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Recognising Indigenous Knowledge when Naming Meteorite Craters

An Australian Case Study

Abstract: As scientific organisations work to decolonise their respective fields, Indigenous languages, ontologies, and epistemologies are being recognised for their important contributions to the canon of human knowledge as well as the practice of scientific research. One of the initial steps taken by scientific organisations is to recognise Indigenous languages with special reference to nomenclature. The astronomical community is leading this effort by establishing protocols and guidelines for the naming of celestial objects and phenomena, and formally adopting Indigenous names for stars, planetary features, and asteroids, as well as re-naming astronomical and space facilities, such as observatories. This paper focuses on designing protocols and guidelines for naming terrestrial meteorite craters.

UNESCO established 2019 as the International Year of Indigenous Languages, providing an opportunity for the world's leading scientific organisations to reassess how the scientific community can better recognise, include, and promote the importance of Indigenous languages globally. The initiative met with such success that the United Nations declared 2022-2032 as the International Decade of Indigenous Languages.¹ A push by the scientific community to acknowledge Indigenous and traditional names and nomenclature is part of a larger movement to decolonise science and its practices.²

For the scientific community to engage in collaborative research on a global scale, it is important to formalise names for objects, phenomena, concepts, and placenames to achieve clarity and precision when these objects or ideas are the focus of scientific study. A lack of standardised names leads to error, misidentification, conflation, and confusion, which can significantly hinder research, and negatively impact associated outcomes. This creates a need for the scientific community to standardise the names of objects and phenomena, such as stars, planets, constellations, and other celestial bodies. In the (Western) scientific realm, each of these have a unique and consistent name, or clear boundaries set, for example, to denote the precise locations of constellations. Because Indigenous knowledges are holistic, multifaceted, and developed locally, this creates challenges when applying naming practices using Indigenous terms, particularly when scientific research involves people from cultures across the globe – each with their own unique ontologies, practices, and expectations.

Names have power and Western science has historically given overwhelming preference to names from cultures that are politically attributed to establishing

1 Cf. UNESCO: Upcoming Decade of Indigenous Languages (2022-2032) to Focus on Indigenous Language Users' Human Rights.

2 Cf. Glen S. Aikenhead, Dean Elliott: An Emerging Decolonizing Science Education in Canada; Rohan Deb Roy: Decolonise Science; Artwell Nhemachena, Nokuthula Hlabangane, Joseph Z.Z. Matowanyika: Decolonising Science, Technology, Engineering and Mathematics (STEM) in the Age of Technocolonialism.

the canon of Western scientific thought.³ Non-Western cultures of the world possess their own traditional names for celestial objects and terrestrial landscape features, but many have been subject to a form of palimpsest. When colonial powers ventured to the south seas and viewed groups of stars previously unknown to them, the stars and constellations were assigned names devised by European explorers rather than names adopted from the cultures with which they came into contact and later colonised.⁴

Today, scientific organisations are involved (to various degrees) in the process of decolonising science – that is, to move away from framing the practices, ontologies, epistemologies, experiences, and outcomes of science largely or exclusively in terms of European or Western hegemony.⁵ This effort is a small part of a larger movement to right wrongs of the past and change the practice, trajectory, and outcomes of scientific endeavours to be more inclusive and supportive of Indigenous ways of knowing.

Imperialism and colonialism brought complete disorder to colonised peoples, disconnecting them from their histories, their landscapes, their languages, their social relations and their own ways of thinking, feeling and interacting with the world.⁶ ‘Decolonising science’ contests and reframes narratives about the histories of Indigenous communities and the effects of colonial expansion, cultural assimilation, and exploitative Western research.⁷ This approach takes a critical stance towards research practices and discourse that centralise Western approaches and ontologies, with the goal of repositioning the development of knowledge within Indigenous cultural practices.⁸ The failure to recognise Indigenous knowledges, which include names and meanings for natural objects, only furthers cultural dispossession. It is important to acknowledge, as part of this process, that decolonising science is not about “a total rejection of all theory or research or Western knowledge”.⁹

A small but important part of this process involves nomenclature, particularly placenames. Australia is home to over 250 distinct Indigenous languages, with over 800 dialectical varieties; but only thirteen are still passed to Aboriginal children today.¹⁰ About 150 are spoken to various degrees, with some communities having only a handful of fluent first speakers remaining: primarily elders and older generations. Language contains strong cultural roots, generations of knowledge, and personal and spiritual connections to culture and Country. Many Indigenous languages have been pushed to the brink of extinction, having not been spoken for decades (some communities refer to the language as ‘sleeping’),

3 Cf. Gwyneth Heuter: *Star Names*.

4 Cf. Edward B. Knobel: *On Frederick de Houtman’s Catalogue of Southern Stars*.

5 Cf. Linda T. Smith: *Decolonizing Methodologies*; Michael Elliott: *Participatory Parity and Indigenous Decolonization Struggles*.

6 Cf. Linda T. Smith: *Decolonizing Methodologies*.

7 Cf., e.g., Artwell Nhemachena, Nokuthula Hlabangane, Joseph Z.Z. Matowanyika: *Decolonising Science, Technology, Engineering and Mathematics (STEM) in the Age of Technocolonialism*.

8 Cf. Linda T. Smith: *Decolonizing Methodologies*.

9 *Ibid.*, p. 41.

10 Cf. Australian Bureau of Statistics: *Census of Population and Housing*.

with a subset of those undergoing various stages of restructure and revitalisation (sometimes termed an 'awakening' of the language).¹¹

Across Australia, colonial placenames are being changed back to their traditional Indigenous names. Famous Australian landmarks have undergone formal name changes over the last few decades, such as Ayer's Rock to Uluru and the Olgas to Kata Juta,¹² while airports in recent years have begun listing both Indigenous and colonial names for cities, such as Naarm for Melbourne, Boorloo for Perth, and Gimuy for Cairns.¹³ In the world of astronomy, landscape features on other planets have received Indigenous Australian names.¹⁴ In recent years, astronomical facilities have been re-named using Indigenous words in collaboration with local Aboriginal communities. An example is the Parkes Radio Telescope, being renamed Murriyang, a local Wiradjuri word meaning 'Skyworld', the home of the prominent creator spirit Biyaami.¹⁵ Five asteroids were named in honour of prominent Indigenous elders, academics, and a community involved in Indigenous astronomy research, education, and public engagement,¹⁶ including Yiman woman Professor Marcia Langton, Naghir man Professor Martin Nakata, Meriam elder Uncle Segar Passi, Senior Euahlayi Law Man Uncle Ghillar Michael Anderson, and the entire Meriam community of the eastern Torres Strait. This was an important action to recognise those who have contributed significantly to the study of Australian Indigenous astronomy and is an important element of the 'giving back' process of working with Indigenous communities.

