Memorial to Richard Lee Armstrong
1937–1991

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Richard Lee Armstrong died, a victim of cancer, on August 9, 1991, at the pinnacle of his prolific and remarkable career as an earth scientist. He is survived by his mother, Bernice, children Becky, Karl, and Kathy, and their mother Julie.

Dick, as he was known to colleagues and friends, was born on August 4, 1937, in Seattle, Washington. During his illness, Dick remarked that his life was composed of three parts, each 18 years in duration. The first 18 years were spent in Seattle, where his aptitude for science was evident early on. The next 18 years were his Yale University days. He left home in 1955 to attend Yale, first as an undergraduate (B.S. 1959), then as a graduate student (Ph.D. 1964), and afterward until 1973 as assistant and associate professor in the geology department. During his time as a Yale professor, he spent two years away, first in 1963–1964 on a National Science Foundation Postdoctoral Fellowship at the University of Bern, and in 1968–1969 as a Morse and Guggenheim Fellow at the Australian National University and California Institute of Technology. At the beginning of the last 18 years, in 1973, Dick moved back to the west coast to the University of British Columbia in Vancouver, where he was associate and then full professor until his death. He became a Canadian citizen in 1979.

Dick's insight into an enormous variety of earth science problems is nothing short of remarkable. He was regarded as an expert in fields as diverse as isotope geochemistry and geochronology, geochemical evolution of the earth, geology of the entire North American Cordillera, and large-magnitude crustal extension. His passion, in the words of his former thesis supervisor Karl Turekian, "was to understand the earth." Dick pursued this goal throughout his career, and interwove these diverse fields into a research program that significantly affects our view of tectonic processes in the earth. His bibliography contains more than 170 published papers, and he strived to get nearly every isotopic study that he or his students produced into the professional literature. Dick's analytical work was not at the leading edge of high-tech and ultra precise measurement; he never strived for these goals. Instead, he applied methods that were reliable and suited the geological problems he wanted to solve. His work began with K-Ar methods, including neutron activation and isotope dilution methodologies, and then branched to include Rb-Sr, U-Pb and Nd-Sm. By maintaining an academic and laboratory environment with colleagues and students which was very productive, he produced a huge volume of isotopic data that shed light on the chronology of magmatism, metamorphism, and tectonics over most regions of western North America. Several fundamental first-order syntheses of Mesozoic and Tertiary magmatism in western North America were produced by Dick during the last 20 years of his career using this large data base.

Dick was a patient and caring teacher who always had time for those students who needed a bit of extra help; I recall him repeatedly editing my thesis manuscripts with numerous red pencil marks, and returning them to me usually within three days after he received them unannounced; his duty to students was not to delay or obstruct their progress. Dick was generous to a fault, particularly with students. His intellect and geological intuition moved at a pace that easily eclipsed his students, but I don't recall him revealing that he already knew the answer if it was a student project. He would gently nudge and direct, all the while letting his students discover for themselves and take pride in the accomplishment. This sense of generosity was also characteristic of his relationship to his family and friends outside of his professional life, though few of us saw that side of Dick because he was a very private person.

Dick was very active in the community of geoscientists in its broadest sense. In spite of his position in the forefront in several geoscience fields, Dick was not an "ivory tower" scientist. On the local scene, he was an active member of the Vancouver-Victoria geoscience community, which is dominated by mining exploration geologists. As part of his recreation, he attended local lectures and field trips whenever possible, the last being a field trip, one month before he was diagnosed as having cancer, in southern British Columbia organized for mining explorations.

He was an active member of the Geological Society of America and editorial boards for several journals, participated actively in the peer review process of the National Science Foundation and Canada's Natural Sciences and Engineering Research Council, and played an active role in Canada's Lithoprobe program. He did his duty in organizing meetings held locally, including the 1985 GSA Cordilleran Section and the 1987 IUGG meetings held in Vancouver. He was always available to act as a scientific sounding board and gave well-considered advice. His distinguished career was rewarded with election to the Royal Society of Canada in 1981, a Killam Prize at the University of British Columbia in 1986, and the Logan Medal of the Geological Association of Canada in 1990.

