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A REVIEW OF MĀORI ASTRONOMY IN AOTEAROA-NEW ZEALAND

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Abstract: Across the world indigenous people are seeking to reclaim their traditional knowledge. Within the last fifty years the Māori of Aotearoa-New Zealand¹ have made significant efforts to reclaim their language, arts and science. Part of this renaissance includes a growing Māori movement to reclaim their astronomical knowledge. Māori astronomical understanding was infused throughout much of pre-colonial Māori life, culture and belief. The Sun, Moon and stars were an integral part of practices pertaining to agriculture, architecture, fishing, calendrical systems and exploration. Although early ethnographers attempted to record this knowledge, their works seem to only reflect a somewhat superficial level of understanding. Thus this paper highlights some of the current research being conducted on Māori astronomy, which seeks a greater understanding of how the ancestors of the Māori perceived the heavens.

Keywords: Māori astronomy, *tātai arorangi*, *Matariki*, *Puanga*, navigation, *whetu*, SMART

1 INTRODUCTION

There is clear evidence indicating that the Māori had extensive knowledge of the night sky (Best, 1922). The numerous objects and events that make up the cosmos were well known to the Māori, and comprehensively understood well before the arrival of *Pākehā*.² The movements of constellations, the heliacal rising of stars, the arrival of comets, the phases of the Moon and many other astronomical phenomena were noted and examined. This detailed astronomical knowledge resulted in the Māori having a precise understanding of the seasons and helped the ancestors of the Māori to navigate across the vast expanse of the Pacific Ocean. Māori astronomical knowledge is known as *tātai arorangi*. *Tātai arorangi* was considered to be part of the body of knowledge known as *kauwae-runga*, which contained celestial knowledge, knowledge of the creation, the gods, stars and time (Best, 1924). The teachers and specialists of Māori astronomical knowledge were known

as *tohunga kokorangi* and *tohunga tātai arorangi*. Although communities had a general knowledge of *tātai arorangi*, only a select few ever were taught the more in-depth information and given the responsibility to hold and use this knowledge.

1.1 Traditional Knowledge and Colonization

Contact with the new European settlers during the nineteenth century saw the introduction of diseases leading to population decimation; imposed legislation deterring the use of traditional practices; urban migration, and the detachment of later generations from their homelands, cultural practices and language (Dalley and McLean, 2005). These effects forced major changes in Māori society, which also affected the maintenance of traditional Māori astronomy. As other cultural and scientific knowledge entered into exchanges and education systems, Māori astronomy as with other Māori knowledge became sidelined, mixed with the new colonial knowledge

and then was lost. Thus, today there are few individuals who are knowledgeable in the area of Māori astronomy. In a modern contemporary context the Māori have had over two hundred years of mixing with non-Māori through marriage, friendships and collegiality. Very few Māori live in what would be considered a traditional Māori setting, and Māori knowledge-holders certainly have had significant contact with and have been influenced by non-Māori as well as issues connected with globalization. Hence, any attempt to investigate true pre-colonial Māori astronomical knowledge can be challenging.

In the majority of this paper we endeavour to explore the pre-colonial concepts and understandings that the Māori had pertaining to astronomy, and we also discuss some of the contemporary efforts around revitalization. It should be noted that the discussion of Oceanic navigation in Section 2.6 pertains to recreated knowledge derived from individuals from other Pacific nations who were willing to share their ancestral knowledge with the Māori due to the close cultural affinity of the peoples of the Pacific. Thus, this section represents a fusion of traditional Māori, Pacific and contemporary concepts and ideas.

A number of early ethnographers wrote on Māori star lore and knowledge. The most comprehensive works were written by Elsdon Best (1856–1931), and included *The Astronomical Knowledge of the Māori Genuine and Empirical* (Best, 1922); *The Māori Division of Time* (Best, 1959) and *Children of the Mist* (Best, 1996). Other influential works included books by James Cowan (1930), Edward Tregear (1891; 1904) and Herbert W. Williams (1957).

Orchiston (2000) critically examined the works of these early ethnographers, in particular those penned by Elsdon Best. Best's *The Astronomical Knowledge of the Māori ...* contains the Māori names, beliefs and rituals of the Sun, Moon, stars, comets and meteors, whilst his *The Māori Division of Time* outlines the Māori notion of time, explaining how the year was based on the rising of *Matariki* (the Pleiades) and *Puanga* (Rigel), which also incorporated a lunar calendar and seasonal phases based on various biological indicators. After he extensively reviewed these and other published works Orchiston concluded that only fragments of Māori astronomical knowledge are found in the published literature. He stated that the contents of these works were superficial and plagued with source limitations. Best (1922: 64) himself even stated that the amount of Māori astronomical knowledge collated was "... meager and unsatisfactory ...". However, Best (ibid.) incorrectly concluded that all information on this topic had been collected, erroneously stating that "The available data concerning Māori sky-lore is now exhausted,

and this account must be closed."

This assumption is in stark contrast to current discourse between Māori knowledge experts, who are now discussing a myriad of topics pertaining to Māori astronomy, which are not examined in the forementioned publications. Discussions between researchers and communities also often include criticism of early ethnographic works, with many Māori doubting the validity of some of the information that was given to the ethnographers by some informants. There also is concern that the sources of the information often were not disclosed by the ethnographers.

1.2 Revitalization of Māori Astronomy

In the early 2000's there was a resurgence of interest in Māori astronomical knowledge, seeded by the reactivation of mass celebrations of the Māori New Year, called *Matariki* (the Pleiades) or *Puanga* (Rigel) after the cluster/star that signifies its beginning. The resurgence in this celebration has seen interest spread not only through Māori communities but also to the general public of Aotearoa-New Zealand and even to other parts of the world. This sparked interest was preceded by a quest to revitalize oceanic navigation that began in the 1970s. Hector Busby and others in the Pacific were guided by master navigator Mau Pialug, and they revived traditional navigation techniques, including celestial navigation. Some forty years on Busby and his colleagues continue to educate young Māori and share their knowledge with the next generations (Matamua et al., 2013).