In 2016, the International Astronomical Union (IAU) Working Group on Star Names (of which the author is a founding member) set the goal of officiating a single name for each of the visible stars in the sky.¹⁷ The Working Group adopted many of these stars' common names, which are primarily Arabic, Greek and Latin. When the Working Group set out to formalise star names within the scientific community, almost no stars with names from Indigenous cultures were part of this canon. The Working Group set out to include a wide range of Indigenous names, of which six star names from Australian Aboriginal cultures were included: Larawag (Epsilon Scorpii), Wurren (Zeta Phoenicis), Gudja (Kappa Serpentis), and Ginan (Epsilon Crucis) from the Wardaman language near Katherine in the Northern Territory and provided by Senior Elder Yidumduma Bill Harney, Guniibuu (36 Ophiuchi) from the Euahlayi language of far northern New South Wales/southern Queensland and provided by Elder Ghillar Michael Anderson, and Unurgunite (Sigma Canis Majoris) from the Wergaia language of north-western Victoria. An additional star was named from the Boon Wurrung

11 Cf. Kirsten Thorpe, Monica Galassi: *Rediscovering Indigenous Languages*.

12 Cf. Harold Koch, Luise Hercus: *Aboriginal Placenames*.

13 Cf., e.g., Katherine Scott: *Tourism Australia to Use Indigenous Names in Marketing for Major Cities and Tourist Hotspots*.

14 Cf. Alice C. Gorman: *The Cultural Landscape of Interplanetary Space*; Alice C. Gorman: *Australian Aboriginal Place Names in the Solar System*.

15 Cf. Phil Mercer: *Iconic Australian Telescope Celebrates Indigenous Astronomy*.

16 Cf. Duane W. Hamacher: *Native American Traditions of Meteor Crater*.

17 Cf. Eric Mamajek, Beatriz Garcia, Duane W. Hamacher, Thierry Montmerle, Jay Pasachoff, Ian Ridpath, Xiaochun Sun: *Bulletin of the IAU Working Group on Star Names*, No. 1.

language of south-central Victoria, which was approved as part of the IAU's 'Name ExoWorlds' campaign.¹⁸

Meteorite Craters

Over 190 meteorite impact sites are scattered across the globe, with many more discovered annually. The names assigned to these craters are an important element that is often overlooked or regarded as less important than the scientific information their study can reveal. For many cultures, these structures have meaning and agency, serving as sites of cultural heritage. They are regarded variably as points of cosmogony, places of taboo, and spaces of sacred significance.¹⁹

Approximately thirty confirmed impact sites are spread across Australia, mainly found in desert regions of low erosion rates.²⁰ Four of them bear traditional Aboriginal names specific to the crater or a prominent feature of the crater, although they are known in the scientific literature by their Western names (Fig. 1): Henbury (Tatjakapara), Gosses Bluff (Tnorala), Liverpool (Yingundji), and Wolfe Creek (Kandimalal).²¹ By examining the meanings of these sites in local Aboriginal traditions, we can appreciate that these are places of longstanding cultural association and gain a better understanding as to why this is the case.

Henbury Meteorite Crater Reserve (Tatyeye Kepmwere / Tatjakapara)

The Henbury reserve is a crater field consisting of more than a dozen craters of various sizes (ranging from 10 m to 160 m in width) scattered over a square kilometre, about 160 km south of Alice Springs.²² It lies near the border of the Luritja and Arrernte Country, with each group maintaining unique traditions about the site's meaning and formation. When the craters were first identified by Europeans, no local Aboriginal names were reported. The earliest published record regarding Aboriginal traditions of the site comes from a newspaper article that reported that the largest pair of overlapping craters were called the 'Devil's Punch Bowls' by non-Indigenous people, with local Aboriginal people calling them 'Blackfellows' waterholes' that formed when a 'bigfella rat' was dug out

18 Cf. Eric Mamajek, Beatriz Garcia, Duane W. Hamacher et al: Bulletin of the IAU Working Group on Star Names, No. 2.; Eric Mamajek, Beatriz Garcia, Duane W. Hamacher et al.: Triennial Report of the IAU Working Group on Star Names; Duane W. Hamacher: The Stories behind the Aboriginal Star Names Officially Recognised by the World's Astronomical Body.

19 Cf. Sixto R. Giménez Benitez et al.: Meteoritos de Campo del Cielo: Impactos en la Cultura Aborigen; Duane W. Hamacher, John Goldsmith: Aboriginal Oral Traditions of Australian Impact Craters.

20 Cf. John Spray, Beverley Elliott: Earth Impact Database.

21 Cf. Duane W. Hamacher, John Goldsmith: Aboriginal Oral Traditions of Australian Impact Craters.

22 Cf. Peter W. Haines: Impact Cratering and Distal Ejecta.

by ancestors, forming the craters we see today. The author mentions that “the bottom of one is a hard clay pan, which holds a fair amount of water after rain”.²³

When scientific interest in the craters intensified in the 1920s and 30s, University of Adelaide geologist Arthur Alderman claimed that Aboriginal people seemed to have “no interest” in the craters,²⁴ nor any explanations regarding their origins (the possible reasons for this will be discussed in Section 4.2). In 1931, local prospector J. M. Mitchell provided the first detailed information about Aboriginal traditions of the site, having been told by older Aboriginal people that they referred to the craters as ‘tjintu waru tjinka yapu tjina Kurdaitcha kuka’, which roughly translates to ‘the place a fire devil ran down from the Sun, set the land on fire, and killed the people as punishment for breaking traditional Law’.²⁵ The event created the large craters we see today, and it was reported that Aboriginal people would not collect rainwater that filled one of the craters in fear that doing so would cause the fire-devil to fill it with a piece of iron again.²⁶ This is a clear indication of a witnessed event handed down in oral tradition for some 4700 years.

