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## In Memoriam

### Professor Yasuo Mori (1923–2012)



Professor Yasuo Mori, an outstanding leader in the international heat transfer community and a superb educator, Professor Emeritus of the Tokyo Institute of Technology, passed away on March 20, 2012, at the age of 89. Professor Mori was born in Tokyo on February 24, 1923, grew up in the family of parents, two brothers and a sister. He attended the university in the deteriorating environment of war-torn years. By the late summer of 1945 the Pacific War was over, and shortly afterward he finished his college education. He belonged to the generation who experienced social disruption and economic hardship brought by the war. His experience in these difficult years helped in the development of his characters that valued hard work, dignity, justice, and international collaboration.

He graduated from Dai-Ichi High School, a gate way to Tokyo Imperial University (presently, the University of Tokyo), in 1942. At the University he enrolled in the department of aeronautical engineering, and earned the bachelor's degree in October 1945. He was on the way to become a junior faculty member there, but the department was closed in 1946 at the behest of the U.S. government who was busy clipping the remnants of military technologies in postwar Japan. Having seen the career path at the University of Tokyo closed he landed a research job in a government laboratory, the Institute of Physical and Chemical Research (called RIKEN), in 1947. In 1953 he moved to the Tokyo Institute of Technology (Tokyo Tech), and in a few months was appointed as associate professor. During this period he submitted a doctoral thesis to the University of Tokyo, and was granted the Doctor of Engineering degree in 1956. In 1961 he was promoted to professor, and had been with Tokyo Tech until his retirement in 1983. In the final year at Tokyo Tech he also served as adjunct professor at the

Institute of Industrial Science, University of Tokyo. In the succeeding period of 1983 ~ 1988, he continued teaching and research at the University of Electro-Communications in the suburb of Tokyo. After his retirement from the teaching job he consulted for an instrument manufacturing company, Tokyo Keiso, for a few years. In 1990 he was recruited by the Ministry of Foreign Affairs to become an advisor and senior scientist for a US/Japan joint research project at the Pacific International Center for High Technology, in Honolulu, Hawaii. He had served there for two years, then, retired to quiet life in his home town in the western suburb of Tokyo.

In the early 1960s a young Yasuo Mori earned recognition from the heat transfer research circle in the U.S. by his work on the buoyancy effects in forced laminar convection flow over a horizontal flat plate published in the ASME Journal of Heat Transfer. The work was conducted at Cornell University where he stayed as a Fulbright visiting scholar during 1959 ~ 1960. In this work he used a perturbation expansion technique to solve a non-linear problem where vertically applied buoyancy was superposed on a horizontally developing boundary layer flow. Later at Tokyo Tech, he conceived a more powerful methodology to solve complex three-dimensional convection heat transfer problems. The first step of analysis was to identify a non-dimensional governing parameter in the problem. Asymptotic solutions were then obtained by the perturbation expansion in a range of small parameters, and by proper modeling in a range of very large parameters. Experimental data provided information for connecting these asymptotic solutions. This technique was applied to the analysis of flow and heat transfer in tubes and ducts under the influence of various body forces. The results obtained by several graduate students under his tutelage were distilled to a set of concise formulas for use by the designers of spiral tube heat exchangers, coolant paths of electric generators and other equipment.

During his entire academic career Professor Mori had expanded his research to a wide range of subjects concerned with the developments of energy sources and the efficient utilization of energy. In an article he wrote in 1983 for the Journal of Japan Society of Mechanical Engineers (JSME), he summarized his research activities in three categories. The objective of research in the first category was to establish a systematic knowledge base for heat transfer phenomena that involve similar mechanisms. Convection heat transfer under the effect of various body forces was the subject of research in this category. Research work in the second category was associated with long-term national projects, yet motivated by the needs for understanding of underlying physics. One of the projects to which Professor Mori had made commitments for many years was aimed at the development of magneto-hydrodynamic (MHD) power generation plant. Important research topics for this project were heat transfer from plasma in the duct to the electrode, shockwave formation, and combustion in MHD channels. Professor Mori and several generations of his graduate

students worked on these topics. He also extended his research repertoire to other subjects of high-temperature heat transfer arising from another national project on multi-purpose gas reactors. Research in the third category was characterized by the application of a same theoretical method to the analyses of physical processes in different settings. He cited the work on enhancement of condensation heat transfer on a sharply pointed fin tip as an example in this category. In this example, the technique to deal with a singularity problem on the leading edge of an object placed in single-phase flow was applied to the analysis of two-phase flow on the fin tip.

