

MINES MAGAZINE

COLORADO SCHOOL OF MINES ALUMNI MAGAZINE

Spring 2017 Volume 108 Number 2

BIOENGINEERS CONTROL THE FUTURE OF HEALTH

Using innovative technologies and cutting-edge research, Mines researchers and alumni work toward advancements in the medical field.

14

A NEW LAYER TO METAL MANUFACTURING

With the help of an ADAPT consortium, Mines is changing the history of manufacturing and entering the world of 3-D printing.

20



ADAPT officially launched at Mines in January 2016 and aims to make Colorado a leader in innovative manufacturing processes.

Photo by Deirdre O. Keating

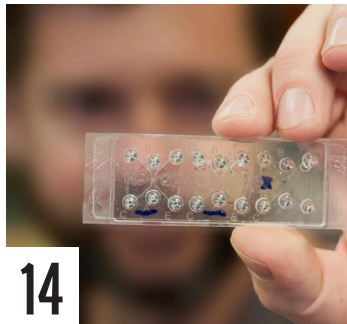
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Cover image: Combining engineering principles with biology, Mines Professor David Marr (right) is leading a team of researchers working to make advancements in medical practices. Alongside graduate students Tao Yang (left) and Dante Disharoon '15 and postdoctoral fellow Onur Tasci, Marr is developing microbots that can be injected into a patient's bloodstream and, using a magnetic field and a joystick, directed through the body to the site of a blood clot and break up the blockage. (Photo by Julian Liu)

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Mines researchers and alumni work toward advancements in the medical field by combining their knowledge of biology and engineering.

A NEW LAYER TO METAL MANUFACTURING 20

With its new ADAPT consortium, Mines is helping industry and government qualify, standardize, assess and optimize advanced manufacturing processes and parts.

WEB EXTRAS | MULTIMEDIA

TO VIEW WEB EXTRAS, PLEASE VISIT MINESMAGAZINE.COM

LASER-CUT LAMP

In January, Mines student Michael Ennis (Class of 2017) set up a timelapse video in one of Mines' makerspaces using a laser woodcutter to make pieces for a lamp. Watch his timelapse video of the woodcutting process and then watch him put the pieces together into a final product.

TO NEPAL AND BACK

In *Mines Magazine's* last issue, we introduced readers to a group of Mines students who traveled to Nepal over winter break with an organization called Hike for Help. Those students reflected on their experiences and described what the trip meant to them. Watch the video on *Mines Magazine's* website.

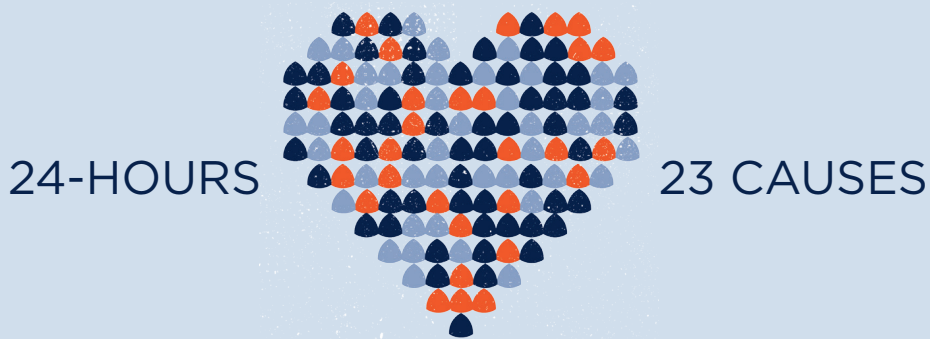
FILMMAKERS AT MINES

Mines has added a new student organization for amateur filmmakers. Students have the opportunity to learn about the filmmaking process, from coming up with video ideas to writing scripts to the final product. Learn more about the club and check out their latest videos at facebook.com/filmmines.

TEDxCSM

Mines students organized a campus version of the popular TED Talks, with the aim of bringing new ideas to the community. The talks included "Failing Successfully in Education," "The Power of &," "The Breakdown of Women in STEM" and a discussion about ethics and engineering. Learn more about the each of the talks on *Mines Magazine's* website.

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VOLUME 108 NUMBER 2
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Mines Magazine is published by Colorado School of Mines and the Mines Alumni Association for alumni and friends of the school. *Mines Magazine* is a critical communication serving the Colorado School of Mines community. Its mission is to keep readers informed about the school, to further the goals of the school and the alumni association and to foster connectedness.

Comments and suggestions are welcome. Contact us via our contact form at minesmagazine.com/contact-us/ or via mail at Mines Magazine, PO Box 1410, Golden, CO 80402. To update your address, go to minesalumni.com/update or email CSMAA@mines.edu.

ALUMNI NOTE

Dear soon-to-be alumni,

The time right before graduation is both exciting and a little terrifying. I remember participating in many of Mines' traditions and longed to keep these connections after leaving Golden. While on campus, I was involved in different activities as part of the Society of Petroleum Engineers, the American Association of Drilling Engineers and the international office, among others. I also held on-campus jobs in the Petroleum Department and Mines Alumni Association. I still wanted to stay connected to Mines but in a different way now that I was about to become an "adult."

Hanging out in Golden, you see people connected to Mines everywhere without having to look for them. But even when I was outside of Colorado, I discovered that whenever I wore some Mines apparel, I still met people who had connections to the school and who would start up conversations just based on the logo on my shirt. That was so much fun and a great way to meet new people.

That's why I've enjoyed staying connected through the alumni association. Upon graduation, everyone is a member. Through their M Clubs and other events, the association provides an easy way to meet people where you live and at events around the world, giving you the opportunity to form relationships with those who share the Mines experience.



Photo by Nathaniel Keller '15

After moving to Arkansas and not knowing anyone, I decided to reach out to the alumni association to see if there were other Mines alumni in the area, and it turns out there were! Last fall I organized a lunch for alumni in the Little Rock area. We had a blast connecting and meeting new people from different majors and class years and while talking, it was fun to realize that, even though we are different ages, a lot of our school stories are similar. I'm working on planning an E-Days 'Round the World celebration for Little Rock, too.

Whether you stay close to campus after graduation or move away, just know there are Mines connections wherever you go. The alumni association is a great resource to use to get in touch!

If you're ever in the Little Rock area, come say hi!

Allyse White '15



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Last year, President Paul C. Johnson joined students in the E-Days festivities for the traditional ore cart pull to Civic Center Park in Downtown Denver.

Photo by Jessica Hochreiter



PRESIDENT'S CORNER

Spring at Mines has its own unique rhythm and feel. There is the unpredictable weather in Golden, many distractions from one's studies (ski slopes, spring break, etc.) and the end of the school year is in sight. The seniors have already calculated the grades they need to graduate—and some are modulating their efforts accordingly. Alumni have told me humorous stories about how they intentionally squeaked by in some classes as seniors, taking great pride in knowing that it frustrated the faculty. I hope someday we can create a "Stories from Mines" archive to capture these and other unique alumni stories.

If you ask any student what they look forward to most during the spring semester, the answer is likely to be about E-Days. It is clearly one of our most beloved traditions, as evidenced by the number of concurrent satellite activities organized by the Mines Alumni Association M Clubs. Dating back to 1927, E-Days is the ultimate celebration of Mines for Mines, with events reflecting our heritage and pride and the opportunity for our hard-working students to blow off some steam. The amount of effort our student-led Mines Activity Council (MAC) puts into planning and producing E-Days is amazing—also reflecting how important this tradition is to students today. My favorite activities are the fireworks (especially the hydrogen flares), concerts and the ore-cart pull. Friends look at me funny when I tell them that about 1,000 students get up at 7 a.m. on an excused day from classes and pull an ore-cart seven miles down Colfax Avenue, all for a breakfast burrito at the start and ice cream sandwiches at the end. Only at Mines...

During the second half of the school year, Elyse and I also enjoy seeing our spring sports teams in action. The Orediggers have become a dominant force in the Rocky Mountain Athletic Conference, and the honors have been piling up this year; so far there have been six RMAC team championships, five NCAA Championship appearances, four Academic All-Americans, seven All-Americans, four RMAC Players of the Year, one National Player of the Year and our first-ever trip to the Elite Eight. Pretty good for a bunch of scientists and engineers carrying heavy course loads! We were very proud when Justin Dvorak '16 was named the Harlan Hill Trophy winner—just about an hour after he crossed the stage at the fall graduation ceremony. See page 8 for more on Justin, and visit minesathletics.com to keep up with the accomplishments of all our teams and student athletes.

I hope you have a great spring wherever you are and that you join us to show your Mines pride at an event on campus this spring or at an M Club event in a city near you. As always, I welcome your ideas for advancing Mines; please contact me anytime.

Go Orediggers!

Paul C. Johnson, PhD
President and Professor

Photo by Deirdre O. Keating

MINES PROFESSOR RECEIVES NSF CAREER AWARD

XIAOLI ZHANG IS RECOGNIZED FOR HER PROJECT ON HUMAN-ROBOT INTERACTION TELEOPERATIONS

Colorado School of Mines Mechanical Engineering Assistant Professor Xiaoli Zhang received an NSF CAREER Award for her project on human-robot interaction teleoperations.

“My work is focused on how humans and robots collaborate, especially in teleoperations, where the human and the robot are not in the same location,” said Zhang. Normally the user operates a keyboard, a mouse or a joystick to remotely control the robot. Teleoperations involves several challenges, such as the indirect visualization and manipulation, as well as the discrepancy between the robotic grip and the device being used to manipulate it.

Zhang explained, “Even using a data glove, the physical structure of a human hand and the robot’s hand are extremely different. If we want robots to do fine manipulations like a human can, we must solve this control problem.”

One of the most successful employments of robotic teleoperations is in a hospital surgical room, where it might be used to remove a gallbladder through a surgical robot. However, there are several situations where teleoperations are also extremely helpful, such as in repairing or inspecting mines, space exploration, search and rescue operations and anywhere that is difficult or dangerous for humans to access.

“The field of robotics is growing quickly, and robots are getting smarter,” said Zhang. “Ultimately, if we want a robot to think like a human, to be intelligent and have autonomy and the capability to regulate itself in order to work with humans, the robots have to first become more aware of how humans achieve those things. Even when it comes to something as simple as picking up a cup, there are multiple ways we approach it, depending on whether our goal is to pass it to someone else, place it on a shelf, drink from it or wash it. We have to investigate our own behavior



patterns in order to formulate a knowledge-based model through machine learning methods for a robot.”

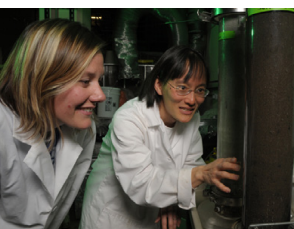
The primary research goal of this project is to develop a novel goal-guided control interface. Instead of passively following the operator’s motion input, the robot will understand the operator’s high-level objective during an object-grasping operation and autonomously conform to task constraints in order to reduce control difficulties and ensure the success of subsequent manipulation.

Another component of Zhang’s research is improving distance-learning systems using robotic teleoperations. When students are in a different location from the instructor, it is a challenge to involve students physically. Zhang hopes to develop an interactive distance-learning system that will involve remote students using teleoperated robots. The system will immerse remote users in the classroom environment by having students control a robot’s arms and hands for object manipulation or interaction with other classmates in the classroom. This will enable remote users to feel present in the classroom and engaged in class activities.

