Richard S. Palais

GRFP Recipient: 1952

Undergraduate Institution:
B.A. 1952, Harvard College

Graduate Institution:
M.A. 1954, Ph.D. 1956,
Harvard University

Graduate Field of Study:
Mathematics

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Current Position:
Professor Emeritus,
Department of Mathematics,
Brandeis University; and
Adjunct Professor,
Department of
Mathematics, University of
California, Irvine

RESEARCH INTERESTS //

Richard S. Palais' long-term research interests have spanned several areas, including Compact differentiable transformation groups, nonlinear global analysis, critical point theory (in particular Morse theory), submanifold geometry and integrable systems and solitons. In recent years, he has become interested in mathematical visualization, an aspect of geometry that allows one to understand and explore mathematical phenomena via visualization. One of Palais' major ongoing projects is the development and continued improvement of a program called 3D-XplorMath, a tool for aiding in the visualization of a wide variety of mathematical objects and processes.

A FOND MEMORY FROM MY EXPERIENCE AS A FELLOW //

"Graduate students in the Harvard Math Department normally would help teach sections of first year calculus. This had dual benefits. On the one hand, the students received teaching fellowship support to help pay their tuition and expenses, but another reason was that the faculty felt it was essential that students should learn through practice how to teach. Although I had a GRF, and so didn't require teaching fellowship support, the faculty still felt that I should have some practice teaching. The solution was one I liked very much! I was asked to teach gratis a small section of second year calculus, and to make things even better for me, they gave me students who had done well in their first year course. Needless to say, I worked super hard to justify this trust in me, and yet I enjoyed this first teaching experience immensely. And another payoff came later. It turned out that three of the students in that class went on to become well-known academic

mathematicians with whom I kept up a friendship over many years. During my teaching career I had 22 Ph.D. students (and 88 descendants), three of whom are National Academy members and one a Presidential National Medal of Science awardee."

BROADER IMPACT OF MY WORK ON SOCIETY //

"About 10 years before retiring from teaching and research, I became interested in computer-aided mathematical visualization. I came to realize that while computer scientists were developing powerful computer graphics hardware and algorithms, almost none of those working in that area seemed to also have the background necessary to apply these discoveries to make visible the many beautiful and interesting objects and processes of pure mathematics. My initial efforts were aimed at developing a software package, later known as 3D-XplorMath. It was designed to enable research mathematicians to visualize a great many different kinds of mathematical objects and processes so as to be able to better understand them and work with them. A number of mathematical colleagues joined me in this undertaking and we call ourselves the 3DXM Consortium. Gradually it became clear that the tools that we were developing were also useful for teaching mathematics, and the NSF Directorate for Education and Human Resources (EHR) supported the development of our software. Later, we were pleased when several artists began to use our software for creating the subject matter for mathematically oriented art."

"Finally we decided that the best approach was not to prejudge how our software would be used, but to simply create what we refer to as The Virtual Math Museum. This consists of two parts. The first of these is a software program, called 3D-XplorMath (http://3D-XplorMath.org), which was designed to be an easy to use program for visualizing hundreds of famous and remarkable mathematical objects and processes. The second is a website, called The Virtual Math Museum (http://VirtualMathMuseum.org), which consists of many galleries, each of which contains images and animations of a large number of mathematical objects of a similar type. The software is downloaded and the Virtual Math Museum website visited thousands of times each month. With my artist collaborator, Luc Benard, we used 3D-XplorMath to design entries for the illustration category of the 2006 and 2009 NSF/Science magazine's International Science and Engineering Visualization Competition, and in both cases we won first prize. Even more satisfying, our 2006 entry was the cover illustration for an issue of Science magazine."

A PERSONAL ANECDOTE OF THE BENEFITS FROM *GRF* PROGRAM //

"My parents were supportive of my educational goals, but my father often had expressed his hope (and expectation) that when I finished my education I would join him in running his business. Since I saw myself as heading towards an academic career in mathematics, our divergent expectations regarding my future led to increasing tension as my graduation approached. He had a hard time comprehending how I could prefer a career as a college professor, which in those days was a pretty low-paying job. What broke this stalemate was my being awarded a GRF! When I came home one day and announced that I had been awarded a fellowship by the National Science Foundation, my father gave in, congratulated me and wished me success."

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AWARDS/ HONORS //

- Paul R. Halmos-Lester R. Ford MAA Award, with co-authors Bob Palais and Stephen Rodi (2010)

- First Prize for Illustration, with partner Luc Bénard, in NSF/Science magazine's International Science and Engineering Visualization Challenge (2009)

- First Prize for Illustration, with partner Luc Bénard, in NSF/Science magazine's International Science and Engineering Visualization Challenge (2006)

- Visiting professor, Nankai Institute of Mathematics, Tianjin, China (1987)

- Member, Mathematical Sciences Research Institute, University of California, Berkeley (1984)

- Speaker, U.S.-China Symposium on Differential Geometry and Differential Equations, Shanghai-Anhui, China (1981)

- Elected fellow, American Association for the Advancement of Science (1980)

- Founding chairman, TEX Users Group (1979)

- Member, U.S. Committee for Mathematics (1979)

- Convenor, Panel on Global Analysis and Analysis on Manifolds, Helsinki International Congress of Mathematicians (1974)

- Member, Princeton Institute for Advanced Study (1974)

- Trustee, American Mathematical Society (1971)

- Research fellow, Sloan Foundation (1965)

- NSF senior postdoctoral fellow and member, Princeton Institute for Advanced Study (1963)

POSITION PROFILE //

2007 - Editor, surveys and research expository papers, The Journal for Fixed Point Theory and its Applications

2007 - Professor Emeritus, Brandeis University

2004 - Adjunct professor, University of California, Irvine

1996-97 - Chair, Section A (Mathematics), American Association for the Advancement of Sciences

1993-95 - Chair, Committee on Publication Policy, American Mathematical Society

1990-95 - Managing editor, research expository papers, Bulletin of the American Mathematical Society

1988-89 - Chair, Committee on the Electronic Exchange of Information, American Mathematical Society

1987 - Chair, Committee on Communications, American Mathematical Society

1981 - Gastprofessor, Universitat Bonn Member, Max-Planck-Institut fur Mathematik

1978-80 - American Mathematical Society Representative to the Conference Board of the Mathematical Sciences (CBMS)

1976-78 - Professor, University of California, Santa Cruz (on leave from Brandeis University)

1970 - Speaker, International Congress of Mathematicians, Nice, France

1968-72 - Member, NSF Advisory Panel for Mathematics

1966-69 - Editor, Transactions of the American Mathematical Society

1966-68 - Chair, Department of Mathematics, Brandeis University

1965-97 - Professor, Department of Mathematics, Brandeis University

1965-82 - Editor, Journal of Differential Geometry

1962-65 - Associate professor, Brandeis University

1960-62 - Assistant professor, Brandeis University

1958-60 - NSF postdoctoral fellow and member, Princeton Institute for Advanced Study

1956-58 - Instructor, University of Chicago