Professor Mori always directed his attention to the problems of social and technological importance. Besides his work on MHD and gas reactors, he extended his research interest to the nitrogen oxide and carbon dioxide issues. He also played a leading role in the projects on the utilization of geothermal and ocean thermal energy. While such large-scale projects were largely run by practicing engineers, he consistently emphasized the role of academics in providing industrial designers with solid and accurate scientific knowledge base. He demanded convergence of theory and experiment in arriving at a conclusion, not by lop-sided work of either. Besides, he applied conceptual tools of physicist to the solution of engineering problems. He emphasized the physics-based approach in his classroom teaching of thermal engineering. In an attempt to encourage the physics-based approach in education of other fields of mechanical engineering he took the initiative in founding a department at Tokyo Tech, named Department of Physical Engineering ('physical' for 'the science of physics'), in 1968. His tenet regarding the research benefited the graduates of his laboratory who numbered more than 300 (including undergraduates who performed BS thesis work). Most of them went to work in the industry, and remembered his teaching during their career. Many of them kept pride in having their names as co-authors of the papers published in journals and conference proceedings. Professor Mori was an author and co-author on more than 300 papers and 15 books.

Professor Mori left his legacies in the Japanese heat transfer community. He was a founding member of the Heat Transfer Society of Japan, and served as its president in 1978. He took the initiatives in developing the Society's organization, enhancing its financial foundation, and creating the scholarly award for young researchers. He also contributed to the development of Japanese mechanical engineering community through his official services in the JSME. He served as a JSME board of director four times in the 1960s and 1970s, and vice president in 1978.

Professor Mori made efforts to establish channels of international collaboration in heat transfer research for his peers and younger generations of researchers and engineers. He chaired the board of International Affairs during his tenure at the JSME board of directors. Through the International Cooperation Program initiated by him the JSME is now supporting bi-national and multi-national thermal engineering joint conferences with its counterparts of various countries. He played a pivotal role in organizing the International Heat Transfer Conference in Tokyo in 1974, and the first Japan/US Heat Transfer Seminar in Tokyo in 1980. He himself served as the principal co-organizer of the first Japan/US Thermal Engineering Joint Conference, Honolulu, 1983, and the Japan/US Heat Transfer Seminar in San Diego, 1985. He made commitments to the development of International Centre for Heat and Mass Transfer (ICHMT) since its foundation in the early 1970s. He served as president of ICHMT during 1990 ~ 1994. His tenure coincided with the period for the Centre to move from Yugoslavia to Turkey. He exercised his leadership to streamline the Centre's organization, thus helped to establish the Centre as we know today. He served as an editor or advisory board member for major interna-

tional journals; International Journal of Heat and Mass Transfer (1973 ~ 1986), International Communications in Heat and Mass Transfer (1976 ~ 1986), Energy Developments in Japan (1980 ~ 1987), and Heat Transfer Japanese Research (1975 ~ 1986). He was invited to present keynote lectures at major international conferences and universities. He served as Springer Distinguished Professor, the University of California, Berkeley, in 1984. In the international heat transfer community Professor Mori is remembered by his quick and intellectual developments of his thought, sharp manner of discussion at conference sessions, yet as a congenial and likable gentleman on private occasions.

The list of awards bestowed on Professor Mori by the Japanese societies and government includes; JSME best paper award four times (1963, 1973, 1980, 1984), the Award for Person of Distinguished Services to the Promotion of Science and Technology (Tokyo municipal office, 1982), the Award for Significant Contributions to the Development of Large-Scale Technology (MITI Japan, 1986), JSME Thermal Engineering Division Award (1989), and the Order of the Rising Sun, Gold Rays with Neck Ribbon (1999). Professor Mori also received honors from the American Society of Mechanical Engineers; the Heat Transfer Memorial Award (1982) and Max Jakob Memorial Award (1988). The International Centre for Heat and Mass Transfer awarded him A.V. Luikov Medal in 1988. He was elected to foreign associate of the U.S. National Academy of Engineering in 1986.

Professor Mori was known as an avid sports player since his youth. He played baseball and skiing with his students, and in later years excelled in golf. Many of his former students challenged him on the golf course, but bit their lips realizing that he was above them even in pastime play. Professor Mori is survived by his wife Reiko to whom he was married for 59 years. Mrs. Mori remembered him as a warmhearted and gentle husband, and could not imagine that he demanded rigor and discipline on his students in their research work. Those students who experienced his stern guidance, however, sensed that he had a genuine warm heart and never lost confidence in anyone who studied under him. Hearing his death the alumni of his Tokyo Tech laboratory staged a memorial event one day. Many stories about Professor Mori were told in the event. Professor Mori's achievements stand out not only in research but in inspiring so many generations of his students who now remember him with great respects, pride, and warmth.

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