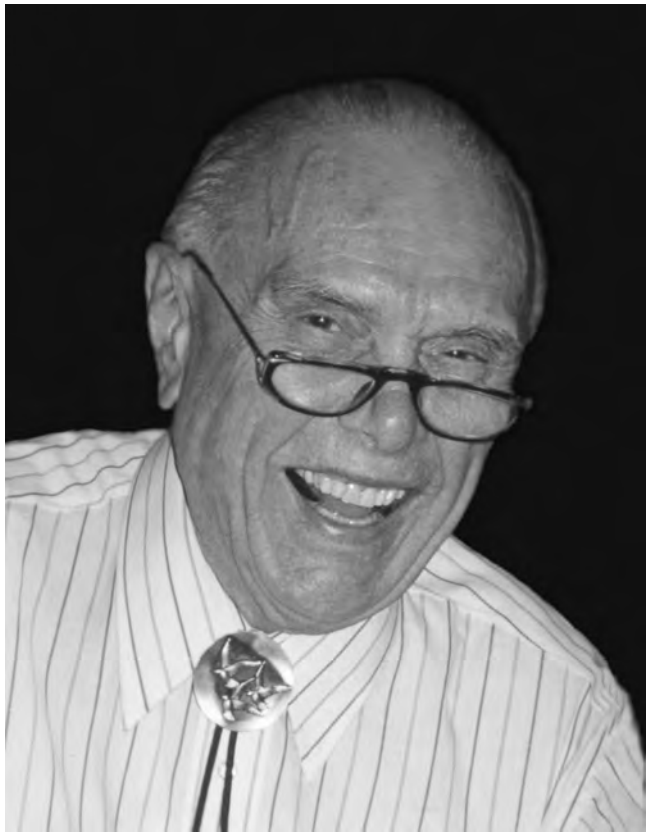

MARK V. MORKOVIN

1917–2014

Elected in 1987

"For contributions to the understanding of instability, transition, and turbulence through outstanding research and distinguished written reviews of the field."

BY ELI RESHOTKO AND WILLIAM S. SARIC

MARK VLADIMIR MORKOVIN, after a remarkable and productive life as an aeronautical engineer and educator, died in Oak Park, Illinois, on October 18, 2014, at the age of 97.

He was born in Prague, Czechoslovakia, on July 25, 1917, to a Russian father and a Czech mother, the youngest of three sons. He was baptized as Vladimir Morkovin. He completed his elementary and secondary education at the Gymnase Réal Français de Prague. After graduating in 1935, he joined his father, who had emigrated to the United States in 1926, in Los Angeles. Based on his schooling in Prague, he was admitted to the University of Southern California (USC) with junior standing in mathematics and physics. He had to learn English very quickly! While at USC he acquired the nickname "Mark," which he adopted as his first name. After graduating from USC in 1937, he became a graduate assistant in mathematics at Syracuse University, leading to a master's degree in mathematics in June 1938. He then became a teaching assistant in mathematics at the University of Wisconsin, Madison. In 1938, in Madison, he met Alva Heup and married her in February 1940. In May 1941, he became a US citizen. In 1941–1942 he was an instructor in mathematics at Michigan State University. He completed his PhD thesis in absentia and was awarded his PhD in applied mathematics with a minor in physics from the

University of Wisconsin in June 1942. He spent the next year at Brown University as a Rockefeller Research Fellow and also was an instructor in civil engineering.

In 1943 Morkovin joined Bell Aircraft as a research aerodynamicist to help in the design of high-speed aircraft. At that time transonic flight was without theory and there was little in the way of reliable experimental information. Mark and the group, with analysis and some guesswork, estimated the lift, drag, and moment coefficients in the transonic regime and were very happy when flight tests of the Bell X-1 aircraft verified the essential correctness of their work. Mark was very proud of his part in the design of the first aircraft to break the sound barrier.

In 1946 he spent part of a year as project manager with the Office of Naval Research during which he organized applied mechanics reviews. In February 1947 he joined the aeronautical engineering faculty of the University of Michigan in Ann Arbor. He enjoyed his work at the University of Michigan, but after a while found that in his enthusiasm, he had overcommitted himself and his personal and family life suffered.

