At a Meeting of the Faculty of Arts and Sciences on May 16, 2006, the following Minute was placed upon the records.

HOWARD WILSON EMMONS

Born: August 30, 1912
Died: November 20, 1998

Howard Wilson Emmons, Gordon McKay Professor of Mechanical Engineering, *Emeritus*, and Abbott and James Lawrence Professor of Engineering, *Emeritus*, the father of and a leading contributor to modern home fire research, died in his 86th year on November 20, 1998. Before Howard and his many doctoral students and visiting fellows conducted their path-breaking body of fundamental fire science research, the primary approach to home fires was to develop techniques for fire suppression. When discussing fires in homes, Howard often reminded us that to make a fire requires more than just fuel for combustion; it depends on the overall arrangement of the combustible materials as well as on their material properties. He often said that every Boy Scout knows that one dry log by itself does not make a campfire, but a triangular arrangement of three logs with kindling makes a nice one. It was the overall interaction among all of the ingredients of a fire-combustion, the convection of the hot gasses, the products of combustion, radiation among the components and to other objects nearby, control of the air supply, and lastly the chemistry of the reactions— that fascinated Howard over the last decades of his long and productive research career.

He was born on August 30, 1912, in Morristown, New Jersey, and educated in local public schools. His father was a carpenter/cabinet-maker who had personally built the home in which Howard and his brother were born and raised. From him Howard acquired the self-reliance, do-it-yourself skills, and work ethic that he practiced every day, whether in the laboratory or at his 1817 home in Sudbury, Massachusetts. At home, he maintained a chemistry laboratory, electronic shop, and self-assembled computer laboratory. His classmates in Morristown High School, who called him "our eminent mathematician ... who will become famous some day," recognized early his intellectual skills. He was an engineer through and through, with a strong science and mathematics base. He received bachelor and master's degrees in mechanical engineering from Stevens Institute of Technology in Hoboken, New Jersey, and the Doctorate of Science degree from Harvard in 1938. His thesis concerned the chemical promotion of drop-wise condensation of steam, a way of increasing the efficiency of electrical generation. He studied steam turbine systems at the Westinghouse laboratories for two years before shifting to the University of Pennsylvania to begin his long academic career. In 1941 he was appointed an assistant professor in the Harvard Engineering School, serving continuously on the Harvard faculty until becoming *Emeritus* in 1983. He remained active in fire research until his death.

Professor Emmons made major contributions to a wide variety of fields of engineering. He was a leader both nationally and at Harvard in the then new field of engineering sciences: engineering based on scientific principles. His insightful mind and an intuitive understanding of the responses of complex systems to thermodynamical and Newtonian forces equipped him for the role of innovator in both teaching and research.

He was an early leader in compressible flow research. He discovered regions of propagating stall in jet engine compressors that can be responsible for destructive forces on their blades. Using a free-surface laminar flow water table flow, he was the first to observe what are now called “Emmons spots” - isolated regions that have undergone transition from laminar to turbulent flow. At that time researchers at the NACA, who had only observed turbulent transition in wind tunnels from the growth of two-dimensional laminar instability waves, doubted that transition could occur in spots. More extensive research on their part proved that “Emmons spots” are a universal mechanism of turbulence transition.

Emmons was a pioneer in numerical methods for scientific computations, using mechanical calculating machines to solve the partial differential equation of heat conduction for complex material configurations long before modern electronic computation was developed. He contributed to our understanding of aerodynamic heating and the drying of paper. Problems arising in the atmospheric re-entry of space vehicles led him, his students, and post-doctoral fellows to undertake experimental and theoretical studies of plasmas at high temperature and pressure. He was an early contributor to the theory of compressible laminar boundary layers, and the editor of *Fundamentals of Gas Dynamics*, Volume III of the Princeton University series of books on High Speed Aerodynamics and Jet Propulsion.

From the early 1950s until his death, Professor Emmons’ sustaining research interest was combustion science and fire research. His 1956 paper, *The Film Combustion of Liquid Fuels*, is now recognized as a classic in the combustion science field and is simply called the Emmons Problem. In 1962 he chaired a National Academy of Science Summer Study on Fire Research at Woods Hole, MA. Its recommendations led to the passage of the Fire Research and Safety Act of 1968. Professor Emmons witnessed President Johnson signing the bill at the White House. Research programs were then established at the National Science Foundation and at the Bureau of Standards (now called NIST).

In the mid 1960s he and his wife Dorothy undertook a sabbatical round-the-world tour of fire safety establishments to understand the worldwide state of fire research. He found little fundamental science-based research results, rather a listing of products by their believed combustibility levels. The item rankings from country-to-country were nearly random. He returned to Harvard and with NSF funding initiated the “Home Fire Project,” beginning to put science into fire science. He was instrumental in establishing a fire research laboratory at Factory Mutual Research Corporation where full-scale tests could be conducted to validate theory.

The Harvard “Home Fire Project” systematically documented the scientific basis of the Harvard Computer Fire Code, a model predicting the development of fires in enclosures. This was the prototype for all subsequent computer program improvements— it was Fire Code Version1.0.

Membership in the National Academies of Engineering and of Sciences and the American Academy of Arts and Sciences flowed to him in recognition of his contributions to both engineering and scientific research. He was awarded the Timoshenko Medal of the American Society of Mechanical Engineering, the Edgerton Gold Medal of the Combustion Institute, honorary doctorates from Stevens Institute and Worcester Polytechnic Institute, the Fluid Dynamic Prize of the American Physical Society, and the Man of the Year Award from the Society of Fire Protection Engineers. He served on many governmental review and advice panels and for 12 years was a member of the Space Science and Technology Panel of the Presidential Scientific Advisor Committee.

When he and Dorothy settled in then rural Sudbury he set out to improve the local school system, serving first as a member of the School Committee for 12 years. He was a prime mover in the establishment of the Lincoln Sudbury Regional High School and served for 11 years on the Regional District School Committee before being elected Sudbury Selectman in 1969-72. These civic commitments were an important part of who he was. He and Dorothy enjoyed their life at their homestead with their three children – house, attached barn, gardens, orchard, and swimming pool. For many years he kept a flock of sheep and he made cider annually from the product of his apple orchard. He also built a clay tennis court and regularly enjoyed playing on Sunday mornings with neighbors or on a summer evening with the family. He took pleasure from the challenge of never-ending repairs, maintenance, and projects of all kinds associated with living in a historic colonial house. He and Dot maintained a welcoming home to neighbors, colleagues, and students. In winter the fireplace was always lit with logs he cut and split from their woodlot.

Physical intuition and towering integrity characterized the teaching, research, and civic activities of Professor Emmons. His was a formidable presence as an expert witness in the courtroom, in meetings with research students, and in everyday technical interchanges with colleagues. He leaves over 50 doctoral students worldwide in positions of leadership, with self-confidence born from their intense technical discussions with him

His is survived by his three children Beverly, Scott, and Keith and three grandchildren; his wife Dorothy died in 1991.

Respectfully submitted,

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