MINES MAGAZINE

COLORADO SCHOOL OF MINES ALUMNI MAGAZINE

Fall 2018 Volume 109 Number 4

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Cover image: Metallurgical and materials engineering student Bobby Puerling shapes a piece of blown glass in Mines' new glass shop on campus. Puerling is also one of the teaching assistants in the new glassblowing class this fall. (Photo by Agata Bogucka)

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TO VIEW WEB EXTRAS, VISIT MAGAZINE.MINES.EDU

SHAPING GLASS, LEARNING SCIENCE

Mines has a new glass shop on campus and launched a new glassblowing class this fall to teach students the art and science of glassblowing. Check out the video on *Mines Magazine's* website to see students in action and learn more about the new glass shop and corresponding glassblowing class.

SCHOOL YEAR KICK OFF

Mines welcomed 1,380 new students this fall. Watch the video on *Mines Magazine's* website to see all the welcome activities students participated in this year, including the annual M Climb, to kick off the 2018-19 school year.

REMINISCING ON FOND MEMORIES

Mines celebrated Homecoming this fall, welcoming alumni back to campus to join current students in celebrating their Oredigger pride. Watch a video of this year's events online and look for the full recap in *Mines Magazine's* winter issue.

TREKKING TO ICELAND

Students and alumni took a trip to Iceland this summer with Mines' Outdoor Recreation Center. See some of the best photos taken on the trip and learn more about upcoming opportunities with the ORC on our website.

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Comments and suggestions are welcome. Contact us via our contact form at **minesmagazine.com/contact-us** or via mail at Mines Magazine, 1500 Illinois St., Golden, CO 80401. To update your address, go to **minesalumni.com/update** or email **minesalumni@mines.edu**.

Bill Zisch ’79 is the current president of the Mines Alumni Association and is helping enhance alumni engagement to keep Mines at the forefront of innovation and success.

Photo courtesy of Mines alumni office

ALUMNI NOTE

THE CERTAINTY OF CHANGE

> As Mines students studying mining engineering in the 1970s, we were only beginning to be introduced to the environmental components that complement safe and efficient mining operations. Social responsibility and sustainability were not as widely taught at Mines as they are now, yet I have spent a great deal of my time and effort over the past 15 years dealing with these ideas as key issues that must be addressed.

In the years since I graduated, Mines has adapted to remain at the forefront of changes in such practices, ensuring that graduates remain well prepared, highly skilled and able to solve problems efficiently and with the least amount of disruption to the communities they work with. In fact, Mines is developing a new strategic vision called MINES@150 with the goal of “creating transformative and enduring value, exploring frontiers and positioning Mines for success in a future of dynamic change.” But that goal isn’t limited to the people on campus.

In *Mines Magazine’s* summer 2018 issue, President Johnson mentioned that there are many ways for alumni to help support this initiative, such as providing input or joining an interest group. The overlap between the changing world that Mines alumni are likely to encounter and the dynamic change identified in the MINES@150 goals is the space where Mines alumni, the university and current students have common interests.

Enhanced alumni engagement, which begins when a student first commits to Mines and continues throughout his/her life, is the primary means by which these interests can be fulfilled. The alumni association is in the process of retooling to respond to these changes by offering more opportunities for engagement and involvement that better reflect alumni demographics and interests and the lifelong relationship between Mines and its alumni.

Join an interest group or look up your local M Club, be an active presence on campus at events or volunteer in the classroom. As alumni, we will continue to be at the forefront of our alma mater’s success and support Mines and our fellow Orediggers through a future of dynamic change.

Bill Zisch ’79
Mines Alumni Association Board President

PRESIDENT'S CORNER

WELCOMING NEW OREDIGGERS AND LOOKING FORWARD

Students experience many welcomes to Mines. It starts at Oredigger Camp about a week before school starts (welcomed by peer mentors and alumni) and continues with move-in (welcomed by student and staff volunteers). Then there's Convocation (welcomed by the school's leadership, student leaders, student athletes and the marching band), the freshman community service event (welcomed by Golden) and CSM 101 success courses (welcomed by peers and faculty).

President Paul C. Johnson participated in his fourth M Climb this year, welcoming new students, faculty and staff to Mines and kicking off another school year.

Photo by Joe DelNero

The welcome new students remember the most, however, will always be the M Climb. After walking about three miles past dozens of enthusiastic and water-wielding student organizations and athletic teams, singing the fight song about every 100 feet, placing their rock on the M and getting splashed in as much whitewash as the M, students descend Mount Zion knowing they are now a part of Mines.

In recent years, the M Climb has become a campus-wide welcoming event, with new faculty, staff and alumni also making the trek to the M. There were alumni who walked with students' family members and others who came because they missed the M Climb when they were students. This year marked my fourth walk up to the M, and it might have been the wettest (tall presidents seem to be a prime water target), but it remains one of my favorite Mines traditions.

Along with our new students, faculty and staff, this year brings a lot of activity and energy tied to our MINES@150 plan. We want to ensure that when we celebrate our 150th anniversary in 2024, Mines is positioned for continued success as one of the world's top schools in our rapidly changing world. Some of this year's changes will be visible, like the construction of our new on-campus residence hall, off-campus apartment-style student housing and a parking garage wrapped with state-of-the art classrooms. We are expanding beyond Golden, with our presence in the new Catalyst HTI building in Denver's RiNo district and the launch of a one-of-a-kind pilot-scale water treatment research facility just north of downtown Denver.

Other changes will be less visible, but equally important, including the launch of new professional development-focused online and on-campus graduate programs, increasing the diversity of our campus community and providing more opportunities for our students to integrate their interests and aspirations into their degree programs.

Alumni play a significant role in our MINES@150 plan. Special-topic alumni interest groups are already providing more awareness of and opportunities for careers in the aerospace industry, attracting more women to Mines, supporting our student entrepreneurs and offering professional development advice. Alumni give guest lectures, remotely Skype into classes and are visible as volunteers at key events on campus. The alumni association is also discussing how they might be involved in our students' development from day one to facilitate the idea that they're "Orediggers for life."

I invite your involvement and hope to see you on campus or at Mines events near your homes this year. Check out the signature events we have coming up and other ways you can connect with your fellow Orediggers by visiting calendar.mines.edu or minesalumni.com/events.

Let's all show our Mines pride this year—Go Orediggers!

Paul C. Johnson, PhD
President and Professor

GROWING AND THRIVING

STUDENTS PARTNER WITH GOFARM TO IMPROVE LOCAL FOOD ACCESS

A geographic information system tool designed by Mines students is helping GoFarm, a Golden-based nonprofit, improve access to healthy, local food in Jefferson County.

Mines students designed a geographic information system tool to help improve access to healthy, local food.

Photo courtesy of GoFarm

"GoFarm has benefited so much from the students' creativity and eagerness," said Eileen O'Rourke, founder of GoFarm. "One of the things I've been so delighted with is the talent and enthusiasm of the students in GoFarm's mission—there's a real awareness of why local food systems are so critical."

This summer, two new pickup locations for GoFarm's community-supported agriculture (CSA) program opened in Arvada—the first locations that GoFarm selected using the data from the Mines GIS project.

"Humanitarian Engineering and GoFarm share a commitment to bringing social justice to communities in need—in this case, food justice to communities that lack healthy food choices," said Juan Lucena, director of the Humanitarian Engineering program at Mines.

GoFarm is growing its CSA using a three-pronged approach—one distribution point is located in a high-income area, one in a low-income area, and then both are connected with as many nearby farmers as possible. The container in the high-income area helps subsidize the low-income one, both sets of customers know they're helping farmers in their own community and the dollars all stay in the local economy.

"Originally the idea was that I wanted to present an approach to our community partner, Centura, to strategically rank 12 of their sites as potential locations for our next distribution point," O'Rourke said. "What I wanted to know was could we integrate the various selection criteria such as market capacity, farm locations and greatest need for food access to determine the optimal location for GoFarm mission expansion."

Mines students populated the tool with data on population density, income, land availability and existing food retailers. "You put all the data on the map and then you rank each site based on how well they line up with the criteria were looking for," said Natalie Haber, a junior in civil engineering.

For GoFarm, the tool worked even better than expected, and they're already using it to plan future expansions.

By **Emilie Rusch**

ATHLETICS
THE STRENGTH OF OREDIGGERS

ALUMNI IN ACTION

Mines' athletic rosters will have an unusual look this school year: 13 alumni will be competing for the Orediggers.

That's right, alumni.

This year will see a group of student-athletes put on the blue and silver having already earned a bachelor's degree from Mines, continuing to lead their teams while working toward master's degrees. While not unheard of—a typical year might see three or four students pull off the feat—the sheer number of graduates on Mines rosters this year is by far the most in school history.

How can a student-athlete double up on their degrees while still competing? In NCAA Division II, student-athletes get five consecutive years to use four seasons of eligibility. They can "redshirt" for a year at any point in that span, which means they can practice with the team but not compete, and there is the possibility of gaining a sixth season of eligibility if an injury forces them to miss all or most of a season.

Student-athletes who end up with remaining eligibility after finishing their undergraduate degrees have three choices: give up that eligibility and go into the workforce, transfer to another institution for graduate school and play there or stay at Mines and continue to play while earning a master's degree. Cross country and track & field runner Chloe Cook '18 chose the latter.

"It feels like I'm still part of the team, and I'm so integrated with the program it still feels the same at practice," Cook said. An all-American in the indoor mile in 2018, Cook earned her bachelor's degree in metallurgical and materials engineering this past May and is now pursuing a master's degree in materials science. She had a medical hardship waiver earlier in her athletic career that allowed her to extend her time at Mines. "It's more the schedule with school and research that will change. There might be days we can't make it to practice because we have a late class or we're finishing up something in the lab, whereas in undergrad, our schedule was more defined."

Cook isn't sure what her future holds, with options of going into industry or possibly law school to study patent law.

"It's pretty exciting to have the degree and know that even though what I'm doing now isn't necessary, I really like what I'm doing," she said. "I could go out in the workforce now, and a Mines degree is such a valuable one to have."

It's a similar story for Grant Colligan '18, a six-time all-American for the cross country and track & field programs.

Grant Colligan '18 clears the steeplechase barrier at the 2018 NCAA Outdoor Track & Field Championships.

Photo by Tim Flynn

The 2017 RMAC cross country champion, Colligan redshirted earlier in his career and earned his bachelor's degree in metallurgical and materials engineering last May. Now, he's looking forward to finding a new balance as his academic career moves more from the classroom to the lab.

"My program, which is extractive metallurgy, is almost entirely research. It's a lot better for running because I can decide when I want to go and do work, and I can kind of make my own schedule," Colligan explained. "And since I have an extra year in school next year, I can still be around and help out with the team."

