

Dr. G. Fred Lee's Education Background

G. Fred Lee was born in Delano, CA the eldest son of a grape ranch foreman and attended Delano High School. In 1953 Dr. Lee began his college education in mining engineering at Texas School of Mines (Texas Western College) in El Paso, TX, where he lived with his grandparents. He could not afford to continue at Texas Western the second semester and returned to Delano, CA where he enrolled at Bakersfield Junior College in geology. In 1954 he enrolled at San Jose State College in what was then called sanitary science, a program that was part of the training for those pursuing a career in public health as a sanitarian. In that program he took a series of courses in the natural sciences including organic chemistry, zoology, entomology, medical entomology, and bacteriology. He supported his undergraduate education by working 30 to 40 hours per week in gas stations and as a mechanic. He did well in his science courses and his professor of bacteriology suggested that he consider going on to graduate school after graduation. He obtained a BA degree in 1955.

Dr. Lee was accepted into the Universities of Minnesota and North Carolina Schools of Public Health. He selected the University of North Carolina School of Public Health since it offered a research assistantship; he took two years to complete a one-year Master of Science in Public Health degree. At that time his chemistry background was limited; on his own he learned considerable analytical chemistry and laboratory techniques and also took courses in water and waste water analysis, bacteriology, limnology, sanitary engineering (water and wastewater treatment and industrial wastes), instrumental analysis, industrial hygiene, and differential equations, in addition to the public health curriculum that included biostatistics and epidemiology. His major professor was Dr. Marvin Granstrom, an engineer who did his PhD degree work at Harvard University under Dr. Carroll Morris. Dr. Morris was a PhD chemist from Columbia University; several of his students conducted their PhD dissertation work on chlorination reactions. At North Carolina, Dr. Lee conducted research on the disproportionation of chlorine dioxide, which was being used by some water utilities to control chlorophenolic taste and odors that develop during disinfection of the water supply. He coauthored the following papers:

Granstrom, M. L. and Lee, G. F., "Rate and Mechanisms of Reactions Involving Oxychloro Compounds," *Public Works* 88:90-92 (1957).

Granstrom, M. L. and Lee, G. F., "Generation and Use of Chlorine Dioxide in Water Treatment," *J. Am. Water Works Assoc.* 50:1453-1466 (1958).

Dr. Granstrom suggested that Dr. Lee enroll at Harvard University and work with Dr. Morris. Morris offered him a research assistantship to work on chlorine reactions, and he enrolled at Harvard in the summer of 1957. At the same time the US Public Health Service initiated a graduate fellowship program at Harvard; Dr. Lee was one of the first five to receive that support. At Dr. Morris' suggestion, Lee conducted his dissertation research on the chlorination of phenol and spent two years doing intensive laboratory studies. Lee completed his draft dissertation in two years but since Morris went on sabbatical to Egypt, he did not read his dissertation until about a year later. Lee took much of his course work in the Department of Chemistry at Harvard because he had already taken many of the sanitary engineering courses at North Carolina. He took courses in instrumental analysis, biochemistry, molecular biology, chemical

thermodynamics, NMR, polymer science, among others. He also took a course in groundwater hydrology, which served as a foundation for his subsequent studies on groundwater quality. The key course that he took in the sanitary engineering program at Harvard was a course in sanitary chemistry taught by Werner Stumm who was at that time an assistant professor in the sanitary engineering program. Stumm had obtained his PhD degree in inorganic chemistry at the University of Zürich, Switzerland in 1952. Stumm's sanitary chemistry course introduced Lee to the concepts of reaction types: acid-base, precipitation-solubilization, redox, complexation, sorption, etc. and graphical representation of chemical equilibria. There was no text for that course. Teaching that course led Stumm to write his renowned book, "Aquatic Chemistry," with J. Morgan. This course formed the conceptual foundation of what became the Water Chemistry program at Wisconsin developed by Dr. Lee.

