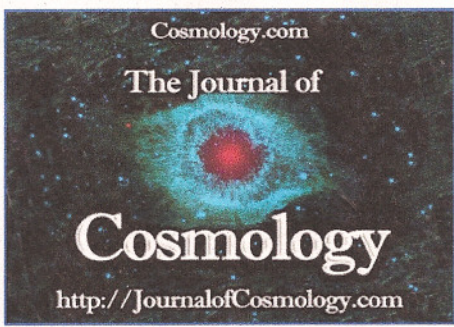
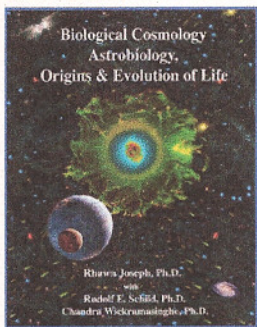


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Prehistoric Cosmology: Observations of Moonrise and Sunrise from Ancient Temples in Malta and Gozo

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Abstract

Evidence of an astronomical considerations in temple buildings in Malta and Gozo dating from 3500-2500 BC is looked for in three ways: orientation, cross-jamb view, and what is termed 'offset illumination'. Practical observations are attempted in some cases. The orientation of three temples is close to the direction of a far southerly moonrise; a fourth coincides with an equinox sunrise and the rising point of the Pleiades in period. The evidence of cross-jamb view is discussed. The architecture creates limits to what is visible. Offset illumination seems to favour the midwinter sunrise and the left side. An illumination to the left is identified with a lateral distinction in the functional space of the buildings.

Keywords: Archaeoastronomy, Ancient Topography, Malta, Gozo, Temples, Far-Southerly Moonrise. Cross-Jamb, Midwinter Sunrise

1. INTRODUCTION

A cosmology well known to Europe is the Biblical history of Genesis, with its seven days in completion and the four rivers of Eden. Agriculture, irrigation, and the social techniques of the state that developed in Mesopotamia in the fourth millennium BC created the organized world of civilization. The organization of this world would be rehearsed in creation myths and early cosmologies telling of the division of water from land, the division of time, and the mediation between man and the sky. Because the successive civilizations of the Middle East have endured to the present, elements of their culture including astronomy have enjoyed a near-continuous transmission: the identification of the planets, the naming of star groups, the division of time, and the theoretical constructions of

space and becoming.

Also familiar to west Europe are the megalithic cultures of the Atlantic seaboard, the Atlantic corridor that runs through Carnac (France) up to Scotland. The astronomical component of the stone circles of which Stonehenge is a late-flowering and well known example remains controversial. However, the orientation of monumental chambered constructions on the direction of sunrise and sunset at the time of the shortest days of the year is incontrovertible. Newgrange (Ireland) dates from about 3200 BC and is orientated on the midwinter sunrise. Maeshowe (Orkney) dates from about 2700 BC and is orientated on the midwinter sunset.

In the first part of the twentieth century it was sometimes supposed that technical and cultural advance was made in the Middle East and then diffused westwards through Europe. For example, it was proposed that the monumental buildings found in Malta and Gozo might have been built by colonists from Crete traveling westwards in the second millennium BC. With the use of radio-carbon dating in the second half of the century that theory collapsed and the date of the temples was pushed back two thousand years.

Malta and Gozo are small islands (250 and 70 sq km) between the East and West Mediterranean, 350km north of Libya, 90km south of Sicily. They are believed to have been settled from Sicily around 6000 BC. In the approximate period 3500 to 2500 BC the inhabitants constructed monumental free-standing stone buildings conventionally called 'temples'. The buildings have a claim to be the oldest free-standing stone structures in the world. Although pottery and obsidian found on the islands demonstrate a limited contact with Sicily, with Lampedusa, and with the Lipari Islands, navigation might have been hazardous, and it appears the culture remained largely isolated, a paradigm case of spontaneous and independent cultural development. That isolation was made complete by the way the culture was suddenly abandoned, perhaps in deforestation and environmental collapse. What is known has to be inferred from the archaeological remains, of which the buildings are a most remarkable part.