Towards the late 2000's, a group called the Society for Māori Astronomy Research and Traditions (SMART) was formed, and dedicated itself to the preservation and revitalization of Māori astronomical knowledge. This group consists of Māori knowledge experts, educators, navigators and scientists. SMART has embarked on research and publications centered on Māori astronomical knowledge (e.g. see Harris and Matamua, 2012).

Groups such as SMART are actively investigating aspects of Māori astronomy. This undertaking is supported by researchers from the University of Auckland, Te Whare Wānanga o Awanuiarangi and Victoria University of Wellington, who are exploring traditional knowledge associated with the Māori Moon calendar. In addition, SMART researchers are investigating alignments of pre-European contact meeting houses; linguistic influences of stars on the Māori language tribal-specific astronomical knowledge; as well as a myriad of other topics. Groups such as these will follow in the footsteps of earlier revitalizers, such as the Oceanic navigators, Māori medicine (*Rongoa* Māori) groups and canoe-builders, by revitalizing yet another part of

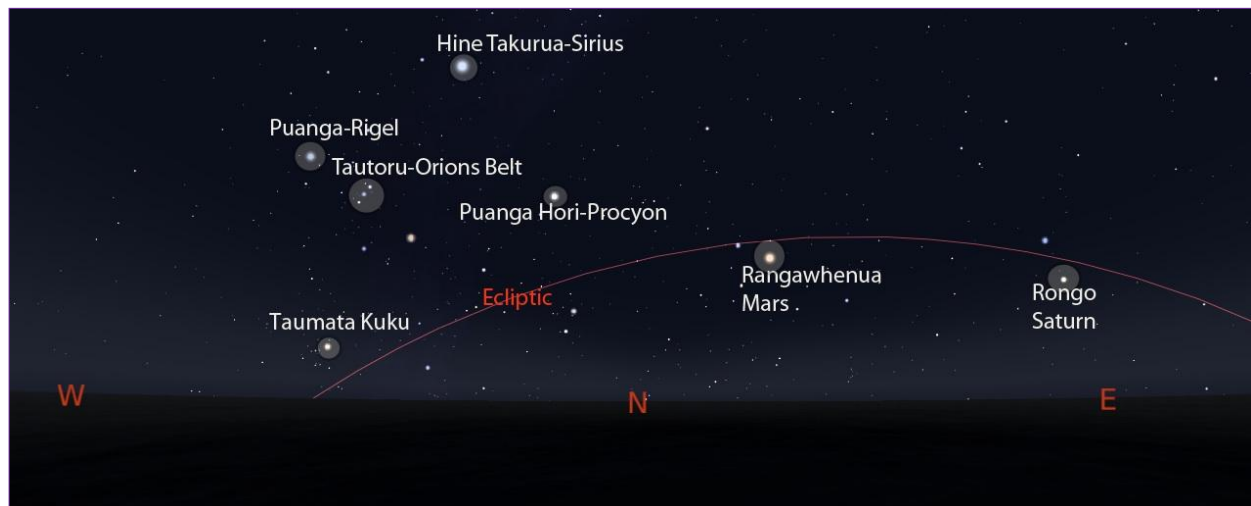


Figure 1: Part of the night sky, with the ecliptic marked in red. This indicates the path that the Sun takes during the day, and also indicates approximately the path the planets follow. Also shown are various star, constellation and planetary names, but these may vary tribally (picture created using Stellarium software).

Māori knowledge, namely, that pertaining to the heavens.

In this paper we touch on some of the more pertinent aspects of Māori traditional star lore. These include cosmological origins, language, food-growing practices, house-building practices and navigation. This is followed by a discussion on some of the efforts to revitalize Māori astronomical knowledge, and what research academics and the Māori community are currently conducting. We also include a summary of some of the main celestial objects, and a section on how the positions of the stars change in the sky throughout the year and how they are seen from different positions on the Earth, in order to assist the reader in understanding how celestial objects were used by the Māori and by other cultures.

1.3 The Motions of the Earth, the Sun, the Moon and the Stars in the Sky

Our Solar System consists of the planet Earth orbiting the Sun, along with seven other planets, dwarf planets, an asteroid belt, dust and other debris. Each planet orbits the Sun at different rates, with the Earth completing one orbit in 365.24 days. All of the planets orbit the Sun in approximately the same plane, so they appear to move across the sky along much the same path as the Sun, which is called the ecliptic. Figure 1 shows a snapshot of the night sky, which contains the names of well known stars, constellations and planets, both in Māori and English. In this figure, the ecliptic is indicated by the red line. Against the background stars the planets can be distinguished as different because of their movement along the ecliptic.

As the Earth revolves around the Sun, different stars fields are visible at different times of the year. Of course this also means that at certain times of the year different stars are ob-

scured from view. Figure 2, shows how certain stars can only be seen at certain times of the year. When the Earth is at position 1, stars at position 3 will not be visible, and when the Earth is at position 2, stars at position 4 will not be visible. In this paper we shall see that certain stars were used as markers for certain times of the year, when they just became visible again in the night sky.

During the day the Sun traverses the sky from east to west. If we observe the daily rising points of the Sun on the eastern horizon, we will notice that the Sun moves incrementally about one-third of a degree per day in Aotearoa-New Zealand, moving towards the North to a maximum point and then moving back towards the South. The extreme points mark the winter and summer solstices.

