



**RAPANUI
ARCHAEOASTRONOMY
&
ETHNOASTRONOMY**



Photo J.A. Belmonte

**FLAG #83 EXPEDITION REPORT
February-June, 2010**

By

EDMUNDO EDWARDS and ALEXANDRA EDWARDS

Expedition Team



Explorer's Club Flag #83 Expedition team 2010 next to a *Tupa* in Hanga Roa.
From left to right: Gonzalo Rojas, Edmundo Edwards, Margarita Riroroko, and Alex Edwards
Not pictured: Juan Antonio Belmonte, José Belmonte, Lynn Danaher, Roberto Glaría, and Jaime Riroroko

Our project was completed between February and May 2010 with team members arriving in different shifts to complete their specific assignments and tasks. For this reason we were unable to photograph our team members all together. Several team members were reprising their roles from previous Explorer's Club Flag expeditions; fieldworkers Margarita Riroroko and Jaime Riroroko, as well as video operator and post production editors Gonzalo Rojas and Roberto Glaría participated in a Flag Expedition to Papua New Guinea in 2008 (Flag #83), while field assistant Alex Edwards and office and field manager Lynn Danaher worked in the Raivavae Archaeological Project Flag Expedition in 2006 (Flag #95). Archaeologist and project director Edmundo Edwards led all these expeditions welcoming the much-needed expertise of astronomer Juan Antonio Belmonte and his brother physicist and volunteer José Belmonte for the 2010 Explorer's Club Flag #83 Expedition to Rapa Nui (a.k.a. Easter Island).



Edmundo Edwards (#95, #83)
Archaeologist & project director



Lynn Danaher (#83 #95)
Logistics manager and PIRI President



Juan Antonio Belmonte
Astronomer



Margarita Riroroko (#83)
Field & logistics assistant



Alex Edwards (#95)
Field assistant & notes writer



Gonzalo Rojas (#83)
Video operator & editor



Jaime Riroroko (#83)
Field assistant & translator



Roberto Glaría (#83)
Video post-production manager



José Belmonte
Field assistant & volunteer researcher

Introduction

Some 3,500 years ago in a span of about 500 years, the Lapita, the ancestors of the Polynesians, used their knowledge of the stars to settle an area 4,300 km wide in what is considered one of the speediest human expansions of the pre-historic world. Their descendents, the Polynesians, eventually settled hundreds of islands crossing millions of square kilometres of water without navigational instruments, guided by nothing more than complex astronomical observations and an understanding of natural signs. The navigators or wayfinders were undeniably skilled specialists who passed astronomical information from one generation to the next for over three thousands years. However, the observation of astronomical phenomena was not limited to navigation and served a far more important function carried out by powerful astronomer priests: to establish a cycle of yearly activities, where the heliacal and cosmic rising and setting of specific stars and asterisms determined when to plant and harvest different cultigens, when the deep-sea fishing season started and ended, and when to carry out their many religious and social activities. The same as their counterparts in other Polynesian islands, the Rapanui sometimes built ceremonial platforms (*ahu*) with an astronomical orientation and set up observatories in places that were especially favourable for studying astronomical events. They had names for celestial phenomena such as comets and meteorites as well as for the sun, the moon, some planets, and several greater and lesser stars, all of which were used individually or in combination to calculate time or for reckoning when out in the open ocean.

For the Polynesians the stars, planets, and constellations were the dwellings of supernatural and immortal beings that resided there from the beginning of time. The number of stars known to them was impressive; Anthropologist Maud Makemson recorded the names of 772 stars and constellations as well as several astronomical terms while working in different Polynesian islands. The Rapanui must have undoubtedly shared this knowledge although it was lost in the past 300 years and it is difficult for ethnographers to reconstruct what now rests in fragments. At the time of European discovery in 1722, inter-island travel had been abandoned in Rapa Nui and there were no navigators left, while the diseases that decimated the population in the mid to late-1800's only helped exacerbate the problem as many specialized priests died taking their knowledge and skills with them. After the simultaneous arrival of Catholicism, anything related to the ancient religion was branded as paganism; the Gregorian calendar was adopted and new religious festivals replaced the old while Rapanui astronomical knowledge was reduced to whatever elements were useful to fishing. By the mid-1960's, only a few elders (mostly fishermen) retained the knowledge passed down to them from their ancestors and remembered where some observatories were located, however, most of the details were forgotten. Although ethnographer Katherine Routledge collected information regarding the ancient Rapanui's astronomical observatories in 1914-1919 and archaeologist William Mulloy and astronomer William Liller studied the relationship between the Rapanui's understanding of astronomy and their megalithic constructions in 1965-1968 and 1989-1993 respectively, Rapanui archaeoastronomy and ethnoastronomy have garnered little attention from the scientific community and the subject remains

obscure particularly when placed in an ethnographic context.

In addition to collecting oral traditions that mentioned stars and asterisms that were important to the Rapanui, such as Antares, Sirius, the Pleiades, and Orion's belt, Routledge also recorded the existence of a cave between Ahu Okahu and the Catholic Cemetery, that was used as both an observatory and a school for aspiring astronomer priests, as well as a stone outcrop with several fishhook petroglyphs on Poike Peninsula named Papa ui hetu'u (the rock for star-gazing). Routledge was told that there were several kinds of astronomer priests and that some were responsible for watching the rising of the Pleiades and Orion's belt from Papa Ui Hetu'u in the lunar month of *Tuaharo* (January/February). Routledge later found what she called a "star map" consisting of a boulder with several cupules about 200 metres from the "star-gazing" rock. Routledge also mentioned that *Tupa* (stone structures shaped like conical towers) may have been used as astronomical observatories. On the other hand, Liller's work, considered the most reliable source on Rapanui astronomy, builds upon Mulloy's earlier archaeological observations, suggests that although most *ahu* are topographically orientated, as many as 20 of those near but not parallel to the coast seem to be oriented to the equinoxes or solstices, the same as those located inland (i.e. at least 500 m from the coast). Interestingly, the *ahu* with astronomical orientations are also some of Rapa Nui's finest megalithic constructions (Ahu Tongariki, Ahu Akivi, Ahu Tepeu, Ahu Ra'ai, Ahu Vinapu I and II (Tahiri), and Ahu Heki'i I and I). Liller also found an astronomical observatory at Orongo (using Poike's peak as an indicator for the June solstice) and a "solar ranging device" in Ahu Huri a Urenga (marking the June solstice and and/or both equinoxes). Liller proposed that the ancient Rapanui used the equinoxes and solstices for either ceremonial or calendrical purposes.

