

## **Micronesian Archeoastronomy Expedition: Kosrae and Pohnpei, The Federated States of Micronesia**



## Expedition Team



Club Flag #71 Expedition Team at Menka, Kosrae FSM. From left to right: Brian Hanson MED '84, Julie Wallace MN'09, Ryan Bennett, Jeanne Wilcke MR'15, Alexandra Edwards, Eric Zember MR'14, Edmundo Edwards ME'90, Captain Lynn Danaher FN'05, Alex Wallace MN'01, James Alexander MN '12, and Linda Alexander

## Expedition Timeline and Notes

The first part of our project was completed between May 2<sup>nd</sup>-6<sup>th</sup> 2017 on the island of Kosrae, at the Menka ruins, the ancient city of Lelu, and Yenasr islet. The second part of our project took place on the island of Pohnpei, at the ceremonial city of Nan Madol and select petroglyph sites at Pohnpaid and Takain Pahsu, between May 6<sup>th</sup>-11<sup>th</sup> 2017. Edmundo Edwards, archaeologist and co-founder of The Pacific Islands Research Institute (PIRI) with the organizational expertise and charge of logistics Captain Lynn Danaher, President of PIRI, led the expedition. Captain Danaher also kept a team photographic record of the expedition. Alexandra Edwards developed the project and the current report, while Ryan Bennett was the essential field assistant.

# The Archeoastronomy of Kosrae and Pohnpei An Explorers Club Flag #71 Expedition Report

## An Introduction to Our Project and Methodology

This project was generated from the fact that the Caroline Islanders are renowned for their navigational prowess, in which they have historically used their prodigious knowledge of the stars and other natural phenomena to navigate between the area islands for millennia; yet although the sites of Leluh on Kosrae and Nan Madol in Pohnpei have been thoroughly studied by archaeologists and historians, very little attention has been paid to Carolinian ethnoastronomy outside of the arena of traditional navigation. Considering that both archaeologist Felicia Beardsley and astronomer Cesar Esteban had registered alignments between local sacred architecture and topographic features and/or astronomical phenomena, yet the subject had not been studied at length on either island—especially in the case of Kosrae—was fundamental in the development of this investigation. In addition to the extensive body of work carried out by previous scholars, Beardsley's and Esteban's findings, strongly suggested that both Kosrae and Pohnpei should have sites that could manifest and support this knowledge with empirical evidence, with astronomical phenomena being used for navigation, but also to keep track of time and to regulate an annual cycle of activities.

Taking into account the conditions that have been found to have significance in sites of astronomical consequence on other Pacific islands, for the purposes of this study we limited the scope of our investigation to ceremonial structures and petroglyph sites. Oftentimes, tombs and sacred sites show alignments to the calendar stars as seasonal and ceremonial markers or the cardinal points as the bearings of the underworld. Meanwhile places that have a high concentration of petroglyphs tend to be located near areas where specialised astronomer priests (skywatchers) observed the night sky; in many cases, the motifs depicted in the rock surface represent the very events that were marked by the rising and setting of specific stars.

The ancient sector of the compounds in Lelu were chosen because of their archaeological and historical/cultural significance, as well as the lesser known site of Menka, also on Kosrae. Esteban suggested in personal communication that we study specifically the Upper Temple of Menka since after reading Beardsley's field reports mentioning that the entrance of the temple was aligned to the peak of Mount Finkol, he believed that it may have also had a relationship with the June solstice. On Pohnpei, we decided to concentrate our studies in the sacred sector of Nan Madol and at the petroglyph sites known as Pohnpaid and Takain Pahsu.

We planned to use a Magellan Explorist 610 GPS device to take measurements and an application called Spyglass equipped on several Apple devices. We felt these instruments were capable of accurately reading the orientation of the selected archaeological sites, as we had done so many times in the past. Unfortunately on the first day of our expedition, at Menka, we had problems with our new GPS, and relied on the Spyglass application to cover this failing, but it wasn't until A. Edwards went over the data collected by two other members of our team that we

realized that there were serious errors with those readings as well. We had similar problems affecting our measurements at Nan Madol, and at Pohnpaid. Thus due to a string of serious technical problems, not just in the instruments used to record data, but also failures in the planetarium projector, we were forced to change the methodology and exclude some of the fundamental elements of our original project. As a consequence, the ethnographic aspects of our study—unaffected by these setbacks—gained much more prominence, leading us to some remarkable finds. Aside from going through hundreds of historical documents seeking to elucidate the importance, context, and use of the sites selected for this study with regards to archaeoastronomy/ethnoastronomy, and the local ceremonial and agricultural cycle, we also reviewed thousands of lunar and solar eclipses before selecting 670 lunar ones and 146 solar ones for detailed analyses using Stellarium (the foremost Astronomy application) to aid in the interpretation of a petroglyph near Takain Pahsu, which we believe is of great significance. Therefore, as much as we regret that this project was unable to proceed as planned, we trust that the valuable ethnographic progress—as an indirect consequence of these unexpected circumstances—may compensate for any shortcomings produced by the necessary modifications.

The results of our study, considering both an ethnographic and astronomical interpretation of the selected sites are presented in the following report.



Large Banyan tree thriving at the Leluh Ruins, Kosrae (Photo by A. Edwards)  
**Previous Ethnographic Work**

*Note: Taking into account the great amount of scientific work carried out*

*on Kosrae and Pohnpei within the last 100+ years, this section of the report concentrates solely on the sites that are of relevance to our studies. We present the sites in the order that our research was carried out.*

Archaeologists arrived early to Pohnpei and Kosrae, as well as in the Southern Marianas, as compared to most Micronesian islands where such investigations generally started after World War II. The extent of archaeological work carried out in Micronesia may be divided into two distinct eras, one being the “Early Years,” marked by the visit of the German Südsee Expedition in 1910, followed by a more active period of investigation after World War II, under American administration and later as U.S. Trust Territories.

There had been no serious and systematic archaeological investigations on Kosrae or Pohnpei before the arrival of the Südsee Expedition. Indeed, historic contact had been sparse, with the odd arrival of Spanish sailors, or French and Russian explorers. This period was followed by one of increased interaction with outsiders, namely whalers and traders, and missionaries. In the late 1800s gentlemen scientists and colonial officials often wrote travelogues, offering an eschewed view of island life, but some insight regarding the local culture, sometimes “excavating” artifacts to collect or sell. The turn of the century introduced a new era of “proper” scientific work, characterized in Micronesia by the Südsee Expedition.

In the years between the two World Wars, the Japanese government took on the administration of many Micronesian islands, and like the Germans, each of these “new” territories became the subject of archaeological investigation by Japanese scholars, however few of these works were ever translated. After World War II, the United States gained trusteeship of the Micronesian islands north of the equator, which included both Pohnpei and Kosrae.

Between the 1950s and 1970s much archaeological work was carried out, with modern archaeological research taking place in the past fifty years as part of programs administrated by the Historic Preservation Office of the U.S. Trust Territory of the Pacific Islands. Despite the extensive amount of information that exists regarding the historical sequence and cultural timeline of places like Leluh and Nan Madol, very little attention has been paid to archeoastronomy.

### *Site 1A: Lelu, Kosrae*

It is no surprise that an archaeological site of the significance and proportion of Lelu should have attracted the attention of many scholars over the years, too many to include here. Nevertheless, a few stand out and deserve mention.

The first observations of the Leluh Ruins—however limited-- were published by Franze Hernalshausen, a German trader and government official in the Marshall Islands. His publication was seconded by Frederick William Christian, traveler and lexicographer of Polynesian languages, who in 1899 printed his own map of the compound of Kinyeir Fulat in Lelu. The earliest fieldwork carried out on Kosrae was undertaken by members of the Südsee Expedition aboard the research vessel *Peiho* on a two-year project proposed by Dr. Georg Thilenius, director of the Hamburgische Wissenschaftliche Stiftung (Hamburg Scientific Foundation). The expedition was carried out between July 1908 and April 22<sup>nd</sup> 1910 in what were then the German holdings in Melanesia, and in Micronesia. The first area was explored under the leadership of Friedrich Fülleborn, while Micronesia was studied in the second year under the direction of Augustin Krämer. It was the Südsee Expedition scientists, who produced the first maps of Lelu. Ernst Sarfert arrived in early 1910 and remained on Kosrae for three months carrying out ethnographic investigations, while Paul Hambruch, the Expedition archaeologist stayed for two weeks concentrating his efforts on Leluh, which at the time, supported a small number of inhabitants just beyond the ancient core of the ruins. Hambruch excavated three tombs (Insru, Inol and Kefal) and conducted a surface collection and survey of the ruins, while other members of his team excavated the more significant compounds. Like other members of this expedition, Sarfert was able to accurately register much ethnographic information despite the limited length of his stay. Even more extraordinary was the wealth of information and amount of work carried out and collected by Hambruch. Hambruch's work stands as an exceptionally thorough account of Leluh and later archaeological investigations have built upon Hambruchs initial observations.

During the years of Japanese Administration, scientists investigated many Kosraen tombs, however their findings have not been translated. All scientific activities ceased with the outbreak of World War II and Leluh became the site of a Japanese military installation.

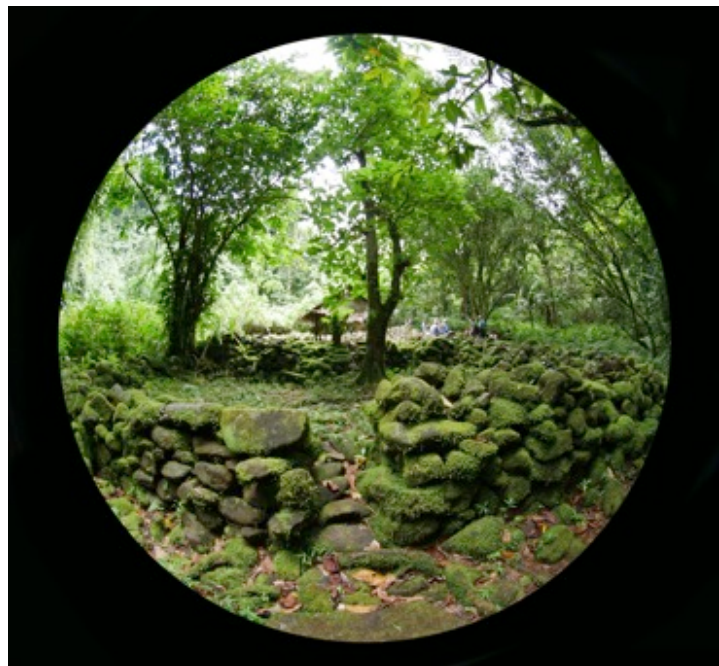
After the war, archaeological work started again. In the 1970s and 1980s, territorial archaeologist Ross Cordy, directed several studies that emerged as the by-products of major Public Works projects. Ross Cordy's work included mapping the extant compounds at Leluh and collecting information about local settlement patterns and social stratification. He is the foremost archaeologist and specialist of the site. Cordy established the developmental sequence of Leluh and his studies effectively consolidated the findings of many previous researchers. Several other scholars have worked at Lelu in more recent times, too many to list here, with investigations that go beyond the discussion of this report. Suffice it to say that Professor Felicia Beardsley of the University of LaVerne in California is the most prolific archaeologist working on Kosrae today.



*Members of the Südsee Expedition aboard the research vessel Peiho, 1909  
(Photo Wikimedia Commons)*

*Site 1B: Menka, Kosrae*

Most of the information that exists concerning Menka comes from the work of Beardsley. Beardsley spent 2010-2013 excavating two temples, a cave, and canoe landing at Menka and its surrounding areas. Beardsley noted that in the past, part of the function of the Menka temples were related to a cult honouring Sinlaku, the breadfruit goddess, the most important Kosraen deity in ancient times; this suggests a connection to a horticultural and ritual cycle—particularly related to the breadfruit harvest. Upriver from the complex, Beardsley investigated a rock shelter with a painted ceiling depicting Sinlaku. Most significantly, Beardsley identified an Upper Temple that from her findings—together with the observations of Cesar Esteban—strongly suggest that the site was significant to skywatchers and that observation of the night sky may have been carried out there.



*A residential compound at Menka  
(Photo by A. Edwards)*

*Site 2A: Petroglyphs at Pohnpaid and Vicinity, Pohnpei*

Although it is one of the few known petroglyph sites in Micronesia, Pohnpaid has by in large escaped scientific attention. Only a handful of scholars have previously conducted any work there. Christian briefly mentions Pohnpaid in a book he published in 1899, while Hambruch went a step further and recorded a few oral traditions regarding the origin and name of the site. Seventy-three years later, archaeologist Takeshi Ueki and Madison Nena (the Historic Preservation Officer for Pohnpei State at the time), published a report in which they recorded over 40 petroglyphs at Pohnpaid. It wasn't until 1999 that the site was first extensively surveyed by archaeologist Paul Rainbird, who raised the total number of petroglyphs at Pohnpaid to over 700, published his finds in the following years, later collaborating with his colleague Meredith Wilson and extending their survey to the vicinity of an assortment of boulders with petroglyphs known today as Takain Pahsu.



*Takain Pahsu and the proprietor of the land where this boulder lies (Photo A. Edwards)*



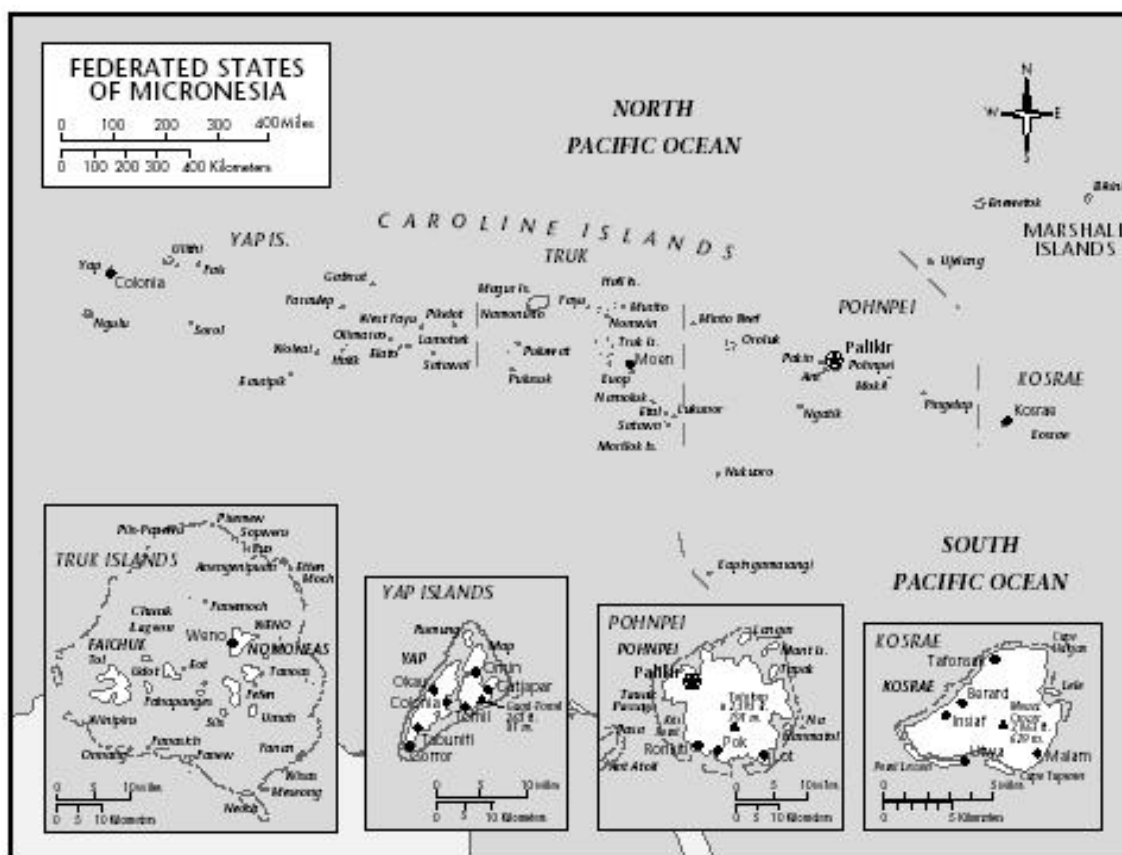
## *Site 2B: Nan Madol, Pohnpei*

As a major archaeological site of World Heritage proportions, Nan Madol has undoubtedly been thoroughly studied over the years. The first report of Nan Madol was written by James F. O'Connell between the years 1828-1833, mentioning it in his memoirs. More detailed accounts were recorded by the missionaries Luther Gulick and E. W. Clark in the 1850s, followed by the more scientific endeavor of naturalist and ethnographer Jan Kubary who in the 1870s excavated several islets and drew the first relatively complete map of Nan Madol. The same as on Kosrae, Frederick William Christian wrote some detailed descriptions of some of the sacred islets and did some collecting on Pohnpei. During the German administration, Governor Victor Berg worked at Nan Madol between 1905-1907, famously dying the day after he excavated the possible tomb of legendary Pohnpeian ruler Isokelekel. Hambruch of the Südsee Expedition arrived in 1910. Again, Hambruch and colleague Anneliese Eilers, recorded a surprising amount of ethnographic information from a variety of local informants, accurately mapping the islets and recording their features and function despite the brief time they spent on Pohnpei. Since then, there has been a bounty of ethnographic works about Pohnpei, with Akira Matsamura standing out among the Japanese scholars operating in Nan Madol in the years between the two World Wars. The 1940s and 50s saw the rise of native historians, with Silten and Luelen Bernart, writing down the history and folklore of their country and people to ensure that their knowledge survived for the benefit of the future generation of Pohnpeians. Anthropologists John Fischer, Saul Riesenber, and Marjorie Whiting edited and annotated Bernart's book, which is the most comprehensive of the available Pohnpeian oral histories. In the 1960s, another native historian—Masao Hadley, Bernart's grandson and Pohnpeian elder—elaborated on Bernart's pioneering work, and published his findings with the aid of anthropologist Paul Ehrlich.

In 1963, the Smithsonian Institution carried out some of the first systematic excavations to employ radiocarbon dating. Since 1977, the Historic Preservation Office together with the U.S. National Park Service have funded much work at Nan Madol, most notably that of anthropologist William S. Ayres. Starting 1977, Ayres and his team have extensively, excavated, registered, and mapped Nan Madol, as well as 200 other sites on Pohnpei in an attempt to elucidate the developmental sequence of Pohnpei. In 1979, Arthur Saxe worked on defining the boundaries of Nan Madol, while J. Stephen Athens mapped 25 islets and conducted excavations on 14 of them in the 1980s. Ayres and many others continue to work in the famous ruins with projects ranging from marine resources utilization, to stone transportation, and even some studies in archaeoastronomy by Esteban in 2014. Most relevant to our project, Esteban conducted fieldwork on the sacred sector of Nan Madol, identifying possible solar and stellar devices on the islets of Nan Dauwas, Karian, and Lemenkou. He also gathered ethnographic information and published these in 2003, 2006, 2013, and 2014. It was he who suggested in personal communication that we investigate the petroglyphs at Pohnpaid and its vicinity.

## **Kosrae & Pohnpei: An Overview**

Kosrae and Pohnpei are part of the Federated States of Micronesia (FSM), an island nation encompassing 607 small islands in the Western Pacific, about 4,000 km southwest of Hawaii. The islands lie just above the Equator and are grouped into four states: Kosrae, Pohnpei, Chuuk (a.k.a. Truk) and Yap (see Figure 1). Except for Yap, the remaining three islands are part of the Caroline Islands archipelago spanning 3,540 km from Palau to Kosrae,, encompassing about 2,150 sq. km of ocean.<sup>1</sup> The Caroline Islands themselves consist of 936 islands, islets, and atolls situated between 1° and 10°N lat. and 131° and 163° E long. Although their total land mass is quite small (1, 320 sq km), they are scattered over an expanse of ocean that is almost 1.5 times the area of France. Considering the geographic location and characteristics of these islands, they are naturally home to a people with an exceptional navigational tradition, passed on from one generation to the next for over 4,000 years.



**Figure 1:** A map of the Federated Sates of Micronesia

<sup>1</sup> Portuguese navigators Diogo da Rocha and Gomes de Sequeira reached Yap and Ulithi in 1525, being carried there by a storm after leaving the Moluccas in Indonesia, but they the name “Islas Carolinas” to designate this large group of islands did not become popular until 1686, after an additional five different European ships had already passed through the area. It was Spanish Captain Francisco Lazcano who named them in honor of King Carlos II of Spain who had funded Lazcano’s expedition.

The capital of the FSM is Palikir on Pohnpei, the largest of the Caroline Islands at 336.7 sq km.