Coaches love the opportunity to have graduate students on their teams. This year, the Mines football program will have four graduate students—Logan Bock '17, Matthew King '17, Miguel Rosendo '18 and Chantz Tanner '17—and head coach Gregg Brandon points to the leadership qualities they bring to the team.

"They're coaches on the field—they help in meetings and overall leadership," Brandon said. His program historically has had the majority of Mines student-athletes pursuing graduate degrees, largely because nearly every football student-athlete redshirts as a freshman. "If I could have 12 of them every year, I'd take them."

MINES WINS THIRD STRAIGHT RMAC ALL-SPORTS CUP

Mines Athletics took home the RMAC All-Sports Cup in July 2018, marking the third consecutive year that Mines has stood at the top of the rankings as the Rocky Mountain Athletic Conference's top overall athletic department.

Mines' All-Sports Cup win came after a fantastic 2017-18 season that saw the Orediggers win RMAC championships in men's soccer, volleyball, men's cross country, men's indoor and outdoor track & field and men's golf, compiling 927.5 points in the cup standings to notch the second-highest point total ever.

In addition to the RMAC honor, Mines finished sixth in the national Learfield Directors' Cup standings, the program's best-ever showing. Mines is only the third institution to win the Cup three times in a row.

"It's an honor, and it's an amazing testament to our student-athletes, our coaches and our staff," said director of athletics David Hansburg about the Cup. "The RMAC as a whole has gotten stronger and stronger over the years, so the competition is always really good and continues to get better. Winning it three years in a row is an amazing feeling."

Hansburg accepted the cup at the RMAC Awards Banquet on July 13, 2018, in Colorado Springs. That event also saw track & field alumna Hannah Davey Briggs '06 inducted into the RMAC Hall of Fame. Briggs enjoyed an outstanding running career that she capped with the 2006 NCAA Division II steeplechase title. The only national champion in Mines women's track & field history, Briggs was also a national silver medalist in the distance medley relay and a three-time all-American overall. She was inducted into the Mines Hall of Fame in 2010.

In addition, Mines' RMAC Coaches of the Year from 2017-18 were recognized, including Chris Siemers (men's cross country), Greg Mulholland (men's soccer), Tyler Kimble (golf) and Matt Sparks (men's indoor and outdoor track & field). Three Orediggers teams earned Brechler Awards for their classroom performance, with baseball, men's swimming and wrestling all earning the top team GPAs in their respective sports.

MINES' NEW SKIPPER

Mines baseball has a new skipper as assistant coach Robby Bales was promoted to head coach on August 7, 2018. Bales had been an assistant coach through the most successful stretch in Mines baseball history, including the program's first-ever NCAA Tournament appearance this past spring. He replaces Jerod Goodale, who accepted the head coaching position at his alma mater, Fort Hays State University.

By **Tim Flynn**

▶ For more on Mines athletics, visit minesathletics.com.

(Top) **Mines' director of athletics, David Hansburg, accepts the RMAC All-Sports Cup from conference commissioner Chris Graham on July 8, 2018.**

(Left) **Chloe Cook '18 runs at the 2018 NCAA Outdoor Track & Field Championships, which took place two weeks after she earned her bachelor's degree in metallurgical and materials engineering.**

Photos by Tim Flynn

KICKING OFF ANOTHER YEAR

A LOOK AT THE CLASS OF 2022

1380 Freshmen and transfer students

31% Women

22.5% Underrepresented ethnic or racial groups

6% International students

1397 Average SAT composite score

31 Average ACT composite score

3.8 Average high school GPA (on unweighted 4.0 scale)

47 STATES, the **DISTRICT OF COLUMBIA,** and **16 COUNTRIES** represented

TOP 5 U.S. STATES

Outside Colorado: Texas, California, Washington, Illinois and Arizona

TOP 5 NON-U.S. COUNTRIES

Saudi Arabia, Malaysia, Kuwait, China and Nigeria

EXPANDING LEARNING OPPORTUNITIES

MINES INTRODUCES NEW DEGREE PROGRAMS

With the start of the new school year, Mines is offering five new degree programs—one undergraduate bachelor's option and four graduate programs.

Photo by Joe DelNero

Mines officially launched five new degree programs for the 2018-19 academic year.

The bachelor of science in engineering will give students exposure to the broad fundamentals of science, mathematics and engineering while engaging in significant project-based learning experiences every semester. Flexibility will be a hallmark of the degree, with students able to build their own specialized area of focus or choose from one of six interdisciplinary areas—energy studies, water security, community development, robotics and automation, corporate sustainability, and music, audio engineering and recording arts.

Mines is also offering professional graduate certificates and non-thesis master's degrees in advanced manufacturing, focusing on data-driven materials manufacturing, as well as additive manufacturing of solid materials like ceramics and metals, as opposed to polymers.

In addition, the school is offering a new Natural Resources and Energy Policy graduate program that will cover both domestic and international topics, natural resources, energy and policy, and will work to link students to industry and potential employers.

The Integrative Graduate Program in Quantitative Biosciences and Engineering will emphasize the quantitative approaches to solving biological puzzles and consist of cell biology and biochemistry, applied bioinformatics and systems biology.

Finally, a PhD program in space resources will prepare scientists, engineers, economists, policymakers and entrepreneurs to responsibly explore, extract and use resources on the Moon, Mars, asteroids and beyond to fuel future space exploration, cislunar development, as well as needs back on Earth.

By **Emilie Rusch**

EXPLORING THE RED PLANET

MINES SCIENTISTS CONTRIBUTE TO NASA MARS INSIGHT MISSION

The NASA Mars InSight Lander is en route to the Red Planet and two Mines scientists are among those eagerly awaiting its arrival in late November.

Paul Morgan, senior geothermal geologist at the Colorado Geological Survey, and Ebru Bozdag, assistant professor of geophysics, are members of the science team for the international research undertaking, the first mission dedicated to seeking geophysical information about another planet.

"There have been many rovers and missions to Mars, but they've concentrated on understanding the surface geology," Morgan said. "We can learn a lot from that, but the InSight mission is focusing entirely on the interior of the planet."

To do that, the InSight lander is equipped with three pieces of scientific equipment: a seismometer (SEIS), a Heat Flow and Physical Properties Probe (HP3) and the Rotation and Interior Structure Experiment (RISE).

Morgan worked on the heat probe, serving as one of three U.S.-based co-investigators on the project. Designed in the U.S. and built in Germany, the probe will hammer 16 feet into the Martian soil, or regolith, to measure the heat coming from the planet's interior.

"Heat is the driving energy for tectonics on Earth. Mars doesn't appear to have plate tectonics, but it does appear to have had volcanism very recently," Morgan said. "We want to know where it is in that stage."

The hammering process will take a month to six weeks, as the probe pauses every half meter to measure the thermal properties. Once it reaches its final depth, the probe will track temperatures for roughly one Martian year, or 687 Earth days, in order to get an accurate measurement, he said.

An expert in geothermal energy on Earth, Morgan helped design the probe with engineers at the NASA Jet Propulsion Laboratory (JPL) in California. A major part of his role was conducting terrestrial experiments, in remote areas of the Upper Arkansas Valley in Colorado, to try to simulate the conditions the probe will likely encounter on Mars and help validate the computer models developed at JPL.

"There are a lot of things that you may not think about instantly, but when you're designing something and you only have one chance at the experiment, you have to think about every possible thing that could happen," Morgan said. "As I've been doing this for 40 years, I've measured just about everything that can happen on Earth. I don't know everything that could possibly happen on Mars. But with colleagues who have worked on planets and engineers who have designed just about anything that can happen on planets, we get together and use everyone's expertise. It's a collaborative effort."

The same goes for the seismometer, which will record "marsquakes" and other seismic disturbances in hopes of answering questions about the crustal dichotomy between the southern and northern hemispheres, the size of Mars' core and the relationship between that core and the planet's lack of magnetic field, Bozdag said.

"We have no idea what kind of data we'll get from Mars—it's the first time we're hopefully going to receive meaningful seismic signals from a planet other than the Earth and the Moon," she said. "Seismology is our primary tool to see planets' interiors. For Earth, we use earthquakes. For Mars, we'll be using marsquakes if there is enough seismic activity, meteorite impacts and other seismic sources, such as dust devils."

A global seismologist, Bozdag got involved in the InSight project while she was a postdoctoral researcher at Princeton. When she moved to the University of Nice in France, she was also supported by the primary investigator for the seismometer, Philippe Lognonnè at the Institute of Earth Physics of Paris, to continue her work on 3D seismic wave simulations of Mars.

Starting this fall, a Mines graduate student will be partially funded by InSight to work full time on Mars simulations and observed data under the direction of Bozdag in collaboration with the InSight team.

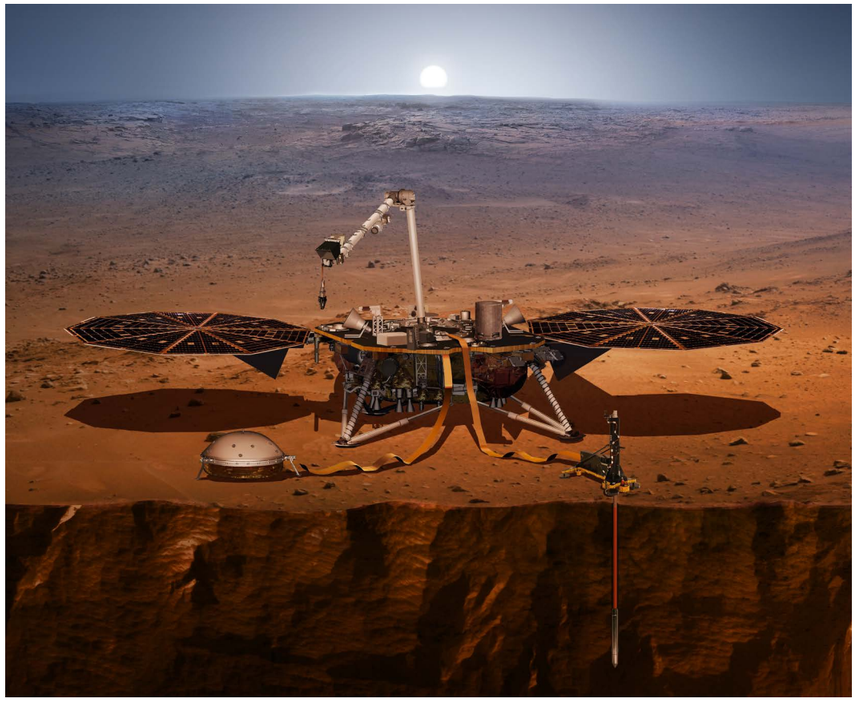
"What we'd like to do is run some high-resolution simulations globally and also focus on some specific craters and mountain areas to see the effect of the 3D structure on Martian waveforms," Bozdag said. "Our goal is not just estimating what kind of data we'll be getting from Mars. It's also to try to identify some real seismic signals from the real data."