In 1983, archaeologist Edmundo Edwards obtained Routledge's unpublished field-notes, which had been stored in dust-covered boxes in the Royal Geographical Society since 1917. Although Edwards believed that Polynesians must have had devices to measure time using astronomical events and that some of their ceremonial structures may have been astronomically oriented, he was suspect of Mulloy's and Liller's interpretation of solar-oriented structures in Rapa Nui because solar cults are completely absent in Polynesian ethnographic literature and none of the hundreds of ceremonial sites Edwards had recorded and mapped in the Society, Australs, and Marquesas islands were particularly solar-oriented. After years of careful inspection of Routledge's unpublished notes, Edwards was able to generate a comprehensive interpretation of the Rapanui lunar calendar and ritual cycle of activities. However, in light of the new evidence, a re-assessment of Rapa Nui's astronomically-oriented structures seemed reasonable. In July 2003, Edwards met with astronomer Juan Antonio Belmonte to conduct a comparative in-depth study of Rapa Nui's existing ethnographic material and astronomically oriented religious platforms, to update and re-evaluate Mulloy's and Liller's works if necessary. Upon close inspection of relevant ceremonial sites, Belmonte fuelled Edwards' reservations of previous studies by observing that most solstitial alignments were better interpreted as being oriented to the Pleiades and most equinoctial orientations may have easily been aligned to Alnitak the star at the centre of Orion's belt. They also studied religious platforms whose names suggested they were used to mark astronomical events,

as well as the “star-gazing” rock and the “star-map” recorded by Routledge, which according to Belmonte’s and Edwards’ interpretation is a physical representation of the Pleiades, one the most important asterisms for the Rapanui and Polynesians in general. This was followed by a comprehensive analysis of ethnographic sources regarding how the Rapanui calendar was derived from astronomical observations and how the heliacal and cosmic risings and settings of different stars and asterisms regulated the annual cycle of activities. Edwards and Belmonte published their results in 2004-2005 invariably challenging the works of authors who argue that some Rapanui megalithic structures are solar-oriented.

Lack of time prevented Edwards and Belmonte from fully studying the astronomical and ethnographic role of the *Tupa* “observatories” and other seemingly astronomically aligned conical markers called *pipihoreko*. More importantly, the report did not examine how the Rapanui may have interpreted well-recorded historical events in lieu of the activities demanded by specific astronomical phenomena and their annual cycle of events. These are two of the three objectives of the Explorer’s Club Flag #83 2010 Expedition to Rapa Nui. Over the last year Edwards and Belmonte have concentrated their efforts to continue their study of Rapa Nui archaeoastronomy and ethnoastronomy for a more comprehensive understanding of the Rapanui’s knowledge of the stars and how astronomical events helped shape their cultural identity. Between May and June, Belmonte and Edwards were able to locate, assess, and corroborate the astronomical function and ethnographic importance of several previously unrecorded (or insufficiently recorded) astronomical structures (most notably the *Tupa* structures) mentioned in Routledge’s unpublished notes and other ethnographic sources. Edwards also places the arrival of the first explorer’s within the context of the Rapanui’s yearly cycle of activities, proposing an interpretation with far-reaching implications that merit further study. The last objective of the Explorer’s Club Flag #83 Expedition to Rapa Nui was to record an hour-long documentary detailing the results of Edwards’ and Belmonte’s findings and offer a comprehensive and entertaining approach to one of Rapa Nui’s least-known aspects in a media popular and attractive to today’s public. After a few setbacks because of unrelated circumstances, the not-for-profit HD documentary shot by Gonzalo Rojas is now in the post-production phase and will be privately released in early 2011 once its promotion and distribution are properly arranged.

Rapanui Archaeoastronomy and Ethnoastronomy

All the planets, stars, and asterisms (some of which comprised up to seven “stars”) were called *hetu’u* in Rapa Nui since the Rapanui did not distinguish planets from stars and asterisms from constellations. “Stars” that were exceptionally bright were called *hetu’u pupura*. The principal stars for the Rapanui were Veri hariu (Vega), Te pou o te rangi (Sirius), Po roroa (Canopus), and Rei a tanga (Antares), as well as several asterisms: Kete (Aldebaran, Deltha, Tetha, and Epsilon Tauri), Matariki (The Pleiades), Nga Vaka (Alpha and Beta Centauri), and Tautoru (Orion’s Belt). Of these asterisms Orion’s belt and the Pleiades seem to have been the most important since they determined when major Rapanui ceremonies and festivals took place. It is interesting to note that Orion had three different names in Rapanui, one for the constellation, one for the belt, and another for

Rigel, one of its main stars. Certain stars disappear from the night sky sometimes for several months as their rotation course leads them to rise during the daylight hours when they cannot be seen. In Rapanui the time during which a star was not visible was called *hitu*. The Rapanui, like all Polynesians, used these phenomena to measure time so that specific festivities, ceremonies, and seasons started (or ended) coinciding with when particular stars appeared or disappeared from the night sky. The traditional Rapanui names for several stars, planets and asterisms appear in Table 1 below together with the many annual festivities, ceremonies, and events they marked. Unfortunately the list is incomplete as it consists of ethnographic data collected by Routledge, Edwards, and others mostly from, fishermen and elders, who still remembered only part of what surely must have been restricted to specialized navigators and astronomer priests in the past.

TABLE 1: The major Rapanui stars and asterisms and what they signalled

Rapanui name	Translation	Star/Asterism	Comments
Hetu'u ahiahi	Evening star	Venus	
Hetu'u popohanga	Morning star	Venus	
Matamea	Red eye	Mars	It was studied from an observatory in Poike and marked the biennial Koro festivals. It may have been a bad omen.
Te ngo'e	The <i>ngo'e</i> , a fabulous marine creature	The Milky Way	
Veri hariu	The stunning worm/centipede	Vega	Marked the opening of the eel fishing season and ritual tattooing at Orongo ceremonial village.
Ko toe ko peu renga	The remnants of the fine pickaxe/energy	Menkalinan & Capella	
Te hau vaero	The headdress made of rooster tail feathers	Castor and Pollux	
Matariki	The small eyes <i>or</i> the chief's eyes	The Pleiades	The foremost asterism for the Rapanui (see Table 2).
Tauroru	The 3 handsome ones	Orion's belt	These stars together with Sirius welcomed the winter season and were key to the Paina festivals (see Table 2). They represented a supernatural being and his 2 sons.
Tau ahu	Beautiful firebrand	Rigel	The dead wife of the former.
E tui	The expelled	Orion	For the Rapanui this constellation consisted of 6 stars.
Te pou o te rangi	The post of the sky	Sirius	Together with Orion's belt they marked the winter season.
Tau a aru ahu	2 beautiful firebrands	X & Y CMa	Two undetermined bright stars in the area of Canis Major.
Taura nukunuku	Nukunuku's rope	Procyon & Gomeisa	
Po roroa	The great darkness	Canopus	A very important star that with Orion's belt marked the Paina festivals (see Table 2) and the planting season.
Veri koreha	The giant eel	Fomalhaut	
Rei a tanga <i>or</i> Ko Pu Tui	Tangaroa's breastplate <i>or</i> The outcast's hole	Antares	This was probably an important star since it crosses the island's zenith.
Nga Vaka	The canoes	Alpha & Beta Centauri	These stars may have been important for navigation and represented the 2 canoes used by brother and sister Hotu Matu'a and Ava Rei Pua, Rapa Nui's legendary founders.
Mata Te Tauroru	The eyes of the 3 handsome ones	Stars in Crux	The 3 brightest stars of the Southern Cross.
Te Tatauro	The cross	Crux	A modern name for Crux.
Po Orongo	Orongo's darkness	Achernar	
Nga Toa Rere	The flying sugarcane	Ursa Major	
Nga Rau Hiva	The leaf from Hiva	The Hyades	Hiva was the home of legendary founder Hotu Matu'a.
Ko Para Tihiri	Tahiri's club	Arcturus	
Ko Te Mata Pu Nui	The eye with a big hole	Spica	
Kete	The basket	Aldebaran, Deltha, Tetha, & Epsilon Tauri	Four stars that announced abundance.