The Moon orbits the Earth and returns to the same place against the background stars every

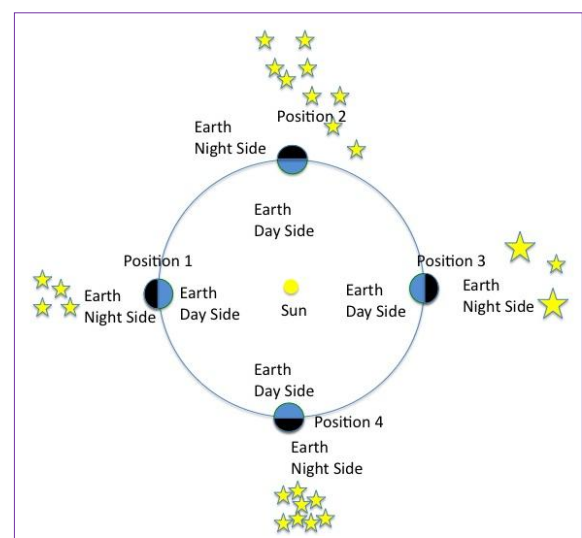


Figure 2: The Earth's orbit around the Sun (not to scale) and the different stars in the night sky visible from different positions during the year.

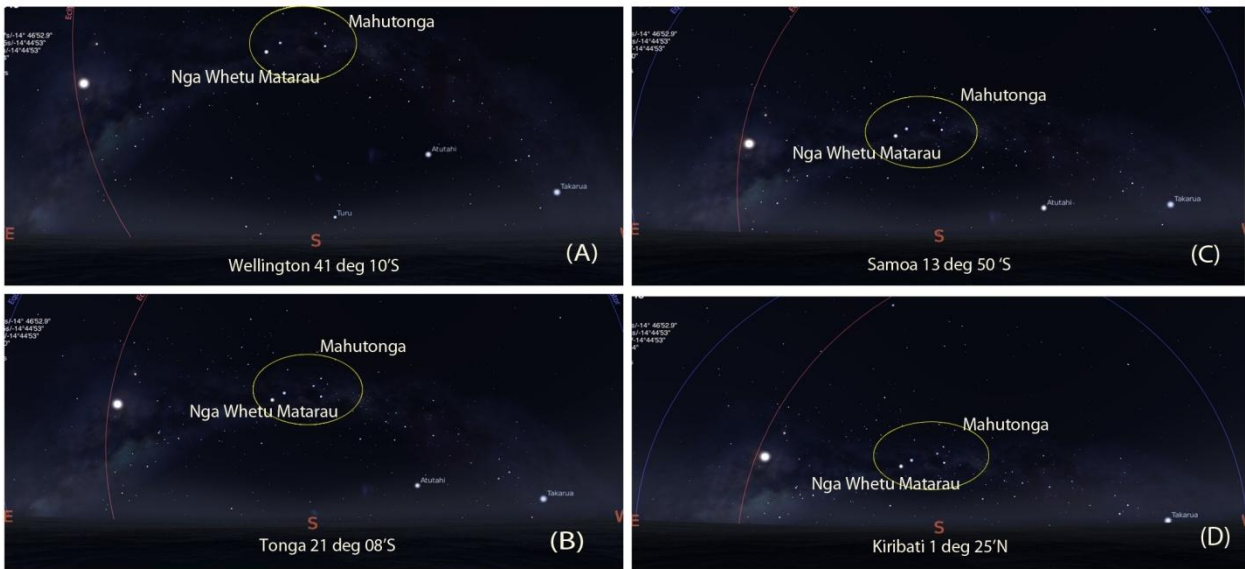


Figure 3: The shift in star positions with changing latitude. Stars to the south will get progressively closer to the horizon as one travels north.

27.32 days, which is its sidereal period. However, the Moon’s phases from one new Moon to the next take 29.53 days, and this is its synodic period. To the Māori, this was particularly relevant in tracking the lunar month.

In regards to how we view the night sky from different positions on the Earth, it is best to think of ourselves in a giant spherical bubble where the stars are fixed attached points. This bubble is called the celestial sphere. As we change our position on the Earth, for example moving in latitude from Aotearoa-New Zealand to Hawaii, different stars on the sphere will become visible and others will no longer be seen. If we look at the Pacific region and take a snapshot of the night sky at one time from four different positions on the Earth, Aotearoa-New Zealand, Samoa, Tonga and further north to Kiribati (these were chosen as they are approximately at the same longitude), we see that as we move northwards in latitude some stars to the south that were visible in more southern latitudes will now no longer be visible. This is because as we shift north over the curved surface of the Earth our horizon drops lower in the north and new stars will appear whilst to the south the horizon relative to the celestial sphere shifts higher. Figure 3 shows the snapshots of the stars for the four above-mentioned locations, and Table 1 shows the co-ordinates of the islands these sky views are associated with. *Mahutonga* is shown in the figure, which is the Southern Cross, and *Ngā Whetu Matarau* are the Pointers. As one moves

northwards from A to D in Figure 3 the Southern Cross gets closer and closer to the horizon. These concepts are particularly important when understanding celestial navigation techniques.

1.4 Celestial Names

The names for various celestial objects are given in Table 2, in both Māori and English. These only include the names of those planets which are visible to the unaided eye. It should be noted that names of celestial objects may vary from region to region within Aotearoa-New Zealand, so only a cross section of different names is presented in this table.

2 MĀORI ASTRONOMY

Māori astronomy impacted on many aspects of Māori culture, traditions and belief, from the origins of the Universe, to traditional calendrical systems, to the use of astronomy in language, architecture, agriculture and oceanic navigation. The extent to which astronomical knowledge impacted on pre-colonial life was impressive. This section discusses some of the more pertinent aspects of these areas to astronomy, which reflect a subset of current research which is being conducted by SMART researchers.

2.1 Cosmology: Origins of the Universe

Māori views on the origin of the Universe and life vary from tribe to tribe, but are still underpinned by thematic similarities. Many of the narratives start with *Te Kore*, the void, followed by *Te Pō*, the night, and lead to the creation of *Ranginui*, the sky father, and *Papatuanuku*, the earth mother. In many of the recollections of the creation of the Universe, it is said that *Rangi* and *Papa* produced more than seventy children (Pio, 1885-1901: 1187, Smith, 1913: 115). These

Table 1: Geographical co-ordinates for island nations in the Pacific.

Figure	Country	Latitude	Longitude
A	New Zealand	41° 10' S	174° 46' E
B	Tonga	21° 08' S	175° 12' W
C	Samoa	13° 50' S	170° 50' W
D	Kiribati	01° 25' N	173° 00' E

Table 2: Māori celestial names.