Ultimately, Zhang hopes to reduce the control burden on the human operator, and as she puts it, “the goal is and always has been to improve how robots can help humans.”

The National Science Foundation CAREER Award is the most prestigious award in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations.

by Deirdre O. Keating



TAP THE POWER OF MINES’ GROWING ALUMNI NETWORK

Connect and network with other Orediggers through the Mines online community.

All alumni can access the online directory and search by class year, Mines degree, profession, location and more. Log in to update your contact info, search the directory or class notes and sign up for new interest groups and volunteer opportunities.

minesalumni.com/connect

ATHLETICS

JUSTIN DVORAK '16 BECAME THE SECOND PLAYER IN MINES HISTORY TO BE NAMED NATIONAL PLAYER OF THE YEAR



Dvorak set many records during his time playing for the Orediggers, accounting for 161 total touchdowns, 13,466 throwing yards and 14,608 yards of total offense—both Mines and RMAC records.

Photo by Steve Oathout

Colorado School of Mines quarterback Justin Dvorak '16 received the 2016 Harlon Hill Trophy on January 6, 2017, recognizing him as the NCAA Division II football national player of the year.

Dvorak was presented with the trophy during a banquet at the University of North Alabama, the alma mater of Harlon Hill. He is the second Oredigger to receive the honor, joining 2004 winner Chad Frieauf '05. Dvorak was announced as the winner on December 16, 2016.

An emotional Dvorak dedicated the award to his teammates and family.

"I want to thank the guys who made me look so good over the last four years, my teammates," Dvorak said. "I couldn't ask for better teammates, and I would give anything to play one more snap with them."

The Hill Trophy is named for the late Harlon Hill, who was a standout with the University of North Alabama from 1950 to 1953 before going on to fame in the NFL with the Chicago Bears. The award is sponsored by the City of Florence, Herff Jones, the Marriott Shoals Hotel and Spa and the University of North Alabama.

UNA hosted Dvorak and his family for a morning of activities that included a visit to the D-II Football Hall of Fame, a visit to the original Harlon Hill Trophy, housed at the Shoals Visitor Center, and a chance to meet UNA's lion mascots Leo and Una. Dvorak received his own copy of the 63-pound oak-and-brass trophy.

"It's been a pleasure, and I've really enjoyed my experience in Florence. It's too bad I don't have another year to try to come back and do it again," Dvorak said.

In 2016, Dvorak earned virtually every honor a player could, including D2CCA National Offensive Player of the Year, AP First-Team Little All-America, NFFCC Colorado Offensive Player of the Year and RMAC Offensive Player of the Year. He led NCAA Division II with 4,584 passing yards and 53 touchdowns, and rushed for eight more. His 380.2 total offense yards per game ranked second in D-II, and his 172.4 rating was sixth. Dvorak also led the nation with 366 points responsible for. In his decorated career, he accounted for 161 total touchdowns (134 passing, 25 rushing, 2 receiving) while throwing for 13,466 yards and producing 14,608 yards of total offense—both Mines and RMAC records.



Dvorak is the second Oredigger to receive the Harlon Hill trophy, joining 2004 winner Chad Frieauf '05.

Photo by Tim Flynn

"He's a two-year captain, and I think that's a special thing," said head coach Gregg Brandon. "The quarterback position exemplifies leadership and you want that out of that position, and he certainly did that."

Dvorak is the third RMAC player to win the honor along with Frieauf and two-time winner Danny Woodhead of Chadron State. Austin Ekeler of Western State was also a 2016 finalist, finishing eighth in the voting. Dvorak beat out Northwest Missouri State's Kyle Zimmerman for the top spot in this year's voting, which is conducted by D-II's sports information directors.

Dvorak said, "It means a lot to me; it's a testament to the very hard work I've been putting in for a very long time."

by **Tim Flynn**



Justin Dvorak '16 received the 2016 Harlon Hill Trophy, recognizing him as the NCAA Division II football national player of the year.

Photo by Tim Flynn

UNLOCKING MYSTERIES, MAKING DISCOVERIES

**AN ANNUAL CONFERENCE ENCOURAGES
GIRLS TO PURSUE A FUTURE IN STEM FIELDS**

The Colorado School of Mines student section of the Society of Women Engineers welcomed nearly 200 students—the largest turnout to date—to its fifth annual Girls Lead the Way conference, which guides young women into science, technology, engineering and mathematics fields.

The conference, with the theme “Unlock the Mysteries, Make Discoveries,” took place Saturday, February 11, 2017, at Mines and brought in girls in grades 9 through 12 from all over Colorado and beyond.

The students attended two sessions in the morning. A panel of Mines SWE members representing various majors spoke about their classes and internships and the career opportunities in their fields, followed by a fashion show-style presentation on dressing appropriately for different professional situations.

In the afternoon, participants were able to choose two hands-on sessions based on their interests. Topics included aerospace, biomechanical engineering, metallurgy and materials science, petroleum engineering and robotics, among others. Previous conferences had only offered one such session, but attendees had wanted more because of their multiple interests and space limitations. “By adding a second session, we were able to give more girls more exposure to the types of disciplines they might be interested in,” said Agata Dean, faculty advisor for the SWE section.



Mines' student section of the Society of Women Engineers hosted nearly 200 students and shared their experiences at the fifth annual Girls Lead the Way conference in February.

Photo by Billy Ciccone

More than 120 parents attended a presentation by Jessica Whelehan on admission to Mines, financial aid and student life. Dean said parents had many great questions and provided positive feedback, including one who said the presentation “increased my knowledge about what is available at Mines.” This presentation was a new addition to the conference. At the end of the day, over 100 students and parents went on campus tours.

Kevin Moore, dean of the College of Engineering and Computational Sciences, sponsored students from underrepresented areas: 14 girls from Denver School of Science and Technology, 12 from Thornton High School and one from North High School. In addition, a donation from Mines alumna Rubecca Martinez Dalton '06 allowed nine students to attend, mostly from Adams City High School. (See page 29 for more.)

Longtime corporate sponsors Aera Energy and BP continued their support for the event, and numerous Mines faculty, staff and students supported the conference as volunteers. Dean praised Olivia Cordova, this year's director of Girls Lead the Way, for running the conference, which was also sponsored by the Rocky Mountain Section of SWE.

by Mark Ramirez

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MEET THE EXPERT

Tissa Illangasekare



Mines professor Tissa Illangasekare has spent his 40-year career trying to help solve global problems related to water availability.

Photo by Tim Flynn

It's not unusual to be fascinated by water when you're a kid, but Tissa Illangasekare did more than just jump in puddles to satisfy that youthful curiosity—he built miniature dams and learned the basics of fluid mechanics. Raised in a small village in the central hills of Sri Lanka, he says the landscape he grew up in provided the perfect opportunity to learn about water. “There were a lot of hills with mountain streams, and water was channeled from the top of the hills down to the terraced rice fields,” he says. “So, actually without knowing at that time, I was introduced to the principles of hydraulics and hydrology by playing in the streams.”

Those childhood fun-and-games sparked Illangasekare's passion for water and set the wheels in motion for his future career in hydrology and water engineering. Now a professor of civil and environmental engineering and the AMAX Endowed Distinguished Chair of Civil and Environmental Engineering at Mines, Illangasekare has spent his 40-year career trying to help solve global problems related to water availability, specifically focusing on groundwater. “Groundwater supplies about 35 percent of the water used by humans worldwide, so this is quite an important resource,” he says.

Although many people think urban water comes mostly from rivers and lakes, less than two percent of the Earth's freshwater comes from surface water sources like rivers and lakes. Groundwater provides about 30 percent of the Earth's freshwater, with the remaining 68 percent locked up in glaciers and ice caps. “Groundwater problems in the coming decade are going to be driven by increased demand for water and by climate change,” says Illangasekare. “Humans already use 54 percent of available freshwater, and by 2023, available water for the global population will decrease by 30 percent.”

Other threats, he says, relate to saltwater intrusion into coastal aquifers due to sea-level rise, and increasing levels of pollutants and toxins in groundwater introduced as a result of agricultural and industrial activity and natural causes. Some of these pollutants that were not known to exist in groundwater can now be detected at very low concentrations using advanced instrumentation. In his past and ongoing research, Illangasekare has taken a novel approach to studying aquifer remediation, the process of mitigating the effects of groundwater contamination from industrial solvents and petroleum waste products. By creating “test aquifers,” Illangasekare and his students can study the long-term effects of contaminants in groundwater in a lab setting.

“These systems allow us to do very fundamental science that we can't do in the field, because the field is naturally very complicated,” he says. “So, we study these things very carefully under highly controlled conditions in laboratory

settings, and then we incorporate that information into numerical models, which can be applied in the field.” In his recent work, he has extended these approaches to study technologies for storage of carbon dioxide in deep geologic formations and loading of greenhouse gases like methane to the atmosphere.

The ability to do innovative research, like the test aquifers, was a big part of what drew Illangasekare to Mines nearly two decades ago. In 1998, while he was still a professor at the University of Colorado, Boulder, he says he was contacted by Mines and invited for a visit. “I came down here, and I was very impressed with their vision for the environment and water program, because it sort of matched what I wanted to do in my career,” he says. “Coming here was a bit of a risk I took, because the program here was small with very few faculty and nobody in my specific research area,” he says.

“I thought this might be an exciting opportunity to build something new.”

- Tissa Illangasekare

Despite the risk, Illangasekare says the idea of coming to a smaller school like Mines appealed to him because he thought it would allow him more opportunity for interdisciplinary collaboration, which he believes is essential to doing cutting-edge research. “I thought, this will be good, because the walls are not too high for me to be able to work across disciplines,” he says.

The endowed position he was offered at Mines came with start-up funds to build a laboratory and infrastructure—now the Center for the Experimental Study of Subsurface Environmental Processes (CESEP), where he serves as founding director and oversees several research projects.

When it comes to future research, Illangasekare plans to move increasingly towards inter-disciplinary work. “The exciting research opportunities in groundwater are not going to be in one core area,” he says. “They're going to be at the interface of the different disciplines—looking at groundwater problems from the perspective of biological science, climate science, ecology, health, and the social sciences.

“I think people should have a vision about their research and be willing to take some risks. This is what I believe will put Mines on the map, because we will be working on problems that are relevant to the world as a whole, rather than just working on one thing on our computers and in our laboratories.”

by Laurie J. Schmidt

(BIO)ENGINEERING THE FUTURE OF HEALTH

Mines researchers and alumni work toward advancements in the medical field

When Colorado School of Mines first opened its doors back in 1874, no one could have imagined the school would become a hotbed for biomedical research.

Today, the Chemical and Biological Engineering Department is taking advantage of the school's quantitative and materials science expertise to devise cutting-edge solutions to vexing medical problems. And Mines graduates are using engineering-inspired techniques in their quest to improve human health, from curing cancer to stopping the flu.

Bioengineering, as it's called, is an increasingly popular field of study both at Mines and across the country. Students are intrigued by the new dimensions of medical research in the era of big data and genetic manipulation. Many also seek careers in a field where opportunities are vast and rapidly expanding.

"In the future, there will be a lot of need for biomedical engineers. Our population is getting older, and a lot of money is going into healthcare," said David Marr, a professor and researcher in bioengineering who has also served as department head.

At Mines, some students are learning to use mechanical engineering skills to design orthopedic devices, while others study the chemical structure of drugs or the workings of cell metabolism.

