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ASTRONOMICAL SYMBOLISM IN AUSTRALIAN ABORIGINAL ROCK ART

Ray P. Norris and Duane W. Hamacher

Abstract. Traditional Aboriginal Australian cultures include a significant astronomical component, perpetuated through oral tradition and ceremony. This knowledge has practical navigational and calendrical functions, and in some cases extends to a deep understanding of the motion of objects in the sky. Here we explore whether this astronomical tradition is reflected in the rock art of Aboriginal Australians. We find several plausible examples of depictions of astronomical figures and symbols, and also evidence that astronomical observations were used to set out stone arrangements. With these exceptions, astronomical themes do not seem to appear as often in rock art as in oral tradition, although it is possible that we are failing to recognise astronomical elements in rock art. Future research will attempt to address this.

Introduction

The dark night skies of Australia are an important part of the landscape, and would have been very obvious to Aboriginal people living a traditional lifestyle. So it is unsurprising to find that stories of the Sun, Moon, planets and constellations occupy a significant place in the oral traditions of Aboriginal Australians. This was first described by Stanbridge (1857), and since noted by many other authors (e.g. Mountford 1976; Haynes 1992; Johnson 1998; Cairns and Harney 2003; Norris and Norris 2009). The focus of most of these works is on the correspondence between constellations, or celestial bodies, and events or characters in traditional Aboriginal oral traditions.

For example, in many Aboriginal cultures the European constellation of Orion is associated with young men, particularly those who are hunting or fishing (e.g. Massola 1968; Wells 1973). The constellation is called Djulpan in the Yolngu language, and the three stars of Orion's belt are associated with three brothers sitting across the width of a canoe, with Betelgeuse marking the front of the canoe, and Rigel the back. The three brothers were blown into the sky after one of them had illegally captured a kingfish, which corresponds to Orion's sword (Wells 1973).

Similarly, the cluster of stars known to Europeans as the Pleiades, or Seven Sisters, are associated in many Aboriginal cultures with a group of young girls, or sisters (e.g. Massola 1968; Harney 1959; Andrews 2005). Many traditional Aboriginal stories refer to the sisters as pursued by the young men in Orion, which is curiously similar to the traditional European myth about these constellations. This may indicate either cultural convergent evolution, reflecting the subjective masculine and feminine appearance of Orion and the Pleiades respectively, or else suggest a much earlier story common to both cultural roots.

In addition to these narratives, the skies had practical applications for navigation and time keeping (e.g. Cairns and Harney 2003; Clarke 1997). It has been argued by Norris and Hamacher (in press) that a deep intellectual content is also present, in which meaning is sought for astronomical phenomena such as eclipses, planetary motions and tides.

An impediment to this study is the widespread but mistaken belief that 'no Australian Aboriginal language has a word for a number higher than four' (Blake 1981), which persists even though complex Aboriginal number systems have been well-documented in the literature (e.g. Tindale 1925; Harris 1987; McRoberts 1990; Tully 1997). Such colonial belief systems also maintain the misconception that Aboriginal people would not be interested in or capable of careful astronomical measurements, but we find no evidence to support this belief.

The astronomical component of Aboriginal oral traditions is well-established, with hundreds of examples appearing in the literature cited in this paper. Astronomical themes are also widespread in ceremonies and artefacts, such as the Morning Star pole used in Yolngu ceremony (Norris and Norris 2009), and in depictions of constellations such as Scorpius in bark paintings (ibid.). In this paper, we explore the extent to which these strong astronomical

Figure 1. *Wardaman rock painting of the Sky Boss and the Rainbow Serpent. The serpent at the bottom represents the Milky Way, and the head of the Sky Boss is associated with the Coalsack nebula, although a researcher could not deduce this astronomical connection without access to the cultural insight of Wardaman elder Bill Yidumduma Harney (photograph courtesy of Bill Yidumduma Harney).*

traditions are reflected in Aboriginal rock art. It is instructive to note that in some cases where the traditional Aboriginal culture is largely intact, we have first-hand accounts linking rock art to astronomy (e.g. Cairns and Harney 2003). However, in some of these cases, such as Figure 1, the astronomical connection would not be apparent to a Western researcher unless guided by cultural knowledge.