Two atolls, Ant and Pakin, lie outside of the barrier reef of Pohnpei, with many islands and islets lying between the reef and the shore. Kosrae with an area of 111.3 sq km is the only solitary island without a large fringing reef. Despite these initial differences, both Kosrae and Pohnpei lie in the Eastern Carolines and share similar climate and geography. They are high volcanic islands, with mountain peaks that rise 778 m on Pohnpei and 634 m on Kosrae; they are home to lush forests and extensive mangroves, and both possess several cascading waterfalls and are surrounded by pristine turquoise waters. Lying just north of the equator (Kosrae; Lat. 5.3 N, Long. 162.9; Pohnpei: Lat. 6.9 N, Long. 158.2 E), both islands lie in the inter-tropical convergence zone, where the northern and southern trade winds meet and nullify each other. The area is known as the “doldrums” marked by a humid tropical climate and uniformly even warm temperatures. Nevertheless, they have been historically affected by tropical storms and monsoon type rains. Despite the relative uniformity, shifts in the trade winds establish two seasons: A drier one dominated by northeasterly winds, and then a rainier one when the prevailing winds start shifting westward. Rainfall is heaviest during the summer months, from May to December.

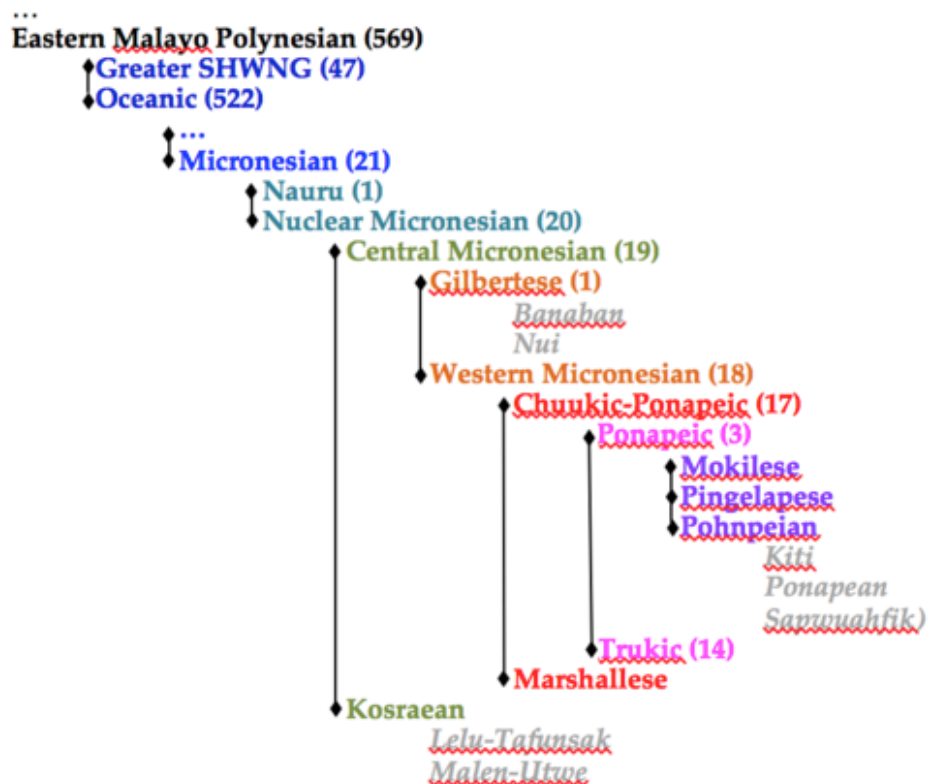
While the socio-political organization of the different peoples of these islands is quite uniform, the first Micronesian settlers hailed from at least three quite separate points of origin, comprising several cultural and linguistic stocks. For these reasons several anthropologists have found fault with the grouping of these islands into what is known as “Micronesia”, a term meaning “little islands” in Greek and established by French explorer Jules Dumont d’Urville in the 1830s.

Most linguistic and archaeological evidence indicates that the islands were first discovered and settled between two and three thousand years ago, from East to West. Even though the atolls of the Marshall Islands were colonized at about the same time,

it seems that the high islands of Kosrae, Pohnpei, and Chuuk were settled earlier than most lower islands. These migrations were accomplished in multiple voyages. Originally departing from island Southeast Asia with one branch settling in the Marianas and Guam, another group spread to the Bismarck Archipelago, the Solomon Islands and Vanuatu, continuing onwards to parts of Micronesia (see Figure 2). Recent radiocarbon dating places the initial occupation of Pohnpei at the end of the first millennium BC, and that of Kosrae at about the same time or slightly earlier, although these dates are constantly changing with the advent of new archaeological discoveries.

The heterogeneous origin of these early settlers is reflected in the diversity of languages that exist in the region. Although the languages spoken in Chuuk, Pohnpei, Kosrae, and in the atolls of Yap State are classified as Nuclear Micronesian, a subfamily of the Austronesian (Malayo-Polynesian) language family, Kosraean belongs to its own distinct branch. While the language spoken on Truk and those of Pohnpei and its islands are related, Trukik splits off into 14 languages, and Ponapeic, into 3 distinct languages in addition to 3 dialects spoken on Pohnpei alone. Not to mention that in more recent times Pohnpei received an important migration of Polynesians from Kapingamarangi (see Figure 3). Nevertheless, they are all an Austronesian-speaking people whose origins are in Taiwan and the Philippines. Plainware pottery (a late form of the Austronesian Lapita culture, shell adzes, fishhooks, lures and other implements that point to a settlement coming from the southeast have been excavated on Kosrae and Pohnpei.

Figure 2: Pacific Migrations





**Figure 3:** The place of Kosrae and Pohnpei in the Austronesian Language Family

Kosrae and Pohnpei each evolved in their own way, and historical-based legends were created regarding their different origins. The early inhabitants made woven materials, cooked in earth ovens, and practiced agro-forestry with a diet relying mainly on breadfruit, and also taro and marine fauna. The people settled on the flat areas by the shore and developed populations with firm political and economic boundaries, intrinsically tied to the land they occupied and the sea that provided them with sustenance, but also allowed them to communicate and trade with outsiders. Social status was marked by house platform size and ritual feasting; stone tombs were built to reflect status and ownership and exploitation of land.

Breadfruit trees were present from the time of earliest human settlement and were an important food crop in Micronesia, but particularly so in the high islands of Kosrae and Pohnpei (Peterson 2006: 85). At the time of early settlement, a breadfruit variety grew wild on the high islands of Micronesia, originating from the Asian continent. It first spread to the Marianas and later it mixed with a type of seedless breadfruit from Melanesia/Polynesia introduced by migrants entering Micronesia from the southeast. Over the years a series of hybrids were generated as a result, including a salt tolerant variety that grew well on the atolls. Breadfruit requires very little labor beyond harvesting, and is nutritious enough to support a large growing population. On Pohnpei an acre of land can yield between 3-5 tons of breadfruit per year (Peterson 2006: 85-88). Aside from this direct food surplus, breadfruit was fermented and could be stored for future use in special pits. Some specialists say that it was this “breadfruit revolution” that freed enough manpower to allow the kind of economic and political development seen on Kosrae and Pohnpei.<sup>2</sup> Both islands adopted a lunation-based ritual and agricultural calendar related to breadfruit production. Kosraens developed a cult to “Sinlaku,” the goddess of breadfruit, who up until the arrival of Catholic missionaries was the most important deity on the island. Sinlaku was worshiped in a temple near the heart of Kosrae at Menka, a very early site and one of the places we studied in this expedition.

As the people of Kosrae and Pohnpei relied increasingly on cultivated food, they developed rival semiautonomous polities, forming alliances involved in an island-wide struggle for power. Complex chiefly societies emerged as a result of mounting environmental and economic pressures. The rise of the ceremonial centers of Eastern Micronesia –Nan Madol and Lelu– are the tangible evidence of this increasing social, political, and economic stratification. Kosrae developed a firm political structure early on, headed by a supreme ruler and a high priest. On both islands this culminated in a developed feudal kingdom seated in a monumental lithic setting: the ancient cities of Lelu and Nan Madol, which will be discussed in greater detail later in this report.

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<sup>2</sup> On Pohnpei there is a clan named 'Under-the-breadfruit-tree-clan' (Dipwenpahnmei in Pohnpeian). They are the most widely dispersed clan in the region. Perhaps originating in Kosrae, they spread all the way to the Marianas and Pulo Ana in the far southwest (Marck 2004).



## An Introduction to Micronesian Ethnoastronomy: Kosrae and Pohnpei

The Caroline islanders are most well-known for their extraordinary navigational skills, where inter-island travel and trade became an integral part of their subsistence and survival on some of these very isolated islands. This was especially true of the atolls. Many scholars have dedicated their careers to studying the intricacies of Carolinian traditional navigation ever since the first Europeans came into contact with these native specialists. Therefore Carolinian star-lore has been very well-documented, even if not always well-understood.

Carolinian navigators employed a star compass, divided into 32 different coordinates with Altair Aquilae in the East being the first cardinal point, followed counter-clockwise by a fixed set of stars, usually Gamma Aquilae, Aldebaran, The Pleiades, Vega Lyrae, Alpha Cassiopeiae, Alpha Ursae Majoris, Beta Ursae Minoris, and finally Polaris in the North position.<sup>3</sup> These points are marked by the place where the different stars may be observed rising and setting on the horizon. The points East to South are marked by the rising of Beta Aquilae, Orion's Belt, Corvus, Scorpii, Shaula or Kappa or Lambda Scorpii, and Crux as seen at the rising of Alpha Centauri, with south indicated by Crux upright (*ibid.*; see Figure 4). It is important to note that on Pohnpei and throughout Polynesia, the Pleiades, were seen as the greatest of all the stars, coinciding with good winds and the harvest (Bernart 1977: 97).

The Caroline islanders adopted several different calendars, a lunar one, marked by the cycles of the moon within a twelve month period, and then also two sidereal ones dividing the year into 12 and 19 star “months” of varying lengths marked by the first appearance of specific stars 45° above the eastern horizon at dawn (heliacal rising). The sidereal calendars, associated to the seasons and navigation, were popular in the central Carolines (Goodenough: 1953).

Carolinian skywatchers were aware of the year in a solar as well as a sidereal sense, coinciding with annual seasonal variations and the breadfruit cycle with its related feast-day calendar. The solar year in the Southwestern Carolines began when the sun rose in the compass position marked by Altair in the summer months (due East—the native version of the March Equinox). As the Sun continued to move north, it rose in the compass point marked by the Pleiades, while its southernmost position was that of Antares (the solstices). The sun then moved back to Altair and another year began (*ibid.*). Native observers were evidently aware of the southerly and northerly extreme positions of the sun as it moves in relation to its background of stars, encompassing an annual revolution of the skies, but the Carolinian year was primarily divided for practical purposes (*ibid.*). On Kosrae the year was divided between March to August and September to February, coinciding with the seasons. On Pohnpei, Gulick lists what is probably Antares as the first month, and Bernart states that the breadfruit season (and the year) was marked by 12 stars starting with Antares and ending with the Pleiades, but whether these refer to compass points or the time of heliacal rising is uncertain; furthermore, the names listed by Bernart have a very limited overlap with those of months or stars in other sources (Bernart 1977: 1977: 89; Gulick 1871). A chart explaining the different Carolinian calendar

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<sup>3</sup> Ward Goodenough who collected this information admits that some of the stars that are not constellations, may actually be part of a larger asterism). We have calculated the reference year as 1500 for the heliacal calculations.



years appears in Figure 5.

Figure 4: The Carolinian Star Compass (after Goodenough 1953: 109)

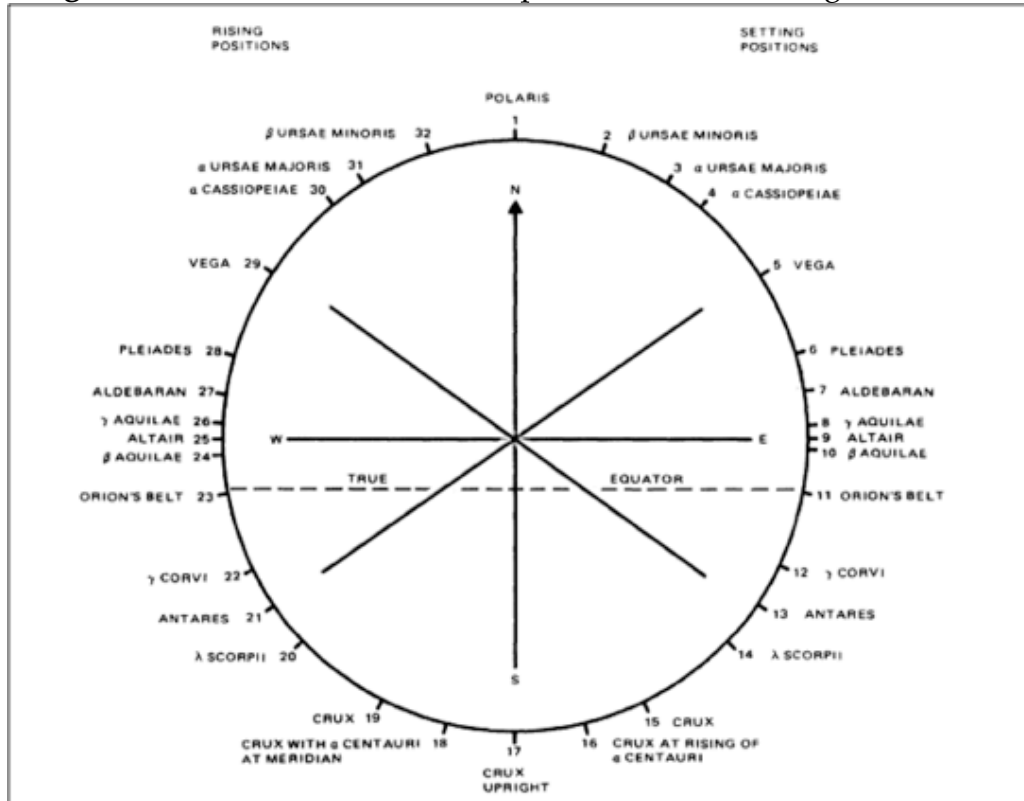
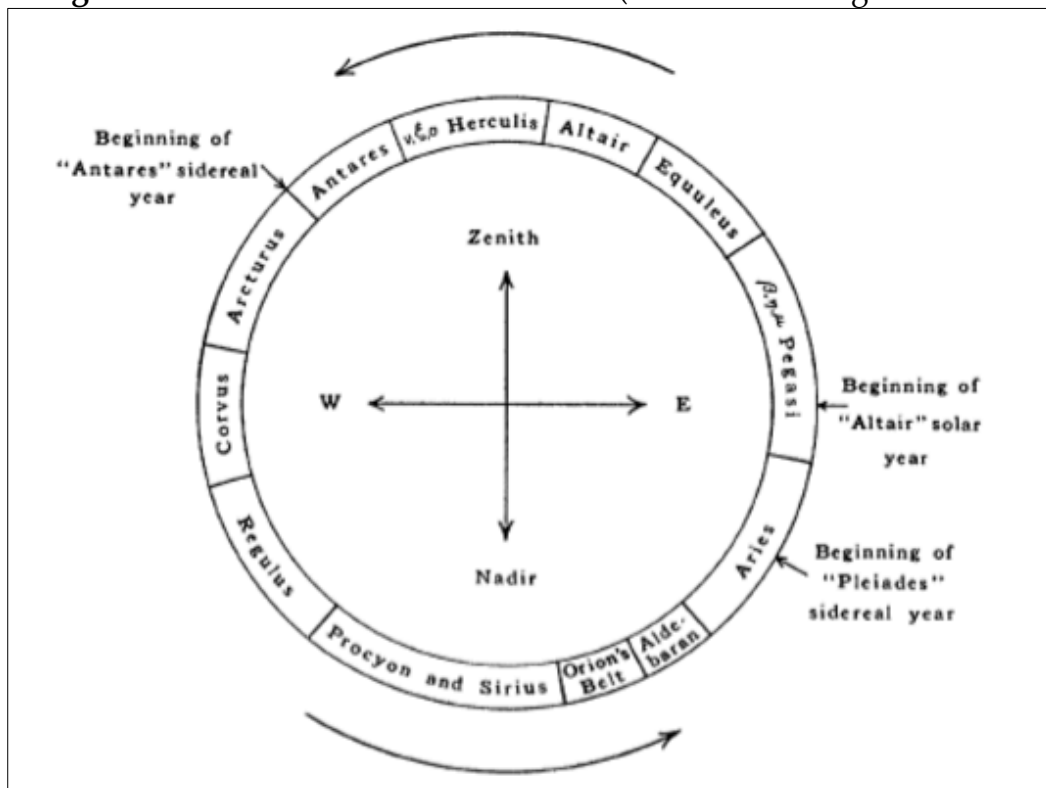


Figure 5: The Carolinian Calendar Years (after Goodenough 1953: 109)



Of the lunar months, these were divided into 30 “moons” or nights and named after the activities that could be carried out that day or the appearance of the moon at that time. The names of these “moons” and their sequence are uniform in all the Carolines, being divided into three periods depending on the amount of available light at night. The first and last set of days, were a period of darkness and feared as the time when ghosts and sorcerers were active, while the nights when the moon was visible at night were favored for social activities with feasts and dances of fertility taking place on the full moon (Goodenough 1953; Christian 1899: 387; Bernart 1977: 97-98). Although unrelated, the nights of the sidereal months were also called “moons”.

In addition to the lunar months, navigators divided the year into 18-19 unequal periods based on the heliacal rising of particular stars and constellations, which they used to determine the best time of the year to undertake particular voyages dependent on the prevailing winds and currents. This system was not meant to divide the year into a fixed number of periods of equal length, but rather mark shifts in the weather conditions. The shorter sidereal calendar of 12 “months” was an abridged version of the navigator’s calendar consisting of 12-14 unequal time divisions, which were also called “moons” though they were named for stars (Ibid.). Although the stars marking each month in the sidereal calendar were generally uniform throughout the Caroline Islands, their names of course varied depending on the different languages spoken. A general version of the Carolinian calendar months appears in Figure 6; the actual names vary from island to island. The same has been done with the previously listed star names.

**Figure 6:** The Carolinian Sidereal Months (Goodenough 1953; Christian 1899)

Month	Micronesian Month Name	Star/Asterism (in order of heliacal rising)
1	Tumwur	Antares, Scorpio
2	Maacik Meen	Hercules Vega and Lyra
3	Maanap (Pillar of heaven)	Altair, Aquila
4	Seeta (Bowl) Naa Kyyw (Porpoise) Jenimate	Delphinus, Cygnus, Equuleus Formalhaut, Pegasus Andromedae Andromedae
5	Mweriker	Pleiades
6	Wuun (Penis), Uul	Aldebaran, Eye of Taurus
7	Jenywen	Orion’s Belt
8	Maan (Bird)	Castor, Pollux, and Procyon
9	Jiie (Rat)	Regulus, Leo
10	Jonumas Jimnenikak	Crater Virgin
11	Pwuupw	The Southern Cross
12	Serepwen (Soropuel, Sarapoli, etc,...)	Corvus
13	Jaap Joromoj Ceew (Net)	Spica, Virgin Arcturus, Bootes Corona borealis

Although this is not the extent of Carolinean ethnoastronomy, we have limited the entries to what is most significant or relevant to our findings.

**SECTION I, KOSRAE: Kosraen Settlement Patterns**

Kosraen oral tradition tells of how Kosrae was created when the gods decided to make a mountain in the shape of a man, but then decided to make it female so that it should bear seeds (i.e. people). When the gods became angry with the woman, they lay her down in a sleeping position in the middle of the ocean, but she was menstruating at the time, which explains the presence of red soil deep in the forest in the place where her torso splits into her legs.<sup>4</sup> The attributes of the women of the different villages of Kosrae were interpreted in reference to the part of the sleeping lady that lay within their territory. Thus the women of Utwe were said to have beautiful legs, those of Malem beautiful thighs, the women of Tafunsak beautiful hair, and those of Leluh—from where the peaks and ridges that form the silhouette of the “sleeping lady” may actually be seen—were supposed to have beautiful faces and breasts (Rainbird 20054: 56; see Figure 7).

