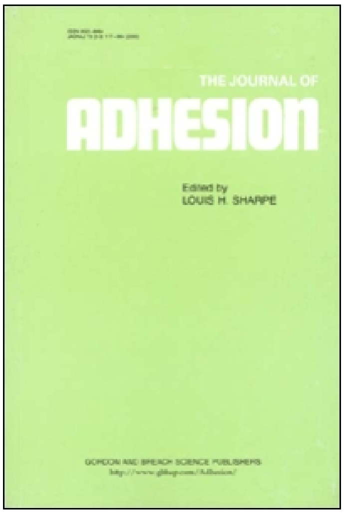

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In Memoriam

Dr. Willard D. "Bill" Bascom

1931–1991

Willard D. Bascom

October 8th was a sad day for the scientific community in general and adhesion specialists in particular since one of their most valued contributors and leaders, Dr. Willard D. "Bill" Bascom, died.

After graduating from Worcester Polytechnic with a B.S. degree in chemistry, Bascom joined the Naval Research Laboratory (NRL) in 1956. William A. Zisman, assisted by Curtis R. Singleterry, had built a world-class surface chemistry program, and Bascom became a member of Singleterry's Surface Chemistry Branch. In the years that followed, Bascom came to admire Singleterry very much, particularly his relationship with associates, which Bascom once described as quiet tutorage. This became a strong influence as Bascom developed his own management style, which consisted of leadership by example, discussion, and consensus. This style was a key element in his ability to form cooperative programs with many diverse groups and to bring out the best in each person. Such relationships were a hallmark of his later career.

His early work focused on classic surface chemistry. Together with Singleterry and Kaufman, he began investigating the solubilization of small polar molecules by oil-soluble soap micelles. These materials had been used for decades as additives in protective coatings, rust inhibitors and detergents in lubricating oils, and as solubilizers in dry cleaning solvents, even though the pertinent mechanisms of action were largely obscure. The research detailed the structure of the adsorbed film and determined the interrelationship between the surface energies and wetting behavior of oil/water/metal systems containing dissolved oil-soluble soaps. In the mid 60's, the group turned to studies of the creep of oil over metal and other high energy surfaces. They found that the complex and often contradictory spontaneous spreading phenomenon was due to an interaction between surface tension and capillary forces known as the Marangoni effect. This work helped the Navy formulate oil and water displacing solutions that are used to salvage electronic equipment flooded by oily seawater.

Bascom also focused his attention on the wetting behavior of fluids on metal and glass surfaces including glass filaments where wetting has a direct influence on the origin and removal of microvoids. The concepts developed are still critical to the minimization of voids in adhesives and composites. There were also important studies with low energy surfaces performed with Halper and Jarvis.

In the late 60's, he was assigned to study the new phenomenon called polywater at the request of the Office of Naval Research (ONR). This effect had first come to the attention of scientists through reports from ONR's London Office. His studies suggested doubts about the existence of polywater at an early date, but the results were published in reports rather than in the general literature. It wasn't until Franks wrote his well known book on polywater that Bascom's accomplishments became widely known. In response to a request from Franks through the London Office of ONR, Bascom wrote a history of his work. Franks included excerpts from this description as part of a chapter, and much like the famous book by Watson on the double helix, Bascom's reply was a marvelously entertaining and enlightening picture of the personalities and personal interactions that so often go on behind the scenes of advances in science.

While working at NRL during the day, Bascom continued his education at night. In 1962 he received his M.S. in physical chemistry from Georgetown University and, with the help of an Edison Memorial Scholarship, completed his PhD in physical chemistry from Catholic University in 1970. This experience of continuing his education under difficult circumstances made him very receptive to the problems of the students he met while teaching in short courses and later when he joined the University of Utah.

He became the Head of the Adhesion Section of the Surface Chemistry Branch at NRL in 1972. This was at a time when surface science was the dominant theme in adhesion. In addition to studying problems associated with wetting, Bascom was active in the area of stress corrosion cracking which was very important to the Navy. This work culminated some years later with a 1979 paper published in Adhesives Age that is still the best starting place to learn about the field. This background also helped him to become the Navy's expert on rubber to metal bonding, and he was instrumental in solving a number of important problems involving moisture attack on such bonds.

