William S. Pellini

1917-1987

By William J. Harris, Jr.

William S. Pellini, a major contributor to the science and practice of metallurgical engineering and component design, died February 25, 1987, of a heart attack at age sixty-nine. He was known to his friends, colleagues, and professional associates as one of the most astute and competent investigators of complex phenomena in the fields of materials and service performance. During his long and distinguished career, he made significant contributions to the design of highly stressed steel structures, to the design and inspection of nuclear containment vessels, to the failure analysis of railroad equipment, to the development of programs for research on methods of controlling aerodynamic heating, and to many other fields.

Mr. Pellini was raised in a family that emigrated to the United States from Italy. His forbearers came from a small community in Northern Italy that was known throughout the world for their skill in design and construction of stone structures. Members of the community would take commissions from Russia, Central Europe, England, or elsewhere that might require them to be away from home for two or three years engaged in stone cutting and the erection of magnificent personal or public buildings.

He had an early interest in metallurgy and entered Carnegie Mellon University in the depths of the depression. He completed his work and received his initial degree in 1940, but continued work at the University until 1942, when he was commissioned in the United States Navy. From 1942 to 1946, he served at the Naval Proving Ground, Dahlgren, which was a center of research and study related to light and heavy armor and projectiles. The work done at the Armor and Projectiles Laboratory at the Naval Proving Ground, Dahlgren, vastly improved the capability of both naval ships and naval aircraft to operate and survive in the combat environment. He made critically important contributions to the heat treatment of steel during his service with the navy and became deeply interested in the problems of materials fracture at high strain rates.

In 1947 he joined the Oak Ridge National Laboratory, but left there in 1948 to join the Naval Research Laboratory (NRL). At NRL, he became head of both the casting and the welding divisions. He made singular contributions to the flow of metal in castings and to the processes of welding.

In his work on welding, he not only contributed to the technology of welding itself but also used weldments as a basis for comparing the fracture resistance of different kinds of steel. He applied explosive techniques that he had learned at the Naval Proving Ground, Dahlgren, to achieve rapid deformation of a plate made up of two different kinds of steel joined by a brittle weldment. Under identical explosive loading conditions, brittle cracks moved rapidly into the two different plates. This made it possible to learn much about brittle fracture and materials selection to control brittle fracture. His contributions came at the time that George Irwin and others were studying fracture. The combination of Pellini's applied metallurgical approach and Irwin's more fundamental physics approach led to the establishment of the science and engineering of fracture mechanics. Mr. Pellini was one of the pioneers in this field, with his work started in 1949 on the explosion bulge tests.

Mr. Pellini became superintendent of the Metallurgy Di vision at the Naval Research Laboratory in 1954 and led a group of dedicated individuals in work on the Navy Nuclear Submarine Program and the Naval Ship Program. They examined the relationships between design requirements, material selection, and fabrication. They studied the effect of nuclear radiation on fracture properties. In his career, he demonstrated that brittle fracture occurs when there is an error in design, fabrication, or materials selection. A brittle material can survive if there are no flaws in fabrication and if the design prevents dynamic loading. His genius in failure analysis and his ability to extract the right inferences from complex design and fabrication issues were legendary.

In 1958 Mr. Pellini took leave from the Naval Research Laboratory to join the staff of the National Research Council of the National Academy of Sciences and its Materials Advisory Board. He served as staff director of a major project on reentry materials that grew out of the 1956 and 1957 von Kármán studies on long-range planning for air force research and development. The program was directed at designing a long-range program of research on materials to cope with aerodynamic heating. Mr. Pellini assembled a distinguished group of preliminary designers and thermo-dynamicists to establish the thermal environment in missions ranging from reentry of intercontinental ballistic missiles, to vehicles returning from moon missions and vehicles engaged in extended supersonic operations in the atmosphere. He assembled the data on the thermodynamic environment and established a relationship between that environment and properties of the promising materials and designs. He was able to present this information in a single chart that elegantly portrayed the most promising avenues of research for addressing the aerodynamic heating problem. The work done by Mr. Pellini was used as a guide for many years in directing work on ablative materials, on cooling systems, and on radiating materials such as the tiles currently used in the space shuttle.

He continued his studies at the National Research Coun cil as staff director on a project to address space power requirements. With the help of preliminary design advisers, he was able to establish an array of requirements, taking into account weight, power requirements, and duration of mission. On that array, he was able to overlay the capability of a wide variety of systems to provide space power and demonstrate the most promising directions of research for satisfying the emerging missions. His work made a significant contribution to research in this field.

In 1958 he returned to the Naval Research Laboratory, resuming his position as superintendent of the Metallurgy Division and serving temporarily as an associate director of the Naval Research Laboratory. In the Metallurgy Division, he continued to supervise important work on materials and their behavior until he retired in 1974.

Upon retirement, he joined the Association of American Railroads as a senior consultant, working on problems of brittle fracture. While there, he completed textbooks on the reliability and safety of structural steels and narrated videotape short courses defining sound approaches to design and materials selection.

During his study of tank car failures, he began to examine opportunities for new materials in tank car designs. This led him to an exploration of work being done on micro-alloyed steels with lower carbon contents than were current in American practice. He established the value of these lower carbon, high-strength steels, with their high weldability and very good impact properties. Through a series of studies and demonstrations, he won support for application of these materials to new tank cars. The current standards in the industry require these materials. His pioneering work on fracture problems and solutions contributed in a significant way to the reduction in service failures in the railroad industry.

Those who worked under his direct supervision and who were privileged to be his associates benefitted greatly from his scholarly assessment of materials, their behavior, and their performance. His work on nuclear containment vessels, ship structures, railroad components, and the broad issue of design to accommodate fracture made a major contribution to the entire field of materials design and engineering.

He received many honors in the course of his long professional career. The Washington Academy of Sciences recognized his work in 1954 and awarded him an Outstanding Achievement Certificate. The U.S. Navy awarded him the Distinguished Civilian Service Award in 1961. His brilliant work on the flow of metals in castings was recognized by his receipt of the John A. Penton Gold Medal of the American Foundrymen's Society in 1961. His continuing work on submarine hulls, nuclear vessel containment, and related naval problems earned him the Gold Medal Award of the American Society of Naval Engineers in 1962. He was awarded the U.S. Department of Defense Distinguished Civilian Service Award in 1963. His contributions to the development and application of the field of fracture mechanics won him the Albert Sauveur Achievement Award of the American Society for Metals in 1972, and the U.S. Navy's Robert Dexter Conrad Award for scientific achievement in 1973. He was a fellow of the American Society for Materials International.

He was elected to the National Academy of Engineering in 1974.

Mr. Pellini was a brilliant student, hard working, self-effacing, competent, and capable of moving to new fields and accommodating to their requirements, while achieving his objectives.

Those of us who had the pleasure of his company over the several decades of his professional life are grateful for his contributions to engineering. We continue to miss him.

At the time of his death, survivors included his wife, Katheryn Hatch Pellini, who has since died; two daughters, Linda Pellini-Dunn of Carver and Carolyn Ross of Waldorf, Maryland; one son, Carl Pellini of Oxnard, California; and seven grandchildren.