurse practitioners, for example, or physician assistants.

But insurance companies had excluded pharmacists, even though the same procedures were covered if performed in a doctor's office.

"It was absolutely ridiculous," says state Senator Linda Evans Parlette, a '67 WSU pharmacy graduate. "I have worked on this since probably 2007."

It took a legal ruling from Washington's attorney general and the intervention of a bipartisan panel of state lawmakers to change that.

Legislation introduced by Parlette requiring insurance companies to reimburse pharmacists for clinical services they're licensed to provide won near-unanimous approval last year and was signed into law by Governor Jay Inslee. Pharmacists seeking reimbursement must be part of the insurance carrier's approved provider list.

Pharmacy faculty at WSU and the University of Washington are assisting in its implementation. The new requirement, which is being phased in through 2017, puts Washington at the forefront of enhanced pharmacy clinical services nationwide.

"Most community pharmacies haven't fully explored the extent of what they can do," says Akers.

The expansion into clinical treatment has long been seen as the next logical step.

learning to work cooperatively: magazine.wsu.edu/extra/health-teams

Meanwhile, as the legislative battles were being waged, health care organizations that don't rely on insurance reimbursements have been transitioning pharmacists into greater primary care roles for a while.

At the Mann-Grandstaff Veteran's Administration Medical Center in Spokane, for example, clinical pharmacists are handling some of the more routine patient exams.

They primarily monitor drug interactions and the effectiveness of treatments that rely heavily on prescription therapies, such as high blood pressure and cholesterol. By assigning certain follow up visits to licensed pharmacists, who can bring in staff physicians if necessary, it gets patients in quicker and enables medical doctors to focus on those with more complex needs.

"We're looking for the best outcome and pharmacists are very good at coaching a patient along," says Sunil Wadhwani, the medical center's chief of pharmacy. "They're functioning as a part of the primary care team."

Wadhwani has worked closely with WSU's pharmacy college. "We provide a rich environment for training," he says. "The VA is at the front end of these changes and improving patient safety."

Enabling the enhanced roles is the increasing academic and clinical preparation that pharmacy colleges have built into their curriculum.

"For the past 10 years, all pharmacists entering the profession have earned a doctor of pharmacy degree," MacLean notes. "What this means is we are trained and have the credentials to be decision-makers and health care providers."

Additionally, all of WSU's health and medical science programs emphasize cross-disciplinary cooperation. That emphasis soon will be moving beyond classroom simulations.

A 43,000-square-foot medical clinic nearing completion at WSU Spokane will house a physician residency program that also will enable nursing, pharmacy, and other health science students to gain practical experience working together as primary care teams.

WSU Spokane Chancellor Lisa Brown describes it as key to improving health outcomes and lowering costs.

"As medicine becomes more sophisticated, it's going to take all health care providers to deliver it," Brown says. "Especially in rural areas where many of our future doctors, nurses, and pharmacists will practice, the ratio of health care providers to population is low and they will need to have knowledge of each others' skills … often providing care that was previously exclusive to one field."

In Spokane, where WSU's health and medical programs are located, exposure to the team approach begins early.

That training includes simulations based on actual medical cases and uses local actors and actresses who have been trained how to behave during exams and how to respond to various questions that might arise from the student teams. The cases typically involve multiple chronic conditions, such as asthma and anxiety.

"Each profession brings its own roles to the care team," explains Barb Richardson '10 PhD, a pediatric intensive care nurse who now serves as director of WSU's Interprofessional Education and Research program. "It's important that the students know how to communicate with each other and … it's better to have them learning in a simulated setting where it's OK if you don't get it right the first time."

Those studying to become medical doctors, physician assistants, and nurse practitioners do the actual diagnosing but often must rely on the expertise that the other members of the team bring from their fields of study, such as nutrition and occupational therapy, to determine the proper course of treatment.

"We're looking for them to learn how to work together," Richardson says, "because we want to make sure that next generation of health care leaders is prepared and workforce ready."

Back in Mill Plain, few know better than McCarty the emphasis WSU places on clinical services and interdisciplinary cooperation.

He entered the workforce nearly two decades ago and, like many veteran pharmacists, it took a bit of a shift to prepare for the challenges of providing pharmacy-based treatment. He embraced the challenge, though, and now strives to help others understand how much the profession is evolving.

That's why when a patient arrived at the pharmacy for a clinical procedure not long ago, McCarty called over the intern to observe and help out.

"He was one of our WSU interns and I thought I'd bring him in to assist and show him where the profession is heading," McCarty recalls. "I figured it would be a great learning opportunity and I'd have a chance to really impress him with how much things are changing."

But it was McCarty who ended up being impressed.

"He looked at me and was like, 'Oh yeah, we've been doing this in school,'" McCarty says. "Here I thought I'd be showing him something new and for him it was already a part of the job."

Here are some of the common ailments and conditions that pharmacists who have working agreements with local physicians are able to directly treat:

Allergies and allergic reactions, certain respiratory ailments, burns, animal bites, insect stings, strep throat, swimmer's ear, urinary tract infections, and vaginal yeast infections. They also can prescribe emergency refills for epinephrine, migraines, birth control, and insulin.

OPPOSITE: DOCTOR OF PHARMACY STUDENTS IN THE PHARMACEUTICAL AND BIOMEDICAL SCIENCES BUILDING ON THE SPOKANE CAMPUS, PHOTO CORI MEDEIROS

← PHARMACY
← MEDICAL SCIENCES

ALUMNIpedia

37 alumni *profiles*
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4TH OF JULY FIREWORKS IN PULLMAN

Within the urban fabric

The architectural responsibility of making more than just buildings

WHEN THE CITY OF VANCOUVER, British Columbia, planned to expand their convention center in the late 2000s, they wanted a structure that would reflect the city's environmental values while tripling the meeting space of the downtown facility. The Vancouver Convention Centre West, designed by LMN Architects and completed in 2009, exceeded their vision: The gentle slope of the 6-acre green "living roof" provides bird habitat; the building is heated and cooled by seawater; and fish and shellfish inhabit the base of the building.

The Vancouver project fits exactly with the philosophy of the Seattle-based architects and firm partner Rob Widmeyer '75. It also contributed to the successes that garnered LMN the highest award in the industry, the 2016 Architecture Firm of the Year from the American Institute of Architects (AIA).

"We have a culture at LMN that believes in the integration of how the building functions and the surrounding environment," says George Shaw, another partner at LMN. "We live in an age of urbanism where the quality of our urban environments is increasingly important to the quality of our society."

Widmeyer says Vancouver Convention Centre West is one project that he's most proud of. "It's completely integrated into the fabric of the city."

Shaw and Widmeyer say the Vancouver Convention Centre West shows how a major civic building connects to its environment. It achieved LEED® Canada Platinum certification, the first convention center project in the world to earn the program's highest rating. Its distinctive roof—the largest non-industrial living roof in North America—is covered with 400,000 native plants. Below, underwater terraces host mussels, kelp, and Dungeness crabs. These sustainable aspects integrate seamlessly with the convention and retail space.

LMN has also made a mark in Seattle with iconic buildings like Benaroya Hall. The firm is leading a $1.4 billion expansion of the Washington State Convention Center, and the architects say they'll bring in some of the lessons they've learned from Vancouver.

Throughout North America—such as convention centers in South Padre Island, Texas and Cleveland—LMN often collaborates with other architects even though it has a single Seattle office, says Shaw. He and Widmeyer say they appreciate that the AIA award shows the respect of their peers, partly because of those collaborations.

Washington State University also has benefitted from LMN's expertise. The new Paccar Environmental Technology Building (see below) was designed by LMN, as were the WSU Vancouver Engineering and Computer Science Building, the Biotechnology and Life Sciences Building in Pullman, and the Intercollegiate College of Nursing Building at WSU Spokane.