The data should help scientists better understand not only Mars but also our own home here on Earth, she said.

"Mars is like an early version of the Earth," Bozdag said. "If we can understand what's currently happening on Mars, it will also help us understand the past of Earth and how our planet, together with our solar system, has been evolving over time."

The InSight Lander, which launched from California's Vandenberg Air Force Base on May 5, is set to arrive on Mars on November 26.

By **Emilie Rusch**



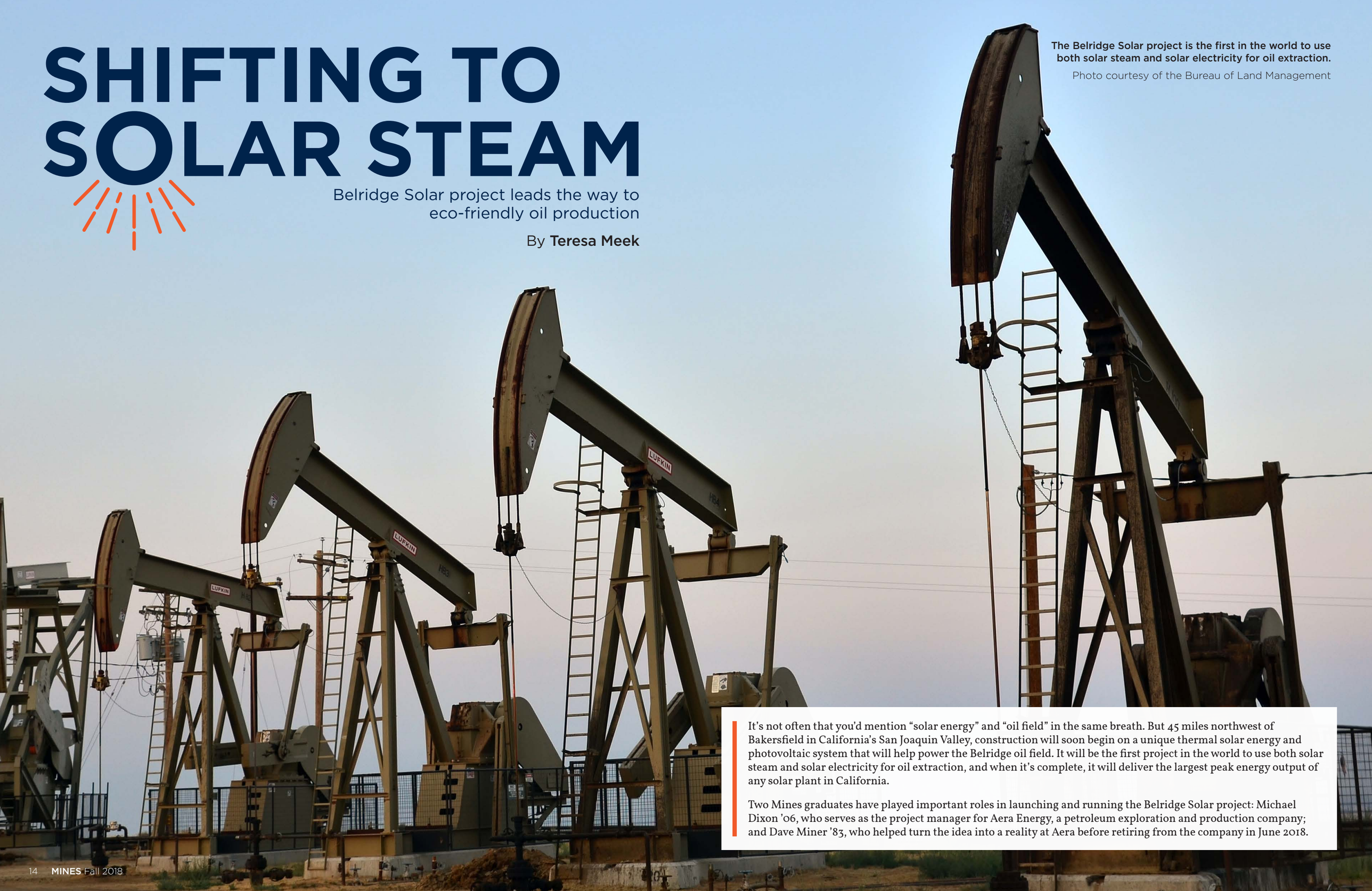
The NASA Mars InSight Lander is the first mission dedicated to collecting geophysical data about another planet.

Photo courtesy of NASA

SHIFTING TO SOLAR STEAM

Belridge Solar project leads the way to eco-friendly oil production

By **Teresa Meek**



The Belridge Solar project is the first in the world to use both solar steam and solar electricity for oil extraction.

Photo courtesy of the Bureau of Land Management

It's not often that you'd mention "solar energy" and "oil field" in the same breath. But 45 miles northwest of Bakersfield in California's San Joaquin Valley, construction will soon begin on a unique thermal solar energy and photovoltaic system that will help power the Belridge oil field. It will be the first project in the world to use both solar steam and solar electricity for oil extraction, and when it's complete, it will deliver the largest peak energy output of any solar plant in California.

Two Mines graduates have played important roles in launching and running the Belridge Solar project: Michael Dixon '06, who serves as the project manager for Aera Energy, a petroleum exploration and production company; and Dave Miner '83, who helped turn the idea into a reality at Aera before retiring from the company in June 2018.

STILL STEAMING ALONG

Aera, which is jointly owned by Shell and ExxonMobil, operates the Belridge oil field, which began production soon after oil was discovered there in 1911.

At 15 miles long by 2.5 miles wide, the oil field is one of the largest land-based fields in the country. Aera operates not only the oil field, but also owns much of the surrounding land, including the parcels to be used for the solar project.

"We had enough space to place the project on our land adjacent to the field," Dixon said. "And the land is flat, which reduces the cost of installation. It was the ideal place for the facility."

At its peak, Belridge produced 160,000 barrels of oil a day. Today, though the natural pressure that causes oil to flow into the reservoirs has subsided over time, engineers still coax out more than 72,000 barrels per day.

What keeps the oil field going after more than a century of extraction is a process invented in the 1960s called enhanced oil recovery. Steam is injected into wells to lower the viscosity of the heavy oil, loosening it up so that it slides off the rock and flows into wellbores. From there, it is pumped to the surface.

Enhanced recovery allows wells to be productive much longer, producing 30 to 60 percent more oil than they would without the process, according to the U.S. Department of Energy. "We have a substantial amount of life left in that field—there are decades of production to come," Dixon said.

To heat the oil, companies usually use steam generated by natural gas. That's where the Belridge Solar project is different.

SOLAR THERMAL AND PHOTOVOLTAIC ENERGY

Aera and its partner, GlassPoint Solar, will build 630 acres of solar "glass houses" that contain curved aluminum foil mirrors suspended by wires. Small motors will pull the wires to adjust the mirrors' angles, changing by day and by season to capture maximum light as the sun moves across the sky. The mirrors will reflect the sunlight onto pipes filled with water, heating them to make steam. It's the equivalent of a power plant operating at 850 megawatts and is expected to produce 12 million barrels of steam a year.

Natural gas will still be used for steam generation some of the time. But the solar thermal system will eliminate 376,000 metric tons of carbon emissions a year—the equivalent of the exhaust of 80,000 cars, or a third of the cars in Bakersfield.

After the oil and water from the steam are pumped to the surface, they will be separated and the water recycled to make more steam.

In a separate system, the plant will use photovoltaic solar panels to generate 26.5 megawatts of electricity, supplying power for up to 25 percent of the oilfield's machinery as well as offices to support the 2,300 employees and contractors who work at the facility.

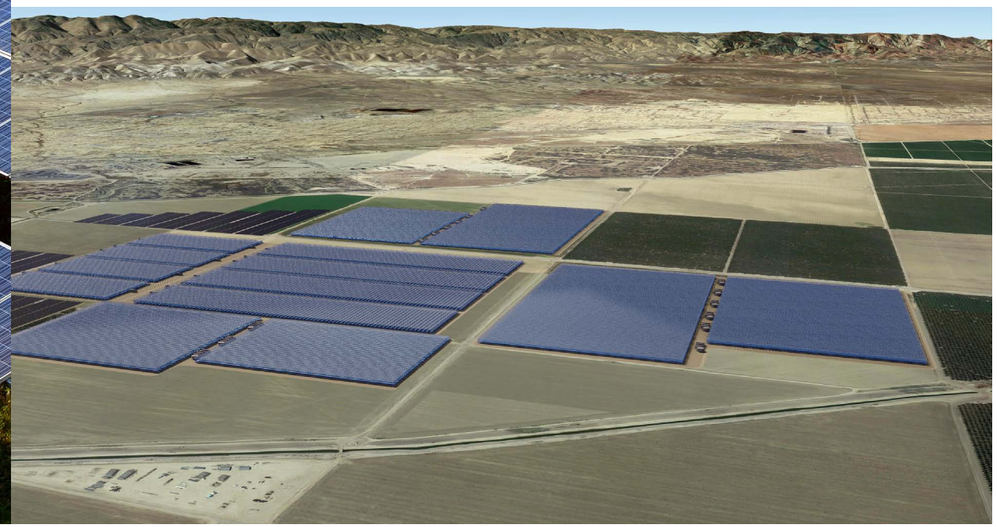
In addition to conserving natural resources and lowering carbon emissions, the Belridge Solar project will reduce the amount of nitrogen oxide and other pollutants that could harm the San Joaquin Valley. Construction workers have been trained not to disturb local fauna, and the facility will minimize lights that could disturb or attract wildlife at night.

Aera hopes the eco-friendly project will serve as a bellwether for the oil industry.

"The people in our communities are counting on us to help them get to school and work each day and allow their businesses to thrive," Dixon said. "We are proud to be an active part of California's low-carbon future and lead the industry by adopting bold and efficient solutions to deliver valuable energy, while protecting the environment."

"We are proud to be an active part of California's low-carbon future and lead the industry by adopting bold and efficient solutions to deliver valuable energy, while protecting the environment."

- Michael Dixon '06



This rendering shows what the Belridge Solar project will look like once completed. The project will deliver the largest peak energy output of any solar plant in California.

Image courtesy of GlassPoint Solar

GETTING IT OFF THE GROUND

The idea for Belridge Solar had been bandied about for a decade or so before it came to fruition. GlassPoint, which had completed a solar thermal project in Oman without the photovoltaic component, periodically reached out to Aera, but the numbers didn't work very well, Miner said.