**Figure 7:** “The Sleeping Lady” as seen from the vantage point of the district of Leluh (Photo by A. Edwards)



The special place Leluh occupies in Kosraen folklore (as well as that of the other districts) is told in how the four main villages of Kosrae were established and named by the children of a woman who lived in Lelu (which at that time was not yet called Lelu). When this legendary woman grew old she bid her children to find new homes elsewhere as she could not keep taking care of them. The eldest son settled on the western part of Kosrae, and called the place Tafunsak, meaning “the half with trees” as in past times that part of the island was heavily timbered. The woman’s only daughter settled on the southeastern part of the island and named the place Melem or “moon” because the girl arrived there on a brightly moonlit night, which made her

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<sup>4</sup> Since red is the color of sacredness in all cultures that share Austronesian descent, the area where the red soil of Kosrae was located was reserved for the bravest men and used to paint their canoes. This was done to seemingly revert or harness the feared “negative influence” of the menses, which was believed to be especially harmful to men about to embark on a fishing or sailing expedition (Rainbird 20054: 56).

look particularly beautiful, a trait which the women of Malem are well-reputed for.<sup>5</sup> The middle son wandered for a long time until he arrived to the south coast of the island, and stayed there only because he could not go any further. The young man had trouble naming the place, but then called it Utwe because he had gone to the back part of the island to make his home. The youngest son, who had always cared for his mother stayed with her until she died, and remained on the mother's home island after her death. As it was completely surrounded by water, he named it Lelu, meaning "inside of the lagoon/lake." The four main districts and their locations can be seen in Figure 8)

**Figure 8:** The four districts of Kosrae (Map from Wikimedia Commons)



Kosrae would have appeared quite different 2,000 to 2500 years ago, when its first settlers arrived. At that time, the steep hillsides descended directly from the mountains into the sea. Some mangroves at the mouths of the four small rivers drained the uplands, and there may have been a few small lagoons behind sand bars that formed a fringing reef (Athens 1995). About 500 years later this changed through progradation, adding significantly to the land area and Kosrae became what it is today.

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<sup>5</sup> Up until the arrival of Catholic missionaries in the 1800s, dances of fertility took place on all the Pacific islands on the nights of the full moon. Since the first tradition mentioned here notes that the women of Malem were known for their beautiful thighs, it may reasonably be inferred that the most valued female attributes on Kosrae were closely linked to the concepts of sexuality and fertility.



*The natural beauty of Kosrae (Photo by A. Edwards)*

Kosrae developed a highly centralized and stratified society, sharing several cultural features with its neighbor islands such as matrilineal descent, and kin groups ranked as nobles or commoners, with the higher strata controlling land use and dominating the lower class. Early settlements consisted of clans, divided into extended families sharing a single cookhouse. However, at about 1200 AD, the people of Kosrae started to build a city of monumental proportions, home to a population of 1,500 people at its peak and covering an area 0.27 km<sup>2</sup>. This form of settlement was different; firstly because it was inhabited by an assortment of families that were not all related (an actual “city” in the anthropological sense), but the most remarkable feature of all is that it was built on the fringing reef of a small coastal island, on man-made land. This was the walled city of Lelu. The Tokosra (paramount chief) lived there with his royal entourage where he received important visitors from other islands, seeking an audience. Other noblemen and their families and servants also inhabited the site, which became a regional symbol of power, authority, and centralization, where rival island polities coalesced into a single major political and economic center. Although the Tokosra system was discontinued, the rank of people of noble heritage is still acknowledged, and the capital of Kosrae is in the district of Leluh, in Tofol just across from the ancient ruins in an area that can support the growing and expanding population. According to Kosraens, “All roads lead to Leluh”.

## Expedition Site IA: Lelu, Kosrae



*Expedition team member Lynn Danaher taking measurements at Kinyeir Fulat, Lelu  
(Photo by A. Edwards)*

Considered one of the wonders of the Neolithic world, the Leluh ruins sit at an elevation of just 3 m above sea level. From 1400 to 1800 it represented the peak of Kosraen cultural development and architectural achievement, being not only the capital center of Kosrae, but also the seat of a realm whose influence extended throughout the islands in the region. Leluh was built over a period spanning several hundred years, using multi-ton basalt prisms that were transported across the island from Tafunsak to build walls, some of which rise up to 7 m high. Archaeologists have classified the compounds of Leluh into three site categories: Habitation, Sacred, and Mortuary. The city grew to support about 100 walled compounds including royal residences, three royal tomb complexes, and 17 sacred compounds; additionally, there were administrative structures and an unknown number of dwellings belonging to commoners (Beardsley et al 2015: 421). The compounds were connected by pathways nearly 6 m wide and paved with coral. A canal, at one time 800 m long, ran the full length of the artificial island providing access to the sea and many of the compounds via boat landings at high tide (Ibid). As artificial man-made territory, Lelu was considered both a no man's land and an every man's land without ties to place and time, and exempt from the traditional land tenure pattern (Ibid.). Lelu was a city, supporting all four strata of Kosraen society. The parts of Leluh that housed the commoners is the extent of modern development on the island today. Except for the sacred core, which is about 250 m<sup>2</sup> and remains intact, Leluh was never abandoned despite missionization and depopulation as a result of increased contact with outsiders, which is quite remarkable. (Beardsley et al 2015: 402). In fact, at the time of European contact Leluh was a thriving city "infused with pomp and ceremony" (Cordy 1985 and 1993 in Beardsley 2015 et al: 420).

The artificial part of Leluh extends westward from the shoreline of an existing lagoon islet of the same name, adding about 28 ha to the 60-80 ha of the original island (see Figure 9). The small off-shore islets Pisin, Yen Yen, and Yenasr were also artificially-filled, extending from tiny lagoon islets. Pisin and Yen Yen lie just off-shore, to the west and southwest of Lelu; in the past, they supported residential compounds, although Yen Yen may have boasted restricted access. Yenasr lies 300 m to the north of Lelu and was associated with funerary rites, dedicated to the burial ceremonies of the highest chiefs and their associated feasting activities (Beardsley et al 2015: 423).

Different oral traditions talk about the material used in the construction of Lelu and their provenance. In one story a typhoon created a sand-bank on the reef, which the local people fortified and elevated with coral plates and sand. In another account, it was the work of a sorcerer and his two sons, all from Taf, the district from where the columnar basalt quarry used in the constructions is located. The father carried most of the stones in a canoe with the help of spells that helped with the tides. These stones piled themselves up magically while two were raised by people whom the king had congregated for this purpose. In a third account, a nobleman from Walung, but living in Tofol (across from Lelu), decided to build an islet on a sandbar, so the people of Tofol formed a chain across the reef and passed the coral pieces from one hand to the other to build Pisin Islet (Beardsley et al: 418-420).

The historical sequence of Lelu has been divided into six principal eras (Beardsley et al 2015: 246-248):

AD 340 - >1250: The western shore consisted of a sandy beach and a freshwater swamp suitable for taro cultivation. Shell middens and plainware pottery from 340-500 AD appear during this time. Internal power struggles plague the island

AD 1250-1400: Period of Initial Expansion. Sand and coral filling are added to the western beach of Lelu Island. Foundations, retaining walls, and small compounds are completed with coral being the dominant material for construction. Most of Kosrae is united under Lelu.

AD 1400-1600. The Monumental Core is built. The largest and most impressive compounds are built (Lurun and Kinyeir Fulat) as well as several sacred and royal tomb complexes. Lelu expands further westward, beyond Kinyeir Fulat. The central canal, and interconnecting pathways and canoe landings develop. Enclosed compounds with basalt boulders and prismatic/columnar basalt "logs" dominate the architecture.

AD 1600-1650. Central Lelu. The central area of Lelu is expanded by filling in the shallow bay area. New dwelling sites are added to the city core. The building of high-walled compounds is consolidated, but no new high walled or sacred/burial compounds are built. Basalt dominates the constructions with corals used in wall fascia.

AD 1650-1800. Completion. The full extent of Lelu is reached. Additions are made to existing compounds. Lelu reaches its pinnacle of development with more than 100 walled compounds, including 17 sacred compounds, 3 royal tomb complexes, and an unknown number of un-walled areas where commoners lived.

AD 1800-1850. Decline. What has been categorized as a super typhoon strikes Kosrae at about 1800. The extent of the damage on the western coast of Lelu is such that it is not rebuilt. The impact is exacerbated by the arrival of the European traders, missionaries, colonizers, and

Figure 9: Map of Western Lelu (Hambruch 1910 in Sarfert 1919)

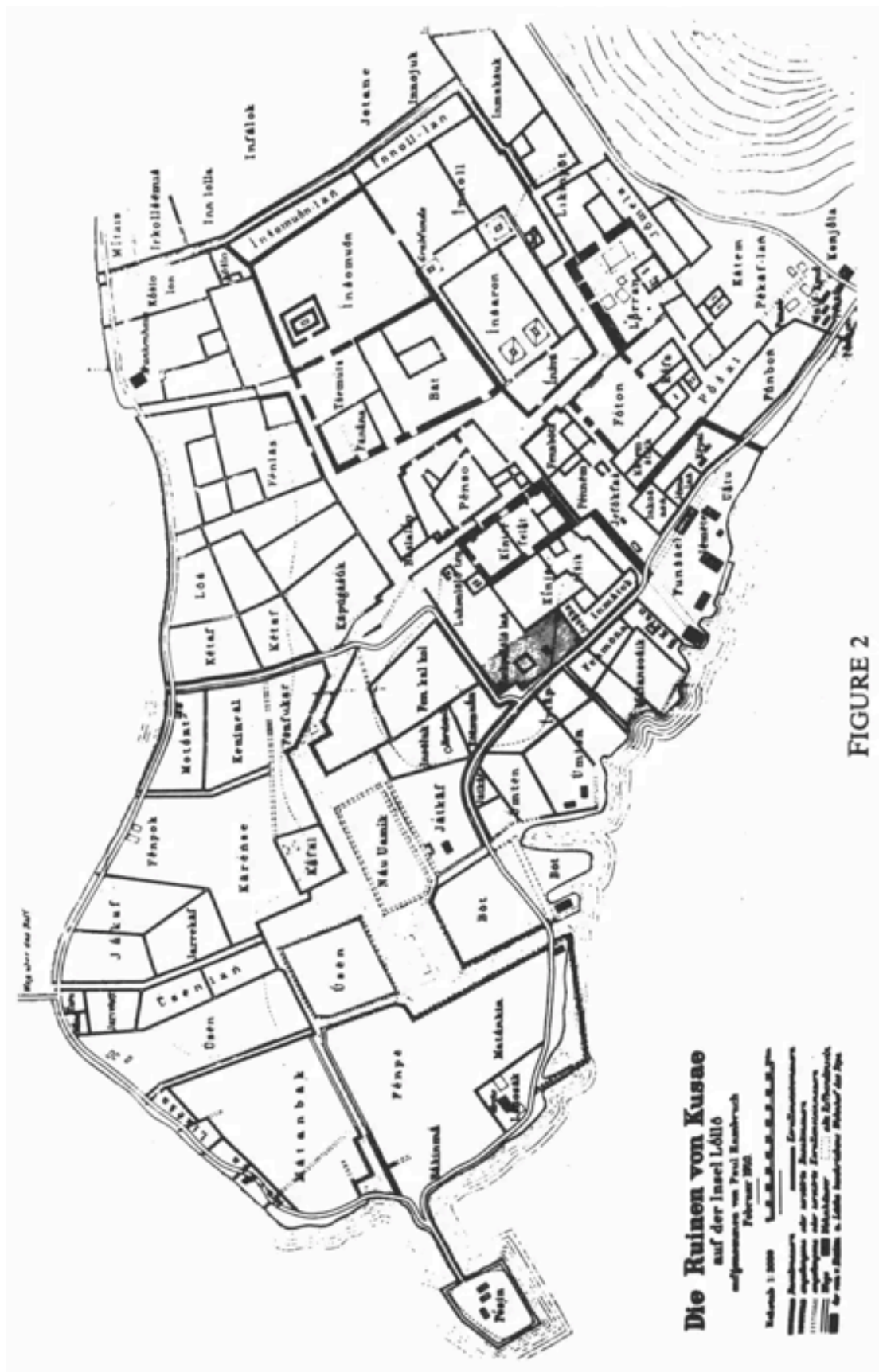


FIGURE 2

High chiefs and paramount rulers lived in the central area of Lelu in compounds

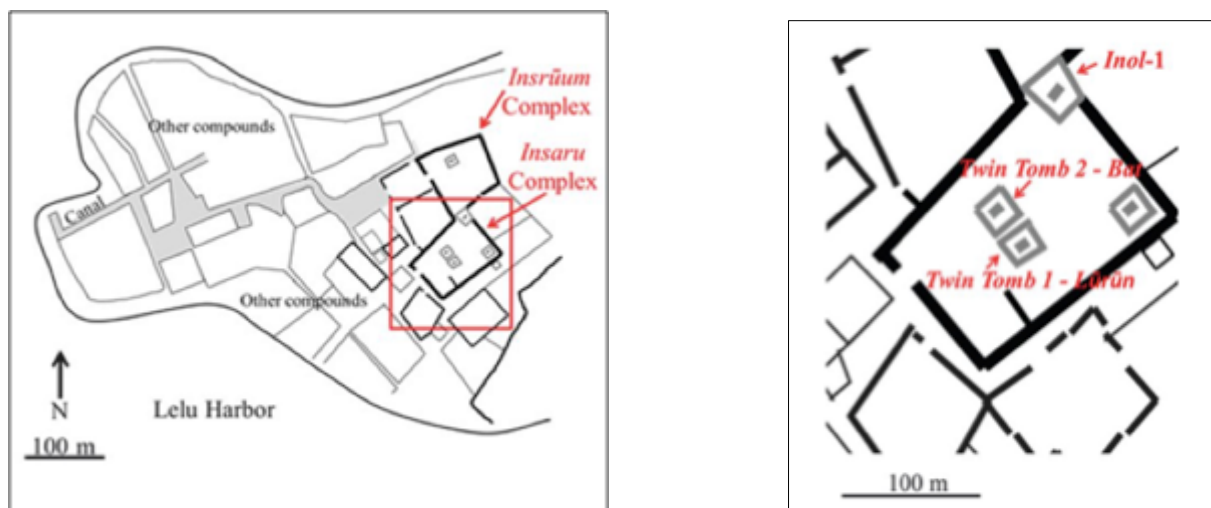


with thick walls that were up to 6.4 m high made of columnar basalt and rounded basalt boulders, enclosing as many as 8 houses (Ibid.). A low wall was built behind a large feast house located near the main entrance, separating it from the private quarters comprised of several smaller houses for the children, servants, the wives, and the lord himself. Gardens with medicinal plants were also located in this area, together with family cemeteries, although paramount rulers were buried in a separate compound built for that very purpose (Cordy 1985 and Morgan 1988 in Beardsley et al 2015: 242). Low chiefs occupied the west end of the island in compounds with low coral walls ( $\leq 1$  m high), and like their wealthier counterparts, their compounds consisted of several dwellings, cookhouses, and a feasting house. Commoners lived in the periphery of Lelu, their houses generally had no protective wall and consisted of three associated dwellings; this pattern was similar on the main island, with the addition of small nearby cemetery areas.

The sacred compounds have an associated spirit house and priest's house. They are located near the chiefly house sites in Lelu core, and also have thick high walls made out of basalt. These were only used for specific ceremonies (Cordy 1993 and Morgan 1988 in Beardsley et al 2015: 425)

Lastly, the royal mortuary complexes of Insru/Inol (four tombs) and Insruun (one twin tomb) are also found in the vicinity of the compounds of the high chiefs (see Figures 10 and 11); Associated funeral feast houses are located nearby. These compounds are accessible from the open sea via the central canal. The basalt walls surrounding the tombs are dressed with coral caps. The tombs consist of truncated pyramids about 3 m high and are unique to Lelu. They have cores of columnar basalt with a flat coral facing enclosing a single crypt with a cribbing of columnar basalt. After a public display that lasted several days, the body was laid down in the crypt with burial goods. After several months the remains of the Tokosra were taken to Yenasr islet, where the deceased was honored in a special ceremony before the remains were deposited in a hole in the reef known locally as the “Blue Hole” (Ibid).

**Figures 10 and 11:** The Royal tombs in Lelu core (Richards et al, 2015: 2)



**Findings & Discussion Site 1A:**

## I. The Significance of the use of Coral in a Mortuary Context in Lelu, Kosrae

Archaeologists and researchers have noted that the tomb complexes of Lelu are built using coral in a manner different from the secular buildings of the site. They discuss in detail the use of coral fascia, filling, etc, and although they all point out that this served a specific ritualistic purpose, none have suggested what this might be. Considering that Micronesians and Polynesians share a common ancestry and that many of the fundamental concepts regarding death and the afterlife are shared between the two, we propose that the same as elsewhere in Polynesia and Micronesia, the use of coral—aside from a decorative function—is best understood as an article that facilitates passage to the spirit world in the ocean, by being an object that manifests qualities of both the land of the dead and the land of the living; it seemingly possesses some of the same qualities of stone (strong, enduring), yet it is material that originates from the sea.

The constructions of Leluh involve the use of basalt and coral in a variety of styles. These have been categorized into the following (Beardsley et al 2015: 425-428):

- a) High walls with lower courses of large block basalt, upper courses of columnar basalt placed in a header-stretcher pattern
- b) High walls of rounded basalt
- c) High walls of block basalt
- d) Moderately tall walls of header-stretcher columnar basalt capped with flat coral
- e) Moderately tall walls of rounded basalt and rounded coral
- f) Low walls of flat coral.

While the filling of the islets was most easily made with coral, and the material is easily accessible from Lelu, archaeologists and ethnographers working in Lelu have repeatedly suggested that the use of coral appearing in a mortuary context seems to serve a more specific purpose. Rainbird specifies:

The use of coral rubble at Leluh appears to be spatially distinct and, given its contexts, may have imparted specific meaning. As noted above, at Lelu the mortuary enclosures and their associated tombs are central to the complex and the tombs are constructed using basalt in the style of a four-sided, truncated pyramid, covered by a layer of coral rubble. Similarly, the boundary walls of the mortuary compounds, unlike other walls at Leluh are constructed of basalt capped with coral rubble. [...] The coral clearly demarcates these non-domestic enclosures, and this must have been the intention of the builders. Corals cover the tombs and forms a clear boundary around them. That coral is significant in a non-secular context appears likely, and may indicate a non-secular function for the Lela ruins. (Rainbird 2004: 221)

So what would be the religious function that Rainbird suggests? Among the places with the greatest similarities in sacred architecture to Leluh is Nan Madol. Thus a look into the use of coral in Pohnpeian burials may help contribute as to the purpose behind the coral components in Kosraen noble tombs.

On Pohnpei, monumental burials (*lolong*) were also built using a filling of coral or as parts of the walls. Ayers noted: “Some enclosing walls for *lolong*

structures within the Nan Madol complex are entirely of coral with little or no basalt stone facing,” (Ayres and Seikel 2014: 152-153). Ayres and his team later point out that incorporating small pieces of coral in the platform or wall construction stresses the ritualistic use of a material with a *marine* provenance. They observe:

The ritual significance of this has been considered, and it is noteworthy that the *lolong* constructed almost entirely of coral within Nan Madol are in the so-called “priestly” sections of the eastern seawall set of artificial islets [...]. The practice of incorporating small quantities of coral in the architectural fill of the *lolong* [...] is one aspect of probable ritual use of marine material. While little ethnographic detail exists, material from the sea was purposefully buried or incorporated into the stonework of these structures, presumably for symbolic purposes. [...] Other marine associations are documented in the presence of marine shell. Bivalves, especially pondylus (*Spondylidae*) and Tridacna (*Tridacnidae*), as well as Conus (*Conidae*) shells were important for producing shell ornaments, and [some are] associated with graves, especially in the Nan Madol context (Ayres and Seikel 2014: 154-155).

Ayers and Seikel have pointed out similarities between Tongan stepped pyramidal tombs, which also incorporate large coral slabs, and the monumental burials of Nan Madol, concluding that “The Pohnpei pattern is best understood as part of a broader development encompassing Eastern Micronesia and West Polynesia” (Ayres and Seikel 2014: 163). Considering these relationships, Lelu would also show conceptual similarities with their counterparts in Tonga. Within those broader associations, we suggest extending the *comparison* to the Marquesas, Ra’ivavae and Rapa Nui (a.k.a. Easter Island) for if one were to find the same significant fundamental concepts as widespread as that, then it would suggest that these traditions might be shared from the time of their early Austronesian ancestors, and the practices of one, may shed light on the other.<sup>6</sup>

Coral rock is rare in the Marquesas Islands of French Polynesia, but it was used in tombs and sacred architecture located up to 4.8 km inland (Linton 1925: 156). The reasoning for this has not been discussed at length, it is implicitly accepted that it is because the Marquesan spirit world lies in the depths of the ocean, as noted by E. Edwards during his many years of fieldwork in the area 1984-1992. The people of Ra’ivavae in the Austral islands of French Polynesia used large slabs of unworked coral as the receptacle of the spirit of deified ancestors during Ancestor Cult ceremonies and also in the construction of tombs. Again, its use in this context is because one of the properties of coral was to facilitate mediation between the different spheres of existence as per its marine provenance, because the spirit world was believed to lie in the depths of the ocean.

