Archaeoastronomical Analysis of the Temple of Diana to Cefalù (Sicily)

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Abstract The so-called *Temple of Diana* is situated on the Rock of Cefalù, that dominates the namesake fishing village in the northern coast of Sicily. The megalithic temple has a main entrance direct to the West, through which starts a corridor leading to the rocky cistern characterized by a dolmenic coverage. After the first drawings and reliefs between '700 and '800, respectively of Jean Houel and George Nott, the first official archaeological excavations were made by Pirro Marconi in the first half of the twentieth century. These excavations allowed to acquire more informations about the age of the temple and the cistern. With this study we present the first complete archaeoastronomical analysis of the building, allowing to find out that the megalithic architecture is a real Sun temple. The front door of the temple is indeed oriented to the point where the Sun sets at the equinoxes. This finding suggests that in these periods of the year the solar hierophany most likely invited to come inside the temple to reach the cistern, where they carried cults and rituals related to water. This study propone to identify the temple as an Artemision. The study made it possible to realize the first 3D relief of the temple also, suggesting a new process for the protection and enhancement of the archaeological site.

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1 The Rock of Cefalù: Tectonic and Geological Framework

The *Rock of Cefalù* is a large limestone plateau that rises about 300 m on the Cefalù's promontory, situated on the Tyrrhenian coast, to the eastern borders of the province of Palermo, in northern Sicily (Fig. 1). The rocks that outcrop belong to Panormide Tectonic Unit (Unit Maghrebids "external") being a sequence of Mesozoic carbonate platform with a siliciclastic and marly tertiary coverage.

In particular there is the formation of Cefalù (CEU), Upper Jurassic—Early Cretaceous age, characterized by reef carbonate limestone gray-bluish sometimes pseudoolithics (Fig. 2); there are levels of reddish or yellow-ocher intraformational breccias also. The limestones are fossiliferous and contain rudist, gastropods, corals, algae and bryozoans.

Structurally and tectonically this area is characterized by the presence of dislocation lines (normal faults) mainly in the northeastern area of the "Rocca" (Lunardi et al. 1994).

The micro-karst geomorphology it's very interesting; the limestone is dissected into blocks, called clints, bounded by vertical fissures known as karst crevasses (*Kluftkarren*). Apart from clints and crevasses, limestones also have a number of characteristic surface formations known as runnels (*Rillenkarren*), furrows (*Rinnenkarren*), dissolution/corrosion pans and tubs.

Fig. 1 The Rock of Cefalù and the town photographed from East (authors' photo)

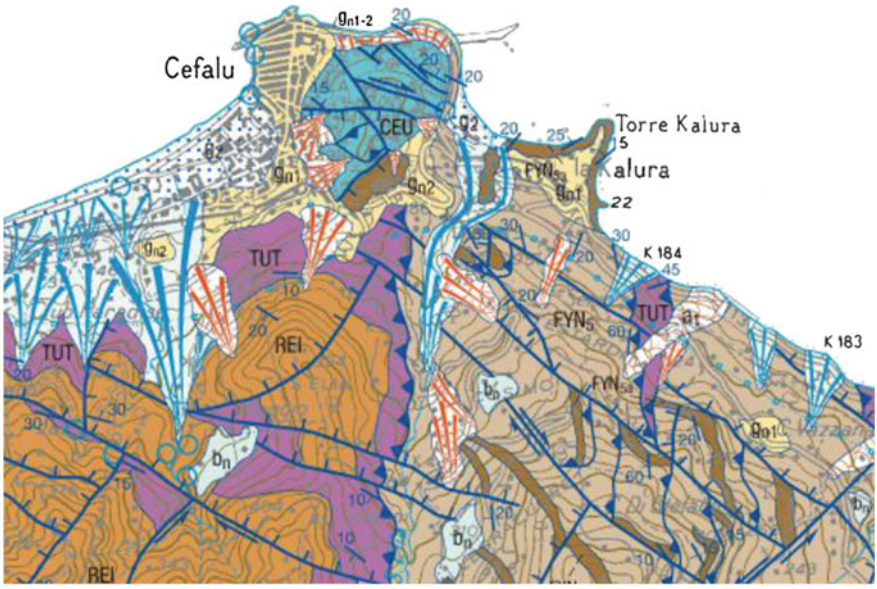

Fig. 2 Geological map of "Rocca di Cefalù" (modified from Carta Geologica d'Italia 1:50.000—Foglio 597 Cefalù, ISPRA)

2 Temple of Diana: Description

There are some reliefs and descriptions about the megalithic temple and the dolmenic tank in the works of Houel (1785), Hittorf and Zanth (1829) and Nott (1831).