Finally, the stars aligned. "We were looking to reduce our operating costs in the field as well as reduce carbon emissions and the need for imported gas," Miner said. Plus, federal tax credits that could be applied to the project will start to phase out in 2020.

In addition to federal tax credits, the project will receive carbon credits and tax incentives from the state of California. It's a big investment, but over time, the solar systems will save the company money on its field operations, Miner said.

As Miner and others held discussions and did preliminary calculations, discussions with GlassPoint began to get more serious. But Miner, who was a middle manager at Aera at the time, still needed executive support to move the project forward, not only from his own company, but from ExxonMobil and Shell.

The biggest hurdle was trying to pitch the benefits to both energy giants, Miner said. Each company had its own list of concerns. But initial presentations, put together by Miner and Dixon, went well, and the companies decided to proceed.

Now Aera needed someone to manage the operation. Miner, with several other projects on his plate, couldn't do it.

"We identified Michael [Dixon] as the perfect person to lead it," said Miner, who was Dixon's manager at the time. In addition to having engineering experience in facilities, production and reservoirs at the company, Dixon could work a spreadsheet. "He has a really good business acumen. It was the right combination," Miner said.

In the early stages, Dixon spent a lot of time developing contracts and working out negotiations between all the parties. Extensive permitting has been a hurdle that continues to this day, even though Aera owns the land. "California is one of the world's leaders in emissions reduction and environmental awareness, which results in extensive regulations and permitting efforts," Dixon said.

Dixon oversees all preconstruction activities for the project. He manages the commercial and contractual aspects of the project, as well as oversees the land team, environmental health and safety team, and the engineering and design team. Though his engineering experience is critical to the role, using his interpersonal skills is equally important. "My job is to make sure all team members work together and everything is aligned. When conflicts arise—which you see on projects of this size—I work with team members to find the best solution for all parties," he said.

MINES INFLUENCE

Miner and Dixon both say their background at Mines has helped them a great deal in working on the Belridge Solar project.

"The job I had was the perfect application for my education," said Miner, who earned a master's degree in mineral economics from Mines. The project required complex economic evaluations due to its scale and many moving parts. Tax calculations were especially challenging. "When I got done, I thought, this is exactly what I was trained for," he said.

Dixon appreciates the variety of engineering courses he was able to take outside of his mechanical engineering major, including circuits and an introductory course in control logic. "They have helped me substantially in this project and in my career," he said. "At Mines, you gain a more diverse skill set than you get at most other colleges."

Through Mines' Career Center, Dixon landed an internship at Coors Brewing Company as an undergraduate, where he worked on a $250 million program, giving him an early sense of how large projects work.

Dixon was also a scholar athlete on Mines' men's soccer team, which he said influenced his view on the value of teamwork and his drive for success.

But perhaps most helpful to Dixon were the interdisciplinary groups he participated in as a part of Mines ethics classes. "You learn how to deal with others who think differently from you and how to bring out the best in other people," Dixon said. "That's what my core job is right now—bringing out the best capabilities in others to make the project succeed."

"The job I had was the perfect application for my education."

- Dave Miner '83

Aera Energy and GlassPoint Solar will build solar glass houses with curved aluminum foil mirrors that will reflect sunlight onto pipes filled with water, heating them to make steam, which is then injected into wells to lower the viscosity of oil underground to then be pumped to the surface.

Image courtesy of GlassPoint Solar.

BELRIDGE SOLAR PROJECT AT A GLANCE

YEAR OIL FIELD DISCOVERED:	1911
AREA:	15 miles x 2.5 miles
PEAK OIL PRODUCTION:	160,000 barrels per day (1986)
CURRENT OIL PRODUCTION:	72,000 barrels per day
SOLAR THERMAL CAPACITY:	850 megawatts
PHOTOVOLTAIC CAPACITY:	26.5 megawatts
STEAM GENERATED BY SOLAR THERMAL OPERATION:	12 million barrels per year
STEAM GENERATORS:	100
CARBON EMISSIONS ELIMINATED:	376,000 metric tons per year
NATURAL GAS REDUCTION:	4.9 billion cubic feet per year
CONSTRUCTION JOBS CREATED:	500

PLAYING WITH FIRE

Mines students express their artistic sides while learning the science of glassblowing

By **Ashley Spurgeon**

When many think of blown glass, images of master artisans and the delicate, colorful objects they shape from hot, glowing orbs often spring to mind. Yet while glassblowing is often an artistic pursuit, there is also a concrete science behind the art form, which Mines students are now able to understand firsthand.

Mines' new glass shop—housed in the foundry in the basement of Hill Hall on campus—allows Mines students to learn the craft of glassblowing while studying the material's properties and the applications of glass in everyday life.

A glass object emerges from the furnace, which is heated to about 1,100 degrees Celsius.

Photo by Agata Bogucka

BRINGING GLASSBLOWING TO CAMPUS

The idea of a glass shop was first introduced to campus about a year ago by Jake Ivy, a materials science PhD student, and his advisor, Associate Professor Geoff Brennecka. Ivy first took up glassblowing as an undergraduate at the Missouri University of Science and Technology and, with Brennecka, started brainstorming how they could introduce glassblowing into the Mines curriculum and take advantage of the foundry facilities.

"One of the things Mines is known for is the hands-on experiences students are able to get here, and being able to blow glass was another opportunity to take advantage of the expertise and facilities we already have to give students the chance to not only play around with hot glass and learn how materials work in a different sort of setting but also to express a little bit of their artistic side," Brennecka said.

Ivy started by creating a list of the equipment they would need, and Brennecka worked on getting the appropriate funding. The Materials Research Society provided the funds to purchase the initial smelting tank, and a tech fee provided for the rest of the smaller tools. Students also contributed by building additional tools as their EPICS projects.

The glass shop also enlisted the help of Mines' Keramos chapter, a ceramics-focused professional fraternity, to oversee and maintain the facility. "We have to look after the equipment and staffing side of the glass shop, keep up with running the shop on a day-to-day basis and make sure trained gaffers are at events," said Kelsey Cannon, president of Keramos.

Soon Mines had a fully operational glass shop ready to be put to use. Yet, Brennecka and Ivy knew they didn't want the space to be used just for fun.

"I thought it would be good for Mines, because it's a place where we work really hard but like to have fun on the side," Brennecka said. "Usually that fun involves some sort of work as well, and this a good example of being able to merge the two."

TEACHING THE SCIENCE BEHIND THE ART

The combination of the technical with the artistic came to fruition in the form of a new class added to the Mines curriculum this fall. Students visit the glass shop for a couple of hours each week to try their hand at glassblowing and learn the techniques for shaping glass into a desired shape. Then, they attend Brennecka's lecture to learn about the properties behind the material they shaped.

"We have plenty of lab time to go down and actually work with the glass and see how the material behaves and understand and see some of the physical properties and optical properties changing," Brennecka explained. "And then we go into the lecture and actually discuss all the physics behind it: how viscosity changes with temperature and what that means in terms of glass structure and atomic arrangements, where colors come from and what sort of interactions are happening to give various optical effects in the glass—those kinds of topics."

Each section of the lab, led by teaching assistants who were trained by Ivy in a pilot course over the previous year, walks two or three students through the glassblowing process. Working with a furnace that runs at 1,100 degrees Celsius, students start out making solid objects such as paperweights and small sculptures and eventually advance to hollow items, such as cups and vases. They also learn how to overlay colors and add handles, wraps and more complex details to add creative touches to their pieces.

While glassblowing takes a fair amount of practice, students tend to pick it up quickly. "Nobody is good right at the beginning," said Bobby Puerling, a metallurgical and materials engineering student and teaching assistant. "It's really fun seeing people finally have it click and have them

Erin Sweeney is currently in the glassblowing class and is learning the basic techniques for shaping glass.

Photo by Joe DelNero

start to understand how things work properly, how you need to have [glass] at different heats for different things you're doing, different ways of working the glass. It's really fun seeing that progress."

Puerling assists with two sections of the glassblowing lab, each with two students. He walks them through how to use the tools—one of which, the pipe cooler, he actually helped make as his EPICS II project—and then the basic techniques students need to know to make any sort of object.

When outlining the course, Brennecka and Ivy recognized the opportunity of making it available to students across campus, not just those studying metallurgical and materials engineering who would have the most practical applications for the knowledge acquired in the class.

"There is always value, I think, in having as many people involved with almost any project as you can," Ivy said. "There is certainly a lot of practical experience for MME students to be able to come down and work with hot glass because that's what they're learning about, but that is not to say that a chemical engineering student or mechanical engineer wouldn't have just as much fun and learn just as much from having access to this equipment and learning how different materials respond to different pressures."

Ivy said the class also teaches students how to be effective leaders and collaborators. "As we go through the process of teaching people how to work with glass, we're also trying to teach them to think on their feet a little bit and how to work together and talk to each other," he said. "When you're making something in the glass shop that requires more than one set of hands, you have to communicate."

Brionna Dumlao and Bobby Puerling are teaching assistants for the glassblowing class, instructing other Mines students on the proper techniques for creating an object.

Photo by Agata Bogucka

Current student Myly Fabre works on a piece as part of the glassblowing class.

Photo by Joe DelNero

THINKING BEYOND THE GLASS SHOP

Despite the artistic components of glassblowing, Brennecka said learning the technical aspects of the material is valuable to understanding much of the technology in use today. Glass is one of the most-used materials in the world, from container glass such as beer bottles and window glass to the fiber optics that carry the backbone of the internet and the tiny components that make up wireless communication devices.

"Glass itself is another class of materials, like metals and ceramics and polymers, that's ubiquitous," Brennecka said. "It's everywhere, but we don't necessarily think about it."

Brennecka thinks knowing how to manipulate the properties of glass gives students a new perspective on the materials they interact with every day. "I think the idea they can appreciate is that there was some thought that went into designing the material to have whatever properties it has, and it's just one avenue to get them thinking there's more to glass or there's more to metal or there's more to any material that's out there than just what meets the eye," Brennecka said. "It's not even about knowing. It's about thinking and asking."

The future looks bright for the glass shop, judging by the passion and dedication from the students who have already been trained to use the new equipment.

"It's just a great way to play with fire," Ivy said. "Everyone's got a bit of a pyromaniac inside of them, because almost everything we do encounters extreme heat at some point in the process, whether that's putting a piece of ceramic or metal into a high-temperature furnace—something that goes over a thousand degrees Celsius—oftentimes is a great way to literally touch a material that hot."

This is certainly true for Puerling, who finds he has a hard time staying away and dedicating time to his other studies. "The biggest challenge of the glass shop, at least for me, is not being here all the time," Puerling said. "I love it so much—I'm down here as much as I can."

