



WARREN G. SCHLINGER

1923–2017

Elected in 1991

“For the development of advanced coal gasification processes.”

BY C. JUDSON KING

WARREN GLEASON SCHLINGER died February 10, 2017, at the age of 93. He was highly accomplished and respected for his development of fossil fuel processes, notably for desulfurization and coal gasification. He and his wife Katie were also generous philanthropists and fine human beings in all respects.

Warren was born in Los Angeles on May 29, 1923, to William G. and Esther Gleason Schlinger. His father was from a German family that had come to the United States in the mid-1800s; his mother, born in Iowa, had moved to California as a young girl. William cofounded a small, two-person local delivery service in the Los Angeles area that, through various mergers and acquisitions, became part of United Parcel Service (UPS), for which he became West Coast vice president.

The Schlinger family moved around the Los Angeles area to accommodate changes in his father’s roles with UPS and its predecessor companies. As a youth Warren lived in Long Beach, Pasadena, Hollywood, and Glendale, where he graduated from high school in 1941.

In 6th grade he became fascinated with a friend’s Gilbert chemistry set, and soon he was given his very own. As was the case for so many chemists and chemical engineers of his generation, it was the chemistry set that sparked his career interest. His interests in science in general were cultivated by

Leland Lease, his teacher for both 7th grade mathematics and 9th grade science. Lease was also a lover of photography and the outdoors, and took Warren on trips to Death Valley and Yosemite. In addition, he inspired Warren's interest in Caltech, where Warren attended public lectures delivered by leading faculty and annual open house events.

Warren entered Caltech in 1941. Unlike his peers during World War II, military service was not an option for him because he was deaf in one ear since 7th grade.

As was the case at many universities at the time, students studied year-round at Caltech, and Warren thus completed his BS in applied chemistry in 1944. Chemical engineering was still in a developmental stage at Caltech and had only two faculty members, William Lacey and Bruce Sage. Warren knew he wanted to stay at Caltech for a master's degree in chemical engineering, but the university had essentially closed down for the remainder of the war and was not admitting new chemical engineering graduate students. He assisted and did war-related research with Ernest Swift, an analytical chemist.

He entered the master's program in chemical engineering at Caltech in 1945, the first opportunity to do so, and got his degree in 1946. While working toward his master's degree, he met Katharine (Katie) Stewart, who was secretary to Bruce Sage. They married in June 1947, a union that would last 66 years until her death in 2015. They had three children—Michael (1951–2013), Norman, and Sarah—and lived their entire lives in the Los Angeles area, supplemented by a vacation home in Mammoth Lakes, CA, reflecting their lifelong love of the Sierra Nevada and outdoor activities there.

With Katie's encouragement Warren continued at Caltech to get his PhD (1949), in both chemical and mechanical engineering. The institute's PhD program in chemical engineering was new after World War II, and he was its third degree recipient.

During his graduate work, he did paid work for American Petroleum Institute (API) Project 44, which determined thermodynamic and thermophysical properties of many hydrocarbons and for which Lacey and Sage were principal investigators. PhD in hand, Warren considered a teaching

career while Katie continued in her position with Sage. He accepted appointment as a research fellow at Caltech, teaching and continuing to work on API Project 44 and in related areas.

In 1953, as a result of conversations with Sage, who consulted for Texaco, Warren went to the company's Montebello Laboratory near Los Angeles to get some industrial experience. Although initially intended as a stay of only a few years, it became his professional career and, with his overall abilities and intellectual qualities, he rapidly assumed successive technical leadership positions at the laboratory, from supervisor of research to laboratory manager to laboratory director. In the early 1980s he concluded that his management roles cut too much into his time for technical activities, and scaled back his responsibilities to be associate director for gasification. He retired at the end of 1987, but maintained a position as consultant to the laboratory.

The Montebello Laboratory was a mainstay of the process-licensing end of Texaco, known as the Texaco Development Corporation. It was responsible for creating and developing useful processing approaches, many of which were not used by Texaco but instead licensed to other companies. It was Warren's strong innovation and leadership in the development of several aspects of fossil fuel processing, most notably coal gasification, that earned his election to the National Academy of Engineering. He first worked with oil shale, conceiving and developing a process called *hydrotorting* that retorted mined shale with hydrogen. He and his associates then turned to the use of hydrogen to desulfurize middle distillate and gasoline by catalytic hydrogenation to form easily removed hydrogen sulfide.

A close working relationship between the Montebello Laboratory and the Electric Power Research Institute (EPRI) then led to a major Montebello program of research and development on coal gasification processes. Initially, the residuum from solvent-refined coal was mixed with coal and used to make hydrogen. Activities then turned to what is now called *combined-cycle coal gasification*. Texaco technology was used to gasify coal and remove the hydrogen sulfide from the gas. The

resultant combination of carbon monoxide and hydrogen was mixed with steam and fed to a gas turbine to generate power, and the exhaust was used to generate additional steam and thereby more power. The relatively low combustion temperatures resulted in the much lower formation of nitrogen oxides, which are atmospheric pollutants.

The process was of great interest to EPRI. A successful demonstration plant was built at Coolwater, CA, near Barstow, and became operational in 1982. There are now over 60 commercial plants in operation using this technology, making the approach of Schlinger and his associates one of the most widely used gasification technologies. Feedstocks range from natural gas to heavy oil, coal, and petroleum coke.

In addition to membership in the National Academy of Engineering, Warren was recognized by the American Institute of Chemical Engineers with the Lawrence B. Evans Award in Chemical Engineering Practice in 1981, only the eighth granting of that award. He also held over 60 patents.

Warren had one sibling, a younger brother named Evert, who was also accomplished, a longtime faculty member in entomological science and parasitology at the University of California–Berkeley. He was also cofounder, with Robert van den Bosch, of the field of biological control, whereby pest management is accomplished through the use of predators rather than chemical substances.

Warren's father was often paid in UPS stock, and as the company enlarged and matured after World War II the stock grew manyfold in value. Warren's parents placed stock into a family foundation, which continued to grow and was passed on to Warren and Evert. As in all aspects of life, Warren and Katie were both generous and very helpful in their giving, and largely used their share to support education, the performing arts, and animal protection. They created endowed professorships in chemical engineering at Caltech and the University of California campuses at Berkeley and Santa Barbara.

They also did much else for Caltech throughout their lives. Warren was active in the Caltech Associates, including as president (1995–96). Their largest single physical legacy is the

Warren and Katharine Schlinger Laboratory for Chemistry and Chemical Engineering, a highly energy-efficient (LEED Gold) and modern 62,300 sq. ft. building opened in 2010.

Warren and Katie are survived by Norman and Sarah, five grandchildren, and two great-grandchildren.