Graduate student Tao Yang inspects the coils that create the magnetic field used to control microbots as they travel through the body toward a clot.

Photo by Joe DeNero



THE FANTASTIC VOYAGE TO A BLOOD CLOT

In his own research, Marr is creating small, injectable particles called “microbots” that transform themselves into powerful clot busters. Made of plastic, the tiny particles can be combined with a solution and injected into a person’s bloodstream. Once they’re inside the body, a physician directs them with a joystick that controls a magnetic field.

“It’s like ‘Fantastic Voyage,’” Marr said, referring to the 1966 science fiction film in which a miniature submarine is injected into a scientist’s body to destroy a blood clot in his brain. Marr’s bots travel to the site of a clot and assemble themselves into a larger structure that is capable of breaking up the clot. When the magnetic field is turned off, the bots disassemble themselves and are carried away by white blood cells.

At least, that’s the theory. So far Marr has tested the microbots in a lab and is now beginning animal studies in collaboration with the University of Colorado.

Clot-busting drugs currently bedevil physicians because once they’re injected, they spread throughout the body and can cause excessive bleeding and other side effects. Marr’s microbots would give doctors pinpoint control over the clot busters’ location. If the treatment proves successful, these microbots might also be used to remove plaque accumulations associated with Alzheimer’s, or even atherosclerosis.

Marr is not the only Mines researcher working on blood clots. Associate Professor Keith Neeves, who works with Marr on the microbots, is developing diagnostic devices to determine whether a person is at risk for clots. He’s also working with Children’s Hospital of Colorado to predict how badly children with hemophilia will bleed and how they will respond to therapy.

In addition to the microbots, Marr is developing a laser cytometer, a device to measure the mechanical properties of cells. This project follows a classical engineering format: applying a force (the laser beam) to a cell to calculate the amount of force necessary to stretch the cell, revealing how flexible or stiff the cell is. They are currently using this approach to study malaria, which stiffens blood cells to the point where they can no longer enter capillaries, leading to complications and sometimes death.

Marr has two patents on the cytometer and has submitted a patent application for the microbots.

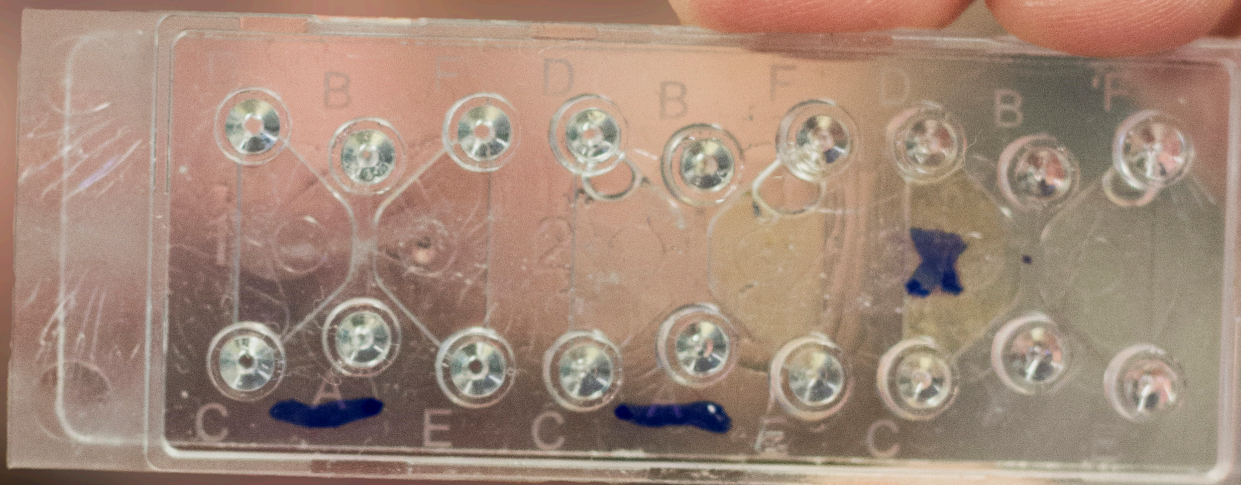


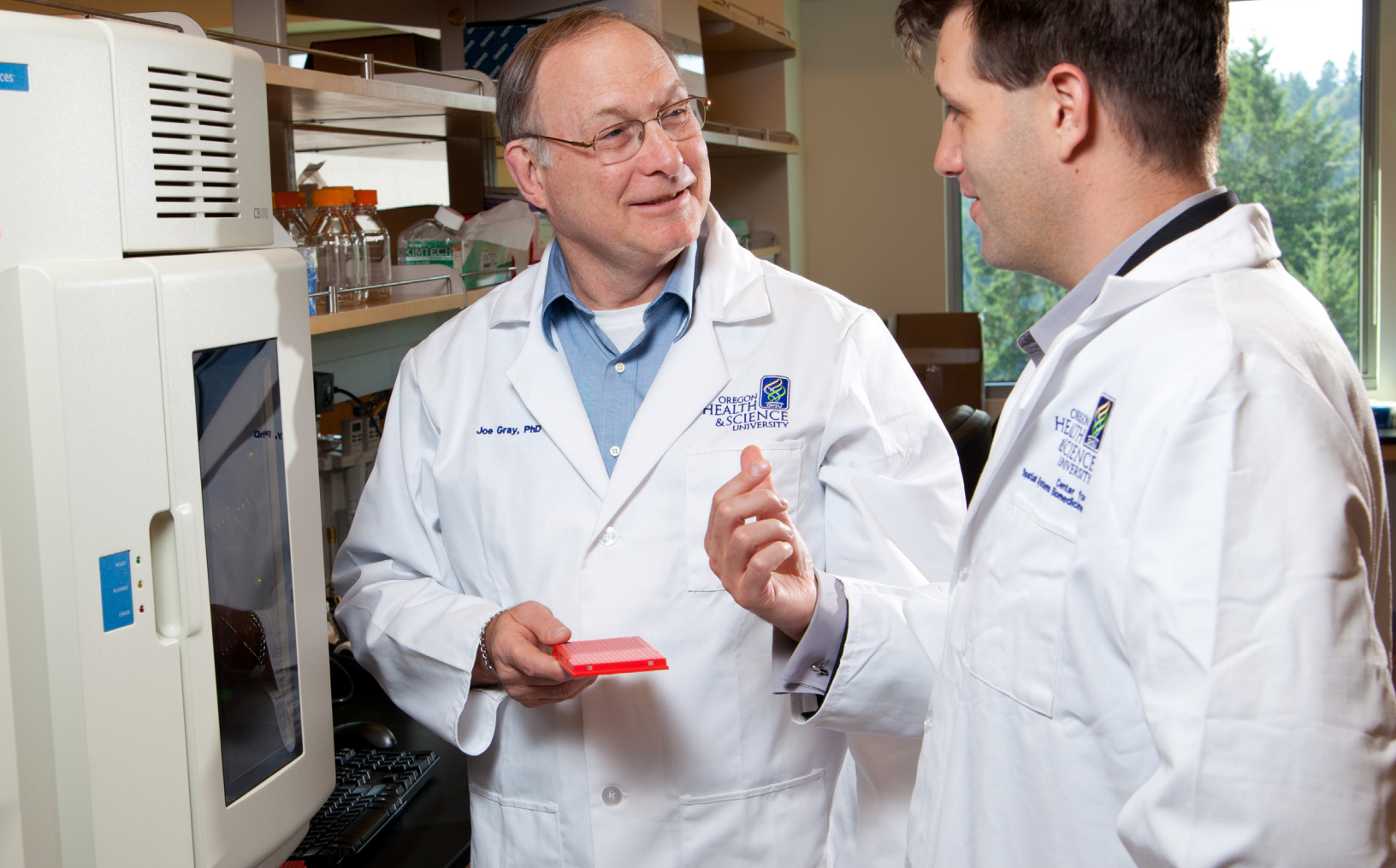
Mines Professor David Marr is creating injectable particles called “microbots” that have the ability to break up blood clots. Here, he works with graduate student Tao Yang.

Photo by Joe DelNero

The microbots (pictured here in a microscope slide, though unable to see with the naked eye) developed by David Marr’s research team may have endless applications in the medical field, including Alzheimer’s or atherosclerosis treatment.

Photo by Joe DelNero





AN ENGINEERED APPROACH TO FIGHTING CANCER

Mines alumnus Joe Gray '68 became interested in biology while in graduate school at Kansas State University, where he was studying nuclear physics and shared an office with geneticists trying to understand how yeast cells work. "It was apparent to me that they could use better tools to do that," Gray said. He began helping them, but his interest in cellular biology and medicine was truly piqued when his father was diagnosed with lung cancer. "I became aware of how little we understood cancer," he said.

Gray switched his career to biomedicine, developing cell measuring devices for Lawrence Livermore National Laboratory before moving to the University of California, San Francisco, where he directed a breast cancer program, and then moving to the Lawrence Berkeley National Laboratory program.

In 2011, Gray was hired by Oregon Health & Science University to develop the university's Center for Spatial Systems Biomedicine, which uses light and electron microscopes to study cancer, cardiovascular disease, infectious disease and neurological disorders.

The center houses an impressive suite of microscopes that allow scientists to see detailed, multiscale 3-D cellular images. "We're trying to develop the Google Earth view of cells and tissues,"

Gray said. "Once we have that view, we want to understand how the parts interact."

Cell and tissue interaction is key to Gray's work. Many researchers study cells in isolation, but in real life, the picture is different. Like people, cells live in communities that shape them and influence their behavior. "If you put two cells that are identical in different environments, they behave differently. We're trying to understand that," Gray said.

The research has many practical applications. Gray studies cancer cells and why they become resistant to treatment as the cancer progresses. He is starting a clinical trial, taking cell samples

from cancer patients during treatment and studying them for abnormalities and mutations. "We want to know, what has your tumor done to escape control, and what can we do about it?" he explained.

Gray's approach is informed by the engineering physics education he received at Mines. "My entire career has been guided by engineering principles and the work ethic instilled when I was at Mines," he said. "I've always taken an engineering approach, trying to understand step by step how cells and tissue behave and how we can control them."

"I became aware of how little we understood about cancer."

- Joe Gray '68

MINES SEEKS TO ADD A BIOSCIENCE PROGRAM

Driven by the high student interest in bioengineering, Mines is in the process of developing a new interdisciplinary graduate program in bioscience.

“The 21st century is the century of biology,” said Keith Neeves, associate professor in the Chemical and Biological Engineering Department. More students now take Biology 101 than Geology 101. Neeves’ Intro to Biomedical Engineering class, which is not required for any major, regularly draws 60 to 70 students every semester.

Bioscience is at a crossroads, with genome sequencing and other developments happening at a pace that’s almost impossible to keep up with, Neeves said. In the past, biology was considered to be less quantitative than chemistry or physics, but as massive amounts of data are collected and analyzed, that’s no longer true. Understanding big data and interpreting it to create something useful plays to the strengths of Mines students, Neeves said.

Currently, courses related to biology and medicine are spread across departments. Over the past decade, the school has added faculty to meet demand. “Thirty of our 130 faculty are directly involved in biosciences in some way,” Neeves said. “The motivation is to put it under one umbrella in an interdisciplinary program. The university needs these programs to be competitive and relevant.”

The program is still in early stages of development.

