



Maurice C. Furstenau

MAURICE CLARK FUERSTENAU

1933–2012

Elected in 1991

*“For outstanding contributions to mineral processing,
hydrometallurgy, and engineering education.”*

BY KENNETH N. HAN, ROE-HOAN YOON,
AND FRANK F. APLAN

DR. MAURICE C. FUERSTENAU died on October 7, 2012. At the time of his death he was emeritus professor of metallurgy in the Department of Mining and Metallurgical Engineering at the University of Nevada, Reno. Right up to the onset of his final illness, he remained active in both teaching and research.

Maurice Fuerstenau was born on June 6, 1933, in Watertown, South Dakota, to Erwin and Hazel Karterud Fuerstenau. At the time of his birth, Maurie’s parents were farming, but they left a year later, victims of the Dust Bowl, moving to the Lemmon area and then to Mobridge where Maurie started grade school. In 1943, his parents moved to Rapid City, South Dakota, where he completed grade school and high school. After graduating from Rapid City High School in 1951, he entered the South Dakota School of Mines and Technology and graduated with a bachelor of science degree in geological engineering in 1955. He then enrolled as a graduate student at the Massachusetts Institute of Technology where he was awarded the degrees of master of science (1957) and doctor of science in metallurgy (1961). His thesis supervisor at MIT was Professor A.M. Gaudin (NAE, Founding Member). In 1953, he married Joyce Helen Snyder.

Having participated in the ROTC program as an undergraduate, late in his graduate studies he was called to active duty where he spent six months as an engineering officer at the Aberdeen Proving Ground. After graduating from MIT, Dr. Fuerstenau worked as a research engineer for the Beryllium Corporation in Reading, Pennsylvania, and later for the New Mexico Bureau of Mines in Socorro where he conducted detailed research on the flotation of beryl, the main source for beryllium. This sparked his long-time interest in the role of metal ion hydrolysis in flotation. In 1963, he decided to pursue an academic career and went on to teach on the faculties of the Colorado School of Mines, the University of Utah, the South Dakota School of Mines and Technology, and the University of Nevada, Reno. He was the consummate educator, championing excellence in teaching, counseling students, guiding research, and in professional and public service. He inspired countless students to achieve excellence in themselves and their careers. Former students, protégés, and business associates describe Dr. Fuerstenau as an exceptional teacher, a sensitive counselor, and an internationally renowned scholar. His contributions in the field of mineral processing and extractive metallurgy over his long and productive career have been recognized worldwide.

His first academic position was as assistant professor of metallurgical engineering at the Colorado School of Mines. He taught undergraduate and graduate courses in mineral processing and extractive metallurgy and initiated a very active graduate program. During his tenure at the Colorado School of Mines, he turned out more PhDs in mineral processing than had been produced in this area at the school prior to his arrival.

When he joined the University of Utah in 1968, the Department of Metallurgy and Metallurgical Engineering had great strength in hydrometallurgy but essentially none in mineral processing. Dr. Fuerstenau was able to bring one of his recent PhD graduates from the Colorado School of Mines to Utah as an assistant professor, and they organized and developed a very strong program that is still one of the premier programs in mineral processing/extractive metallurgy in the

country. He came to Utah as associate professor but after one year was promoted to professor of metallurgical engineering.

Upon being invited to be the head of the Department of Metallurgical Engineering at the South Dakota School of Mines and Technology, Dr. Fuerstenau returned to South Dakota in 1970 and served there with distinction for 18 years, as professor and head of the Department of Metallurgical Engineering for 17 years and, in the last year, as Interim Vice President for Academic Affairs. Under his leadership, several new faculty were brought in and the Department of Metallurgical Engineering was transformed into a world-class undergraduate program. He also made very important contributions to the school's infrastructure. His dedication to teaching and research was recognized with his selection as the first recipient of the Presidential Award (Outstanding Professor) of the School of Mines in 1979 and Distinguished Professor of Metallurgical Engineering in 1985. He was also honored by the school with the prestigious Guy March Silver Medal (1998) and the Distinguished Alumni Award (2004).

Maurie concluded that his year as interim vice president was too stressful and when an opportunity arose at the University of Nevada, Reno in 1988, he accepted it and joined the faculty there as Echo Bay Mines Distinguished Professor. He taught undergraduate and graduate courses in mineral processing and extractive metallurgy and continued an active research program right up to the time of his death. In the very week before he entered the hospital, he had recorded the first two lectures of his fall course that was to be available online. He served the university in many administrative and advisory capacities. His excellence as an administrator was known, and he was asked to serve as acting chair of departments (Mining Engineering and also Mechanical Engineering) in two different colleges. He was named a University of Nevada Foundation Professor in 1996 and recipient of a Senior Scholar Mentor Award in 2002.

