



MINING FOUNDATION OF THE SOUTHWEST

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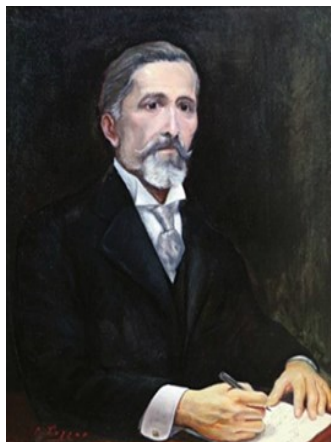
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CONCENTRATES

2016 Mining's Past Inductees



Marco Chiapponi (1854-1929)
Italian Engineer

Marco Chiapponi was an Italian Mining Engineer who immigrated to Chile and played a crucial role in the resounding success of the Braden Mine, better known as El Teniente.

In the late 1890's, Chiapponi examined some inactive mines in the Andes for the Concha y Torro family. When advised of

the cost to bring into production, the family hired Chiapponi to sell the property. Chiapponi approached William Braden in 1903. Capital was raised and the Braden Copper Co. started developing the deposit. Braden received founder's shares which he split with Chiapponi.

Chiapponi played a major role in the development of the mine. He was contracted to build a road connecting the mine with the railroad and also in freighting equipment to the mine. Over 1000 men were employed in this endeavor. By 1906, the concentrator started production. Production slowly expanded and it was apparent a railroad would be needed. To get additional capital, Braden sold out to the Guggenheims in 1910.

As expansion proceeded, mill recoveries became a serious problem, falling under 50%. Confident that low grade ores could be processed, Chiapponi's last and perhaps most important act was to suggest to Braden to send ore samples to Minerals Separation Co. in London for testing. These tests were successful, and Braden became the first mine to successfully use flotation for concentrating copper.

Chiapponi returned to Italy before his death in 1929, leaving remarkable achievements including the development of the world's largest copper mine and the successful application of copper flotation.



Theodore Hoover (1871-1955)
American Mining Engineer, Conservationist & Educator

Theodore Jesse Hoover, the older brother of President Herbert Hoover, graduated from Stanford University in 1901 with a BA degree in Geology and Mining.

Hoover's professional career began as an assayer at Keystone Consolidated Mining Company. A year later he joined Standard

Consolidated Mine as an Assistant Manager where he successfully applied the Moore Slimes Process in recovering gold from slimes. This made Standard Consolidated financially strong and Hoover was promptly promoted to Manager.

In 1907, Hoover became the General Manager of Minerals Separation, Ltd. in London, a firm founded to buy and license the new froth flotation process to recover minerals from ores. He directed the firm for over four years, and had a large influence in the design and development of a very successful flotation machine.

Hoover then became successful as an international consultant, engineer or administrator of many mining companies in Asia, Australia, Europe, Africa and America. He was the author of *Concentrating Ores by Flotation* (1912), *Economics of Mining* (1933), and *The Engineering Profession* (1941) and of numerous technical articles.

In 1919, Hoover returned to Stanford. He was the principal guide in the formation of the School of Engineering and served as Dean of the Department from 1925 until his retirement in 1936. Under Hoover's leadership, Stanford developed a strong engineering curriculum.

Equally revered as a naturalist, Hoover was a founding member of the Cooper Ornithological Society. Hoover Lake in Santa Clara County and the Theodore J. Hoover National Preserve in northern Santa Cruz County, both in California, were named in his honor.

2016 Mining's Past Inductees, cont..



Robert Bogart (1923-2002)
Visionary General Manager,
Bagdad Copper Company

Robert Bogart graduated High School in Globe, Arizona. His strong background in math and surveying enabled him to get a job as Assistant Engineer at the Hillside Mine in 1941. He then joined Bagdad Copper Company as a surveyor but left in 1944 to join the armed services. On his

discharge in 1946, Bogart rejoined the company while enrolled in correspondence courses in Civil Engineering.

After being appointed Assistant General Manager, one of his first acts was to institute long range mine planning. More responsibility and promotions followed. Upon the merger of Bagdad with Cyprus Mines in June of 1973, Bogart became Assistant General Manager and Vice President of the new Bagdad Copper Co. By October 1973, he was promoted to General Manager, a position he held until his retirement.