Other rock art sites in Australia display motifs of astronomical designs. For example, on a hilltop near Palm Valley, Northern Territory, is a depiction of the Sun, crescent Moon and stars (Austin-Broos 1994). However, in this case, the Arrernte description of the site has evolved from a traditional view to one that was shaped by Lutheran missionaries that settled the area in the late 19th century. When asked about the purpose of these astronomical petroglyphs, the Arrernte informant explained that they had been placed there by God to direct Jesus while in the desert. Many features of the landscape had incorporated Christian mythology into the pre-existing oral traditions, including that of a star which was said to have fallen and made a hole between two trees where the Hermannsburg church was later built. Other geographical features of the area served a mnemonic purpose relating the land to Christian events, such as Noah's Flood and the inception of the Ten Commandments (ibid.).

In addition, certain star-like motifs can be found engraved in rock in the Sydney-Hawkesbury region (e.g. Sim 1966), although their meaning is unknown. These designs typically involve a small circle with lines radiating outward, suggesting a Sun, star or sunburst motif.

The Sun and Moon in Aboriginal rock art

In most Aboriginal cultures, the Moon is male and the Sun is female. For example, a Yolngu oral tradition explains the motion of the Sun in terms of Walu, the Sun-woman. She lights a small fire each morning, producing the dawn (Wells 1964), and decorates herself with red ochre, some of which spills onto the clouds to create the red sunrise. Carrying a blazing torch made from a stringy-bark tree, she travels across the sky from east to west, creating daylight. At the western horizon, she extinguishes her torch, and travels back underground to her morning camp in the east. Warner (1937) reports that he was told the Sun goes clear around the world by a Yolngu man who illustrated this by putting his hand over a box and under it and around again.

The Yolngu people call the Moon-man Ngalindi. The phases of the Moon are caused by Ngalindi being attacked by his wives, who chopped bits off him with their axes, reducing him from the fat full Moon to the thin waning Moon (Wells 1964; Hulley 1996), and eventually dying (the new Moon). After staying dead for three days, he rose again, once more growing round and fat to become the full Moon, when his wives attacked him again. Yolngu culture also recognises that the tides are caused by the Moon, and that the height of the tides depends on the phases of the Moon. This is explained in terms of a complicated interaction between the rising Moon and the sea, the Moon alternately filling and emptying, depending on its phase, as it rises through the ocean horizon.

While the details of such stories vary from one Aboriginal culture to another, there exist similarities that transcend Aboriginal cultures, such as the gender of the Sun and Moon, which are female and male respectively in nearly all Aboriginal cultures (Johnson 1998; Fredrick 2008). Details similar to those of the Yolngu story also appear in other language groups, such as the Wardaman people (Bill Yidumduma Harney, pers. comm., 2010) who have a story in which the Moon-man is expelled to the sky for breaking a taboo.

Given these strong oral traditions, we might expect to find depictions of the Sun and Moon in Aboriginal rock art. Examples of 'solar images' exist, such as those at Ngaut Ngaut, South Australia (Fig. 2) which are supported by local oral tradition (Tindale 1986), and many more are surmised, such as the 'bicycle wheel' or 'sunburst' petroglyphs in the petroglyphs at Sturts Meadows, New South Wales (Fig. 3). However, the latter can entertain many interpretations, including a supernova (Murdin 1981), and caution is required when interpreting such images in the absence of

Figure 2. *The 'Sun petroglyph' at Ngaut Ngaut, South Australia.*

Figure 3. *A 'bicycle-wheel' or 'sunburst' petroglyph at Sturts Meadows, New South Wales. While this may represent the Sun, or perhaps even a supernova, there is no information to support these interpretations, and so any interpretation remains speculative.*

cultural context.

Crescent shapes are also common, and may represent the Moon, although they have also been attributed to boomerangs. Many examples of crescent shapes are found in the Sydney Basin petroglyphs, and are traditionally referred to as boomerangs (e.g. McCarthy 1983). However, there is a clear difference between a boomerang-shape and a crescent Moon: boomerangs from the Sydney region typically have straight sides and rounded ends (Norris and Hamacher in prep.), whereas the crescent Moon always has a curved shape and pointed ends (Fig. 4). We interpret this difference as support for the hypothesis that the Sydney petroglyphs contain a significant astronomical component.

