REPORT OF THE MEMORIAL RESOLUTION COMMITTEE FOR
ROGER A. BROUCKE

The special committee of the General Faculty to prepare a memorial resolution for Roger A. Broucke, professor emeritus, aerospace engineering, has filed with the secretary of the General Faculty the following report.

Sue Alexander Greninger, Secretary
The General Faculty

IN MEMORIAM
ROGER A. BROUCKE

Roger A. Broucke passed away on Tuesday, June 21, 2005, in Austin, Texas, at the age of 73. He is survived by his loving wife of forty-five years, Ludgarde Broucke; his daughters Ingrid Broucke, M.D. and Mireille Broucke, Ph.D.; his son-in-law Daniel Keleti, M.D.; and grandchildren, Isabel, Alexandra, and Michael Keleti. He is also survived by his sister, Antoinette Broucke, and brother, Willy Broucke, of Belgium.

Broucke was born on March 25, 1932, in a farmhouse in Furnes, Belgium. Early in his life as a farm boy, he acquired an interest in science and mathematics, a love he maintained throughout his life. At an early age, he was sent to a boarding school to study mathematics. He earned a B.S. degree in mathematics at the University of Louvain, Belgium, in 1955 and a master’s degree in mathematics in 1957 where he studied under Professor George LeMaitre, the originator of the Big Bang Theory on the creation of the universe. In 1958, he entered the military service in the Belgian army and was stationed in Germany. He continued his graduate studies at the University of Brussels and earned a second master’s degree in operations research in 1960. He also worked as a research mathematician at Petrofina Oil Company in Brussels from 1959 to 1961.

He was fortunate to meet Ludgarde Van de Wiel, whom he married in 1960. Ludgarde, his devoted companion and friend, shared with him a lifelong passion about learning, which they passed on to their children. Ludgarde Broucke contributed to the groundbreaking pictures of periodic orbits in the three-body problem which appeared in her husband’s Ph.D. thesis, which became one of the significant contributions of his career.

In 1962, Broucke received his Ph.D. in mathematics from the University of Louvain in Belgium. In 1963, he joined the Jet Propulsion Laboratory (JPL) in Pasadena, California, as a senior research engineer. For the next thirteen years he was an integral part of NASA’s space flight program. A pinnacle historical moment at that stage of his scientific career occurred on July 20, 1969, when man first walked on the moon.

During these years, some of Broucke’s happiest hours were spent teaching and mentoring graduate students at several universities while maintaining his position at JPL. He was a lecturer at West Coast University and the University of Southern California; in addition, he was an acting associate professor at the University of California at Los Angeles (UCLA), an adjunct professor, and finally an associate professor at UCLA between 1969 and 1974.

His desire for more autonomy in his research pursuits led him to accept a position as associate professor in the Department of Aerospace Engineering and Engineering Mechanics at The University of Texas at Austin in 1975. He became a full professor in 1982. He became an internationally renowned scientist in the areas of celestial mechanics, satellite theory, and particularly, in computational mechanics related to orbital dynamics. He was one of the first members of the Texas Institute for Computational Mechanics, officially founded at The University in 1976, and he began work on a number of projects involving the use of computers and computational mathematics to model nonlinear dynamics and to solve the governing equations of complex problems in celestial mechanics. He was an active member of a group of colleagues involved in applied and computational mathematics research.
Broucke made several fundamental contributions in celestial mechanics. First, he devoted a significant effort to the investigation of the general and restricted three-body problems of celestial mechanics. He studied several different variants of the problem, and he used different forms of a mathematical technique called regularization to find new classes of trajectories, especially the important group of periodic orbits. In his Ph.D. dissertation in 1962, he made extensive numerical studies of the restricted three-body problem corresponding to the Moon-Earth ratio for two of the masses at a time when computers were just being introduced in celestial mechanics. In particular, through these studies he presented a classification of the types of stability and instability of orbits which had never appeared before. He proposed a principle about how certain orbits transform in the limit as the ratio of the Moon-Earth masses go to zero. This became known as "Broucke's Principle" in celestial mechanics, and it was formally proved to be correct in 1981 by Lawrence Perko.