Bogart, in his 39 years spent at Bagdad, consistently demonstrated superb engineering skills overseeing major expansions in 1973 and again in 1979. His most significant accomplishment was championing, pioneering and implementing the Solvent Extraction/Electro Winning process. Bogart successfully supervised a team to build a pilot plant at Bagdad which proved the process viable. In 1970 a full scale plant came on stream and paved the way for this cost efficient method of recovering leachable copper to become the industry standard adopted throughout the world. Bagdad now has the distinction of having the world's oldest operating SX-EW operation.

During Bogart's tenure, Bagdad always operated with the highest morale, consistently achieving optimum efficiency and productivity. In 1990 Bogart authored the book *Some Talk about a Copper Mine: A History of Bagdad, Arizona*.



Maurice C. Fuerstenau (1933-2012)
Professor Emeritus of
Metallurgical Engineering

Maurice C. Fuerstenau earned his B.S. in Geological Engineering from the South Dakota School of Mines and Technology, and received his M.A. and Sc.D. in Metallurgy from the Massachusetts Institute of Technology.

Known internationally in the areas of froth flotation, hydro - metallurgical processing and environmental remediation, Fuerstenau's storied teaching career began at the Colorado School of Mines in 1963 followed by a brief appointment at the University of Utah. For the ensuing 18 years spent at the SDSM&T, he was Head of the Department of Metallurgical Engineering and was honored by SDSM&T with the Presidential Award in 1979, the Guy March Silver Medal in 1998, and the Distinguished Alumni Award in 2004.

Fuerstenau joined the University of Nevada, Reno in 1988 as Echo Bay Mines Distinguished Professor and was named Foundation Professor in 1996, Professor Emeritus in 2005 and was the Senior Mentor Award recipient in 2002. Fuerstenau was further granted the Newmont Endowed Professorship in Minerals Engineering in 2010, the highest honor UNR can bestow on its faculty.

A consummate educator, Fuerstenau always challenged his students to reach their potential. He published 125 technical papers and edited numerous books. *Principles of Mineral Processing*, published in 2003, remains an industry standard and his research accomplishments are referenced extensively. He was awarded three patents, was elected to the prestigious National Academy of Engineering in 1991 and the South Dakota's Hall of Fame in 2006. Fuerstenau was President of SME in 1982 and received the SME Distinguished Member Award as well as countless other recognition.

2016 Medal of Merit, Young Professionals



Justin Cross

***General Manager, Bagdad Operations
Freeport-McMoRan Inc.***

Justin Cross currently serves as the General Manager of Freeport-McMoRan Bagdad Operations. After graduating, Cross began his career with Freeport-McMoRan as a Rhenium Production Supervisor at Sierrita Operations in 2006. Since then, Cross has worked in a variety of operations and maintenance roles at various Freeport sites. He became the Hydrometallurgical Manager and a member of the Morenci Senior Leadership Team in 2012 at age 31. In 2014 Cross became Manager of Haulage at Morenci leading a department of 600 people. Cross assumed the role of General Manager of Bagdad Operations in 2016.

Cross defines success as being a part of high performing teams, regardless of his role. The opportunity to contribute to large scale mining operations and work side by side with people dedicated to meaningful work have been the biggest rewards of his career.

Cross has championed advances in the mining industry through several key initiatives, including new product commercialization serving the solar and specialty alloy industries and large scale cathode quality improvement efforts. The cathode quality initiatives allowed Morenci to achieve LME certification for its three electrowinning tankhouses and led to best practice and cathode quality improvement across Freeport-McMoRan's hydrometallurgical operations.

Contributing to improvements more locally has also been a focal point for Cross. During his time as Manager of Haulage, Cross' department led the charge in optimizing haulage efficiency while meeting increased mill ore requirements of Morenci's recently expanded mill as it went from 55 to 125ktpd. His passion for enhancing development opportunities for young mining professionals contributed to notable results in the development of the internship program and improvements in the onboarding of young professionals.

A native of Tucson, Arizona, Cross received bachelor and master's degrees in Metallurgical and Materials Engineering from the Colorado School of Mines. He is a strong supporter of SME, serving as the Morenci Section chair for 3 years. During that time he led the organization in recruiting members across a spectrum of careers and fostered a positive environment for mentoring and career development for members.