The Rapanui Stellar/Lunar calendar and the Cycle of Yearly Activities

In all of Polynesia, the calendar and annual cycle of activities were associated with a local subsistence system based on a horticultural cycle determined by wet and dry periods and the arrival of seasonal resources. The fact that Rapa Nui is located South of the Tropic of Capricorn means that the arrival of migratory birds and offshore fish usually occurs during the spring or early summer months and the wet and dry seasons are reversed as compared to Polynesian Equatorial islands. Rapa Nui's marine environment was not only different from those of most Polynesian islands, but also poorer because of its extreme isolation. The island's first settlers had to adapt their calendar to their new reality, thus the Rapanui calendar is subject to the meteorological and ecological conditions related to the cultivation of yams and sweet potato, the Rapanui's most important cultigens because they grew best in this colder, more southerly island.

The Pleiades, one of the night sky's most notable constellations, was the most important to all Polynesians since it marked the start of the new lunar year, a custom that may have been practiced for over 2,500 years. Because of the islands' different locations, not all Polynesians celebrated the new year on the same date. The Rapanui actually adapted their lunar year so that the ritual cycle and the horticultural cycle coincided and the wet months fell on the southern winter and the dry months in summer; with this conversion, the Pleiades also marked the start of the bountiful season (Hora Nui) in all of Polynesia. The Rapanui annual cycle of activities was called "The Work of the Gods" and began with the first full moon after the heliacal rising of the Pleiades on June 16th; the calendar was divided between rainy and dry seasons during which the rising and/or setting of particular stars indicated when the chiefs were supposed to carry out rituals to petition the family gods for successful harvests and the return of migratory birds, turtles, and fish. On Rapa Nui the deep-sea fishing season and the bountiful period started with the cosmic rising of the Pleiades in mid-November and inversely the Pleiades' heliacal setting in mid-April (when they disappeared from the sky) marked the end of these two seasons, which was sometimes followed by a period of intermittent warfare. All this information is detailed in Table 2, where The Pleiades and Orion stand out as markers for some of the Rapanui's most important annual activities and events (see Table 2, next page). It is important to note that because the Rapanui months started on the night of the full moon they hardly coincide with their solar counterparts in the Gregorian calendar. A depiction of what may represent a lunar cycle can be observed in Illustration 1.

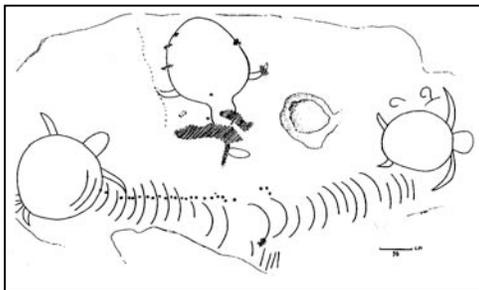


Illustration 1: Turtle petroglyphs on a rock called papa mahina (rock of the moon). The 28 incised crescents may represent a lunar cycle.

TABLE 2: “The Work of the Gods” or the Rapanui Cycle of Yearly Activities

Rapanui Lunar Month	Season	Cultural and Astronomical Event (H: heliacal; C: Cosmic; R: Rising; S: Setting)
Anakena (July/August)	Tonga Nui	Considered to be the first lunar month of the year (counting upwards from 0 to 1). Anniversary of legendary founder Hotu Matu’a’s arrival to the island.
Hora Iti (August/September)	Hora Iti	The sooty terns arrived to nest between the 7th and 10th of September. The Tangata Manu (Bird-man) competitions took place at Orongo & Motu Nui.
Hora Nui (September/October)	Hora Nui	The Bird-man competitions ended and the winning faction began their search for sooty tern chicks in Motu Nui. The Bird-man went into seclusion.
Tangaroa Uri (October/November)	Hora Nui	The bountiful season (Hora Nui) began when Matariki (The Pleiades) appeared for the first time after twilight (CR Nov. 16th). The deep-sea fishing season opened, and a first fruits ceremony called Te Vai Hakairi o te Ariki took place after the first yam harvest. Rituals in honour of the chiefs and ancestors took place.
Ruti (November/December)	Hora Nui	The Paina festival started when Tautoru (Orion’s Belt) was high in the night sky (CR Dec. 1st) and either Alpha or Beta Centauri set in the West. The sweet potato harvest started in full.
Koro (December/January)	Hora Nui	The Koro festival began when Tautoru (Orion’s belt) and Matamea (Mars) appeared in the night sky. Since Mars has a synodic period of 780 days (two years and 50 days) it would appear that the Koro festival was celebrated biennially.
Tuaharo (January/February)	Hora Nui	The Paina festival ended when Po Roroa (Canopus) appeared for the last time in the sky at dawn (CS Feb. 14 th). Matariki (The Pleiades) would be in the meridian at sunset on February 20.
Te hetu’u (February/March)	Tonga Iti	The first complete lunation indicated the commencement of the bleakest season (Tonga Iti) and changes in the weather were expected.
Tara Hau (March/April)	Tonga Iti	The disappearance of Matariki (The Pleiades) before the crescent of Tara Hau (HS April 18th) signalled suffering for humankind. The deep-sea fishing season ended and warfare began.
Te Vai Tu’u Nui (April/May)	Tonga Iti	The planting season began with the rising of Po Roroa (Canopus) before sunrise (HR May 21st) and the eel-fishing season started when Veri Hariu (Vega) disappeared at dawn (CS May 30th). Eels were fat and plentiful at this time and sea urchins have larger gonads.
Te Vai Tu’u Potu (May/June)	Tonga Iti	The rising of Matariki (The Pleiades, HR Jun. 12th) and the setting of Tautoru (Orion’s belt, HS June 6th) started the countdown for the new year (after the first complete lunation). <i>Pua</i> (turmeric) was harvested and made into <i>renga</i> (body paint). Offerings of turmeric were made to the paramount chief.
Te Maro (June/July)	Tonga Nui	The new year started once the first lunation after the rising of the Pleiades (HR Jun. 12th) and the setting of Orion’s belt (HS June 6th) was complete (which probably included the winter solstice on June 21 st). The paramount chief authorized the organization of the Tangata Manu (Bird-man) Cult ceremonies with the apparition of Orion’s belt (HR June 22nd). Ritual tattooing took place at Orongo ceremonial village with the appearance of Vega (CR July 27th).