When an opportunity arose for teaching and research at the graduate level with essentially no administrative duties, he joined the Department of Aeronautics at Johns Hopkins University in Baltimore in the summer of 1951. He maintained a relationship with Hopkins as a lecturer even while from 1958 to 1967 he was a principal research scientist with the Baltimore Division of the Martin Marietta Corporation. It was during this period that his concentration on issues of turbulence and transition intensified. In 1956, he published the paper "Fluctuations and Hot-Wire Anemometry in Compressible Flows," where he laid out the procedures for implementing hot-wire anemometry and the proper interpretation of the data. These procedures are in use to this day. In 1962 he conceived and published the Morkovin hypothesis, "that for moderate Mach numbers compressibility effects do not influence the dynamic behavior of turbulence directly, and the principal effect of high speeds is felt through the change in fluid properties."

In the fall of 1967, Mark moved to the Illinois Institute of Technology (IIT) as professor of mechanical and aerospace

engineering. Within one year he devoted his considerable energies to establishing lectures on boundary-layer transition and turbulence heretofore not taught, revising the undergraduate fluid mechanics curriculum using the new series of National Science Foundation films and film strips, and modernizing the wind tunnel facilities. The Mechanical Engineering Department had just moved into a new building and he was determined to make use of every available space, which resulted in the eponymous Mark V. Morkovin Wind Tunnel. These efforts were instrumental in attracting to the department a new generation of graduate students (Hassan Nagib, Thomas Corke, Unmeel Mehta, and Ahmed Naguib, among others) who are still having an impact on fluid mechanics today. The spirit of his efforts laid the foundations for Nagib and Corke to build the National Diagnostic Facility—a world-class, low-turbulence wind tunnel at IIT. From 1968 to 1973, he attracted and managed a major program funded by the Department of Defense through the Air Force Office of Scientific Research under the THEMIS congressional initiative. This further helped establish IIT as a world leader in fluid mechanics. Periodically, Mark would publish written reviews of some aspect or other of turbulence and transition. Mark retired from IIT in 1982, becoming professor emeritus. He nevertheless remained very active in transition research.

From the mid-1950s onward, Mark made a habit of visiting laboratories in the US and abroad to both lecture on and learn of the ongoing work in turbulence and transition. In 1969 he was a member of a small committee that recommended to the National Aeronautics and Space Administration (NASA) the formation of a Transition Study Group, which was founded in 1970. Initially the group was composed of researchers from the various government laboratories. Reshotko, by virtue of being on the NASA Aeronautics Advisory Committee at the time, was also appointed to the group and became its chairman. Mark was quite disappointed not to be made a member of the group but was kept informed of the group's activities. In 1974, the group presented a series of papers at a session of an American Institute of Aeronautics and Astronautics meeting

and Mark was the reviewer of all the papers for their publication a year later.

When the Transition Study Group became less formal (after NASA the group had no consistent sponsor), membership was opened up and Mark became a major contributor to the group's activity. A preliminary measure of his contribution was that the group's meetings ran twice as long with him as without him. His real contribution was as the conscience of the group. He was the sounding board for many of our ideas, good or bad. He never hesitated to question what we did and in the process sharpen our understanding. If any of us thought that we understood a particular point, he would reach into his briefcase and pull out a figure that represented a counterexample.

In this period of time, Mark set out to write the definitive book on boundary-layer transition. With his wife, Alva, as his typist and editor, he wrote drafts of many chapters and circulated some of them for comments. The problem was that the field was moving faster than he could compose and therefore many chapters could not be kept up to date. Many of us suggested that he simply date each chapter. He did not accept our suggestion and in the end there was no book. Later on he concluded this activity by giving a week-long series of lectures at various research centers featuring the many figures from his lectures over the years that he could put together in a somewhat coherent form.

In the early 1990s, Mark visited the Institute for Computer Applications in Science and Engineering (ICASE) at NASA Langley and became aware of a new theoretical formulation of stability issues. Knowing that Reshotko would be visiting ICASE a few weeks later, he advised him strongly to find the appropriate papers and read them. While at ICASE Reshotko met a young researcher, Peter Schmid, who was completing his doctorate in Sweden and who showed him his work. On reading Schmid's papers, Reshotko realized that his work was about "transient growth." Peter Schmid was then invited to the next meeting of the Transition Study Group to give a tutorial on his work. It was clear to us that we had to incorporate

his approach to our understanding of the "paths to transition." This led Mark, Thorwald Herbert, and Reshotko to try to absorb the implications of "transient growth" on the transition process and on features that we had described as "bypasses." The result was a roadmap diagram that Reshotko presented at an American Physical Society meeting in 1994 under the authorship of Morkovin, Reshotko, and Herbert. This likely was Mark's last publication and is referred to often in the subsequent stability literature.

Mark's wife Alva died in 1998. He is survived by sons Michael and Gregory, and two grandsons. Mark Morkovin was a cherished colleague and a true friend.