



IN MEMORIAM

Jerrold Eldon Marsden
Professor of Mathematics, Emeritus
Professor of Electrical Engineering and Computer Science, Emeritus
UC Berkeley
1942 – 2010

Professor Emeritus Jerrold Eldon (known to all as Jerry) Marsden, born in Ocean Falls, British Columbia, on August 17, 1942, died on September 21, 2010, at his home in Pasadena, California. A member of the Department of Mathematics at the University of California, Berkeley, since 1968, he retired almost 30 years later, in 1997. From 1988 until his retirement, he also held an appointment as professor of electrical engineering and computer science.

In 1995, he went on leave to take up a position at the California Institute of Technology (Caltech), eventually becoming the Carl F. Braun Professor of Engineering, Control and Dynamical Systems, and Applied and Computational Mathematics, a position which he held until his death. He was also founding director of the Fields Institute in Canada from its inception in 1987 to 1994, taking periodic leaves from Berkeley to carry out his duties there.

During his career at Berkeley, Jerry supervised the Ph.D. theses of 23 students. He was a Miller Professor in 1981-82. His service to the campus included membership in the 1980s on the steering committee of an institute for nonlinear science, the Coordinating Committee for Nonlinear Science, and the Applied Science and Technology Committee. He was also director of the Research Group on Nonlinear Science and Dynamics. From 1975 to 1981, he was coordinator of the Community Teaching Fellowship program in which graduate students were placed as mathematics specialists in local public schools. Starting in 1985, he was instrumental in developing the first calculus computer laboratory in the Department of Mathematics.

Someone who did not know Jerry could be forgiven if, looking in the mathematics database MathSciNet at the long and wide-ranging list of published books and articles by Jerrold E. (or J. E.) Marsden (numbering 367 as of January 13, 2011), he thought that “Marsden” was the pseudonym of a collaborative group consisting of several pure and applied mathematicians. In fact, Jerry was a distinctive individual, known for his generosity as a mentor of students and young colleagues and as a communicator to diverse audiences, as well as for having boundless energy and an extraordinary ability to find and exploit the underlying mathematical principles behind issues in science and engineering.

Jerry's first publication, written when he was an undergraduate at the University of Toronto, was a note on involutions in Desarguesian projective planes. This was followed by two papers with Mary Beattie and Richard Sharpe: one on finite projective planes and one on a categorical approach to separation axioms in topology. Already in this earliest work, one can see the interest in symmetry which guided Jerry's view of mathematics and its applications.

In 1965, Jerry began his graduate work at Princeton University, where his interests in analysis and mechanics were stimulated by contact with Ralph Abraham, Gustave Choquet, and Arthur Wightman, among others. A more concrete outcome was the beginning of Jerry's long career in book writing and editing. He assisted Abraham in the writing of *Foundations of Mechanics*, Choquet with the three-volume *Lectures on Analysis*, and Wightman with his *Lectures on Statistical Mechanics*. The book with Abraham went through several subsequent incarnations; it became, and has continued to be, one of the central texts in the field known as geometric mechanics, wherein methods from symplectic geometry are applied to problems concerning the motion of particle and continuum systems. In addition to this and other graduate-level books, Jerry was well-known as the author of numerous widely used texts for lower-division calculus and upper-division real analysis and complex analysis.

In 1968, Jerry completed his Ph.D. thesis, under Wightman's direction, on "Hamiltonian One Parameter Groups and Generalized Hamiltonian Mechanics." This work, on flows generated by nonsmooth hamiltonians, was motivated in part by problems of hamiltonian dynamics in infinite dimensions, the subject of much of Jerry's later work on continuum mechanics. Rereading the thesis today, one also sees ideas which have reappeared recently in the "pure" mathematical theory of continuous hamiltonian dynamics in finite dimensions.

The beginning of the 1970s saw Jerry's major work with David Ebin, in which they applied infinite-dimensional geometric analysis to prove uniqueness and short-time existence of solutions to the Euler equations of motion for ideal, incompressible fluids. At the same time, he began a series of papers with Arthur Fischer, Vincent Moncrief, and others on the hamiltonian structure of Einstein's evolution equations. This work developed into a more general interest in the hamiltonian formulation of field equations in the so-called multisymplectic formalism.

In the early 1970s, following work by Stephen Smale on celestial mechanics, Jerry, along with Alan Weinstein, introduced a construction in symplectic geometry now widely known as "Marsden-Weinstein reduction." This construction, which produces smaller symplectic manifolds from symplectic manifolds on which symmetry groups act, has found application, not only in geometric mechanics, but also in such diverse areas of mathematics and physics as algebraic geometry, representation theory, and topological field theory.

In the late 1970s and early 1980s, Jerry added several new topics to his wide range of interests, including classical field theory, bifurcation theory, geometric phases, and control theory. With Weinstein, he began to find applications of symplectic reduction to the hamiltonian formulation of dynamical equations for plasmas, fluids, and other continuum systems, leading to a broad spectrum of results on equilibria and their stability. Jerry continued to pursue these applications with many collaborators, notably Darryl Holm and Tudor Ratiu.

Toward the middle of the 1980s, as Jerry's work on control theory began to move to the center of his attention, his research shifted gradually towards engineering mathematics. During the last 15 years of his life, following his move to Caltech, Jerry added yet more topics to his list of interests, including nonholonomic mechanics, structure preserving algorithms, variational calculus for mechanical systems (both continuous and discrete), mission design for spacecraft, and the application of Dirac structures to electrical networks. At the same time, he worked on foundational problems in Lagrangian mechanics, particularly in connection with reduction.

Jerry never dropped a subject; he only added to his list of interests. As a result, he saw bridges between very different areas. For, example, he would apply ideas from relativity to elasticity, thereby arriving at remarkable foundational results. Or he would use geometric mechanics ideas in numerical algorithms. Control theory and dynamical systems techniques would find their way into spacecraft mission design, asteroid orbit analysis, or studies of molecular motion. Discrete differential geometry or locomotion problems would be treated using geometric mechanics and Dirac structures.

Among the recognitions received by Jerry Marsden were: the Norbert Wiener Prize of the American Mathematical Society in 1990; the Humboldt Prize in 1990–91 and 1999, and the Max Planck Research Award in 2000 from the Alexander von Humboldt Foundation; and the John von Neumann Prize lectureship in 2005 from the Society for Industrial and Applied Mathematics. He received an honorary doctorate from the University of Surrey in 2006. He was a Fellow of the American Academy of Arts and Sciences and of the Royal Societies of Canada and of the United Kingdom.

Although Jerry certainly appreciated this recognition, his life was enriched as much by the personal interaction which he had with so many colleagues and students, to whose careers he made extraordinary contributions. Numerous testimonials in a memorial article to appear in the Notices of the American Mathematical Society show how others' lives were enriched by his.

Jerry Marsden is survived by his wife Barbara; his children, Christopher and Alison; grandchildren Eliza and Isaac; and sister Judy.

Alan Weinstein
Alexandre Chorin
Shankar Sastry
2011