The Rapanui who in their isolation maintained an early form of the Polynesian language, and who are believed to be fruit of two migrations who fused together in the Gambier islands –one originating from the Australs, the other from the Marquesas – espoused the same beliefs. On Rapa Nui, where coral is present, but not in a reef, there are no burials with coral assemblages, but coral was used in a sacred context, restricted a few very special ceremonies supported by fundamental Austronesian beliefs about the afterlife.

Like the Micronesians, the Polynesians had a cult venerating their ancestors,

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<sup>6</sup> Other candidates for comparison undoubtedly exist, but as per the scope and time limits of this report, we have limited our discussion to the selected three: Marquesas, Raivavae, and Rapa Nui, considering them to hold a strategic placement in the cultural and physical landscape of Remote Oceania.

and the spirit of the deceased could be temporarily summoned through ceremony for the purpose of worship. As was the case in Easter Polynesia, the clan deity would generally embody a *moai* (ancestral figure) and the statue became “alive” with the spirit of the ancestor only when the eyes—made out of coral and obsidian or coral and red scoria—were set in place. Another ritual involving the use of coral however is more precise in its function. The Rapanui placed stones encrusted with calcareous algae over the headdresses of the *moai* statues to absorb the *mana* of the ancestors, later to be used in ceremonies regarding the cultivation of sweet potato. *Mana* is another Austronesian term of widespread dispersal; although difficult to translate, *mana* may be interpreted as an aggregation of the following words: magic, supernatural, psychic, divine, power, authority, charisma, status, and influence. Unlike the use of coral to carve the eyes of the statue, which despite its straightforward import may be interpreted as used solely for aesthetic purposes, the significance behind the ritual with the coral-encrusted stones, rests upon the fact that they allow communication with the spirit world as objects that originate from the ocean (Edwards and Edwards 2015: 219).

Considering all this information, it is reasonable then to infer that the ritual use of marine material in the tombs of Leluh mentioned by Rainbird has to do with the fact that for area people, the ocean and the underworld were very much connected. This was true in Kosrae, exemplified in function of Yenasr islet and the “Blue Hole”, and in Pohnpei where “the structure of the cosmos for the ancient Pohnpeiians - similarly to other places in East Micronesia - had four basic parts: (a) a layered sky world; (b) the land - Pohnpei; (c) the sea; and (d) the world under the sea, the residence of the spirits after death that joins the sky at the horizon” (Dobbin 2011: 75). Perhaps in the case of Kosrae, Ponpei, and Tonga, with the earthen burials that were surrounded by heavy slabs of rock, and even walls in the case of Leluh and Nan Madol, the use of coral may have been a way to ensure and facilitate communication/passage with their final resting place in the depths of the ocean (Ibid).

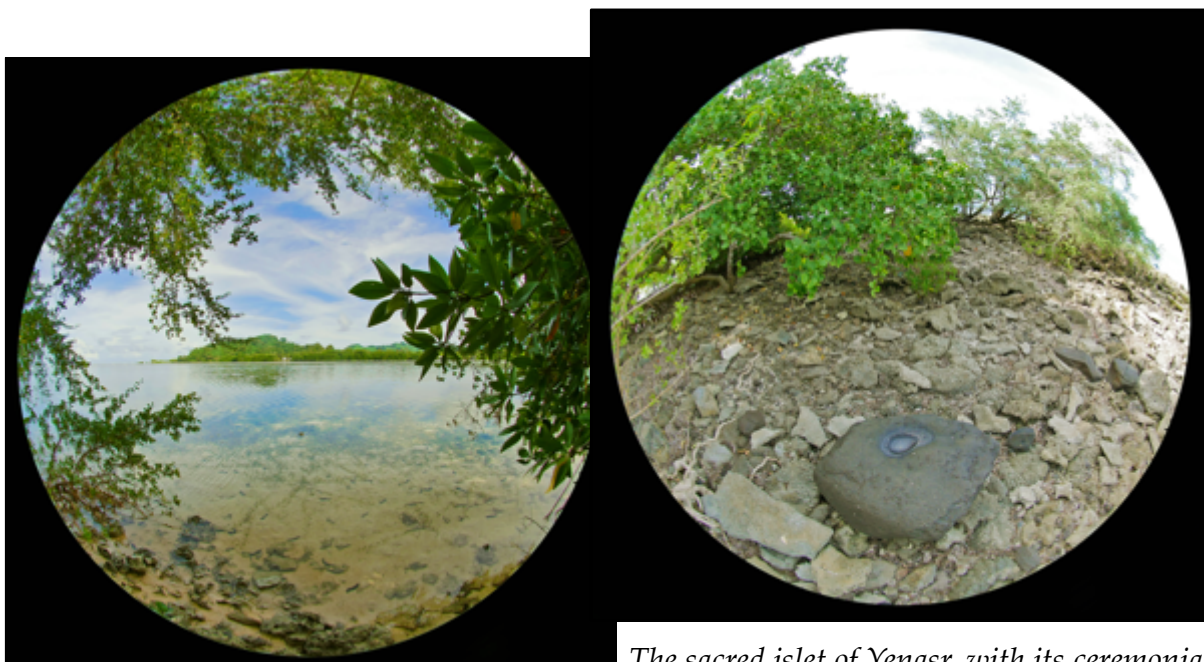
Regarding the diversity of burial types, either because of status or chronological differences, on Pohnpei, aside from basic grave, burial platforms, and monumental tombs sometimes the dead were buried at sea or set adrift in a ritual canoe. These seem to have been early Austronesian burial traditions with boat burials being recorded in the funerary practices of the Philippines, several regions of Malayo-Indonesia, the Marquesas, Hawaii, an even Rapa Nui during the early and middle historical phases (see Figure 10; Mahdi 1999: 165-168; Ayres and Seikel 2014: 132-134; Edwards and Edwards 2013: 304). What links these practices to cultural dispersal is the fact that these were not necessarily privilege burials, and that in the case of the Marquesas and some parts of Indonesia, actual coffins were built in the shape of boats and the words for boat and coffin were one and the same. Over time, burial practices diversified and this remained a common practice in fewer areas, but spread very far apart.



*Manunggul Cave burial jar depicting the ship-of-the-dead motif (the Philippines 890 to*

In the case of Kosrae, a secondary water burial called *kosanon*, took place 2-3

months after the earth burial of the deceased. The remains of the dead were cleaned and then sunk at sea, sometimes after the body was treated to a partial mummification, all of these also practiced in places as far as the Marquesas and Rapa Nui (Sarfert 1919 Vol II: 314-315, Edwards and Edwards 2013: 272). The remains of the paramount chief were taken from Lelu to Yenasr before dropping them into the deep hole in the reef lagoon known as “The Blue Hole” (Beardsley et al 2015: 424). Both water and canoe burials relate to the pan-Oceanic notion that the spirit world—where most human souls wandered to after death—was either a real or mythical island to the east (generally), or in the depths of the ocean (Edwards and Edwards 2013: 103-105; Sarfert 1919 Vol. II: 314, 413; Beardsley et al. 2015: 424, Dobbin 2011: 75). The significance of the East cardinal point and possible observation of the equinoxes and solstices will be discussed in the next section.



*The sacred islet of Yenasr, with its ceremonial sakau (piper methysticum) pounding stone*

#### **Findings & Discussion Site IA:**

#### **II. Observation of the Solstices within the Context of Lelu, Kosrae**

While conducting our investigations on Kosrae we were fortunate enough to meet several people who were interested in our research and we were happy to share our thoughts and findings with them, hoping that they might be able to accomplish what in the limited amount of time we spent there and considering the technical difficulties we encountered, we had not been able to do. One of these people was Maria Grazia Fanelli Stephens. Fanelli Stephens conducted her own independent research, which with her consent we would like to include here, since her observations relate to our investigations and we believe that they merits mention within a more scientific framework.

Fanelli Stephens noted that on December 16th 1827, the Russian naturalist, Baron Heinrich von Kittlitz visiting Kosrae on an expedition, set out to explore some villages, but found them deserted except for a few men. He surmised that everyone was attending special ceremonies taking place in the capital. On December 21, the Russians spent the night in Lelu. Von Kittlitz writes:

At midnight, we were awakened and, to our great surprise, invited to see a *cochon* [pig]. Indeed, after a pair of partitions were removed, a large, very fat pig was led past two sides of the building by several people carrying burning torches of dry coconut leaves. We had not earlier known of the existence of such animal (Ritter & Ritter 1982: 47-48).

Von Kittlitz later reminisced:

These massed accumulations of people in the capital, especially of the females, while on the land empty houses and always only few people were found, must absolutely have a significance. (Ritter & Ritter 205-206)

From Sarfert it is possible to propose that the people were indeed celebrating and that it was probably related to the breadfruit harvest:

Kusae is blessed with breadfruit trees in a lavish manner and their ripening times, approximately from June to August and from December to February, are the natives' feasting times of the year, when life is easygoing and gourmet like and when everybody feasts on these most prized fruits. The summer harvest yields more fruits than the winter harvest. Because the different kinds do not ripen at the same time. (Sarfert 1919: 95)

Dances until midnight were held on the nights of the full moon on Pohnpei, the Marshalls, and the Gilberts, and presumably also on Kosrae, but that year the new moon was on December 18<sup>th</sup>, so both the 16<sup>th</sup> and 21<sup>st</sup> of December the moon would have looked like a very slight crescent moon. Nevertheless, it would seem that December 16<sup>th</sup> is the time of the heliacal rising of Arcturus, and the start of a new month on Kosrae. Whether the December 21<sup>st</sup> feasts documented by Von Kittlitz were related to solstice observation merits consideration as Fanelli Stephens has suggested.

Earlier in the report we mentioned that Micronesians supported a solar year as well as a sidereal year and that Micronesians were aware of the compass positions of the sun on the Equinox (in line with Altair); they also knew the maximum northward and southward excursions of the sun (the solstices) by setting it against the position of Antares and the Pleiades in the night sky. So there is a possibility that the solstices would have been observed, but whether the feasts witnessed by Von Kittlitz in 1827 were related to the solstices is likely, but still uncertain.

We could not find the original reference in Sarfert, but in her fieldwork report about Menka, Beardsley quotes an oral tradition recorded by the German anthropologist that tells an alternative story about how Kosrae was created:

The village rests at the foot of Mt. Finkol, which in the oral histories plays a significant role—Finkol is the head of a snake monster that gave birth to the island and formed the mangrove channel surrounding it. In the legends, Fin, the highest point or place, and Kol, gold or shiny, referred to the image of the mountain when viewed from Leluh: under a full moon, at certain times of the year, the snake monster would be called to the surface; proof of its presence was the transformation of the top of Mt. Finkol into a pair of glowing eyes (Beardsley 2014: 197).

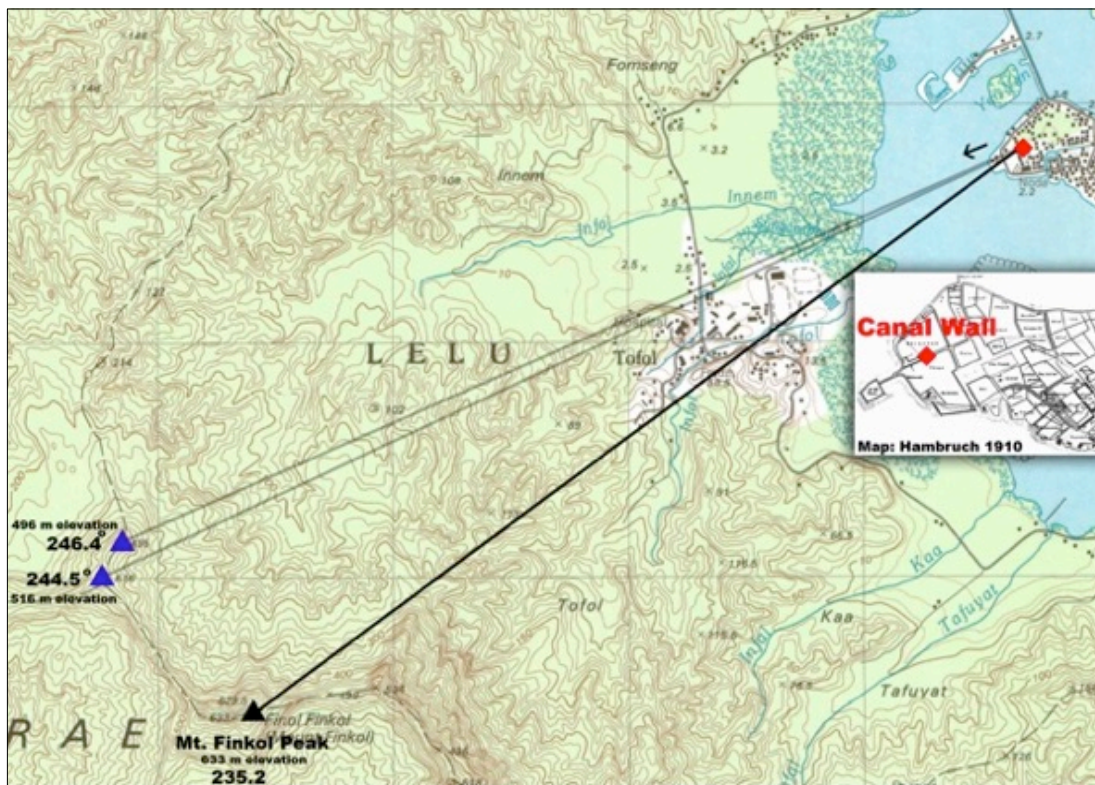
From this tradition, it is possible to postulate that in ancient times it may have been possible to observe an interesting visual effect on Mt. Finkol, the highest summit on Kosrae, as viewed from a specific vantage point in Lelu when conditions

met (ie. the perfect climatological conditions or the cast of shadows during a specific time of the year). Considering the height of some of the walls in Lelu core, it seems likely that the lookout point would have been located close –but outside of– the sacred sector. The best unobstructed vantage point may have been from atop one of the large retaining walls. Sarfert mentions a place at Lelu that seems quite fitting:

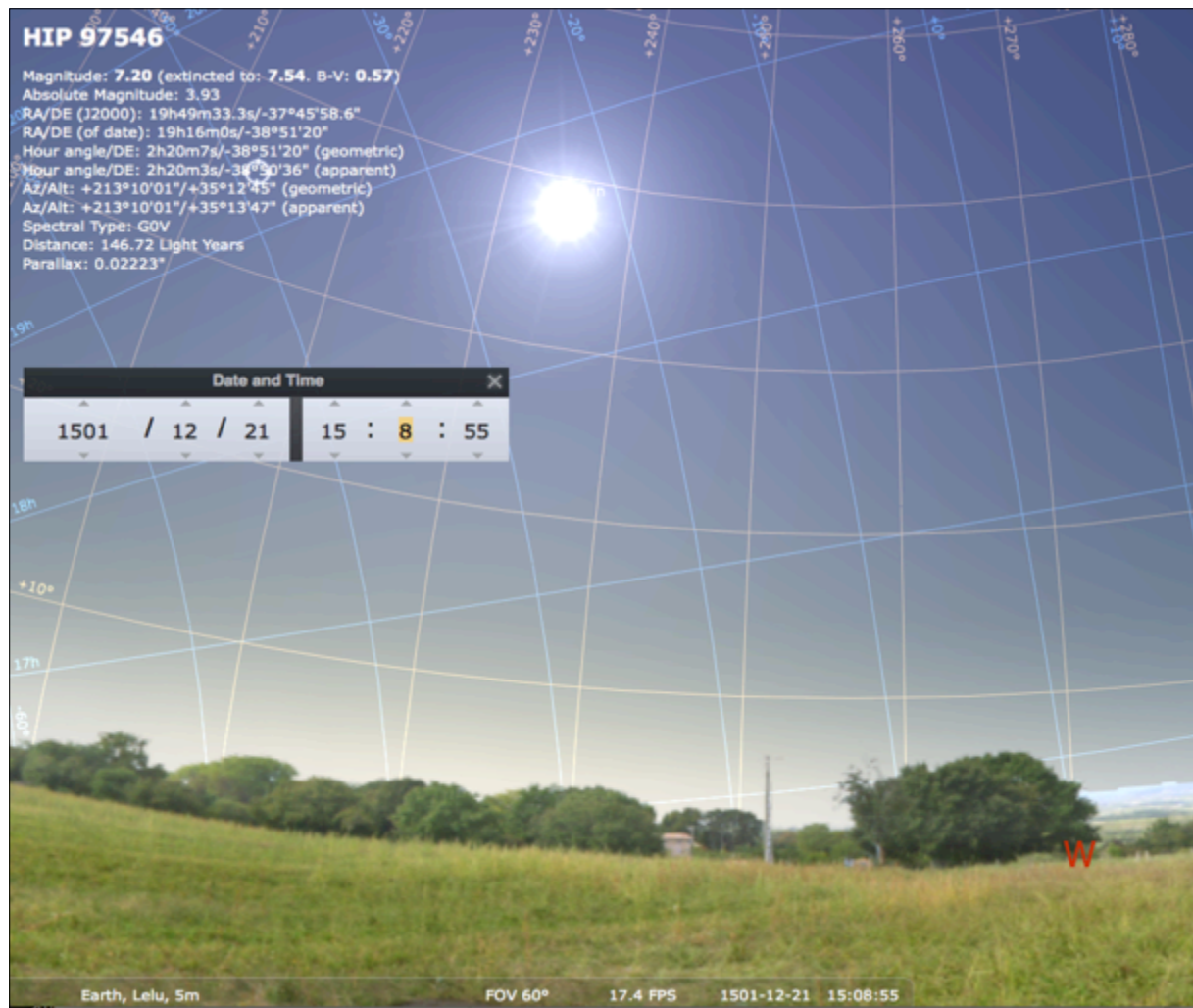
A part of the top of the huge channel wall had been made ready, so that in the beautifully moon lit nights people liked to sit there. A special sitting opportunity was the 24 m long and 1 m wide wall path on the inner side of the channel wall in the W corner. (Sarfert 2019: 279)

The above information, seems to reinforce the idea that an astronomical event—maybe marked by the position of important seasonal stars at sunrise or sunset—was observed from a determined spot in Leluh—perhaps Sarfert’s wall—in conjunction with a topographic feature on Mt. Finkol (not necessarily the highest peak, but a very prominent feature as has been seen in topographically-aligned sites in Polynesia (Cruchet 2013 and 2015; Edwards and Edwards 2013: 198-202; Edwards 1995). The position of Lelu in relation to Mt Finkol also raised the possibility of an alignment to the December solstice. As far as we know, direct solstice orientations have not yet been recorded in Micronesia before, but archaeoastronomy studies in Micronesia have also been very few, and our findings have suggested two other solstitial alignments with Mt Finkol elsewhere on Kosrae (see Menka, next section). Examining the collected data, we were able to plot a theoretical alignment to the December solstice, as seen from the location of Sarfert’s wall in Lelu to the summit of Mt. Finkol (see Figures 12 and 13).

**Figure 12:** Possible solstitial alignment between Lelu the Mt. Finkol ridgeline.



The orientation falls within the range of the December solstice, whose compass position is (246.5°) on the horizon, but is seen at 235° when it is 38° above the horizon (see Figure 13).



**Figure 13:** Position of the sun at 235° when at 38° above the western horizon as seen from Sarfert’s wall on Lelu (reference time and date: December 21st, 1501, at 15:08 pm).

At the moment it is not possible to confirm the exact time and altitude of the sun before it dips behind Mt. Finkol. Further studies *in situ* on the day of the solstice would be required. We will discuss the possibility with Fanelli-Stephens. The ostensible alignment may be no more than a myth, however, if it was not, the purpose behind such an observation would have most likely been part of a ritual calendar involving the December breadfruit harvest and related festivities, which were known to play a key part in the Kosraen annual cycle. This solstitial observation may or may not be independent of the oral tradition recorded by Sarfert.



## Expedition Site 1B: Menka, Kosrae

Much more discreet and quiet than Leluh, the ancient sacred site of Menka, sits amidst the tropical jungle rain forest at the foot of Mt. Finkol, in the southward district of Utwe. Felicia Beardsley is the foremost archaeologist working at the complex and during her many years of fieldwork identifying the site, amongst several other features, she recorded two temples that were related to a cult honoring Sinlaku, the goddess of breadfruit. The smaller of the two temples is older than Lelu and is located further upslope at the edge of a ravine; it consists of a single two-room structure reserved for ceremonial priests, and a nearby altar with a once colonnaded promenade that was oriented to the peak of Mt. Finkol. Basalt statues of fish, a clam, manta rays, and turtles, are clustered a bit further up, by the ravine.<sup>7</sup> Downslope, at an elevation of 77 m there is a larger temple of more recent construction that was built to welcome the great many visitors who would have arrived at there to worship Sinlaku. Menka, nearly at the heart of Kosrae, was the seat of a cult dedicated to this goddess, which in former times was the most important deity of the island.



