HORIZON-BASED ASTRONOMY ON EASTER ISLAND: SOME NEW FINDINGS

by

Vincent H. Malmström and Juan Carlos Navarro Q.
Dartmouth College, Hanover, NH. 03755

The suggestion that some of the altars, or ahu, of Easter Island might have been constructed to incorporate astronomical alignments in their design was first advanced by members of the Norwegian Archaeological Expedition in 1955-56. William Mulloy, working at the site of Vinapu, and Carlyle S. Smith, in his examination of Ahu Tepeu, were both led to hypothesize that perpendiculars drawn to the faces of these structures may have commemorated equinoctial and/or solstitial sight-lines. Moreover, Edwin N. Ferdon, Jr., in his investigation of the ceremonial center of Orongo, identified four holes drilled in the rock near the center of the site as the base of an astronomical sighting device used to chart the annual movements of the sun. In April 1982, a re-examination of several of the features cited above was carried out by the present authors and a new astronomical appreciation of many of the sites is now possible.

As a result of the Norwegian expedition, a three-fold division of the island’s prehistoric chronology was developed, namely an Early Period stretching from 400-1100 A.D., a Middle Period extending from 1100-1680 A.D., and a Late Period embracing the time between 1680 and 1868- the latter year essentially marking the beginning of the modern era. Though modifications of this scheme have since been made by Mulloy and others, it still serves to provide a temporal framework for the discussion to follow.

Initially, ahu with suggestive astronomical alignments were found to date to the Early Period, though subsequent investigations have revealed that this practice seems to have continued into the Middle Period as well. However, one characteristic of the ahu that appears to be exclusively diagnostic of the Early Period is carefully cut and fitted stone-work--a trait not continued into Later times. According to Heyerdahl and others, the antecedents for this meticulous stone carving cannot be found in Polynesia, but trace instead to Andean South America. In the same way, Heyerdahl argues that, whereas astronomical alignments are almost totally lacking in the architectural structures of Polynesia, they are commonly found in the Tiahuanaco and later cultures of South America. (Heyerdahl, 1961: 498:497).

Vinapu. When Mulloy excavated the ceremonial center of Vinapu near the southwestern corner of Easter Island, he commented on the likelihood of Ahu No. 1 being aligned to the summer solstice sunrise (a measured azimuth of 114º , as compared to an actual azimuth of 116.6º) and of Ahu No. 2 being oriented to the rising sun at the equinoxes (an azimuth of 91.5 º, or 1.5º south of true east). Because no obvious astronomical referent existed near the point on the horizon where a perpendicular drawn to the facade of Ahu N6. 3 would fall, he concluded that this altar may have been oriented to the top of the hill on whose flank it was located. (Mulloy, 1961:94).
It is interesting that nowhere in his report does Mulloy remark on the relatively distinctive geographic setting of the Vinapu ceremonial center. Unlike most of the nearly 300 ahu on the island, Vinapu lies near the coast (110 m inland) rather than on the coast. Moreover, the fact that it lacks easy access to the sea suggests that this was not a factor in its siting, whereas most other ahu are in immediate proximity to landing-places. That Vinapu was one of the earliest structures on the Island is revealed by a radiocarbon sample from Ahu No. 2 dating to 857 A.D. + 200 years. (Mulloy, 1961:118).

The present authors would suggest that Vinapu's rather uncharacteristic location can be explained by the relationship which the site has to the geometry of its surroundings, especially to the volcano Pua Katiki on the eastern horizon. If Ahus No. 1 and 2 are oriented toward the December 22 solstice and the equinoxes as Mulloy postulates, they can be calibrated only against the empty horizon of the sea, which may account for errors in alignment up to 20º. However, the one solar alignment missing from the architecture of Vinapu is that of the winter solstice sunrise (June 21) -- an event that the present authors believe was marked by the peak of Pua Katiki, located on the Poike Peninsula. Its azimuth, as seen from Vinapu, was measured at 63º, or within a half-degree of the solstitial sunrise position. (See Figure 1.) Indeed, it may have been this relationship that was instrumental in determining Vinapu's more inland, more elevated, and less water-oriented site initially. (Interestingly, Mulloy makes a similar argument with regard to two inland ahu that he excavated in 1975. In this later paper, he suggests that Ahu a Kivi and Ahu Vai Teka were probably located with reference to one another, so as to establish an equinoctial base line. In this instance, however, the axis they defined was 2º52' away from a true east-west line.) (Mulloy, 1978:6).