Māori Name	Western Name
<i>Autahi, Atutahi, Aotahi</i>	Canopus
<i>Puanga, Puangarua, Puaka</i>	Rigel
<i>Matariki, Tātai o Matariki, Huihui o Matariki</i>	Pleiades
<i>Waiti</i>	A star in Matariki
<i>Waitā</i>	A star in Matariki
<i>Tupu-a-nuku</i>	A star in Matariki
<i>Tupu-a-rangi</i>	A star in Matariki
<i>Waipuna-ā-rangi</i>	A star in Matariki
<i>Ururangi</i>	A star in Matariki
<i>Tautoru, Te Kakau</i>	Orions Belt
<i>Mahutonga, Te Taki o Autahi, Te Punga</i>	Southern Cross
<i>Taumata Kuku</i>	Aldebaran
<i>Ngā Whetu Matarau</i>	The Pointers
<i>Te Waka a Tamarereti,</i>	Tail of Scorpio
<i>Whānui</i>	Vega
<i>Poutūterangi</i>	Altair
<i>Putara</i>	Betelgeuse
<i>Rehua</i>	Antares
<i>Whakaahu</i>	Castor, Pollux
<i>Takurua</i>	Sirius
<i>Te Mangaroa, Mangoroa, Te Ika a Maui, Te Ika nui, Te Ika roa</i>	Milky Way
<i>Tamanuitera, Ra, Komaru, Mamaru</i>	Sun
<i>Marama, Mahina, Hina</i>	Moon
<i>Whiro</i>	Mercury
<i>Meremere-tū-ahiahi, Kōpū, Tawera</i>	Venus
<i>Papatuanuku</i>	Earth
<i>Rangawhenua</i>	Mars
<i>Pareārau, Hine i Tiwaka, Kopu nui, Wahine Tiwaka, Wahine Karihika</i>	Jupiter
<i>Rongo</i>	Saturn

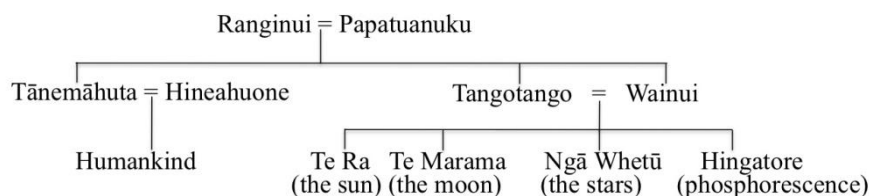


Figure 4: The relationship between humans and various celestial objects.

children were trapped between their parents as they embraced each other. The children's desire to get free led them to separate their parents against their will. The separation of *Rangi* and *Papa* is recalled in tribal recollections to have been finally caused by *Tāne Mahuta*.³ Following the separation of *Rangi* and *Papa*, knowledge was fetched from the uppermost realm of the sky parent. Included with this knowledge were the celestial beings, the Sun, Moon and stars.

The stars were perceived as beings, who were bound together as a family through a hierarchical structure. The lineage of the stars begins with *Rangi* and *Papa* and the union of their children *Tangotango* and *Wainui* (Best, 1922: 7). After the separation of *Rangi* and *Papa* narratives from Mataatua (Best, 1996: 748) state that *Tāne Mahuta* asked his siblings *Tangotango* and *Wainui* to give the children to him so that he could adorn their father, *Ranginui*. The children he wanted were *Tamanuiterā* (the Sun), *Marama* (the Moon) and *whetū* (the stars), and once he received them he sought the help of his relative, *Tamarereti*, who was the owner of a canoe called *Puna Ariki*. Three baskets were

placed in the canoe. The first two baskets contained the Sun and Moon, while the third basket contained the stars in the Milky Way (*Te Mangaroa*). Being the eldest of all the stars, *Atutahi* (Canopus) was suspended from the outside of the basket, and he remains the brightest star in the sky outside of the Milky Way. The *whaka-papa* (lineage) relationship between these celestial objects and humans is given in Figure 4.

2.2 Māori Traditional Calendars

From ancient times, civilizations have used the heavenly bodies to track the passage of time. The regular motions of the Sun, Moon and stars were used as clocks for agriculture, rituals, festivities and other activities (Aveni, 1983: 297). The Māori, too, used the observations of the stars, the Moon and the local environment to determine the time of the year and to predict various events.

For the Māori, the seasons of the year and the start of the year were measured by the heliacal rising and setting of stars. During the year certain stars or constellations were obscur-

ed from view for varying periods due to the position of the Earth as it orbited the Sun (see Section 1.3). *Matariki* (Pleiades) was such a star cluster, which was no longer visible in the night sky around April, and rose again in late May or early June. Therefore the Māori New Year was celebrated by the heliacal rising of *Matariki*, or *Puanga* (Rigel), depending on which region one lived in (Best, 1959: 12). Although *Matariki* has become increasingly popular nationwide for the celebration of the Māori new year, *Puanga* was used by the tribes in the far north such as the Ngā Puhi, to the west in Taranaki, in the central North Island around the Ruapehu area, as well as in the South Island where *Puanga* took on a dialect variant, *Puaka*. In these regions as part of a growing movement to revitalize this knowledge, *Puanga/Puaka* celebrations are held. According to *Mātauranga* Māori experts in the far north, the New Year starts during the first Full Moon called *Rākaunui* following the appearance of *Te Puanga*, and when the tide is incoming, called the *Taipari* (Rereata Makiha, pers. comm., 2013). As for *Matariki*, this seems to be recognized by the rest of the country as a New Year indicator.

The main seasons were known as *Raumati* (Summer), *Ngahuru* (Autumn), *Takurua* (Winter) and *Koanga* or *Mahuru* (Spring), and these seasons were signified by the appearance of certain stars and the changing path of the Sun during the year between its extreme solstice points on the horizon. Mahupuku (1854) describes how it was *Paaia* (the Milky Way) who placed certain stars in the sky to indicate to his siblings when certain seasons had arrived. He states that *Takurua*, *Wero-i-te-nihinihi* and *Wero-i-te-kōkota* are the stars that travel in the winter. He also describes *Makeo* and *Tautoru* (Orion's Belt), as stars that separate summer and winter.