▶ Check out our video about the glass shop on *Mines Magazine's* website to see students in action and learn more about the new glassblowing class.

HILL HALL HOT SHOP

As part of the Hill Hall Hot Shop, the glass shop is just one of several opportunities for students to get hands-on practice with materials. Learn more about the facilities available for students to learn about materials at **metallurgy.mines.edu/facilities**.

▶ FOUNDRY

The foundry offers opportunities for students to cast molten metal. It also hosts Free Pour Fridays for anyone across campus to experience sand casting to make an aluminum object.

▶ GLASS SHOP

Students are able to try their hand at glassblowing and can take a new glassblowing class to learn more about the craft and the science behind it. It also hosts Soda Lime Saturdays for anyone on campus to shape their own glass object.

▶ FORGE

Students get the chance to experience blacksmithing and can take a new forging and forming class to expose them to different possibilities within the metals industry.

GOLDEN BOOSTER AND BOLD VISIONARY

WILLIAM A. H. LOVELAND'S INFLUENCE ON GOLDEN AND MINES

The name Loveland is well known around the state of Colorado, but many may not realize Loveland's connections to Golden and Mines.

Loveland Cottage, Golden's oldest building, holds a place of pride at 717 12th St. The Loveland Block, at 1122 Washington Ave., is a designated historic landmark. And Loveland Pass, which cuts through the Rocky Mountains along the Continental Divide, is infamous across the country for its treacherous winter conditions. All these places are named in honor of William A. H. Loveland (1826-1894), an entrepreneur and civic leader who was one of Golden's earliest citizens and greatest benefactors. Together with his wife, Miranda, and fellow Golden resident and friend Charles C. Welch, Loveland also founded Lakewood, Colorado.

William Austin Hamilton Loveland arrived in Golden in 1859, drawn to the town, like many others at the time, by the Pikes Peak Gold Rush. It was not as a miner, however, but as an entrepreneur and businessman that Loveland made his mark, subsequently proving instrumental in the development of both Golden and the state of Colorado. Indeed, his accomplishments would later earn him the moniker "Prince of Pioneers."

A visionary, Loveland worked tirelessly to promote the health and prosperity of his adopted city and state. He helped found the Colorado Central Railroad, was instrumental in securing Golden's place as capital of the Colorado Territory and embraced his civic responsibilities by serving as both mayor of Golden and lieutenant governor of Colorado. "Loveland was a citizen of Golden from almost its very beginning and was highly involved in the building of the city," observed Richard Gardner, a Golden-based historian.

Although Loveland was only mayor of Golden for one year, he made a lasting impression during his tenure with an event that took place outside city limits. "On May 21, 1874, Loveland ordered Golden's firefighters into action to defend Central City from the great fire threatening to engulf it," Gardner explained. "Being also the Colorado Central Railroad owner, Loveland had a locomotive with a flatcar ready and waiting for the firefighters at the depot the moment the order came. It was the first mutual aid call in Colorado history, and Golden's firefighters succeeded in saving the city above the Teller House where they made their stand."

But it's Loveland's championing of the establishment of Mines, however, that remains among his most notable accomplishments. "Loveland greatly believed in the future of Golden and of Colorado and was among many who believed that a mining school was key to the future of the region," said Gardner. "He was instrumental in persuading the Colorado Territorial Legislature to authorize funds to establish Mines. He very likely believed that Mines would help build up Golden by establishing a prominent institution of higher education which would be key to the future of the territory."

William A. H. Loveland was instrumental in the development of Golden and the surrounding areas and was key to establishing Mines at the end of the 19th century.

Photo courtesy of Golden History Museum, City of Golden Collection

After securing funds to establish the school, Loveland served as the first president of the board of trustees. "He was elected to that role by the board, whose members, including him, were appointed by the Legislature," Gardner continued. "As president, Loveland oversaw the allocation of the $5,000 the Territorial Legislature had appropriated for the institution. His first official act was accepting the gift of the school from the Episcopal church and the gift of additional land from Charles Clark Welch."

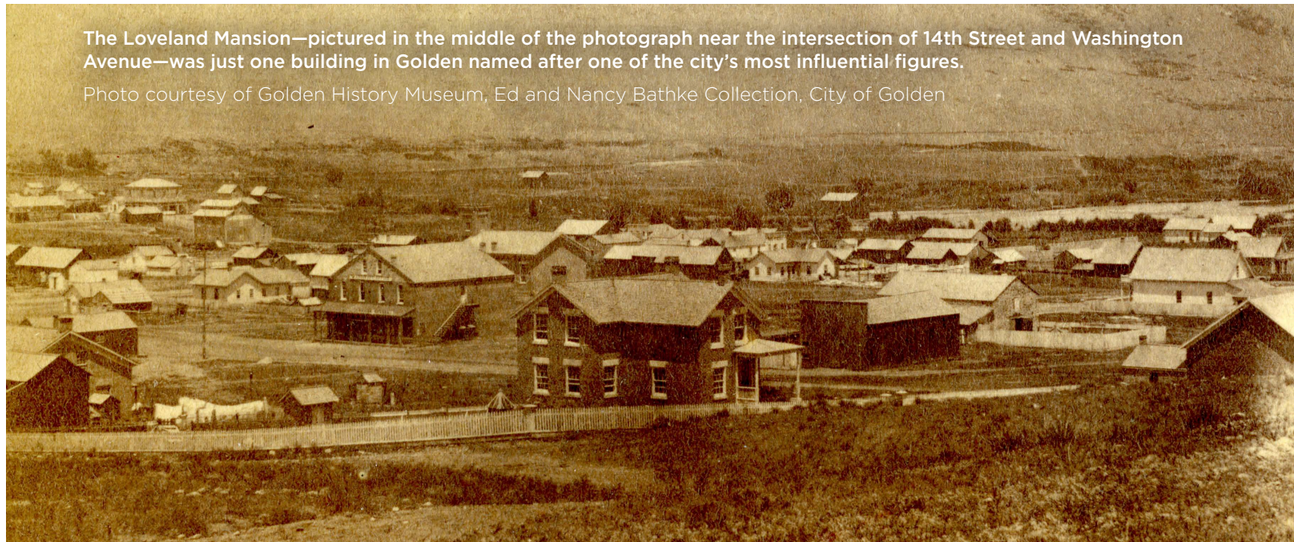
Welch was another prominent Golden citizen who did much to develop both the area and Mines. A member of the Territorial Legislature, Welch introduced the bill to establish Mines, donated the ground for the site of the school's first building and served on the board of trustees for 10 years.

Among the spending allocations Loveland oversaw during his tenure, Gardner noted, was the appropriation of funds to complete the first Mines building—Engineering Hall—which, while operational, was still in an unfinished state. "Its ground floor actually still had a dirt floor," Gardner said.

Loveland led the effort to place Mines upon a firm foundation in public hands, enabling it to become the institution it is today, Gardner said. "He doubtless would have seen the opening of a university in Golden as a way of enhancing the city, its prospects and its reputation, which he worked tirelessly to promote in many dimensions."

"Loveland's influence is incalculable," Gardner concluded. "In my estimation, he could well be said to be Golden's most valuable citizen. Many live in subdivisions he helped create. Mines continues vibrantly today as a key institution of higher learning, not just in Colorado but the world. And his railroad lines operate today through the state—tourists enjoy part of one at the Georgetown Loop. Passengers riding the Regional Transportation District's West Line travel rails that Loveland created, and four of the churches for which he gave land still support worshippers today. Golden and Lakewood would not be here today without him. It's quite a legacy."

By **Lori Ferguson**



The Loveland Mansion—pictured in the middle of the photograph near the intersection of 14th Street and Washington Avenue—was just one building in Golden named after one of the city's most influential figures.

Photo courtesy of Golden History Museum, Ed and Nancy Bathke Collection, City of Golden

OREDIGGERS FOR LIFE

CONNECTING ALUMNI AND STUDENTS THROUGHOUT THE MINES EXPERIENCE

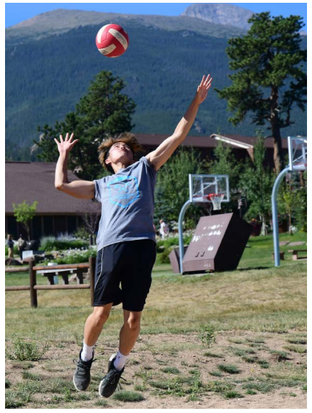
Photos by Colorado School of Mines

In the spring of their senior year of high school, many students make one of the biggest decisions of their lives and commit to a university to pursue an undergraduate education and kick off the next chapter in their education. When a student commits to Mines, they become an Oredigger for life. But until they set foot on campus and nervously—or excitedly—move into their residence hall and say goodbye to their families for a few months, many students don't understand what being an Oredigger means.

But Mines and its alumni hope to change that. Last year, Mines launched Oredigger Camp, a 2½-day event where incoming freshmen first learn what it means to be a Mines student and are welcomed into an exclusive community of engineers and scientists. Through team-building activities, self-reflection exercises and countless fun events, new students learn the value of their Oredigger pride that they are able to carry with them from the start of their first semester through their next several years at Mines.

However, this year's camp was slightly different. Recognizing that the Oredigger community was often split into two groups—current students and alumni—the alumni association proposed to have more involvement in the undergraduate experience. After all, students don't stop being Orediggers when they graduate, but instead, as they walk across the stage and flip their tassels from the right side of their cap to the left, join an extension of the community they were a part of as an undergraduate. The alumni association wanted to integrate the student and alumni communities right from the beginning and started by introducing themselves to the Class of 2022 at Oredigger Camp.

A couple of alumni met new students at the YMCA of the Rockies in Estes Park, Colorado, ready to spark an affinity for the place that was so influential in the development of their adult lives and alleviate any anxieties new students might have when starting this new journey.



"As the executive director of the alumni association, I felt it was important to observe, participate and see where alumni might make an impact on these newly arriving Orediggers," said Damian Friend '75. "I came away with the opinion that alumni presence is critical at Oredigger Camp as a means of introducing new students to alumni culture and to have the visibility and participation that indicates Oredigger affinity for Mines."

Friend, along with Stu Bennett '66, President Paul C. Johnson and several members of the Mines administration, joined the new freshmen in pickup games of gaga ball—a variation of dodgeball—and nine square and hiked through Rocky Mountain National Park. Friend even judged the tinker toy competition and awarded a prize to each member of the winning teams. Alumni got to know the students and make them feel at home in their new community while offering advice on how to navigate their first year as an undergraduate.

"Watching them move from a 'deer in the headlights' on the first day to building friendships and shedding stereotypes and expectations was interesting and fun," Bennett said. "They are open, engaging, curious and, if cultivated and allowed to bloom, are definitely the potential leaders of tomorrow."