In addition to Widmeyer, a number of other WSU alumni work for LMN, including John Petterson '76, Tim Rice '81, Tom Burgess '82, Jennifer Milliron '01, Kjell Anderson '02, Robert Smith '01, Tyler Schaffer '05, and Mark Lo '10. LMN has also assisted with WSU student portfolio review and other educational projects.

"We see our responsibility to the community as more than just making buildings," says Widmeyer, also pointing to LMN's involvement with bringing Seattle high school students onto year-long projects with contractors, architects, and engineers. "To have the best architects, you need to engage people in the process, show them what's possible, and get them excited about the profession."

COURTESY LMN ARCHITECTS

The new Paccar Environmental Technology Building (PETB) brings together interdisciplinary research and education in clean technology, like renewable materials, sustainable design, water quality, and atmospheric research. The building is constructed using renewable materials and technologies developed at WSU, including wood composites, recycled concrete, and pervious pavement, all of which help make it the greenest building constructed so far at WSU Pullman. Located on Grimes Way, a block from the Lewis Alumni Centre, the PETB labs and shared common spaces house researchers from engineering and other disciplines to work on reducing the region's dependence on foreign oil, minimizing carbon footprints, and improving air and water quality.

Deadliest toxin microbiologist

A RESEARCHER'S LIFELONG INVESTIGATION OF THE *BOTULINUM* BACTERIA

Millions of juvenile salmon died mysteriously in hatcheries across the Northwest from 1979 to 1982. Bankruptcy loomed for seafood companies as fish wobbled around the hatchery tanks and then expired.

Eventually, they brought in **MEL EKLUND '55**, a microbiologist and pathogen expert with the National Marine Fisheries Service in Seattle. His wife, Helen, had seen a news report about the dying salmon and when she told him, Eklund got to work.

He analyzed the fish samples in his lab and discovered what he suspected: The salmon were poisoned with botulism, one of the most powerful toxins in the world. Some of the hatcheries' rearing ponds had earth bottoms where the *C. botulinum* bacteria had grown and produced the neurotoxin in dead juvenile fish. These fish in turn would get buried in pond sediments where live salmon cannibalized them, says Eklund. "On a warm day around 70 degrees, one dead fish contained enough toxin to kill 70 others."

He trained hatchery managers on proper handling of the fish and corpses, and the following year, "They had so many fish, they had to truck them out."

Eklund received the Gold Medal Award from the U.S. Department of Commerce for his work. It was just one recognition for Eklund's work and discoveries, particularly with the bacteria that cause botulism. Over his 35-year career with NMFS, scientists and regulatory agencies from around the world applauded Eklund's efforts in understanding and controlling this toxic danger.

Botulism is a paralytic illness caused by *C. botulinum* bacteria. Fortunately, the neurotoxin is destroyed by chlorine in municipal water systems and also by heat. The spores of this bacteria are often found in freshwater and marine sediments and in soil. Botulism in humans is relatively rare. Eklund and his NMFS lab researched *botulinum*, making a number of key discoveries and helping the seafood industry control this bacteria.

Eklund grew up in the tiny town of Saco, Montana, but when his mother died he moved to Chehalis, where he became involved with FFA. Thanks to his FFA leader, Eklund visited and then attended Washington State College, majoring in animal husbandry and pledging with the Alpha Gamma Rho fraternity.

When Eklund's advisor realized he didn't know about spoilage bacteria, he steered Eklund into a microbiology class, which fascinated him. His enthusiasm led to a 1957 master's degree at WSC in food science and microbiology, and then to Purdue University for a doctorate in the same field. Eklund credits WSC professors John V. Spencer and William Stadelman with his success.

Although he studied microbiology, Eklund says he had no interest in working with *C. botulinum* after a professor took them to the U.S. Army quartermaster lab in Chicago. "They were working with botulism, and I thought, 'I'm never going to work with that. It's too dangerous,'" he says.

That changed after Eklund went to work for the NMFS in 1961. In the 1960s, botulism in packaged smoked fish and canned tuna sickened people in the Midwest, which led to surveys around the world to determine incidences of *botulinum* bacteria. Eklund's lab analyzed marine and freshwater environments from Alaska to southern California for that study, which led to some discoveries.

Strains of *C. botulinum* are designated Type A through G based on the neurotoxin produced and split into groups based on whether they can digest proteins (proteolytic) or not (nonproteolytic). During the survey, Eklund isolated nonproteolytic Type F for the first time. He also determined that it could grow at lower temperatures than previously believed, thriving as low as 38°F.

PHOTO ROBERT HUBNER

Other findings caught Eklund's attention. "During the incident study, I got interested in bacteria that look like *botulinum* but wouldn't produce toxin," says Eklund. He explains that his lab found for the first time that bacterial viruses called bacteriophages govern lethal toxin production in Types C and D *botulinum*.

His findings—published in the journal *Science*, with a follow-up study in *Nature*—opened a new line of research. Letters from prominent genetics researchers, such as Nobel Prize winning microbiologist Joshua Lederberg, praised the significance of Eklund's work in understanding how *C. botulinum* produces toxins.

Laboratories and companies applied Eklund's research to produce specific antigens and antitoxins to help protect animals from the disease.

Later, Eklund confirmed the first case of infant botulism in Seattle in 1978. He developed protocols for Alaska Natives to control bacterial pathogens in smoked and dried salmon. Eklund also developed and patented a selective and differential medium for the isolation of pathogen *Listeria monocytogenes*.

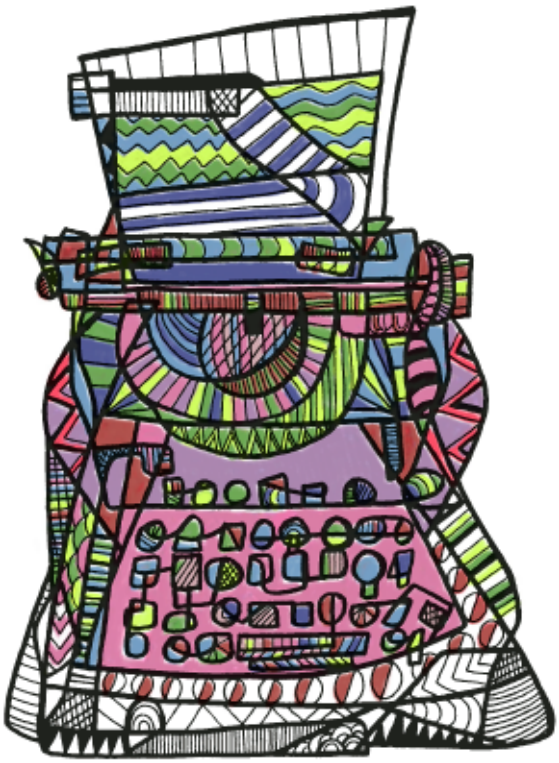
Eklund says the recommendations from his lab for time, temperature, and salt levels in processed seafood are still FDA requirements.

He retired from the NMFS in 1996, but continued consulting with seafood companies. Eklund received the WSU Alumni Achievement Award in 1998. He still keeps busy at the Seattle home he built and his 51-acre farm near Chehalis. He has two daughters, Cheryl Eklund and Lynda Eklund.

color your own WSU world: magazine.wsu.edu/extra/color-your-world

color my worlds

An alumna artist brings out the kids in us



Tarah Luke felt like her hands would fall off after completing 120 pages in adult coloring books over five and a half weeks.

Luke '05 didn't color the pages, though. The Seattle-based artist designed and drew the images featured in the four books. The Eiffel Tower, a marching band, an octopus, and a movie camera are just a few examples from the series of themed volumes divided into places, music, animals, and inventions.

Luke's collection is part of a growing national trend. Adult coloring books, usually featuring complex patterns within images, have become an increasingly popular pastime.