One way of investigating the buildings and thereby the culture that produced them is to look for an astronomical component. Evidence of astronomical interest is found elsewhere in Europe at about the same period, including the orientation of rondels towards sunrise in the late Neolithic culture of the Carpathian Basin (Pasztor 2009). The present essay describes three ways of looking for an astronomical component in temple architecture: orientation, cross-jamb sighting to sunrise, and what is called 'offset illumination' by midwinter sunrise. Practical observations have been attempted in some cases.

Seen in plan, most temples have chambers arranged round a central corridor reached through an entrance formed by monumental slabs. A common scheme is three chambers arranged in the shape of a cloverleaf, with the central corridor in place of the stem. If and how they were roofed is not known, although corbelling in the walls of some chambers is evidence of an architectural tendency towards roofing. Archaeological restoration has placed lintels over the uprights at the entrance to some temples.

The buildings have been dated in two main phases. A Ggantija phase about 3500-3000BC is named after the Ggantija temples in Gozo. Buildings are discrete megalithic structures, trefoil or cinquefoil in plan, with a main axis and a single open entrance. A later and more decorated phase about 3000-2500 BC is named after the Tarxien temples in Malta. Tarxien buildings are various in plan. Chambers at the head are reduced (in the case of Hagar Qim replaced by a secondary entrance). Buildings are butted into others to create a complex of temple enclosures looking in a variety of directions and sometimes into each other. Sills and thresholds display symmetrical arrangements (including reversals) of spiral and vegetation patterns in low-relief carving (Fig. 1).



Figure 1. Spiral patterns seen in Tarxien South Temple, left side. Some tablets may be replicas; the wall seen to the rear is a modern build.

Temples and temple complexes are themselves found in a number of clusters that might have formed distinct communities with centers at Ggantija in east central Gozo, Ta'Hagrat and Skorba in south west Malta, Hagar Qim and Mnajdra in south east Malta, and Tarxien in north east Malta.

Recent archaeological interpretation of the temples have laid emphasis on the idea of exclusion, that areas of the temple were screened off and with access restricted to an elite (Stoddard et al 1993). The Hal Saflieni hypogeum in Malta and the Brochtorff Circle at Xaghra in Gozo combined ritual and burial use and have characteristics in

counterpart to the overground buildings. Excavations at Xaghra have suggested the idea of an ancestor cult, and reflect the idea of a functional division in the overground temples in the Tarxien period, with images and hidden objects contained to the left (looking into the temple), and with 'oracle holes, feasting residues, and fire pits on the right side of entry' (Malone and Stoddart 2009 p.373).

The orientation of chambers to the left and the right of the corridor might signify in a discussion of orientation in the buildings. Where the building faces south, chambers to one side face east, to the other face west. In the same building the intent could be practical: if the chambers were roofed, then an unroofed corridor would give light to both sides of the building. If the direction of the corridor is studied for symbolic meaning, the orientation of the main axis can be read in two directions, looking in, and looking out. Stoddart et al (1993) suggested both could have had been significant, perhaps changing emphasis over time.

In a theory of terrestrial targets the direction (looking in) might in some cases be identified with the direction of ancestral homelands and sources of trade. Theorists looking for astronomical significance in prehistoric structures have mostly looked the other way, looking out. The orientation of temples and altars is related to the direction of sunrise in both ways according to the Roman architect Vitruvius (IV.V & IV.IX); orientations looking out that favour the midwinter sunrise and sunset found in chambered mounds from the North European Neolithic such as Newgrange and Maeshowe have already been mentioned. Theoreticians such as Mircea Eliade have attempted to find a common meaning in such astronomical events across a wide range of cultures. However, in such an early and comparatively isolated case as Malta and Gozo in the third and fourth millenium BC the evidence must be searched for in the buildings.

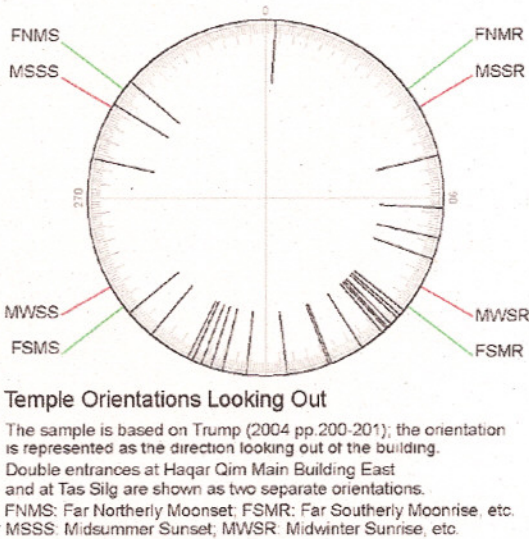


Figure 2. Temple orientations, looking out (sample of 25 temples).