The words were linguistically analysed by Hamacher and Goldsmith who identified the language as Luritja (Western Desert language family),²⁷ which is a very different language from Arrernte (Arandic family). Arrernte traditions of the craters exist today, which are called ‘Tatyeye Kepmwere (Tatjakapara)’.²⁸ Unlike Luritja traditions, Arrernte traditions do not describe it as having formed from a cosmic impact.²⁹

Gosses Bluff (Tnorala)

Gosses Bluff is a 22 km-wide, 142 Ma impact structure, which lies 175 km west of Alice Springs.³⁰ The crater is highly eroded, with the only prominent component being the complex crater’s central uplift, which is seen today as a ring-shaped mountain range 4 km wide and 200 m high that formed from differential erosion. It is named ‘Tnorala’ (meaning ‘Father of the Mountains’) in the eastern Arrernte language³¹ and traditions teach that in the beginning of the world, a group of women were dancing a ceremony as stars in the Milky Way. One of the women placed her baby in a turna (wooden cradle) and sat it on the edge of the galaxy. As the women danced, the Milky Way shook and the turna slipped off. The baby tumbled down and crashed to the land as a falling star. The impact

23 F. R. F.: *Life in Central Australia*.

24 Arthur R. Alderman: *The Meteorite Craters at Henbury, Central Australia*, p. 28.

25 Cf. the addendum by L. J. Spencer in: *ibid.*, p. 31.

26 Cf. *ibid.*

27 Cf. Duane W. Hamacher, John Goldsmith: *Aboriginal Oral Traditions of Australian Impact Craters*.

28 Cf. Parks and Wildlife Commission of the Northern Territory: *Henbury Meteorites Conservation Reserve: Draft Plan of Management*.

29 Cf. Duane W. Hamacher, John Goldsmith: *Aboriginal Oral Traditions of Australian Impact Craters*.

30 Cf. Daniel J. Milton et al.: *Gosses Bluff*.

31 Cf. Warwick Thornton: *Tnorala*.

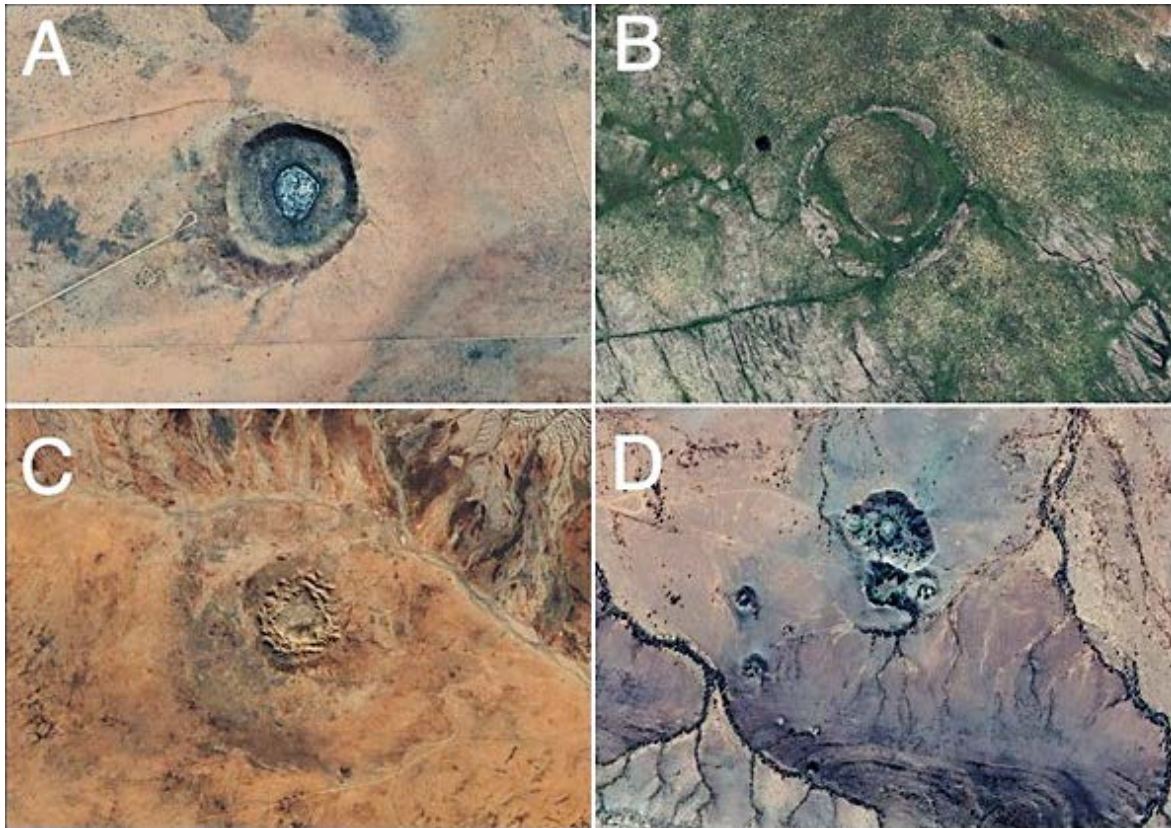


Fig. 1: Satellite images of the 5 known craters bearing Aboriginal names: (A) Kandimalal/Wolfe Creek, (B) Yingundji/Liverpool, (C) Tnorala/Gosses Bluff, and (D) Tatjakapara/Henbury. Google Earth.

drove the rocks upward and the turna fell on top of the baby, covering it. The baby's parents, the Morning and Evening Stars, take turns searching for their lost baby to this day. Today, the turna is visible tumbling out of the Milky Way as the arc of stars in the constellation Corona Australis.

Although the mountain range was long known to the Arrernte, the Englishman Ernest Giles named the structure Gosses Bluff in 1872, after Henry Gosse, the brother of Australian surveyor William Gosse.³² Gosses Bluff was accepted by the scientific community as an impact structure nearly a century later.³³ This traditional knowledge was passed down by Hermann and Mavis Malbunka, Arrernte custodians and caretakers (*kurturngula*) of the Tnorala story, as documented by her nephew Warren H. Williams³⁴ and Aboriginal filmmaker Warwick Thornton.³⁵

In terms of spelling, Tnorala is the currently accepted version. In 1909, Carl Strehlow recorded the spelling as 'tnorula' in the Arrernte language, referring to both the excrement of ingunanga grubs and the name of Gosses Bluff.³⁶ In the neighbouring Luritja language, it is spelled 'anurulu'.