Last December, five out of the top ten print books sold on Amazon were coloring books. Major publishers are reporting tens of millions of sales of them through the end of last year. Adult coloring books can be found in most bookstores, craft stores, and sometimes the grocery checkout lane.

Luke didn't immediately jump into the coloring book scene when it began to gain traction last spring, although she has been creating and selling art for years.

She got started while on a mission trip to Romania between community college and attending Washington State University. Luke had always enjoyed artistry, but hadn't taken classes. When she finished a 120-foot mural on that trip, her path was clear.

"It was then that I realized that I had to do art. It's in me—I'm fueled by it," she says.

When she arrived at WSU, Luke changed her major from psychology to fine arts. She especially remembers learning a lot from her advisor and painting instructor Chris Pratt.

"I used to do nothing but realistic stuff, but he asked me if I had ever worked with just color and abstract. I did nothing but abstract for years after that," says Luke.

After graduation, Luke continued to develop her artistic talents while working a series of other jobs in Seattle. About three years ago, she began to sell a lot of her abstract black-and-white line drawings online.

It was those images that inspired her father to suggest coloring books last August.

"I didn't even know adult coloring books were a thing," says Luke. "My dad said, 'I think those drawings you sell a ton of would make amazing coloring book pages.'"

Her father's company—Topics Entertainment—had never sold coloring books before, but Luke got right to work.

After settling on the four themes and the images, Luke drew pages every day.

"They take anywhere from an hour to three hours depending on the complexity of the image," she says. "With these pictures, I do it all in one continuous motion. I find a way to abstract it in that flow."

Luke says each drawing has some pattern that is unique to that drawing. For example, a drawing of a lion has African patterns. One of Luke's favorites has a Mayan pattern.

The books went on sale last December. As with other adult coloring books, they tout the stress-relieving and meditative benefits of coloring.

There are some proven advantages. A 2005 study by Nancy Curry and psychologist Tim Kasser found that coloring mandalas reduced anxiety in students, unlike free-form doodling.

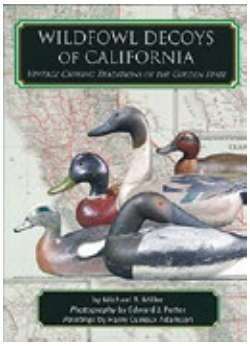
Luke thinks the adult coloring book craze offers a physical release from the digital age. "There's so much screen time on cellphones, iPads, and computers," she says. "People want to find some escape where they're not being bombarded by technology and information."

She found the coloring books to be a welcome stress relief even when she was drawing her own. Luke says she colored in others' books last fall and enjoyed the distraction.

"You can disconnect, but you're not so disconnected that your mind wanders," she says.

For now, Luke has commissions to do other work, such as a 30-foot mural in a brewpub, but the coloring books still hold promise.

"I think there are a lot of people who don't even know about this trend yet," she says. "It feels like it's just amping up."



Wildlife Decoys of California: Vintage Carving Traditions of the Golden State

MICHAEL R. MILLER '68

TRIPLE-D BOOK PUBLISHING: 2015

More than 40 years ago, Michael R. Miller '68 was passing through a Sacramento antique shop when he came upon a carved duck decoy. It was a pintail drake. Carved from a single piece of redwood, it had an elegantly pointed bill and tail and subtle shades of gray, black and off-white. Like so many of its ilk, it was just outside the ordinary aesthetic of art, but worthy of the moniker "art that came unasked."

As a child, Miller hunted with his grandfather and father across the scabland waters and wheat fields outside Spokane. He was fascinated by their wooden decoys, but at the time deployed duller birds, usually of plastic.

The Sacramento decoy set him in a new direction, in a big way. While they once dabbled with the fishes in muddy swamps and sloughs, vintage decoys have taken their place alongside some of the most coveted works of folk art. *Antiques Roadshow* viewers have seen them valued at $10,000 to $20,000. Works by A. Elmer Crowell, a revered Massachusetts carver, have sold for more than $1 million.

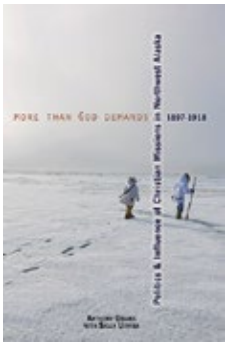
Miller and Frederick W. Hanson wrote *Wildfowl Decoys of the Pacific Coast*, a 384-page look at decoy-carving from California to British Columbia, in 1989. Miller, a retired federal waterfowl biologist, notes in his preface to *Wildfowl Decoys of California* that he has "doubled the hardbound decoy history of the West." And then some, if you consider that this book comes in at a lap-crushing 679 pages, with scores of color photographs and short biographies of more than 300 carvers dating back to the late nineteenth century.

Among them: Ed Frederickson, the carver of the decoy that set Miller on this course. A Spanish-American War veteran and blacksmith, Frederickson carved redwood that schooners brought from California's Humboldt Bay to a Rio Vista lumberyard where he worked. He hunted a little, but mostly he carved pintails and canvasbacks that took on what came to be known as the Rio Vista style.

Frederickson worked in a dark era of waterfowl hunting, as many decoys were made to serve market hunters. From 1870 into the 1930s, they slaughtered massive numbers of birds and other game to serve San Francisco and Los Angeles diners. Conservation laws stemmed the carnage, and decoys over time came to be seen as folk art and floating sculptures.

The book and its predecessor are largely for collectors, curators, and scholars. But as a testament to a hidden craft's beauty, and one man's commitment, it has few equals.

—Eric Sorensen



More than God Demands: Politics & Influence of Christian Missions in Northwest Alaska 1897–1918

ANTHONY URVINA '85 WITH SALLY URVINA

UNIVERSITY OF ALASKA PRESS: 2016

Tucked away in cabinets and forgotten closets at the Alaska regional offices of the Bureau of Indian Affairs in Juneau was a collection of old documents known simply as the Reindeer Files.

Anthony Urvina '85, a natural resource manager at the BIA, began digging through them in 2003 while trying to locate information for an Alaskan tribe about a 1920s stock certificate. What he found instead was a troubling history of cultural decimation and an emotional journey of understanding into his own ancestry.

In *More than God Demands*, Urvina chronicles the devastating effects on Alaska's native populations of intertwining U.S. policy and Christian ideology. Missionaries were given broad latitude under the authority of the U.S. Department of Education to "civilize" the Alaskan frontier, an approach that was seen as easier on the federal treasury.

Backed by the federal government, Christian missionaries began replacing thousands of years of indigenous Alaskan history through forced relocation of native populations and the banning of cultural practices and traditions.

"The American government, in collaboration with the American Church, had merged Christian ideology with Anglo-American culture to define the terms of 'civilization,'" Urvina writes. "The merger would characterize an Alaska Native pathway to citizenship. For an entire generation of Inupiat, that new path in life would lead to personal loss and destruction, expressed starkly within the Reindeer Files."

Woven into the history is a tale of self-discovery as well.

Urvina's mother was a native Alaskan orphan removed from her village and raised in one of the missions. The Reindeer Files helped Urvina better understand his mother's early life and he uses it as a narrative arc to personalize otherwise bureaucratic reports and correspondence.

The book's title is drawn from the comments of an early-1900s Quaker missionary, Otha Thomas, who once observed: "Sometimes, I think the church expects more of the Eskimo than God demands."

—David Wasson

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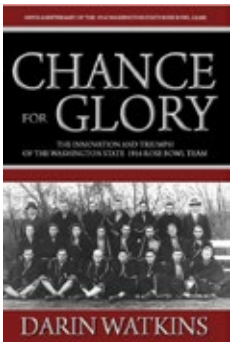
ALUMNI ASSOCIATION

Members Make the Difference.

Last spring, the WSU Alumni Association exceeded 30,000 members for the first time, ever! Members joined because of the amazing events, exclusive programs, special services, and fantastic discounts. When Cougs get together, the more the better. Become a member and help us reach 40,000—because it's Cougs like you who make the difference. Find us online at alumni.wsu.edu/join or call 1-800-ALUM-WSU.



