

Shan-Fu Shen

August 31, 1921 — December 22, 2006

Shan-Fu Shen, Professor Emeritus of Mechanical and Aerospace Engineering at Cornell University, passed away after a short illness in Ithaca, New York, on December 22, 2006. He was 85 years old.

Born in Shanghai, China, in 1921, Professor Shen received the Bachelor of Science degree in 1941 from the National Central University in Chungking. In 1943, he won the prestigious Tsin-Hua Fellowship in Aeronautical Engineering by placing first and winning its fifth national competition. This fellowship supported postgraduate work at any U.S. institution. In 1944, he won the prestigious Sino-British Boxer Indemnity Fund Fellowship in Aeronautical Engineering by placing first and winning its ninth national competition. This fellowship supported postgraduate work at any British institution. In 1946, he accepted the Tsin-Hua fellowship and began graduate study at MIT. He brilliantly completed the Sc.D. degree in Aeronautical Engineering in 1949, with Professors C.C. Lin and H.S. Tsien, two of the world's leaders in theoretical and engineering fluid mechanics, as thesis co-advisers.

Following two years as a Research Associate in the Mathematics Department at MIT, Professor Shen joined the faculty of the Aeronautical Engineering Department at the University of Maryland, where he became a full professor in 1957. Then, in 1961, after eleven years at Maryland, he was convinced by W.R. Sears to become a Professor in what was then the Graduate School of Aeronautical Engineering at Cornell University, and there he remained for the rest of his professional career. A distinguished scholar in aerodynamics, fluid dynamics, and heat transfer, Shan-Fu Shen taught and advised Cornell undergraduates and graduate students, conducting his own research and guiding others until his retirement in 1991 as the John Edson Sweet Professor Emeritus.

During his career, a number of special appointments attest to his international distinction. He was a Guggenheim fellow at the Eidgenössische Technische Hochschule, Zürich in 1957; he served two one-year terms (1964, 1969) as Visiting Professor at the University of Paris; in 1977, he was a Visiting Professor at the Technical University of Vienna; and in 1984-85, he was a Visiting Professor at the Institute of Space Sciences at the University of Tokyo, and at three universities in China. Dr. Shen has also been a consultant to the David Taylor Ship Research and Development Center of the U.S. Navy on matters concerning the seaworthiness of marine vessels on rough seas, the dynamics of giant helicopters with circulation-controlled rotors, and design modification of aircraft for carrier landing.

Professor Shen's work over the years is striking for its diversity. He made important contributions in all regimes of aerodynamics including transonic and hypersonic, in aeroelasticity, in finite-element methods for aerodynamics, in hydrodynamic stability (including a notable review of the subject in the "Princeton Series"), in the kinetic theory of gases, in non-Newtonian flows, including modeling of polymer flows with heat transfer, in rarefied gas dynamics, and most recently, in the theory and computation of boundary-layer separation, especially in unsteady flow over maneuvering bodies.

Professor Shen made other notable engineering contributions in the years from 1974-88, when he was a Co-Principal Investigator, along with Professor K.K. Wang, who was the leader of the Cornell Injection Molding Program (CIMP). This program was conceived at Cornell in the early 1970s to help manufacturers facing difficult problems in producing plastic parts. The program initially was supported for one year by the National Science Foundation via its RANN (Research Applied for National Needs) program in the high risk—high potential benefit category. Because of the program's successes, the NSF support continued for a total of 12 years, as part of its aim to foster university-government-industry collaboration. In 1979, an industrial consortium was established so that a membership of more than 50 major corporations throughout the world might benefit from the results of the Cornell effort. The goal of CIMP was to establish a scientific basis for solving practical problems of injection molding, and Shan-Fu Shen contributed the necessary theoretical understanding of relevant fluid mechanics and heat-transfer issues. He made significant contributions to the success of this effort through research, with colleagues and graduate students, on transient and non-isothermal flow and solidification in polymeric materials. Professor Shen and colleague Dr. C.A. Hieber (Cornell Ph.D., 1970) published their results in the *Journal of Non-Newtonian Fluid Mechanics* in 1980; their predictions of flow-front positions and cavity pressure distributions agreed very well with experiments. The efficient numerical scheme that they developed paved the way for further advances in the analysis of flow and solidification of polymer melt in realistic mold cavities. Today, Shan-Fu Shen's studies of non-Newtonian flow and properties of polymer melts are recognized as important for enabling the efficient design and manufacture of the countless plastic products needed in the modern electronics and consumer products industries.

In recognition of these wide-ranging contributions to engineering science, Shan-Fu Shen was elected to the National Academy of Engineering in 1985. Professor Shen has received many other awards as well. He received the Achievement Award from the Washington Academy of Sciences in 1958 and was elected Fellow the same year. He was elected corresponding member of the International Academy of Astronautics in 1969 and in 1985 received

Germany's Alexander von Humboldt Senior Award. He became a member of the Academia Sinica (Republic of China) in 1972.

Over the course of his career, Dr. Shen has authored 75 refereed and invited articles appearing in, among others, *Annual Reviews of Fluid Mechanics*, *Advances in Applied Mechanics*, Vol. 4 of the Princeton series in *High Speed Aerodynamics and Jet Propulsion*, *Journal of Fluid Mechanics*, *Journal of Math and Physics*, *Journal of the Aeronautical Sciences* and *AIAA Journal*, *Journal of Statistical Physics*, *Journal of Computational Physics*, *Journal of Non-Newtonian Fluid Mechanics*, *Israel Journal of Technology*, and *Rheologica Acta*. Also, through the years, he has supervised many graduate students and post-doctoral fellows who went on to dot the map of universities and companies throughout the world.

Professor Shen always showed the greatest sense of responsibility for the fortunes of the graduate students he advised and led in research; they attest to the integrity, decency and imagination as well as scientific depth with which he inspired them, along with his rigor and occasional severity! One former student (W.G. Habashi, now of McGill University, a leader in the burgeoning field of computational fluid dynamics) especially remembers how tough and uncompromising Professor Shen was in his final Ph.D. exam. But, he also remembers Dr. Shen's friendly concern for his subsequent career, urging him to be independent, to go beyond his thesis subject and to do new things.

Shan-Fu Shen's faculty colleagues at Cornell remember him as a serious-minded but warm and helpful friend. K.K. Wang, recalling his association with him in the injection-molding program described earlier, says that at a critical time when he needed a partner to initiate interdisciplinary research on injection molding of plastics, Shan-Fu stepped in; and that for 14 years, Shan-Fu generously contributed his vital expertise in fluid mechanics and heat-transfer to the program; that, during that time, he was always a sincere and constructive critic, a reliable advisor and major contributor in matters of computational fluid mechanics; and that he was highly regarded not only by the students and research staff in CIMP, but also by program collaborators from industry and other institutions. Now, Professor Wang adds, "He will be remembered fondly by all of us who have worked closely with him for so many years."

Shan-Fu Shen was devoted to China and its culture, and to his family—his wife Ming-Ming and their son Hsueh-Yung and daughter Hsueh-Lang, who all survive him. He was certainly proud of the musical talents and accomplishments of Ming-Ming and both his children. And he was the proud host of many dinners at his home, where Ming-Ming showed her mastery of classical Chinese cuisine, to the delight of privileged guests!

So we must say farewell to Shan-Fu Shen, distinguished scholar, engineering scientist, faithful teacher, colleague and friend.

Franklin K. Moore, Chair; David A. Caughey, P.C.T. deBoer