The monthly calendar (*maramataka*) was based on the phases of the Moon. The beginning of the month was signified by the phase immediately following New Moon, as this was the time when the Moon was said to have died and gone to bathe in *Tāne te Waiora*, the life-giving waters of *Tāne*. The *maramataka* was instrumental in determining when to plant and harvest crops, as well as the appropriate times to hunt and fish for specific animals. It helped the Māori monitor seasonal changes, weather, migratory patterns of birds and fish, as well as enabling the accurate tracking of rituals and other important matters. There were many *maramataka*, as they varied from tribe to tribe. Recently, Roberts et al (2006) presented 43 published and unpublished *maramataka* from various tribes, and they found that within these the number of Moon nights per month varied from 28 to 32. The year, however, had 12 months (Best, 1922), therefore some sort of reconciliation had to

occur to synchronise lunar cycles with star risings at New Year. This occurred in other cultures which fine tuned their calendars to best synchronise the two by adding an extra (intercalary) month every couple or so years. Māori astronomers may also have added a 13th month from time to time (e.g. see Roberts et al., 2006: 16), but this still needs further investigation.

Within a *maramataka* information pertaining to fishing and planting was found, so it was an essential tracker for when it was time to go out and catch specific species of fish. Planting also was associated with the Moon, whereby plants needed to be planted on certain Moon nights and oriented in a certain way to ensure better growth. These planting techniques are used today by many people, both Māori and non-Māori, and especially by those seeking to return to traditional food-gathering and growing techniques. Prayers were also said to acknowledge the Sun, the Moon and the stars when planting and harvesting occurred, and this is discussed later, in Section 2.5.

2.3 Te Reo o Ngā Whetū: The Language of the Stars

Due to the oral nature of traditional Māori society, astronomical knowledge was often contained in mythology, rituals, incantations, songs and the arts of carving and weaving. Therefore, a unique genre of language pertaining to Māori astronomy developed, and examples of this language can be found within Māori idioms, proverbs, chants, songs, incantations and laments. This language uses naturally-occurring astronomical events to describe and discuss people or groups, their characteristics, behaviour and interactions.

References to the stars and the movements of the heavenly bodies can be found in everyday conversation. For example, the following phrase, "*Ka tō he rā, ka whiti he rā*" (Best, 1996: 801) literally means: "The Sun will set and the Sun will rise again." However, in a wider context it describes the never-ending progression of time. This phrase can be used to remind people that no matter how complex or difficult life can be, time will not cease.

When someone is referred to as *Pareārau wahine tiweka*, they are likened to a woman with questionable morals. *Pareārau* is the planet Jupiter, and to the Māori this planet is a woman. Unlike the stars that move across the sky in a predictable fashion *Pareārau* wanders according to her desires, and she might start her journey close to one star and end near to another (Best, 1996: 810).

There are a number of proverbs that mention stars and other astronomical events. These pro-

verbs take inspiration from the heavens, and apply the examples of the celestial bodies to human interactions. For example the proverb, “*E whai i muri i a Rēhua, kia kai ai koe i te kai.*” (Mead and Grove, 2007: 50), speaks of the greatness of the star *Rēhua* (Antares) in Scorpius. Loosely translated this proverb means: follow behind *Rēhua* in order to be fed. *Rēhua* is a chiefly star, located near to other smaller and less-important stars. This saying speaks of the benefits that others gain by befriending and positioning themselves near people of standing. It also is a term that can be applied to those who live on the reputation of others.

References to stars are often found in lamentations for the dead. In a particular sonnet for a deceased relative, *Tūhoe* songstress *Mihi ki te kapua* refers to the Pleiades and states:

I gaze up at the stars,
And the Pleiades are gathered together
Which gives rise to many thoughts
That well up within, and freely
Do the tears pour forth
And flow shamelessly from mine eyes.
(Ngata, 2007: 121-122; his English translation).

In another dirge from the Waikato region, *Tawera* (Venus) is very close to the Moon, or about to be occulted, and this is seen as an ill omen denoting death:

Breaks the dawn
And *Tāwera* (Venus) is biting (the Moon)
'Tis the dread omen of death.
(Ngata, 2007: 398-399; his English translation).

Likewise, references to the stars can be found in songs and phrases used to express feelings for a lover or a betrothed. The proverb, “*Mehe-meā ko Kōpū e rere ana i te pae*” (Mead and Grove, 2007: 295) translates to mean “like Venus as it appears over the horizon in the morning”, and is applied to an attractive person.

In her famous love song, Pakiri of the Ngā Puhī tribe likens the approach of her lover to the rising of Vega and Canopus:

Lo, Vega and Canopus
Have risen quietly o'er the horizon.
Silently too, did *Whatitiri* draw nigh;
Your stealthy hand reached out
And gently caressed this body of mine.
(Ngata, 2007: 162-163; his English translation).

The above quotes are a very small cross-section of examples that show how the astronomical knowledge of the Māori contributed to the development of a unique style of language. This particular language has been recorded to some extent within the numerous stanzas, laments, proverbs, traditional songs, prayers and sayings of the Māori. It is evident that a more detailed study of the language of Māori astronomy is needed to reveal the extent of this contribution to the Māori language.

2.4 Astronomical Alignments and Traditional Architecture

Astronomical alignments have been most famously linked to cultures such as the Inca and Mayans in which buildings and structures were orientated towards the Sun at certain times of the year such as the solstices or equinoxes (Aveni, 1983: 296). According to tradition, Māori meeting houses always faced the rising Sun. Houses needed to be positioned so that the Sun encroached upon the porch, and if this did not occur it was considered an *aitua*, or a sign of miscalculation that could lead to death. In some districts, such as on the East Coast of the North Island, this meant that the porches had an easterly orientation.