A NEW APPROACH TO THE FLU

The sad truth about flu shots is that even if you get one, you can still come down with the flu. But if Mines chemical and biological engineering alumna Merika Treants Koday '10 and her colleagues at Virvio succeed, flu vaccines won't be necessary at all. Simply inhaling their solution will prevent any type of flu virus from infecting your system.

The flu virus has been a tough nut for scientists to crack. It takes about eight months to develop a vaccine, which must be ready by flu season. But it's hard to predict which strain will be the most prevalent, and vaccines are typically only 50 percent to 65 percent effective.

Today, researchers are approaching the problem from a different angle. A flu virus looks like a ball covered with hundreds of lollipops. Each “lollipop” has a big head attached to a stem, and while the head changes every year, scientists have discovered a spot on the stem that doesn't change. A lab at the University of Washington, where Koday received her doctorate in microbiology, designed a protein that would bind to the permanent spot on the stem. The protein prevents the virus from infecting cells. Creating it was a eureka moment.

“They were sitting on a gold mine,”

- Merika Treants Koday '10

After receiving her doctoral degree, Koday became one of the founders of Virvio, which opened in late 2015. Using big-data computational power, Virvio creates millions of virus-stopping prototypes on a software platform and narrows the field to perhaps a hundred. The company has started animal studies on the most promising leads.

The proteins they use are small and stable and don't require refrigeration. Unlike a vaccine, they don't affect the body's immune system, so there's no risk of a bad reaction.

Koday's experience at Mines informed the perspective she uses every day. “Engineering taught me to think about things differently. It's helped me a lot,” she said. “In biology, you memorize facts. In engineering, you find the information you need and use it to look at the problem in the right way.”

If the product succeeds, variants might be developed to treat asthma, diabetes, chronic pain or even cancer. “The sky's the limit,” Koday said.



Melissa Krebs received one of Delta Dental of Colorado Foundation's 2016 Innovation Grants to fund her research.

Photo by Leah Pinkus



Mines postdoctoral researcher Jacqueline Harding works with a material that could revolutionize dentistry.

Photo by Leah Pinkus

NO MORE FILLINGS

Once you have dental problems, they never seem to end. Fill a cavity and eventually the filling breaks down and you need a bigger one. Then a crown. And even crowns don't last forever.

Mines' Melissa Krebs, an assistant professor of chemical and biological engineering, has a better idea. With a grant from Delta Dental, Krebs, along with postdoctoral researcher Jacqueline Harding and graduate student Matt Osmond, is developing a natural, porous, mineralized material that can integrate with the body's own tooth cells. Once that happens, those cells can repair and regenerate the missing part of the tooth. The biodegradable filling material would dissolve over time as the tissue repairs itself. Instead of a permanent filling, the patient's tooth would ultimately return to its original healthy state.

"People will still get cavities, but this could bring the tooth back to its native state and prevent it from getting worse over time," Krebs said.

To make her material easy to handle, Krebs uses polymers to create a thick, honey-like liquid that can be injected directly into the cavity. Once in place, the material holds its shape. The repairs will occur over time without the patient even being aware, and before they know it, their tooth will be back to normal.

The material Krebs is developing contains a form of calcium phosphate that can be tuned to match the mineralized materials found in teeth and bones. Beyond dental applications, this type of material may also have use in bone grafts and bone putties as a kind of "glue." Current graft and putty materials don't always work, but these new materials being developed in Krebs' lab would be bioactive and porous, integrating better with surrounding bone tissue and making for a faster, better recovery for the patient.

Whether they're studying teeth and bones, flu, blood clots or cancer, Mines researchers are using their engineering backgrounds to analyze medical problems in new ways. Developing new materials and shaping them step by step to solve a problem is a process that comes naturally to engineers. When they apply their thinking to medicine, the whole world stands to benefit.



Graduate student Matt Osmond works on developing a new dental filling material that could one day change cavity repairs.

Photo by Leah Pinkus



Brandan Kappes explains how the innovations ADAPT and Mines are involved in to keep the manufacturing industry competitive while also improving design and functionality.

Photo by Deirdre O. Keating

A NEW LAYER TO METAL MANUFACTURING

With its new ADAPT consortium, Mines is changing the history of manufacturing and entering the world of 3-D printing

By Mark Ramirez

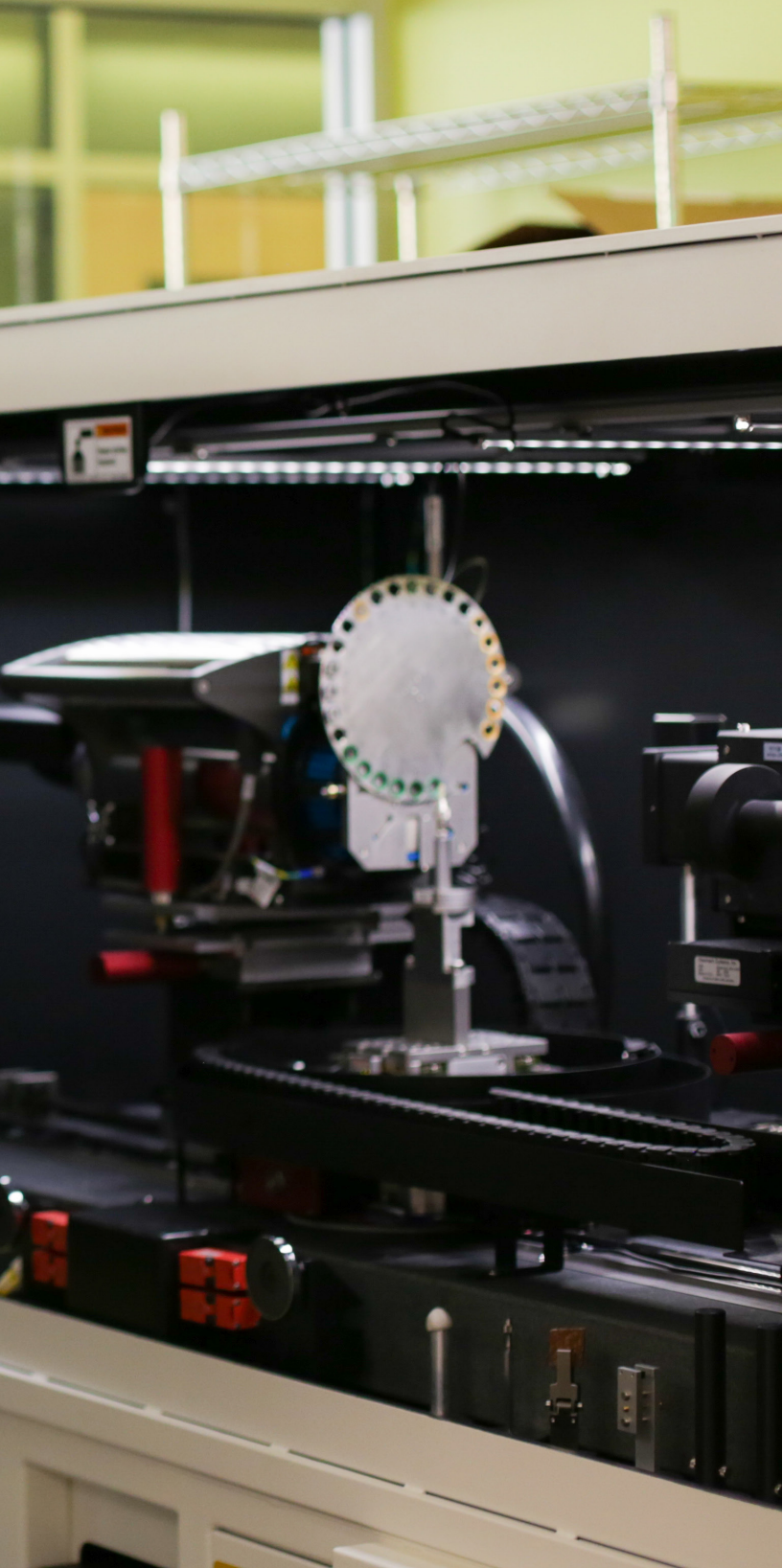
Ask an expert about the possibilities that 3-D metal printing holds for the manufacturing industry, and chances are you'll hear about GE Aviation's fuel nozzle.

This important component of the CFM International LEAP engines that GE uses, which need to dispense precise amounts of liquid fuel, once required manufacturing and assembling 18 different parts. Now it's just one piece, made with a laser that turns powder into solid metal, layer by layer, resulting in the desired shape. Not only does it save time and millions of dollars—the result is a component that's 25 percent lighter and five times more durable than its conventionally manufactured predecessor.

But 3-D metal printing, also known as additive manufacturing, isn't just for companies worth hundreds of billions of dollars. The field is so new, so wide open, that established companies are buying printers without fully knowing what they'll use them for, and even start-ups operating out of garages are getting into the game.

Making sense of all this creative chaos is the mission of the Alliance for the Development of Additive Processing Technologies, or ADAPT, which officially launched at Colorado School of Mines in January 2016.

The people behind ADAPT are not shying away from high expectations.



"ADAPT is going to make Colorado the center of the universe for this knowledge, and we're starting to see that already," said Tom Bugnitz, executive director of the center and CEO of Manufacturer's Edge, a nonprofit working to boost the competitiveness of the state's 6,000 manufacturers through technical assistance and by fostering government and university partnerships.

"It will be iconic in changing the history of manufacturing," said Heidi Hostetter, the vice president of Arvada-based Faustson Tool and chair of ADAPT's Industry Board who led the effort to create the consortium. "In 20 years, people flipping through a book will see that a place called ADAPT helped change the face of manufacturing."

Hostetter started the process that led to ADAPT three or four years ago. "It was the voice of the customer," she said. "We deal with Ball Aerospace, Lockheed Martin—everybody was saying we need someone to champion this emerging technology. If we're going to continue to grow as a contract manufacturer, we'll have to figure this out."

Bugnitz compares it to personal computers in the early 1980s. "Big businesses knew they had to watch it," he said. Companies are investing in 3-D printing knowing they won't turn a profit on it right away, Bugnitz said, "because if we don't, we're going to have our lunch eaten in five years."

Hostetter and her fellow manufacturers identified the data analytics side of 3-D metal printing as a need nobody was filling, which is where Colorado School of Mines and a team led by Assistant Professor of Mechanical Engineering Aaron Stebner, ADAPT's technical director, comes in.

Hostetter said successful previous collaborations with Mines professors led her to pitch ADAPT to Stebner. "What's beautiful about Mines running it is that it's just big enough and just personal enough," she said. "The location is important, as well as the right team, and because of the size of the school, we're more agile."

"It's a natural for Mines," Bugnitz said. "Aaron is world-class, and Mines has a fantastic reputation in metallurgy, which is important. Mines has all of the things in place already: all the right people and all the right facilities."

Stebner, who joined Mines in 2013, conducted postdoctoral research at the Graduate Aerospace Laboratories of the California Institute of Technology, where he specialized in the advanced characterization and modeling of the mechanics of metals. But he got his start in manufacturing as an intern for the Electric Device Corporation in Canfield, Ohio, eventually becoming responsible for the design and manufacture of automation solutions for assembling, testing and calibrating circuit breakers.

With personnel in place, founding stakeholders Ball, Faustson, Lockheed and Manufacturer's Edge put up a combined \$4.5 million toward ADAPT. The group successfully applied for a \$2.5 million grant from the Colorado Office of Economic Development and International Trade, while Mines provided \$1.2 million to outfit 2,200 square feet in the CoorsTek Center for Applied Science and Engineering, currently under construction and scheduled for completion in fall 2017.

