



*H. K. Benbaum*

# HOWARD K. BIRNBAUM

1932–2005

Elected in 1988

*“For exceptional work on the effect of hydrogen and hydrogen embrittlement on properties of metals.”*

BY IAN M. ROBERTSON

SUBMITTED BY THE NAE HOME SECRETARY

HOWARD KENT BIRNBAUM, 73, emeritus professor of the Department of Materials Science and Engineering and emeritus director of the Frederick Seitz Materials Research Laboratory at the University of Illinois, died January 23, 2005, in Champaign. He was known throughout the world for his pioneering contributions to the fundamental mechanisms controlling the mechanical properties of metals and in particular for the discovery and development of the hydrogen-enhanced localized plasticity mechanism of hydrogen-induced degradation of materials.

His work on hydrogen in metals included the discovery of quantum tunneling to account for the low-temperature diffusion of hydrogen, hydrogen trapping, ordering, phase transformations, and embrittlement. Through the novel use of a transmission electron microscope he demonstrated that the introduction of hydrogen to a metal accelerated the production and enhanced the mobility of dislocations. He explained this effect by developing the hydrogen shielding mechanism, now known as the hydrogen-enhanced localized plasticity (HELP) mechanism, accepted as a viable mechanism of hydrogen embrittlement.

Howard was born in Brooklyn, New York, on October 18, 1932, to Ida and Jack Birnbaum, who were Polish immigrants.

His passion and talent for engineering started early and he applied and was admitted to the prestigious Brooklyn Technical High School (1946–1950). He earned his BS (1953) and MS (1955) in metallurgy from Columbia University.

He followed his advisor Thomas A. Read from Columbia University to the University of Illinois at Urbana-Champaign and received his PhD in 1958. This was a major decision for Howard as the trip to Illinois was his first west of the Hudson River; it marked the beginning of his career in the Midwest.

After his PhD he moved to the University of Chicago, first as an instructor and then as an assistant professor in the Institute for the Study of Metals. His time there was brief and he returned to the University of Illinois in 1961. Nevertheless, his tenure at the institute and his mentorship by Charles Barrett impacted his career as he learned the importance and value of interdisciplinary research.

Throughout his career, Howard was a champion of interdisciplinary research. This was exemplified in his leadership of the broad materials science and engineering community at Illinois as director of the Frederick Seitz Materials Research Laboratory, a position he held from 1987 until he retired from the University of Illinois in 1999. After that, his natural intuition and his mastery across multiple disciplines allowed him to continue his research, teaching, and mentorship of faculty and students despite his failing eyesight.

Howard's contributions and achievements were recognized by membership in the National Academy of Engineering (1988) and fellowship status in the American Academy of Arts and Sciences (1996), Minerals, Metals, and Materials Society (1995), American Physical Society (APS; 1971), American Society of Metals (ASM; 1988), and American Association for the Advancement of Science (1992). Among his numerous awards were a Guggenheim Fellowship (1967), the Department of Energy Prize for Outstanding Research in Metallurgy and Ceramics (1984 and 1988), the Robert F. Mehl Gold Medal from the American Institute of Mining and Metallurgical Engineers (1986), and the Von Hippel Award from the Materials Research Society (MRS; 2002).

He was an articulate and persuasive spokesperson for the needs and future of materials science and engineering and served on numerous committees and panels for federal funding agencies, the national laboratories, professional societies, and journals. For example, he was a member of the board of governors for Argonne National Laboratory and *Acta Metallurgica*, he served on advisory committees for the Advanced Photon Source at Argonne National Laboratory and SLAC National Accelerator Laboratory at Stanford University, as well as on the APS, MRS, and ASM councils. Through these and many other activities Howard helped to shape the field of materials science and engineering both nationally and internationally.

I was recruited to the University of Illinois as a postdoctoral fellow in 1982 to work in Howard's group on the transmission electron microscope experiments related to hydrogen embrittlement. Over the next few years, Howard and I spent countless hours working side by side on the experiments that showed hydrogen enhancing the velocity of dislocations. I found it remarkable that someone of his stature would want to be directly connected to the experiments, but I quickly learned the pleasure he derived from actually doing the research. He enjoyed designing and building equipments to probe new areas of research; he assumed everything was possible if we put our minds to it. Those days in the microscope room with Howard were an incredible experience and the collaboration and learning continued for another 20 years.

Although he was known as demanding and a fierce debater and defender of the HELP mechanism, he was best known for his loyalty and friendship, which were brought home to me after my first conference presentation on the HELP mechanism. The questioning was tough and I remember feeling somewhat discouraged after the talk. Howard just smiled and commented that it went better than he expected. He then introduced me to the members of the "opposition" and we arranged to meet for further discussion. The debate was again fierce, as it often was with Howard, but it was between friends.

I was reminded of the extent of Howard's friendships as we gathered in 2006 to celebrate his achievements and

accomplishments. Friends from around the world paid tribute to their sometime adversary but always friend. Listening to the personal recollections at that meeting, I was reminded of his sense of humor and what fun it was to spend time in his company. My tenure at Illinois, over 30 years, was made easier and more enjoyable and fruitful by Howard and his wife Freda who helped me and my family in countless ways. As I think back to the events that brought me in contact with Howard and his family, I feel very fortunate to have had the privilege of having had such a mentor and friend.

Petros Sofronis, who was mentored by Howard during his graduate days and throughout his career, recalled that “every meeting I had with him turned into an instructive and exciting tutorial session spanning the disciplines of materials science and solid mechanics. Howard had no patience for the worn-out path in scientific research and he encouraged me to push the boundaries of the field.” This observation was echoed by the many who were guided and mentored by Howard. He cherished all of his students and postdocs and enjoyed mentoring them both professionally and personally.

Howard and Freda Silber married on December 25, 1954, in Brooklyn. Howard was a perfectionist and expected much from his family, students, and colleagues, but he was always fair, even when he disagreed. And although he had a tough demeanor, he was known by his friends and family to have a good sense of humor. He loved travelling with his family and collecting glass, which started as a hobby and was ostensibly for his children. This interest became a passion that continued throughout his life and he and Freda built an impressive collection of art glass.

Freda now lives in Dallas. Their eldest daughter, Dr. Elisa Birnbaum, lives in St. Louis; their son Scott Birnbaum is in Indianapolis; and their daughter Dr. Shari Birnbaum is in Dallas. There are six grandchildren: Aaron, Sam, Zach, and Hannah Zuckerman, and Holly and Alice DeVane. Howard is also survived by his sister Sybil Licht who lives in Atlantic Beach, NY.