Twelve temple sites out of twenty one are in good enough condition for orientations to be found. Some sites contain several temple enclosures, and an orientation can be found for twenty-five temples altogether (Fig. 2). A case for astronomical significance is a coincidence between the orientation of three temples and the direction of a far-southerly moonrise, noted by George Agius and Frank Ventura (1981). John Cox emphasized the same coincidence in a later article (2001). That coincidence involves a prominent temple in three out of the four large scale groupings identified above (Fig. 3).

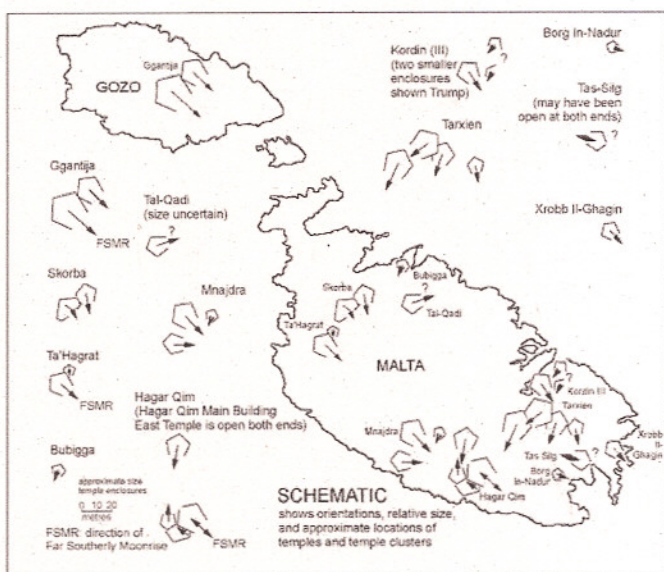


Figure 3: Schematic map of temple sites and clusters. An orientation coinciding with the direction of the far southerly moonrise is found in Ggantija South Temple, Ta'Hagrat South Temple, and Hagar Qim Main Building East Temple.

2. ORIENTATIONS TO MOONRISE

The moon reaches its maximum declination north and south every (tropical) month, and reaches its extreme maximum of declination N. & S. for a number of months towards one end of an 18.61 year cycle. When the moon is close to a maximum declination it can be observed as a particularly far northerly or southerly rising or setting point, and at the maximum end of the 18.61 year cycle the moon returns to a similarly extreme rising or setting point once a month for a number of months.

Each of the four possible observations to the horizon has its own character. In observations of the far southerly moonrise in the period 2005-2007, attempts to observe the moon on the horizon in daylight were not successful. Only moonrises observed in twilight and darkness were visible as they took place on the horizon, so the effect was to restrict visible moonrises to the series full moon to last crescent. The azimuth of the rising point ranges from most northerly to most southerly every month, so in any one month only one of the series full moon to last crescent is observed at the most southerly rising. In practice the observation of most southerly moonrises runs in a series backwards through the phases, one every (tropic) month, starting with a last crescent observed shortly before dawn after midwinter, running through last quarter rising at midnight around spring equinox, and completing with a full moon rising after sunset at midsummer. No far southerly moonrises are visible in the second half of the year.

A small team attempted observations of moonrise from the three temple enclosures Hagar Qim Main Building East Temple, Ta'Hagrat South Temple, and Ggantija South Temple, over the period May 2005 to June 2007. Observations were made from a position midway between the orthostats found towards the centre of each temple and out through the entrance. The position of moonrises at declinations in the range 27° to 28.5°S were used to estimate the position of a moonrise at 29°S , the calculated declination of a far-southerly moon in the period of the temples' use, 3500-2500 BC.



Figure 4. Moonrise from Ta'Hagrat observed 2007.

