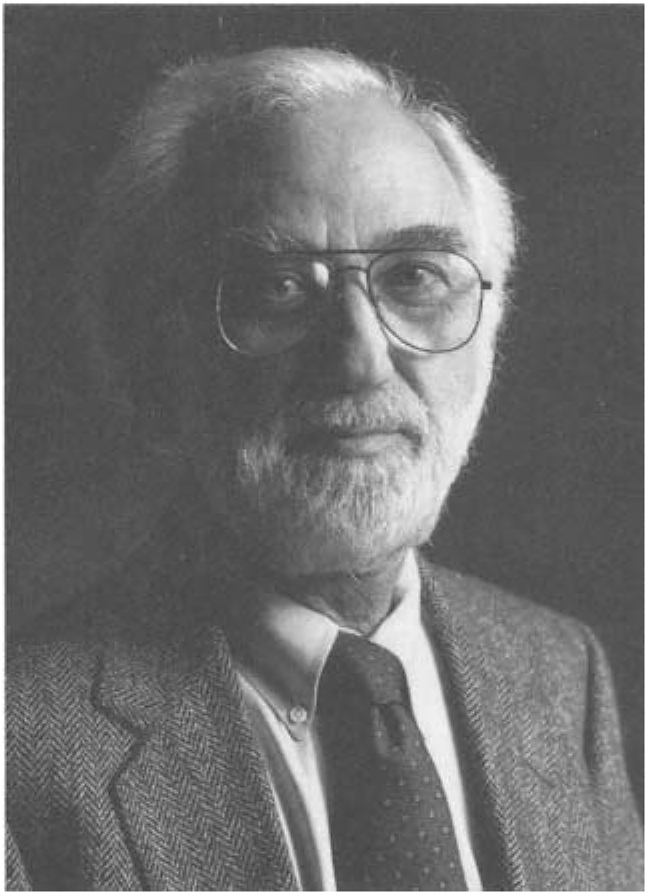

A. E. Dukler

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1925-1994

By Dan Luss and Moye Wicks

On February 12, 1994, Professor Abraham E. "Abe" Dukler of the University of Houston died at the age of sixty-nine. Abe was known worldwide for his contributions to the understanding of multiphase flow. Among the other honors he received, Abe was elected a fellow of the American Institute of Chemical Engineers (AIChE) (1978) and a member of the National Academy of Engineering (1977). He served on the editorial boards of three major technical journals: *International Journal for Multiphase Flow, Desalination,* and *Chemical Engineering Communications.*

Abe was born in Newark, New Jersey, on January 5, 1925. He earned his undergraduate degree from Yale University in 1945 and his M.S. and Ph.D. in chemical engineering from the University of Delaware in 1949 and 1951, respectively. After three years with Rohm and Haas, he joined Shell Oil at its Houston refinery in 1950. From 1952 until his death, he was affiliated with the University of Houston's Chemical Engineering Department, where he achieved the rank of professor in 1961. As one of the department's founders, he led its rise to prominence among schools of chemical engineering in the United States. He was dean of the Cullen College of Engineering from 1976 to 1982, then returned to research-his first and continuing love.

Abe was executive director of the governor's Energy Council for the state of Texas from 1973 to 1975. He organized and supervised a state-funded coordinating program designed to provide information for policymaking in Texas. These efforts introduced sound technical considerations into Texas state policies on energy management, regulations, allocation, and control.

Abe's lifelong interest was in two-phase phenomena. Such phenomena appear frequently in chemical engineering practice and in many other industrial processes, and proper understanding and modeling constitute a crucial step in the design and scale-up of a large variety of chemical and physical processes. Unfortunately, despite the enormous practical importance of this subject, it is so complicated that most fluid-mechanics research experts chose to take simpler, "cleaner" problems. Although some simple cases can be treated from a strictly analytical point of view, most multiphase-flow phenomena are far too complex to yield to treatments that do not derive from a clear physical insight and an ability to make proper simplifying assumptions. It is in this sense that Abe Dukler made major contributions in this difficult and complicated field. Through an impressive series of publications, he led an effort to bring order to the understanding of two-phase flow and laid the foundation for follow-on scholarly work by himself, his students, and others.