Richard Lee Armstrong's scientific contributions, which will be remembered decades from now, are numerous; perhaps surprisingly, three of these advances were conceived before 1970, during and within a few years after he received the Ph.D. degree. He published 43 papers prior to his 35th birthday, including most of the main conceptual breakthroughs of his career. The concepts advanced by Dick required both great intellect and intuition because at the time a convincing supportive data base did not exist; this put Dick squarely in the midst of professional controversy with well-established colleagues.

One of these breakthroughs evolved from his Ph.D. thesis work in the Sevier orogenic belt of Nevada–Utah. As part of this overall geological study, he examined existing maps of low-angle faults which mainly placed younger rocks on older ones, and he concluded that these were rotated Tertiary normal faults. His interest in Tertiary magmatism no doubt helped him focus on the involvement of these younger rocks in the faulting, because he realized that the distribution of older rocks that were younger demonstrably overlain by Tertiary volcanics required that the low-angle faults were younger Tertiary normal faults and not older thrust faults as was previously assumed. His 1972 paper on this subject was a watershed that spurred on a generation of scientists to fully describe and study the now famous metamorphic core complexes of the Great Basin of the Cordillera.

Second, Dick was interested in using isotopic methods to determine the chronology of magmatism, plutonism, and cooling of crystalline rocks, and thereby to understand crustal processes better. Through his Ph.D. work and the postdoctoral fellowship in Bern in 1963–1964, he recognized the effect of metamorphism and thermal disturbance on mineral isotopic ages, and interpreted dates in metamorphic areas as ages of cooling. His 1966 paper on the metamorphic veil remains a key seminal paper; subsequent research by many others involved quantifying the thermal retentivity of daughter isotopes into closure temperature theory.

The third main breakthrough was probably the most misunderstood and controversial of Dick's remarkable contributions: his formulation of a terrestrial geochemical model incorporating recycling of crustal materials, including sediments and continental crust, in a plate-tectonic context. This model was formulated at a time when most earth scientists did not even accept the main tenets of plate tectonics! It was a view 20 years ahead of its time. Using initially a very meager data base and arguments of continental freeboard, Dick explained the evolution of first Pb, then Sr, and finally Nd isotopes by a near–steady-state process of crustal recycling in a dynamic earth with near-constant volume of continental material from the early Archean.

His views were controversial, to say the least, and contested by many prominent isotope geochemists of the last 20 years. In his final paper on this subject, "The persistent myth of crustal growth," he was unrepentant and continued to argue that if all other planetary bodies in our solar system differentiated at their earliest stages, why then did Earth have to wait and have its own differentiation dragged out over billions of years?

A growing number of isotope geochemists are adopting Dick's view, after such a long period of gestation, and his 1968 proposal of crustal recycling has now clearly been proven with ^{10}Be and other geochemical evidence. The evolution of this controversy is puzzling and ironic, but reminiscent of other brilliant scientists whose ideas had to wait decades for acceptance and vindication. Dick was very happy at the recognition he finally received for his model of crustal recycling at the 1990 ICOG meeting in Canberra. It is very fitting that the writing of his final paper on this subject and the vindication of his ideas occurred while he was still alive.

Finally, most of Dick's professional effort was spent not on these lofty breakthroughs, but instead on the grueling effort of systematically working with rock after rock, area after area, student after student to build the enormous data base in the Cordillera. A large number of geological colleagues are indebted to him for his efforts, which have made their work more fruitful and interesting. All those who knew Dick felt a great sense of loss at his premature passing, and know that such talented, inspiring, and thoughtful scientists as he touch our lives much too rarely. He was very concerned that his work in radiogenic isotope geochemistry and geochronology be carried on at the University of British Columbia in a vigorous tradition, a hope that is shared by all of his students and professional colleagues. An endowed scholarship in Dick's name has been established at the Department of Earth Sciences, University of British Columbia.

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