Ta'Hagrat South Temple (Malta) is a three-apse Ggantija phase structure about 15m in length from the entrance to the far end of the head chamber. The lintels are modern restoration. Seen from the interior, the horizon is formed by the edge of a ridge-like plateau seen over a distance of 2000 meters at an elevation of 3°. The horizon is visible beneath the level of the lintels from a height of about one and a half meters at the head of the building; from the waist of the building the horizon is seen from a standing position. Moonrises at declinations approaching 28.5°S were observed at an azimuth about one degree north of the center of view (Fig. 4).

Ggantija South Temple (Gozo) is a five-apse Ggantija phase structure, the largest temple on the islands, 26m from the entrance to the far end of the head chamber. The building is stepped downhill to an entrance formed by massive stone slabs, but with no lintel. The modern horizon is a roofline of three story dwelling houses built along a limestone plateau, observed at elevation 1° and distance 2000 meters. The sightline crosses an intermediate limb of the plateau at 1500 meters and a level below that of the roofscape; without the buildings this plateau would probably form the natural horizon seen from the forward part of the temple. If Ggantija had ever had a lintel over the entrance it would have cut out the view of the horizon when observed from the head.

The center of view is to the rising point of an object at about declination 28°S, about one degree short of the calculated maximum of declination 29°S observed 3000 BC. Observations in the period 2005-2007 were made difficult by low-lying haze. In fifteen attempts only three observations at the level of the horizon proved successful, each of a moon close to full. In theory those three observations were sufficient for 2006 to have been identified by a naked eye observation of the rising point as the year of the most southerly moonrise in the current cycle. The difference in azimuth between the moonrises observed from Ggantija in 2005 and 2006 was about half a diameter (Fig. 05). In a different 18.61 year cycle it might not be possible to distinguish between the far southerly positions of moonrises seen over two years.



Figure 5: Comparison of moonrises observed from Ggantija 2005-2007.

Hagar Qim Main Building was extensively remodeled in the Tarxien phase. The East Temple is an asymmetric four apse building with a second entrance at the head. The sea is visible from the main entrance. From the waist of the temple the horizon is formed by two built structures, one ancient, one modern. To the left at a distance of 20 meters is a megalithic block in the remains of a separate structure 'the eastern building'. To the center and right of view is a late twentieth century wall 2 meters high seen at a distance of 100 meters and an elevation 0° at its lowest part. It is possible the wall blocks a view of the sea to the centre of the field, and blocks a view of the flank of the ridge to the right.

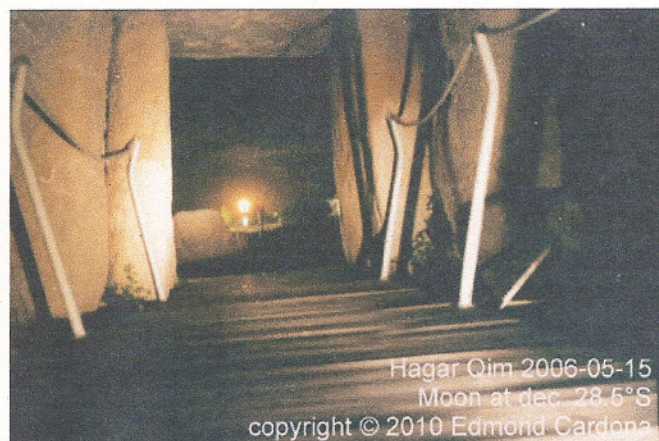


Figure 6: Moonrise from Hagar Qim observed 2006.

From observations made 2006 (Fig. 6) it seems the main axis of the temple is orientated about two degrees south of the notional position of a moonrise at declination 29°S . Modern obstacles make it difficult to establish the precise view. The southernmost moonrise at the period 3000 BC might have been seen over the sea just clear of the East Building. The rising track would take it through the centre of view in the entrance, and been visible from the head of the temple and from outside of the north-western end.