A second significant contribution of his work was algorithms for the manipulation of Poisson series, which arise in the computation of orbits in celestial mechanics. More general mathematical manipulation systems like Mathematica, Reduce, and Maple were already used in many fields. But these general systems are not useful for the Poisson series manipulations in celestial mechanics because intermediate results become too large. Broucke developed a set of algorithms which were widely distributed because of their machine independence and which have been a foundation in many problems in celestial mechanics.

The third significant contribution of Broucke’s career is the discovery of a family of periodic orbits in the Anisotropic Kepler problem in celestial mechanics. Formerly, it had been thought that the system was completely chaotic. Broucke’s discovery contributed to a shift in thinking in nonlinear dynamics away from the view that dynamical systems are either integrable or chaotic.

Broucke also made contributions in inverse problems in celestial mechanics, optimal computation of the solution of the Kepler problem, studies in gravitational potentials of irregular bodies, and perturbation theory. He applied his theoretical studies to problems such as the motion of comets and orbital maneuvers required by artificial satellites with emphasis on swing-by maneuvers.

Broucke was a member of many national and international scientific societies. He was a member of the American Institute of Aeronautics and Astronautics (AIAA), the Astronomical Society, the International Astronomical Union, the Society of Engineering Science, and the American Academy of Mechanics. He was vice president of the Division of Dynamical Astronomy of the American Astronomical Society between 1985 and 1986. He was promoted to the grade of Associate Fellow of the AIAA in 1969, and he received the NASA Apollo Achievement Award in 1973. Broucke was a member of the editorial board of Celestial Mechanics, a member of the Association for Computing Machinery, and a member of the Division of Dynamical Astronomy of the American Astronomical Society. He was a member of the Celestial Mechanics Institute, and he became the executive editor of Celestial Mechanics in 1973. He published 100 scientific papers on applied mathematics, celestial mechanics, and orbital dynamics. He supervised over twenty-five students, including sixteen Ph.D. dissertations and ten master’s theses. In 2002, he received the Dirk Brouwer Award for his significant and numerous contributions to the theory of dynamical systems and space flight mechanics. Following his retirement, he became professor emeritus at The University of Texas at Austin.

Broucke was also interested in foreign languages; he was fluent in Dutch, French, Spanish, and German. He built one of the first personal computers, a MITS Altair 8800, in the early 1970s. Among his other hobbies were oil painting, classical music, and interest in the Human Genome Project.

Broucke’s daughter, Mireille, remembers his technical interests as being primarily focused on mathematical dynamics.

For him, mathematics was a sanctuary of order and beauty, unlike the human world with its contradictions and inexplicable sufferings. He had an uncluttered interpretation of scientific subjects, which was born out of a love of simple, but decisive pictures. Indeed, much of his career was focused on producing decisive pictures to explain and expose phenomena in celestial mechanics. What most inspired me about him were his essential rationality, his conviction that through disciplined reflection, the human mind can put an order into a
seemingly unstructured reality, his humility, and his delight in the unending novelty of scientific inquiry.

Broucke is remembered as a kind and generous man with a good sense of humor and a fondness for his work and his students. Frequently, he and his family would hold dinners for his students, which often featured barbeque and intense discussions of mathematics and celestial mechanics. Throughout his life, he held a fascination for the cosmos, motion of the stars, and heavenly bodies. His favorite book was The Little Prince by Antoine de Saint-Exupéry:

All men have the stars, but they are not the same things for different people. For some, who are travelers, the stars are guides. For others, they are no more than little lights in the sky. For others, who are scholars, they are problems. You—you alone—will have the stars as no one else has them.

To Roger Broucke, the stars were beautiful problems, whose luster and motion could succumb to mathematics and scientific understanding.

This memorial resolution was prepared by a special committee consisting of Professors J. Tinsley Oden (chair), Linda Hayes and Cesar Ocampo.

Distributed to the dean of the College of Engineering, the executive vice president and provost, and the president on December 13, 2006. Copies are available on request from the Office of the General Faculty, WMB 2.102, F9500. This resolution is posted under "Memorials" at: http://www.utexas.edu/faculty/council/.