Eclipses

Several Aboriginal cultures recognised that eclipses are caused by a conjunction of the Sun and Moon. For example, in north-west Arnhem Land a solar eclipse is caused by the Sun-woman being hidden by the Moon-man as they make love, while a lunar eclipse is caused when the Moon-man is pursued and caught by the Sun-woman (Johnson 1998; Warner 1937). Similarly, Bates (1944) reports that the solar eclipse of 1922 was said by the Wirangu people to be caused by the Sun and Moon becoming husband and wife together.

These stories demonstrate an impressive intellectual achievement by some unrecorded thinker. To understand a solar eclipse, in which the Moon comes between the Earth and the Sun, is impressive, but not surprising if traditional Aboriginal thinkers carefully studied the motion of the Sun and Moon. However, to understand a lunar eclipse, in which the Earth's shadow extinguishes the Moon, requires a significant leap of understanding, since it occurs when the Sun and Moon are diametrically opposed in the sky, and it is precisely this alignment that causes the eclipse.

Amongst the crescent motifs found in the Sydney petroglyphs are several examples that depict a man and woman under, or next to, a crescent shape. In the case of the Basin Track petroglyph (Fig. 5), the

Figure 4. *A crescent-shaped petroglyph from Calga Springs, New South Wales; the crescent Moon, and a boomerang. Note the smooth curve and pointed ends of the petroglyph, as opposed to the relatively straight lines and rounded ends of the boomerang, which is similar to those most commonly found in the Sydney region.*

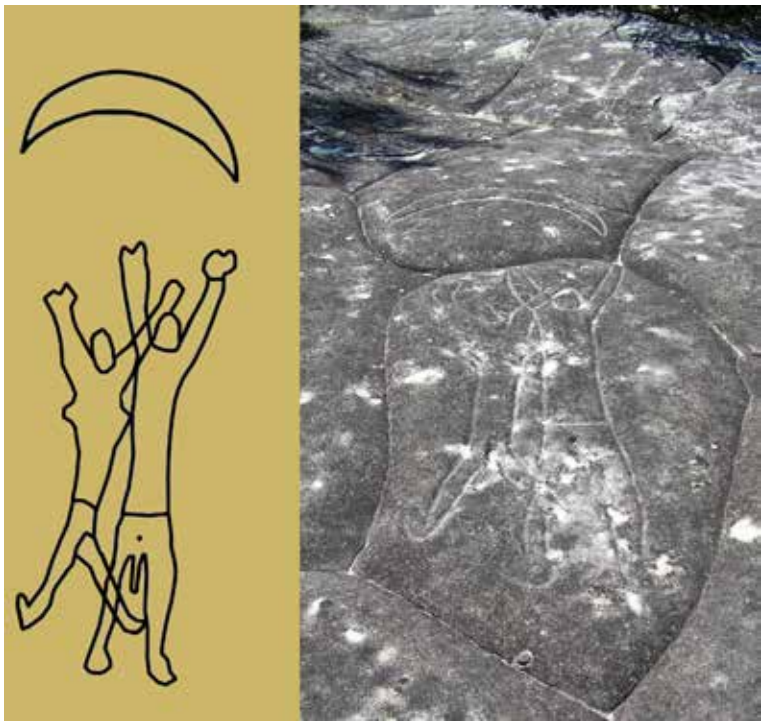

Figure 5. The 'eclipse' petroglyph at the Basin Track, Ku-ring-gai Chase National Park, New South Wales.

sign erected by the National Parks and Wildlife Service explains that the petroglyph shows a man and woman with a boomerang. However, it is unclear why a man and woman should reach up towards a boomerang above their heads. Even if, as suggested above, the crescent represents a Moon rather than a boomerang, it is still unusual in that the moon is shown with the two horns pointing down, a configuration normally seen only when the moon is barely visible in the early morning or late afternoon. But such a configuration can be seen during an eclipse, and this suggestion is supported by the two figures, one of which partially obscures the other. Such carefully drawn obscuration is unusual in these petroglyphs, and we might speculate that the image represents the Moon-man obscuring the Sun-woman (or vice-versa) during an eclipse. Other circumstantial evidence for this hypothesis is that the man and woman face toward the north-eastern horizon, in the direction a solar eclipse could be seen in the early morning. For example, such an eclipse, with the horns pointing downwards as depicted, took place in that direction on the morning of 8 August 1831 (calculated by the authors using the *Starry Night* software package), and similar eclipses would have been visible on many earlier occasions. John Clegg (pers. comm., 2010) has also speculated that a hermaphrodite figure near this petroglyph may represent the Moon-man and Sun-woman fully superimposed during a total eclipse.