Chance for Glory: The Innovation and Triumph of the 1916 Washington State Rose Bowl Team

DARIN WATKINS '84

AVIVA: 2015

"I have decided to put my fate in your hands," said Washington State College football coach William "Lone Star" Dietz to his players, as they prepared to take on Brown University in the 1916 Rose Bowl after an astounding 1915 season. Dietz promised to return as coach if WSC won.

The team fought hard, using Dietz's radical play-calling system, and defeated Brown on that rainy New Year's Day, 14–0.

Murrow College alumnus Darin Watkins tells the compelling story leading up to that Rose Bowl contest, with its fascinating characters and high sports drama. But it was about more than football, he argues.

Watkins lays out the case for the football team's success running parallel with efforts by the nascent college to gain more recognition from state lawmakers and step out from the shadow of the University of Washington.

The college had expanded beyond its agricultural mission, and in 1915 faced a legislative investigation that could restrict WSC's growth by preventing duplicate programs offered by UW. President Enoch Bryan saw the threat, writes Watkins, and knew the state's media were more engaged with the WSC football program than legislative committees.

So Bryan hired Dietz, who had studied under legendary coach "Pop" Warner. The 1915 season reversed the college's football fortunes and brought positive attention to the school in Pullman.

—Larry Clark

BRIEFLY NOTED

Immortal of the Cinder Path: the Saga of James "Ted" Meredith

By **JOHN JACK LEMON '78**

2015

In this first tribute to early twentieth-century athlete James "Ted" Meredith, Lemon introduces a mostly forgotten, and sometimes heartbreaking, story of a world-record breaking runner, Olympic gold medalist, and all-around sports star.

Hope

By **SUZANNE D. LONN '67**

WESTBOW PRESS: 2014

This third novel from Lonn explores family dynamics through adoption, obsessive compulsive disorders, and salvation. *Hope* is a sequel to Lonn's earlier novel *The Game of Hearts* (2003 Exlibris). She also published *Mixed Nuts* in 2008, a novel about elder abuse, alcoholism, depression, and dementia.

A Bag of Badgers

By **CASEY MCGOVERN '04**

McGovern, a WSU fine arts graduate, offers up 51 quirky poems that include strange uncles, tenacious badgers, wily raccoons, elusive poultry, and a variety of criminal mischief, illustrated with black and white drawings.

The Dowser

By **DONALD WHITE '63**

2015

Crime thriller set in the fictional small town of Markos, a quiet semirural place where the arrival of an unkempt stranger raises community concerns and eventually leads the city's new police chief and the FBI to a serial murder suspect. This is White's fourth novel.

The Counterfeit Detective

By **PAUL R. PARADISE '75**

KOEHLERBOOKS: 2015

The shadowy depths of trademark counterfeiting drive the events in this novel by Paradise. When a private investigator's best informant is murdered, a cabal of counterfeiters threaten his livelihood, and his life. Paradise has drawn on his expertise in trademark counterfeiting for numerous articles, as well as this novel.

Boxing day for Cougs

Hundreds of eager WSU seniors prepare to leave Pullman each spring after graduation. Some might be headed to new jobs or internships. Others will go to graduate school, the military, or the Peace Corps. Whatever the destination, almost all those Cougs have a common need: sturdy boxes.

As they pack their crimson sweatshirts, posters, and books, the graduating students will

carry away another reminder of their college days: free WSU-themed packing boxes.

And they can thank Dave Wilson '86 for his volunteer efforts in arranging delivery of about 1,500 of those boxes for the last eight years.

"The way the box is designed you don't even need tape. It's a specialty type box that automatically pops together," says Wilson. "You can close the lid, it latches together, and away you go."

Wilson works at Spokane Packaging, where the boxes are produced. Each one has the WSU logo along with information on joining the Alumni Association. Seniors pick up the boxes at the Lewis Alumni Centre during the celebration barbecue the Friday before graduation in May. The Graduate BBQ Bash is a free lunch event hosted by the Alumni Association every year.

Wilson and Alumni Association staff thought of the box idea eight years ago. Because of his

unique occupation, he was in a place where he could make it happen. His dedication to WSU helped the cause. "Everyone I work with recognizes my affection for Washington State," says Wilson. "There isn't anybody who knows me that doesn't know that Dave is a Cougar."

After he graduated from WSU in 1986 with a degree in hospitality management, Wilson decided the migratory life of hospitality executives wasn't a fit for him. He worked in Kirkland and Seattle, and eventually moved to Spokane in 1995 for a position with Spokane Packaging.

PHOTO ROBERT HUBNER

As he progressed in his career and joined the Alumni Association, Wilson wanted to give back to his alma mater. The boxes fit perfectly.

"I'm happy that I'm in a position where I can help facilitate this. I don't view it as anything but helping out WSU a little bit," he says.

Wilson could be seeing some of those boxes around his own house soon. His son Tim will be a senior starting fall 2016, with plans to graduate next May. Tim plans to be a science teacher.

When the WSU students become newly-minted alumni, they'll see Wilson's example of volunteerism as they unpack their belongings and pursue their future. Perhaps they'll feel inspired to give back as well.

Find out the many ways you can volunteer with the Alumni Association by sending email to wsuaa.volunteers@wsu.edu *or visit* alumni.wsu.edu.

THE BEST ALUMNI ASSOCIATION IN THE WORLD NEEDS VOLUNTEERS

We love our volunteers—they are the best.
But we need more! If you love WSU, and are dedicated, passionate, and a die-hard Coug, we need you.
Contact the WSU Alumni Association at **1-800-ALUM-WSU**
or **wsuaa.volunteers@wsu.edu** to speak with a member of the Alumni Engagement team about ways you can help us help WSU.
Go Cougs!

ALUMNI ASSOCIATION

Members Make the Difference.

CLASSnotes

BY DAVID WASSON

TONY OVERMAN/THE OLYMPIAN

High school counselor **KIM REYKDAL '94** doesn't wait around for students to make appointments. She searches them out.

Whether it's scholarship applications, information about opportunities with the U.S. military, or the latest on specialty or technical colleges, Reykdal is known to work the lunchroom, if necessary, to get students setting goals for life after high school.

That commitment to student achievement earned Reykdal a trip to Washington, D.C. in January as one of four 2016 national Counselor of the Year finalists, where first lady Michelle Obama praised her efforts in a White House ceremony. The recipients also met with lawmakers and attended a congressional hearing.

"It is a tremendous honor," says Reykdal, a career and college readiness counselor at Olympia High School who also advocates for improved student readiness throughout Washington. "What I think gave me the ability to be recognized at a national level was not just the work I do inside the building but at the district and statewide level."

Obama singled out Reykdal's efforts during the ceremony by reading a letter from an Olympia High School student. "One day, Ms. Reykdal approached me during lunch to give me a scholarship application highlighted and annotated just for me," the first lady read. "If she has information for a student, she will hunt them down just to give it to them." This drew laughter among those attending the ceremony.

Reykdal's husband, state Representative Chris Reykdal '94, also is an educator and is running for the Superintendent for Public Instruction this fall. He traveled with her to Washington, D.C.

The trip, in fact, spawned some good-natured ribbing between Kim and her politician husband: "We sort of joke that the first time we get to the White House is because of me."

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WILLIAM MINSHALL ('51 Geog.) worked as a cartographer for 25 years with an aerospace firm in Glendale, California, where he also met his wife. After owning and operating an RV park near Tillamook, the Minshalls are now retired in Cloverdale, Oregon.

