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Obituary: Richard Limon Stanton AO FAA DistFRSN

16 February 1926–25 August 2020

Richard (Dick) Limon Stanton AO FAA DistFRSN (1926–2020), was Professor of Geology at UNE from 1975 to 1986. Born in Sydney on 16 February 1926, Professor Stanton died in Canberra at the age of 94 on 25 August 2020.[1]

He was appointed as one of 14 Fellows of the Royal Society of New South Wales when Fellowships were first created in 2010. Professor Stanton received this honour from the then Governor-General, Her Excellency Ms Quentin Bryce AC, at Admiralty House, Sydney, on 29 March 2010.

Ms Bryce outlined Professor Stanton's major discoveries about the formation and structure of metallic ore deposits. "He recognised the role of volcanism and sedimentation in the formation of new ore deposits, and the physics and chemistry involved in the concentration of copper, zinc and lead in volcanic lavas," she said. She added that this work was "documented in his numerous publications and books," which include *Ore Petrology* (1972) and *The Precursor Principle* (1989). His book *Ore Elements in Arc Lavas*, published in 1994, represents the culmination of 40 years of research on the ore deposits resulting from volcanic activity along island arcs such as the Indonesian archipelago. He also did some very important early work on so-called conformable lead (Pb) deposits, which set the stage for dating the age of the Earth. He predicted that Broken Hill-type ore deposits (of copper, zinc, and lead) were likely forming in hydrothermal vents on the modern sea floor.

As an undergraduate, Dick Stanton studied geology and mathematics at Sydney University's New England University College in Armidale in the 1940s. During his undergraduate years he learnt to appreciate the elegance of science. In one class there was a mathematics problem that none of the students could solve. At the beginning of the next class Dick asked the lecturer whether he would work through the problem on the board — which he did, attacking it in a way that Dick had never thought of, so that the answer just dropped out. After completing this most elegant solution, the lecturer turned to the class and said, "Isn't that beautiful?" Dick remembered thinking to himself, "Yes, it is beautiful." In his future career Dick Stanton achieved some beautiful solutions to problems in ore genesis.

He worked as an exploration geologist for Broken Hill South Ltd, in mines in Broken Hill, far north Queensland and Burraga. This was the start of Dick's most important contribution to economic geology: the theory that massive sulphide deposits of zinc, lead and copper form on the seafloor associated with volcanism in regional volcanic island arc settings.

Dick quickly realised that on a larger scale than Burraga, the old mines and workings south of Bathurst occurred in a distinct pattern related to the geological features of the area: a particular association of volcanic rocks, shales and coralline reef limestones. Subsequently this became the topic of his PhD at the University of Sydney, started in

1 I'm indebted to Don Hector FRSN and Professors Hugh O'Neill at ANU and Ross Large at Tasmania for information in this obituary. [Ed.]

1950 and completed in early 1954. In summary, the key finding from Dick's thesis was that, over a very large area, the massive sulphide deposits occurred in sedimentary rocks that had been laid down on the seaward side of little coral reefs that had developed round old volcanic islands. He published his research in 1955 in *Economic Geology*, resulting in diverse reactions from the economic geology community, either "brilliant" or "mad."

During his studies, he had been involved in the first systematic geological mapping of the Solomon Islands, for the British Geological Survey, as a Lecturer in Geology at the University of Sydney. He told of being dropped off on a beach of an island inhabited solely by locals by an inter-island steamer, and told to be back on the beach in six weeks to be picked up.

On completing his PhD, Dick took up a National Research Council of Canada two-year post-doctorate fellowship at Queen's University, Ontario, which gave him the opportunity to study some of the recently discovered massive copper and zinc sulphides in New Brunswick, in a district coincidently with the name of the Bathurst camp. Dick was amazed by the similarities in the geology and style of mineralisation between the two Bathursts. This subsequently led to three publications in Canadian journals in 1960 and 1961, which had a major impact on massive sulphide mineral exploration in Canada. The last of these papers, laid out the model for massive sulphide mineralisation and the key parameters for their exploration. By this time Dick had gained an international reputation for his work, both in academia and the exploration industry.

