Preface

A paradigm shift according to Thomas Kuhn (1962) constitutes a change in the basic assumptions within the ruling theory of science. It is not a term to be used lightly, except in relation to major breakthrough in the understanding of nature. In the field of Earth Science this term can be used in connection with the conception of gradualism in terrestrial evolution by James Hutton (1788) and Charles Lyell's (1830), sea floor spreading and plate tectonics by Harry Hess, Bruce Heezen, Robert Dietz, and Sam Carey, and the identification of meteorite craters and astroblemes ('star scars') by Eugene Shoemaker and Robert Dietz, both having been my mentors. My introduction to extraterrestrial impacts in 1968 was related to the study of Gosses Bluff Structure, Central Australia, where the United States Astrogeology Branch, led by Eugene Shoemaker, was planning a study of Moon-like landscapes in preparation for the Apollo program (Fig. 1.1). At the time few geologists realized the role of asteroid impacts. In subsequent years, the sea-change discovery by Walter and Louis Alvarez of the KT asteroid impact boundary and associated mass extinction of species has changed this attitude. This was followed by the identification of the relations between the 580 Ma-old Acraman impact structure, the Bunyeroo ejecta, and radiation of Acritarchs by George Williams, Victor Gostin, and Kath Grey. Based on geological studies of Archaean terrains during the 1980s and 1990s I raised doubts whether many Precambrian Earth features were triggered exclusively by internal mantle and crust processes. A breakthrough came in 1986 and following years when Don Lowe, Gary Byerly, Bruce Simonson, and Scott Hassler and their students began to discover millimeter scale impact spherules (microkrystites) in Archaean sediments, overlain by tsunami deposits, initiating a paradigm shift in the study of early crustal evolution. Given the difficulty in identifying spherule units in the field, impact frequencies documented to date inherently represent only a minimum flux, namely the 'tip of the iceberg', yielding support to an extension of the Late Heavy Bombardment. This monograph, focusing on impacts craters larger than 20 km in diameter, is based on research of Archaean and younger terrains during 1964–2012, including studies of impact ejecta units and large buried impact structures on the Australian continent. Notably detailed research in the Pilbara Craton, with the support of Arthur Hickman of the Western Australian Geological Survey and my field mate John Vickers, enabled follow-up of discoveries by Lowe, Byerly, Simonson and

their students. Suggestions that Archaean extra-terrestrial impacts acted as triggers of internal mantle-crust events will meet with resistance by proponents of uniformitarian schools of thought. Traditionally, geology—the study of Earth—focuses on internal crust, mantle, and core process, taking little account of the effects of large asteroid impacts. However, the two are not mutually exclusive. Whereas purely endogenic mantle-crust dynamics and plate tectonic cycles are manifest, the intermittent triggering of thermodynamic events by large extra-terrestrial impact clusters constitutes a combination of Cuvier's catastrophism and Lyell and Hutton's gradualism throughout Earth history.

Reference

Kuhn TS (1962) The structure of scientific revolutions. The University of Chicago Press, Chicago

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