32 Cf. NT Place Names Register: Place Names Register Extract for 'Gosses Bluff'.

33 Cf. Daniel J. Milton et al.: Gosses Bluff Impact Structure.

34 Cf. Warren H. Williams: *The Stories, The Songs*.

35 Cf. Warwick Thornton: *Tnorala*.

36 Cf. Carl Strehlow: *Comparative Heritage Dictionary*, p. 347.

Wolfe Creek (Kandimalal)

Wolfe Creek in the northeast of Western Australia, at nearly 900 m wide, is the second largest crater in the world bearing meteorite fragments after Meteor Crater in Arizona.³⁷ In the local Jaru and Walmajarri languages, the crater is known as Kandimalal, the meaning of which is reported to mean ‘place of no (bush) potatoes’ as yams will not grow in or near the structure.³⁸

Aboriginal communities of the area share a variety of traditions explaining the craters’ formation, ranging from the place a Rainbow Serpent emerged from the ground to where a star fell from the sky after getting too close to the Moon, shaking the ground and causing a deafening boom.³⁹ In 1999, Jaru elder J. Jugarie explained how the crater formed:

A star bin fall down. It was a small star, not so big. It fell straight down and hit the ground. It fell straight down and made that hole round, a very deep hole. The earth shook when that star fell down.⁴⁰

Jaru elder S. Sturt recounted a similar version:

That star is a Rainbow Serpent. This is the Aboriginal Way. We call that snake Warnayarra. That snake travels like stars travel in the sky. It came down at Kandimalal. I been there, I still look for that crater. I gottem Ngurriny – that one, Walmajarri/Jaru wild man.⁴¹

In 2019, a team of geoscientists published a paper based on their work re-dating the site,⁴² showing the age of the crater is less than half of the upper limit of the original estimate of 300 000 years, as proposed by Eugene Shoemaker and colleagues.⁴³ The motivation of the Barrow teams’ study was driven, in part, by Jaru traditions describing its formation,⁴⁴ an idea proposed by a team led by Susan Hopper.⁴⁵

Liverpool (Yingundji)

Liverpool, or Yingundji in the Kunwinjku language of Western Arnhem Land, is a circular 1.6 km wide, 150 Ma structure in the far north of the Northern Territory.⁴⁶ In the traditions of the local Kurulk clan, the crater was described by

37 Cf. Eugene M. Shoemaker, Francis A. MacDonald, Carolyn S. Shoemaker: *Geology of Five Small Australian Impact Craters*.

38 Cf. Erin Parke: *Why Wolfe Creek Crater attracts scientists, Indigenous traditional owners and horror movie fans*.

39 Cf. John Goldsmith: *Cosmic Impacts in the Kimberly*.

40 Peggy R. Reeves-Sanday: *Aboriginal Paintings of the Wolfe Creek Crater*, p. 26.

41 *Ibid.*, p. 15.

42 Cf. Timothy T. Barrows, John Magee, Gifford Miller, L. Keith Fifield: *The Age of Wolfe Creek Meteorite Crater (Kandimalal), Western Australia*.

43 Cf. Eugene M. Shoemaker, Carolyn S. Shoemaker et al.: *Ages of Australian Meteorite Craters*.

44 Cf. Duane W. Hamacher, John Goldsmith: *Aboriginal Oral Traditions of Australian Impact Craters*.

45 Cf. Susan Hopper, Ray L. Frost, Wayde Martens: *Kandimalal Geomorphology*.

46 Cf. Eugene M. Shoemaker, Francis A. MacDonald, Carolyn S. Shoemaker: *Geology of Five Small Australian Impact Craters*, p. 479.

two brothers as the nest of a giant catfish. While visiting the site to film a documentary, Eugene and Carolyn Shoemaker learned about this from two Kurulk brothers and found rock art depicting catfish on the walls of the crater.⁴⁷ This is a common rock art motif in the region and the crater lies near the Liverpool River system, which is inhabited by large catfish.⁴⁸

Establishing Protocols and Guidelines

The scientific community has not yet established any guidelines or protocols for naming meteorite craters. Any attempt to accomplish this requires the development of informed protocols. Some geological organisations have established similar protocols, as have certain countries such as Sweden,⁴⁹ but no policy with regard to the international community has accomplished this to date. The International Meteoritics Society's Committee on Meteorite Nomenclature (est. 1980) sets out detailed guidelines for naming meteorites and fall sites,⁵⁰ but impact craters do not fall under these guidelines.⁵¹ Instead, naming craters is based on a loose set of historical practices. To propose protocols for naming meteorite craters, it is important to address why this is important, how it could be done, what things need to be considered, and what challenges may be faced in this process, informed by lessons learned in the process of naming stars.

Tatjakapara, Tnorala, Kandimalal, and Yingundji are craters that have special significance in the knowledge and traditions of the local Aboriginal communities. They are sites of cultural heritage, and it is positive that scientists are beginning to use the traditional names in their published research, such as Timothy Barrows' team who titled their paper 'The Age of Wolfe Creek Meteorite Crater (Kandimalal), Western Australia'⁵² and J.N. Dunster's team who included the traditional name and story in the title and text of their geological report of the crater: Gosses Bluff (Tnorala) impact structure.⁵³

Establishing appropriate guidelines and protocols can be achieved by taking guidance from local regions where similar guidelines have been established. For example, The Government of South Australia published guidelines for naming geographical places within the state.⁵⁴ The Intergovernmental Committee of Surveying and Mapping set out detailed guidelines by the Committee for Geographical Names in Australasia,⁵⁵ which focus on five main areas: Recognition,

47 Cf. Eugene M. Shoemaker, Carolyn S. Shoemaker: Notes on the Geology of Liverpool Crater, Northern Territory, Australia.

48 Cf. Paul S. C. Taçon: Identifying Fish Species in the Recent Rock Art of Western Arnhem Land.

49 Cf. Risto A.: Guide for Geological Nomenclature in Sweden.

50 The Meteoritical Society: Guideline for Meteorite Nomenclature.

51 Cf. The Meteoritical Society: Guidelines for Meteorite Nomenclature, Section 2.1b.

52 Cf. Timothy T. Barrows, John Magee, Gifford Miller, L. Keith Fifield: The Age of Wolfe Creek Meteorite Crater (Kandimalal), Western Australia.