Dr. Fuerstenau was an excellent teacher and he loved to teach, particularly classes for undergraduate students. He was enthusiastic about the opportunities in a metallurgical

engineering career, and was an avid recruiter of freshmen metallurgical engineering students. He was known for his dedication to the welfare of his students. He was very proud of the large number of undergraduates and graduate students who studied under his direction—more than 80 master's degrees and doctorates during his 50 years in academia. A major fraction of his former students have had outstanding and exceptionally productive careers. A number of them selected academic careers and have themselves produced more than 100 MS and PhD graduates. Some of his former students became presidents of companies, and one the president of a major university in Nigeria. Maurie was a truly dedicated teacher in the broadest sense, one who inspired countless young extractive metallurgists and mineral processing engineers in their earliest careers, mentoring not only his own former students but other young engineers in industry. His impact in teaching was recognized nationally by the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) in 1989 when he was named the recipient of the AIME Mineral Industry Education Award.

On several occasions Dr. Fuerstenau was invited to present short courses or to participate in special conferences around the world. On five or six occasions he was invited as the principal instructor or lecturer at various places in Mexico. The first was quite momentous in that after his presenting a series of lectures in Mexico City, two outstanding students chose to come to South Dakota where they earned their MS degrees and then continued their graduate education in Berkeley for their PhD degrees. Both returned to Mexico where they have had distinguished careers as university professors in metallurgical engineering. In 1978, he and his brother, Professor Douglas W. Fuerstenau (NAE 1976) of the University of California, were invited to give a special one-week winter course at the South African Institute of Mining and Metallurgy on the principles of flotation. This course resulted in a monograph *Principles of Flotation*, edited by Professor R.P. King (NAE 2003), then of the University of Witwatersrand. Of the thirteen chapters in the book, nine were written by the Fuerstenau brothers.

In 1981, Maurie was invited to China where he presented a series of seminars on his flotation research at six universities and institutes in various regions of the country, this still being quite early in the opening of China to foreign visitors.

He was known internationally for his research accomplishments in the areas of froth flotation, hydrometallurgical processing, and environmental remediation. Many classic papers resulted from these investigations. Of particular note are the large numbers of seminal papers that helped unravel the complex surface chemistry and solution chemistry involved in the selective flotation of a wide range of mineral systems—research that enhanced the recovery of minerals in the processing of ores. His half-century of research extended over a range of areas important to mineral processing. His initial research was concerned with solid/liquid separation, namely thickening. He pioneered the use of X-rays to determine the concentration of solids in a slurry during the thickening process. When he moved into the investigation of flotation principles, he and his graduate students showed in an unambiguous way how metal ion hydrolysis and the formation of insoluble surface compounds control the flotation of various metal oxides and silicates. In particular, they showed that optimal flotation with chemisorbing collectors occurs at the pH where surface metal ions hydrolyze. He sparked the synthesis and development of a chemical reagent that is now used worldwide as a flotation collector and flocculant in the mining industry: potassium octyl hydroxamate, which he patented in 1965. This reagent is especially effective for minerals containing copper, iron, and rare earth elements. He was the first person to study carefully the electrochemistry of pyrite flotation, clearly showing that the xanthate collector is oxidized to dixanthogen at the surface. This has major importance in optimizing pyrite flotation, particularly for gold-bearing pyrite.

There has always been great interest by the mineral industry in understanding the effect of residual reagents in tailings and effluents on the environment. Being an avid fisherman, Dr. Fuerstenau pioneered the study of the effect of the toxicity of selected sulfhydryl collectors on the population of fish. For

this purpose he obtained fingerling trout from the local fish hatchery. He also developed various means and models to remove fine particles and various toxic metal elements from water using packed beds and other media. Some of his effort was also directed at the dissolution kinetics of oxide/sulfide mineral systems and laid down factors that control dissolution rates. Another example of how far his contributions to mining could reach was his detailed investigation that showed considerable cost savings could be had by optimizing energy costs in mining and ore preparation. Specifically, he showed that increased ore grindability and plant throughput could be achieved with controlled blasting in mining the ore. During his half-century of research, he published more than 100 technical papers. He also authored one book and edited six in mineral processing/extractive metallurgy, including the textbook *Principles of Mineral Processing*, one of the top selling books published by the Society for Mining, Metallurgy, and Exploration (SME). He played a leading role in planning the commemoration of the 100th anniversary of the establishment of the froth flotation process: a symposium was held in Australia in 2005 and a commemorative volume was published by SME in 2007. This volume, entitled *Froth Flotation: A Century of Innovation* and edited by Maurice C. Fuerstenau, Graeme Jameson, and Roe-Hoan Yoon, includes the historical aspects of flotation, flotation fundamentals, flotation chemistry, flotation cells, modeling and simulation, and plant practice. Dr. Fuerstenau took it upon himself to obtain pertinent papers and personally edited each one. This comprehensive volume should have a long and useful life as a reference for scientists and engineers in mineral engineering.