Cross graduated from Canyon del Oro High School in Tucson, where he met his wife, Shawna Raikes, during his Junior year. They are the parents of 3 young daughters and currently reside in Bagdad, AZ.

2016 Medal of Merit, Young Professionals, cont.



Michelle Lammers

Corporate Manager of Development Projects & Services
ASARCO LLC

Michelle Lammers, following her father's footsteps, attended the South Dakota School of Mines & Technology and received her Metallurgical Engineering degree in 2001. She was a member of the Mining & Mucking Team and was on the only all-women's team ever fielded by SDSM&T. In her last year of participation in the annual Intercollegiate Mining & Mucking Competition, won first place in jackleg drilling.

Upon graduation, Lammers was immediately hired by ASARCO as a Control Room Supervisor in the North and South Mills at the Mission Complex. Within 2 years, she was transferred to the Ray Complex as Supervisor over the Concentrator and the L-SX-EW (Leaching- Solvent Extraction- Electrowinning) processing plant. She was named the Acting General Maintenance Supervisor in 2004 and was awarded the official title in 2005, a position rarely given to Metallurgical Engineers. In 2007, in addition to serving ASARCO's Ray Complex as the General Maintenance Supervisor, Lammers was given additional responsibilities as Acting General Operations Supervisor. Under her leadership, the plant met all its safety, production and cost goals.

Lammers continued her upward career path and was named the General Operations Supervisor at the Ray Concentrator in 2008. At the age of 31, she became the Manager of South Mill in 2010. During her tenure there, Lammers was also tasked with the responsibility of overseeing the South Mill Expansion Project. Again, she exceeded expectations with South Mill increasing production by 33% and recapturing its capital investment within a short time. After spending three years at Mission, she was assigned to the Tucson Headquarters to her current position as Corporate Manager of Development Projects & Services overseeing multi-million dollar expansion from concept through construction. The Hayden Converter Retrofit Project and the Silver Bell Mammoth Heap Leach Facility are among her current responsibilities.

Born in Fresno, CA, Lammers was a scholarship varsity basketball player at SDSM&T and played on the squad reaching the NAIA Final Four! The 1997-98 Lady Hardrockers basketball team with the 28-4 season, setting records with most points in a game (104) and with the highest season scoring average (81.0), unbroken to this date, was inducted into the SDSM&T's Hall of Fame in 2015.

Lammers has spent her entire working career at ASARCO and is an active SME member.

OUTREACH CORNER by Pam Wilkinson

MFSW Outreach Coordinator Activities: July—September 2016

The summer ended and the school year started and almost 1000 students and 11 teachers in classroom settings have participated in activities and presentations. The schools and cities are listed in the chart below. All of these schools have participated in the program in the past. This is down a bit from last year, because some schools have changed the time of year they teach certain curriculum, and teachers change what they teach, still a good start to the year.

School	City	Students	Adults	Date	days	classes
Bogle Jr Hi	Chandler	41	1	9/9/2016	1	1
Ironwood Ridge HS	Oro Valley	148	1	9/13/2016	1	6
Sonoran Foothills School	Phoenix	85	1	9/15/2106	1	4
Snowflake HS	Snowflake	156	1	9/20/2016	1	6
Blue Ridge Jr Hi	Pinetop	90	1	9/21/2016	1	3
Scottsdale Prep Acad.	Scottsdale	141	3	9/23/2016	1	6
Mohave HS	Bullhead City	295	3	10/3-5/2016	3	15
Total		956	11		9	41

The Nevada Mining Association teacher workshop in Reno was a huge success; I taught 30 teachers my rock cycle and mineral deposits activity. It met with great success and there are plans to create an app for the game. I will be coordinating with Jonathan and Beth Price (former state geologist of Nevada) and Joseph Riney of the Nevada Mining Association on this project. We hope to enter the activity into the Move Mining Competition at SME. Also during the two day workshop I interacted with and taught most of the additional 50 teachers who attended the workshop. Here is the group of teachers at the Stillwater Geothermal Plant and fossil hunting in the diatomite quarry:



I spent time working with Suzanne Kinney who is consulting for the Arizona Mining Association education committee to see what AMA can do to support museums around the state in presenting the modern face of mining. We had phone calls, meetings and tours of several museums (Desert Caballeros, Castle Dome Mines Museum, Copper Art Museum, and River of Time Museum) around the state. This project is in its infancy and we are not quite certain where it will go from here. The museums all have very different needs and also service very diverse communities.