One of the first representations of the megalithic temple of Diana is that of the famous French painter and architect Jean Houel, one of the greatest travelers of the Grand Tour. During his trip to Sicily Houel realized over 200 drawings, which will be collected in the four volumes of the *Voyage pittoresque des isles de Sicile, Malta et de Lipari* (1785). This collection is considered one of the most important works of the eighteenth century. From the drawing of the temple on the Cefalù Rock (Fig. 3) we note in particular the three rows of stones above the main door.

The first reliefs of the temple of Diana was performed by George Nott, an Anglican clergyman, scholar and lover of Italian culture, that lived in between '700 and '800.

The general plan of the building (Fig. 4) shows the original megalithic structure (dark lines) and adding medieval church (gray lines). We see three doors from the plant (H, L, J), the corridor (I), the main chamber (M) and the smaller secondary room (K). With the letter Y Nott indicates the cistern carved into the rock. Reliefs of the elevation of the west facade (Fig. 5) is to emphasize the presence of the gargoyle gutter that was used to drain the water from the terrace or roof that covered the large room. Even from Nott's reliefs it can still be seen three rows of stones above the front door.

Fig. 3 The temple of Diana in the Jean Houel's drawing (1785)

Today the most evident part of the temple's ruins consists of a building leaning against the rocky slope of the mountain, in the western part of the Cefalù Rock, where is the only route access to the structures present on it. The floor plan of the temple is irregularly rectangular: the longer side of the building, facing west, is not continuous, in fact in its southern part it has a greater rectum stretch (11.45 m), while proceeding towards the north it pronounces a recess, and continues for 7.75 m, backward of 2.10 m from the remaining front. The temple is preserved to a considerable height, and therefore constitutes a ruin of important dimensions; on the South-West corner the greater height amounts at 5.07 m.

Also the corners of the temple, except the north one's, have a rudimentary decorative work in a kind of pilaster.

The front door is not at the center of the building, but near the North-West corner. The door is composed of a monolithic lintel, 2.58 m long and 0.69 m high, placed on two jambs of 0.65 m wide, composed of various segments, connected to the walls of the building. The door is 2.68 m high and has a light of 1.19 m at the bottom and 1.16 m on the top. Entering through the door starts the corridor, approximately 7 m long, which leads to the dolmenic cistern, whose coverage is set to a higher share of about 4–5 m above the megalithic temple's floor. Each of the walls that surround the corridor has a door that leads into the two side compartments of the building (the north room has dimensions of 3.05 × 5.00 m, while the south room 7.85 × 4.14 m).

In the largest room was built a church dedicated to Santa Venera in high medieval age (Brunazzi 1997).