Beginning with his doctoral work on falling films, Abe was one of the pioneers in the use of computational techniques, applying them in his 1960 paper on heat-transfer in condensers—a major extension of Nusselt's 1906 paper on heat-transfer through liquid films. From 1960 to 1965 Abe directed the American Gas Association-American Petroleum Institute project NX-28 at the University of Houston, a project that led to the first schema for data collection and reporting of multiphase-flow measurements. This "data bank" was continued and extended by workers at the University of Calgary in Canada and the Harwell Laboratory in the United Kingdom. Recognizing the lack of communication between academic researchers and industrial practitioners, Abe's drive and enthusiasm sparked the formation of the American Institute of Chemical Engineers' Ad Hoc Committee on Multiphase Flow.

Through his guidance and persistent efforts, the activities of this committee culminated in the establishment of the AIChE Design Institute for Multiphase Processing (DIMP). Abe served as the first chairman of its Technical Committee.

Abe was clearly a key force in the DIMP effort. With Y. Taitel and others, he developed methods to predict the types of flow regimes that exist under given conditions of flow rate, fluid properties, and pipe geometry, laying the groundwork for systematic studies of the phenomena contributing to pressure-drop and energy-loss in each flow regime. All flow regimes received a share of Abe's attention, and in each case the technical community was enriched by his efforts. Indeed, without these contributions, the petroleum industry probably would not have rational design tools to size offshore oil-and gas-transportation systems reliably. Abe's research led to major improvements in design methods for flow in vertical and deviated oil and gas wells and made accurate hydraulic design possible.

With great insight, Abe developed new, unique experimental tools and accompanying analytical methods to examine the detailed behavior of two-phase systems, including capacitance probes for film thickness and bulk-entrainment gauges. These techniques allowed flow-pattern identification from wall-pressure fluctuations, determination of local void-fractions and surface-wave thickness, and droplet-size and diffusion measurements. Abe's measuring methods have become standard techniques. He was also the first to break down complex two-phase flow problems into their component parts with subsequent systematic analyses of each part. An understanding of the underlying physical phenomena was then integrated and used to solve important "real-world" two-phase flow problems. Abe had a special ability to reach to the heart of complex problems, pulling out their essential features and obtaining solutions of academic interest and practical value. His rare insight permitted specific identification of which problems should be attacked and when. Whether to the inspiration or occasional dismay of his students, Abe kept a watchful eye on any advance in technology that might give insight into the macroscopic design information needed by practitioners.

In recent years, Abe worked on two-phase flow problems in space technology. In space stations, climate control is achieved by transporting heat from laboratories and living areas to space radiators placed in remote locations. Very efficient heat-transport may be achieved with volatile two-phase mixtures, often driven by capillary forces. Unfortunately, the behavior of two-phase flow in zero gravity is unknown. Abe and his students, in close collaboration with J. Fabré of L'Institut National Polytechnique de Toulouse, modeled the intriguing behavior of two-phase flow under microgravity conditions. In cooperation with the NASA Lewis Research Center and the Johnson Space Center, Abe designed and built two experiments to be conducted on the 1998 space shuttle flights. Sadly, these experiments will now be conducted without the benefit of Abe's keen insight.

Additional national and international honors earned by Abe Dukler during his career included a senior postdoctoral fellowship from the National Science Foundation (1967), the Alpha Chi Sigma Award for chemical engineering research from the AIChE (1970), the Lady Davis Visiting Scholar Award from the Technion Institute in Israel (1976), the Chemical Engineering Lectureship Award for Research from the American Society of Engineering Education (1976), and the Donald Q. Kern Award from the AIChE (1988). Local recognition included the bestowal of the Cullen College of Engineering Alumni Association (EAA) Distinguished Faculty Award (1989), the EAA's posthumous naming of the award in Abe's honor, the University of Houston's Esther Farfel Award for excellence in teaching (1989), and the "Best Fundamental Paper" award of the AIChE's south Texas section (eight times).

Out of respect for Abe's enduring and pioneering contributions, the Engineering Dean's Office of the University of Houston has established and is coordinating the Abraham E. Dukler Scholarship Endowment.