That the Polynesians practiced a horizon based system of astronomy is clearly attested by Makemson (1941:121); that they made their observations in the early morning twilight, and thus were especially dependent on the eastern horizon, is also well established (Makemson, 1941:117). The specific use of Pua Katiki as an astronomical marker is strongly suggested by place-name evidence. Barthel translates the mountain's name as "flowery aura", whereas the elevated peninsula on which it is situated is called Poike, which means "height", "to be just above the horizon", and "to rise, as a star". (Barthel, 1978:44-45). The same author is 'amazed' to discover in his linguistic studies of time-space relationships on Easter Island a coincidence between mountains and astronomical landmarks. (Barthel, 1978:48). He further points out that legendary evidence strongly links Vinapu with the month of June and that the secondary name for the landing-site of Vinapu, a place called Hanga Te Pau, means "the middle (or zenith) of the land", suggesting that a line may have been drawn across the island from this point. (Barthel, 1978:231). To these suggestive bits of evidence, the present authors add the measured alignment itself.

Orongo. Important as Vinapu may originally have been in the ceremonial life of the Easter Islanders, there can be little doubt that the most sacred place on the Island through most of its prehistory was the spectacular site of Orongo on its far southwestern corner. Located on the rim of the Rano Kao crater at an elevation of 308 meters, Orongo
is perched on a knife-like ridge that is constantly being cut into by the sea. The breathtaking panorama afforded from its heights includes the three largest Islands off the coast of Easter Island, of which the biggest and most distant--Moto Nui--figured prominently in the annual bird-cult ceremonies.

As Edwin Ferdon was excavating that portion of the southwest the rim of the crater, he located four holes in the bedrock that he deciphered as the matrix of an astronomical sighting-device. Although the holes varied in depth from 2 to 5 cm, they ranged from 3 to 6 cm in diameter for holes number 2, 3, and 4, up to 35 to 45 cm for hole number 1. The distance between holes 2 and 3 measured 68 cm; between 1 and 3, 93 cm-- and between 1 and 4, 139 cm. Measuring the azimuths between the holes, he found that a line between holes 2 and 3 equated to 56.5° -- a bearing which he presumed to mark the June 21 solstice (actual value 63.4°); the azimuth between holes 1 and 3 was 105° -- which he concluded was the December 22 solstice (actual value 116.6°); and that the line between holes 1 and 4 fell on an azimuth of 81° -- which he argued was an indicator of the equinoaxes. (Ferdon, 1961:228). That his values should vary from 7 to 11° of the true azimuths he attributed to the 'shadow effect' of structures that may have been in the way and/or the eastern rim of the crater. (Ferdon, 1961:228). In any case, legendary sources indicate that the two most important annual ceremonies were keyed to the December 22 solstice and the spring (September 20) equinox, so that a means of defining these dates was fundamental to the Easter Islanders' religious cycle of events. Yet, if we are to accept Ferdon’s hypothesis, these are precisely the alignments that are most poorly defined by his 'astronomical device'.

Among the more interesting results of Ferdon’s excavations were (1) the discovery of carefully cut and fitted stone-work in the base of what he called Structure 1 (once again suggestive of the meticulous workmanship of the Early Period); (2) the importance of fire in the religious rituals, suggesting an emphasis on the worship of Makemake, the supreme creator and sun-deity, at this site; (3) the shift of focus to the highest point on the rim of the crater at a later date; and (4) the apparent abandonment of the fire ceremonies about 1420 A.D. and a transfer of activities to the bird-cult structures located farther to the southeast. (Ferdon, 1961:248-255).

