

*At a Meeting of the Faculty of Arts and Sciences on December 6, 2016, the following Minute was placed upon the records.*

## **RICHARD JOHN O'CONNELL**

Born: August 27, 1941

Died: April 2, 2015

Professor Richard O'Connell, who arrived at Harvard as Assistant Professor of Geology in 1971 and passed away on April 2, 2015, was a towering figure of post-modern geophysics.

Rick's path to Harvard and science was not linear. He was raised in Montana, where his paternal grandparents had emigrated from Ireland and his grandfather worked as a gold miner. His father was a successful cattle rancher and, for a time, Sheriff of Lewis and Clark County. Rick's mother, a musician, raised her children during her husband's long absences and after he was seriously injured in a bull goring. In this challenging environment of hard work, high expectations, and encouragement, a home life that began in the county jail and was centered on the ranch that he returned to throughout his life, Rick developed an abiding affection for America's wide-open spaces and the values of those who live within them.

He left Montana to pursue an undergraduate degree in physics at the California Institute of Technology. Gerald Wasserburg, the legendary experimental geochemist, convinced Rick that Earth science was the most promising application of physics and explained that his group would have a vacancy once an underperforming undergraduate was told that his career in geochemistry had come to a premature end. Rick remained at Caltech as a graduate student, working with Wasserburg and Don Anderson, and his thesis made two enduring contributions. First, he explained the enigmatic origin of many sedimentary basins that form within continents. These basins are a ubiquitous feature of the geological record and growing up close to a widely studied example, the Williston Basin, no doubt sparked Rick's interest in the topic. Second, Rick turned to data related to the Earth's changing shape following the ice age to estimate the viscosity of rocks within the Earth's deep mantle. He demonstrated that this region is not rigid, as widely believed, but has a viscosity low enough to permit solid-state flow. This insight remains a paradigm of modern geophysical research, and it provided an early example of a theme within Rick's entire body of research: the energetic bucking of what Kenneth Galbraith called, in another field of study, "conventional wisdom."

After post-doctoral work at UCLA working on experimental high-pressure mineral physics, Rick was recruited to Harvard University, along with seismologist Adam

Dziewonski, to build a geophysics program in the Department of Geology. The post-plate tectonics world was preoccupied with elucidating the driving force responsible for plate motions and, seizing this opportunity, Rick turned his attention to theoretical research focused on that question. He found support within the Center for Earth and Planetary Physics led by atmospheric physicist Richard Goody, and a kindred spirit in the applied mathematician Bernard Budiansky. Together, O'Connell and Budiansky developed a seminal mathematical theory for treating defects in cracked and porous rocks and for predicting the impact these defects have on Earth's deformation over time scales ranging from seconds to decades. Even today, students who embark on research in mantle anelasticity are commonly advised to "start with O'Connell and Budiansky."

After being tenured in 1977, Rick helped merge the Center for Earth and Planetary Physics with the Department of Geology, creating the new Department of Earth and Planetary Science. With the support of Michael Spence, the Dean of the FAS, the department quickly established itself as a world center for solid Earth research.

During this period and beyond, in the quickly evolving post-plate tectonics world, Rick, and his students, were responsible for transformative contributions to our understanding of thermochemical mantle flow and its connection to the geological record. His group pioneered calculations of three-dimensional mantle convection. They discovered that energy in plate motions was equipartitioned into poloidal and toroidal components—a now fundamental constraint on the mantle-plate system; they argued that the dip angle of subduction zones implied that upper mantle flow penetrated into the lower mantle and showed that global flow strongly impacts back-arc spreading rates, revealing an important limitation of regional tectonic studies; they modeled "ablative" subduction, an elegant framework for reconciling observations in a range of subduction environments, and used mantle flow modeling to explain the distribution of plumes and hotspot tracks and the enigmatic bend in the Hawaiian–Emperor seamount chain; and they presented a new model of mantle dynamics in which long-lived and segregated "blobs" of chemically distinct material reside within a high-viscosity lower mantle, subducted slabs penetrate into the lower mantle, plumes rise sluggishly from their deep sources and a relatively weak shallow mantle permits the energetic evolution of Earth's surface geology. A review in the journal *Science* credited the new framework as pointing the way toward a unified view of the Earth that reconciles geochemical, mineral physics, and seismological data. In later work, Rick expanded his geophysical focus to write influential papers on the interior properties of exoplanets and was a visionary founding member of the Origins of Life Initiative at Harvard.

Rick's profound scientific legacy is reflected in the prestigious honors he received—the Augustus Love Medal from the European Geosciences Union, the Inge Lehmann

Medal from the American Geophysical Union, and the Arthur L. Day Medal from the Geological Society of America—and in the generations of young scientists he supervised. His former students, intellectual leaders in their own right, have elevated the many institutions to which they belong, including MIT, UC Berkeley, Harvard, Los Alamos National Lab, NASA, GFZ Potsdam, and the University of Toronto. Rick will be remembered for his extraordinary generosity and his love of the logic and precision of science. His legacy in life includes, first and foremost, his family: his wife Susan, whom he adored and who happily shared his world of ideas and his adventurous spirit on a different kind of wide open space, the ocean; his son, Brian; and his step-daughter, Lily. Those of us lucky enough to call Rick a friend miss his incomparably sharp wit, and the sense, whenever we spoke to him, that we were sharing time with an irreplaceable human being of great substance and dignity.

Respectfully submitted,

Jeremy Bloxham  
Stein B. Jacobsen  
Michael B. McElroy  
Dimitar Sasselov  
Jerry X. Mitrovica, Chair