The information from the Table above indicates that the correct observation of stars and asterisms, and the Pleiades in particular, was essential for the ancient Rapanui. However, it was evidently very important to also know how to correct the inherent seasonal and chronological shortcomings of a lunar calendar; a lunar month has 29.54 days so that a lunar year consists of 12 lunation's totalling 354.48 days as opposed to the 365.2 days in a solar year. These tasks were carried out by specially trained astronomer priests called *Tohunga*, who observed the movements of the stars and moon and accordingly adjusted the Rapanui lunar calendar establishing the cycle of yearly activities. A possible “lunar calendar” may be observed in Illustration 2 below. According to oral traditions collected by Routledge there were several kinds of astronomer priests, each with a specific skill and or duty. Some of them studied the tides and other meteorological phenomena providing weather forecasts and predicting seasonal variations that benefited farmers and fisherman. Routledge’s informants stated that specialized priests lived in circular stone towers called *Tupa* that were used to announce when turtles returned to the island. Routledge thought her informants meant that these priests climbed on top of the *Tupa* to literally “see” the turtles swimming towards the island and called these structures “turtle watchtowers.” However, because some of them are located far inland and are clearly inadequate as lookouts, it seems more likely that what Routledge’s informants meant was that astronomer-priests climbed on top of the *Tupa*’s roofs to observe the sky, and determine when the turtles would come by observing the stars that heralded their arrival. Routledge was also told that astronomer priests congregated in specific places on the eastern flank of Poike peninsula during certain times of the year to make astronomical observations. Therefore, one of our expedition’s main objectives was to relocate these structures and determine whether they actually served as astronomical observatories and what specific astronomical events may have been observed from them.

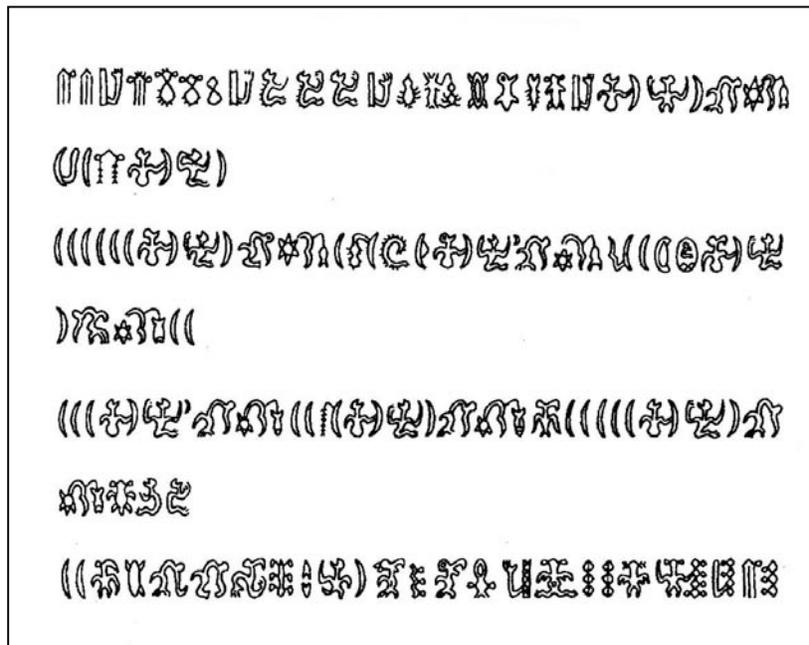


Illustration 2: Rongorongo tablet with crescents that may represent a “lunar calendar.”

The Explorer's Club Flag #83 Expedition to Rapa Nui

1. Astronomical Observatories and Structures

Tupa Stone Towers And Their Use As Astronomical Observatories

Although stone towers called *Tupa* may be found in several parts of the island they proliferate on the Rapa Nui's North coast, particularly in the half closest to Poike Peninsula, which according to oral tradition was one of the most optimal places for observing the stars. Interestingly, there are also several small stone markers called *pipihoreko* near the places where many *Tupa* now lay in ruins (see Photo 1). Our goal was to map these *Tupa* and see what astronomical observations they favoured, if any.



Photo 1: A *Tupa*, on the left, and a couple of *pipi horeko*, on the right, near Ahu Ra'ai.

It is difficult to determine exactly how many tupa structures exist on the island. Father Sebastian Englert recorded 7 *Tupa* near Hanga Nui Bay in 1946; however, these were destroyed by a tidal wave on May 21st 1960 while our team was unable to locate another previously registered by him in 1946. In 1984 while working on Rapa Nui's archaeological survey, Edwards registered two round *Tupa*-like towers located inside the Tupahotu clan's territory in Quadrangle N°31. However these were not included in our study for lack of ethnographic evidence. A few more *Tupa* lie on the island's South and West coasts in areas not yet inventoried in Rapa Nui's incomplete archaeological survey. Our expedition considered a total of 18 different structures located in different parts of the island that ethnographic sources indicate were *Tupa*. We expect to continue studying and locating more *Tupa* in the future in order to gain a better understanding of Rapanui archaeoastronomy and ethnoastronomy.

Our study found that all but one of the *Tupa* we studied were built with a specific orientation: either their entranceways were directed to a star or asterism that marked an important event in the Rapanui annual cycle of activities or they were built on a North-South or East-West axis orientation. Considering that the overwhelming majority of the structures we registered have an astronomical orientation, it seems that the *Tupa*

evidently were used as astronomical observatories and their orientation is not accidental. Using all the ethnographic data collected by Edwards, Routledge, and others we were able to link some of the Rapanui calendar's most important activities to the astronomical events observed in 17 of the 18 *Tupa* we studied.

In addition to the ethnographic value of our expedition, we also discovered that although all *Tupa* served the same function and most of them were built the same way this was not always the case. Sixteen of the *Tupa* we registered had a circular or oval floor plan with a rounded wall and a flat roof. The two other *Tupa* differ significantly from the rest and consist of a long narrow stone structure with a cantilevered roof similar to the houses found in the ceremonial village of Orongo. One of these seems to have a complex relationship with different nearby landmarks that may have been used to observe the movement of the stars and probably accounts for this *Tupa*'s very different shape. We recorded 16 *Tupa* built near the coast or right by the shore while only 2 were located further inland. The complete results of our study are detailed in Table 3 (see Table 3).

A. Round Tower-Like *Tupa*

It seems that the vast majority of Rapa Nui's *Tupa* were round and tower-like. Illustration 1 shows islanders standing on top of an archetypical *Tupa* on the island's North coast during the expedition of Jean-François Comte de La Pérouse in 1786 (see Illustration 3). Our expedition registered 16 of these structures. The 7 *Tupa* previously recorded by Englert as well as the one we were unable to locate were all of this type, meaning that only two of all 26 of these *Tupa* had a different shape.