53 Cf. John N. Dunster, Peter W. Haines, Timothy J. Munson: Gosses Bluff (Tnorala) Impact Structure.

54 Cf. The Government of South Australia: Guidelines for Naming Geographical Places.

55 Cf. Committee for Geographical Names in Australasia: Policy Guidelines for the Recording and Use of Aboriginal and Torres Strait Islander Place Names.

Preferences, Writing System, Education and Procedure. They emphasise the importance of consulting with relevant Indigenous communities throughout the process from the start, obtaining their permission, and establishing mutually agreed upon terms, such as spelling, pronunciation, and understanding how the names will be used globally in the scientific literature.

Like the IAU's Working Group on Star Names, the establishment of nomenclature guidelines will require the formation of a committee of experts, which should either include or directly consult Indigenous scholars, Indigenous organisational representatives, and/or personnel with expertise in Indigenous heritage, languages, and knowledges. The development of guidelines for naming craters on Indigenous lands should consider the following primary factors:

- a. Identifying the relevant registered Indigenous organisation(s) that represents the community that owns or manages the land on which the crater(s) is found. There may be more than one organisation as a large crater may cross different language or community boundaries.
- b. Identifying any names of the crater that exist in the public domain.
- c. Consulting with the relevant Indigenous organisation(s) or community to find out if traditional names exist and are appropriate to use.
- d. Seeking and obtaining permission to use a traditional name. If granted, ensure it is clear how the name will be used in the scientific literature, presentations, and public communication.
- e. Agreeing on a standardised spelling and pronunciation (phonetic text and audio).
- f. If no traditional name for a crater on Indigenous lands exists, the relevant Indigenous community should have the opportunity to propose one.
- g. The committee must ensure local or regional rules and laws are followed regarding establishing placenames. This may involve seeking the involvement of other interested/concerned groups, such as land councils, local government authorities, or language centres.

Considerations

It is critical to acknowledge that a range of challenges, sensitivities and restrictions related to knowledge and traditions of impact sites may arise during this process, as is reflected in the guidelines set out by the Committee for Geographical Names in Australasia.⁵⁶ Below, specific considerations are raised that relate to meteorite craters and meteoritic phenomena.

- a. Any use of names of Aboriginal or Torres Strait Islander origin should be made following consultation and approval, with appropriate recognition.
- b. A recognition to be given to the use of traditional names for places and localities bearing an officially or recorded name from another source.

56 Cf. *ibid.*, 3.3.1a.

- c. A recognition that more than one Aboriginal or Torres Strait Islander place name may exist for any particular feature, both within a specific language group and from two or more language groups.
- d. A recognition that Aboriginal and Torres Strait Islander place names were in use prior to European occupation.
- e. A recognition that the recording of placenames in Aboriginal and Torres Strait Islander oral traditions has equal standing with written recording.
- f. A recognition that some Aboriginal and Torres Strait Islander place names may be subject to restrictions that must be respected. This may apply to some names in common usage which are of a very sensitive nature – either sacred or offensive. Names in this category will be revealed following the establishment of good relations between the communities and the nomenclature authorities and should be negotiated on an individual basis.
- g. A recognition of Aboriginal and Torres Strait Islander cultural expectations. This particularly applies to methods of contact, community structures, respect for community wishes, etc.

Existing Placenames

The committee must work with the relevant Indigenous community(s) before using a proposed Indigenous name in media releases or publications, as the proposed name may already be in use by that community for a different landscape feature. In initial publications, such as those reporting the discovery of a meteorite crater, it is generally acceptable to refer to the proposed crater in terms of the region, such as the Connelly Basin structure. Historically, this is the way most meteorite craters have been named. However, the selection of a proposed Indigenous name must go through the formal process. Otherwise, one may unintentionally cause offence. It is important to share lessons learned about this process candidly.

As an example, during the author's early PhD research on Aboriginal astronomy, he read about an Aboriginal tradition that described a star falling from the sky and landing in a waterhole named Puka.⁵⁷ Curious if the story described a witnessed event, he examined the area using Google Earth and identified a unique bowl-shaped escarpment in the area. He assembled a team of colleagues and conducted a geophysical survey of the site, with permission from the governing body which approved research access in the region.

The initial findings found possible evidence for an impact origin of the structure,⁵⁸ and the team issued a press release,⁵⁹ where the author proposed naming the crater after the waterhole in the traditional story. Concerns about the name's use were later raised by the area's representative Aboriginal organisation, as

57 Cf. Géza Róheim: *The Eternal Ones of the Dream*, p. 183.

58 Cf. Duane W. Hamacher, Andrew Buchel, Craig O'Neill, Tui R. Britton: *An Impact Crater in Palm Valley, Central Australia?*

59 Cf. Deborah Smith: *Google, Dreaming lead to ancient crater.*

another site in the region already bore that name and the author had not sought consultation about proposing a placename with the local community.

'Sorry Business'

Restrictions with placenames or physical sites might relate to what is considered 'Sorry Business'. This is when a loved one passes on, and time is dedicated to mourning and ceremony.⁶⁰ It can also relate to a place or situation that may relate to death, such as a massacre site or a place of natural disaster. Places associated with sorry business may be considered taboo to visit, discuss, or name out loud.

Aboriginal traditions of the Henbury craters describe them in such a way as to indicate they may have been considered a sorry place. Those traditions also showed that the people living in the area more than 4000 years ago may have witnessed the impact firsthand, with the stories being passed down through oral tradition.⁶¹ When scientists first began investigating the crater field, they realised that local Aboriginal people would not venture near the site and feigned disinterest or ignorance about the place. The reasons for this were later clarified when local Aboriginal men shared traditions describing it as the spot where people were killed by a fire devil running down from the sky as punishment for breaking traditional law, which was recorded in the Luritja language.⁶²

The motif of fiery stars as punishment for not following traditional law is common in Aboriginal traditions across Australia.⁶³ Examples include a fiery star that was cast to Earth near Lake Macquarie, north of Sydney, as punishment for breaking Law;⁶⁴ a Wardaman story describing a spirit named Utdjungon who will cast down a falling star to destroy the people if laws are not followed;⁶⁵ and Wurundjeri traditions of a cavern near Melbourne called 'Bukkertillibe', where the sky-ancestor, Bunjil, caused a star to fall from the sky and strike the Earth, creating the hole and killing people for doing things that displeased him.⁶⁶