He returned to Armidale in 1959, having been invited to take up a position as Senior Lecturer in Economic Geology at the University — by then the autonomous University of New England — where he spent 29 years contributing very significant research in a number of aspects of ore deposit genesis. Probably his best recognised achievement in this period was his 1972 book *Ore Petrology*. This was the first publication to consider ore deposits as a natural part of geological evolution and to recognise that classes of deposits were controlled by their geological environment. The book was an immediate success: over 18,000 copies were sold world-wide. It became the basic text on ore deposits in most western universities for over 30 years.

During this time, Dick was constantly drawn back to Broken Hill, to study the ores, banded iron formations and host rock sillimanite schists. He supervised an excellent PhD thesis by Max Richards on the significance of the banded iron formations in the Broken Hill district, later published in *Economic Geology*. The most influential and helpful connection he established was with Haddon King, director of exploration and research with Zinc Corporation at Broken Hill and, ultimately, CRA. King was an international figure, very well-known and respected, and had an excellent research group which Dick worked with on understanding Broken Hill geology. King was the father of the syngenetic ore theory for Broken Hill, and thus together they had mutual interests and stimulating discussions. In the 1980s Dick became interested in the origin of the mineralogical banding in the banded iron formations and the sillimanite schists at Broken Hill, which led to him questioning the basis of regional metamorphism. The *precursor principal* that he published in 1989 demonstrated the impor-

tance of original composition and mineralogy on later metamorphic mineralogy and that iso-chemical metamorphism, involving little fluid, was a key process at Broken Hill.

After retiring from his personal chair at UNE in 1986, he maintained his connection with the University as Emeritus Professor. During his time at UNE he had taken sabbaticals to Harvard (1966–67) and Oxford (1978–80). Professor Stanton had been a Royal Society Bursar at Imperial College London and the University of Durham in 1964, Hoffman Research Fellow at Harvard in 1966–67, and British Council Visitor in the Department of Geology, Oxford, in 1978–80.

He was elected to the Australian Academy of Science in 1975 and was Vice-President of the Academy from 1989 to 1990. Professor Stanton's many awards include a Fulbright Award (1966), the Inaugural President's Award of the Australasian Institute of Mining and Metallurgy (1974), the Goldfields Gold Medal of the Institute of Mining and Metallurgy, London (1976), the William Smith Medal of the Geological Society, London (1987), the Browne Medal of the Geological Society of Australia (1990), the Penrose Medal of the Society of Economic Geologists (1993), the Haddon Forrester King Medal of the Australian Academy of Sciences (1998). He became an Honorary Fellow of the Institute of Mining and Metallurgy (London) in 1984 and was elected as an Honorary Fellow of the Geological Society of America in 1991. In 1993 he was one of UNE's Inaugural Distinguished Alumni.

As a teenager, he had been struck down by polio, which ended his swimming career. He married Alison Meyers (dec.), and they had three children (Ruth, Marion, and Richard Roger, dec.) and six grandchildren. He was an avid gardener and tree planter at his house in Armidale: "I have farming in my blood." At 84 years of age Professor Stanton was still as active as ever in research. "In fact, I'm now involved in the most complex piece of work I've ever undertaken," he said in 2010. These projects included collaborative work with one of his former UNE research students — Ross Large, Professor of Geology at the University of Tasmania — and with Professor Hugh O'Neill at the ANU's Research School of Earth Sciences.

Professor Stanton joined the Royal Society of NSW on 27 July 1949 and was one of its longest standing members. During his career, he received several awards from the Royal Society, including the Archibald D. Ollé Prize in 1956,[2] the Society's Medal in 1973, and the Clarke Medal in 1998; he had presented the Clarke Memorial Lecture in 1985. He was made a Fellow of the Society in 2010 and was elevated to Distinguished Fellowship in 2012.[3] Moreover, he was instrumental in its successful operation and served as a long-standing chair, of the New England Branch of the Society. He was honoured for his achievements by becoming an Officer of the Order of Australia in 1996.[4]

— Robert E. Marks, Editor

2 In 1955 Stanton published two papers in this journal: Stanton (1955a) and Stanton (1955b); it is not clear which was the prize-winning paper.

3 When the membership grade of Fellow was created in 2012, the existing 14 Fellows were elevated to Distinguished Fellowship.

4 In 2008 he was interviewed at length by Ken Campbell. See https://www.science.org.au/learning/general-audience/history/interviews-australian-scientists/professor-richard-stanton

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