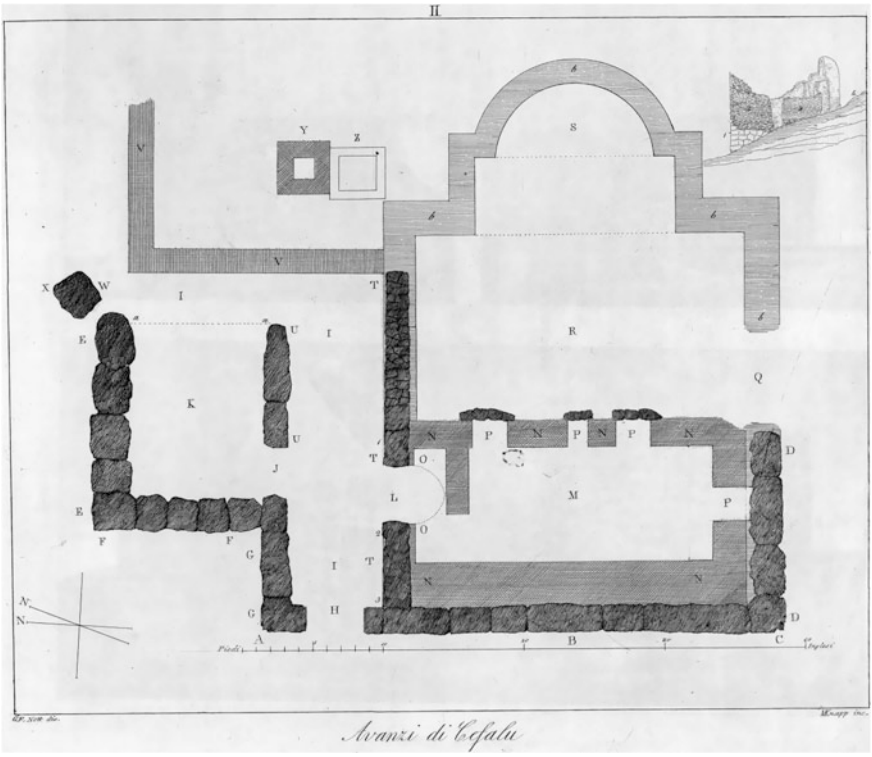

Fig. 4 The Temple of Diana's plan (from Nott 1831)

While the front and sidewalls are remarkable elements, as regards the eastern rearward part the elements are still very poor. All the walls are formed of blocks placed in situ, as they had been plucked from the mountain, and they were assembled to dry, in fact the mortar present in some part of them is of recent times. The size and shape of the blocks are very different, there are colossal stones and other rather small. These blocks should be to form three rows of blocks in height (Fig. 5). From different photos taken from the beginning of XX century until today it is evident that the three rows of blocks are no longer present, there are in fact only small portions of the rows of stones (Figs. 6 and 7).

2.1 The Dolmenic Cistern

The cistern is located on a deep pit of the rock, a veritable little sinkhole, which has a small pool of water used since ancient times as a reservoir of water. The tank has a surface area of 19 m^2 with an elliptic shape.