The Emu in the Sky

Across the zenith of an Australian autumn evening sky stretches the bright band of the Milky Way. Within it can be seen a number of dark patches and streaks, caused by clouds of interstellar dust in which new stars are being born. Perhaps the best-known Aboriginal constellation is the Emu in the Sky, formed not of stars, but of the dark patches between them (Norris and Norris 2009). Amongst the Sydney petroglyphs, close to the Elvina Track, is a finely engraved 'emu' (Fig. 6), carefully drawn to show the gizzard and other anatomical features. On the other hand, its legs trail behind it, in a position that would be unnatural for a real emu, but is very similar to that of the Emu in the Sky. This was first noted by Cairns (1996), who suggested the petroglyph might represent the Emu in the Sky rather than a real emu. This suggestion is further supported by the fact that the time of the year when the Emu in the Sky

Figure 6. The Emu in the Sky, consisting of dark patches in the Milky Way, above the 'emu' petroglyph at Elvina Track, Ku-ring-gai Chase National Park (photograph courtesy of Barnaby Norris).

Figure 7. *The 'lunar petroglyphs' at Ngaut Ngaut, said by local tradition to represent cycles of the Moon.*

stands in the evening above her portrait, in the correct orientation, is the same time when real-life emus are laying their eggs. It therefore seems possible that this petroglyph is a picture of the Emu in the Sky rather than a real emu.

Astronomical records

The hypothesis that Aboriginal rock art contains a significant astronomical component would be strongly supported if a piece of rock art could be identified as a record of known astronomical phenomena. The petroglyphs of the Sun and Moon at Ngaut Ngaut, South Australia (Fig. 2), provide clear evidence of an astronomical connection at this site. Close to this petroglyph are carved a series of dots and lines (Fig. 7), which, according to the Nganguraku Traditional Owners (Richard and Cynthia Hunter, pers. comm. 2005), show the cycles of the Moon.

This oral tradition has been passed through generations from father to son, but since initiation ceremonies were banned (along with the Nganguraku language) by Christian missionaries over a hundred years ago, only this fragment of knowledge survives, and it is not known exactly what the symbols mean. Certainly the dots and lines resemble tally marks, and the site's astronomical connection supports the suggestion that they represent astronomical records. However, we have so far failed to decode them, and so from a scientific perspective it remains uncertain whether or not they represent astronomical records. We plan to conduct further tests to search for evidence supporting or refuting the hypothesis of astronomical periodicities in the marks, but for the moment it appears the jury is still out.

Meteors and comets

Hamacher and Norris (in press a, b) report some 150 different oral stories involving meteors, and 25 involving comets, from about 150 separate groups. Given this apparent importance of meteors and comets in traditional Aboriginal cultures, it might be expected that they would appear in rock art. However, there are few potential examples.

Near Kalumburu, Western Australia, is a rock painting on the side of a rock called Comet Rock. Bryant (2001) suggests that the rock painting represents a motif of a cometary fragment that impacted the Indian Ocean causing a great tsunami that swept over the land, which he speculates is supported by Aboriginal stories. The rock is 5 km from the ocean on a plain covered in a layer of beach sand. A similar example is given by Jones (1989) who reports an oral tradition that local rock art describes a cosmic impact, followed by a deluge, in the Darling Riverbed near Wilcannia, New South Wales.

Another site, near Alice Springs, is said to be a comet dreaming site, and contains petroglyphs which may depict comets with several tails (R. G. Gunn, pers. comm. 2010). In the Sydney region are several petroglyphs which depict a creation hero, often identified as Baiame or Bulgandry (Fig. 8), with a distinctive hair arrangement or headdress which resembles the tail of a comet. It has been speculated (Hamacher and Norris in press b, and references therein) that this headdress may indeed represent a comet, in which case a comet may have been viewed as an apparition of Baime/Bulgandry.

Mathews (1896) reports engraved trees depicting meteors, but none are known to have survived. Given the large number of traditions involving meteors or comets, this relative paucity of depiction in rock art is surprising. Perhaps we have failed to identify them in rock art, or perhaps it was inappropriate for some reason to depict them in visual art.