*Lower Temple ruins at Menka, Kosrae (Photo A. Edwards)*

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<sup>7</sup> Due the thick forest growth, except for a large statue of a head with two faces, we were unable to see the petroglyphs and statues associated to the Upper Temple.

## Findings & Discussion Site IB:

### I. Solstitial Alignment at Menka, Kosrae

From a cultural perspective, Menka is at the heart of Kosrae's traditional culture, as the center of the old religion. Although very little is known regarding the activities related to the cult to Sinlaku, or the exact manner of worship, Sinlaku is described by visiting ethnographers as both a prophet spirit and a feisty goddess. As the former, Sinlaku was responsible for medicine, magic, and premonitory dreams, but as the latter, she presided over activities related to breadfruit production and could produce food despite the dry season, but she also brought typhoons, famine, and drought when unhappy. According to legend, Sinlaku returned to her home in Yap when the first missionaries arrived in 1852 (Beardsley 2014: 195-197).<sup>8</sup> In essence, Sinlaku was a goddess of the realm of weather prediction and the seasons, including most importantly food resources, but her foreign roots also spread her influence to navigation, all of which are related to skywatching. The location of the Upper Temple of Menka in relation to Mt. Finkol shows, as Esteban noted, an alignment to the June solstice, expanding the function of the site to the observation of the sun at the time of the greater breadfruit harvest and related festivities.

Before Beardsley, Menka was regarded as a semi-mythical place. Over time—after the upheavals that swept Kosrae in the 1800s-1900s—the village, which was said to support a hundred houses within its boundaries and purportedly congregated 1,000 followers during the feast season, was abandoned (Beardsley 2014: 198). However, ethnographic sources and Beardsley's findings indicate that at least part of Menka—the Upper Temple—was *reserved* for the powerful elite, namely healers and sorcerers who met at specific times of the year in a ritual cycle, that included rites related to the breadfruit harvest and mediating between the goddess and the people (Beardsley 2012: 8). That her priests and sorcerers must have been skilled in the arts of skywatching, is almost a fact. As the keepers of time and sacred lore, Skywatchers were in a position of great responsibility and power. The harvest was important not only as related to food production and surplus, but through feasting and ceremonies it was also of great social and symbolic significance. Food-sharing expressed kinship ties and solidarity, and validated a set of principles, social codes, rights and duties. It was imperative that the seasonal activities and feasts should be performed at the right and auspicious times.

According to Hamlet Jim, an informant to Beardsley, the ancient name of the village was *Monika*, which means something like “this is the right place for Sinlaku, that she and this place are just right for the people of Kosrae” (Beardsley 2014: 197). *Monika* may also be interpreted in a strictly literal sense, where the location of the temple to Sinlaku is exactly in the right position within the landscape to be able to honor the goddess. Menka is one of the few archaeological sites located deep in the interior of Kosrae. It has already been mentioned that the colonnaded entrance to the upper temple lies in a “direct line-of-sight to Mt. Finkol” (Beardsley 2014: 202).

This is the same Mt. Finkol that from Lelu appeared as a mythological

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<sup>8</sup> Adding to the mystique of Menka is the fact that Beardsley registered a complete piece of stone money near the lower temple, in what is the first tangible connection to Yap (Beardsley 2012:10). It also seems to support the connection between Sinlaku and Yap, mentioned in the oral traditions.

monster whose eyes would shine on a specific full moon night (Sarfert 2019: 279). If oral tradition hints at Lelu having an orientation to Mt. Finkol for the occasion of a celestial event, it is possible to consider that the colonnade at Menka was also purposefully oriented to Mt. Finkol for the conjunction of astronomical phenomena. The Finkol alignment is what had attracted Esteban's attention, and in his preliminary studies he noted that there seemed to be a solstitial alignment.

It has already been mentioned that the seasonal calendar of Kosrae was linked to that of the breadfruit harvest, and that celebrations were held from June to August and from December to February, when the breadfruit was ripe. They offered the first fruits of the harvest to the high chiefs, as was customary in the entire region. (Beardsley Sarfert 1920: 403). What stars would the skywatchers have used to know when to declare the start of the activities that followed the months of June and December? The heliacal rising of the Pleiades on June 21, 45° up in the sky just before dawn, easily marks what is essentially the June solstice. Bernart mentions that the Pleiades were the stars of a time of plenty, the "greatest of all the stars. It is big and strong and it makes a good season and good winds", and indeed the June breadfruit harvest produced a greater surplus than the December one (Bernart 1977: 97; Sarfert 1919: 95). However, surely there were places with a better vantage point for skywatching than Menka. Kosrae is characterized by having a hot, rainy, and humid climate and Menka is well in the mountainous interior; on average, there is a third more rainfall at higher elevations than at lower ones, so what are the chances that any sort of astronomical observation could be carried out there at all. In actuality, the wetter months are February to April and August to October while the drier periods fall within the time of the solstices: from June to July and then again from November to January (Beardsley 2013: 10). Mt. Finkol was a legendary place and one must not underestimate the importance that traditional Oceanic cultures placed on topographic features, and the perceived "magical" qualities they were believed to possess (Cruchet 2013 and 2015). The observation would have been *more special*, more infused with magic, if viewed from sacred place like Menka in relation to Mt. Finkol, an arresting summit, rising highest into the sky. Beardsley states in her report: "Mt. Finkol was clearly visible from this site, and once dominated its skyline" (Beardsley 2012: 13). Considering all these factors, Menka was probably not a place where skywatchers habitually studied the stars, but rather a place where *a specific special event* was observed.

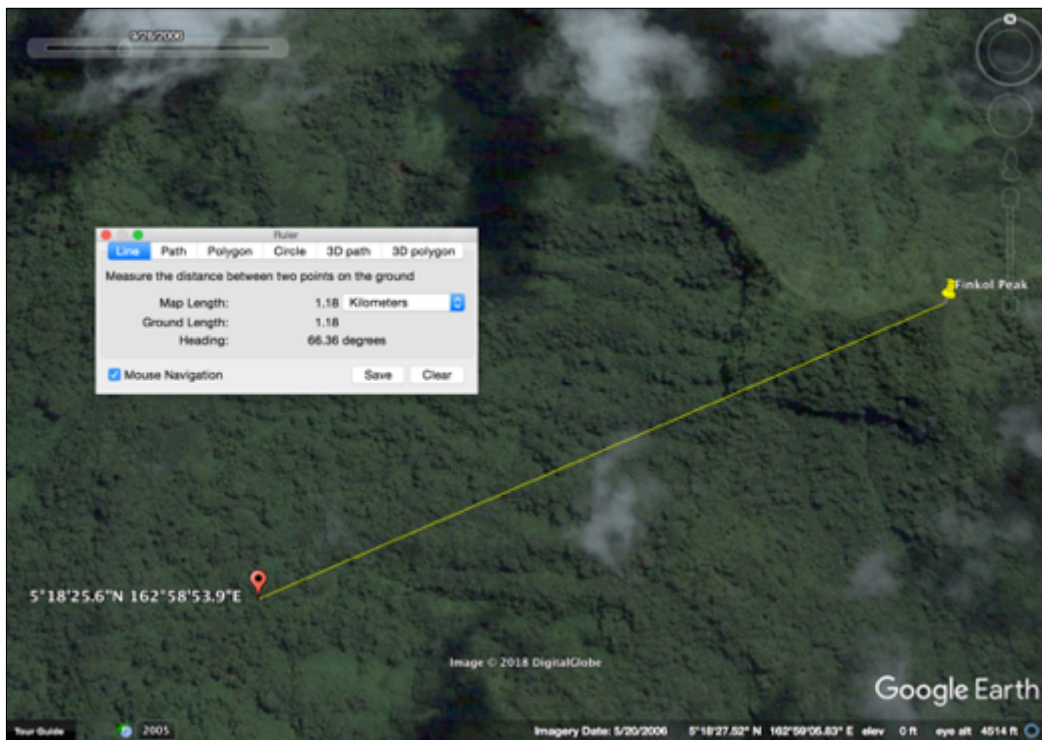
Although our measurements were invalidated due to faulty equipment and software, we were fortunate enough to be able to review Beardsley's final report and thus the GPS positions of the pathway of the Upper Temple. In her report, Beardsley states: "A paved pathway with shallow, broad steps and flanked by a colonnade of standing stones leads directly from the river to the compound, the altar and the statue cluster. At the end of the pathway (on the west side of the compound), there is a meter-long statue of a box-fish, *otwot* in Kosraean, a clan symbol." This is the same colonnaded entranceway that Beardsley states is in "a direct alignment to Mt. Finkol" (Beardsley 2012: 12; Beardsley 2014: 211) (see Figure 14). The GPS coordinates of the *Otwot* fish which lies at the end of the pathway, as registered by Beardsley, is 5° 18.427'N and 162° 58.898'E in degrees decimal minutes format (Beardsley 2012: 19).<sup>9</sup> When plotting these coordinates on a map of the island with Mt Finkol, the angle of the alignment is 66°. The Sun on the horizon at the June solstice would be rising at the 67°

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<sup>9</sup> This is equal to 5°18'25.6"N and 162°58'53.9"E in degree minutes seconds, which is the coordinate system used by the Google Earth application.

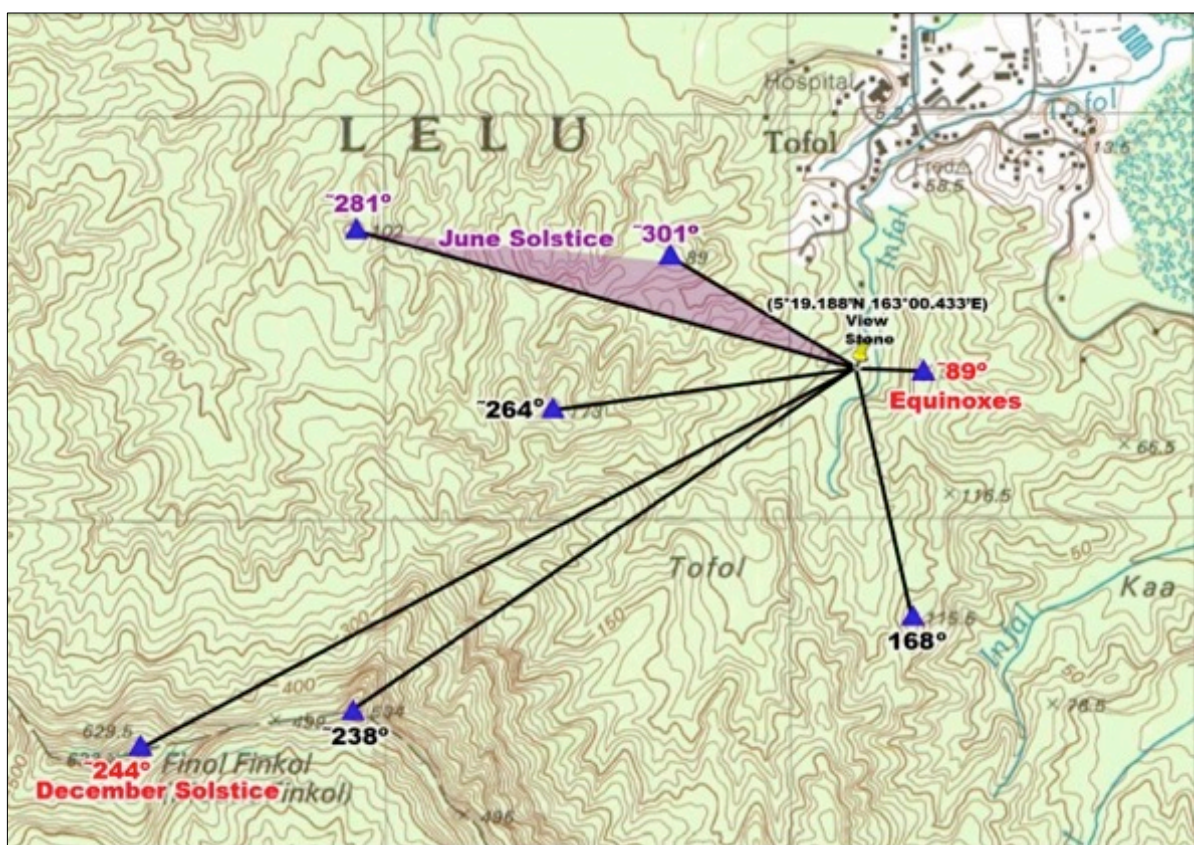
compass position (see Figure 15).

**Figure 14:** The main complex of the Upper Temple. Note the fallen columns of the once colonnaded entryway. The otwot fish statue lies at the end of the entranceway and follows the same line (Beardsley 2012: 30).



**Figure 15:** Angle of alignment between the Upper Temple entranceway to Mount Finkol

Taking into account that the exact angle of the sun will shift a few degrees southward as it rises and the timing of the event is not available without a study *in situ*, the solstitial alignment cannot be truly verified at this time. Yet considering all we have postulated above, there is a very strong argument in favor of an alignment to the June solstice.



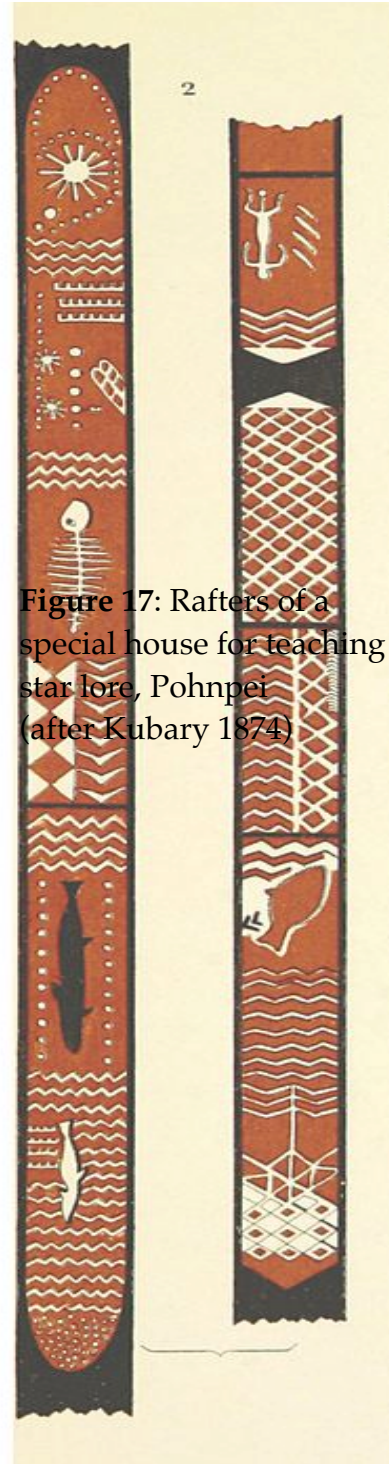
Going through Beardsley's report, and not part of our original project, we couldn't help but notice an entry in Beardsley's report registered as "Stone with view of mountain // Sleeping Lady "breasts" (the peaks of Tofol and Innem; Beardsley 2012: 19). This stone, which is associated to three graves—perhaps an indicator of a spiritual or higher significance—has the following GPS location: 5° 19.188'N and 163° 00.433'E (Ibid.). Plotting the stone on a map reveals that it seemingly lies in an alignment to the equinoxes in relation to a hill to the east, but also—if the views allow—to the June Solstice between two Mountain peaks at 293.5° and also the December Solstice in relation to the summit of Mt Finkol (see Figure 16). It would be interesting to see if there are any other alignments related to Carolinian calendar stars in relation to the other hills and mountain peaks visible from this location.

**Figure 16:** Possible alignments of the Mountain-view Stone

Being able to access Beardsley's GPS coordinates, allowed us to accomplish an important part of the goals of our project. We are confident in the research and calculations that allowed us to find these possible alignments, which being at least three so far as this report is concerned, and to the same prominent topographical features, affords our argument more strength. We hope that with the help of Fanelli Stephens or other local people from Kosrae interested in our findings, they may try and confirm our observations with visual evidence and or confirmed measurements.

## SECTION II, POHNPEI: Skywatching on Pohnpei

Most of the information regarding Carolinean ethnoastronomy today deals with navigation, and there is a wealth of material regarding this subject, which is beyond the scope of this report. However, it seems significant to mention that on Pohnpei, as in many area islands such as the Gilbert Islands, and Kiribati, navigational concepts were reserved for the elite, passed on from father to son, and lessons were taught in special houses whose rafters were painted to represent different parts of the sky (Kubary 1874: 35 1974: Grimble 1931; Turbott 1949). The ethnographer Kubary noted that on Pohnpei four out of 90 rafters were colored red and black, with motifs related to the rising of specific stars at sunrise and what they marked throughout the course of the year; such as fish, nets, fertility, etc. (see Figure 17, from Kubary 1874: Plate IX, No. 2). This would seem to indicate that the astronomical knowledge taught in these special houses was not restricted to



**Figure 17:** Rafters of a special house for teaching star lore, Pohnpei (after Kubary 1874)

navigation, serving also a calendrical function.

Pohnpeians divided the year between the rainy and wet seasons, *Rahk*, from March to September, and *Isol*, from September through March. These coincide roughly with the equinoxes, which is why some Micronesians celebrated a solar year that started in March (Esteban 2014: 182; Riesenbergs 1968: 78-85). The rainy season was the time of plenty and there were five feasts in honor of the breadfruit. *Isol* was traditionally the season of famine; during this time there were 6 feasts honoring different types of yam (ibid.). In the district of Kiiti there was a special priest by the title of *Saumwenleng* who celebrated an annual ritual of supplication and thanksgiving as part of the worship of the land called *Pwonginsapw* (Trussel based on Sohl et al). In addition, ceremonies termed *Pwonginsarawi*, “nights of sacredness” were also carried out during specific times of the year and war was taboo in this period for fear of supernatural punishment (Fischer et al 1977: 94). Evidently all of these activities would have required a specialized priest or skywatcher who could read astronomical phenomena in order to keep track of time.

On Pohnpei, the same as in other Western Pacific island societies, there were several different kinds of priests, higher and lesser ones, although many ceremonies were circumscribed to the chiefs themselves, they being considered the lords of the heavens and the most sacred beings in the land of the living (ibid.; Fischer et al 1977: 149). In past times there were a variety of religious specialists who mediated between the world of the living and supernatural forces, each responsible for specific tasks such as divination, healing, navigation, and controlling the weather, seasons, and victory in battle. From the accounts of different ethnographers, it would seem that Pohnpeian astronomer priests or skywatchers were called *Rakim* or *Saurakim*; nevertheless, this term has also been used to describe master storytellers, expert housebuilders and carpenters, as well as a god of disease, death, famine, and war; thus the term may either be interpreted as the generic word for master, sorcerer, or skywatcher, perhaps with overlapping functions (Fischer et al 1977: 5-8).<sup>10</sup> Nevertheless, it should be noted that nowadays the Pohnpeian term for a shaman/sorcerer is *Sounwinahni*, while a practitioner of traditional medicine is called *Sounwini*.

The Pohnpeian celestial dome was viewed as the underside of a roof, with the eaves coming down to earth like that of a house (Bernart 1977:28). The sky itself was called *Lang* (or *Leng*) and consisted of several superimposed heavens, one of which was occupied by the high gods and another by the supreme deity of Pohnpei and revered ancestors; meanwhile the underworld also had different divisions, one located in the depths of the ocean where the less fortunate human spirits lived, and another in a mythical island to the East that was accessed by a twisting bridge. (Fischer et al 1977: 159, 186, 188).

The same as in other Pacific island societies, the Pleiades and Antares were ranked as two of the most important Pohnpeian calendar stars (Goodenough 1953; Osmond 2007: 176). As previously mentioned in this report, Antares, in the western

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<sup>10</sup> Fischer et al (1977: 5-8) tell us that in modern times the term *Saurakim* (*Jaurakim*) refers solely to either either clan or master, the full word translating as “the fortune of the *Rakim* clan” or “the fortune of the Masters of *Rakim*” .

constellation of Scorpio was sometimes used to mark the year on Ponpei (Bernart 1977: 97-98). Although there are different accounts collected by European ethnographers in the late nineteenth and early twentieth centuries, according to native historian Luelen Bernart the Pohnpeian year began with the heliacal rising of Antares (March 21<sup>st</sup>—the Equinox) and ended with the heliacal rising of the Pleiades (about September 27). The Heliacal rising of Antares coincided with the blossoming of the Erythrina tree, thus the first part of the year was “called the Period of Erythrina (trade wind season, winter); and when the blooms fell down and were finished and the seeds started growing, the name of that time was changed to Period of Growth,” (Ibid.) Although Antares was evidently a very important star together with the other 11 that marked the Pohnpeian sidereal calendar, the Pleiades were considered the greatest of all the stars, a time of good winds and the breadfruit harvest (Ibid.).

