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## Robert A.L. Wray (1966 – 2017)

Robert W. Young

I write this memoir of Robert Wray in two states of mind: first and foremost is the pleasure of commenting on his scientific achievements, but there is also the sadness at the far too early death from a debilitating illness of a former student and close friend. My contact with him began in my university office in Wollongong 28 years ago, when he came seeking formal training in geomorphology, which until then had been an increasingly pleasurable hobby as his first degree had been Commerce. It ended when I presided at his funeral in a church filled with family, friends and colleagues who had come to pay tribute to this man of great talent and generous personality. During those years I supervised both his B.Sc (1<sup>st</sup> Class Honours) and Ph.D theses, encouraged his teaching career, and co-authored a dozen scientific articles with him. Thus, although his scientific work has received well-earned international acclaim, this is very much a personal memoir of his achievements.

The decision to put his major effort into studying the development of karst landforms in quartz-rich rocks, which began with his Ph.D thesis, was entirely his choice; I had suggested the very different thesis topic of long-term landscape history, on which we later did co-operate in a series of papers. It was not so much the topic of the thesis that was innovative, for Robert was well aware of the Australian examples described a decade earlier by J.N. Jennings and of those later described by me: it was rather the level of analysis to which Robert lifted this field of study that was outstanding. His considerable experience of karst in limestone gave him a ready eye for seeing essentially similar features in the quartz sandstones of the Sydney Basin, and I remember well the somewhat chastening experience of being his pupil in the field on several occasions. In 1997 the greater part of his Ph.D thesis appeared in *A global review of solutional weathering forms on quartz sandstones*, which set the bench mark for further studies, not only in its detailed account of morphological diversity, but also in its treatment of the varied combination of processes which formed them. To write a global review was certainly a bold venture so early in his career, yet it was based on his already thorough grasp of the relevant literature worldwide.

Other parts of the thesis, together with results from subsequent research, were published in a series of papers dealing with specific aspects of quartzose

karst. Three of these appeared in the same year as the *Global review*. *Quartz dissolution: karst or pseudokarst?* was a contribution to the ongoing dispute over whether the term *karst* should be limited to situations where chemical dissolving of rock was the *dominant* process, or, as Jennings had argued, could be applied where such action was the *critical* process in the shaping of landforms. Then came two papers dealing with speleothems that occur in many caves in the sandstones of the Sydney region, and based on detailed microscopic analysis. The first was *Opal and chalcedony speleothems in quartz sandstone*, written mainly for a national audience, which appeared in the Australian Journal of Earth Sciences; the second, *The formation and significance of coralline speleothems in the Sydney Basin*, addressing a wider audience, appeared in Physical Geography. An even more general audience, especially of archaeologists, was addressed in 2008 through a paper co-authored with Andy Spate on *Capules and other geomorphological phenomena*, published in Rock Art Research.

The paper with Spate was also indicative of a major shift in the geographical location of quartzose karst addressed in Robert's work, from the temperate lands of southeastern Australia to the tropical lands of the northern part of the continent. He had become increasingly interested in the mode of the movement of water through sandstone, and in the late 1990s he began field studies, partly with me, in the sandstones of the subhumid tropical lands of central Queensland. The focus of his work there was on the extensive springs in the Carnarvon Range that were first reported by the noted explorer Thomas Mitchell during a major expedition in 1845-46. *Phreatic drainage conduits within quartz sandstone: evidence from the Jurassic Precipice Sandstone, Carnarvon Range* summarized the results of Robert's observations and mapping over several field seasons of the movement of water through these sandstones that are far more permeable than the sandstones he had previously observed near Sydney, and that gave him new insight into the effects on hydraulic conductivity exerted by lithology and structure. His work in the tropics culminated in a field study over 3 months in 2008 of the wonderful sandstone tower landscapes and caves in a huge area between central Queensland and the Kimberley region of Western Australia. Co-authored with Ken Grimes, Andy Spate and Ian Houshold, the



Robert Wray at Cradle Mountain in Tasmania (photo: R.W. Young).

highly informative 85 pages and brilliant illustrations of *Karst and pseudokarst in Northern Australia*, created a new standard for the study of sandstone landforms in Australia. Unfortunately this report done for the Commonwealth Government has never been published. But far more serious was that the later stages of the expedition saw the onset of the progressive decline of Robert's health.