Stone arrangements and Bora rings

Several stone arrangements and Bora (ceremonial) rings, throughout Australia, appear to be aligned to the cardinal points. For example, the Carisbrook site in Victoria (Fig. 9) is a boomerang-shaped (as

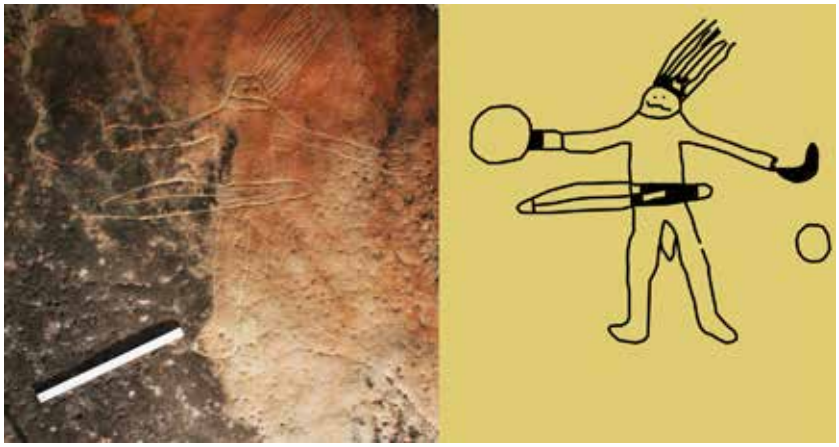

Figure 8. *The Bulgandry petroglyph near Woy-Woy, New South Wales (left), and the drawing by W. D. Campbell of 1893 (right).*

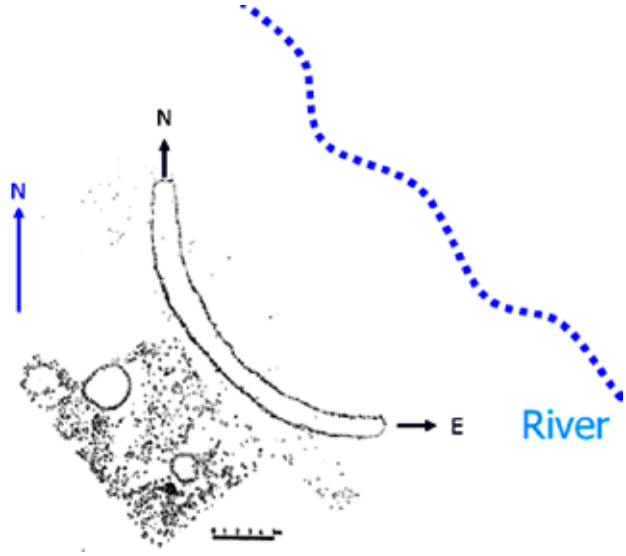

Figure 9. *Plan of the Carisbrook stone arrangement, Victoria. Adapted from Lane and Fullagar (1980).*

opposed to a lunar crescent) arrangement whose axes point within a few degrees of due north and due east. Others we have surveyed are the Dungowan Stones near Tamworth and two stone arrangements at Elvina Track in Kur-ring-gai Chase National Park north of Sydney.

Since there is no pole star in the Southern Sky, finding the cardinal points without a compass or GPS is not easy. Contrary to popular belief, the Sun does not rise in the east and set in the west, but varies considerably over the course of a year. To find east and west to an accuracy of a few degrees using the Sun requires careful measurement. For example, east and west may be found by marking the positions of the rising or setting sun's locations on the horizon over the year, then marking the halfway point between the extreme positions. Similarly, the well-known technique of plotting lines from the Southern Cross and pointers is only useful if someone else has already determined true south and then tells you how to find it, and so leaves unresolved the question of how to determine the position of true south in the first place. One possible technique is to observe the rotation of the Southern Cross over the course of a winter's night, mark the position on the horizon vertically below its extreme easterly and westerly positions, and then mark the half-way point between them.

Such determinations require a process of astronomical observation and measurement, and the intellectual motivation to do so. Thus the very existence of a significant number of structures aligned to the cardinal points implies a degree of planning, observation, and measurement that seem to be absent from most anthropological accounts of Aboriginal cultures. Of course, they could be aligned to the cardinal points purely by chance, which implies that there must be a far larger number of structures that are *not* aligned to cardinal points. Although experience suggests that this is not the case, a proper statistical study is being undertaken by the authors.

