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ASTRONOMICAL USE OF CERRO SACROMONTE

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RESUMEN

Este trabajo retoma datos de una investigación de hace ya algunos años, de finales del siglo pasado para ser más precisos; tiene que ver con el registro de la salida del sol durante las fechas de solsticios y equinoccios, entre otros, que coinciden con las festividades prehispánicas. El registro se llevó a cabo desde la entrada de la iglesia de "El Sacromonte", situada en lo alto del cerro del mismo nombre, en el municipio de Amecameca de Juárez, Estado de México. Esta observación mostró la existencia de un calendario de horizonte en donde el sol marca los cambios de estación y festividades; y donde se encuentran lugares de ritual a la montaña, tanto en época prehispánica como moderna.

ABSTRACT

This work takes up research data from several years ago, from the end of the century to be more precise; it deals with the sunrise registration during dates as solstices and equinoxes, among others, that match pre-Hispanic festivities in turn. Registration was carried out from the entrance of the Church of The Sacromonte, located at the top of a hill, in the town of Amecameca, State of Mexico. This observation showed the existence of a calendar's horizon, where the Sun marks the seasons along the geographic landmarks, and where places of worship of pre-Hispanic times have been found in the high mountains as well as some modern remains.

Key Words: archaeoastronomy

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1. INTRODUCTION

This work incorporates research data from a few years ago, which I use to reinterpret the data recorded of the trajectory of the Sun from Sacromonte.[2] The observation of this celestial body is not new, all human societies, even the most primitive ones, have been concerned with the flow, measurement and interpretation of time. This concept has been evidenced through the construction of calendars that reflect the understanding of the role of each society in space. As examples of this are the Chinese yearbook depicting images of mythical animals like the dragon, or the Greeks, that describe human figures through the union of stars, or the civilizations in Mesoamerica, which included emblems such as a rabbit, a reed, a house, and rain, among others, in their calendar. Each society constructs its calendar according to their development, location, and climate, among other factors.

Man confronted with its need for certainty of his surroundings must have begun to observe nature and upon finding repetitive elements was able to keep records. The explanation of the phenomena could correspond to the following two criteria, one of theme, idealistic, where it is interpreted that there is a time of origin. By the repetition of the cosmogonic act, the specific time in which construction takes place is projected into mythical time, in *illo tempore*, when the foundation of the world took place (Eliade, 1968:27). In Mesoamerican societies there was a link between the observation of nature and its explanation, through myth and/or religion. It must be kept in mind that their economic base was agriculture, and that they privileged everything in its regard; the welfare of the community and the cosmos depended on the practice of appropriate rituals (López and Mondragón, 1998:118).

The other criterion is a materialistic conception, where a systematic observation of the Sun allowed for the development of agriculture, resulting in the production of surplus crops and potential for population growth; thus production is appropriation within the individual of nature and through a particular form of society (Marx, 1978:252).

This ability to measure time brought greater wealth to society, hence, more class divisions, and political and economic development. The points of view outlined above, can help to explain why it was so important to measure time by observing the Sun in its journey through the sky. Dividing the year

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[2]This elevation has been used by societies since prehispanic times up to our time, as a place of worship. For this reason remnant materials from different periods were found at this location.

Fig. 1. Church of The Sacromonte.

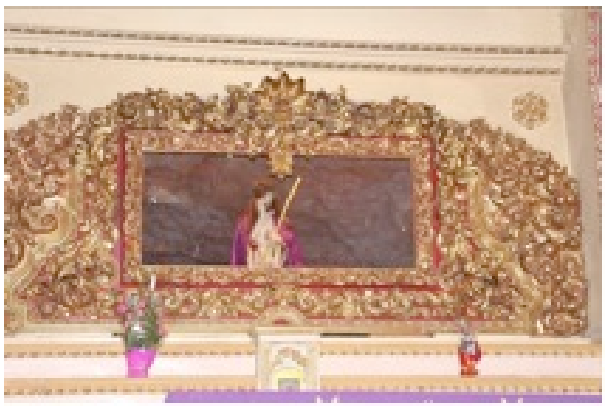

Fig. 2. Altar in front of cave represents the image of Christ of the cane.[3]

into seasons should have been fundamental in building calendars.

Some chroniclers that have recorded the life of the pre-Hispanic populations, addressed their accounting of time, indicating that it was done through an eighteen month calendar of twenty days each. It is indicated that every month was dedicated to a god and each had a holiday in his honor.

One must bear in mind that every religious festival [consists of] the reenactment of a sacred event that took place on a mythical past, thus time had been created and was sanctified by the gods because of that, its creation and sanctification was renewed by the celebration (Eliade, 1968:63). The birth of a god gives life to a civilization, the gods die so that man may live; and the stars represent this birth and death.

In this context, solar observations from The Sacromonte allowed the division of time and timely commemoration rituals; This hill is located within the town of Amecameca, in the municipality of the same name in the State of Mexico, at geographical coordinate 99°39'43" West and 19°14'53" North; this is part of the Chichinautzin Formation and stands in front of the Sierra Nevada.

This site is referenced extensively in information sources of the region, it is worth mentioning some historical references to identify how old was the historical and mythical use of the site. For the year 1258 (rabbit 13) The Sacromonte Hill was called Chalchiuhmomozco and several groups lived on it, including the Xochteca, the Olmec, the Quiyahuiztec, the Cocolca; they were the holders of the nahual of the rain, nahual of the beast, which traveled inside clouds to go to Chalco to eat people (Chimalpain, 1991:89). About these groups, the reason for their settlement at this elevation is referenced. These groups came from the course of the Mictlan, they were looking for the paradise called Tamoanchan.