Friend said he noticed a change in the students at the camp, gaining confidence and newfound leadership skills, even in the short time between when they first stepped off the bus at the camp and when they left.

"By the time they departed their camps, they had the camaraderie and Oredigger spirit that is great to see in the student body and future graduates," Friend said. "They are as smart as past Oredigger classes and work well together."

And while Oredigger Camp was a special event for new students, it was equally impactful on the alumni who joined them.

"I can think of no better or more valuable way to share time and talent and love of this place that—for many of us—has provided the opportunity to live and contribute in ways the rest of the world can only imagine and wish for," Bennett said.

Yet alumni involvement in the development of Mines' undergraduates isn't limited to Oredigger Camp. In fact, many alumni returned to campus for Fall Kickoff—the week before the semester starts—to help with and participate in campus activities essential to welcoming the newest group of Orediggers.

Alumni were spotted weighing students' rocks before the M Climb to make sure rocks less than 10 pounds didn't make it up Mt. Zion. Some alumni even made the climb themselves, walking alongside new students' family members or simply making the trek because they missed the tradition when they were a student.

Alumni will also have a larger presence on campus throughout the school year, mentoring students through their undergraduate experience, giving guest lectures and volunteering at signature events. No matter where they might be found, alumni are key in ensuring the success of their fellow Orediggers, both in their studies and future careers. But most of all, they are essential to supporting the Mines culture and making sure all are welcomed into the Mines family.

"The alumni body are the connectors to that tradition and culture," Bennett said. "But that culture, the M that watches over campus, the gold dome of Guggenheim and the experiences, knowledge and wisdom of the alumni population will endure."

By **Ashley Spurgeon**

ALUMNA PROFILE

STUDYING WAVES TO CONTEND WITH THE WOLF NOTE

Deborah Miles MS '77 created the CelloStone, a travertine tile that sits at the base of a cello and dissipates the "wolf note" that musicians have contended with for years.

Photo by John Kalk

Beloved by musicians and music lovers alike, the cello is the most versatile of the string instruments, able to cascade from a high alto to a low bass in seconds. Of all the instruments, it is said to have a sound closest to that of the human voice, and it adds warmth, richness and complexity to many musical arrangements.

To create beautiful music, however, cellists must contend with the "wolf note." This note, which got its name from the animal-like howl it creates, occurs when the cello emits two frequencies close together, resulting in interfering frequencies. The quality of craftsmanship, small damping devices and a special clamp can all help mitigate the wolf note. However, it is always present in the feel of the bow, and even the most experienced of cellists must work around it.

Deborah Miles '77, however, has changed how musicians think about the wolf note—and made waves in the physics world—with her invention of the CelloStone, a square travertine tile designed to dissipate the problematic energy completely.

Miles first became interested in the cello—and the accompanying wolf note—when she sought out a luthier to make a quality instrument for her daughter, who had been practicing for years on a basic cello and was ready to play more seriously. The luthier attributed the lack in quality of sound to the plies (thin layers of wood veneer) in plywood instruments. Hearing this, Miles thought something was off. Based on her 30 years of experience working with seismic data, she knew if the sound was truly acoustic, then the plies shouldn't matter.

Miles approached the problem from a geophysical perspective, comparing the plies to thin strata in bedding planes. "Compression energy doesn't care one bit about thin beds, it just averages," she said. "So saying that it's acoustic energy in the cello makes no sense. The only logical energy, if plies really make a difference, is shear wave energy."

Miles set out to test her theory. The wolf note was almost inaudible in the workshop where the cellos were made, but as soon as they were in the hands of the cellists, the wolf note was strong. Back in the workshop for repair, the wolf note would disappear again, frustrating both the luthier and the cellists. Miles suspected the concrete floor was dissipating the sound differently than in other floors. She asked the luthier to have his clients to play their instruments in a place with a concrete floor (like a garage), and sure enough, the wolf note would all but disappear.

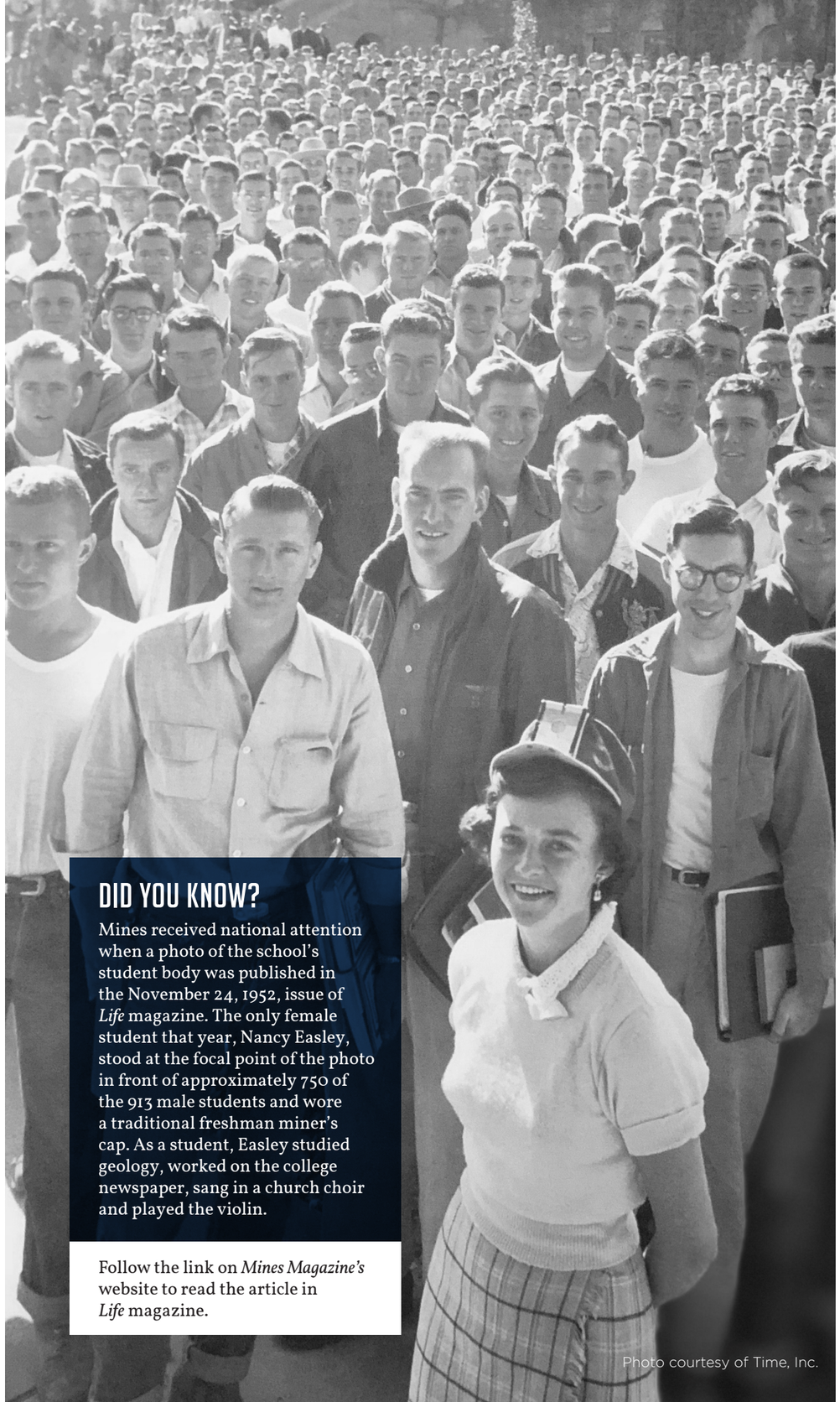
Once it became apparent that the concrete *did* make a difference, Miles set out to find a stone to sit at the base of the instrument that could match the frequency of the wolf note but with a small enough surface area to be portable. After visiting several different tile stores and looking at the qualities of stone, she settled on travertine, a material with the appropriate shear velocity to dissipate the wolf energy.

Miles knew her invention was a success when an experienced cellist using the stone played outdoors during a thunderstorm—where the change in humidity would usually affect the wolf note—and didn't have to adjust her instrument at all. To the musicians, the complete elimination of the wolf note was like magic.

The reaction from the physics community, however, has been less enthusiastic. "There's a lot of indifference," said Miles. "People who have been studying this forever are saying it can't possibly be true." The cello couldn't possibly be making sound from shear waves.

But Miles doesn't let that deter her, even when physicists question how she knows she's working with shear wave energy. "The answer is that I can hear it, and I can see it in my data," she said. "It doesn't have to be a sound wave to make sound." Amplitude spectrums show the stone does not remove frequencies, only the wolf.

By **Amanda Schuster**



DID YOU KNOW?

Mines received national attention when a photo of the school's student body was published in the November 24, 1952, issue of *Life* magazine. The only female student that year, Nancy Easley, stood at the focal point of the photo in front of approximately 750 of the 913 male students and wore a traditional freshman miner's cap. As a student, Easley studied geology, worked on the college newspaper, sang in a church choir and played the violin.

Follow the link on *Mines Magazine's* website to read the article in *Life* magazine.

Photo courtesy of Time, Inc.

OREDIGGERS GIVE BACK

GENEROSITY SHOWS COMMITMENT TO INSTITUTION AND INDIVIDUALS

Kendra (Sublette) Lema '96 has long kept a list of 100 goals she'd like to accomplish in her lifetime. She recently crossed one of them off—becoming a member of the Mines Century Society, a distinguished group of loyal individuals whose lifetime giving to Mines exceeds $100,000. As a director of development engineering for ConocoPhillips, she was able to take advantage of the corporation's matching gifts program, which matches employee giving dollar-for-dollar.

"I set the goal relatively early in my career, and by contributing regularly and using the match, I was able to reach it earlier than maybe is traditionally seen," said Lema, who became the youngest alumna inducted into the society. While she didn't think of herself as an extraordinary student while at Mines, Lema believes the university prepared her to be extraordinary in her career. Because of this, she wanted to support Mines.

Lema's primary area of giving is the Lema Endowed Scholarship. The scholarship was created with her husband at the time, Raul Lema '98, and provides four years of scholarship support to a Mines student. Even though she was a civil engineering major, Lema liked the idea of not placing degree restrictions on the scholarship, which rotates between a female and male student every four years.

"What I consider a flexible and long-term commitment to individual students has helped me create relationships with them," Lema said. Lema visits with her scholars and stays in touch with them after they graduate and start their careers.

"I have a picture of each one of them at graduation," she said. "I hope to have an entire wall of them."