60

Northwestern Mutual honored Albuquerque financial representative **WILLIAM E. EBEL** ('65 Ag. Econ.) with membership to its 2015 Forum Group in recognition of his helping clients plan for and achieve financial security. This is the fifteenth time Ebel has received the Forum honor. Utah State University President **STAN L. ALBRECHT** ('68 MA, '70 PhD Socio.) announced his plans to retire. He will continue in his role until the search for a successor is complete. Albrecht's tenure saw USU grow in terms of student enrollment and research programs, as well as the successful conclusion of a comprehensive fundraising campaign.

70

BRUCE MACKEY ('70 MA, '73 PhD Ag. Econ.) was reelected to a three-year term on the Washington Agriculture and Forestry Leadership Program board of trustees. The Washington Agriculture and Forestry Education Foundation is guided by its mission to advance the natural resource industries through enhanced understanding, education, and empowerment of future leaders. The Ohio State University College of Food, Agricultural, and Environmental Sciences Alumni Society named **JACK ELLIOT** ('75 Ag. Ed, '78 MA Ag. Econ.) the recipient of its 2016 Distinguished Alumni Award. Before earning his doctorate at OSU, Elliot worked as a farmer and teacher. Since 2009, he has been at Texas A&M, the Norman Borlaug Institute for International Agriculture, and the graduate faculty at Texas Tech. **TIMOTHY J. WHITE** ('76 Arch.), AIA, joined BernardoWills Architects as an architect. White, who has nearly 40 years of professional architectural design experience, is presently managing the renovation of the gymnasium at Fairchild Air Force Base's Survival School. California State University, Chico will have a new dean for its College of Agriculture beginning August 1, when **JOHN UNRUH** ('79, '81 MS Animal Sciences) will leave his current position as chair of the Food Science Undergraduate Program at Kansas State University to head up the CSU Chico college. Unruh grew up on a farm near Warden.

80

JOHN KORN ('80 MS, '81 Civ. Eng.) retired from The Boeing Company at the end of 2015. Over the course of a more than 34-year career at Boeing, Korn held several engineering and management positions working on a variety of military and commercial aircraft projects. The Vermont Department of Liquor Control and Liquor Control Board named **PATRICK T. DELANEY** ('82 Hotel & Rest. Admin.), a veteran of the hospitality and alcoholic beverage industry, the new commissioner of the Department of Liquor Control. Humptulips native **TOM GWIN** ('84 Ag. Econ.) was elected as the Washington State Grange master and president, overseeing the state's 250 granges. Gwin's focus has been to bolster youth involvement in the longstanding agriculture-based organization. During his time at Washington State University studying agriculture and business, Gwin served for a year as a state grange youth ambassador. The Distilled Spirits Council of the United States tapped **KRAIG NAASZ** ('84 History) to serve as president and

CEO. Naasz previously worked as chief executive of the American Frozen Food Institute, the National Mining Association, the Fertilizer Institute, and the U.S. Apple Association. **KYLE SQUIRES** ('84 Mech. Eng.) is the new dean of the Ira A. Fulton Schools of Engineering at Arizona State University. Squires has served as vice dean and interim dean of the Fulton Schools since June 2015. Over the next five years, Squires has plans to raise the profile and impact of the Fulton Schools worldwide. **MICHAEL DREYER** ('85 Psych., '86 MBA) was appointed to the board of directors of Finisar Corp., a global technology company for fiber optic subsystems and components that enable high-speed voice, video, and data communications for a variety of applications. Dreyer is currently the chief operations officer of Silicon Valley Bank and is responsible for bank and non-bank operations worldwide. Central Life Sciences named **KEN TURRENTINE** ('89 Comm.) director of marketing for the Zoëcon Professional Products Division. Turrentine oversees marketing planning and strategy for the vector and professional pest control business segments. Central Life Sciences acquired Syngenta Horticultural Services in 2012 where Turrentine held roles of increasing responsibility since 2006.

90

ROB MYERS ('90 History) took up the mantle of director of sales for Phillips Industries. Myers has spent the past fifteen years in vice presidential roles at nonprofit organizations, including his last position as executive vice president of development for City of Hope National Medical Center. **SAM THORNTON** ('90 Hort.) joined Arysta LifeScience as a technical sales specialist for seed treatments in the northern plains region. Most recently, Thornton worked as a sustainable solutions lead for Syngenta, covering the western United States and Canada. He also is past director of research and grower relations with the Washington State Potato Commission. **JIM HANNA** ('92 Enviro. Sci.), former director of environmental affairs at Starbucks, will lead clean energy projects across the widespread network of Microsoft's cloud data centers. Hanna will address environmental concerns ranging from supply chain to energy and water reduction to policy engagements. The Downtown Walla Walla Foundation has selected **CINDY FROST** ('93 Hotel & Rest. Admin.) as its new events and public relations manager. A 12-year resident of the area, she previously managed human resources and accounting for Walla Walla's Courtyard by Marriott. Northern Marianas Islands Lieutenant Governor Victor B. Hocog appointed **JOHN O. GONZALES** ('93 Poli. Sci.) as his chief of staff. Gonzales previously served in various management positions at the NMI National State Library and NMI Department of Public Lands. He was a policy cabinet member in a prior administration with extensive policy, NMI-federal relations, and capital infrastructure improvement work. **NATHAN F. FAHRER** ('94 Poli. Sci.) was promoted to partner at law firm Perkins Coie. Based in Chicago, Fahrer represents commercial real estate clients in complex transactions involving acquisitions, dispositions, development, financings, and leasing. *Women of Distinction Magazine* chose **SHELLEY D. RICHARDS** ('95 Civ. Eng.) as a distinguished professional in her field. Richards, a licensed professional engineer, is a project manager with HDR, a civil consulting business that handles infrastructure, water, oil and gas, waste, and federal, power, industrial, mining, architectural, and construction projects. The Moses Lake Samaritan Healthcare Board of Commissioners selected **JULIE WEISENBURG** ('96 Busi.) as its new board chair. Weisenburg has more than 15 years of experience in human resources work in the health care sector, 14 of which have taken place in Moses Lake. **SONYA LENZI** ('98 MA Interior Design) was named board president of the Idaho Botanical Garden. She is a longtime garden friend, donor, and board member. Lenzi is an interior designer at Carol's Design House and president of the Boise Garden Club. Hotel Zephyr, a Davidson Hotels & Resorts' property and one of San Francisco's newest boutique hotels, appointed **JILL PLEMONS** ('98 Hotel & Rest. Admin.) as director of sales and marketing. Plemons joins Hotel Zephyr after a distinguished 17-year career in hospitality and service operations with a specialty in boutique and independent hotels.

00

MICHAEL MARCUM ('00 MBA) joined the Anoto Group as senior vice president of product strategy. In this position, Marcum will oversee strategic planning of Anoto's global product portfolio spanning all business areas and will collaborate on brand strategy and product positioning. Soil surfactant company Aquatrols tapped **GREG KVISTAD** ('01 MBA) as its new director of agricultural products. Kvistad spent the previous 19 years in sales leadership and account management positions at FMC Corporation, where he was highly instrumental in growing crop protection business. **KELLY PARKER** ('02 Busi.) joins the Idaho Independent Bank as its new vice president of community relations and product development. Parker most recently worked at the Boise nonprofit Create Common Good as director of community engagement and sales. She will continue serving on Create Common Good's strategic advisory board. The Middle East Forum appointed **CLIFFORD SMITH** ('02 Comm.) as director of its Washington Project. Smith will lead the Forum's efforts to educate policy makers and opinion leaders in Washington, D.C. on policy recommendations. **MATT WAKEFIELD** ('02 Comm.) was named communications manager of Travel Tacoma + Pierce County. He will work with Travel Tacoma's partners to promote Tacoma and Pierce County as a destination for visitors and conventions. Wakefield enjoys traveling and recently spent three years living and working in China. **DAVID ABEYTA** ('05 Poli. Sci.) has been named a partner in the law firm Abeyta Nelson Injury law. He joined Abeyta Nelson in 2010, specializing in personal injury and wrongful death cases. The Yakima native serves on the board of governors for the Washington State Association for Justice. Abeyta is also active in the community with the Yakima Valley Community Foundation