ADAPT signed its contract with the state in January 2016 then moved into its temporary space in Brown Hall, holding an open house on June 23, 2016. Mines later welcomed Governor John Hickenlooper who was given a tour of the center on September 30 to kick off October as Manufacturing Month in Colorado.

The consortium started with two fundamental research programs. One, for Faustson, essentially seeks to calibrate the company's 3-D metal printer, which uses the same powder bed laser sintering method as GE's. After many service calls for software updates for its machine, Faustson prints a test plate and sends it to ADAPT, which tests the samples for quality using incredibly advanced equipment, such as the first X-ray diffraction microscope owned by a U.S. university that's capable of both diffraction contrast tomography and submicron-resolution computed tomography.

“We’re characterizing their printer to help them know how to set their processing parameters for whatever part they’re trying to make,” Stebner said.

The second project involves refining the new method Lockheed Martin hopes to use to manufacture spheres to be used as rocket fuel containers for launching satellites. Right now, they’re made using solid blocks of titanium, 52 by 52 by 30 inches, which are machined out into extremely thin 48-inch hemispheres then welded together—a process that takes about 14 months.

In contrast, using a process that feeds titanium wires into an electron beam on a moving plate and creates a continuous meld in the desired spherical shape, plus the machining to smooth out the surface, takes about eight weeks. “That’s a game-changer to them,” Stebner said.

Other ADAPT projects include designing new alloys for biomedical applications and studying radiation damage in 3-D-printed materials for the NSA.

Individual projects aside, ADAPT’s main goal is to use data to solve problems in industry. And doing so requires compiling what Stebner calls “high-pedigree data.”

“Everybody’s working on what’s the next material, what’s the next process, how do I make this part better, but nobody’s

looking at data fundamentally as a way to qualify additive manufacturing parts,” said Stebner. “That’s where we’re focused. Different companies have different data problems, and we’re trying to set up a framework that can solve all of this.”

ADAPT can currently characterize about 4,000 parts per year; in two years, Stebner expects capacity to go up to 15,000 parts annually.

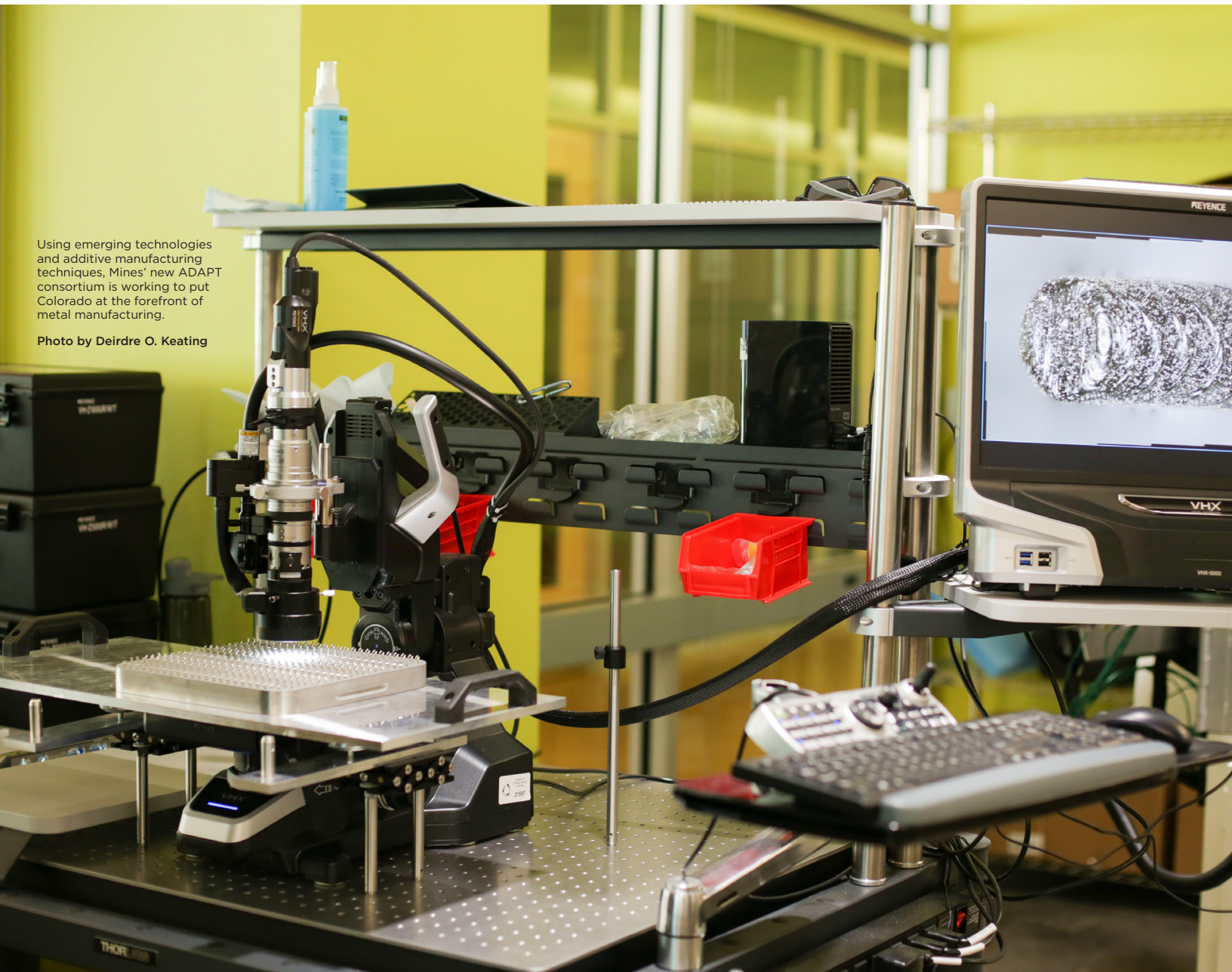
It’s about bridging the gap between academia and industry, said ADAPT Operations Manager Branden Kappes, a research assistant professor of mechanical engineering at Mines who oversees several undergraduate and graduate researchers as well as a postdoctoral fellow. “We’re transforming data from the lab into a format that industry can use in designing a new part.”

And it’s not just for members who have 3-D metal printers—at up to three-quarters of a million dollars, the cost is a pretty substantial barrier to entry—the data can be used by companies seeking consistency and quality in outsourced work.

The consortium has partnered with Citrine Informatics to use machine-learning techniques to create computer models that optimize the parameters for manufacturing a given part using a particular printer. These models are then made available to consortium members via a private database.

Using emerging technologies and additive manufacturing techniques, Mines’ new ADAPT consortium is working to put Colorado at the forefront of metal manufacturing.

Photo by Deirdre O. Keating





Colorado Governor John Hickenlooper visited Mines on September 30, 2016, to kick off October as Manufacturing Month. Pictured from left to right: Aaron Stebner, Katie Woslager, Governor John Hickenlooper, Branden Kappes, Mickle Bragg, Sumer Sorensen-Bain, Heidi Hostetter, Craig Brice, Alicia Svaldi and Douglas Van Bossuyt.

Photo by Deirdre O. Keating

Since launching, ADAPT has added several members just through word of mouth, including Reaction Systems Inc., Qualtek Manufacturing Inc., Elementum 3D (formerly Sinter Print) and Confluent Medical Technologies.

ADAPT leaders expect to add more members in the coming year. Manufacturer's Edge has been reaching out to economic development corporations as well as to manufacturers directly. "We've been getting a good reception," Bugnitz said. "Companies are probably thinking about 3-D metal printing already, and they have the same questions we all have. It's on everybody's radar screen, even though it's new."

Kappes sees plenty of opportunity for growth in the industry. "It's analogous to the App Store or Google Play, where individual developers can distribute a game," he said. "3-D printing allows individuals to fill little niches, pivot to new parts, address changing customer demand."

The ultimate promise of 3-D printing would be the flexibility to suddenly shift and build a general production part, to "build drone wings one day and widgets the next," Kappes said. Printers could be networked and simply download new programs, similar to how viewers choose movies on Netflix.

Another frontier for 3-D metal printing is size—the ability to manufacture both larger parts and components as small as one micron, or one millionth of a meter.

The possibilities extend beyond traditional manufacturing applications, as shown by Confluent Medical's membership. The company established a postdoctoral fellowship with an initial \$100,000 gift. "We're developing partnerships with the University of Denver and their biomechanics department for building artificial implants, with the goal of building parts specific to the individual," Kappes said. "In a futuristic view of this technology, you would go in and perform a CT scan of a patient's hip and build a part that matches their physiology and anatomy."



The CoorsTek Center for Applied Science and Engineering will eventually house ADAPT and provide a central hub for manufacturing innovation on the Mines campus.

Photo by Joe DelNero

"The whole goal, from my perspective, is creating jobs, and we're going to see that," Bugnitz said. He expects machine shops and defense contractors to further adopt 3-D printing and hire more people, and he envisions companies involved in 3-D printing to cluster in Colorado—such as those that make the powders used in the process.

"Companies are going to come here," Bugnitz said, "and companies that are already here are going to expand."

LEARNING FROM A TRAGIC ACCIDENT

Remembering those lost in the 1889
disaster at the White Ash Mine

By Leah Pinkus



As a former gold rush town, Golden, Colorado has an extensive mining history. Along with the growth and prosperity that came with the large influx of people in search of gold and other natural resources, the town has seen its fair share of accidents in its 158 years. The White Ash Mine disaster of 1889 was one such incident that will be remembered long into the future. In 1993, The Foothills Genealogy Society of Colorado archived the event in its book “WPA History of Golden, Jefferson County, Colorado” as “the most serious accident in the history of Golden.” On a Monday afternoon, “at about 4 o’clock in the White Ash Coal Mine, 10 men were at work in the lower level, 730 feet from the surface, when a flood of water broke in on them without a moment of warning, and they were all drowned.”

To paint a clearer picture of this event, Stan Dempsey, a geologist, historian, lawyer, author and recent inductee into the National Mining Hall of Fame, provided a geologic background of the area as well as a historical account of the mine. He commented that given the White Ash Mine’s location along the Front Range, the coal seam sloped at nearly a 90-degree angle. “The White Ash Mine contained a bed of coal that had been upturned along the hogback,” Dempsey explained. While most coal mines are generally flat lying, with little to no dip in the rock formation, the White Ash Mine exhibited characteristics of a vein deposit, more like a metal mine than a coal mine. As a result, “they had to adapt the mining techniques,” said Dempsey, and “they were able to use stoping methods since they didn’t have any roof problems because they were mining on a vertical seam.” Development began in 1877, and by 1888 the shaft was 730 feet deep, making it the deepest coal mine in the state.

But the disaster ultimately stemmed from the White Ash Mine’s northern neighbor, the Loveland Mine, which had been

abandoned in 1881 due to a coal fire. “This left [the Loveland Mine] unattended with two and a half miles of workings filling with water seeping in from Clear Creek,” explained Dempsey. “The White Ash miners had driven as far north towards the now flooded Loveland Mine as the company deemed safe, leaving a 90-foot pillar between the two mines.” However, the coal fire in the Loveland Mine had unknowingly burned downward, thinning the 90-foot pillar separating the two mines.