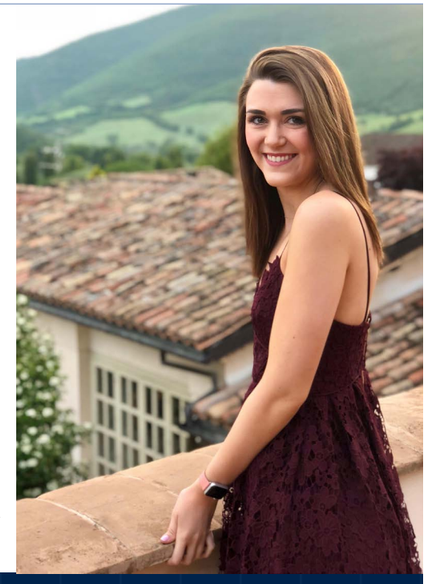
By **Anica Wong**

"Being the recipient of the scholarship eased my financial burden and allowed me to take my time with my coursework and other electives of interest. Initially, I had planned to graduate early with a petroleum engineering degree, but because I received several scholarships, I was able to take computer science courses and decided to double major. The Lema Scholarship allowed me to pursue other interests and made me a better engineer by diversifying my skill set. I am forever grateful."

Daniel Zarrini '16

"The scholarship has been a wonderful opportunity to have a relationship with an alumna who is encouraging and has continued to be involved in the Mines community. It is nice to connect with another female engineer. Kendra and I have had several opportunities to meet while she is in town. Being a scholarship recipient has been rewarding, and I really look up to her for giving back to Mines. It gives me a more concrete sense of the legacy at the school and how helping future students can make an enormous impact on their experience as well."

Johanna Henry
Mechanical Engineering, Class of 2018



MINES CENTURY SOCIETY:

For more than 20 years, the Mines Century Society has recognized those individuals who, through a lifetime of giving, have shown an extraordinary commitment to the continuing excellence of the school. This society comprises more than 300 donors whose lifetime giving to the school exceeds $100,000. Their names are prominently displayed on the donor wall in the Starzer Welcome Center.

Giving levels within Mines Century Society are denoted by varying gemstones and precious metals. These resources symbolize Mines' commitment to earth, energy and environment.

▶ To learn more about the Mines Century Society, visit **giving.mines.edu**.

UPDATES ON ALUMNI ACTIVITIES

CHECKING IN WITH THE ALUMNI INTEREST GROUPS

The Aerospace Interest Group has been hard at work participating in, co-sponsoring and planning many events, including the Trajectories 2018 networking event on Oct. 19, at Mines. Additionally, members are working closely with the American Institute of Aeronautics and Astronautics on the upcoming annual technical symposium. Interest group members are also supporting two Mines students who were awarded scholarships from the Astronaut Scholarship Foundation at the Innovators Gala in Washington, D.C., on Aug. 25. For more details about upcoming events and opportunities, visit minesalumni.com/aerospace.

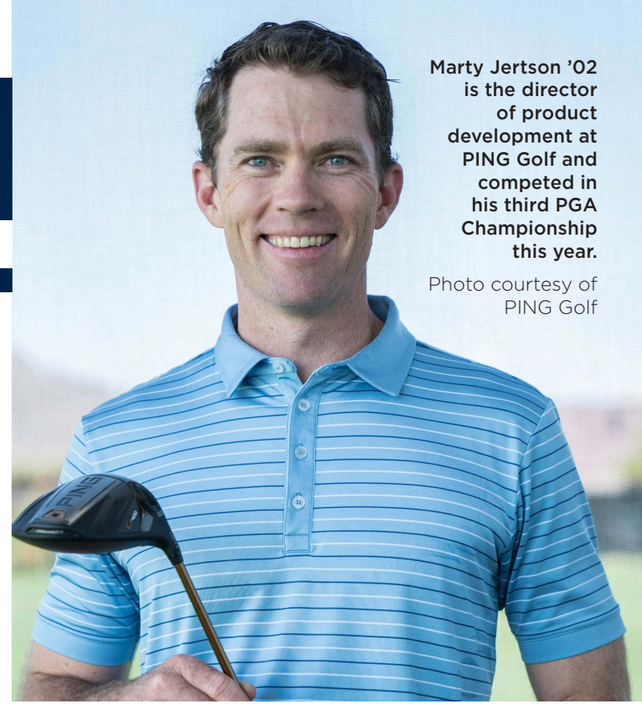
The Entrepreneurship and Innovation Interest Group combined efforts with Mines' Center for Entrepreneurship and Innovation, the Women of Mines Interest Group and the newly formed Mines Black Alumni Network for the first official Mines event at the DaVinci X exhibition to be held at the Denver Pavilions later this fall. The interest group has also helped the Aerospace Interest Group plan the Trajectories 2018 event. In addition, the group welcomed students who completed the University Innovation Fellows program to be involved in entrepreneurship and innovation efforts on campus. To learn more about the interest group, visit minesalumni.com/eandi.

The Leadership in Social Responsibility Interest Group is steadily growing. A book club meets every two months, both virtually and in person, and all are welcome to join. The current book is Jacqueline Novogratz's *The Blue Sweater: Bridging the Gap Between Rich and Poor in an Interconnected World*. The group is also planning an event in the fall, with alumni sharing experiences on social responsibility from within profit-seeking companies. Finally, the group is planning a trip to South America in 2019. If you'd like to be involved in any of these activities or have suggestions for what you'd like the group to do, contact Nicole Hanson at nrhanson75@gmail.com. Details for all events can be found at minesalumni.com/lsr.

On Sept. 2, the Women of Mines Interest Group held a "dress for success" event at Truly BoHotique in Golden in advance of Career Day on campus. Alumnae from the Denver area, the Denver Geophysical Society and the Rocky Mountain Association of Petroleum Geologists donated professional and business clothing for students to impress potential employers. Nadine Wilson, owner of Truly BoHotique, also visited Mines after the event to talk to members of the Society of Women Engineers about how to make a good first impression, dining etiquette and appropriate professional attire. Learn more about the interest group at minesalumni.com/womenofmines.

ALUMNUS PROFILE

A MAJOR COMPETITOR DRIVES INNOVATION



Marty Jertson '02 is the director of product development at PING Golf and competed in his third PGA Championship this year.

Photo courtesy of PING Golf

It can easily be said that Marty Jertson '02 has an affinity for golf.

"My dad got me into it," Jertson said, having played the sport since he was 7 years old. "Golf was what we would do every weekend."

When he got to Mines, Jertson played golf all four years, finishing third at the RMAC Championships as a senior. After graduating with his mechanical engineering degree in 2002 and a short stint trying to earn his way on the PGA Tour, he accepted a job at PING Golf, a golf equipment manufacturer. Today, Jertson is the director of product development, designing clubs for the sport he loves.

"I lead the vision of our talented and passionate design group with a 10- or 20-year outlook and work on product design," Jertson said. "I get to do 3D CAD work, finite element analysis, simulated airflow analysis and try to actionably integrate technologies together into our product designs."

For the recent PING G Ladies Edition driver, Jertson and his team worked to make the club head light but also forgiving. "We did a big impulse-momentum optimization," Jertson said. "We optimized the head weight around the distribution of the club head speed that would be used by women."

Additionally, Jertson had the original idea for and worked on the development of iPING, an app that utilizes the gyroscopes and accelerometers in the iPhone to measure attributes of a putting stroke. "We leveraged the sensors in phones to make an amazing tool," Jertson said. "I don't know if we would've come to market with this without my experience at Mines."

Though Jertson spends much of his time designing clubs, he still finds time to compete on the golf course and recently qualified for his third PGA Championship.

"It was fun to be able to get back in there after six years," Jertson said, acknowledging that he last qualified in 2012 before he became a father and focused on his growing family.

Jertson says his engineering background has helped him stay in the game. "I take a very technical approach to my game plan, my equipment and understanding when temperature and elevation can affect my trajectory and ball flight," he said. "My engineering background has given me an immense advantage that allows me to play and practice less than my competitors but still allows me to compete against them."

The motivation to improve the design of each new club is embedded in Jertson's lifetime appreciation and love for the sport.

"I experience the joys of my work but also pain in any shortcomings," Jertson said. "Having skin in the game gives me that much more motivation and that much more understanding of the problems we are trying to solve."

By **Joe DelNero**

LUCKY GOLF TOOL
Divot tool

FAVORITE COURSE TO PLAY
The California Club of San Francisco

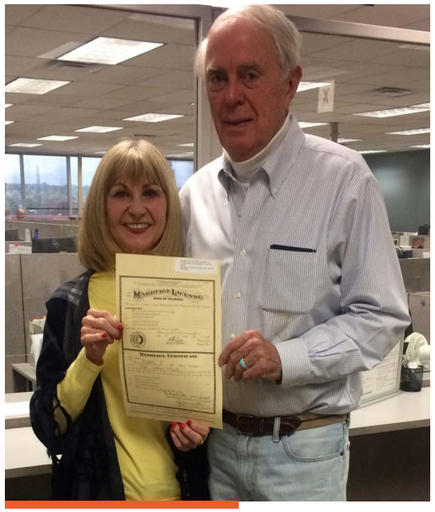
FAVORITE PING TECHNOLOGY
Turbulators (the angled ridges on the leading edge of the driver crown)

NEXT-LEVEL GEAR
Rangefinder

FAVORITE GOLF MOVIE
Dead Solid Perfect

TIP FOR SUCCESS
"Good equipment that's custom-fit for you, a good instructor and good practice habits."

WEDDINGS



COURTHOUSE WEDDING

Edwin H. Crabtree '60 and Janice M. Durant were married at a courthouse in Littleton, Colorado, on Oct. 6, 2017. Ed is a Denver patent attorney, program chairman for the Denver Mining Club and a past president of the Mines Alumni Association. Jan is a graduate of Kansas State University in business administration. She had a successful career with Raychem Corporation in California and now works as a sales agent with United Healthcare. The couple only paid $30 in cash for their wedding.