Outreach cont.

Peoria School District invited me to be a part of an in-service teacher workshop day. I had 14 teachers in my class and taught them about mineral use, mining, and they played the rock cycle and mineral deposit game. It was a success and I am being invited to return to another teacher workshop in early 2017.

September found me at MINExpo in Las Vegas where among other events I managed to meet with a Reno teacher who was there because their school is creating a mining track and she wanted to learn more about the mining industry and possible career opportunities for her students. I introduced her to many people who can assist her in creating the program at her high school. I was also instrumental in assisting Catie Carter, who was sent to host the Arizona Geological Survey/State Geologists booth by herself. It was her first time at the event. I spent time making certain she had what she needed and introducing her to people in the industry. In addition I took many photos that I can use in my presentations. I also attended the SME mid-year meeting while in Las Vegas, as I am on the products and services strategic committee.

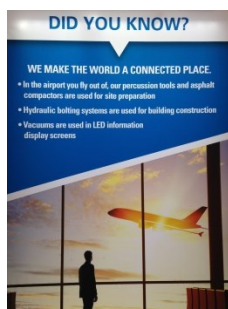


Komatsu Haul Truck: Payload: 320 tonnes



Komatsu Driverless Haul Truck: 230 metric tons

Atlas Copco had a magnificent display titled "Did You Know?" which linked the mining industry to fresh water, breakfast, hospitals, fruit juice, watches, airplanes, skiing, football, fossil discovery, clothing, automotive safety, bathrooms, parking lots, glasses, and kitchens. I have been in touch with their marketing group to see if we can take that information and make it into something that can be used by everyone in the industry.



While at Blue Ridge Junior High School in Pinetop for the 7th grade science classes, I also had the opportunity to speak with a small group of special needs students and their teachers. They especially enjoyed the chrysocolla sticking to their wet fingers and how the hectorite made their hands feel soft.

All in all, a great start to what looks to be a very busy school year!

IN MEMORIAM



Lee Allison, Director of Arizona Geological Survey, passed away this past August 16. During his nearly 11 year tenure at the Arizona Geological Survey, Allison managed to double the agency's personnel and activities despite a 45% drop in state support. In addition, he led the effort to convert more than a million paper files into searchable computer form; obtained sizable grants from the National Science Foundation enabling massive amounts of geological data into usable format for researchers; completed mapping Earth fissures and created a network of seismic sensors to record small tremors and created the National Geothermal Data System. Allison was the recipient of the Public Service Award of the American Association of Petroleum Geologists, the Tanya Atwater "Encourage" Award from the Association for Women Geoscientists and the John T. Galey Jr. Award for Public Service. Previous to being appointed as Arizona State geologist, Allison was state geologist for Utah and Kansas. While at Kansas, he supported "creation science" and eventually founded the Coalition on the Public Understanding of Science.



Conrad E. Huss, MFSW's 2015 Inductee, passed away this past September 16. Despite his humble roots, Huss earned dual undergraduate degrees in English and Engineering; earned his Master's and PH.D. in Engineering Mechanics; served as a Lieutenant Junior Grade in the Navy; taught high school science and math; accepted a professorship at Northern Arizona University; worked design and engineering jobs at Raytheon, RGA and Mountain State Engineers. Huss eventually helped found M3 Engineering & Technology Corporation in 1986 and served as its Chairman of the Board for its entire 31 years. Over the years, through Huss' guidance, M3 emerged to a full discipline firm offering complete project execution in architecture, engineering and construction management. A devout Mormon, Huss spent 13 years working with toddlers at the church nursery and last served the Bishopric as the Financial Clerk.

EVENT: CELEBRATING LEE ALLISON'S LIFE

Place: Performance Garden of Tohono Chul Park, 7366 N. Paseo del Norte

Day & Time: Saturday, November 19, 6:00 to 10:00 p.m.

Rsvp: Kristi Sagar, ksagar@clearcreekassociates.com

Light Dinner & Drinks (Cash Bar)