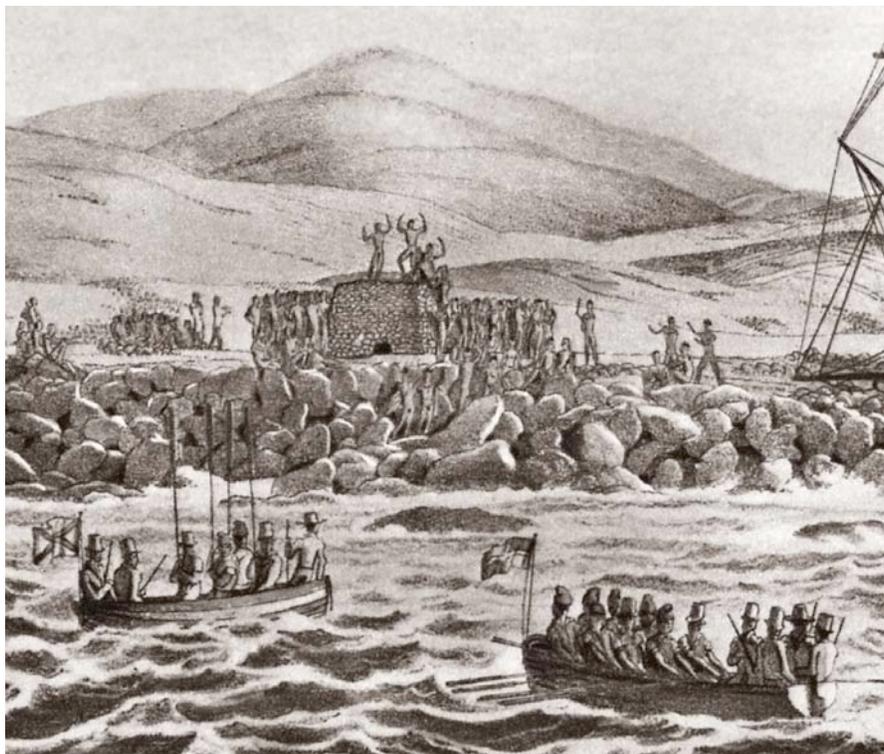


Illustration 3: Engraving showing a *Tupa* in La Pérouse's *Voyage autour du monde*, 1797.

The round tower-like *Tupa* are quite simple consisting of a small chamber with a vaulted roof. The entranceways are strait, low, and narrow so that one must crawl in and out of the structure, a feature common to all Rapanui dwellings. Ethnographic sources indicate that this was meant to keep evil spirits from entering the house by clinging to a person's back, preventing these evil spirits from devouring a sleeping person's wandering soul at night. The inside chambers are 2-4 m wide at ground level, tapering a bit as they get closer to the roof. The roofs are no more than 3 meters high (see Illustration 4).



Illustration 4: A *Tupa* and *Pipihoreko?* in William Thomson's *Te Pito o Te Henua*, 1891

The orientation of the entranceways of all but one of the *Tupa* seemed to have astronomical significance (see Table 3). Two of them (N°6 and N°9) were oriented directly northwards, or on a North-South axis. Other entranceways were directed to the major Rapanui stars and asterisms: *Tupa* N°7 and N°18 were oriented to the cosmic rising of the Pleiades (November 16th), N° 20 to the heliacal setting of Orion's belt (June 6th), N° 2 to the cosmic setting of Vega (May 30th), N°7 and N°26 to the heliacal setting of the Pleiades (April 18th) and the heliacal rising of Orion's belt (June 22nd) using Marotiri islet as an indicator. Therefore half of them present astronomical orientations related to significant events in the Rapanui calendar. Only N°26 was located far inland and had an entryway with an East-West axis orientation. The only structure that seemed to have no particular orientation was *Tupa* N°1 located behind the present day cemetery. This *Tupa* was recently reconstructed after it was partly dismantled to build the cemetery wall in 1916 and it is possible the original entryway is not in the same place where it is today, accounting for the anomaly in our study. The results of our study are included in Table 3 below, together with the activities that are linked to the astronomical events related to each structure.

Table 3: Location of Tupa and their Astronomical significance

Tupa name & Location	n°*	a(°)	h(°)	δ(°)	Comments
		±1°	±½°	±1°	
Okahu	1	308	0	33½	M
Hanga Oteo	2	313	0	37¾	M; <i>Veri Hariu</i> (αLyr) set. Marked the opening of the eel fishing season
Ahu Ohiro	3	303	1	28¾	m; Cuadrangular tupa; MNL
Anakena	4	283	2	10¾	M
Tua te Manu	5	118	9	-28¾	Peculiar structure; Not a tupa. MSL Full moon of New Year. Axis > W 25¾°
Hanga Kihikihi	6	354	0	63	M; N-S
Ahu Heki'i	7	66	0	21½	M; <i>Matariki</i> rise. The start of the deep-sea fishing season and the bountiful period.
Hanga Hoonu	8	328	0	49½	M
Ahu Ra'ai	9	360	0	63½	M; N-S
Vai Maneo	10	285	1½	12¾	M
Hanga Nui I	18?	65	3	21	<i>Matariki</i> rise. The start of the deep-sea fishing season and the bountiful period.
Hanga Nui II	20?	267	0	-02½	<i>Tautoru</i> set
Hanga Nui III	21	230	0½	-35	Ahu poepoe structure. Not a tupa?
Hanga Tuu Hata	22	150	0	-50	M; Cross rise?; 24° over M. Marotiri. With the Pleiades this marked the start of the new year. <i>Pua</i> (turmeric) was harvested and offered to the chiefs
Mata Hiki	23	126	0	-31¼	M; #23 > #22 > Poike cliff: <i>Matariki</i> rise (20¼°). 23° over Motu Marotiri
Hanga Maihiku	25	169	0	-60¼	M
Rano Raraku	26	358	1	62¼	N-S; <i>Tautoru</i> rises on Ahu Tongariki and set on Rano Raraku S peak (-2°); <i>Matariki</i> sets on Raraku N peak (22¾°) The rising of Orion inaugurated the Bird-man cult ceremonies as well as the Koro and Paina festivities. The setting of the Pleiades marked the end of the deep-sea fishing season, which was usually followed by wars.

*: From S. Englert, "The Land of Hotu Matua". 19, 24 and 27 in ruins; 12 to 17 destroyed by tsunami in 1960.

Sun at 27.1°S 63.5 WS, 116.5 SS, 243.5 SS, 296.5 WS

B. Rectangular Tupa

Although there are only two *Tupa* whose structures differ significantly from all the others we registered in this study, ethnographic evidence indicates that they have been called such for over a century and they were therefore included in this study.

Tupa N°5 known locally as Tua te Manu, is a rectangular platform with a forked western tip shaped like a crescent. The small narrow entranceway is oriented towards the major southerly Moon lunation. Like Tupa N°5, N°26 is also rectangular with a single chamber and the characteristic entranceway of most Rapanui dwellings. The location of N° 26, however, was evidently chosen with great care; it rests on a small outcrop on the plain at the foot of Rano Raraku volcano (where most of Rapa Nui's stone statues were carved) with a great vantage point of Ahu Tongariki, Rano Raraku's two highest peaks, and a small stone tower on the northern horizon. From the top of N° 26 all three landmarks indicate several important astronomical features: Orion's belt rises exactly at the centre of Ahu Tongariki and sets behind Rano Raraku's southern peak (-2°), the Pleiades set behind Rano Raraku's northern peak ($22\frac{3}{4}^\circ$), meanwhile the entranceway is oriented to the conspicuous stone tower on the horizon marking the North-South axis upon which the stars rotate.¹ It is interesting to note that the entranceway's North-South axis orientation was also observed in round tower-like Tupa N° 6 and 9, a feature that is repeated in other important Rapa Nui archaeological structures including some ceremonial platforms as well as large stone structures along the island's North and West coasts called *ahu poepoe*, which resemble a boat with an elevated prow and sometimes have one or more burial chambers inside.