Lee's PhD dissertation involved the study of the kinetics of eight consecutive-simultaneous reactions in which chlorine was substituted on phenol in the ortho and para positions. This reaction was of interest because some water supplies were experiencing chlorophenolic taste and odors in their chlorinated water supplies. That research involved programming those reactions on the Univac 1 computer to plot their courses of reaction to identify reaction products over time. From the computer-calculated concentrations of reaction products (chlorophenols) and the threshold odor numbers of those phenols, Lee was able to calculate threshold odors of the combination of the reaction products over time as a function of such factors as the pH of chlorination. He presented a paper on those studies, entitled, "Chlorination of Phenol," at the ACS Meeting, in Atlantic City, NJ in 1959, and published the following paper:

Lee, G. F. and Morris, J. C., "Kinetics of Chlorination of Phenol-Chlorophenolic Tastes and Odors," *Air and Water Pollut.* 6:419-431 (1962).

While Morris was on sabbatical during 1959-60 Lee held the equivalent of a post-doctoral position with half of his support being provided by a research project that Morris had with the US Public Health Service devoted to use of polarographic techniques to analyze heavy metal complexes. At that time he constructed and used a coulometric analyzer for heavy metals.

The other half of Lee's support during 1959-1960 came from research support Stumm had obtained from the US Public Health Service for studies on the reactions of ferrous iron and dissolved oxygen. From that work the following paper was published:

Stumm, W. and Lee, G. F., "The Chemistry of Aqueous Iron," *Schweizerische Zeitschrift für Hydrology* XXII:95-139 (1960).

Lee was responsible for conducting the laboratory studies that led to publication of the following papers:

Lee, G. F. and Stumm, W., "Determination of Ferrous Iron in the Presence of Ferric Iron with Bathophenanthroline," *J. Am. Water Works Assoc.* 52:1567-1573 (1960).

Stumm, W. and Lee, G. F., "Oxygenation of Ferrous Iron," *Ind. Eng. Chem.* 53:143-146 (1961).

He also presented the following papers:

Lee, G. F., "Discussion of paper, 'Role of Multivalent Hydrous Metal Oxides on Limnological Transformation,' by J. Morgan and W. Stumm," Proc. 2nd Int. Conf. Water Pollution Research, Tokyo, August, 1964, Pergamon Press (1965).

Chlorophenolic Tastes and Odors Rudolph's Conference, Rutgers University, 1965

In 1961 Lee accepted a position as Assistant Professor of Sanitary Chemistry at the University of Wisconsin Madison. Throughout his undergraduate and graduate degree work he had found that sanitary chemistry was in many ways a “step-child” of the sanitary engineering field. In going to Wisconsin he had decided to work toward making sanitary chemistry into a stand-alone field that merited recognition equal to that of sanitary engineering. As discussed in the “Development of the Water Chemistry Program at the University of Wisconsin Madison,” Lee developed the Water Chemistry Program at Wisconsin into a nationally recognized program for educating students for careers in the water quality management field.

Lee, G. F., and Jones-Lee, A., "Development of the Water Chemistry Program at the University of Wisconsin Madison & Follow-on Activities of Dr. Lee in Developing the Water Chemistry Field," Report of G. Fred Lee & Associates, El Macero, CA, January 1 (2012). <http://www.gfredlee.com/Education/WaterChemProgramDevel.pdf>

During his professional career Lee has endeavored to expand the depth and breadth of his understanding of fields ancillary to but supportive of his primary interest in impacts of chemical contaminants on water quality, including sedimentary geology, historical geology, and geochemistry as they related to his work on lake sediments, climatology as part of his studies on paleoclimatology, geotechnical engineering as part of his landfill liner studies.

The evolution of Dr. Lee’s career has been from sanitary science, sanitary chemistry/water chemistry to environmental engineering; he has found that his emphasis on engineering has been a significant asset to his work on water chemistry as it propels him beyond simply investigating a situation to identifying, understanding, and solving water quality problems. In general, “engineers” enjoy greater recognized status than “chemists” in the environmental management field. Lee’s background and experience enabled him to become a registered professional engineer in Texas, and an American Academy of Engineering as a Certified Environmental Engineer. Dr. Lee served as the Chief Examiner for the AAEE (American Academy of Environmental Engineers) Board Certification for New Jersey in 1985-1989, and for Northern California from 1990 through 2009. He has been a member of the American Society of Civil Engineers since 1980s and in December 2009 Lee was elected to the American Society of Civil Engineers “Fellow” grade. In September 2010 the Sacramento Section of the American Society of Civil Engineers selected Dr. Lee as the Outstanding Life Member of the section.