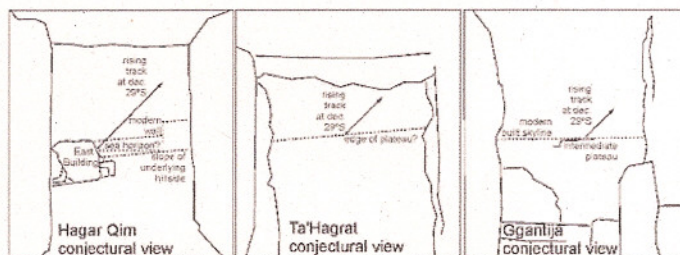


Figure 7. Conjectural views of the far southerly moonrise from three temples.

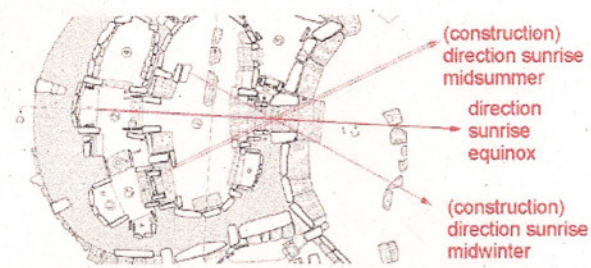
From those observations it can be conjectured the orientation of Ta'Hagrat South Temple is within a degree of the notional position of a moon rising at declination 29°S , the orientation of Ggantija South Temple is to a position about 1° north, and the orientation of Hagar Qim East Temple is to a position about 2° south (Fig. 7).

3. ORIENTATION TO SUNRISE AT MNAJDRA

Detailed plans of the better preserved temples and temple complexes are found in J.D.Evans (1971). From a study of those plans the only candidate for an open orientation towards the direction of a significant sunrise or sunset (meaning solstice or equinox) is Mnajdra South Temple.

Mnajdra South Temple is a four-apse Tarxien phase building 15 metres from entrance to head, one of two Ggantija phase buildings in a complex close to Hagar Qim. The building faces a hillside of about 4° elevation towards azimuth about 93° , a near exact orientation to the equinox sunrise. A deliberate orientation could have been found by bisecting the positions of midsummer and midwinter sunrise. However, in the period 3000 BC the same view would have coincided with the rising point of the Pleiades and would have seen the heliacal rising of the Pleiades close to the time of the spring equinox, a remarkable coincidence of targets for an astronomical theory.

A niche at the head of the temple contains a table or shelf at a height of about 130cm. Lintels limit the view along the main axis. From the top of the shelf the view of the sky is a strip less than one degree clear of the hillside, and about 7° wide. Close to equinox the position of sunrise moves along the horizon at the rate of one solar diameter every day. A casual observation of the sun rising at the centre of the field would be enough to fix the time of the equinox within one or two days. Alternatively, the first full moon observed in the field following the first sunrise observed in the field would fix a lunar calendar, in a way similar to Passover and Easter.

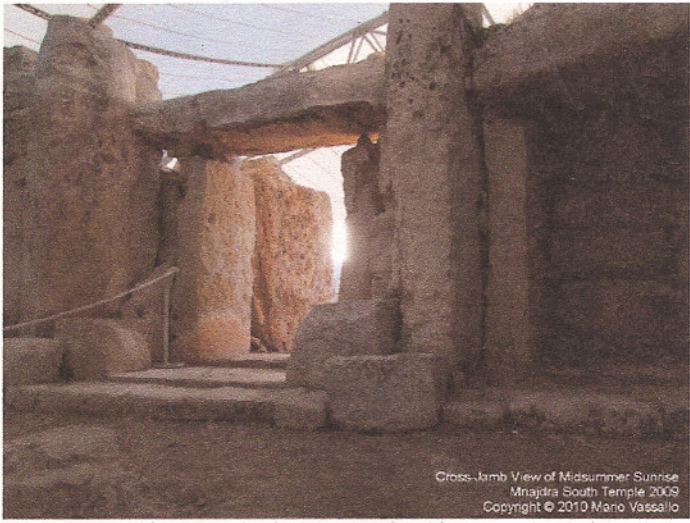


Orientation of Mnajdra South Temple to sunrise at the equinox; cross-jamb views to the solstices

Temple Plan from JD Evans 1971 by courtesy Continuum Publishing copyright © 2010 Continuum Publishing

Figure 8. Plan of Mnajdra South Temple.