Observatories in Poike Peninsula

Another goal of our expedition was to survey the eastern slope of Poike peninsula and relocate the "star-map" rock and Papa ui hetu'u, the star-gazing rock, mentioned by Routledge and determine the existence of one or more nearby astronomical observatories. Both Belmonte and Edwards had studied these "observatories" in 2003. However the results seemed to add very little to the existing understanding of Rapanui's archaeoastronomy and a second more thorough visit seemed warranted.

Our expedition was successful in finding Papa ui hetu'u located on the eastern side of Puakatiki volcano, in a place with a great vantage point of the whole eastern quadrant of the night sky and where the stars can be seen rising from the ocean. The "observatory" consists of a small basalt outcrop composed of a dozen basalt blocks. One of these, with a surface measuring about 4 m² and an irregular shape, is covered with several petroglyphs depicting stone fishhooks used for catching tuna and other large offshore fish (see Photo 2 and Illustration 5). About 80 m away we found the isolated small basalt boulder with 11 man-made cupules, which Edwards and Belmonte previously interpreted

¹ Interestingly the yellowish tuff used to carve Rapa Nui's famous monolithic statues was called maea Matariki, or The Pleiades stone, whether this meant that the Rapanui believed the stone was endowed with some kind of supernatural power merits further discussion and study.

as a physical representation of the Pleiades (see Photo 3).



Photo 2: Papa ui hetu'u and fishhook petroglyphs in Poike peninsula

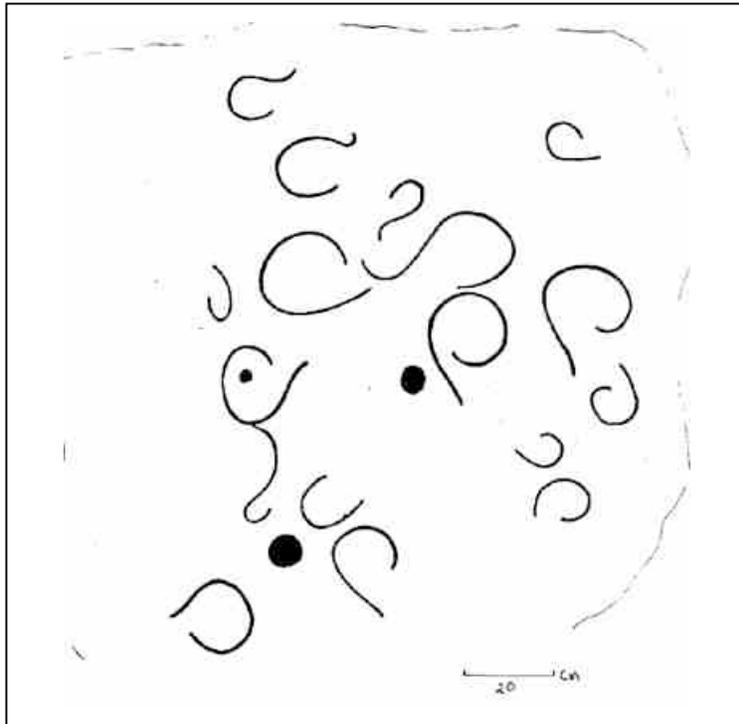


Illustration 5: Mapped fishhook petroglyphs on Papa ui Hetu'u



Photo 3: The representation of the Pleiades on Routledge’s “star-map” rock.

Upon closer inspection neither of these structures seemed to offer any more information other than that aside from the remote and scarcely-populated northern slopes of Maunga Terevaka. These two “observatories” are located in the only place on the island where the Pleiades can be seen rising and setting from a clear open horizon over the ocean. This small fact, which seems insignificant at first, is actually quite revealing. First it indicates that the Rapanui must have inspected every part of the island (a formidable task!) until they found the most optimal location to observe each and every astronomical phenomenon they were looking for. Secondly it stresses the fact that the Pleiades were the foremost asterism in the Rapanui night sky. Thirdly, although one expects the petroglyphs in Papa ui hetu’u to have some sort of direct relationship with the astronomical phenomena supposedly observed there, (as is the case with Routledge’s “star-map” rock), it seems significant that the subjects depicted are not of any obvious astronomical incident but of the very important events they announce (i.e. the start of the bountiful period and the deep-sea fishing season). This fact reveals the close relationship that specific stars and asterisms had with the events they marked—these stars were not important in and of themselves because they were brighter than others or not, but because of the events they signalled; it is for these reasons why for the Rapanui and other Polynesians a great celestial body such as the sun, or a bright constellation such as Scorpio and others, were not more important than the Pleiades or Orion’s belt. For the Rapanui the cosmic rising of The Pleiades on November 16th marked the start of the deep-sea fishing season and although tuna can be caught year around, they arrived in great schools in the summer months. The opening of the deep-sea fishing season was extremely important to the Rapanui, particularly because the island’s southerly latitude and isolation translated into fewer resources. In all Eastern Polynesia, petroglyphs of marine animals and fishhooks were associated with rituals to ensure a bounty of fish and

a plentiful catch and that was certainly the purpose of Papa ui hetu'u's fishhook petroglyphs. We believe that since both of these "observatories" are located in the best place to view the Pleiades, together with the fact that they have images that represent either the stars or events related to this major Rapanui asterism, this indicates that the Pleiades and other stars were evidently observed there.

2. Historical Events and the Rapanui Cycle of Yearly Activities

Although it was not our original intention to place well-documented early historical events in the context of the Rapanui's annual cycle of activities we were surprised to find several coincidences during the course of our work. Their implications were so far-reaching that they were impossible to ignore. A total of 53 ships are recorded to have passed by Rapa Nui between 1722 and 1862, of which 39 are known to have anchored. These included the visit of explorers, traders, profiteers, and slave traders. Although it would be very difficult and time-consuming to try and place all these visits within the context of the Rapanui calendar of activities, it is interesting to observe that most of Rapa Nui's early visitors happened to land on the island between March and April, which according to the Rapanui calendar was the start of the bleakest season (Tonga Iti) exacerbated by the disappearance (heliacal setting) of The Pleiades on April 18th when the deep-sea fishing season ended and warfare began. Rapa Nui's first visitor, Jacob Roggeveen, sighted Rapanui on April 6th 1722. The island's second and third visitors, Felipe González de Haedo and James Cook sighted Rapa Nui on November 15th 1770 and March 11th 1774 respectively, while La Pérouse, the island's 4th visitor arrived on April 9th 1786 and Urey Lisjanski on April 17th 1804. One can only guess how the Rapanui reacted to the arrival of these first visitors, especially at the start of the Tonga Iti period considering the casualties the Rapanui suffered during their first encounter with Roggeveen and others. One can only assume that these first contacts made more of an impression on the Rapanui than later ones, when the "outsiders" became more familiar. However, two of the early visits remarkably stand out: Lisjanski's, a day before the heliacal setting of the Pleiades on April 18th at the end of the deep-sea fishing season, and Gonzalez de Haedo's, who landed on the exact day that the Matariki festival began on November 16th. Unfortunately Lisjanski's account does not reveal much about how the Rapanui reacted to these foreigner's visit. By contrast the Spanish expedition's reports are full of interesting details, never before discussed in any publication that we know of.