At Tnorala, Arrernte traditions describe how a small community once lived inside Tnorala, long before the arrival of Europeans.⁶⁷ One day a man went hunting for kangaroo. When he returned, he discovered that everyone had been murdered by Kurdaitcha men – fierce warriors who lived in the desert to the south. The man informed neighbouring communities and they formed a party that tracked down and killed the Kurdaitcha men. Because of the massacre, Tnorala

60 Cf. Bronwyn Carlson, Ryan Frazer: *It's Like Going to a Cemetery and Lighting a Candle*.

61 Cf. Duane W. Hamacher, John Goldsmith: *Aboriginal Oral Traditions of Australian Impact Craters*.

62 Cf. *ibid.*

63 Cf. Duane W. Hamacher, Ray P. Norris: *Australian Aboriginal Geomythology*; Duane W. Hamacher: *Recorded Accounts of Meteoritic Events in the Oral Traditions of Indigenous Australians*; Duane W. Hamacher, John Goldsmith: *Aboriginal Oral Traditions of Australian Impact Craters*.

64 Cf. Lancelot Edward Threlkeld: *An Australian Grammar*, p. 51.

65 Cf. William E. Harney, Adolphus P. Elkin: *Songs of the Songmen*, pp. 29 ff.

66 Cf. Robert B. Smyth: *The Aborigines of Victoria*, p. 456.

67 Cf. Duane W. Hamacher, John Goldsmith: *Aboriginal Oral Traditions of Australian Impact Craters*.

is known as a 'sorry place' and the centre of the crater is considered sacred ground.⁶⁸ Although a small area in the crater's interior is open for visitors, most of it is fenced off from the public, with access forbidden.

Men's Business and Women's Business

Some sites may relate to information that is restricted by gender, dubbed 'Men's Business' or 'Women's Business'.⁶⁹ In fact, one of the craters bearing an Aboriginal name is related to certain information that is regarded as Women's Business (the identity of which is not discussed here to protect that association). One famous example of Women's Business related to Aboriginal star knowledge involved a legal battle in the 1990s between land developers and a group of Ngarrindjeri women regarding the construction of a bridge between the mainland and Hindmarsh Island in South Australia's coastal Coorong region, as the island was a place of secret Women's Business related to the Pleiades star cluster.⁷⁰ In some communities of the Pilbara region of Western Australia, astronomical knowledge is highly restricted to initiated men only.⁷¹ Communities are equipped to let you know if the site or related traditions are considered men's or women's business.

It is also important to consider that some places may be considered secret-sacred, which are only to be visited by selected people within the community, such as senior elders. In other cases, placenames relating to certain ancestral figures bear restrictions. In some Aboriginal communities of New South Wales, the name of the creation ancestor is not to be uttered by women or uninitiated men between certain months of the year. Instead, they use an alternative name.⁷²

Taboo, Death, and Evil

Meteors, meteorites, and impact craters are often linked to death, omens, and evil⁷³ and the taboo associations may present challenges when seeking a formal name. Meteors are commonly viewed as spirits of the dead (both benign and malevolent) and evil spirits (often in the form of serpents and monsters). In the Torres Strait, bright meteors are called 'Maier' and are seen as the spirits of the recently deceased going to (or returning from) Beig, the land of the dead.⁷⁴ In Aboriginal communities of the Top End, meteors are variably described as the manifestations of evil beings, such as the ghoulish Papinjuwari in Tiwi traditions,⁷⁵