Accepting the thesis that Orongo played a major, though changing, role in the island's prehistoric religious life, the present authors were not inclined to doubt the need for charting the sun’s movements in the heavens, though they were dismayed by both the crudity and inaccuracy of the 'device' identified by Ferdon to carry this out -- especially when such excellent horizon-referents are available from the Orongo site. From the highest point on the northwestern edge of the crater, the December 22 solstice sunrise is marked by an abrupt 'step' in the seaward cliff, so the sun can be seen to rise out of the sea directly in line with this topographic break (azimuth 116.6°). (See Figure 2). From the same vantage point, the equinoctial sunrises will be seen to take place directly above the highest and most pronounced rock-wall on the east side of the crater (azimuth 90°). And finally, though no one has previously commented on it in the literature, Orongo has precisely the same orientation to Pua Katiki on the far eastern end of the island as does Vinapu; thus, the June 21 solstice can be calibrated using this horizon marker as well, for
the eastern rim of the crater dips down just enough to permit a straight line-of-sight to this eminence at an azimuth of 63º. Alone among the ceremonial centers of Easter Island, Orongo affords topographical 'fix-points' for all the major events of the solar year. (See Figure 1).

Other Easter Island Sites of Possible Astronomical Significance.

In the report of the Norwegian Archaeological Expedition, frequent mention is made of the similarities in stone-masonry between Vinapu on the one hand and Ahu Tepeu and Ahu Te-pito-te-kura on the other, suggesting that the latter in all likelihood are products of the same Early Period workmanship. Furthermore, Smith finds a suggestive astronomical orientation at Ahu Tepeu and insinuates the rather special role that Ahu Te-pito-te-kura must have played in the island’s ceremonial prehistory. (Smith, 1961:189:204). The name of the latter means "the navel of light" and is derived from a spherical stone supposedly brought to Easter Island by Hotu Matua, the first settler and king. (Smith, 1961:205). Smith also points out that the largest moai, or statue, ever erected on the island originally stood at Ahu Te-pito-te-kura -- a monster which measured 9.8 meters in height and weighed an estimated 82 tons. (Smith, 1961:203).

Although the present authors were unable to carry out field surveys at the two sites mentioned, their study of detailed maps of the west and north coasts of the island suggest that astronomical alignments to key topographic features may have figured prominently in the location of both. Like Vinapu, Ahu Tepeu is not immediately on the coast, but some 100 meters inland. Smith points out that perpendiculars drawn to the seaward walls of altars 1 and 2 are 113 º and 110 º , respectively, and thus approximate the sunrise position on December 22 (azimuth 116.4. However, the present authors would also call attention to the fact that the sunrise position at the time of the June 21 solstice coincides with the top of Maunga Tere Vaka, the highest 'peak' on Easter Island, as seen from Ahu Tepeu and thus may have been instrumental in the initial placement of the site. (See Figure 1).

Ahu Te-pito-te-kura is a more 'typical' site in that it lies immediately on the coast adjacent to a sheltered landing-place. Though Smith found no structural alignments which indicated an interest in astronomy, the present authors believe that this site may be worthy of further study. Because it is (1) one of the earliest settlements on an island whose original name was Te-pito-o-i-te-henua., or "the navel of the world"-, (2) its own name seems to reinforce its nodal position by being termed "the navel of light"; (3) its mammoth statue is characterized by an abnormally large representation of its own navel (around which a petroglyph of a crescent-shaped ship has been pecked); and (4) it appears to be situated directly in line with the December 22 sunrise position over Pua Katiki (the same topographic feature to which both Vinapu and Orongo are oriented), Ahu Te-pito-te-kura may conceivably have derived is special significance from its unique geographic-astronomic relationship. (See Figure 1). (It is also worth noting that the terraced mountain, Maunga Hau Epa, which Barthel identifies as having had “a special importance”, shares the same alignment.) (Barthel, 1978:45).
Conclusions. The present authors believe that, in addition to the ‘suggestive’ astronomical alignments of early structures built on Easter Island and identified by previous researchers, several key solar orientations exist between the sites themselves and prominent topographic features. Such orientations have been demonstrated for the two most ancient and important ceremonial centers on the island and have been hypothesized for two more Early Period sites on the west and north coasts.

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Figure 1.
Figure 2. Looking east from Orongo over the Rano Kao crater. From this site, the extreme positions of the sun may be marked by the summit of Pua Katiki on the winter solstice (June 21) and a distinct seaward notch at the summer solstice (December 22). Directly east across the crater, marking the equinoxes, a rock cairn has been reported by Barthel.

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