The Matariki Festival of 1770

On the morning of November 15th 1770 the Rapanui must have been preparing for the annual Matariki Festival, which started the next day after twilight when the Pleiades (Matariki) appeared for the first time after a long absence. As mentioned earlier, the cosmic rising of the Pleiades welcomed the start of the bountiful period and the opening of the deep-sea fishing season. It was one of the most important times of the year, a time when the first harvests were offered to the chiefs and merry ceremonies were held to honour the deified ancestors for their generosity and support.

Ethnographic sources indicate that important astronomer-priests must have been staying in a cave on the eastern side of Maunga Vai a Heva (Heva's water), the highest dome of Pua Katiki volcano on Poike peninsula during the nights before and after the Matariki festival. Edwards was told that a very powerful priest called Heva had lived there in the company of other astronomer priests all of whom were considered to be the foremost wisemen of the island. Together they had built several small ceremonial platforms with trachyte stone statues on each of the domes and near the base of the cave so that the whole area was considered sacred. They must have been surprised, the same as everyone else on the island, to see two large ships looming over the horizon shortly after sunrise November 15th 1770.

Forty-eight years had passed since the first European explorers landed on Rapa Nui in early April 1722, and forty-eight years since the Rapanui had seen muskets and witnessed the first deaths by gunfire. Captain Felipe Gonzales y Haedo, commanding "The Santa Rosalía" with 70 cannons, and the frigate "San Lorenzo" with 30 more, arrived with a total of 814 men in what would be the Rapanui's second contact with outsiders after Jacob Roggveen's disastrous exchange decades before. After circling the island for a whole day with many islander's gathering on the shore, the Spanish launched some small boats to find anchor at 8am on November 16th.

Aside from the natural excitement with which the Spanish were greeted, there are several indications that this was a special time of the year for the Rapanui. The Spanish recorded seeing many people painted with white, yellow, and mostly red pigments—red being the colour that most attracted their attention; in addition, the "important men" had their entire bodies painted bright red with drawings of chickens and "very ugly faces" on their abdomens. Red was the colour of sacredness in all Polynesia, which is why it would have been particularly important during these festivities, while the chickens were probably symbolic of the bountiful season or fertility. The figures painted on the abdomen—the seat of knowledge for Polynesians—probably represented the face of god Make Make, the Rapanui creator god. Although it was customary for the Rapanui to decorate their bodies with paint it seems that the common themes observed by the Spanish were more than just accidental. The Spanish also recorded seeing a figure called Ko Peka that was about 3.5 m long stuffed with dried grass and hair made out of dark bulrushes. According to the Spanish, the Rapanui carried it to their different gathering sites and it was meant for amusement. Obviously this was not a figure that was put together overnight and if the Spanish were correct it was probably used in the first harvest feasts. Furthermore the Spanish were not met with any degree of hostility but with much excitement, rejoicing, and merriment: they were offered chickens, bananas, and several kinds of tubers, while one small group that ventured inland was conducted to a chief's house or meeting house where the Rapanui sang and danced for them. This may be interpreted as the islanders' natural generosity and cheerful disposition, but it is also possible that for the Rapanui, these were offerings and honours they were paying the "gods." This seems to be the case especially since all Eastern Polynesians believed that during the Matariki Festival certain "gods" descended from the *ao* (skyworlds) and mingled with ordinary people in the *kainga* (world of the living). Although only a few small Spanish groups had explored the island so far, revolving shifts of as many as 400

Rapanui at a time gathered aboard the frigate “San Lorenzo” over the course of the next two days. The cultural impact of the Spanish explorer’s visit would clearly not have been as tremendous had they arrived at a different time of the year. However it multiplied twofold when they decided to perform a magnanimous ceremony of their own on November 20th, adding a whole other dimension to the festival.

At half past four in the morning of November 20th González y Haedo decided to formalize the possession of Rapa Nui in the name of the Spanish monarch Charles the III, and instructed 125 marines and 125 fully armed seamen instructed in musketry, as well as a few Catholic priests in full religious dress with three wooden crosses, to land in Hanga Ho’onu bay. On shore, the Spanish were met by hundreds of Rapanui who joined the procession with dancing and singing and responding “*ora pro nobis*” to the Catholic priests’ litanies along with everyone else as they marched across the North coast straight to Poike peninsula where the Spanish planned to erect the three crosses on each of the trachyte domes of Pua Katiki volcano, right where the most important astronomer priests lived. As the procession advanced with banners flying and drums beating, they met up with the inhabitants of the Rapanui settlements they passed on the way who offered cloaks to the Catholic priests, as well as hens and pullets (symbols of fertility), crying Make Make, the name of the Rapanui creator god. Undoubtedly the Rapanui were not merely mimicking the behaviour of the Spanish, but were aware of the religious character of these activities and since everything seemed to coincide with what the Rapanui considered sacred, it is no wonder they were more than happy to follow along, most evidently with a very different interpretation of the same events. Once the procession arrived at the domes on Pua Katiki volcano, the Spanish dug holes to set up the crosses and an abundant spring of water burst out from the one in the middle dome.² After reading a proclamation, the Catholic priests then proceeded to perform blessings by chanting in Latin next to each of the crosses, which were simultaneously raised on all three mounds at once, while the Spanish officers took possession of the island with all due formalities handing the Rapanui chiefs or priests an official document to sign, which they did with markings of their own design (some drew petroglyph-like birds, others just lines).³ Everyone then cheered the king seven times, which was followed by a triple volley of musketry from the whole party, and 21 guns from the ship, which understandably terrorized the Rapanui. After taking possession, the Spanish climbed down Poike Peninsula, walked back to Hanga Ho’onu, returned to their ship and left on the afternoon of the next day.

It seems interesting that none of the Spanish explorers mention the three Rapanui

² Considering the nature of the terrain, it is hard to believe that water miraculously burst out of a hole there.

³ Other Polynesians may have developed a form of writing, however the Rapanui are the only ones who can prove it. There are 28 different objects that have *rongorongo* figures carved on them (mainly wooden tablets, but also small stones, staffs of power, breastplates, and votive figures). Attempts to decipher *rongorongo* have not been successful although it is evidently pictographic and written in reverse boustrophedon style. Some scholars suggest that the Rapanui invented it after European contact, possibly after the arrival of the Spanish in 1770. According to Rapanui oral tradition *rongorongo* script was developed by chief Ngaara I, who was paramount chief at the time of Spanish discovery, and it was he who set up several *rongorongo* instruction in different parts of the island in the early 1800’s. Unfortunately the script was lost when diseases killed all those who knew how to write or read it.

ceremonial platforms that stood on the top of these three mounds, especially since they recorded all other religious structures they passed on the way there. Since it seems unlikely that they were in disrepair, it is possible that the Spanish simply overlooked them favouring their own activities instead. Nevertheless, what was so easily overlooked by the Spanish is precisely what would have made these events all the more memorable for the Rapanui. The fact that these strangers arrived at the “right time” and carried out their official ceremonies and religious blessings at the “right place” flaunting their “superiority” and power must have been a small coincidence with great repercussions for the Rapanui. The sacredness of the astronomer-priests dwellings and ceremonial platforms must have increased considerably as a result of the of Spanish explorers’ visit, while it is uncertain how it would have affected the social organization of the island and the power of the chiefs and priests in the years that followed.

