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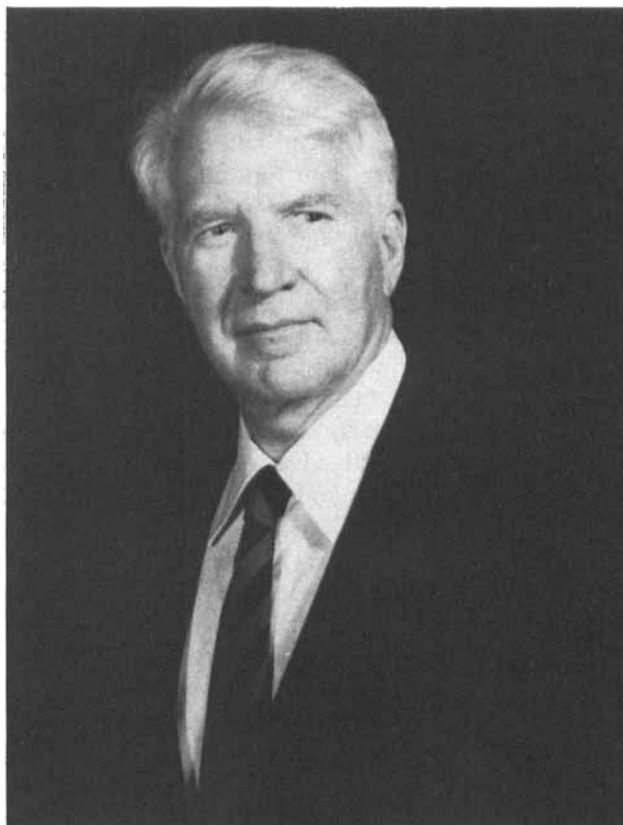
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In Memoriam†

Dr. Frederick M.
Fowkes
1915–1990



October 18, 1990 was a sad day for the international professional community of interfacial science and technology, as one of its most distinguished and revered members, Dr. Frederick M. Fowkes, died.

Born in 1915, he was raised in Chicago and was educated in the public school system of that city, graduating from Morgan Park High, a small suburban school where a high percentage of graduates went on to college. He attended the University of Chicago at a time when emphasis was on a broad education and on personal freedom for students. As a result of taking a heavy course load, he completed all of his undergraduate course work for a bachelor's degree in Chemistry in two years. He then started taking graduate courses and carried out graduate research with Professor William Harkins in 1934. His PhD dissertation

† Text adapted in part from S. Ross, *J. Adhesion Sci. Technol.* **4**, 243–54 (1990).

was a study of monolayers adsorbed from aqueous solution by a number of hydrophobic materials. This was the beginning of contact angle studies in Harkins' Laboratories, and it required Fred to build new equipment himself.

While a graduate student, he worked in the Nalco research laboratories for 6 months while carrying out his university research at nights and on weekends. He was able to devote full time to his graduate research when he was awarded a Proctor and Gamble fellowship, a rare occurrence during the Depression. He completed all of his graduate research during the next year, and was awarded a PhD degree in 1938. Meanwhile, he married Royce Elizabeth Budge, whom he had met when he was a graduate student and she was an art student at the Art Institute of Chicago. A friend had brought them together at a picnic meeting of Episcopalian students. Their four children are Gordon Seley Fowkes (born May 11, 1939), Joan Berkeley Piper (born December 19, 1941), Mary-Elisabeth Tobin (born January 18, 1950), and Virginia Mayhew Clark (born September 19, 1958). Fowkes then joined the Continental Can Company after graduation. He was put in charge of a group testing the interaction of polymeric can linings with various canned foods. The need for testing results precluded the time for fundamental research on the interactions.

Fowkes, who had been in the Reserve Officers Training Corps (ROTC) in college, was called up to serve as a First Lieutenant in the Army in February 1942. After training and subsequent promotion to Captain, he served in combat with the 31st (Dixie) Infantry Division in various parts of the Pacific and was awarded the Silver Star Medal for Gallantry in Action. By the time he returned to the United States in late 1945, he had attained the rank of Major.