On September 9, 1889, the pillar finally broke, and water burst through to the 280-foot level of the White Ash Mine, flowing down to the 440-foot level and eventually down the shaft to the very lowest level of the mine, where 10 miners were working in the lower depths. “The force of the mining debris drowned the miners within minutes,” said Dempsey.

Foreman Evan Jones, superintendent of the White Ash Mine on the day of the accident, was able to make it down to the 300-foot level after installing electric lights and attaching heavy ropes; however, bad air forced him back to the surface. The next day at 7:30 a.m., “Jones and the State Mine Inspector went down in a heavy iron bucket to conduct an inspection,” said Dempsey. But after reviewing what they could of the damage and any possibility of getting to the trapped workers, it was decided that for the safety of the crew and rescue team, no further rescue attempts could be made. The shaft at the surface was covered to stop the draft between the two mines.

Since the White Ash Mine disaster and other subsequent mining disasters, the Mining and Metallurgical Society of America was formed in 1908 to address mining safety issues. The “MMSA and the American Mining Congress lobbied to put together the U.S. Bureau of Mines and was tasked with figuring out how to avoid a lot of these types of problems and what to do if you need to conduct a rescue,” Dempsey said.



To commemorate the 1889 White Ash Mine disaster, Mines erected a bronze statue at the new memorial site across from the Marv Kay Football Stadium.

Photo by Calvin Lamdasaputra

To commemorate the White Ash Mine tragedy, Mines held a dedication ceremony on October 29, 2016, for the 10 miners who lost their lives, providing the land, design and funding to create a memorial site. Additionally, the statue of the bronze miner, completed by artist Cloyd Barnes and previously kept in the Colorado School of Mines Geology Museum, was unveiled at the memorial site across from the Marv Kay Football Stadium. The dedication ceremony was led by Marv Kay '40, former Mines football coach and athletic director. "As part of the Clear Creek Athletic project, [Mines] felt the need and desire to see that a permanent memorial be established," said Kay. With this memorial site, he hoped to provide "an eternal remembrance of the tragic disaster and a final resting place for those 10 White Ash miners."

"We're sitting here today just imagining what it was like those couple of days with the wagons, miners and grieving widows," said Kay. "History talks about how the city was full of all the people that were willing to help."

The White Ash Mine in Golden, Colo., was opened in 1862 and became one of the most extensive early coal mines in the state.

Photo courtesy of Golden History Museums, City of Golden



THE MINES RESCUE TEAM

To help keep mining practices safe, the Colorado School of Mines Mine Rescue Team was founded in 2009. Mines established one of the first collegiate mine rescue teams in the world and has now expanded to include three teams: a men's team, a coed team and the world's first-ever all women team. The teams travel nationally, competing in Mine Safety and Health Administration Metal/Nonmetal Mine Rescue Contests. Mines also hosts an Intercollegiate Mine Emergency Response Development exercise every other year at the Mines-owned Edgar Experimental Mine in Idaho Springs, Colorado.

The Mine Rescue Team competes in contests all over the U.S., testing their skills in mine safety and rescue.

Photo courtesy of Mines Rescue Team

SAN FRANCISCO BAY AREA

Orediggers recently gathered at the popular Thirsty Bear Brewpub in downtown San Francisco in conjunction with the annual American Geophysical Union conference. The next day, alumni in the East Bay Area met at Jupiter in downtown Berkeley to enjoy lunch, networking and campus updates. The alumni population in the Bay Area has grown tremendously in recent years, with many graduates pursuing careers in computer science and technology.

San Francisco Bay Area

DENVER The Denver Metro M Club hosts a variety of gatherings throughout the year, including quarterly networking luncheons. These exclusive opportunities provide Orediggers in various industries the chance to get acquainted, trade business cards and get the latest news from campus. Keep an eye out for luncheons in Lakewood, the Denver Tech Center and more in the coming year.

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Reno

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CONNECT WITH AN M CLUB NEAR YOU

Whether you are traveling for business or pleasure, settled in your community or looking to relocate, you can find a fellow Oredigger in almost every major city around the world.

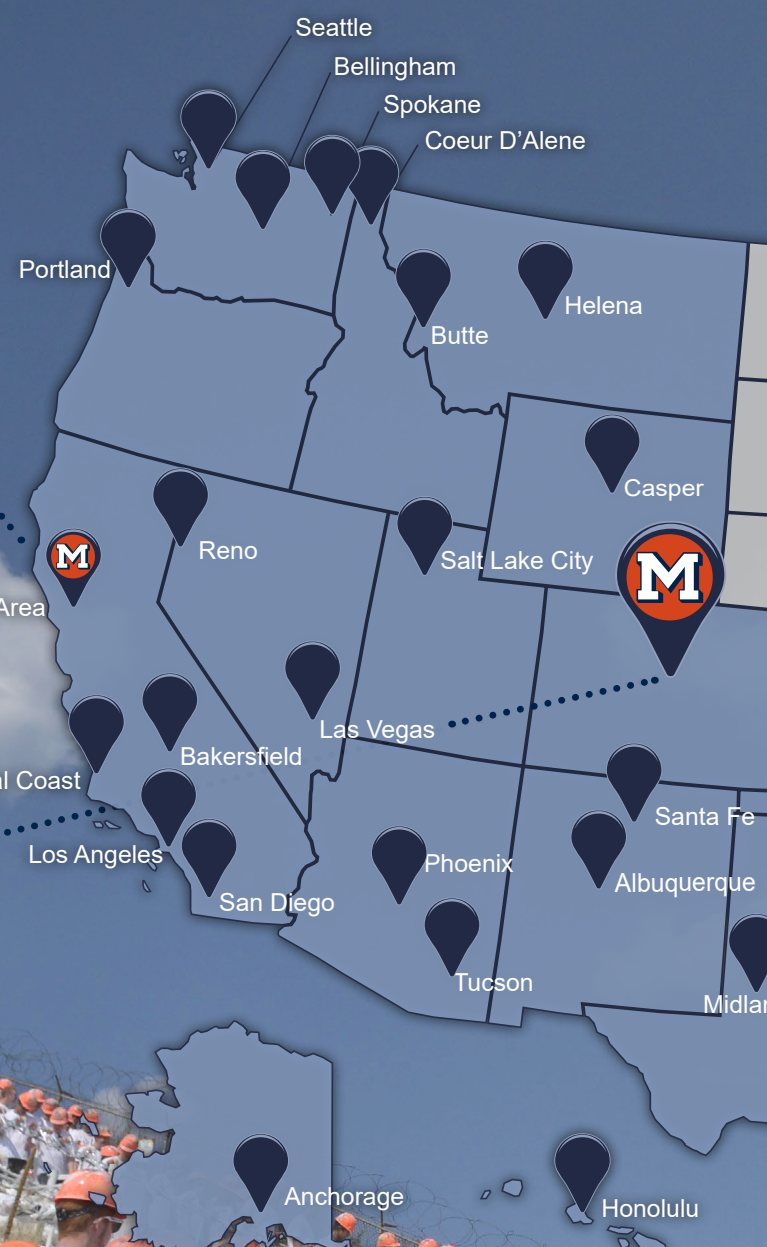
With each new graduating class, M Clubs grow as our newest alumni embark on their next journey. Alumni volunteers lead the charge and organize a variety of events and programs throughout the year to keep alumni connected and informed.

M Club leaders are the cornerstones of our global, robust alumni network, which currently includes 55 clubs (and counting!) and serve as university ambassadors.

Favorite gatherings include E-Days 'Round the World, networking events, professional development programs, golf tournaments and welcome parties for incoming students.

We invite you to stay connected and celebrate the Mines spirit!

Interested in taking an active role with alumni in your community? We have clubs all over the country and around the world. **Visit minesalumni.com/MClubs** to connect with an M Club near you!





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St. Louis

Knoxville

Oklahoma City

Little Rock
Dallas/Fort Worth

The Woodlands

Corpus Christi

Houston

Austin

San Antonio

Boston

New York City

Philadelphia

Washington, D.C.

WASHINGTON, D.C. Alumni in the capital city keep a busy calendar, and 2016 was no exception. With events ranging from meet-ups at Key Bridge Boathouse in Georgetown for afternoon kayaking on the lake, to Virginia wine country tours and escape room adventures, Orediggers enjoy an M Club event nearly every month of the year.

HOUSTON M Club Houston hosted three separate college football watch parties during the 2016 season to cheer on the Orediggers at the alumni-owned Town In City Brewing Company. With such great response from our Houston Orediggers, we look forward to more watch parties in the future. The Houston M Club rounded out 2016 with a holiday luncheon at the Petroleum Club with special guest President Paul C. Johnson, who shared a glimpse of campus from his perspective.

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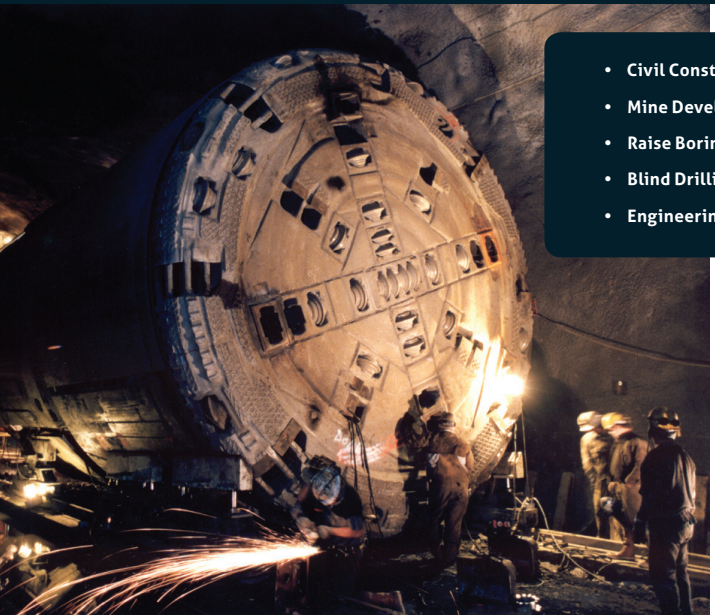
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PUTTING INTO THE PGA TOUR

Every year, Jim Knous '12 and several of his friends make the Waste Management Phoenix Open appointment viewing. This year, however, Knous decided to break par.

Knous played his way into the tournament, securing the third and final spot to compete at TPC Scottsdale on February 2-5. Knous had never played in a PGA Tour event, and he became the first Oredigger in Mines' golf history to earn a professional card on a golf tour. He missed the cut to move on in the PGA Tour but has gone on to compete in the 2017 Web.com Tour in Central and South America.



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ALUMNA PROFILE

GIVING BACK TO MAKE
STEM MORE ACCESSIBLE



Rubbecca Martinez Dalton '06 was first introduced to Colorado School of Mines when she visited the Geology Museum in the third grade, but it wasn't until she entered high school that she was introduced to the possibility of a career in engineering.

For three summers, Dalton participated in Metropolitan State University's Denver Prep Program, where high school students could take math classes that were designed like college courses. She said the professors she learned from described math as a subject that anyone is capable of studying and creates an even playing field for all students. "Before that," Dalton said, "engineering was never on my radar. When you come from a school like North High School, which wasn't a very good school at the time, and of course, I'm female and Hispanic, there are a lot of people who tell you that those are disadvantages. So to have two professors say that math is a great equalizer, that is so empowering. All that mattered was if you could do the math."

