



Contents lists available at ScienceDirect

## International Journal of Multiphase Flow

journal homepage: [www.elsevier.com/locate/ijmulflow](http://www.elsevier.com/locate/ijmulflow)

## Professor Howard Brenner



(16.3.1929–18.2.2014)

Howard Brenner, my mentor and, later, a very good friend has passed away just before reaching the age of 85. “A bright light has gone out” to quote a colleague passing to me the news of his death. Being among his first Post Docs I was privileged to work *with* him and not *under* him. He endeared himself to me by making me feel that we stand on the same pedestal despite the fact that he was already a renowned researcher and I was experiencing my first steps in the world of science. His enthusiasm about “doing” research was unparalleled and continued until his very last days. There was no “small talk” with Howard. A clear indication of Howard’s unbounded passion towards research was a comment made by his wife Lisa. She complained that despite the fact that he was away from home many times, he almost never went touring the area and stayed at the hotel room making it his extended office. His generosity and affection was well known by many of his friends. Many summers my wife and I were invited to stay in Howard’s apartment at the Back Bay and lately in Lisa’s house by Crystal Lake. Our stay was peppered with his unique sense of humor, where self-deprecation was the motto.

I already miss you.

The following portrays briefly milestones in Howard’s long scientific road to fame.<sup>1</sup> Howard Brenner, born in the Bronx to an underprivileged family, was proud to have become the Willard H.

<sup>1</sup> Some of the factual data are based on “Howard Brenner’s Legacy.. So Far” written to honor Howard’s 80th birthday by Dorfman, Rinaldi Ramos and Yariv *Chem. Eng. Comm.* 197, 1, (2009).

Dow Professor of Chemical Engineering at MIT, “the country’s best school”, from 1981 until his retirement four years ago. Prior to his time at MIT, Howard was on the faculties at New York University (1955–1965), Carnegie Mellon University (1966–1977), and the University of Rochester (1977–1981). During this time, he conducted fundamental research in a number of areas in fluid mechanics and transport phenomena. His seminal work on creeping flows and his book together with John Happel, “Low Reynolds Number Hydrodynamics”, has become the “bible” on Stokes flows and has been translated into many languages. His work on suspension rheology, and generalizations of Taylor and Aris’s theories of solute dispersion was followed by the comprehensive development of macrotransport theory. At the age of 70 he was engaged in a completely new field that dealt with what he perceived as an ambiguous and very profound notion of fluid velocity. Is there a difference between mass, momentum and volume velocities and how does it affect the Navier–Stokes equations. His suggestions were confronted by a skeptical community of fluid mechanicians. Lately his articles were accepted for publication after an uphill struggle. This episode epitomizes Howard’s ability to fight for his views no matter how hard it gets.

Howard’s research efforts have resulted in more than 200 articles, 35 book chapters, and three books. Howard’s work on porous media and suspension rheology was summarized in two review articles in the *Annual Review of Fluid Mechanics*. Many of his papers have had a tremendous impact on the development and applications of microhydrodynamics. Of these, perhaps the most famous are his two 1967 articles (together with Cox and Goldman) on low-Reynolds-number wall effects, each of them having been cited more than 500 times.

He insisted that one should work on fundamental problems without worrying about their application. It can come later. Howard’s investigation on low Reynolds number hydrodynamics, a forty years old work, is an excellent example. The tensorial formulation for the hydrodynamic drag force exerted on small particles of various sizes and shapes and the effect of near surfaces has been applied only recently in bioengineering and macro- and nano-technology.

Howard’s research and teaching accomplishments have been recognized by numerous awards. He was elected to the National Academy of Engineering in 1980 and to the National Academy of Sciences in 2000. He was also a fellow of the American Institute of Chemical Engineers, the American Association for the Advancement of Science, and the American Society of Mechanics. Professor Brenner has won all three major AIChE society awards, receiving

the Alpha Xi Sigma award for Chemical Engineering Research in 1976, the William H. Walker Award for Excellence in Contributions to Chemical Engineering Literature in 1985, and the Warren K. Lewis Award for Chemical Engineering Education in 1999. The fluid mechanics community has recognized his work with the Bingham Medal from the Society of Rheology in 1980 and the Fluid Dynamics Prize from the American Physical Society in 2001.

While awards and publications play an important role of Howard's legacy, one should not fail to mention the many students and postdoctoral researchers from all over the world who were privi-

leged to work with him. His legacy continues to live in their hearts and minds.

Indeed, a bright light has gone out but many, many lights were rekindled all over the globe. My dear and beloved friend: rest in peace, the torch is passed on to the next generation.

*Professor  
Shimon Haber  
Faculty of Mechanical Engineering,  
Technion-Israel Institute of Technology, Haifa, Israel*