The significance and quality of his wide-ranging research were recognized with a number of awards and honors. He was recipient of the Arthur F. Taggart Award and the Antoine M. Gaudin Award of SME, the Robert H. Richards Award of AIME, and the Frank F. Aplan Award of the United Engineering Foundation.

Dr. Fuerstenau had an excellent rapport with the mineral industry, particularly after moving to Nevada where gold

mining is extensive. As a consultant, he advised numerous companies in their efforts to improve gold extraction techniques and the flotation of gold-bearing pyrite in complex ores. He was particularly effective in utilizing his fundamental knowledge to solve the kinds of complex problems encountered in his consulting, and as a result was widely respected by other engineers and executives for his successes.

His professional society activities were mainly with SME and AIME. He served as SME president in 1982 and on the board of directors of both of these organizations. Under his leadership as president of SME, the Society launched a major effort to expand its scope in the international area. The first long-range planning study undertaken by SME was initiated under his leadership and resulted in a number of new directions and innovations. An example of his interest in fostering SME programs was his conception and implementation in 1976 of the Antoine M. Gaudin Award (NAE Founding Member) for scientific or engineering contributions that further the understanding of the technology of mineral processing. We would like to point out that Dr. Fuerstenau spent considerable effort in shepherding nominations of deserving engineers for recognition with various awards, such as the Gaudin Award and others.

Dr. Fuerstenau was chair or member of over two dozen committees in AIME and SME and their divisions, and also served on numerous advisory panels/committees and workshops for the National Academy of Sciences, the National Academy of Engineering, the National Research Council, and the National Science Foundation. Fellow committee members found it a pleasure to work with Maurie because of his pleasant personality, his respect for other viewpoints, and the many new ideas that he often put forward. His overall impact on the mineral engineering profession was recognized by his election to the National Academy of Engineering and by his being named an honorary member of AIME. In 2006 he was inducted into the South Dakota Hall of Fame in the "professional" class.

Dr. Fuerstenau always felt the need to give back to the institution that provided the foundation for his outstanding

career. He endowed the Maurice C. Fuerstenau Scholarship for students majoring in metallurgical engineering at the South Dakota School of Mines and Technology. He and his brother Douglas endowed the Erwin, Hazel, and Richard Fuerstenau Scholarship for students majoring in the minerals industry fields. Many students from South Dakota have benefited from these scholarships.

Dr. Fuerstenau was also active in his community. He gave generously to service in the community in Rapid City, and was especially active in youth basketball and softball, serving as organizer, coach, and umpire. He was also actively involved in the governance of St. Martin's Academy in Rapid City, serving on the school's board of governors for three years and as board president for two years. With the need for a gymnasium at the school, he chaired the organizing committee to select a building design and establish financing.

Maurie's main avocation related to the outdoors. He was a fairly active golfer. Through most of his life he fished for trout, but in two of his last summers, he went to Alaska to a salmon fishing camp, about which he was really enthusiastic. However, his overriding enthusiasm was for hunting. He liked to go deer hunting, but especially enjoyed hunting pheasants on the farms of his South Dakota cousins. He virtually never missed the opening weekend for pheasant hunting; and after moving to Nevada, he went back to South Dakota every year for the opening of the pheasant season. He had even made plans for October 2012.

Dr. Maurice C. Fuerstenau will be remembered as a consummate educator, world-renowned researcher, and dedicated professional and public servant. To those who knew and interacted with him, Maurie is remembered as a caring person who was considerate, patient, very kind, genuinely enthusiastic, and who had a delightful personality. He is greatly missed by his family, friends and many professional colleagues. He is survived by his brother Douglas (Peggy) Fuerstenau; sister Jean Hadeen; children Gregg (Shelley Graves) Fuerstenau, Jeff (Therese) Fuerstenau, Beth (James) Schuster, and Anne (Mark) Maxwell; 13 grandchildren; and numerous nieces and nephews.