In the modern period the architecture of Mnajdra South Temple allows a cross-jamb view of sunrise around the time of the solstices. The entrance to the temple is formed by opposed pairs of orthostats, rectangular worked slabs that together form a short corridor. Two diagonal views from the rearmost inside corner on one side to the foremost inner corner on the other (the 'jambs') give a view to the position of sunrise at midsummer and at midwinter (Figures 8 and 9). The views are not equally wide (Trump 2004 p.151).



Cross-Jamb View of Midsummer Sunrise Mnajdra South Temple 2009 Copyright © 2010 Mario Vassallo

Figure 9. Mnajdra, cross-jamb view towards midsummer sunrise.

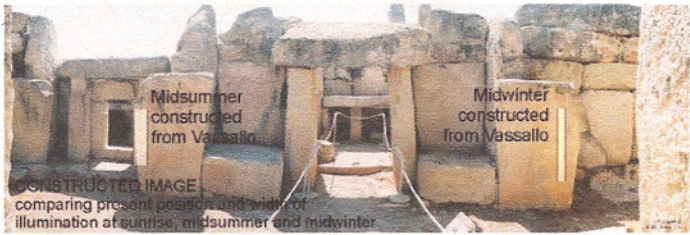


Figure 10. Constructed view of Midsummer and Midwinter Illumination.

In photographs taken by Mario Vassallo the cross-jamb view at midsummer is wider than the view at midwinter. The illumination at sunrise in midsummer lights up the left side of the orthostat to the left side of the left hand niche at the waist of the temple, and spills onto the frame of the porthole entrance to the southwestern apse (Evans' room 3). By contrast, the midwinter illumination is a sliver of light inside the right edge of the orthostat to the right (Fig. 10).

4. OFFSET ILLUMINATION AT MIDWINTER SUNRISE

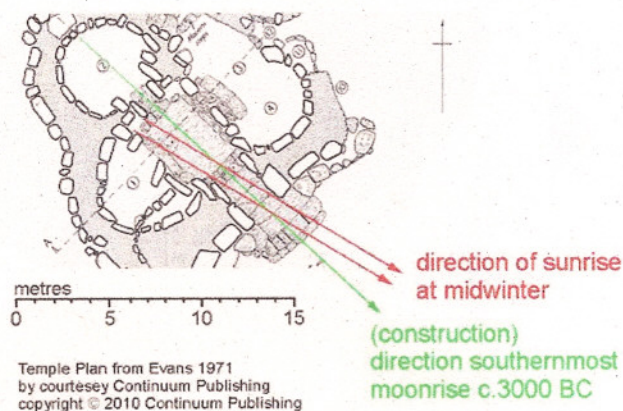


Figure 11. Plan of Ta'Hagrat showing line to midwinter sunrise.

From the position of niches and orthostats in some of the temples there are views of sunrise or sunset seen through the entrance. This essay looks at a restricted case. A study of plans found in Evans (1971) suggests eight possible cases of a so-called 'offset illumination' involving the whole and discrete illumination of a niche or orthostat by sunrise or sunset at the solstice along a line offset from the line of the main axis (Fig. 11). Six involve the midwinter sunrise, of which three are found in the temple complexes already studied for the position of a far-southerly moonset. Practical observations were attempted in December 2008.



Figure 12. Midwinter sunrise observed from the left hand niche at Ta'Hagrat, 2008.



Figure 13. Illumination of left hand niche by midwinter sunrise, Ta'Hagrat, 2008. The conditions were hazy: the area of illumination is seen in the reddened appearance of the stones in the niche.

Observed (2008-12-16) from the left hand niche at the center of Ta'Hagrat South Temple, the sun rose from a position in the middle of the entrance open to view (Fig. 12). Looking into the temple, the niche was illuminated by sunlight while the interior on either side remained in shadow (Fig. 13).