Again, this is not the extent of Pohnpeian astronomical knowledge, but for the purposes of this report these are the concepts most relevant to our investigations  
**Expedition Site II: Pohnpaid and vicinity, Pohnpei**

#### **Findings & Discussion Site 2A:**

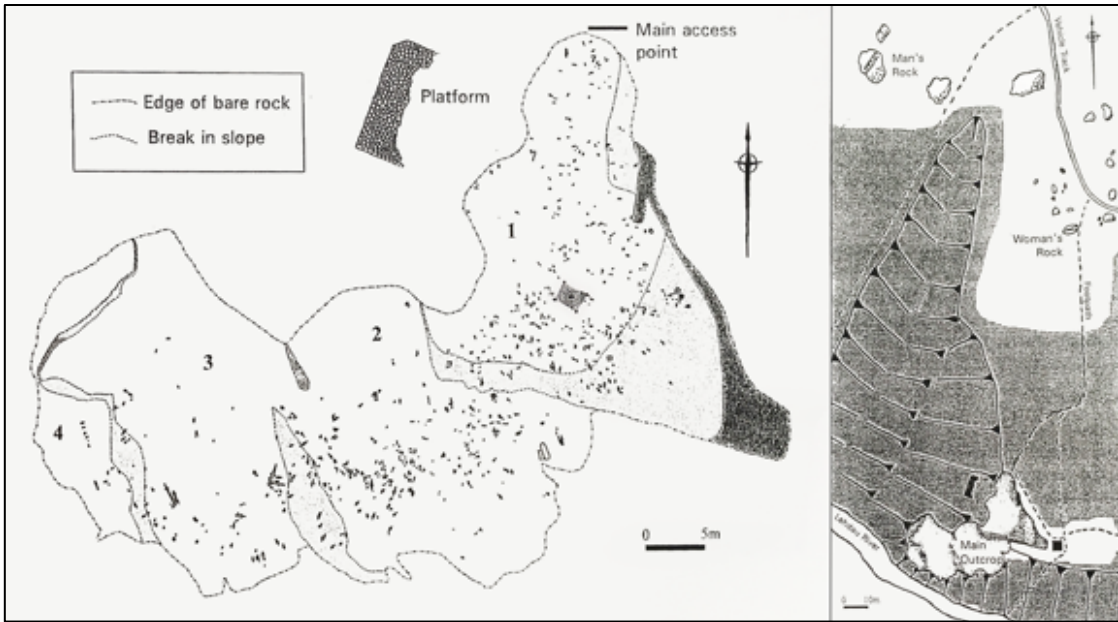
##### **I. Significance and Interpretation of the petroglyphs at Pohnpaid and its environs.**

Near Sapwalap village, next to the Lehdau River, lies a site this is unique in Micronesia: Pohnpaid. Petroglyphs are not common in Micronesia, yet archaeologists Rainbird and Wilson have recorded over 700 individual engravings carved on Pohnpei, at a site called Pohnpaid, meaning literally “on the boulder” (Rainbird and Wilson 1999). The petroglyphs are carved on 4 terraces of metamorphic rock on an outcrop measuring approximately 60x25 m at its widest points (see Figure 18). The Lehdau River lies about 20 m below the lowest terrace. About 70 m to the north of the site there is a grassy plateau with two tall rock outcrops and a cluster of several large boulders some of which are also covered with petroglyphs; this site is known today as “Takain Pahsu” (see Figure XX, inset). There is no definitive myth regarding how the petroglyphs came to be, the only agreement is that they were made “by an unknown ancient culture preceding that recalled in oral histories” (Rainbird 2002b: 239). The majority of the motifs consist of a number of repeated forms, which included human figures, feet, hands, dots, fish, canoes, the sun and moon, and many shapes often mistaken for daggers that may represent fishing lures or loom pegs. An especially interesting find is the presence of enveloped crosses that are a feature of Melanesian rock art, both painted and engraved, and which appear in Lapita pottery decoration starting about 1500-1300 BC in the Bismarck Archipelago (Rainbird 2002b: 233). Enveloped crosses appear in pottery in New Caledonia dated between approximately 50-900 BC (Rainbird 2002b: 239).

**Figure 18:** Map of Pohnpaid (main) and Takai Pahsu (inset). (From Rainbird 1999: 7-8).

Note the emplacement of the “altar” at Pohnpaid, marked by a stone rectangle at the center of the highest terrace (right).





What is known as Pohnpaid in the present-day has been called various other names in the past: “Inden-lang”, “Takai-nin-Talang”, “Takai-en-Intolen”, “Til-en” and “Takai-en” in different sources (Rainbird 2002b: 241 Bernart 1977: 15-16; Gulick 1871: 9; Hambruch 1936: 57). Considering the poor translation of native words by foreigners, the actual name may be inferred to be “Takai-Intin-Lang” (stone of drawings of heaven) or “Takai-in-Lang,” (stone of heaven) as recorded and translated by Bernart (Hambruch 1936: 57-60; Bernart 1977: 15-16). From the descriptions of Christian, Hambruch, and Bernhart it is possible to suppose that the name may not actually refer to Pohnpaid, but to a greater complex that included the Takain Pahu site; in fact, it is possible that the name *only* refers to what is known as Takain Pahu today, and because the two sites were associated in the past the line between the two became blurred (Christian 1899-99-100; Hambruch 1936: 57-60; Bernart 1977: 15-16). Therefore for practical purposes, further in this report we have decided to refer to the flat site with terraces as Pohnpaid, and the site with boulders as “Takai-in-Lang”, which we suggest as the more accurate name, one which alludes to the function of the stones within the physical and cultural landscape; in this scenario, “lang” or heaven, becomes a significant component of the name.

In one account, two magician brothers, Olsipha and Olsopha, the legendary builders of Nan Madol, are said to have created the petroglyphs on the flat terraces of Pohnpaid by laying down a blanket that was covered with designs (Ueki and Nena 1983: 537). Hambruch was told that the site was home to two men: Mahntik (Muantik,) and Mahnlap (Muanlap; Hambruch 1936: 57). As a means to explain the forgotten origins of the petroglyphs, Hambruch relates that the two men navigated away and were never heard from again (Ibid). There is in fact, an association to navigation regarding the oral traditions related to Pohnpaid and Takai-in-Lang. In Bernart’s account, two magician brothers, Sarapwau (Jarapwau) and Mwohnmur (Monimur), played at Pohnpaid before travelling to Yap (Bernart 1977: 31). Returning to Pohnpei, the two brothers, now called ‘Jenia/Puilitak (Mwohnmur) and Monia/Lejtak (Sarapwau) go on to create several



geographic features including two places called Takai-eu or “standing stone” (Ibid; Fischer 1977: 23). The first Takai-au is a stone (actually an island) in the district of U (Uanik) that the brothers brought from Yap through a magical spell; the other Takai-au, is a prominent steep rock outcrop located on the north shore of Madolenihmw Bay, by the entrance the *Sapwalap* estuary (Bernart 1977: 31-32; Fischer et al 1977: 23; see Figure 19).<sup>11</sup>

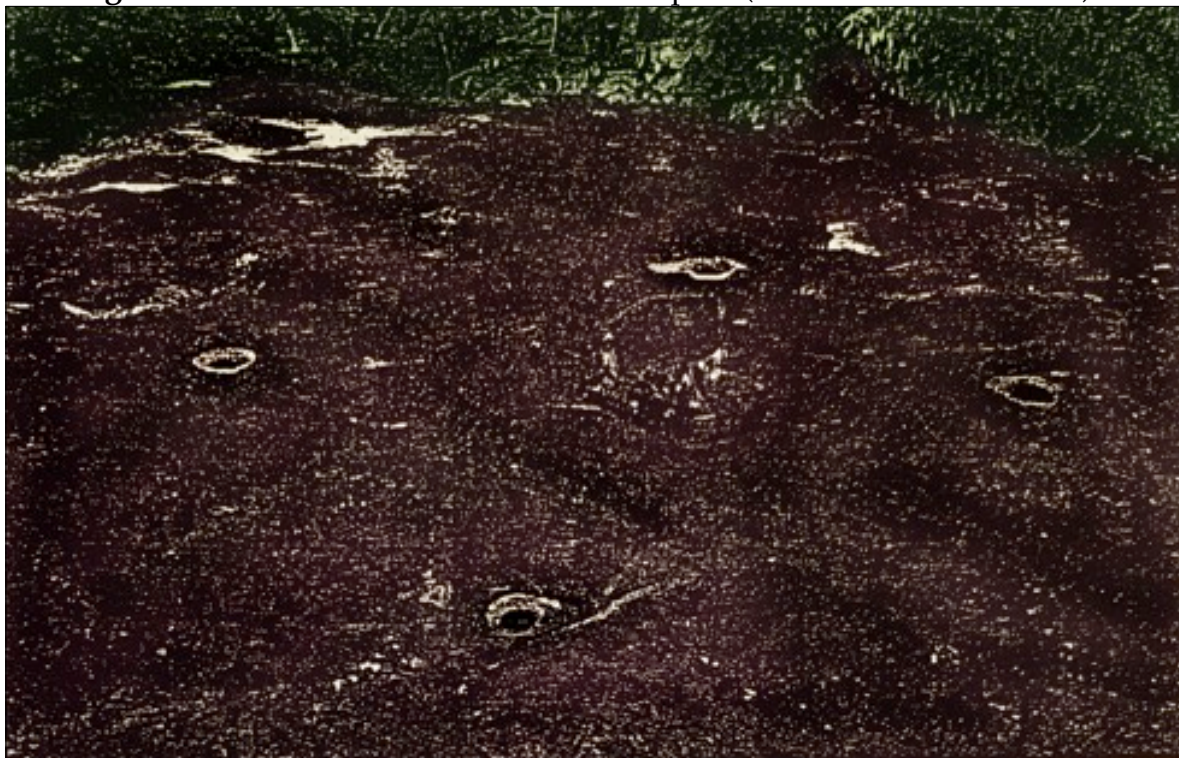
According to Bernhart, the Takai-eu in Madolenihmw Bay came to be when an older sorcerer, Lapoange (Lapone), challenged the two magician brothers to a duel of magic. The contest was for Lapoange to dig a channel through the island before the boys could build a mountain to the sky. The brothers worked at their task and soon had a mountain that reached the lower layer of heaven, while Lapoange, transformed

<sup>11</sup> The conspicuous steep Takai-u of Madolenihmw bay was known to nineteenth-century European visitors as the “Sugar Loaf.” It stands 160 m high and is shaped roughly like a traffic cone.

into a giant, dug a tunnel with his penis, creating the Lehdau channel (up to the emplacement of Pohnpai; Rainbird 2004: 238). Lapoange threw a *flat rock* at the mountain in envy; it fell apart into 6 pieces, leaving only Takai-eu (Bernhart 1977: 31). A mass of rock on one side of Takai-eu and more in the water below are referred to as the six pieces that were broken off the mountain, but nothing has been said of what became of the flat rock (Fischer 1977: 23-24). We propose that it may refer to Pohnpaid and that Takai-in-Lang mentioned earlier in the text refers to Takain Pahsu. Again, because the two sites are associated there has been confusion in connection with their names.

Located on the main engraved terrace at the top of Pohnpaid, there are 4 prominent postholes that belonged to what has been identified as a covered shrine or altar at the very entrance of the site, 1.5 by 2 m in size (see Figure 20). According to Rainbird, the long of the axis of the altar faces SE and lies in a direct line to the summit of a Takai-au, which we suggest connects the two places mentioned in Bernhart's account, making it possible to interpret it as the flat stone. Intriguingly, Fischer et al, needed help translating Bernart's text: "*palian japat pali*"; Oliver Nanpei translated it as "spear", but they noted that "*pali*, literally 'side', seems an unusual numerical classifier to use with a long object such as a spear," while other informants said they thought it referred to a flat rock. Perhaps the "spear" part refers to some of the petroglyphs at Pohnpaid, which are variously referred to as loom pegs, spears/dagger/swords, and fishing lures.

**Figure 20:** Postholes of the "altar" at Pohnpaid (From Rainbird 1999: 21)



Furthermore, there is perhaps another connection between Pohnpaid and Lapoange. What is known as "the magic door of Pohnpaid," —a section of the outcrop that consists of exfoliating rock and sounds "hollow" when it is struck—may relate to Lapoange's failed tunnel task (Rainbird 2004: 198). In Bernart's account,

after the challenge, everyone returns to Lehtau (Pohnpaid?) and the boys then descend to a place where the river widens and drown Lapoange (Bernart 1977: 32). The existence of these different versions only serves to reinforce the antiquity of the designs, and what stands out in these accounts, is that all are magicians (within the realm of skywatchers) and that Takai-in-Lang Takai-eu, and Pohnpaip are connected in a relationship with each other and the heavens. In addition, the mother of Sarapwau and Mwohnmur was born in the peak of Sapwatic (a high place, close to the heavens) and her name was Lienlama, meaning “a woman who could prophesy what was before us” or “woman of thinking” (et al. 1977: 21). This seems to reinforce the connection between the function of the stones and skywatching. It is interesting that in both Hambruch’s and Bernart’s accounts there is an association with greater Pohnpaid and navigation, and that it is always two brothers (under various names), that are connected.

Whether there is any significance to the alignment of Takai-eu we cannot say at this time. The angle of observation would be about is  $236^{\circ}$  ( $-124^{\circ}$ ). So far we have studied important calendar stars, the solstices and equinoxes, and no clear alignment stands out. Nevertheless, the commanding view Pohnpaid has of Nan Madol, immediately in front of it towards the coast is noteworthy. The emplacement of Pohnpaid is very favorable, providing a panoramic view of the landscape, overlooking a large quadrant of the eastern sky, which was in the direction where one could observe the heliacal rising of stars (see Figure 21).



**Figure 21:** Panoramic view from Pohnpaid.<sup>12</sup>

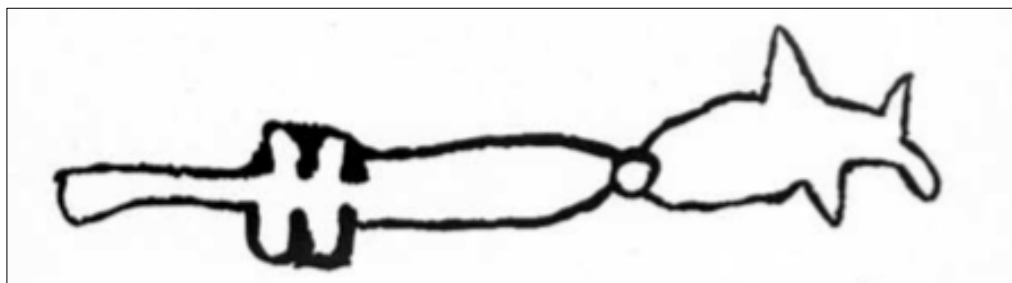
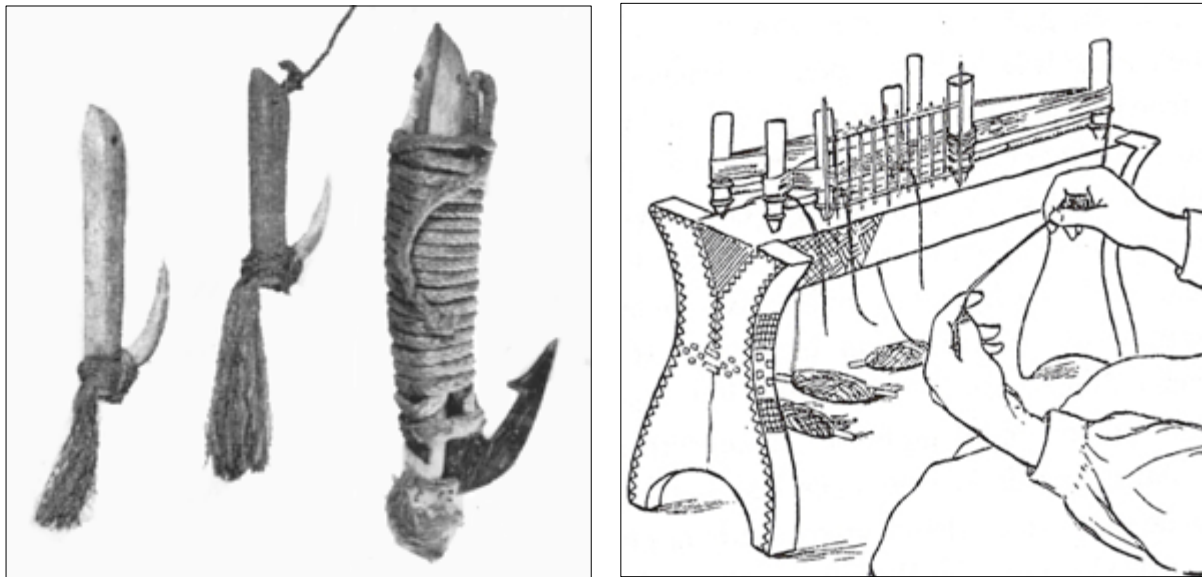
It is at an altitude of 77-72 m, Pohnpaid has a privileged view of the landscape before it, with large mountains lying to the West (behind it). It is located inland, but in a stretch of lower land that does not attract the condensation and cloud cover that encircle the mountainous areas. Carving rock art in the vicinity of places where astronomical events were observed was standard for other Pacific islanders, people who share key cultural traits with Micronesians with regards to skywatching and wayfinding, undoubtedly rooted in their common ancestry (Edwards and Edwards 2010a, Cruchet 2013 and 2015). Drawings related to the events marked by the stars that can be observed in a given area are one of the most common conventions

**Figure 22a:** Oceanic compound spinner type

**Figure 22b:** Kosraen warping bench with loom pegs (from Sarfert 1919: 177).

<sup>12</sup> The view is digitalised from downloadable topographic 3D maps of Pohnpaid for Google Earth offered by the Pohnpei State Historical Preservation Office. We used the maps since today the view is obstructed by vegetation.

in Polynesian rock art (ibid.). There is a particular design in the petroglyphs of Pohnpaid that has been especially hard to identify. It has been said to represent, among many other things, a loom peg or a fishing lure (see Figures 22a and 22b).<sup>13</sup> This intriguing design is the preeminent petroglyph in the lower terraces of Pohnpaid. An association to loom pegs exists in the oral tradition recorded by Bernart where the two brothers Mwohnmur and Sarapwau (meaning “loom peg”) create several features on the island while playing with their mother’s loom peg before arriving at Takai-in-Lang (Bernart 1977: 31). However, there is a very strong argument regarding the fish lure interpretation. The archaeologists who have most worked on the site have identified them as lures because two petroglyphs—not superimposed from different eras—show these instruments set in the mouth of a fish (see Figure 23).



**Figure 23:**  
Possible

representation of a fish caught by a fishing lure (from Rainbird 2001: 239).

The type of lure in question is a specific lure, which existed in parts of Melanesia and Micronesia; it is called a compound spinner type, and was the only hook to exploit the surface feeding habits of certain deep-water fish. The shank of the hook was made of mother-of-pearl shell, and affixed in lures that ranged from 5 to 15 cm long, excluding the feathers (Reinman 1967: 135-139; Rainbird 2004: 197; see

<sup>13</sup> The dagger or sword option has been discarded as neither existed on Pohnpei at the time when the petroglyphs were probably carved.

Figure 23). Oftentimes the hooks were un-barbed for easy removal.

It has been argued that deep-sea fishing was not widely practiced on Pohnpei because there is little evidence of pelagic fish remains found in middens, but it is also possible to consider that, like turtles in Polynesia, deep-sea fish (mostly bonito) were a catch reserved for the elite, not meant to be shared with the populace (Rainbird 2004: 196; Rudrud 2010). Since these hooks were made out of mother-of-pearl shell, a material of foreign provenance in Pohnpei, Hambruch and Eilers found that pearl shell lures functioned as a shell valuable or type of money; lures appear as status goods in noble burials at Nan Madol together with rare basalt stone adzes and imported obsidian flakes (Rainbird 204: 186). In addition, there are also a few motifs that may be interpreted as representing canoes and fishnets, making marine motifs dominate the iconography at Pohnpaid (see Figures 24 and 25).<sup>14</sup>

**Figures 24 and 25:** Petroglyphs possibly representing a fish net (left) and a canoe (right) (Photos by John Amato)



The Südsee Expedition dedicates an entire section, with detailed descriptions and illustrations of the various fishing nets found in Micronesia (Hambruch 1936; Sarfert 1919). All of this adds considerable weight to the fishing lure interpretation. As such, the petroglyphs of lures are significant in that they present a relationship with a valued food resource and also as a testament of navigational prowess. One is connected to skywatching with regards to the seasonal cycle, the other as a fundamental branch of their artful skill. It would seem that the various motifs at Pohnpaid lay honor to both, with the etchings of hands and feet being a manifest of presence and/or movement. The people of high islands such as Pohnpei and Kosrae navigated less than those who lived in the smaller islands with fewer resources, but as a rarity, it may have been even more admired and valued, and commended upon for posterity via rock art.