Dalton decided she wanted to pursue engineering and chose Mines for the typical reasons students want to attend Mines: the small campus, the welcoming community and the lure of the outdoors. But a less typical reason Mines appealed to her was that the school didn't charge a fee to apply. Not having to pay an application fee made it more accessible for her to pursue her dreams, she said. And now as she has established her career as a welding engineer, Dalton wants to pay it forward and help other women have the same opportunities and exposure to STEM as she did.

"My mom is a high school teacher, and she has a lot of students who are really talented and interested in STEM," she said. "There are a lot of good programs out there, but some of these kids can't afford an extra \$5 a week, much less a \$30 application fee or a \$100 registration fee." Knowing how much her introduction to STEM meant to her, Dalton said she had always envisioned creating a scholarship program to help young students learn more about engineering and science. "It's always been on my list," she said.

Knowing how important STEM programs were to her as a high school student, Rubbecca Martinez Dalton '06 is ensuring other young women are able to have the same opportunities and be able to enter engineering and science professions.

Photo courtesy of Rubbecca Martinez Dalton

Dalton chose to start with a program close to home. She decided to sponsor nine high school girls to attend the Girls Lead the Way conference, organized by the Mines student section of the Society of Women Engineers, which guides young girls into STEM fields. "As a former Mines student who greatly benefitted from programs like this while in high school, I wanted to offer some students who may not have been able to afford the \$30 registration fee a chance to attend as well," she said.

She explained that the best way to give back was to start small. "I realized that I don't need to wait until I have \$100,000 or until I have a huge corporation or charity," she said. "I could just do something small that I could afford right now. Maybe it's only a few girls right now, but it might do something big for those girls."

Dalton sent out some emails to friends she thought might be interested in helping sponsor these students and quickly was able to pull together some funds. "Instead of saying that I can't help these girls until I do something big, I changed my mindset to do something small first," she said. "That was really the thinking behind it: what can I do right now?"

Dalton says that programs like this are really just the first step in helping more women enter engineering and science professions. "Engineering is a really good place—there are a lot of talented women coming up in the ranks, and it's so inspiring to see," Dalton said. "Giving high school girls access to a mentor program and normalizing that there are women in the field is really a step in the right direction."

written by **Ashley Spurgeon**
interviewed by **Leah Pinkus**

CADDYING MINES' FUTURE

ALUMNI GOLF TOURNAMENTS
SUPPORT STUDENT SUCCESS



Mines alumni and friends warm up with a few practice swings before the annual Golden Golf Tournament begins.

Photo by Eric Mohr

Every spring, Colorado School of Mines Alumni Association (CSMAA) hosts four annual golf tournaments, each led by a committee of Mines alumni and friends. This year, all proceeds from each event will support Mines student scholarships.

The Golden Scholarship Golf Tournament, now in its 33rd year, will raise funds for student scholarships for the second year in a row. With the recent change to the alumni association's membership model in 2016, the Board of Directors voted to create a Golden golf scholarship fund, instead of using the proceeds to benefit alumni programming and operations.

This model follows suit of the other three scholarship golf tournaments, led by the Houston Endowed Scholarship Tournament. Created in 2001 by George Puls '75, Kim Harden '74 and Dean Stoughton '75, MS '78, the Houston Golf Tournament was established with the goal of providing athletic and academic scholarships for deserving students from Houston.

Now leading the charge are Mike Scherrer '83 and Lew Mologne '83, along with other members of the Houston Golf Committee. The tournament has raised endowment funds totaling over \$547,000, offering 35 scholarships to students. A current mechanical engineering student and volleyball player from Houston, Alanna Winfield (Class of 2017), was a scholarship recipient last year and says this scholarship has made her dreams possible.

"Ever since I was little, I wanted to study math and science, and starting in middle school, I wanted to play college athletics," explains Winfield. "This organization has made it possible for me to play a successful collegiate sport at an amazing institution and graduate in four years, juggling both of these with a mechanical engineering degree that is setting me up for a successful future."

Next in line to establish a golf tournament was the Oklahoma City Section (now known as the Oklahoma City M Club), spearheaded by T. Weston Hamilton '07 and 2016 Mines Alumnus of the Year, Jim Taylor '76. Proceeds from this tournament benefit the Oklahoma City Endowed Scholarship Fund, which has raised over \$164,000 since its inception and has awarded nine scholarships.

UPCOMING GOLF TOURNAMENTS

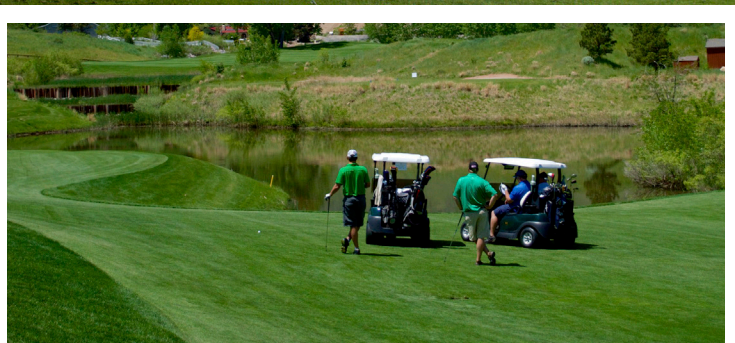
17th Annual Houston Endowed Scholarship Golf Tournament
Friday, April 21, 2017
Gleannloch Pines, Spring, Texas

8th Annual Endowed Oklahoma Scholarship Golf Tournament
Friday, May 5, 2017
Silverhorn Golf Club, Edmond, Oklahoma

3rd Annual DFW Scholarship Golf Tournament
Friday, May 19, 2017
Bear Creek Golf Club, Dallas, Texas

33rd Annual Golden Scholarship Golf Tournament
Monday, June 5, 2017
Fossil Trace Golf Club, Golden, Colorado

Learn more and register today at www.minesalumni.com/events.



The 33rd annual Golden Scholarship Golf Tournament will be held on June 5, 2017, at Fossil Trace Golf Club near the Mines campus and will benefit student scholarships and awards.

Photo by Eric Mohr

Last year, Gregory Chapman (Class of 2018), was awarded one of the scholarships. "My family and I are so thankful for this scholarship," says Chapman. "Being able to go to Mines is such a privilege, and this scholarship has helped me be where I believe I am supposed to be."

In just its third year, the Dallas/Fort Worth Scholarship Tournament is the most recently established alumni golf tournament. CSMAA Board Member Tim Saenger '95, working with Debbie Ozee and Jeff Frayser '83, led efforts to create a golf tournament in another part of Texas, where many Mines alumni and friends live.

Rachel Becker (Class of 2017), was one of the first recipients of the DFW scholarship. "Mines has created many amazing opportunities for me, both in academia and in extracurricular activities," says Becker. "I am so appreciative of the donors and sponsors of this scholarship fund who make our education and experiences like these more attainable."

The Golden Golf Committee will be led this year by several alumni, including Scott Hodgson '03, Lee Fanyo '04, MS '05 and CSMAA Executive Director Damian Friend '75.

"We're excited that for the second year, proceeds from the Golden Golf Tournament will go to support student scholarships," says Ray Priestley '79, president of the CSMAA Board of Directors. "Participants can help the alumni association share the gift of a prestigious Mines education with our world's future leaders."

by **Danelle Herra**

ALUMNUS PROFILE

HOOKED ON RUNNING

Many people try to run a marathon at least once in their lifetime, training for perhaps a few months prior to the event to build their endurance. Ed Thompson '71 took this idea several steps further.

Thompson didn't get hooked on running until he was 56 when a coworker detailed his experience running the Chevron Houston Marathon in January 2005. Sparking his interest, Thompson decided to give it a try and signed up for a program to make himself ready for the next Chevron Houston Marathon. "I began run-walking a mile," Thompson said. "After a couple weeks, I could run three miles. One morning, I ran a half-marathon distance before work." Within a matter of a few months, Thompson had discovered his passion for marathon running.

"My first marathon participation, in 2006, was not a fast one: 5 hours and 37 minutes and the fastest I ever ran," Thompson admitted. While the last 6.2 miles took him over two hours, as Thompson looked around at the finish, he "was surprised it had been so easy," he said, having "envisioned crawling across the finish line." But Thompson perhaps shouldn't have been so surprised given how much preparation he put into training for this marathon. By the time the next Chevron Houston Marathon arrived, Thompson had run seven timed races, including a 25K trail race and a 30K street race, and lost 40 pounds. In the eight years that followed, Thompson ran 32 marathons in 10 states, 10 of which were ultra-marathons—specifically, three 50-mile marathons and seven 50K marathons.

Thompson also shares that through this sport, he has had the opportunity to get to know some inspiring people and build meaningful relationships with his fellow runners. Not long after discovering his passion for running, Thompson befriended a young 17-year-old boy with cerebral palsy. "He could not speak and walked at a kilter to one side," explained Thompson. "Running straightened him up, and he ran and ran for hours." The two were kindred spirits. "On a vacation to South Padre Island," Thompson recounted, "I put [text to speech] software on a laptop; he typed away and his first spoken words to me were "'How can I be a better runner?'" After gaining permission from the boy's parents, Thompson began taking him to races. "I was essentially his coach," said Thompson. The two completed 12 marathons together, including the Boston Marathon. "Runner's World even did a feature on him," said Thompson, "but all good things come to an end, and he moved away."

As Thompson's passion for marathon running grew, so did the intensity of his races. He completed 11 marathons and two more 50K ultras in 2010, growing his resume by running the Boston Marathon and the Maui Marathon. As 2011 rolled around, Thompson continued pushing himself, running 50-mile races, one in Washington and one in Texas, in addition to two 50K's in Texas and a marathon in Oklahoma. Thompson completed another five marathons in 2012, starting with a 50-mile race and adding marathons in Little Rock, Arkansas; Modesto, California; and Boise, Idaho, as well as a 50K in Texas. 2013 marked Thompson's last year of marathon running, tallying his final numbers as 22 regular-



Over the span of eight years, Ed Thompson '71 ran a total of 22 regular distance marathons, seven 50K marathons and three 50-mile races. He is pictured here completing the San Antonio Marathon.

Photo courtesy of Ed Thompson

distance marathons, seven 50K marathons and three 50-mile races.

After eight years of marathon running, Thompson has left the sport with fond memories. Thompson now spends his free time traveling across the globe. As usual, Thompson is never one to go half way, and has explored 22 countries in five years with his wife. "We have climbed the leaning tower of Pisa, the Acropolis to the Parthenon, the Cathedral of Notre Dame, too many castles to count, looked out from the top of Pikes Peak and the St. Mark's Campanile in Venice," said Thompson.

"I miss the fun of the marathon," admitted Thompson, "I have photo albums on my cell phone for each of the marathons. However, I have left that for younger persons."

by Leah Pinkus

SPRING 2017

ON OUR WALL

What was your favorite thing to do on the weekends when you were a Mines student?



Maintenance on the M as part of Blue Key.

-Kimberly Lewis '92, MS '03



Climb a fourteener.

-Eric Hamacher '94

BABIES



MINI GEOLOGIST

Geoffrey Sterling '09 and Amelia Sterling '09, MS '12 are thrilled to announce the addition of a baby boy to their family. George was born on Oct. 19, 2016, and joins his sister, Dash, a lovable boxer/Rhodesian ridgeback mix.



EXPANDING THE FAMILY

Sarah Ruth Alquist was born on Oct. 22, 2016, to Rachel (Miller) Alquist '08, MS '10 and her husband. The family lives in Colorado.