and United Way of Yakima. **CIARA CHRISTENSEN** ('05 Psych, '12 PhD Coun. Psych.) is the new adult psychologist at St. Luke's Magic Valley Medical Center. While at WSU, she focused on mind-body treatment interventions. As a licensed psychologist, she provides her knowledge and care to adults with a broad spectrum of needs including mood and anxiety disorders, trauma, pain management, sleep disorders, as well as evaluation and treatment of eating disorders. **REBECCA AGHAKHAN SHEPARD** (Comm. '05) joined the University of Idaho's communication and marketing office as senior director of marketing. Shepard has extensive strategic marketing experience for a variety of industries. She has worked for Lucasarts Entertainment, Ubisoft, Sony Pictures, and Hasbro, Inc. The American Society of Civil Engineers, Oregon Section, selected **DAN SHAFAR** ('06 Civ. Eng.) for the 2015 Young Civil Engineer of the Year Award for demonstrating good character and integrity, exhibiting a high level of technical competence, and helping advance the profession of civil engineering. Shafar is a project engineer with BergerABAM. Global engineering, construction, and project management company Bechtel named **DAVID WILSON** ('06 MTM) its new deputy chief innovation officer. Wilson will manage Bechtel's Future Fund, a new program designed to encourage employees across the company's global sites to create, share, explore and develop new ideas to enhance performance and competitiveness. **CHELSEY STEWART** ('07 HBM) is the new sales manager for the Fairmont Pittsburgh, a Four Diamond hotel. Before relocating to Pittsburgh, the Washington state native was the convention services and catering Manager at Motif Seattle.

10

CRAIG MEADOR ('15 EDD) is the new president of the American Printing House for the Blind. A former teacher and educational leader for blind and visually impaired children, Meador has served as APH's vice president of educational services and product development since mid-2015.

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EMILIE V. BRANNFORS ('38 Microbio.), 98, January 3, 2015, Seattle. **MARGARET GRACE LOGEN** ('39 Busi.), 97, December 8, 2015, Stanwood.

40

BUEL LAUD SEVER ('40 Gen. St.), 95, February 4, 2014, University Place. **BARBARA COLE** ('42 Socio.), 94, December 31, 2015, Spokane Valley. **CLARENCE L. HELGESON** ('42 BPH), 97, February 18, 2016, Ellensburg. **HAZEL E. LOCKLIER** ('42 Phys. Ed.), 94, July 5, 2014, Marlin, Texas. **DOROTHY E. SMITH** ('43 Phys. Ed.), 94, February 24, 2016, Shoreline. **LEWIS JOHN CAMPBELL** ('44 DVM), 98, September 11, 2015. **WILMA CAROL OERTLI** ('45 Home Econ.), 91, December 31, 2015, Olympia. **ROBERT JOHN REED** ('45 Ag. Econ.), 92, April 18, 2015, Yakima. **WILLIAM W. OSBORNE** ('46 Microbio.), 95, October 13, 2015, Warminster, Pennsylvania. **JOHN P. BOWLAND** ('47 MS Ani. Sci.), 91, December 15, 2015, Edmonton, Alberta, Canada. **CARL HERITAGE CLARK** ('47 DVM), 89, September 8, 2015, Auburn, Alabama. **ERNEST HENTO** ('47 Busi.), 94, December 22, 2015, Keizer, Oregon. **STANLEY BERRY** ('48 Ed., '59 ME Higher Ed. Admin.), 92, December 18, 2015, Pullman. **VERN JAQUISH** ('48 Acctg.), 95, January 15, 2015, Reno, Nevada. **WILLIAM CYRIL KINARD** ('48 Elec. Eng.), 93, November 24, 2015, Portland, Oregon. **CLARICE MCCARTAN** ('48 MS Home Econ.), 91, December 8, 2015, Olympia. **MARGARET JEAN REED** ('48 Soc. St.), 88, December 14, 2015, Yakima. **EMERY C. CARPER** ('49 Phys. Ed.), 85, December 16, 2015, Spokane. **NORMAN E. CUNNINGHAM** ('49 DVM), 92, September 17, 2015, Anderson, South Carolina. **HENRY WILLIAM DIXON** ('49 MA Poli. Sci.), 97, April 4, 2015, Phoenix, Arizona. **EUGENE S. DZIEDZIC** ('49, '59 MS Wildlife Bio., Sigma Xi), 92, December 28, 2015, Lacey. **KEN HAMMOND** ('49 Elec. Eng.), 89, January 23, 2015, Portland, Oregon. **MARVIN RAY JEGLIN** ('49 Ani. Sci.), 88, January 28, 2016, Homeland, California. **RICHARD F. JOHNSON** ('49 MS Ani. Sci.), 95, December 14, 2015, San Luis Obispo, California. **ROBERT A. MACKENSTADT** ('49 Elec. Eng.), 88, December 24, 2015, Redding, California. **GEORGE ELDON MARSHALL** ('49 Acctg., Sigma Alpha Epsilon), 91, December 25, 2015, Olympia. **ALICE MARIE ORDWAY** ('49 Socio.), 93, August 31, 2014, Kent. **GEORGE MARSHALL PARIS SR** ('49 Gen. St., Sigma Chi), 88, February 11, 2016, Wenatchee. **HAROLD W. VAUGHN** ('49 Hort.), 90, January 17, 2016, Lewiston, Idaho.

50

SAMUEL JOHN CIRANNY ('50 Elec. Eng.), 86, July 3, 2014, The Dalles, Oregon. **HENRY STEVEN LEIGH** ('50 Mech. Eng.), 90, November 27, 2014, Bellevue. **DONALD M. NEWQUIST** ('50 Ag. Eng.), 90, November 16, 2015, Yakima. **CLYDE LEROY REESE** ('50 Elec. Eng.), 88, November 27, 2015, Burlington, Vermont. **VIRGINIA DEE MCINTOSH ANDERSON** ('51 Home Econ.), 86, January 13, 2016, Seattle. **DONALD F. CORFMAN** ('51 Pharm.), 86, January 9, 2016, Des Moines. **BENNER T. CUMMINGS** ('51 Speech & Hearing Sci.), 89, January 28, 2016, San Clemente, California. **J. HUBERT DUNN** ('51 MS Phys. Ed.), 94, January 31, 2016, DeKalb, Illinois. **JOHN W. FISHBACK** ('51 Zool., Phi Delta Theta), 79, November 19, 2015, Sun City West, Arizona. **NEIL V. FOLLETT** ('51 DVM), 89, December 25, 2015, Walla Walla. **DONALD B. GARTLAND** ('51 BPH), 86, October 28, 2015, Beaverton, Oregon. **DAVID TIGGES KIRK** ('51 Busi.), 87, January 15, 2016, Olympia. **CLYDE L. PAINTER** ('51 Agro.), 94, December 21, 2015, Kennewick. **RICHARD T. STREISSGUTH** ('51 Socio.), 86, December 14, 2015, Vancouver. **ALBERT P. FRIEDMAN** ('52 BPH), 88, January 27, 2016, Spokane. **ROBERT L. HERRIOTT** ('52 DVM), 92, July 28, 2014, Shoreline.