The creation narrative of *Rangi* and *Papa* formed the basis of the construction of a meeting house. The land on which it was placed was *Papa*, and upon her a raised structure was built, this being *Rangi*. The structure itself represented the separation of the Earth and sky by *Tāne*, and the creation of light and darkness.

The position of the Sun on the horizon from the winter solstice to the summer solstice and its pathway throughout the year was traditionally known as *Te Ara Whānui a Tāne*, or the broad path of *Tāne*. In stories of creation, this was the path that *Tāne* took each day when pursuing the dawn, *Hine Titama*, who continually fled from him towards darkness. Where the Sun rose and set were two primary spatial designations from which all subsequent orientations and calculations regarding building construction were made.

Te Ara Whānui a Tāne is also sometimes referred to as *Te Tāhuhu a Rangi* or the backbone of the sky parent *Rangi*. In pre-colonial meeting houses on the East Coast of the North Island, the Sun rose, then it travelled and descended along the backbone of the house. Also, central to the construction of the meeting house was the Milky Way, which in traditions was often referenced by its shape as a fish. The various names include *Te Ikaroa* (the long fish), *Te Ikanui* (the great fish), and *Te Mangoroa* (the long Mango shark). During the Māori New Year in mid-winter and at the time of the winter solstice the *tāhuhu* lay in the same position as the ‘great fish’ or ‘*Mau*’s fish’ in the sky. This significant representation was adorned as patterns on the ridge-beam of the meeting house. Extending from the ridge-beam or backbone of the sky were the rafters which connected to wall panels, which were sometimes carved to represent ancestors. In pre-colonial times the rafters were often painted in patterns that resembled shapes of star groupings that were observed in the sky. These patterns also related to foods and resources that were accessed seasonally by the tribe. A contemporary Māori artistic representation of the Milky Way is shown in Figure 5.

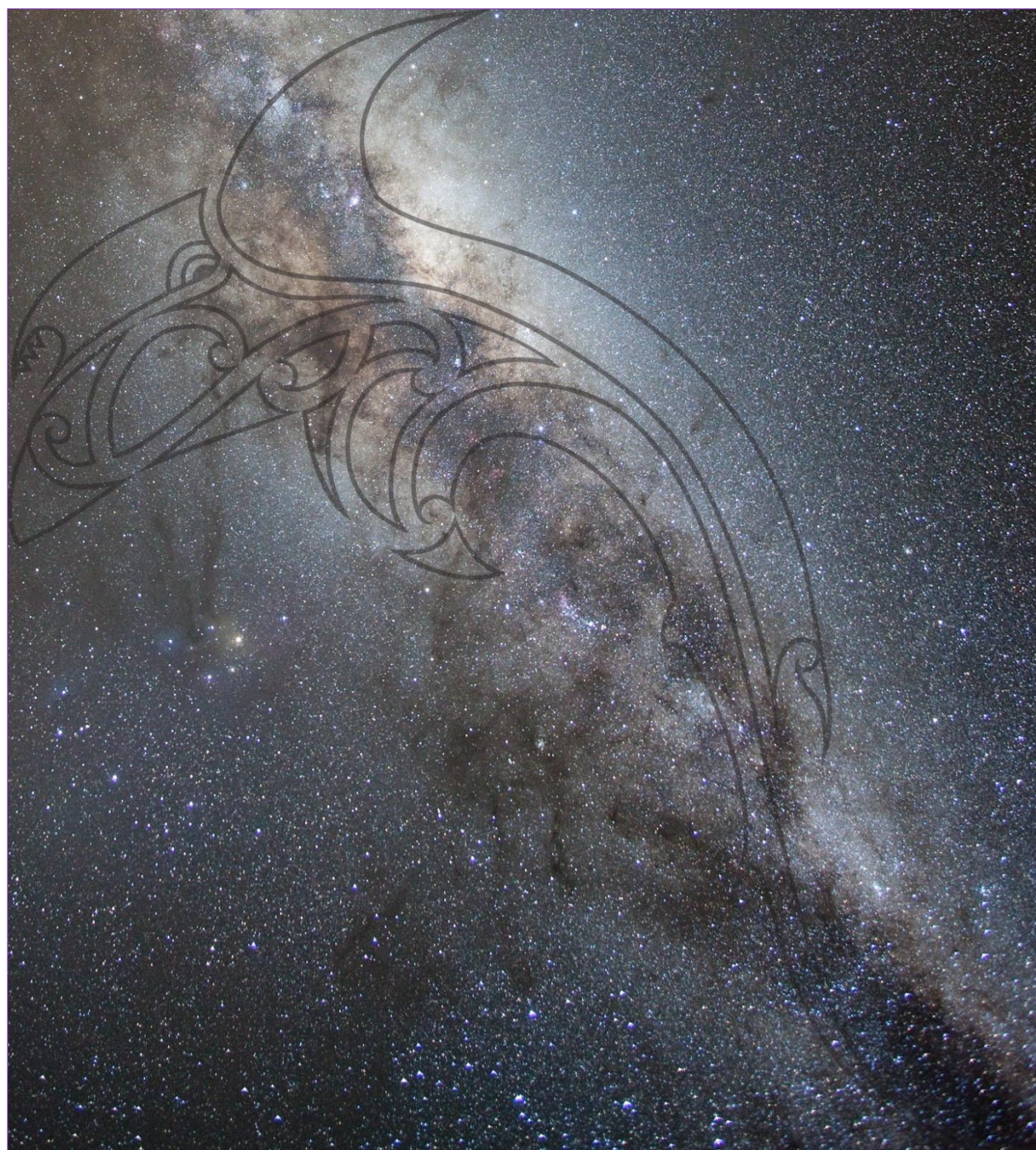


Figure 5: *Te Mangaroa*, the shark, and the home of the stars (the Milky Way) (image provided by SMART and illustrated by Kāterina Kerekere, with the photograph kindly gifted by Fraser Gunn).