Nevertheless, if the loom peg interpretation was to be correct, the petroglyphs would still in some way attest to the extent and expertise of inter-island communication and navigation; a type of weaving loom, originating from Micronesia is found only along a specific coast of New Guinea, the Santa Cruz Islands and Ontong Java (Simmons et al 1965: 136; Haddon and Hornell 1937: 51). As lures or loom pegs, they are the physical manifestation of centuries of widespread cultural communication by means of mastering

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<sup>14</sup> Triangular designs are also common in Melanesian and Lapita ceramics, indicative of an association network (MacLachlan 1939: 262-263; Schurig 1930).

methods firmly founded on observation of the night sky.

Two of the most intriguing designs found in the Pohnpeian petroglyphs, are enveloped cross motifs and an elaborate circle with a “wheel” inside, the latter appearing exclusively in what is known as the “male rock” at Takai-in-Lang (see Figures 26 and 27).<sup>15</sup> This boulder has several etchings of enveloped crosses, a glyph that has been associated with pottery designs of the Lapita, active in the area about 2,000 years ago (Rainbird 2002b: 239). As a whole, the closest affinities to the motifs at Pohnpaid are found in mainland Papua New Guinea, Manus, New Hanover (New Ireland), Solomon Islands, Vanuatu and New Caledonia.

**Figure 26:** Enveloped cross  
(Photo by John Amato)



**Figure 27:** Elaborate wheel-in-circle design  
(Photo by Lynn Danaher)



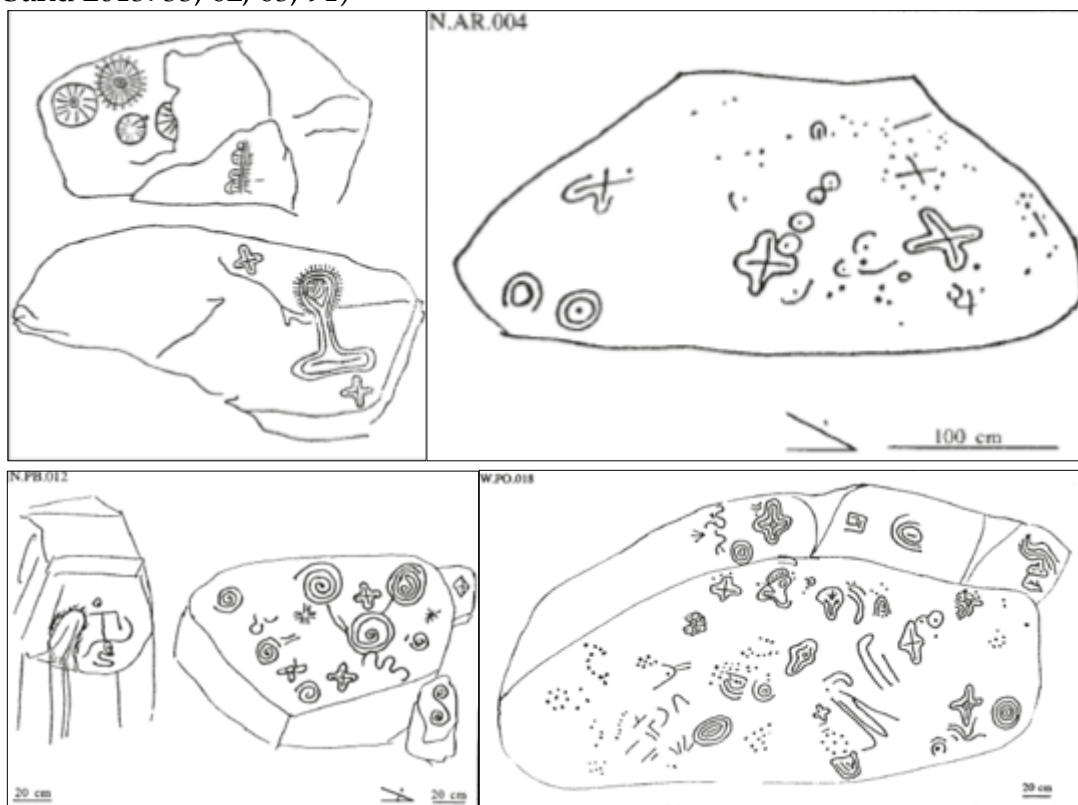
The enveloped cross designs belong to an ancient rock art tradition, dating back to the time of the Austronesian roots of the Pohnpeian people. Enveloped cross designs appear in different forms and are often associated with cupules, circles, and wheels-in-circle designs; nowhere are they more numerous and elaborate than in New Caledonia where they often appear strung together in a series (Monnin and Sand 2015; see Figure 28).

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<sup>15</sup> This boulder is called the male rock because there is an oral tradition that credits the creation of the boulders in that area to a group of people who were turned to stone by a magician. The boulders are said to represent the different body parts of the punished. This we learned from people at Pohnpaid, but we have been unable to find the oral tradition in Hambruch, Bernhart, or elsewhere, although similar myths exist in the neighboring islands (Mitchell 1973). The boulder known as Takain pahsu is supposed to be the vagina of one of the victims; *pahsu* means clam, but is also a colloquial name for a woman’s genitals.



**Figure 28:** Various boulders with “enveloped crosses” from New Caledonia (Monnin and Sand 2015: 33, 62, 65, 91)



Specialists claim that enveloped crosses do not represent star as there are many other recognizable pan-Oceanic star designs, including shooting stars and comets, generally drawn with a sort of asterisk as the fundamental form (Monnin and Sand 2015). Indeed, although enveloped star petroglyphs have been thoroughly recorded, there has been no substantial argument nor consensus as to what they depict. Although similar designs exist elsewhere in the world and enveloped crosses appear in Melanesian tattoos, and considering that “envelopes” are definitely a design style as they are seen to encircle different forms, we would like to humbly postulate another theory regarding their interpretation, but must first address these points. With regards to them existing elsewhere in the world: those are restricted to simple cross motif with only one envelope and there is no reason for various peoples to generate similar basic designs with different or similar meaning. We suggest that the design, which appears in a Lapita ceramic from Nenumbo, the Solomon Islands (see Figure 29), may have included the “envelopes” in relation to something functional, like navigation, but as this was represented in art, it became an art *style* applied to all sorts of different images. With the loss of contact and exchange networks the meaning behind enveloped crosses was lost, perhaps retaining only the art aspect of the design. In Papua New Guinea, where navigation was less common, the enveloped cross appears mostly in paintings, whereas elsewhere it is generally engraved on rock. (Rainbird and Wilson 2002a: 635). Within this framework, it is possible to consider that in ancient times only navigators and the elite were tattooed with this design, which became more widespread as the meaning behind it was forgotten.



**Figure 29:** Lapita pottery with enveloped cross design, Nenumbo, the Solomon Islands, (from Monnin and Sand 2015: 212)

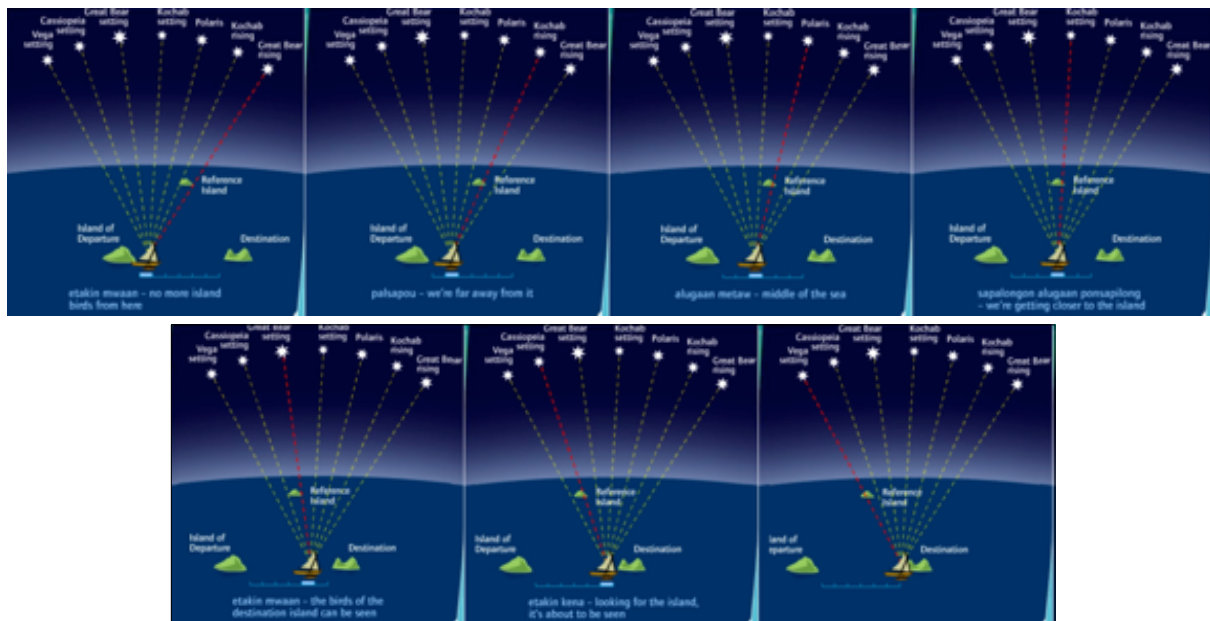
Our impression, which was formulated when reviewing the wealth of ethnographic material studied in the process of our investigation, is that it may be possible to consider that the envelope cross design represents a guiding star as described in the Carolinian *etak* system of navigation, where each island lies at a distance of *etaks*—a term used interchangeably to refer to the “sections” or the stars—these originally being the “envelopes” outside of the cross that also became an art style. In New Caledonia, the vast majority of petroglyphs are found in places along the coast (33%), followed by near rivers, creeks and waterfalls (27%), and thirdly hills (16%); the remaining 24% is divided amongst 8 other geographical areas (Monnin and Sand 2015: 204). The fact that there is a higher concentration of petroglyphs on the coast may have more to do with settlement patterns than anything else, but the ones near water sources and on hills may have had a particular function, either securing the provision of specific resources and/or in areas reserved for skywatching.

Out of the many intricate techniques involved in traditional navigation, Carolinian navigators have a method to calculate longitude that perplexed most of the Europeans trying to record and understand the navigational feats of the Micronesians. In the *etak* system the voyaging canoe is conceptualized as stationary beneath star points, whose positions are also regarded as fixed, while the sea and the land move backwards. The navigator calculates the rate at which a third island, off to the side, moves from beneath the dome of stars in reference to the stars or “sections” under which it passes from the moment of departure to the arrival at destination (see Figure 30).

The *etak* system of navigation has been recorded in Micronesia, and it is possible to consider that it was a system uniquely developed by them, but it may also be regarded as the sole extant evidence of a system of navigation passed on to them by their Austronesian ancestors. It was in the Solomon islands where Austronesian navigators breached a navigational gap and stepped into a part of the world where no humans had ever set foot before, opening a millennium of island discoveries. It is possible that the navigational skills in places that were closer together, where the *etak* system applied less to their navigational necessities, this system was lost, to remain only as encrypted drawings in the form of enveloped-cross petroglyphs. However, that Pohnpei was part of an early inter-island communication network is apparent in the fact that an obsidian blade found in Nan Madol was sourced to Manus, and kava, which is native to Vanuatu, was introduced to Pohnpei and Kosrae

and then from there to Manus and the Madang coast (Spriggs 1997: 191-192). According to Haddon there was a Micronesian sphere of influence that extended as far as the Santa Cruz Islands who fashioned their canoes and sails after those of the central Carolines (Haddon 1937: 51). Hostile raids by Papuans travelling to Micronesia have also been recorded (Simmons et al 1965: 136). It should be noted that compound fishhooks with a shell lure shank only occur in the Huon Gulf-Finschhafen part of New Guinea, and are common in the Solomon Islands, which has been interpreted as the likely source of the compound fishhooks of Palau, Fais, Pohnpei, and Majuro (Specht et al 2006: 40). More links are evident in the languages of the northern islands of the Bismarck Archipelago, mixing words from the Manus area with Nuclear Micronesian and Yápepe (Ibid). If contacts provided an exchange of artefacts, language, and even genes, why could it not also involve the circulation of the very concepts that allowed them to navigate and communicate with each other, the *etak* navigation system, represented in a shared iconographic style.

**Figure 30:** Diagram explaining the *etak* system of navigation. Images 1-7 from left to right (from <http://www.canoeisthepeople.org>)



Of the other noteworthy designs on the “male rock”, is a circular design with a cupule, a motif often associated with enveloped crosses (Monnin and Sand 2015; see Figure 31). The meaning of this design is unknown, but it has often been interpreted as being related to celestial phenomena (Ibid). Indeed, enveloped cross petroglyphs very much look like they are related to the heavens (see Figure 32). Note the elliptical shaped design on the top left of Figure 31, which may be interpreted as a fishnet or some sort of calendar device. What may be a lure and several triggerfish are etched on that part of the boulder as well (see Figure 33); one of the fish has something in its mouth, either food or a lure, while another looks pregnant.

**Figure 31** (left): Circle with cupule near enveloped cross, Pohnpei (Monnin and Sand 2015: 220, from Rainbird and Wilson 2002)

**Figure 32** (right): A boulder with enveloped crosses and associated motifs, from the site Bwarakwekete at Canala, New Caledonia (Monnin and Sand 2015: 220)



**Figure 33:** Fish petroglyphs on the “male rock” of Pohnpaid (Photos A. Edwards)



The final, and most significant design that we tried to interpret is a very complex etching, also on the “male rock”. It is a twist on the cross-inside-circle petroglyph seen in island Melanesia and even as far as Pitcairn Island where they were carved by the original Polynesian settlers (Monnin and Sand 2015; A. Edwards personal observation). In the case of Pohnpei the etching depicts a large circle with a frayed edge on either side, directly above another circle with a wheel inside. The “wheel” is irregular, marking the cardinal points as well as a NE-SW direction. Below it is a crescent moon that encompasses the bottom end of the wheel-inside-circle glyph. Directly beneath the crescent there is a smaller somewhat pill-shaped design that has a line crossing it in half, below it is a very small circle (see Figure 33). The measurements we took at the site, indicate that the vertical line of the “wheel” lies in a perfect N-S orientation (see Figure 34).

**Figure 33** (left): Boulder with



the intriguing wheel-in-circle petroglyph (Photo by A. Edwards)

**Figure 34** (right): Orientation of the petroglyph (Spyglass screenshot by Alex Wallace)

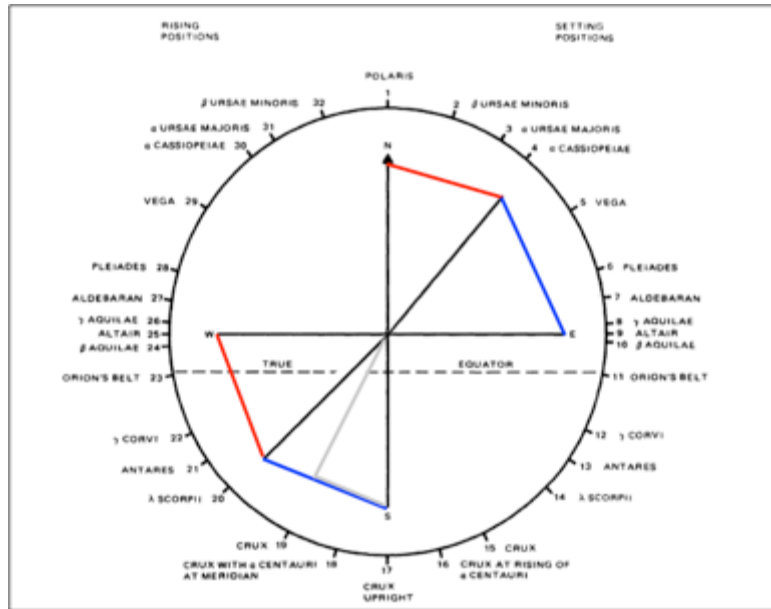
The wheel-inside-circle design has been used all over the world to represent the sun, calendars, and the cardinal points, however considering the many representations of the Carolinian star compass, this seems like the most fitting interpretation. The N-S and E-W lines would be setting the fundamental rule as to the function of the design: to indicate a direction. The transversal line would be the direction it is marking. This line does not actually cut the quadrants in equal portions (see Figure 35). In the NE section the line lies closer to North, whereas the opposite is true on the other side. One might suppose that the asymmetry of the transversal line is an error, however the skill of such carvers was quite advanced and it seems like it would be easy enough to make the points equidistant. But as it is, it resembles the Carolinian star compass even more, since the stars lie in unequal positions in relation to each other and the different cardinal points. In this case it would be marking Cassiopeia - Scorpius, and as it is crossing from the East to the West, it would probably be indicating a SW direction (see Figure 35).

Regarding the design of the petroglyph itself, the circle at the top is reminiscent of a solar eclipse with a corona emanating from the sides. Although it is fainter because of exposure and erosion, they were probably all carved together.<sup>16</sup> However the crescent moon at the bottom, seemed to be related to a lunar eclipse. The “pill-cut-into-two-halves beneath it, with its associated small circle is also curious. Considering the other petroglyphs on the boulder it may also be considered as a calendar device, but we decided to investigate the eclipse theory, to see if there were any eclipses that matched the criteria that the petroglyph suggested as a whole.

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<sup>16</sup> E. Edwards pulled back a thick layer of moss to reveal the lower section of the petroglyph.

**Figure 35:** Carolinian Star Compass with transversal line marking a NE-SW direction from Cassiopeia to Scorpius. Shorter distances between compass points are marked in red, longer ones in blue. Grey line to the South marks the place where the Southern Cross is seen upright, but it is too close to S to be the point marked on the petroglyph (based on figure by Goodenough)



The first step was to set a parameter of dates. Pohnpei is said to have been settled around 2,500-2,000 years ago in a series of waves. Because of erosion, Rainbird considers Pohnpaid to be 2,000 years old at the most, but admits that other researchers may place the designs as part of the Lapita Pottery style (Rainbird 1999:10, 16). At the same time, Rainbird states that enveloped cross motifs in general have been dated to 1-900 AD, acknowledging that “more research is required before more recent dates can be excluded” (Rainbird 1999: 16). We took into account all these statements and set our earliest search date to 500 BC, about 500 years after what some researchers have postulated as the very earliest settlement date, most agreeing on some time before 100 BC. We picked this as the earliest date because of Rainbird’s comment regarding erosion. The latest date was set at 900 AD, which is when the design disappears from the regional rock art inventory. It is possible to consider that in the relative isolated location of Pohnpei, the continuity of the designs may have had a more extended presence, but without evidence for this we stuck to the 900 AD date.

First we studied the possibility of a representation of a solar eclipse. Contributing factors for the solar eclipse option were the following criteria:

1. Location: Did it take place in the W-SW quadrant of the sky?
2. Time: Did the eclipse take place at an important time of the day?
3. Month: Did it take place in during the acronychal /heliacal rising/setting of Scorpius/Antares?
4. Exceeding circumstances: Was it particularly long, brilliant, etc. (length, brilliance, etc.)
5. Age: Did the eclipse take place very long ago, or recently?
6. Visibility: What season was it when the eclipse took place?
7. Extra: Proximity to a Total Lunar eclipse

We found that between 500BC and 900AD there were 6 eclipses that could be visible from Pohnpei. Four were total eclipses and 2 were annular. We discarded the annual ones as less significant. The earliest Total Solar eclipse occurred on February 22<sup>nd</sup>, 198 BC, another one on August 23<sup>rd</sup>, 81AD, another on February 8<sup>th</sup> 147, and finally one on July 27<sup>th</sup>, 808. The February 18<sup>th</sup> 147 one, though listed as visible from Pohnpei with

regards to the coordinates on the path table, is not identified as a full eclipse on Stellarium, so it must have been right on the border of visibility ([www.eclipsewise.com/solar/SEpath/0101-0200/SE0147Feb18Tpath.html](http://www.eclipsewise.com/solar/SEpath/0101-0200/SE0147Feb18Tpath.html)). In fact, none of the solar eclipses met a convincing set of our criteria, so we extended our search for Total Solar eclipses that may have been seen by local fishermen or navigators. Of these there were 5, but one occurred at sunset, which actually mutes the more striking visual effects of a total eclipse. The closest one had a range of visibility that ran only 11 km North of Pohnpei, on August 27<sup>th</sup> 295. Of the others, the next closest occurred at a distance of 85 km, and the farthest at 248. Eventually, as again, none of these seemed to effectively meet the criteria we had set—and the transversal NE-SW line was almost completely irrelevant to the solar eclipses—we went on to study a lunar eclipse option.