Shortly after his return, he accepted employment with the Shell Development Company, located at Emeryville, CA, which was the largest research laboratory on the West Coast during the forties and fifties. Fowkes was given an opportunity to build a well-instrumented surface-chemical laboratory, which included several instruments which he designed. His research group concentrated on the understanding of surface-active solutes. They pioneered the understanding of non-aqueous micelles, oil-soluble surface-active polymers, electrostatic and steric stabilization in organia media, surface active cosolutes for aqueous systems, the mechanism of antifoaming additives, and the concept of dispersion forces and acid-base contributions to the work of adhesion and to the surface tension of liquids and solids.

In 1962, the Sprague Electric Company of North Adams, MA offered Fowkes the position of Director of Research in a new Research Center, for which he was to recruit ultimately about half of the eventual 200 people. The research was at the forefront of the new semiconductor and integrated-circuit business. Under Fowkes' direction the Sprague Laboratory pioneered many developments that are now key techniques of the semiconductor industry, such as ion implantation, plasma-assisted chemical deposition of silicon oxides, nitrides, and carbides.

Following a decline in sales in the late 1960s, Sprague Electric deemphasized research. Fowkes resigned in 1968 and accepted an offer as Chairman of the Chemistry Department of Lehigh University.

As Chairman of the Chemistry Department at Lehigh, Fowkes transformed a teaching faculty into a more research-oriented faculty. During his 13 years as chairman, the funding for research by the Chemistry Department grew to about \$2.5 million annually. Such funding has doubled since then.

In his role as Chairman, his research program was small due to time required for other duties. After his retirement in 1981 from the duties of the chair, he continued to teach one course each semester. His "retirement" started as a commuting Visiting Scientist at the Materials Laboratory of Wright-Patterson Air Force Base near Dayton, Ohio. He and his two-to-five man group determined the acid-base characteristics of polymer-solvent interactions through measurements of chemical shifts and swelling of polymers by solvents. This work was concluded successfully with the publication of "Acid-Base Complexes of Polymers".

During the last few years of his life, Fowkes' research group averaged ten to fifteen members. He received research grants from both industry and government.

The professional honors that he received included the Hillman Award of Lehigh University for the "person who has done the most for Lehigh University." Symposia in his honor, sponsored by the Division of Colloid and Surface Chemistry of the American Chemical Society, were held at Lehigh University in 1980 and 1990 on the occasion of his 65th and 75th birthdays. He received the Adhesion Society Award for Excellence in Adhesion Science in 1989, which is an award sponsored by the 3M Corporation.

Fowkes' distinguished career in science featured a long-standing commitment to applying scientific understanding, often times pioneering to expand such understanding, to solve technologically important problems dependent on surface chemistry and interfacial interactions. Such knowledge has been readily given to others through publications, courses, research projects, seminars, consultancies, among other methods. As a result, his efforts have led to the scientific enrichment of his students and collaborators, who have benefitted also from personal interactions with him. Further, such efforts and innovations have led to new materials and processes, which have benefitted mankind. Finally, his creative insights have enhanced greatly the knowledge about the nature of surfaces of materials, their characterization, and the basis for molecular interactions leading to interfaces. Fifteen of his students received PhD degrees, and twelve their M.S. degrees.

Fowkes' professional activities included consultancies. He was a consultant to NSF on materials laboratories, to NIH on dental and pulmonary research, to NBS on polymers, to Redstone Arsenal on composite propellants, to Lawrence Livermore Laboratories and Idaho National Laboratory on flocculation in geothermal-energy recovery. His industrial consultancies included those with 3M (12 years), the Shell Development Company, Union Carbide Corporation, Atlas Powder Company (now ICI Americas), and the Du Pont Company, among others.

Fowkes was active in various scientific societies also. He was a member of the American Chemical Society (since 1935), the Electrochemical Society, IEEE, and

Industrial Research Institute. He was the Chairman of the American Chemical Society's Division of Colloid and Surface Chemistry in 1968, and he chaired two Gordon Research Conferences (Chemistry at Interfaces, 1971; Science of Adhesion, 1973).

All of us were saddened by his passing. However, we have been enriched by knowing him personally or through his teachings. He was a gifted man, whose gentle personality and leadership skills combined to distinguish him in music, athletics, field of battle, and science. It was my good fortune to have been associated with him over a period of time, which was highlighted in 1973–1974 through our collaboration on acid-base interactions and their relevance to adhesion. We can cherish our memories of him and his work, and marvel at the significance of his accomplishments to mankind. A pioneering and great scientist, educator, and friend will be sorely missed.

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