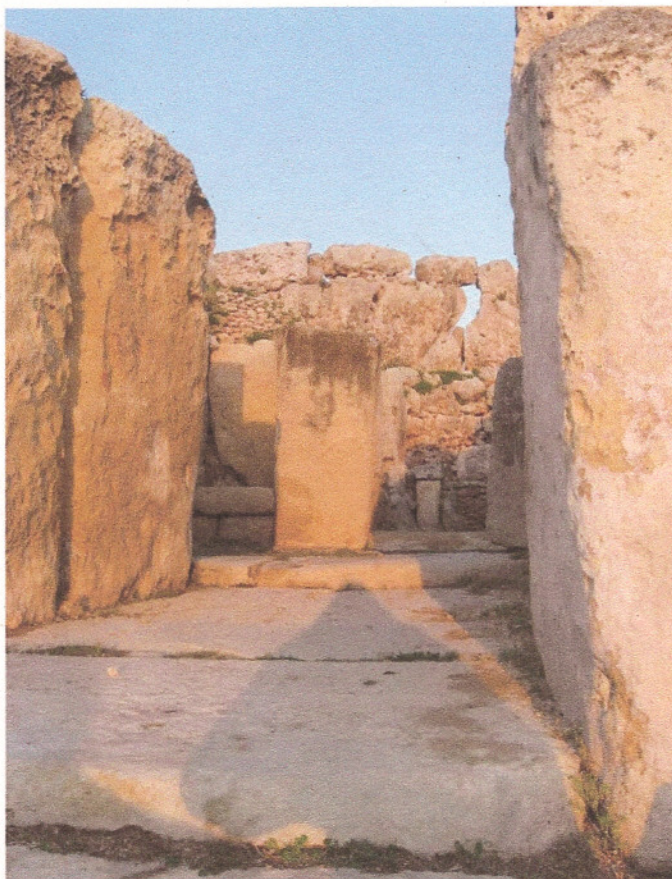


Figure 14. Illumination of left side orthostat Ggantija North Temple by midwinter sunrise, 2008.

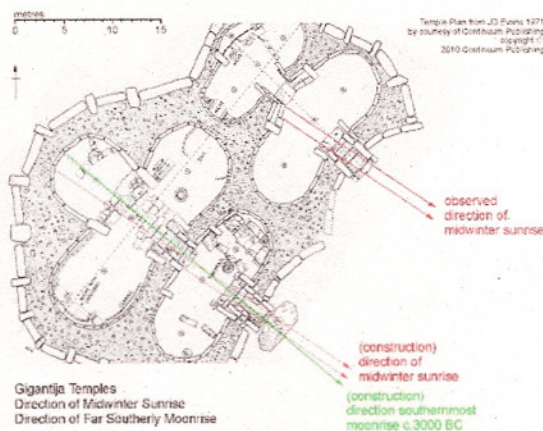


Figure 15. Observed and Conjectured Illuminations at Ggantija by Midwinter Sunrise.

Observed in Ggantija North Temple (2008-12-15 and 20) the illumination of the midwinter sunrise missed most of the left-hand niche, but illuminated the left-hand orthostat (Fig. 14). The orthostat has two unusual features: the long axis lies across the main axis of the temple, and the upper part of the stone is free-standing, not butted against others.

The midwinter sunrise from Ggantija South Temple is hidden by a tree in front of the temple. Observations (2008-12-15 & 20) made some minutes after sunrise were consistent with a cross-jamb view from the head, but an observation must wait on a clear view to the horizon (Fig. 15).

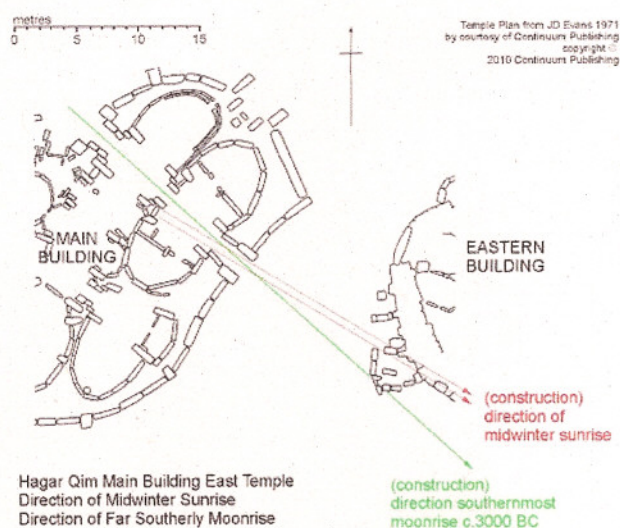


Figure 16. Plan Hagar Qim Main Building East Temple.

