IN MEMORIAM

Paul Ludwig Chambré
Professor of Nuclear Engineering and Mathematics, Emeritus
UC Berkeley
1918 – 2013

Paul L. Chambré, professor emeritus of the Department of Nuclear Engineering and the Department of Mathematics at the University of California, Berkeley, died peacefully at home at the age of 94 on April 13th, 2013. Professor Chambré's six- decade career in nuclear engineering and mathematics spanned the fields of applied mathematics, reactor physics and safety, the nuclear fuel cycle, and radioactive waste management. Chambré was an outstanding and inspiring educator and mentor with profound affection, rigor and patience toward students. His wisdom and guidance will surely be missed.

Chambré was born August 7, 1918, in Kassel, Germany, as the son of Ernst and Minna Chambré. He and his family moved to California in his teens to avoid Nazi persecution. He started his collegial study at San Jose State College in 1937, and received his bachelor's degree in chemistry from UC Berkeley in 1941. Upon graduating, he worked at the Pan American Engineering Company, Berkeley, as a research chemist in 1941-43. Following this, he moved to southern California, where he worked at the Airesearch Manufacturing Company, Los Angeles, as a research engineer in 1943-1944, and as a theoretician at the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, in 1944-1946. He received his MS degree in mathematics from New York University (NYU) in 1947, joining the US Air Force's Project Squid at the Institute for Applied Mathematics and Mechanics at NYU. Returning to UC Berkeley, he continued his studies in the Low Pressure Research Project, and earned his PhD degree in 1951 with a dissertation concerning combustion and rarefied gas dynamics written under Professor Samuel Schaaf in the Department of Mechanical Engineering. As Professor Schaaf was a doctoral student of Professor Griffith Evans of Mathematics (for whom Evans Hall is named), Chambré can be considered a mathematical grandson of Evans.

Professor Chambré joined the faculty of the UC Berkeley mathematics department as an Instructor in 1951, and was advanced to assistant professor in 1953. In July 1957, he was promoted to associate professor and given a joint appointment with 50% in mathematics and 50% in engineering. Upon the creation of the Department of Nuclear Engineering in 1958, the engineering half of his appointment was subsequently assigned there, where he was promoted to full professor in 1962. He retired from the University of California in 1989, but continued his affiliation as professor of the Graduate School.

At UC Berkeley, with his profound expertise in partial differential equations, special functions, and integral transforms, Professor Chambré led research and education in the fields of applied mathematics, and theoretical studies on transport phenomena for neutrons, momentum, heat and mass. By his knowledge of the underlying mathematics, he provided mathematical modeling for, and insight into, complex physical phenomena, such as reactor safety, inter alia, loss- of- coolant accidents (LOCA), optimal feedback control and stability of nuclear reactors, heat transfer in two- phase fluid flow, and later radionuclide transport in

geological media for nuclear waste management.

In the 1960's and 70's, his work, which was always pioneering in nature, was centered on neutron transport theory and nuclear reactor safety. Examples are the outstanding contributions in approximation methods for neutron transport in the early 60's, studies on the stability of nonlinear space dependent reactor dynamics in the middle 60's, and on nonlinear optimal control and related problems in the early 70s. In the last twenty years, he also made significant contributions in explaining the role of nucleation in rapid phase change processes related to nuclear reactor safety. Retaining a keen interest in research, he was a precious source of information regarding publications and research performed dozens of years ago up to his last days. A draft of his last paper, On the behavior of liquid under extreme impact tensile stress, is currently in preparation by his research collaborator from the Technion, Israel; Chambré provided his final comments only a few weeks before his death. In each of these areas, he opened whole new avenues of research with significant importance to, and impact on, nuclear reactor analysis.

After the late 1970s, Professor Chambré devoted himself to developing the theoretical foundation and mathematical models for predicting the long- term behavior of radioactive and chemical waste in underground disposal sites. One of his most important achievements in this field is his analytical solution that predicts the dissolution rate of waste solids disposed of in geological media. It was thoroughly reviewed and adopted by the 1981 National Academies panel. Since then, it has been adopted in this country and abroad as the valid technique for predicting the dissolution source term. For the first time the formidable task of making reliable predictions of dissolution processes in a geological repository that occur over tens of thousands and hundreds of thousands of years has been put on the solid technical basis of a theory that is clearly correct and that requires no arbitrary adjustable parameters for prediction. Experiments to validate Chambré's theory were carried out in another laboratory, and the results confirm the theory within a remarkable accuracy of a few percent!

Professor Chambré played a major role in launching the careers of his students and in mentoring junior colleagues. Students highly praised his organization, his meticulous board work, and his thorough coverage of a complex subject, both in his Mathematics courses and Nuclear Engineering courses. Chambré was particularly successful in Mathematics 220, the graduate level mathematics methods course for students in physics, chemistry, and engineering. Professor Thomas Buck had made this course famous for many years. Professor Buck had retired in 1952, and Chambré and others continued the tradition in this course, which was of considerable significance for the relations of the mathematics department with other departments in the physical sciences and engineering. Chambré also taught an equally successful undergraduate course in mathematical methods, Mathematics 120. In 1980 and 1981, two students in his classes gave cash gifts to the mathematics department in gratitude for the classes with him. Although his class notes were at the publishable level almost as they were, he tore them up after each semester ended. One student asked why. He replied, "Each class consists of students with different background and preparation. The same notes cannot and should not be used."

Chambré's loving wife Jane, his brother Carl and his sister Ruth predeceased him. He is survived by his three daughters, Erica Ann Chambré, Suzanne Chambré Sternlicht, and Marianne Wolford, and his five grandchildren, Christopher Paul Chambré, David Alan Brown Jr., Kate Jane Sternlicht, Ryan Thomas Wolford, and Nicolas Paul Wolford.

Joonhong Ahn

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