His research was by no means limited to Australia, for he made a series of invited field trips to study and offer advice on the magnificent Danxia sandstone karst of southeast China. In co-operation both with local researchers and other invited experts from overseas, he contributed to a greater understanding of the processes, constraints and erosional timescales of these fascinating landscapes. And, although his health was already waning, it was essentially Robert's initiative when we wrote together *Some Danxia-like landscapes of Northern Australia*. His Chinese experience was again applied to Australia when Hayden Washington and he wrote an important paper on the geomorphology and geoheritage value of the sandstone pagodas in the Blue Mountains west of Sydney, which added significantly to the material that he and I had written a decade earlier in *The geomorphology of sandstones in the Sydney Region*. Moreover, he showed great skill in drawing together wide-ranging material when writing *The Gran Sabana: the world's finest quartzite karst?* for *Geomorphological landscapes of the world* edited by Piotr Migon.

Because of his exceptional expertise on sandstone weathering, he was repeatedly invited to contribute overviews of this whole field of research. When my wife Ann and I revised our book *Sandstone Landforms* in 2009, we asked him to write the greatly extended section on weathering, for he had long surpassed our understanding of it. In 2004, with Stefan Doerr, he wrote the entry on *Pseudokarst* in the *Encyclopedia of Geomorphology* published by Routledge, and in 2013 he wrote the entry on the same general topic for the *Treatise on Geomorphology* published by Academic Press. But all of these contributions were surpassed by his final paper, *An updated review of solutional weathering processes and forms in quartz sandstones and quartzites*. Although the original review in 1997 was an outstanding piece of work, it too has been

surpassed by this wonderful new review written 20 years later; and for this we are all greatly indebted to Francesco Sauro, for without his extremely important contribution and initiative, the revised review would never have been finished.

While Robert's reputation rests overwhelmingly on his studies of karst in quartzose rocks, he also made important contribution in other aspects of geomorphology. He contributed to a series of papers with me, my wife Ann, and David Price who carried out the essential TL dating, on alluvial deposition along streams in southeastern Australia, and applied his very considerable remote sensing skills in *Palaeochannels of the Namoi River floodplain*. He also added much to a study of crevasses and caves caused by block gliding, rather than weathering, in sandstones south of Sydney. Robert demonstrated his grasp of geomorphology in general when co-authoring with me several papers on the long-term evolution of landforms in Australia. It was a very productive period for us in reaching an international audience; in 1999 we published *The longterm development of river valleys: evidence from the passive margin of Southeastern Australia* in the Japanese Journal of Geomorphology, and in the next year *Contribution to the theory of scarpland development* in the Journal of Geology. The latter was an unexpected outcome of our trip to study the hydrological conductivity of sandstones in central Queensland, which endorsed the pioneering work on scarplands by the great German geographer Alfred Hettner. Our final co-operative effort was written when Robert was already largely confined to a wheelchair and finding any sustained effort to be increasingly difficult. Most appropriately for our swansong, it was about sandstones. It referred to an internationally important geomorphologist, and it dealt with interesting sites in Australia: it was *Rock control in sandstone landforms: a tribute to Eiju Yatsu with Australian examples*. For me this was a fitting closure to 25 years of rewarding co-operative work and genuine friendship. Robert was a highly talented scientist who happily ventured into a wide range of research topics, yet was always painstaking in his handling of detail.

The postscript to this memoir must be an acknowledgement of the wonderful support that Robert

received from his colleagues at University College in Wollongong, and especially from his wife Jayne, both in the good years of very active companionship and even more so in the hard years of his physical decline.

#### Robert's chronological speleological milestones

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