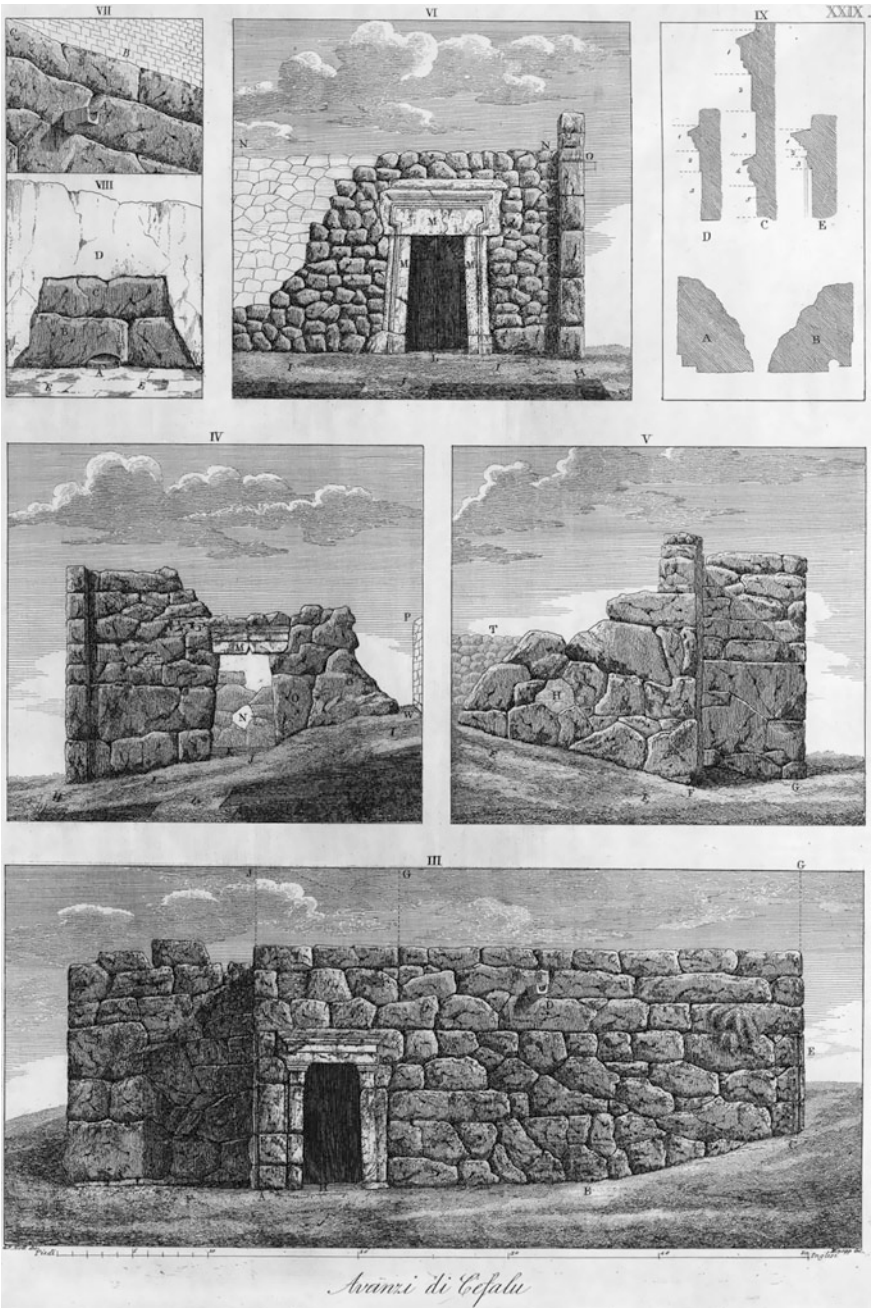

Fig. 5 Reliefs (from the *bottom* to the *top*) of the elevation of the west façade (*III*), the access door to the small room (*IV*), the outer wall of the small chamber (*V*), the access door to the large room (*VI*), particular of the gargoyle (*VII*, *VIII*), moldings (*IX*) (Nott 1831)

Fig. 6 The Temple of Diana in a rare photo of the beginning of the '20s of the twentieth century, before the Pirro Marconi's excavations (courtesy of Photo-Archive and Photo Library by Varzì and Brunetti, Cefalù)

The "primordial" tank is a little cavity in the limestone bedrock, caused by the wellspring water erosion until a corrosion tub. The cistern is located on a deep pit of the rock, a veritable sinkhole, which has a small pool of water used since ancient times as a reservoir of water. The tank has a surface area of 19 m^2 with an elliptic shape (Fig. 8).

The maximum depth of the tank is about 4 m, while the bottom, flat, occupies an area of just 6 m^2. The tank was then closed with a dolmenic type cover. A series of large slabs of limestone in fact rest on the edges of the cavity and on two rectangular monoliths that act as lintels, which in turn are imposed on a central pillar formed by 4 stones suitably machined and overlapped, three of which are of cylindrical form while one is rectangular. The pier is located at the center of the cavity and thus sustains the entire dolmenic roof, formed by seven irregular slabs: 4 monoliths depart from the midline (lintels) to the west, while the others 3 are directed from the opposite side to the east. The greatest segments measured 2.60 m in length, others arrive at 2.30 or 2.40 m, while the width varies between 1÷1.75 m. The heads of the slabs rest directly on the edge of the rocky cavities, without any recess housing had been practiced to accommodate them (Fig. 9).

Fig. 7 The Temple of Diana as shown today (authors' photo)

2.2 The First Archaeological Excavations

The first area's archaeological excavations on the so-called Temple of Diana were conducted by Pirro Marconi in the first half of the twentieth century. The archaeological investigations, regarding the temple structure, led to the discovery pottery fragments dating from Greek times, as painted shards, fragments of tiles and pithoi, and from Middle ages, like fragments of Norman dishes and Byzantine pottery. As regards the dolmenic cistern were found several fragments of impasto vases, reddish and yellowish, recalling without any doubt to prehistoric times, probably to the period of the advanced Bronze Age, at the beginning of the first millennium BC (Marconi 1929).