2.5 Astronomy in Traditional Māori Growing Practices

The Sun, Moon and stars were an integral part to the growth cycle of plants and humans, with the Moon and stars in particular prevailing in this domain. In general, the Sun was the *mauri* (essence) that provided energy for growth in the realm of daylight (*te ao mārama*) and the Moon was the *mauri* which provided energy, warmth and nurturing for growth in darkness. However, the Moon and stars were the key factors during planting and incubation (Smith, 2011: 8).

The appearance of particular stars at a cer-

tain time of year acted as planting and harvest indicators. For example, during March and April such foods as *tuna* (eels) and *kūmara* (a type of sweet potato) were harvested, so they could be stored for the winter months. On the East Coast of the North Island, it was the appearance of the star *Poututerangi* that would coincide with the inspection of the *kūmara*, and the storage pits would be prepared, whilst in the Mataatua district *Whānui* (Vega) signalled the inspection for the *hauhakenga* (harvest). Hamiora Pio (1814–1901) of the Ngāti Awa tribe described how the *kūmara* came to Earth in the story of *Whānui* and *Rongo Maui* (Pio, 1885-1901: 1187). *Rongo*

Maui, who dwelt on the Earth, wanted some of the *kūmara* children of *Whānui*, and asked him if he could take them back to Earth. When the request was denied *Rongo Maui* kidnapped them leaving *Whānui* bereft and lamenting for his children. In revenge he sent down various types of grubs, such as the *Anuhe*, to destroy their harvests as punishment.

The Moon played a particularly important role in planting, in that certain phases were a more optimal time to plant than others. These particular phases were better in supporting the influence of the Moon on plant growth. Moon calendars, called *maramataka*, contained information about the suitable phases for planting and fishing. For example, a *maramataka* from the Ngāti Kahungunu tribe (Mitchell, 1972: 261-262) contains information for the phase following the New Moon called *Hoata*, which is a “Good day for planting and fishing, the moon is well shown ...”, or for the night *Tamatea-kai-ariki*, which is a “Bad day for planting and fishing, [as the] sea is disturbed by ocean currents.”

Each night contained these types of descriptions, which were specific to a particular region of Aotearoa-New Zealand. As described in Section 2.2, thus far 43 *maramataka* have been documented (see Roberts et al., 2006), but many more unpublished versions exist.

Along with planting at the correct time of year and lunar phase, tribes often used prayers or *karakia* in conjunction with planting and harvesting practices (Smith, 2011: 14). These *karakia*, for example, would be chanted to render the soil fertile (Pio, 1885-1901: 1187) or to protect the crops (Mitchell, 1972). The following excerpt is from a *karakia* to protect the crops from frost, and it acknowledges the stars *Atutahi* (Canopus) and *Takurua* (Sirius), which are among other stars found later in this *karakia*:

Tupurupuru, potential from beyond,
Ascending with the long Sky parent
Feed into the face of the present situation
Atutahi, potential from beyond
Climbing with the Sky parent
Feed into the face of the present situation
Takurua, potential from beyond.
(Smith, 2011; his English translation).

Detailed knowledge of the environment and ecology were needed to understand the optimal times for agricultural and hunting practices, and early ethnographic accounts of Māori growing practices often were veiled by colonial bias and a lack of in-depth understanding of the cultural context. Land loss also impacted greatly on traditional growing practices, as did discouragement by missionaries to practice pre-colonial *karakia* relating to crops (Smith, 2011: 3), so by the 1850's in many tribal districts the pre-colonial systems of growing and harvesting crops had already been abandoned in favour of the prom-

ise of economic prosperity associated with a European lifestyle.

2.6 Oceanic Navigation

Since the 1970's significant efforts have been made to revitalize Oceanic navigation techniques by the likes of Hekenukumai (Hector) Busby and others. They, along with other Polynesians such as Nainoa Thompson, have learnt and adapted knowledge from Mau Pialug, a *tohunga* (expert) from Satawal in the Caroline Islands, to produce a form of knowledge and skills resembling that of the first Māori who voyaged to Aotearoa-New Zealand. It is thought that following the main migration of the Māori to Aotearoa-New Zealand, exploration of this strange new land became a priority over return journeys to their ancestral homeland. Thus, knowledge of Oceanic navigation was lost after several generations, and would remain dormant for perhaps a thousand years. The renaissance of Ocean navigation was seeded by the earlier efforts to revitalize Māori art, crafts and canoe-building in the 1920's by Sir Apirana Ngata and Sir Peter Buck (Te Rangi Hiroa) and then later, in the 1930's, by Princess Te Puea, who initiated a canoe-building project for the 100th anniversary of the Treaty of Waitangi (Matamua et al., 2013). This later project brought together master canoe-builders, and taught a new generation of young Māori the skills needed to continue this craft.

Successful Oceanic navigation requires a knowledge of the Sun, the stars, currents, cloud formations, wave patterns and the migratory behaviour of birds and sea life (Howe, 2008; Matamua et al., 2013). This, in combination with years of accumulated experience and a sense of inherent knowing, can enable a captain and the crew to safely arrive at their destination.

The celestial component of Oceanic navigation relies on knowledge about the rising and setting of particular stars during a journey. These rising and setting stars are measured by the type of ‘star compass’ shown in Figure 6. These star compasses are split into sections, called houses, and are based on the view of the horizon from the *waka* (canoe/boat), which is located at the centre of the compass. By understanding where particular stars rise and set, the navigator can steer in the right direction.