DEWAYNE R. KRUEGER ('52 BPH), 86, January 22, 2016, Kalispell, Montana. **BENJAMIN F. MAGILL** ('52 Ani. Sci.), 88, January 6, 2016, Independence, Oregon. **LESLY PATCHING** ('52 Wildlife Bio.), 84, December 6, 2013, Weston, Oregon. **MARY LOUISE ATKINSON** ('53 Math.), 84, October 29, 2015, Shoreline. **JEAN MARIE GREEN** ('53 Home Econ.), 84, December 14, 2015, Issaquah. **ELLERY HOWARD HARVEY** ('53 Soc. St.), 85, September 17, 2014, Kingsport, Tennessee. **RICHARD A. MIKULEC** ('53 MS, '56 PhD Chem.), 86, January 12, 2015, Morton Grove, Illinois. **DONALD E. SPARKS** ('53 Ed.), 83, May 10, 2015, Cathedral City, California. **WILLIAM WARDINSKY** ('53 Busi.), 85, January 27, 2016, Kirkland. **SHIRLEY IRENE DORAN** ('54 Nursing), 85, January 13, 2016, West Palm Beach, Florida. **PATSY ANN WALL** ('54 Ed., Alpha Phi), 82, February 5, 2016, Dallas, Texas. **KATHLEEN HANSON** ('55 Home Econ.), 82, December 9, 2015, Olympia. **PETE F. HELKE** ('55 BPH), 92, February 14, 2016, Colbert. **W. RODGERS HIGGINS** ('55 Acctg., '63 MBA), 82, December 14, 2015, Center Valley, Pennsylvania. **MONA (EIKREM) HOWELL** ('55 English), 84, December 27, 2015, Everett. **LORETTA LOU PENROD** ('55 Fine Arts), 84, January 23, 2016, Anacortes. **RUTH H. GLASSER** ('56 English), 95, October 20, 2015, Newark Valley, New York. **ADOLFO E.S. KOENIG** ('56 Mech. Eng.), 83, October 28, 2015, Tacoma. **EDWARD F. KOESTER** ('56 Civ. Eng.), 80, May 27, 2015, Trout Lake. **LARRY G. SODERHOLM JR** ('56 DVM), 85, December 10, 2015, Forest Grove, Oregon. **CECELIA J. STALLCOP** ('56 Ed.), 81, January 20, 2016, Carmichael, California. **DONALD WAYNE STEIGER** ('56 Geog.), 81, December 4, 2015, Menlo Park, California. **KENNETH EDWIN STOREY** ('56 Busi., Beta Theta Pi), 81, November 23, 2015, Lake Tapps. **ROBERT H. CLAUSEN** ('57 Econ.), 80, July 16, 2015, Woodinville. **ROBERT WYCKOFF OTTO** ('57 DVM), 93, December 7, 2015, Jerome, Idaho. **FRED RICHARD TODD** ('57 Phys. Ed.), 85, January 22, 2016, Harwood, Maryland. **LOIS E. KLINDWORTH** ('58 Ed.), 79, January 17, 2016, Kennewick. **ROBERT SUTTON RAE** ('58 Ed.), 85, January 16, 2016, Mill Creek. **PETER LESLIE TAYLOR** ('58 Zool.), 80, February 7, 2016, Sun Valley, Idaho. **LARRY L. CHARLTON** ('59 Forest Mgmt.), 82, December 23, 2015, Yakima. **JAMES C. HANSEN** ('59 Ag. Eng.), 87, November 20, 2015, Gig Harbor. **LINDA JOHNSON** ('59 English), 78, February 10, 2015, Redmond. **TERRENCE M. O'CONNOR** ('59 Psych.), 78, October 30, 2014, Montesano.

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PHYLLIS ELAINE AHLF ('60 Ed.), 78, January 24, 2016, Olympia. **JOHN G. CARRIERE JR** ('60 Arch. Eng.), 81, January 1, 2016, Tucson, Arizona. **DEAN C. KILE** ('60 Forest & Range Mgmt.), 81, March 26, 2015, John Day, Oregon. **GEORGE SYBRANT** ('60, HRM, Sigma Iota, Sigma Alpha Epsilon), 77, January 22, 2016, Cathedral City, California. **MICHAEL L. WOHLD** ('60 Ag. Econ.), 78, December 16, 2015, Oregon City, Oregon. **DAVE E. HOLMAN** ('61 Forest & Range Mgmt.), 77, January 9, 2016, Boise, Idaho. **JAMES VEENHUIZEN** ('61 HBM), 76, November 4, 2015, Seattle. **JERRY R. BROWNING** ('62 Arch. Eng.), 77, November 6, 2015, Coaldale, Alberta, Canada. **LILLIAN M. MOIR** ('62 Gen. St.), 75, November 13, 2015, Blaine. **THOMAS L. BROWN** ('63 DVM), 82, September 28, 2015, Woodland. **WAYNE JOSEPH DAHMEN** ('63 Chem.), 75, February 16, 2016, West Lafayette, Indiana. **MARVIN GRANT FIFIELD** ('63 EDD), 83, December 4, 2015, Logan, Utah. **CARL E. GUSTAFSON** ('63 MS Wildlife Bio., '72 PhD Zool.), 79, February 13, 2016, Pullman. **RICHARD GENE KAUK** ('63 DVM), 76, January 9, 2016, Billings, Montana. **ARNOLD PAUL ANDRES** ('64 DVM), 76, January 8, 2016, Vancouver. **RALPH HARVEY BALDWIN III** ('65 Poli. Sci.), 72, February 12, 2016, Tacoma. **WILLIAM F. BOLDMAN JR** ('65, '67 MA Econ.), 72, February 2016, Spokane. **JUDY LYNN KEPLINGER** ('65 Busi.), 72, February 14, 2016, Kennewick. **NELLIE A. WHETSLER** ('65 Elem. Ed.), 95, December 13, 2015, Tualatin, Oregon. **ROGER EDWARD LAMPITT** ('66 Ag. Econ., Alpha Gamma Rho), 71, October 22, 2015, Tacoma. **MARK JON MILES** ('66 Psych.), 72, November 21, 2015, Moses Lake. **RAY SHEAHAN** ('66 MED), 89, August 17, 2015, Spokane. **NICOLE H. TAFLINGER** ('66 Fine Arts, '68 MFA), 88, February 12, 2016, Pullman. **BENT LAUR JENSEN** ('67 Ani. Sci., '69 Ag.), 87, January 22, 2016, Anacortes. **MARTIN FRANKLIN STONER** ('67 PhD Plant Path.), 72, April 17, 2014, Pomona, California. **SUSAN MAY WALKER** ('67 Ed.), 71, February 3, 2016, Monroe. **DUNCAN ALBERT CARTER** ('68 Soc. Sci., '70 MA English), 69, February 22, 2016, Clackamas, Oregon. **FRED M. SCHUCHART** ('68 BPH), 70, February 6, 2016, Spokane. **GERALD H. "BUD" HOFF** ('69 DVM, Tau Kappa Epsilon), 72, November 20, 2015, Tacoma. **MARGARET RINGROSE KELLEY** ('69 Phys. Ed.), 68, November 29, 2015, Colville. **ELIZABETH J. MCGLYNN** ('69 MA Poli. Sci.), 85, January 30, 2016, Milwaukee, Wisconsin. **WILLIAM RALPH MEHRTEN** ('69 Ag. Econ.), 68, February 12, 2016, Exeter, California. **JAMES W. TRULL** ('69 Ag. Eng.), 69, January 16, 2016, Grandview.