68 Cf. *ibid.*

69 Cf. Hannah R. Bell: *Men's Business, Women's Business*.

70 Cf. Margaret Simons: *The Meeting of the Waters*.

71 Personal communication with Pilbara Elders (unnamed) in 2020.

72 Cf. Duane W. Hamacher, Ghillar M. Anderson: *Solar Eclipses in First Nations Traditions*, p. 18.

73 Cf. Duane W. Hamacher, Ray P. Norris: *Meteors in Australian Aboriginal Dreamings*.

74 Cf. Carla B. Guedes, Duane W. Hamacher, John Barsa et al.: *Death and Maier*.

75 Cf. Charles P. Mountford: *The Tiwi*, pp. 144 ff.

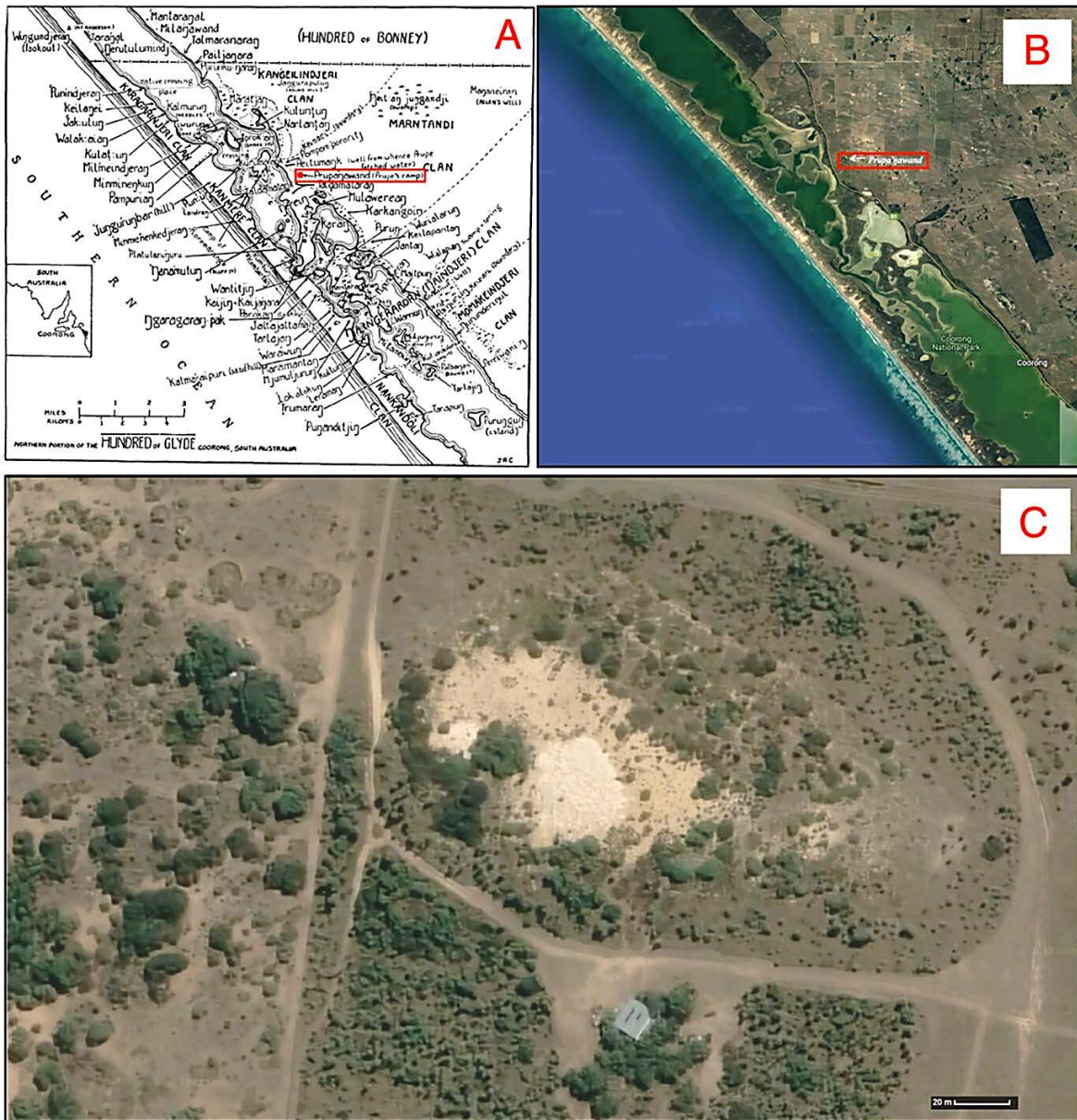


Fig. 2: The location of Prupa'jawand from the Ngarrindjeri story of Prupe and Koromarange: (A) Placenames in the Ngarrindjeri story of Prupe and Koromarange, after Tindale; (B) Google Earth view of the Tindale map; (C) Google Earth view of Prupa'jawand.

the wolverine-clawed Namorrorddo in Kuniñjku traditions of Arnhem Land,⁷⁶ or the serpentine Thuwathu in Lardil traditions of the Wellesley Islands.⁷⁷

Some of these traditions describe places where meteor/falling star spirits came down to the earth. Traditions of this sort may identify the specific location where such an event occurred, with some of them corresponding to known meteorite craters (such as Tatjakapara, Tnorala and Kandimalal) or meteorite falls.⁷⁸ The Wardaman traditions of Utdjungon tell how the falling star will cause the earth to shudder, the trees to topple and turn, and everything to go black, turning day into night.⁷⁹ Similarly, nearby Ngarinman traditions tell of “a large black stone”

76 Cf. Luke Taylor: *Seeing the Inside*, pp. 189f.

77 Cf. David McKnight: *Of Marriage, Violence and Sorcery*, p. 209.

78 Cf. Duane W. Hamacher: *Recorded Accounts of Meteoritic Events in the Oral Traditions of Indigenous Australians*.

79 Cf. William E. Harney, Adolphus P. Elkin: *Songs of the Songmen*, pp. 29ff.

that was thrown from the sky by Utdjungon,⁸⁰ indicating that Aboriginal people may have experienced meteorite falls and impacts firsthand.

In Gurudara traditions of the Northern Territory, the bright star Nyimibili fell from the sky, burning all the grass and trees and causing death.⁸¹ Yolngu traditions of Arnhem Land describe how the fire-spirit Goorda (who lives in the Southern Cross) fell to the earth as a star, bringing fire to the people of the Gainmaui River. When he touched the ground, he set the grass ablaze, which spread, causing death and chaos.⁸²

A large depression, called 'Prupa'ñawand' at Magrath Flat homestead in the Coorong of South Australia, is the location of a Ngarrindjeri tradition that describes it as where fire was kicked down by an evil woman named Prupe onto the camp of her sister (Fig. 2).⁸³ In the story "a great pit took the place of her camp".⁸⁴ Tindale writes that the site of the story relates to "a strange circular depression about thirty metres in diameter and ten deep of unexplained origin". Tindale elaborates:

According to one suggestion this may be a meteorite crater; its form being such as to encourage this view. However, there is no evidence of the presence of meteoric material on the surface near the supposed crater, and the suggestion cannot be accepted until confirmation is forthcoming; nevertheless, definite association exists between such a depression and a story of a catastrophic event accompanied by a blaze of fire. It seems possible that the story, in its present form, may be the dramatisation of an actual meteorite fall at this spot.⁸⁵

To date, no evidence has been published that physically links the depression to a meteorite impact. These associations with death, destruction, and taboo (such as with Henbury) mean that selecting or even enquiring about their traditional placenames should be considered carefully, delicately, and respectfully. A non-response from a local community organisation or Land Council may not be *accidental*. When working with Indigenous communities, silence can be as informative and telling as words.

Offensive Names

One of the more common practices is to name meteorite craters after a local place or landscape feature. This may include a river, body of water, mountains, cattle/sheep stations, or national parks. In some cases, the landscape features were named after people in Australia's colonial history, and this could raise concerns. For example, Foelsche crater is named after the nearby Foelsche River, which in turn is named after Paul Foelsche (1831-1914), the first police officer of

80 Ibid, pp. 72ff.

81 Cf. Ronald M. Berndt, Catherine H. Berndt: *The Speaking Land*, pp. 25ff.

82 Cf. Louis A. Allen: *The Time Before Morning*, p. 109.

83 Cf. Norman B. Tindale: Prupe and Koromarange; for the placenames in the Ngarrindjeri story of Prupe and Koromarange, see p. 18.

84 Norman B. Tindale: Prupe and Koromarange, p. 24.

85 Ibid, p. 18.

Port Darwin, Northern Territory. He was known to have developed an interest in Aboriginal language and culture, but his actions reflected a much darker side.