So the megalithic temple seems to date back to the VI–V century BC while the dolmenic cistern incorporated on it is considered of proto-historic period by many scholars (Bovio Marconi 1956; Van Essen 1957; Tusa 1959; Tullio 1974). It is interesting at this time to emphasize how Marconi already proposed a parallel between the function of the megalithic complex present on the Rock of Cefalu and that of Agrigento, the archaic rocky sanctuary situated on the Rupe Atenea.

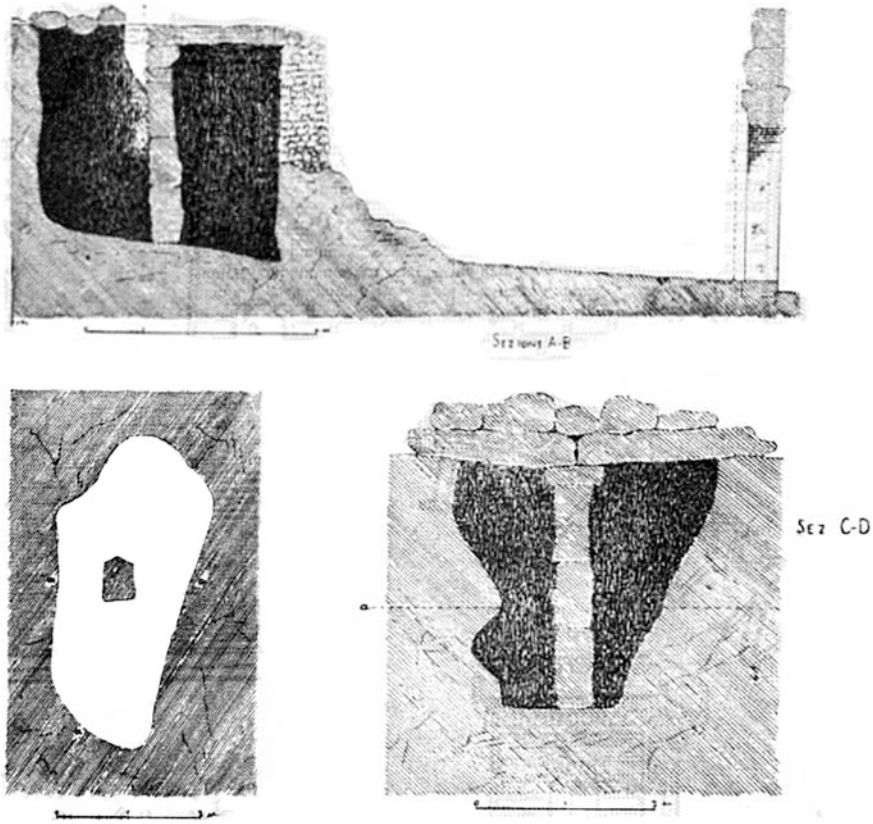

Fig. 8 The dolmenic cistern (from *top* to *bottom*, *clockwise*): North-South section, East-West section, plant (from Marconi 1929)

3 The Cult of Water

The study of the Temple of Diana and the dolmenic tank is really very interesting, as it still is not well understood what was their real function. As already highlighted by Marconi seems certain, however, that the larger building is closely linked to the tank: in fact the axis of the building, passing through the main door and the hall tip directly on the tank.

Thereby the temple acts as pronaos: to access on the tank you have to go through the building. So the function of the complex not can be that sacred. The worship of water is among the most frequent and widespread in prehistoric times, in all regions, and in certain (remember Sardinia, for example: Melis 2008) assumes the demonstrations also of great architectural importance (Portale 2012; Collin Bouffier