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DAVID M. SKINNER ('70 Ag.), 68, January 28, 2016, Moscow, Idaho. **DAVEY L. SCHMIDT** ('71 Phys. Ed.), 70, October 26, 2015, Port Angeles. **PAUL HENRY DAMON** ('73 Socio, '75 MS Psych.), 66, December 6, 2015, Colorado Springs, Colorado. **JOHN DAVID HAUSER** ('73 PhD History), 71, August 28, 2014, Astoria, Oregon. **LYNN KATHLEEN WEBER** ('75 Home Econ.), 62, January 5, 2016, Uniontown. **GARY RAY BRISTER** ('76 Forest & Range Mgmt.), 62, February 11, 2016, Spokane. **KENT CHARLES MCVEY** ('77 DVM), 66, February 19, 2016, Rochester, Minnesota. **BRUCE EDWARD TIEDEMAN** ('77 Vet. Sci.), 67, January 4, 2016, Deception Pass. **KEITH GRIENEEKS** ('78 PhD Ed.), 68, November 30, 2015, Seattle. **KATIE MARIE BERG** ('79 Comm.), 59, January 14, 2016, Seattle. **CARLOS G. GOMEZ** ('79 MFA), 64, January 26, 2016, Brownsville, Texas. **BROOKS ALAN HOGLE** ('79 HBM), 58, December 19, 2015, Salem, Oregon. **RONALD DEAN JONES** ('79 Busi.), 58, December 24, 2015, Vancouver. **FRANK DAVID LEWIS** ('79 Busi.), 59,

February 3, 2016, Quincy. **TWILA W. PALMER** ('79 MS Voc. Tech. Ed.), 85, February 24, 2016, Spokane. **LEANN D. LOBEDA PETERSON** ('79 Busi.), 58, January 4, 2016, West Seattle. **E. SPENCER ROCKETT** ('79 BPH), 74, November 26, 2015, Pullman.

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KATHLEEN JOAN JAMIESON ('80 BPH), 58, February 2, 2016, Bellevue. **HENRY MICHAEL DEVEREAUX** ('82 MED), 65, January 28, 2016, Pasco. **RICHARD H. GRAEBER** ('82 Busi.), 69, December 6, 2015, Colfax. **KENNETH S. HAMILTON** ('83 Busi.), 56, December 16, 2015, Issaquah. **MARK PATRICK MOSELY** ('83 Mech. Eng.), 54, December 31, 2015, Seabeck. **SCOTT ALBERT MILLER** ('84 Comm.), 57, February 25, 2016, Fargo, North Dakota. **EDWARD C. ELDREDGE** ('85 Mktg.), 54, February 15, 2016, Duvall. **RONALD W. ROBINSON** ('88 Mat. Eng.), 54, November 21, 2015, Zanesville, Ohio. **SCOTT EDWARD SOPER** ('89 Mktg.), 48, August 24, 2015, Seattle.

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JULIE NICHOLS PAPINEAU ('93 Human Dev.), 45, January 4, 2016, Puyallup. **JONATHAN HOWARD ESVELT** ('94 Ag. Ed.), 45, February 10, 2016, Colville. **MICHELLE ANN MILLER** ('94 Acctg.), 42, August 20, 2015, Royal City. **ANTHONY CHARLES O'KEEFE** ('94 Comm., Beta Theta Pi), 46, December 4, 2015, Seattle. **RYAN ANTHONY DAVIS** ('99 Forest Mgmt., '05 MS Plant Path.), 38, January 10, 2016, Spokane.

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JOSHUA DANIEL LIPKIN ('03 Busi.), 37, December 31, 2015. **KELLY NICOLE MILLER** ('03 Busi.), 34, December 6, 2015, Camas. **DALE GREGORY WALSETH SR** ('05 Psych.), 50, December 17, 2015, Woodland. **NORMAN D. MOORER** ('07 MPA), 67, December 23, 2015, Kennewick.

FACULTY AND STAFF

STANLEY BERRY, 92, Admissions, 1955-1987, December 18, 2015, Pullman. **JACK D. DOWELL**, 91, Political Science, 1960-1986,

December 31, 2015, Sidney, British Columbia, Canada. **JOHN EHRSTINE**, 78, English, 1964-2000, January 5, 2016, Wilsonville, Oregon. **CARL GUSTAFSON**, 79, Anthropology, 1960-1998, February 13, 2016. Pullman. **WILLIAM HAGLUND**, 85, WSU Mount Vernon, 1960-1992, June 15, 2015, Roseville, California **NOREEN KASEBURG-KING**, 78, WSU County Extension, 1978-1997, January 5, 2016, Snohomish. **HARRY "CLINT" KELLER**, 84, Extension CES, 1969-1997, December 7, 2015, Coeur d'Alene, Idaho. **JOHN KICZA**, 68, History, 1980-2009, March 9, 2016, Pullman. **SANDRA LAZELLE-OBRIEN**, 76, Business Services/Controllers, 1979-2000, November 25, 2015, Grass Valley, California. **GERALD MARING**, 72, Teaching and Learning, 1977-2008, November 22, 2015, Woodland. **CLARICE MCCARTAN**, 91, Food Science and Human Nutrition, 1972-1985, December 8, 2015, Olympia. **ISABEL MILLER**, 91, Sociology, 1979-1994, January 26, 2016, Moscow, Idaho. **KENNETH MOCK**, 72, Technical Services, 1994-2004, March 5, 2016, Spokane. **MELODY MUNSON**, 62, Veterinary Clinical Sciences, 2007-2016, February 8, 2016, Palm Springs, California. **DIANE OLBRICH**, 75, Enterprise Computing Services, 1987-1994, February 25, 2016, Pullman. **EDWARD PATE**, 66, Chemical Engineering & Bioengineering, 1980-2016, Pullman. **MC UEL "MAX" PROCTOR**, 86, Housing and Dining, 1974-1992, January 20, 2016, Colfax. **JAMES F. SMITH**, 73, Facilities Services, 1977-1988, December 13, 2015, Orofino, Idaho. **WILLIAM WILLARD**, 89, Comparative Ethnic Studies, 1976-1998, January 15, 2016, Pullman.

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WHAT IS THE KUIPER BELT?

–Zaara A., 7, Deep Bay, Australia

Dear Zaara,

You might say the Kuiper Belt is the frozen frontier of our solar system. Out beyond Neptune's chilly orbit, this saucer-shaped region is home to Pluto, billions of comets, and other icy worlds.

"The Kuiper Belt is really the edge of knowledge," said my friend and astronomy professor Guy Worthey when we met up in the Washington State University planetarium.

"Out there it's a little dim," Worthey said. "We are pretty far from the Sun."

In fact, it's about 3 billion miles away. Even at the speed of a jet airplane, it would take more than 680 years to travel from Earth to the outer solar system. Fortunately, spacecraft like NASA's New Horizons can get there much faster.

Just last year, the world watched as New Horizons flew past Pluto and sent us the first up-close pictures of the dwarf planet. Now, it won't be long before we head even deeper into the Kuiper Belt.

"Everything is going to be dark," Worthey said. "But you'll see these icy bodies. They'll be of different sizes. There'll be lots of little ones and some big ones."

Many astronomers think there are 100,000 objects out there bigger than 60 miles wide, Worthey adds.

"They are sort of a dirty snowball composition," Worthey said.

Just 15 years ago astronomers weren't really sure if this part of the solar system even existed.

In the 1950s, Gerard Kuiper (KI-purr), a Dutch astronomer, was curious about comets, particularly where they were coming from and how they traveled through the solar system. He thought the outer solar system just couldn't be empty.

About 40 years later, two scientists working at an observatory in Hawaii detected the first object in the Kuiper Belt aside from Pluto and its moon Charon. They had been looking for five years when they finally found an ice sphere more than 150 miles wide.

Ever since, astronomers have been using math and science to detect other distant objects. They've detected other dwarf planets like Pluto, including Eris, Haumea, and Makemake.

They've also found Plutinos that, like Pluto, are small worlds that have been caught in Neptune's orbit.

"As you cruise by one of those things, they'll look like spheres or worlds," Worthey said. "They are quiet; they are on slow orbits."

Astronomers are fascinated with these places for a couple of reasons. One is because the region may hold clues about the way solar systems form. Other scientists are particularly interested in the comets. Some wonder if some of these icy objects fell from the Kuiper Belt, and then melted in the Sun's heat to form Earth's oceans.

There's also been a buzz about finding a new ninth planet in the Kuiper Belt or beyond. Though there's no proof of it yet, it's an exciting prospect. If there is another planet in the Kuiper Belt, we'll have to go find it with a spacecraft or a super huge, powerful telescope.

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