Attempts to observe sunrise from Hagar Qim Main Building East Temple were frustrated by cloud. On one attempt (2008-12-19) the sun cleared a few minutes after rising, sufficient for part of the left hand niche and part of the orthostat to be illuminated. The illumination was consistent with the theory that, at a time close to sunrise, the illuminated area would have been confined to the niche (Fig. 16). The precise pattern of illumination and shadow produced by a midwinter sunrise in clear conditions was not discovered; the area in front of the niche contains a tablet with a pair of opposed bas-relief volutes and a pedestal with a vegetation motif (Fig. 17). Eliade (1958 p.156) makes the general remark 'the spiral, for instance, which was taken to be a symbol of the moon as early as the Ice Age, relates to the phases of the moon [...and elements] to do with fertility (the double volute, horns and so on).



Figure 17. Left Hand Niche at Hagar Qim with Volutes and Pedestal.

In a paper study it appears that three other temple enclosures may have offset illumination by midwinter sunrise to a niche at the left side of the waist of the temple: Skorba South Temple, Mnajdra North West Temple, and Xrobb I-Ghagin (shown in a schematic diagram, Fig. 18). In the first two cases this possibility could be explored by practical observations (too dangerous or entirely impossible at Xrobb Il-Ghagin, a building undercut by an eroding sea cliff).

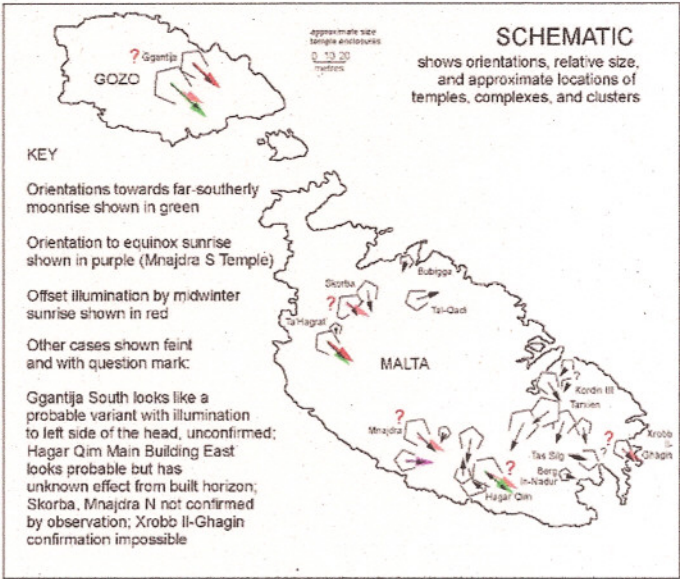


Figure 18: Schematic map showing observed and speculated alignments.

5. DISCUSSION

A major temple complex in three of four groupings has an alignment close to the direction of a far southerly moonrise, a sequence of apparitions conspicuous in an eighteen to nineteen year cycle, that begins at midwinter, and that runs counter to phase to complete at midsummer. In two cases the same complex displays a privileged illumination to the left by the midwinter sunrise looking in, a side of the temple associated with vegetation and growth. Nearby temples might exhibit a similar privileged illumination to the left at midwinter. In a contrary case (Mnajdra South) the illumination to the left is partial and made at midsummer, but remains privileged by comparison with the midwinter illumination to the right, which approaches extinction.

Although the number of astronomical cases is not great enough to demonstrate a deliberate alignment at the time of foundation, their number is sufficient to suggest it may have been intended in some cases. The decorative bas relief sculptures of the Tarxien phase show an interest in symmetrical arrangements that would be able to switch focus from sun to moon, and would be able to celebrate the logic of the far southerly moonrise that starts with the last crescent and moves back through the phases to full. In both cases, the midwinter sunrise, and the far southerly moonrise, the seasonal focus and start point is the midwinter that might be associated with ideas of renewal and growth, perhaps a particular concern had the culture had difficulty sustaining itself. The coincidence between the period of the 18.61 year cycle and the approximate period of a human generation might have also been noticed. A culture so rich in its celebration of repetition and symmetry was surely aware of these astronomical effects in these particular temples.

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