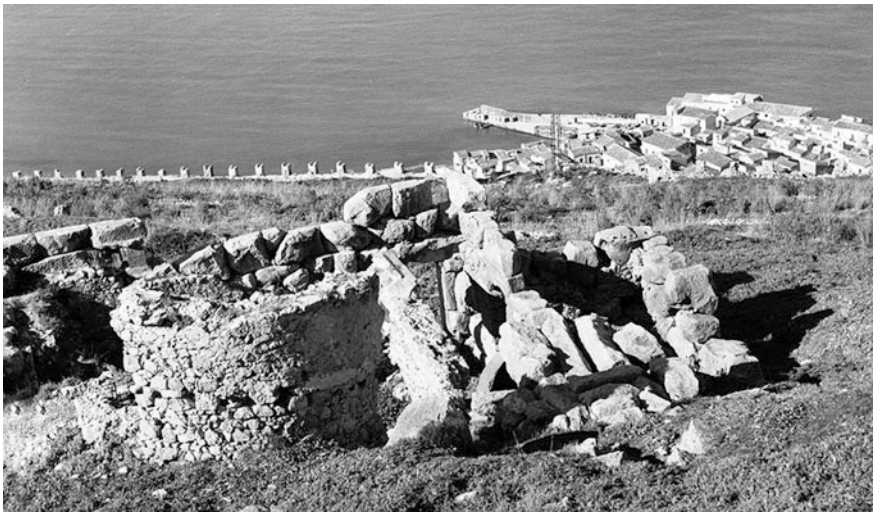

Fig. 9 The temple of Diana with the dolmenic cistern in the 60's of the last century; note the absence of the pine forest in front of the megalithic structure (courtesy of Photo-Archive and Photo Library by Varzì and Brunetti, Cefalù)

2013). By the cult of a pool of water being formed in a natural cavity was born the construction of the sacred place, initially limited to simple protection, while later during the Greek period, access to the holy site has been barred from the building that has the value of pronaos and service.

In this regard we consider the dolmenic tank as a true indigenous sanctuary, while the temple would be identified with an Artemision. It is to remember also that in the Middle Ages on the ruins of the Temple of Diana, in particular on the area to the right of the main entrance, it was built a church dedicated to Santa Venera. It is interesting at this point to consider other possible sites and facilities related to the water's cult in Sicily. The first of these is the Temple of Diana Facellina in Milazzo. Today there are no more traces of this temple, however it has identified a thermal building in the land of Santa Venera near Milazzo (Saporetti 2008).

In this regard we quote an interesting passage from his book: "*We are likely to see an origin of the sacredness of the place in a rich source of healing water, perhaps even worshiped before coming of the Greeks and the consecration of the goddess Artemis/Diana*".

We must also emphasize the fact that the presence of a church dedicated to Santa Venera, built on a sacred pagan site, is not meaningless and not a unique case. In the province of Catania in fact, in the territory of Acireale, we find the archaeological area of *Santa Venera al Pozzo* (Fig. 10).

The presence at the place of enormous quantities of water has led over the centuries the location of structures that could contribute to its exploitation: the baths, the well, the mills, the ducts, the hospital and the buildings dedicated to

Fig. 10 The archaeological area of Santa Venera al Pozzo, in the image are showed the remains of a thermal plant consisting of two rooms covered with vaulted roof used as bathrooms (authors' photo)

religion. Even long before the cult of Santa Venera, under the "Timpa", in front of the main facade of the church dedicated to the Saint, it was to be already a center of worship attested by the discovery of clay figurines related to the cult of Demeter and Kore, protective deities of the land and agriculture (Branciforti 2006; Amari 2006).

And finally we must certainly remember the rocky sanctuary in Agrigento, a place that already from Marconi was identified as a sanctuary of the period before the Greek colonization (Marconi 1926). A place intended for worship of natural forces, perhaps dedicated to nymphal deities (Bellavia et al. 2012; Portale 2012; Fino 2014).

The sanctuary is characterized by two natural caves from which water flows, and which is then collected through a system of tanks. Today the rocky sanctuary is under study yet and is not visible to public.

3.1 The Archaeoastronomical Analysis

Initially we measured the orientation of the megalithic temple using satellite data (tool of GE). From this verification it showed that the azimuth of the entrance of the Temple of Diana is about 270° (Fig. 11).