A notable example, the Wurdi Youang stone arrangement built by the Wathaurung people in Victoria, is an egg-shaped ring of stones, measuring about 50 m, with a major axis almost exactly east-west (Fig. 10). At its western apex are three prominent waist-high stones mimicking three mountains in the distance. Morieson (2003) has suggested that some outlying stones to the West of the circle indicate the setting positions of the Sun at the equinoxes and solstices, when viewed from the three large stones. Norris et al. (in prep.) have confirmed these alignments. More importantly, Norris et al. have shown that the straight sides of the circle also indicate the solstices, and are parallel to the lines to the outliers proposed by Morieson. Thus at this site we have two independent sets of indicators, both indicating the same positions on the horizon, corresponding to the sunset position at the two solstices and the equinox. Taken at face value, this suggests that astronomical observations were used to construct the site, and may have been important in its use.

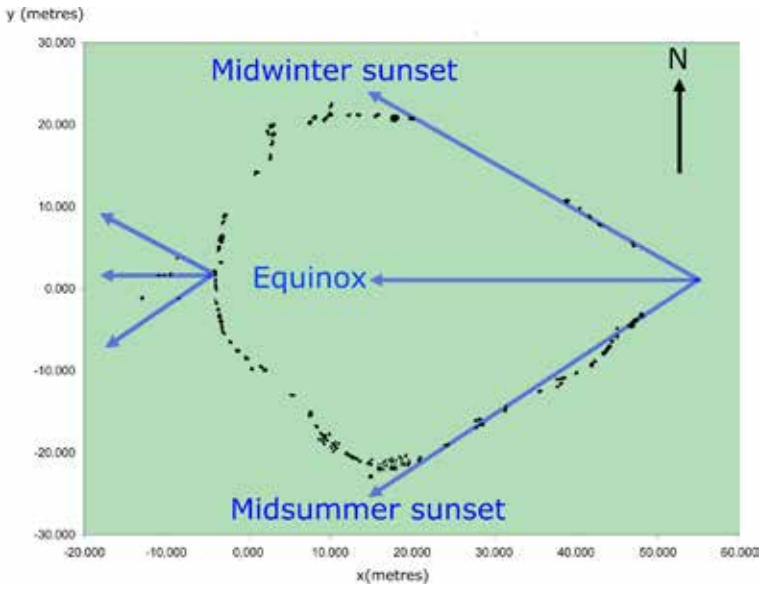

Figure 10. *Plan of Wurdi Youang stone arrangement, Victoria (from Norris et al. in prep.).*

To forestall any concerns about changes in the position of the Sun since the site was constructed, we note that the pole of the Earth precesses relative to the stars, completing a circle of radius 23.5° over a period of 26 000 years. This motion is named the precession of the equinoxes and causes the apparent positions of stars to change by about 1° every 200 years. The declinations of the Sun and Moon, and hence their rising and setting

positions, are unaffected by this precession. However, the apparent declination of the Sun *is* affected by a much smaller effect, the nutation in the obliquity of the Earth's rotational axis, which varies by about 2.4° over a period of 41 000 years. Because the alignments discussed here are accurate to a few degrees, such variations will have no measurable effect on these alignments.

However, the apparent significance of this site is still subject to some doubts:

(1) The outliers are only accurate to a few degrees — could these alignments have occurred by chance?
(2) Although the stones of the circle are large and relatively immovable, the outliers are small and could have been moved.
(3) There are other stones in the vicinity, requiring a subjective decision as to which stones to include in a survey.

These doubts are partly addressed by the alignments of the straight lines in the egg-shape, but an even better way to address them would be to find other sites with similar astronomical alignments. This is a subject of continuing research.

Conclusion

It is well established that traditional Aboriginal oral traditions include a significant astronomical component, including references to individual stars and planets. It is becoming clear that this knowledge includes a deep understanding of the motion of celestial bodies, and so we might expect to find this knowledge reflected in rock art.

In this paper we have examined the evidence for depiction of astronomical themes in rock art. While a few examples are well-established (e.g. Figs. 1 and 2), they are uncommon. We have a larger number of examples where a plausible, but not conclusive, case can be made for an astronomical connection. On the other hand, some of the well-established astronomical examples would not have been recognised as such without access to traditional oral knowledge, and so it is possible that there exist many more examples that are currently unrecognised. Our current research program is examining potential examples, with the aim of placing this discussion on a secure statistical basis. We have already shown that the significance of some subset of rock art could not be understood without taking astronomical oral traditions into account. What is not yet clear is whether this is a tiny or a significant subset of all rock art.

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