As improvements in materials and understanding began to alleviate many of the surface chemistry problems in adhesion, he turned to the increasingly important area of fracture mechanics. Toughening had become a critical concern for structural adhesives, and Bascom began a major program on the rubber-toughened epoxies. Despite the great commercial importance of these materials, which are the basis for many structural adhesives, very few researchers had followed-up the initial publications of McGarry *et al.* Bascom recognized the potential for further studies, particularly in the adhesive bond geometry. For a period of almost 15 years, Bascom guided his group and cooperating scientists elsewhere in a comprehensive program to address this area.

His first results were published in a classic 1975 paper with Cottington, Jones, and Peyser. This paper identified the dependence of adhesive fracture energy on bond thickness. A second paper followed and examined the effects of temperature as well as bond thickness. The results were a major advance for both the efficient design of adhesive joints and for an understanding of the important, but previously unexplained, variation of adhesive fracture energy with temperature. Bascom was also one of the first to realize the significance of testing with realistic (*i.e.* complex) loading and worked with Oroshnik, Timmons, and Hunston to initiate research in this area. Throughout these studies, Bascom used scanning electron microscope observations of the fracture surface to gain information on the nature of the failure process. The insight he gained permitted him to propose deformation processes that are the essence of the currently-accepted mechanisms for toughening.

In 1976, Bascom's Section moved to the Polymeric Materials Branch at NRL and changed its name to Adhesives and Polymer Composites. Bascom extended his studies to toughening in composite resins. Just at the time when delamination began to be recognized as a critical failure mode for composites, Bascom, Bitner, Moulton, and Siebert published a landmark paper which established the first clear link between resin toughness and improved interlaminar fracture behavior in composites. The response to this paper was immediate with industry, government, and academia initiating major programs to develop tougher composite resins and a better understanding of how toughness was transferred into composites.

Between 1978 and 1980, he was on assignment to the London Office of ONR where he reported on the latest research results from Europe. His reports combined information and insight with a critical sense of how the material contributed to the current state of scientific knowledge. His straightforward approach always kept the reports interesting. For example, he once described a particularly confusing paper by saying that if the state of understanding in this field could be characterized as confused, this paper reduced it to a state of chaos.

In 1981 he left NRL to join Hercules in Magna, Utah where he was Manager of Composite Research in the Graphite Fibers Department. There he continued his interest in delamination. He worked with toughened resins and was involved in the development of several innovative new resin systems for Hercules. His ability to work with others made him a valuable part of important collaborations both inside and outside Hercules. A good example is the work with Hunston, Moulton, and Johnston which developed the first detailed relationship between resin toughness and the mode-I interlaminar fracture of composites. This paper was also the first to suggest that the interlaminar fracture energies of thermoplastic composites were less than their full potential because the fiber-matrix interface strengths were so poor.

In response, Bascom initiated studies on the fiber-matrix interface which brought him back to his roots in surface science. The work led to improved surface treatments for fibers used in thermoplastic composites and a better understanding of test methods to measure interfacial strength. A particularly useful contribution was a NASA report published with Drzal that summarized the state-of-the-art in this field, and thus became the starting point for many programs in this area.

In 1986, he moved to the Department of Materials Science and Engineering at the University of Utah. He continued his work on fracture of polymers and adhesive bonds, the surface chemistry of adhesion, and the wetting and spreading of liquids on solids. His experience and contacts helped initiate major research programs with NASA, Boeing, and Hercules. Bascom's intelligence and easy going style won him the respect and admiration of students and associates. A comment from one of his students, Shankar Prashanth, typifies the feelings of all, "Dr. Bascom was like a father to me. I will always remember him for his kindness and concern."

In addition to being a member of the Advisory Board of THE JOURNAL OF ADHESION and Chairman of the 1974 Gordon Conference on Science of Adhesion, Bascom received two of adhesion science and technology's most prestigious awards. In June of 1989, he was presented with the Adhesives Award sponsored by Adhesives Age and chosen by ASTM Committee D-14 on Adhesives for his work on the fracture behavior of elastomer-modified, epoxy, structural adhesives. In 1990, he was given the Adhesion Society Award for Excellence in Adhesion Science sponsored by 3M. The award honored his pioneering research in many subfields of adhesion science including wetting phenomena, fracture behavior of adhesives, and composite interface studies.

Bascom will be missed by all of those who interacted with him, for to know him was to like him. He is survived by his wife, Dene Morgan-Bascom, and three sons, Mark (Aurora, Colorado), Alan (Washington, DC), and Paul (Salt Lake City, Utah).

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