Historian Tony Roberts described Foelsche as “the man who masterminded more massacres in the Territory than anyone else [...] he was cunning, devious and merciless with Aboriginals”.⁸⁶ He later criticised an exhibition of Foelsche’s life that was on display in the Northern Territory parliament house library:

Foelsch masterminded and orchestrated massacres of innocent Aboriginal people in the northern half of the Territory for 30 years. If he were alive today, Paul Foelsche would be prosecuted by the United Nations for crimes against humanity.⁸⁷

In Australia, some local placenames bear offensive terminology. In 2017, ten placenames in Queensland featuring the ‘N-word’ were re-named after a long-fought campaign by Aboriginal communities.⁸⁸ An example with respect to impact structures is Piccaninny Crater in Western Australia, which takes its name from the local Piccaninny Creek in Purnululu (Bungle Bungle) National Park.⁸⁹

‘Piccaninny’ is widely considered to be a pejorative, racist term used to refer to black children in several parts of the world, including the United States, Australia, and New Zealand.⁹⁰ Its origins derive from the Portuguese term ‘pequeno’, which was used for any small child (of any race or colour). However, its offensive use derived from the 17th-century trans-Atlantic slave trade.⁹¹ Although the term is regarded as an ethnic slur in many parts of the world,⁹² some Aboriginal communities do not consider it to be offensive. Given that crater names will be used globally, it would seem reasonable to caution against using placenames that bear generally offensive terminology.

Spelling and Pronunciation

Close consultation with the community through the appropriate organisation (such as the Registered Aboriginal Party or Land Council) will ensure the correct use of language and spelling. It is important to know that in some places, due to language revitalisation, orthography can be an ongoing work in progress, and issues can arise.

Phonetic pronunciations in Aboriginal languages can pose issues for English speakers. In the case of Kandimalal, speakers may generally pronounce it as ‘CAN-di-MAL-al’ with a hard C when the K is pronounced in Jaru and many other Aboriginal languages as a hard G, as in ‘GAN-da-ma-lal’.

As mentioned above, in terms of spelling, Tnorala is the current version in common use. In 1909, Carl Strehlow recorded the spelling as ‘Tnorula’ in the Arrernte language,⁹³ referring to both the excrement of ingunanga grubs and

86 Tony Roberts: *The Brutal Truth*.

87 ABC News: *Glossing over History*.

88 Cf. Meghna Bali: *Racist Place Names in Queensland’s North to be Wiped off Maps*.

89 Cf. Glenn M. Beere: *The Piccaninny Structure*.

90 Cf. Adrian Room: *A Dictionary of True Etymologies*, p. 130.

91 Cf. Philip H. Herbst: *The Color of Words*, pp. 178 f.

92 Cf. Eric Partridge: *Piccaninny*.

93 Cf. Carl Strehlow: *Comparative Heritage Dictionary*, p. 347.

the name of Gosses Bluff. In the neighbouring Luritja language, it is spelled 'Anurulu'. Pfitzner spells it 'Tnurrele'.⁹⁴ In eastern and Central Arrernte, a similar word, 'tnerurre', refers to the ridge of a hill or range.⁹⁵

In the Arrernte language, the letter combination 'tn' uses an apico-alveolar sound (made with the tip of the tongue touching the hard ridge behind the upper teeth) as a pre-stopped nasal, similar to the 'tn' in 'chutney'.⁹⁶ Thus, Tnorala is pronounced 'NOR-ala'.

Can Names be Changed?

Changing names of meteorite craters, even after long periods of use, is a precedent that has been set by the meteoritics community in the past. Informally, the scientific community uses the colloquial name 'Barringer Crater' for the officially named 'Meteor Crater' in Arizona, after Daniel Barringer, a miner and businessman who promoted the meteoritic origin of the structure.⁹⁷ Formally, three craters have undergone 'official' name changes to date:

1. Teague Crater (or Teague Ring) in Western Australia was 'formally' changed to Shoemaker Crater to honour Eugene Shoemaker, a celebrated geologist and planetary scientist who was killed in an automobile accident in 1997 in the Northern Territory while studying meteorite craters.⁹⁸
2. Prince Albert Crater in Canada's Northwest Territories was originally named after the Prince Albert Peninsula when it was first reported in the media but was later changed to Tunnunik, the traditional Inuvialuit name for the inlet in which it was found.⁹⁹ The name Tunnunik appeared in the first publication about the crater.¹⁰⁰
3. The Pretoria Saltpan (or Soutpankrater in Afrikaans) is a crater in north-eastern South Africa, whose name was changed in the 1990s to Tswaing, a word in the Tswana language that means 'place of salt'.¹⁰¹

In two cases, the English name was changed to a local placename in the local Indigenous language, although it was not necessarily the traditional name for that structure (if one existed). The Pretoria Saltpan was described in the scientific literature under this name for twenty-five years, from 1971 until around 1996, when it was changed to Tswaing.¹⁰² The name 'Teague' was in use for twenty-three years, from ca. 1974 to 1997. In both cases, Teague and Pretoria Saltpan were used in the scientific literature for over two decades before being changed.

94 Cf. Gavan Breen, John Pfitzner: *Introductory Dictionary of Western Arrernte*, p. 55.

95 Cf. John Henderson, Veronica Dobson: *Eastern and Central Arrernte to English Dictionary*, p. 553.

96 Cf. Neil Broad: *Eastern and Central Arrernte Picture Dictionary*.

97 Cf. Duane W. Hamacher: *Native American Traditions of Meteor Crater, Arizona*.

98 Cf. Franco Pirajno, Aandrew Y. Glikson: *Shoemaker Impact Structure Western Australia*.

99 Cf. Gordon R. Osinski et al.: *Structural Mapping of the Tunnunik Impact Structure*; Gordon Osinski et al.: *The Prince Albert Structure, Northwest Territories, Canada*.

100 Cf. Keith Dewing et al.: *Newly identified "Tunnunik" Impact Structure, Prince Albert Peninsula, Northwestern Victoria Island, Arctic Canada*.

101 Cf. Robert C. de Jong, Wolf U. Reimold: *The Tswaing Crater Museum*.

102 Cf. *ibid.*

Summary

The act and process of recognising Indigenous nomenclature in the astronomy, space and planetary science communities is important to decolonising science and recognising the contributions and importance of Indigenous knowledges. This paper explored how this was accomplished by the astronomical community regarding star and asteroid names, including challenges faced and lessons learned, which can be used to guide similar processes for naming meteorite craters. This paper lays out the foundations and reasoning behind the proposal to establish a set of protocols for naming meteorite craters in Australia and potentially considering some for re-naming. The process will not always be quick or easy, and guidelines will inevitably need to be updated and developed further as time passes, but it is important for the scientific community to show meaningful respect to Indigenous people and culture, and to acknowledge their ancient knowledge systems. There is much we can learn from these systems of knowledge, and it is arguably the right thing to do.

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