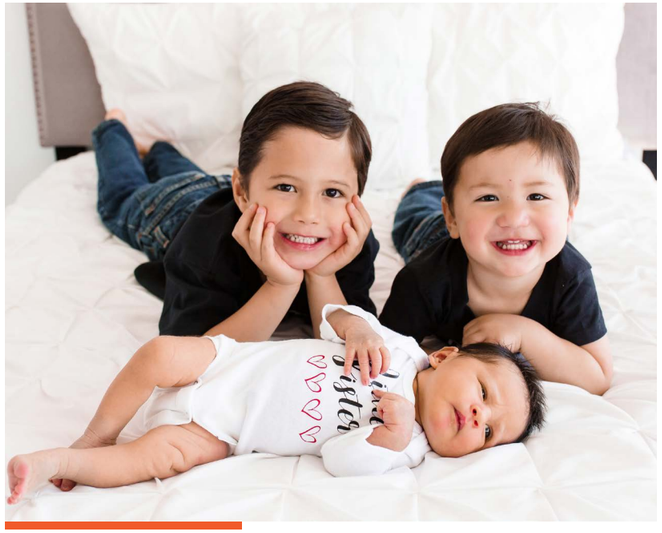
LOVE IN THE MOUNTAINS

Alyssa Brown '15 and Charlie Kendir were married outside of Estes Park, Colorado, on May 27, 2018. More than 24 Mines alumni attended the wedding, including Taylor Madden '15, MS '16 (maid of honor), Matt Heidebrecht '15 (bridesman), and Zach Nahman '15 (getaway driver). Also in attendance were Associate Professor Hugh Miller '86, MS '91, PhD '96 and his wife, Nadia Chornij Miller '87, MS '92. Alyssa is currently an engineering consultant for Blast Movement Technologies and Charlie is a senior software engineer for Northrop Grumman.

GREEK LIFE LOVE

Sean Rozowski '17 married Alexis (Giovannoni) Rozowski '16 on Aug. 10, 2018, in Golden, Colorado. Several alumni attended their wedding, including Chris Bishara '17, Chris Pumford '16, Paige Becker '17, MS '18 and current student Jackson Finamore as members of the wedding party. The couple met as members of Greek Life while at Mines.

BABIES



FINALLY GOT THEIR GIRL

Rachael Watanabe '08 and Sabu Watanabe '08 welcomed a baby girl, Kaori Anne, to their family on April 20, 2018, joining big brothers Dash (2) and Sabu (4). Photo by Emily Dalton '10.

LUCK OF THE ALUMNI

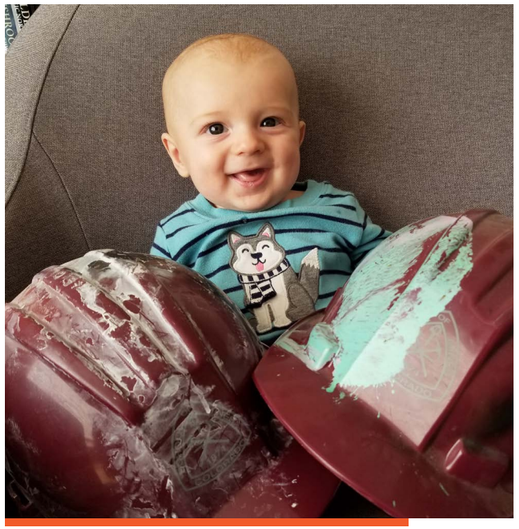
Sara Post '10 and Brad Leick MS '10 welcomed Arthur into the world on March 17, 2018—St. Patrick's Day.

WELCOMING A DAUGHTER

Margo (Game) Brandenburg '11 and Pablo Brandenburg welcomed a baby girl to their family. Josefina Grace Brandenburg was born May 25, 2018, at 10:10 a.m., weighing 7 pounds, 3 ounces. Photo by Richard Waller '06, MS '07.

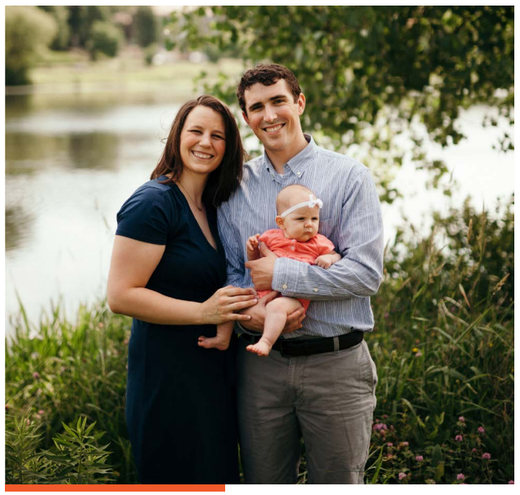
▶ To submit a wedding, birth or award announcement for publication in the magazine, visit minesmagazine.com/submit-an-announcement.

BABIES CONT.



NEW ADDITION TO STEELE LABORATORIES

Kat (Muterspaugh) Steele '07 and Dan Steele '07 are excited to announce the arrival of their son, Orrin Kenneth Steele. Orrin was born on April 17, 2018, at 12:40 p.m. and weighed 8 pounds, 11 ounces. He was 19 inches long.



NEW FAMILY OF THREE

Chris Cutt '11 and Ashleigh Cutt '11 welcomed Morgan Joy on Feb. 25, 2018. They can't wait to see what her future holds.

ON OUR WALL

Which song or music album became the soundtrack to your time as a Mines student?

Radiohead—*OK Computer/Kid A*

Ryan Countryman '02

Cream—"Wheels of Fire!"

Dennis Fagerstone '71

I will always remember Timbuk 3's "The Future's so Bright, I Gotta Wear Shades" from my freshman/sophomore year. It always seemed so appropriate for those of us studying at "the world's foremost school of mineral engineering." I believe it was even the E-Days theme that year.

Jeffrey Duvall '90

IN MEMORIAM

"When you are sorrowful look again in your heart, and you shall see that in truth you are weeping for that which has been your delight."

-Kahlil Gibran

KARL E. BROCKMEIER '84 died Aug. 15, 2018, in Lone Tree, Colorado. Karl was born in 1962 in Hinsdale, Ill., and moved to Broomfield, Colo., in 1968. He was valedictorian of his class at Broomfield High School and went on to graduate from Mines with a bachelor's degree in petroleum engineering in 1984 and earned a master's degree in management information systems from the University of Denver. Karl spent much of his career in information technology and was a talented and highly respected project manager at SCCI, Unisys Corporation, Centura Health, Motorola, ZOLL Data Systems, TriZetto Group and Kaiser Permanente.

DIANA T. CHEATUM '82 died June 21, 2018. She graduated from Mines in 1982 with a bachelor's degree in geological engineering. Diana loved her family, judo, her senior women's basketball team, gardening, beekeeping and home-improvement projects. Her favorite times revolved around good company and sharing time with family, friends and neighbors.

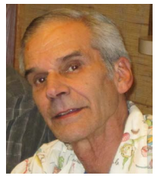
DARWIN D. KING '76 died July 16, 2018, at his home in Birmingham, Alabama. Darwin was born in Clarinda, Iowa, and moved to Loveland, Colorado, in junior high school and graduated from Loveland High School in 1972. He attended Mines on a full-ride academic scholarship and earned his bachelor's degree in metallurgical engineering in 1976. During his career, Darwin worked for Rocky Flats Plant, several high-tech computer manufacturing companies and later owned his own business.

FRANK R. MOULTON, JR. '51 died July 27, 2018. Born in Winthrop, Massachusetts, Frank began his college career at Northeastern University prior to enlisting in the U.S. Naval College. He attended Tufts University and Brown University, where he received his bachelor's degree in naval science in 1945. He was commissioned as an ensign until 1946 when his commission was changed to a reserve, and Frank resigned in 1948 as a lieutenant (junior grade). Frank then earned a degree in geophysical engineering from Mines in 1951 and worked for various petroleum companies throughout his career. He was the president of several companies during his career, including president and chief operating officer of Omni Exploration, Inc., from which he retired in 1984.

ELWYN SHIMODA '58, MS '65 died Feb. 18, 2018. Through the ROTC program, he graduated from Mines with a professional degree in petroleum refining engineering in 1958 and returned to Mines to complete his master's degree in petroleum refining in 1965. He later earned a PhD from the University of Denver. After graduating from Mines, he served five years in the U.S. Army before beginning his engineering career at the Hanford Nuclear Site in Washington. He then returned to Colorado and taught in Mines' chemical and petroleum engineering department from 1966 until 1975. Elwyn then moved to Ponca City, Oklahoma, working in research and development at ConocoPhillips. He returned to Colorado in 1994 where he took a job as a recruiter, often working with Mines graduates and former Conoco colleagues. When he retired a second time, Elwyn became a shuttle driver for Toyota until he was eventually appointed as a liaison for the customer service department.

ALSO REMEMBERED

James M. Rushing '59 ..... May 27, 2018



FRANK VAN DOK, JR. '66, MS '73 died Sept. 16, 2017. Frank was born in Paterson, New Jersey, on July 6, 1944 and raised in Hawthorne, New Jersey. He graduated from Mines in 1966 with a professional degree in physics and then returned to complete a master's degree in mathematics in 1973. Frank became a professional engineer and worked in various industries and companies, including Honeywell, Teledyne Technologies, Gates Energy Products and Columbine JDS Systems. He also taught several math and programming courses throughout his career, including a brief stint at Mines teaching calculus.

To submit an obituary for publication in the magazine, visit minesmagazine.com/submit-an-obituary.

Memorial gifts to the Colorado School of Mines Foundation are a meaningful way to honor the legacy of friends and colleagues while communicating your support to survivors. For more information, call 303-273-3275 or visit giving.mines.edu/givingguide.

Compiled and written by **Ashley Spurgeon**

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MINER'S PIC

A CAN'T-MISS ECLIPSE

Like many people, Chris Bergin '12 knew he couldn't miss last year's Great American Solar Eclipse, a historic celestial event that only happens about once in a person's lifetime. When the event coincided with the bachelor party Bergin was planning for his friend and fellow alumnus Nick Riggert '12, Bergin saw it as an opportunity to celebrate his friend's upcoming nuptials in a nontraditional way. "We were only a short drive away," Bergin said. "It was a no-brainer to make sure we saw it."

Bergin and Riggert, along with Steven Wooldridge '13 and Andrew Corman '12, woke up at 4 a.m. the day of the eclipse and drove south from Portland to get in the path of totality. They stopped in the small town of Mount Angel, Oregon, where Bergin set up his camera.

"I've been a fan of photographing the sky since I took an astronomy class in high school where we got to photograph the sun, moon and deep-sky objects using a telescope," Bergin said. "For these photos, I purchased a solar filter for my camera. It's the same material as the lenses in eclipse viewing glasses but made to fit over a camera lens."

Bergin experimented with his camera throughout the early stages of the eclipse to get the perfect shot. "I was so amazed with the sun in totality that I almost forgot to take a photograph, and it was with only a few seconds left in totality that I remembered to take the photo," he said.

But the real challenge came when Bergin sat down to edit the photos. He had seen some photos of past lunar eclipses that showed a sequence of the eclipse in different phases and wanted to adopt the idea for a series of his own photographs. "Steven Wooldridge actually did most of the editing work after I had taken the photos," Bergin said.

Wooldridge stitched several of Bergin's photos together into one image to create an arc of the various stages of the eclipse. The final result was an exceptional image to commemorate an unforgettable event.

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