Testing for lunar eclipses was much more complicated. There are many more lunar eclipses visible from any given place on earth, than solar ones. The criteria for the lunar eclipses were the following:

1. Location: Proximity to Antares, Ophiuchus, and Scorpius.
2. Relationship with Vega and Cassiopeia
3. Time: Did the eclipse take place at midnight or after midnight (S-SW part of the sky)?
4. Month: Did it take place in during the acronychal /heliacal rising/setting of Scorpius/Antares?
5. Exceeding circumstances: Was it particularly long, brilliant, etc (length, brilliance, etc.
6. Age: Did the eclipse take place very long ago, or recently?
7. Visibility: What season was it when the eclipse took place?

Because of the transversal line marking Scorpius and because lunar eclipses never take place near Vega or Cassiopeia, after much trial and error, we narrowed our search down to: eclipses that had taken place either over Antares, Scorpius, or Ophiuchus; when any of these stars stood at the S-Western compass points marked by them; and at the time of their heliacal and acronychal risings and settings. While the heliacal rising (HR) is when the star becomes most visible viewed in the East before sunrise, the acronychal setting (AS) is when the star is most visible setting in the West before sunrise. On Pohnpei, with regards to Scorpius, these occur close to the same dates, but since the wheel in circle design pointed to Scorpius in a westerly direction, eclipses that had taken place after midnight, towards the western half of the sky were deemed more relevant. In any case, the HR of Antares, marks the month of Tumor in the Ponpeian calendar, but we did not find any significant eclipses under that criteria. The acronychal rising (AR) is when the star or asterism is visible just after the sunset. Lastly, the heliacal setting (HS) is when it is seen setting just after sunset. This amounted to a selection of over 670 Total lunar eclipses. After studying the paths and conditions of each one, the following stood out (local time and date; the one that met the most criteria is highlighted):

DATE	TIME	COMMENT	DURATION
387 AD Mar. 22	23:39 to 00:50	With Spica, Equinox	71 min
459 AD May 4	2:18 to 4:01	Long, bright, w/ Scorpius, <i>Wet season</i>	100+ min
673 AD May 7	3:30-4:15	With Scorpius <i>Short</i>	45 min
<b>759 AD Mar. 18</b>	<b>1:58 to 3:30</b>	<b>AS Scorpius West, ~Equinox</b>	<b>95 min</b>

Any of the above Total Lunar eclipses could have been special enough to merit being

memorialised in rock art form, however the one that fit all of our criteria is the eclipse that took place on 759 AD Mar. 18, between 1:58 to 3:30 pm. The moon was near Spica when the eclipse took place and in the Western part of the sky. Cassiopeia would have been seen at 8° on the equatorial grid just after sunset (NE compass position) with Vega at an altitude of 40° in the NE part of the sky when the eclipse started. It took place on the night when Scorpius (Antares) is seen 45° in the SW before sunrise (AS), on a date very close to the equinox, marking the time of the upcoming bountiful rainier season. The date itself could have been marked by the HR rising of the Pleiades on the equinox, however this would not have necessarily placed the eclipse on the Western quadrant of the sky, and it may have caused confusion as to what it was meant to mark, since the HR of the Pleiades is in itself of great importance in the sidereal calendar. Similarly, the date could have been marked by the compass position of Altair using the solar calendar, but if the wheel-in-circle design had just had the lines for the cardinal points, there is a greater possibility that the petroglyph might be interpreted in a way different from what it was intended. The way the transversal line is placed, marks the setting of Scorpius in the west and this eclipse took place on the Acronychal Setting of Antares/Scorpius. The date also fits Rainbird's note that the petroglyphs would be about 1,000 years old (see Figure



36).

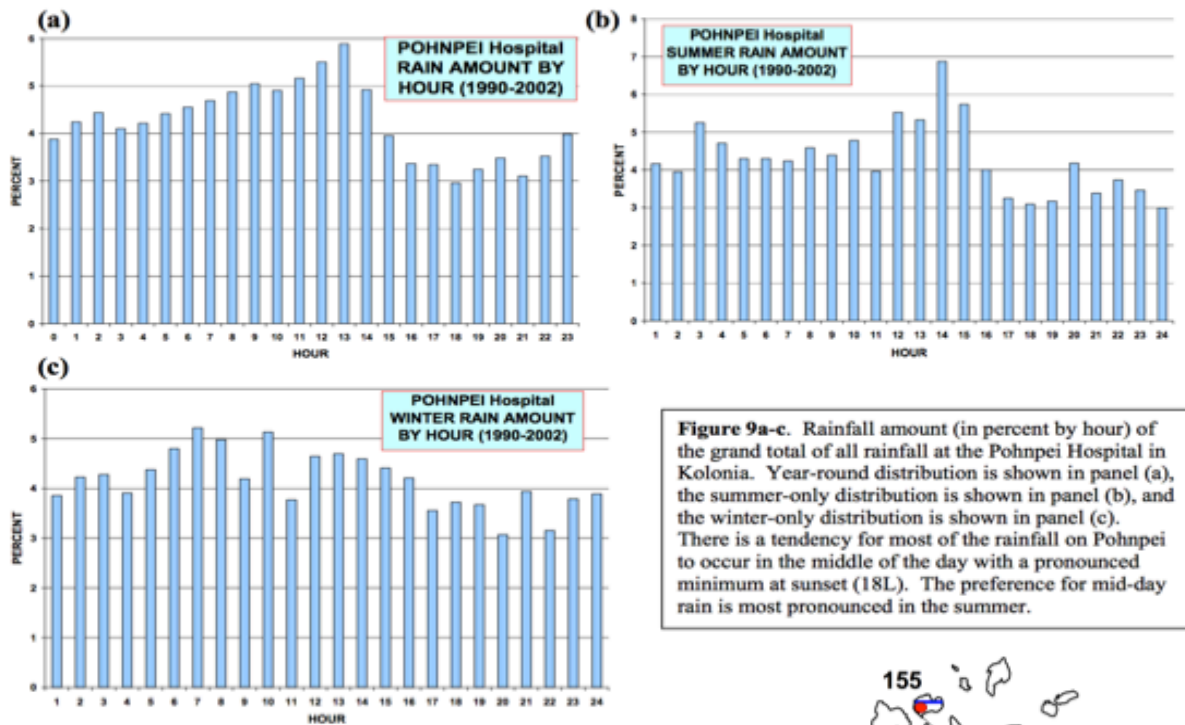
**Figure 36:** The March 19, 759 AD Total Lunar eclipse as seen from Pohnpaid

Regarding chances of visibility, all eclipses take place on the full moon and we know from Hambruch, O'Connell, and others that dances of fertility took place on the nights of the full moon, where according to O'Connell, in addition to the singing and dancing, they would watch the stars: "The natives are passionate admirers of the study of the heavens, and will even sit alone and watch some particular star," (O'Connell 1972: 162). Concerning the 759 lunar eclipse, there is a good chance of visibility as *Totality* occurred just two hours after midnight. The weather conditions for observation also would have been good. March is neither wet nor dry, following the driest months of January and February and preceding the



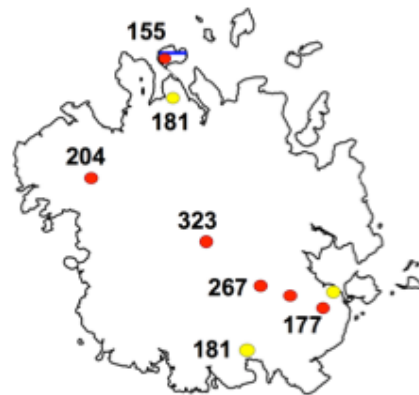
wetter months of April and May.<sup>17</sup> As for the hourly distribution of rainfall, unlike other islands in the area where most rainfall occurs between midnight and sunrise, on mountainous Pohnpei, maximum rainfall is in the afternoon, with less rain falling in the evenings (Ibid.; see Figure 37). Lastly, Pohnpaid is located on a part of the island that in the present-day, receives less rainfall than most other parts of the island, conditions that may have been the same in the past (see Figure 38).

**Figure 37:** Hourly rainfall distribution for present-day Pohnpei (selected site: Pohnpei hospital in Kolonia; from Landers and Khosrowpanah 2004: 14)



**Figure 9a-c.** Rainfall amount (in percent by hour) of the grand total of all rainfall at the Pohnpei Hospital in Kolonia. Year-round distribution is shown in panel (a), the summer-only distribution is shown in panel (b), and the winter-only distribution is shown in panel (c). There is a tendency for most of the rainfall on Pohnpei to occur in the middle of the day with a pronounced minimum at sunset (18L). The preference for mid-day rain is most pronounced in the summer.

**Figure 38:** Values of mean annual rainfall of selected sites on present-day Ponpei (Landers and



Being able to pinpoint the exact eclipse is a tempting prospect, because it would set a parameter of dates for the carving of the petroglyphs in the entire complex, including Pohnpaid. We would not venture as far as to say that this particular petroglyph commemorates the 759 lunar eclipse, but in our view, the petroglyph is of a lunar eclipse, and of all the possible ones they could have depicted, the March 19, 759 AD eclipse fits better than all others. Nevertheless, the important information to take away from this is that in the end, it is the petroglyph as a whole that hints at an eclipse, not its individual parts, and it remains so regardless of whether it is possible to find the exact eclipse it may represent.

<sup>17</sup> The dry season may be prolonged if it follows an El Niño event year; historically, these have been extremely dry years, but there is no way of knowing whether 759 followed such a year (Landers and Khosrowpanah 2004: 14-18).

## Expedition Site II: Nan Madol, Pohnpei

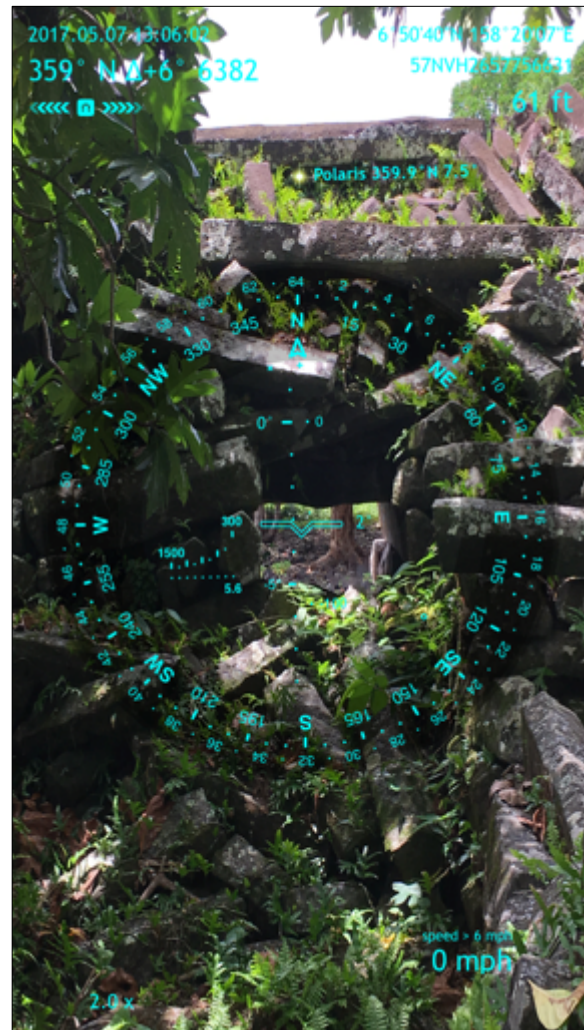
### Findings & Discussion Site 2B:

*This part of the project is still in progress. It is well known that the sacred sector where the tomb islet of Nan Dauwas is located, is purposefully oriented N-S and E-W, and we found that Polaris would have been visible from the openings in the north-side wall of complex; however whether this was intentional or causal could not be determined. Overall, there was little for us to add regarding this site. So far as Esteban's previous studies are concerned, we were able to corroborate his findings.*

*Team member Lynn Danaher has found some significant lines of study to pursue regarding the possibility of an underwater freshwater source at Nan Madol. However it is unrelated to archaeoastronomy, and merits separate study in a new project.*



*E. Edwards working at Nan Dauwas  
(Spyglass screenshot A. Edwards)*



*North wall opening and Polaris  
(Spyglass screenshot A. Edwards)*



*Team members Julie Mesmer and Alex Wallace cross over to Karian to take measurements  
(Photo by A. Edwards)*



*Team Member Eric Zember helps mark alignments of wall openings at Nan Dauwas  
(Photo A. Edwards)*

## **Conclusions**

Kosrae and Pohnpei are both remarkable models of human achievement. However, beyond the grandeur of Lelu and Nan Madol, which are undoubtedly two architectural masterpieces, and apart from the impressive degree of resourcefulness, tenacity, and social cohesion exemplified by these two cities, there are a great many sites and features—cultural perspectives—that have been overlooked more than ignored, obscured by the brilliance of their most extraordinary accomplishments. It is as if each place in vast Oceania, each of its myriads of people, could only be known for one thing. Undoubtedly, this cannot be true. Even concerning a subject that Micronesians are very well known for—traditional navigation—the sphere of knowledge within which it lies, is narrowed down to a singular expression, wayfinding, which would be complimented, not diminished, if coupled with skywatching. Ethnoastronomy, which is so relevant to Oceanic Studies, is a relatively new field, especially for Micronesia. The findings of our expedition become even more significant when understood as a catalyst for future investigation in the area. This was a first step for Kosrae and a second step for Pohnpei. The reaction of the community went beyond favorable. It was invigorating, and it should make ethnoastronomy a welcome addition to the local repertoire.



*Petroglyph at Pohnpaid*  
(Photo by John Amato)

The importance of understanding the ritual use of coral in a funerary context is significant not only because it sheds light on an age-old practice, but because this custom was shared within such a wide cultural area, tracing those traditions to a common ancestry going back 4,000 years. In addition, we found promising evidence indicating that people on Kosrae and Pohnpei were observing the solstices and equinoxes. This may constitute a first for Micronesian studies, but it definitely is not the last word on the subject, rather this opens many possible lines of research. Simply reviewing the previously collected information, can lead to important advances, as was the case with the name Takai-in-Lang, providing a complete perspective on the function of the site, or Beardsley's mountain view stone, which was transformed into an astronomical observatory. Finally, the interpretation of the petroglyphs in the vicinity of Pohnpaid has effectively granted greater perspective to a place that was already quite sacred and special. The wheel-in-circle petroglyph on the "male rock" as the representation of an eclipse is a compelling theory, whether an exact eclipse can be identified or not. Lastly, the enveloped cross as *etaks*, idea, is really just that, an *idea*; sometimes "thinking out-of-the-box" can lead to new perspectives and greater understanding.

Perhaps one of the most interesting results of our expedition is the duality manifest in shared cultural features—be it between Kosraens and Pohnpeians, or between Micronesians and Polynesians—and the unique cultural expressions that developed in isolation, such as the cult to Sinlaku or the wheel-in-circle petroglyph. All cultures share similarities as part of

a whole, but each one also transcends to exceptional degrees of individuality.

We would like to finish this report with a quote by archaeologist and anthropologist Paul Taçon regarding the interpretation of archaeological sites. This is undoubtedly one of the greatest challenges any serious scholar can face, and we have strived to stay true to the rules and guidelines of good science:

This leads to the second point about meaning and interpretation which is

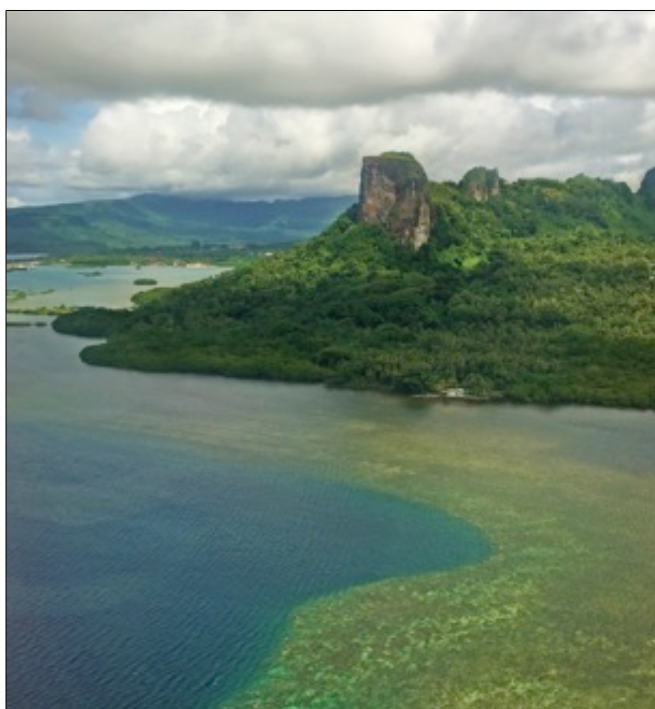


that, whether we like it or not, archaeology will always involve interpretations of the past and that new interpretations based on new pieces of evidence will emerge. Interpreting is not an evil to be avoided, rather something fundamental to all approaches to understanding past human behaviour; it also is fundamental to science.

What is important is to let people know when one is interpreting, on what basis the interpretation has been made and what varied forms analogical or direct evidence lend support to such interpretation. Different levels of interpretation should never be confused and as much as possible all forms of interpretation should always be based on data, either archaeologically derived or otherwise uncovered.

-Paul S. C. Taçon, “Andrée Rosenfeld, The Archaeology of Rock-Art” pp. 98-99, 1999

*Sokehs rock, Pohnpei  
(Photo by A. Edwards)*



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### **Acknowledgements**

*Expedition Leader Edmundo Edwards presents a chiefly breastplate from Rapa Nui to His Majesty Wasa Lapalap Isipahu Kerpet Ehpel, Nahnmwarki of Madolenihmw, who was gracious enough to receive us and permit us to do research work at Nan Madol.*

We would first like to thank Wasa Lapalap Isipahu, Nahnmwarki of Madolenihmw, Pohnpei State, His Majesty Kerpet Ehpel and family for their generosity and support in our research work. We would also like to extend an important word of recognition to César Esteban, Astronomer, Instituto de Astrofísica de Canarias, Tenerife, the Canary Islands, who contributed in choosing the sites for our investigations on Pohnpei, and who was generous enough to share his work and thoughts with us. In addition, we are also greatly indebted to the following people without whom the success of our expedition would not have been possible. They are (in alphabetical order):

Standon Andrew  
KSHPO Historic Preservation Officer, Kosrae State Government  
Kosrae Island Resources Management Authority

Carlos Cianchini  
Biologist, and Assistant to the Pacific Adaptation to Climate Change,  
Kosrae Island Resource Management Authority

Maria Grazia Fanelli Stephens  
Co-owner and Manager Pacific Tree Lodge (Kosrae)

Augustine "Gus" Kohler  
Acting Director National Archives, Culture and Historic Preservation,  
Pohnpei State Historic Preservation Office (PNI HPO), Historic Preservation Program,  
Federated States of Micronesia National Government

Ashley Meredith  
Kosrae State Cultural Anthropologist

Paliknoa Sigrh  
Lelu Ruin Association Secretary/Youth Extension Agent  
CRE Office at College of Micronesia, FSM

Swenson Thomson  
KSHPO Field Supervisor

Mark Stephens  
Co-owner and Manager Pacific Tree Lodge (Kosrae)

Takasy Salik Waguk  
Owner and Tour Guide of Kosrae Jungle Tours

We also received support and collaboration from the staff at the Kosrae State Historical Preservation Office (KSHPO), the Pohnpei State Historical Preservation Office (PNI HPO), the Pacific Tree Lodge at Yapan, Kosrae, and Alloys Malfitani of the Mangrove Bay Hotel & Bar. We heartily thank them all for their counsel, assistance and generosity.

We are greatly honored that we were granted Explorers Club Flag #71 for our expedition to Kosrae and Pohnpei, and we thank the Explorers Club for their support of this and other scientific missions around the world.

### **Expedition Lectures**

*The following is a list of the lectures that we offered during the expedition  
(all presented by A. Edwards):*

“Their Eyes Were Watching the Heavens Micronesian Ethnoastronomy”

“Kosrae: The Jewel of Micronesia”

“Upon a Stone Altar: The Culture and History of Pohnpei”

**THE END**