Stars that appear directly overhead are called zenith stars, and they can be used to identify the latitude and thus help identify a component of a particular island's position. But due to the rocking of a boat it sometimes is difficult to identify zenith stars, so instead the angular displacement of certain stars that appear above the horizon near the north and south celestial poles is used to provide a more accurate indication of latitude. Examples of how a star's angular dis-

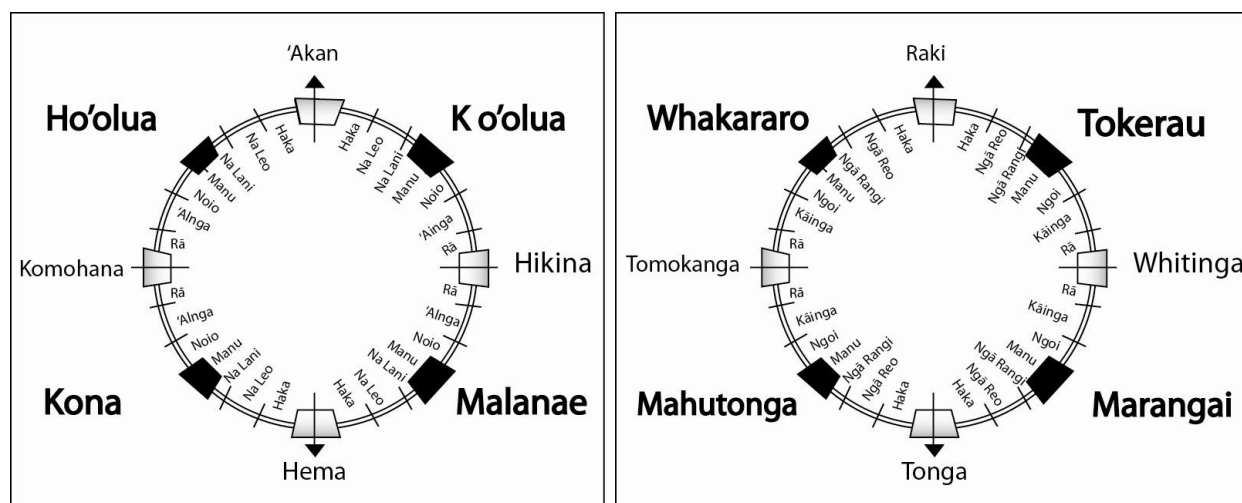


Figure 6: The Hawaiian (left) and Māori (right) star compasses used in navigation (image reproduced from Te Aurere Education Package, Rarotonga–Aotearoa 1995 Voyage).

placement above the horizon varies with latitude was discussed in Section 1.3.

The Sun is used to steer during the day, the rising Sun indicating the general direction of east, while the Sun sets in the west, but within a two month period the Sun can move up to two houses. Typically journeys from Aotearoa-New Zealand to Tahiti would take about 3.5 weeks, so during this interval the Sun and stars would drift into other houses and this needs to be allowed for when travelling between these islands.

Celestial navigation has captured the hearts and imagination of many an enthusiast, and these masterful experts continue to revitalize this old tradition. For many years navigation schools in Aotearoa-New Zealand and Hawaii have been training the next generations of navigators, so this knowledge base seems now to be in safe hands and to be steadily heading in a successful direction.

3 DISCUSSION AND CONCLUDING REMARKS

Māori astronomical knowledge permeated much of Māori life, culture and traditions. From the origins of the Universe, to the tracking of time, to the planting and harvesting of food, the Sun, Moon and stars were no doubt an important and substantial part of Māori knowledge. With more than two hundred years of colonial and global contact, disease, displacement from traditional lands, and an education and legal system aimed at assimilation, Māori knowledge, culture and traditions have undergone significant loss.

In a time of renaissance, the Māori have endeavoured to revitalize their knowledge of language, medicine, song, dance, carving, weaving, science, and now astronomy. The formation of language nests and Māori schools to ensure the survival of the Māori language; Māori universities to ensure educational success of

Māori communities; carving and weaving programs to bring back the ancient arts and crafts; the use of Māori medicinal practices to cater to Māori health needs; and revitalizing the practice of celebrating the Māori New Year, have all sparked the establishment of research around the country into Māori astronomy.

As groups such as SMART endeavour to research astronomical knowledge we see researchers from academia and communities collaborating in this effort of reclamation. As Māori communities engage in dialogue, the celestial knowledge of the past continues to emerge, enabling researchers to record details that were hidden from the early ethnographers, thus countering Best's claim that all sources of information on Māori astronomy have been exhausted. Clearly, further investigation of this vital and exciting area of Māori knowledge and practice is warranted.

4 NOTES

1. 'Aotearoa is the most commonly-used Māori name for New Zealand, and is usually translated as 'The Land of the Long White Cloud'.
2. 'Pākehā' refers to the non-indigenous people of Aotearoa-New Zealand who predominantly are descendents of people who originally came from Europe or Great Britain.
3. *Tāne Māhuta* was the god of the forest and creator of human kind and one of the children of the great sky father *Ranginui* and the earth mother *Papatūānuku*.

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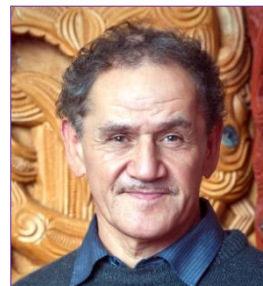


where she is dedicated to searching for extra-solar planets and the collation and revitalization of Māori astronomical star lore. Pauline has been involved in the revitalization of Māori star lore for the past ten years, giving many talks pertaining to Māori astronomy and *Matariki Puanga* in Aotearoa-New Zealand and overseas. She currently is the Chairman of the Society for Māori Astronomy Research and Traditions (SMART).

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to passing on the spirit, traditional knowledge and confidence of the early way-finders to *rangatahi* (youth)

and is committed to enhancing their sense of identity and self esteem.

Toa Waaka is a Mātauranga Māori specialist in *Tatai Arorangi* (Māori astronomy). He studied Māori Anthropology papers at Auckland University of Technology and plans to complete his Masters degree at Te Wānanga O Raukawa, majoring in Māori Cosmology and Astronomy. Over the past fifteen years Toa has worked as a cultural adviser to the Auckland City



Council and various other organizations. In particular, he was involved in the refurbishment of the Carter Observatory in Wellington between 2007 and 2008. In 2010, Toa was recognised by UNESCO and the International Astronomical Union for his commitment and outstanding contribution to the success of the International Year of Astronomy (2009) in Aotearoa-New Zealand.