BIBLIOGRAPHY

- EDWARDS, E. Rapa Nui: cuando el universo era una isla, Universidad de Chile (Santiago, 2010), in press.
- EDWARDS, E. and BELMONTE, J.A. “Megalithic astronomy of Easter Island: a reassessment”, *JHA* 35 (2004), 421-33.
- EDWARDS, E. and M. CLARK: The Astronomical Observatories at Ahu Ra’ai. Easter Island. Proceedings of the I Congress of Archaeology & Antropology of the Eastern Pacific and Easter Island. University of Chile. Easter Island (1984).
- ENGLERT, S. La tierra de Hotu Matu’a: historia y etnología de la Isla de Pascua (Santiago, 1974).
- ESTEBAN, C. “Some notes on orientations of prehistoric stone monuments in western Polynesia and Micronesia”, *Arch. JAC*, 17 (2002-3), 31- 47.
- FERDON Jr., E.N. “The Ceremonial site of Orongo” in *Archaeology of Easter Island: reports of the Norwegian archaeological expedition to Easter Island and the East Pacific, I*, edited by Thor Heyerdahl and Edwin N. Ferdon Jr. (School of American Research and Museum of New Mexico, Santa Fé, 1961), 221-72.
- KIRCH, P.V. “solstice observation in Mangareva, French Polynesia: new perspectives from archaeology”. *Arch. JAC* 18 (2004).
- LEE, G. The rock art of Easter Island: symbols of power, prayers to the gods. The Institute of Archaeology, UCLA, *Monumenta Archaeologica* N°. 17 (1992).
- LEE, G. and LILLER, “The Sun Stones of Easter Island: a revaluation”, *Archaeoastronomy* no. 11 (1987), S1-11.
- LEWIS, D. “Voyaging stars: aspects of Polynesian and Micronesian astronomy”, *Phil. Trans. R. Soc. London*, vol. 276 (1974).
- LILLER, W. “The Megalithic Astronomy of Easter Island: orientations of Ahu and Moai”, *Archaeoastronomy* no. 13 (1989), S21-48.
- LILLER, W. *The Ancient Solar Observatories of Rapanui: the Archaeoastronomy of Easter Island* (Wooland, 1993).
- LILLER, W. “Ancient Astronomical Monuments in Polynesia”, in *Astronomy across cultures: the history of non-western astronomy*, edited by H. Selin (Kluwer Academic Pub., London, 2000), 127-60.
- LILLER, W. and DUARTE, J. “Easter Island’s Solar ranging Device, Ahu Huri A Urenga, and vicinity”, *Archaeoastronomy* (College Park), ix (1986), 39-51.
- MAKEMSON, M.W. *The Morning Star rises. An account of Polynesian astronomy* (Yale University Press, New Haven, 1941).
- METRAUX, A. *Ethnology of Easter Island* (Honolulu, 1960) and *Easter Island: a stone age civilization of the Pacific* (London, 1957).
- MULLOY, W. “A solstice oriented ahu on Easter Island”, *Archaeology and physical anthropology in Oceania*, x (1975), 13-8.
- MULLOY, W. and FIGUEROA, G. *The A Kivi-Vai Teka complex and its relationship to Easter Island architectural prehistory* (University Press of Hawaii, 1978).
- RAMÍREZ, J.M. and HUBER, C. *Easter Island. Rapa Nui, a land of rocky dreams* (Santiago, 2000), 109-10.
- ROUTLEDGE, K.S. *The mystery of Easter Island* (London, 1919).

3. The Promotion of Rapanui Archaeoastronomy and Ethnoastronomy

The results of our expedition have taught us much more than we expected regarding Rapanui's archaeoastronomy and ethnoastronomy, including some surprising insights as to how particular astronomical phenomenon may have influenced the Rapanui people's interpretation of specific historical events. We are certain that the Rapanui relied on skilled astronomer priests who were not only able to predict changes in the season's and tides, but also the arrival of migratory, birds, turtles, and pelagic fish using their vast knowledge of the night sky as well as other natural signs. This same knowledge allowed them to maintain an annual cycle of activities, which they fittingly adjusted year after year. Several structures pay silent tribute to the extraordinary skills of Rapanui's astronomer priests and the complexity of Rapanui's annual calendar. We are thankful for the opportunity to present the results of our expedition in a lecture by Edwards at Oxford's IX Congress of Archeoastronomy and Ethnoastronomy to take place in Lima from January 5-15, 2011. The results will be published in the Proceedings of the Congress, which is a great way for the scientific community to learn more about the recent developments in Rapanui archaeoastronomy and ethnoastronomy. In addition, we also plan to share our results in the form of a comprehensive, straightforward, and entertaining hour-long documentary (see Photo 4). To this end we spent hours interviewing Belmonte and Edwards in different parts of the island asking them to explain the ethnoastronomical significance of different ancient structures, which come to life with their very informative input. The footage was recorded in HD video and is currently in the Post-production phase. A limited number of copies will probably be released in DVD (NTSC) format since the technology for viewing HD is not yet widely available, however, the documentary can easily be re-released in HD format as this technology becomes more popular. The promotion and distribution dates have been moved to early 2011 because a few sudden unrelated setbacks in July and August.

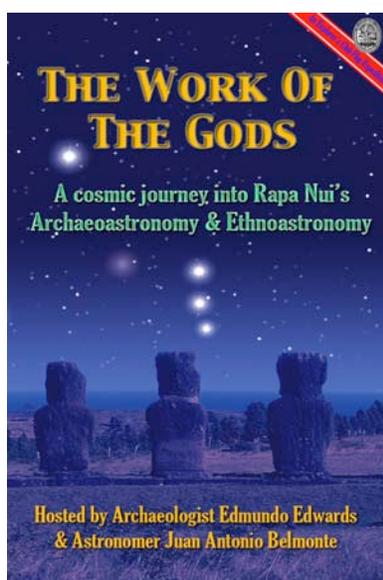


Photo 4: Our expedition's documentary DVD (currently in post-production).

Acknowledgements

We would like to thank all of those Rapanui elders and friends who are no longer with us, but whose friendship, generosity, and knowledge will survive for the benefit of generations to come. Although the names of many Rapanui sages have sadly been forgotten, Felipe Teao, Santiago Pakarati, and his wife Amelia Tepano, all of whom received most of their wisdom from Juan Tepano, Amelia's father, and the group of elders that lived in Mr. Tepano's house during their youth, will be forever remembered in the grateful hearts of those fortunate enough to still learn from them today.

Our team is greatly honoured to have been awarded Explorer's Club Flag #83 for this expedition to Rapa Nui, and we would consider it a great privilege to carry it again on a future expedition.

**This Expedition is dedicated to
our dear former team member, nephew, cousin, and valued friend,**

Sebastián Tuki Riroroko (#83)

November 4th 1981- July 4th 2010



For more information on the
PACIFIC ISLANDS RESEARCH INSTITUTE AND EDUCATION FUND
(a 501c3 non-profit corporation)

Contact:
Lynn Danaher
President
PO Box 2627
Friday Harbor, WA 98250 USA
Phone: (360) 378-6692
e-mail: islandlynx@aol.com
www.pacificislandsresearchinstitute.org