NEW BEST FRIENDS

Chris Locallo '96 and Melissa Locallo welcomed their son, Nikos Christopher Locallo (right), and Scott Hodgson '03 and Sarah Hodgson '09 welcomed their daughter, Charliann Marie Hodgson (left). The babies were born 31 minutes apart on Nov. 20, 2016.



WELCOMING A BABY BROTHER

Sean Fitzsimons '11 and Cindy (Allshouse) Fitzsimons '11 welcomed their second child, Lucas Ryan, on Aug. 9, 2016. He joins his 2-year-old sister, Victoria.



FUTURE OREDIGGER STAR

Samantha (Bauer) Richardson '06 and Brandon Richardson '07 welcomed their baby boy, Logan Bauer Richardson, on July 27, 2016. Logan joins a family of Oredigger athletic alumni, including his grandfather, Gary Bauer '74. Photo taken by Emilyanne (Dalton) Hardy '10.



X FOR XAVIER

Xavier William Hudson was born on Feb. 17, 2017, to Derek Hudson and Kayla Hudson. Xavier weighed in at 5 pounds, 14 ounces and was 21 inches long.



ADDING ONE MORE

Jacqui (Schmalzer) Stackhouse '07 and Dan Stackhouse '07, MS '08 welcomed a baby boy to their family. Logan was born on January 18, 2017, and joins his 2-year-old big brother, Shane.

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To submit a marriage, birth or other alumni news announcement for potential publication in the magazine, visit minesalumni.com/announcement.

WEDDINGS

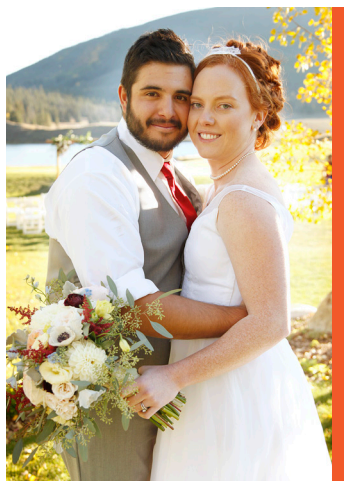


LOVE IN CLEAR CREEK

Jacob Best '14 married and Julia Morin '14 on Oct., 22, 2016, in Colorado Springs, Colo. The couple met during their freshman year at Mines and got engaged at Clear Creek in Golden, Colo. Many of their friends from Mines attended the wedding, including Jesse DeMott '17, Leslie (Sackett) DeMott '14, Christine (Hrdlicka) Jacob '14, Lauren Sepp '14, Josh Morin '10, Quade Lusk '14, Krista (Albers) Cyr '14, Zeb Cyr '14 and Dustin Anderson '14.

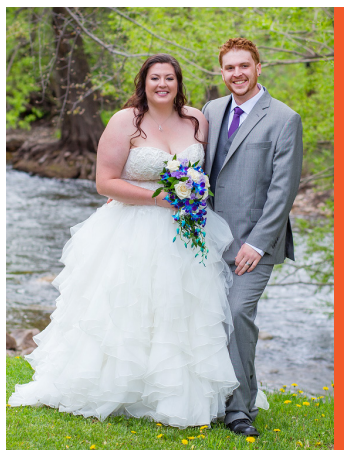
AN IMPRESSIVE GATHERING

Aimee Anderson '16 and Andy Wynes '16 were married on Aug. 20, 2016, at Echo Basin Ranch in Mancos, Colo. Andy and Aimee met in the fall of 2013. The wedding was a three-day event in southwest Colorado. The Mines students and alumni in attendance accounted for over 10 different majors and seven generations of Beta Theta Pi brothers. Alumni in attendance included Lauren Cain '16, Maddy Morones '16, Jessica Lesser '16, Jessica Gerstner '16, Molly Groom '16, Aristotle Vrohidis '14, Stephen Candelaria '16, Aaron Handke '16 and Garrett Sickles '16.



LET'S GET (GEO)PHYSICAL

Roxanna Frary '10 and Brandon Bush '10 were married on Sept. 17, 2016, in Keystone, Colo. Both graduated from Mines with degrees in geophysical engineering. Bo Beins '10, Joey Cohrs '10 and Trent Kennedy '10 served as groomsmen. Other Mines alumni in attendance were Mark Bush '82, Cedes Hoffmann '10 and Paul Schwering '05.



WEDDING BLISS

Nicole White '13 married Seth Stewart on May 20, 2016, in Boulder, Colo. The couple met through Seth's fraternity while he attended University of Colorado Boulder. Mines alumni who attended the wedding included Jon Pigg '12, Mary Monks '12, Brittany Smith '13, Emily Milligan '14, MS '15 and Laken Hartman '16.

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In Other

NEWS



FULBRIGHT SCHOLAR

Greg Stone '97 won a Fulbright grant to be a visiting professor in March 2017 at Taras Shevchenko National University of Kyiv in Ukraine. Stone is currently a finance professor at the University of Nevada, Reno.



MINING THE MOON

Deborah Peacock '78 published "Mining on the Moon; Yes, It's Really Going to Happen," in Mining Engineering's January 2017 issue. The article addresses the numerous private companies that are developing technology to allow the extraction of resources from the moon and asteroids.

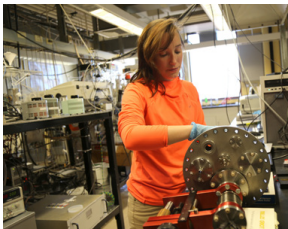


BUSINESSMAN OF THE YEAR

Newth Morris '96 was recently honored as the 2016 Business Person of the Year by the Orange County Business Journal in Southern California. Morris had also been honored as the Innovator of the Year. In 2015, Morris and fellow Mines alumnus Jason Koch '97 were named Entrepreneurs of the Year by the publication. Based in New Zealand, Morris and Koch founded Telogis in 2001 with Ralph Mason and worked with Telogis' leadership team to grow the connected commercial vehicle software company to the point where it was acquired in the summer of 2016 by Verizon Communications.

MINES ALUMNI CAREER RESOURCES

Mines Alumni Job Center offers opportunities for both job seekers and employers.



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Employers: Post jobs and gain access to talented Mines alumni.



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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



ANDREA C. BLAINE '97, MS '12, PhD '14 died Dec. 22, 2016. She was born in 1975 and graduated with three degrees from Mines: a bachelor's degree in chemical engineering, a master's degree in environmental science and engineering and a PhD in civil and environmental engineering. Andrea also earned a master's degree in horticulture from Colorado State University. She was a research assistant

professor of civil and environmental engineering at Mines and the assistant director of the ConocoPhillips Center for a Sustainable WE2ST. Among many publications, Andrea was the lead author of three “Environmental Science & Technology” articles, and her research into the accumulation of perfluorochemicals into crops has been used to inform public health policies in Colorado and beyond. She was also passionate about STEM outreach.



CARLTON E. “CARL” GERITY '61 died Oct. 26, 2015. Born in Denver, Colo., in 1938, Carl graduated from Mines in 1961 with a degree in mining engineering. After graduation, Carl accepted a job with Bear Creek Mining Corp./Ozark Lead Co. and moved to the lead belt of the Missouri Ozarks. Carl worked for the underground mining operation from 1961 to 1975. In 1975, Carl moved back to Denver to

accept a minerals development director position with Occidental Petroleum Corporation. When the company closed its mineral division in 1983, Carl moved into an engineering position with Texasgulf Inc. (later known as Elf Aquitaine). In the 1990's Carl started his own engineering consultant business, Pioneer Minerals Inc. His clients included various gold, silver, turquoise and copper mining operations, as well as the U.S. Forest Service, which was constructing campgrounds in northern Colorado. Carl was a licensed professional mining engineer and land surveyor. He was a 50-year member of the Colorado Mining Association and served as chairman of the Colorado AIME Society of Mining Engineers. He retired in 2005.



JOHN E. HUDSON '50 died Dec. 30, 2016, in Post Falls, Idaho. John was born in 1923 in Lake Wales, Fla. He received a professional degree in geological engineering from Mines in 1950. As a student, he was a member of the Sigma Alpha Epsilon fraternity. He served in the U.S. Army in Europe from 1944 to 1946 and was in the Battle of the Bulge at Bastogne, Belgium. He also served as a field artillery officer in

South Korea from 1951 to 1952. He retired from the military in 1972 with the rank of colonel. Among many awards, he received the Silver Star, Bronze Star with an oak leaf cluster, Purple Heart, Commendation Medal with clusters and the French Croix de guerre. After his military service, he was a registered professional engineer in five states in addition to being registered as a certified general contractor and real estate broker. John was an avid golfer and enjoyed flying planes and bowling.



CESAR M. PALENCIA MS '76 died Jan. 22, 2017. He was born in 1934. Cesar received a master's degree in mineral economics from Mines in 1976. After graduating, he spent his career working as a physical scientist at the U.S. Bureau of Mines' Minerals Availability Field Office in Denver, Colo.



ROBERT G. UNDERWOOD died Jan. 7, 2017.

He received his undergraduate degree from the University of North Carolina in 1967 and completed his PhD from the University of Virginia in 1974. After graduating, he accepted a teaching post at the University of South Carolina and later joined the Mines faculty in the summer of 1978. Robert taught in what was then known as the Department of Mathematical and Computer Sciences. He became an emeritus associate professor in 2003. After retiring from academia, Robert discovered an interest in filmmaking, specifically special effects. He came out of retirement and moved to California to work on the film “The Day After Tomorrow” (2004), developing the movie's water animation effects. He also worked at Rhythm and Hues Studios, a visual effects and animation company, on the film “The Chronicles of Narnia: The Lion, the Witch and the Wardrobe” (2005). He retired for the second time to Annapolis, Md., where he continued to play tennis, cycle and sail.

ALSO REMEMBERED

Dwight F. Barger '61	June 29, 2016
Ralph L. Bradley '47	November 30, 2016
Dennis A. Evans '57	September 29, 2016
Arthur W. Lankenau '48	March 17, 2016
Terry L. Stahr '96	May 25, 2016

compiled and written by **Ashley Spurgeon**

To submit an obituary for publication in the magazine, visit minesalumni.com/obituaries.

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, contact **Christina Dillinger (303-273-3213 or cdilling@mines.edu)** or visit giving.mines.edu/givingguide.

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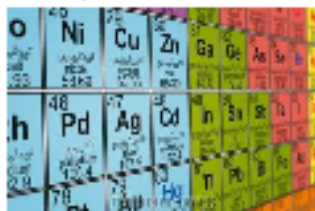
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MINER'S PIC



AN EYE FOR THE ARTS

Daniel Rose (metallurgical and materials engineering, Class of 2017) may have limited experience with the visual arts, only being an active photographer for about a year and a half, but he doesn't let that hold him back. Rose took the photo above as part of a shoot he did for his friend, Jerimiah Owens, a professional pianist and musical director and instructor based in Boulder, Colorado. "We put together a large spread of profile photos and a few more off-the-wall ones," Rose said. "Although his face is not featured, we felt this one in particular captured his spirit quite well."

Rose is vice president of the Mines Photography Club and has found spending time behind the lens to be an inspiring creative outlet. "I've found photography gripping," he said. "It's been an excellent tool to connect with people from all spheres of my life."

To see more of Rose's work, visit his website at www.rosefotograf.com.

To learn more about Jerimiah Owens, visit www.jerimiahowens.com.

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