Fig. 11 Rock of Cefalù. Satellite view of Temple, with the Google Earth ruler showing the azimuths of the building's entrance (Image courtesy Google Earth, drawing by the authors)

Table 1 The table shows the azimuth from inside looking out, the angular height of the horizon in that direction, the corresponding declination and the altitude

	Azimuth (°)	Height (°)	Declination (°)	Altitude (masl)
Temple of Diana's entrance	268.50	0.23	−1.14	154

Then in August 2015 we have achieved the campaign of measures on the Rock of Cefalù. In particular, the study was carried out to measure the azimuth of the Temple of Diana's entrance. To implement the measures we used a theodolite Kern DKM2 of Swiss manufacture. Although the nominal accuracy of the instrument is less than 1', it is estimated that the error of our measurements can reasonably be ±15'. The results are shown in Table 1.

So it was found as the orientation of the front door of the megalithic temple, which leads directly to the corridor, has a clear direction: East-West. The azimuth of the entrance and the corridor of the temple is clearly equinoctial, and this indicates perfectly the direction in which the Sun sets at the equinoxes. Unfortunately, about 50 years ago in front of the temple several pine trees have been planted, so today it is not possible to observe the western horizon and thus the equinoctial hierophany (Fig. 12).

To observe the Sun setting at the equinoxes in alignment with the front door it was realized a virtual 3D reconstruction video using the technique of architectural photogrammetry (Fig. 13).

Fig. 12 The Temple of Diana photographed from East: to notice the pine forest that unfortunately does not allow to observe the Sun sets in alignment with the entrance of the temple at the equinoxes (authors' photo)

Fig. 13 Temple of Diana, entrance: view from inside towards the outside. *Left* photo of 1963 when it was still possible to observe the sea and the western horizon (courtesy of Photo-Archive and Photo Library by Varzì and Brunetti, Cefalù); *right* 3D video reconstruction that shows the moment when the Sun sets at the equinoxes

Fig. 14 *Left* and *right*: two images extract from the 3D Diana's Temple render

3.2 Diana's Temple 3D Model

In order to obtain a georeferenced (UTM-WGS84) 3D model of the megalithic structure, was executed a "non-invasive" photogrammetric survey and a take-over with "total station".

The activities were structured as follows: the megalithic area's inspection, non-invasive and non-destructive survey, post data processing, return the 3D model.

The technologies used during the temple take-over were (Lo Brutto and Spera 2011; Remondino et al. 2014): "total station" for detail points (for object scale commissioning), GPS for reading station points necessary for georeferencing the 3D model in the geographic coordinate (UTM-WGS84), Reflex Nikon camera for photogrammetric survey, targets on rigid support to facilitate the points reading, "Disto Laser" for a checking during the model return.

At the end of the different calculations were produced a 3D model, a render video of the sun sunset at the equinox, a series of 3D Diana's Temple render images and a 3D PDF file (Fig. 14).

A digital copy of the final work was donated to the Municipality of Cefalù to begin a process of protection and enhancement of the Diana's Temple area creating the first "interactive archaeoastronomical museum" of Sicily.

4 Conclusions

The Temple of Diana on the Rock of Cefalù is certainly one of the most attractive monuments in Sicily, the importance of which was little considered for long time.

The archaeoastronomical study carried out made it possible to again refocus attention on it, allowing to start a new protection and enhancement process. The archaeoastronomical analysis of the temple has uncovered as its entrance is oriented

to the sunset at the equinoxes. The Temple of Diana is configured thus as a real Sun temple, a place where during the sunsets at the equinoxes could be observed a magnificent hierophany: the Sun, in alignment with the front door, illuminating the hallway of the temple, inviting participants to go on until the megalithic tank, center of an atavistic water's cult. And it is the presence of water that has led us to propose a new allocation of the temple, considering the goddess Artemis; so we could consider the place as an *Artemision*.

This study was officially presented to Cefalù during a meeting organized in cooperation with the Administration. On January 9th 2016, in the council chamber of the Town Hall, a packed crowd attended the cultural event dedicated to the archaeoastronomical study of the Temple of Diana. Now we hope that in the coming years, the Administration can realize a multidisciplinary tour route and the first 'interactive archaeoastronomical museum', to be implemented most likely in one of the rooms of the *Osterio Magno*, the medieval palace located in the center of Cefalù.

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