> "*Es la verdad, según lo expresan todos los que escriben al respecto, que ésta allá, en la base de la que nombran [línea] equinoccial. Y por eso vinieron avanzando, por eso se vinieron asentando, de manera temporal, junto a los enormes, altísimos y muy largos cerros en donde los veían, porque es verdad que así vinieron pensando la cumbre del cerro, mucho muy corpulento, del Paraíso terrenal*" (Chimalpain, 1991 97).

Also it is indicated that from this hill water was springing, thus they built a house inside of which the fountain remained (Idem, 1991:99). There are also references to the existence on top of a shrine dedicated to the goddess Chalchitlicue. Later on a group called Totolimpaneca arrived, and ended up dominating the groups living in the so-called Chalchimomoztli. There are references to the arrival of the Mexica called Chichimecs towards the year 1464 (*cane* 10); with whom they struggled for control of the Chalco Amecameca region. Their struggle was interrupted by the arrival of the Spanish and the foundation of the parish in 1554.

It is then that the leader of the first twelve Franciscans, fray Martin de Valencia, built from the cave in the mountain the shrine of Sacromonte, redefining the meaning of this hill. It should be noted that to this day it remains a place of worship.

With this brief historical mention it is made evident that this hill has been appropriated and wor-

[3]On the feast of "Ash Wednesday" the Black Christ complete with casket is lowered into the parish of the Assumption of Amecameca, at which time you can appreciate the natural roof of the cave. In its place, another image space is placed, so that the altar is not void.

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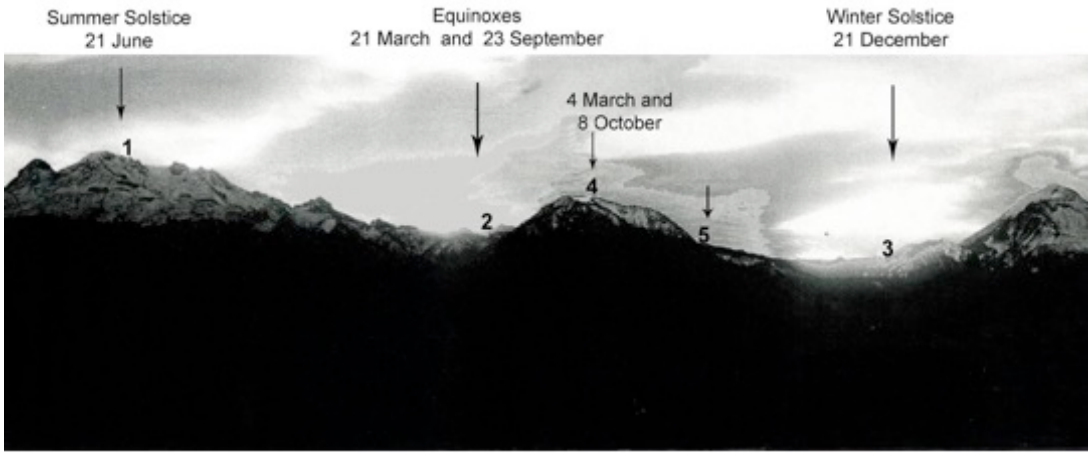

Fig. 3. Landmarks on the horizon.

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shiped through time by different societies. Without going into detail of the historical background, I want to move on into describing the data obtained from observations of the Sun.

The Sacromonte has a cave, now converted into a small chapel where it lays the so-called "Christ of the Holy Sepulcher". From the center of the entrance of the chapel you can see the sunrise on dates of equinoxes and solstices, which would not be important if not because in the places that the Sun marks on the horizon at dawn, were identified archaeological and modern sites related to the worship of the mountain, these sites were:

1. The breast of the volcano Iztaccíhuatl: June 21, Summer solstice.

2. The Cave of "The Witches" or Alcalicán: March 21, Spring equinox, and September 23, Autumnal equinox.

3. The foothills of Mount Yoloxochitl: December 21, Winter solstice.

4. The hilltop Venacho: March 4 and October 8 alignment with the Church of Sacromonte, which roughly corresponds to the alignment of Tenochtitlan's Major Temple.

5. The foot of the hill "The Venacho": February 12, beginning of the pre-Hispanic year for Sahagun (López and Mondragón, 1998), also with this orientation the petroglyphs known as "Tomacoco" or Rabbit's stone.

2. BREAST OF THE IZTACCÍHUATL VOLCANO

The Breast of the Iztaccíhuatl volcano is located at 98°38'30" N and 19°10'30" W, at an elevation of 5,256 meters. This is a semiovoidal terrace on the hilltop that, still in 2003, remained covered with ice. In this area sunrise is seen on June 21, "Summer Solstice".

Going back to some chroniclers, this date would be in the seventh month and would cover the celebration of Tecuilhuitontli "Feast of the Lords". Fray Bernardino de Sahagún referred that this month honored the salt goddess, called Uixtocihuatl, who was sister of the gods Tlaloques (Sahagún, 1982:119). For ten days in a row, women danced and sang; she who would be sacrificed was dressed in the costumes of the goddess (Sahagun, 1982: 120); for his part, fray Duran, as well reports that, it was a rather informal party, more so a preparation for the feast to come (eighth month). The most solemn act was to present roses to each other and share with each other; giving blankets, trusses and jewelry to each other; which is the tradition and practice to this day (Duran, 1984:263).

It is noteworthy that in 1983, members of the Mexican Alpine Club (Guzman, 1983), while performing an endurance test at an elevation of more than 5,200 meters, found surface archaeological materials a few meters below the summit. Researcher Stanislaw Iwaniszweski (1987:258) describes briefly this archaeological material: potsherds, wooden artifacts, obsidian, jade and wax, maguey tips, reeds tied with wire and bone, from the classic to the colonial periods. In 1985 there was an extended visit at the summit by the project members to analyze

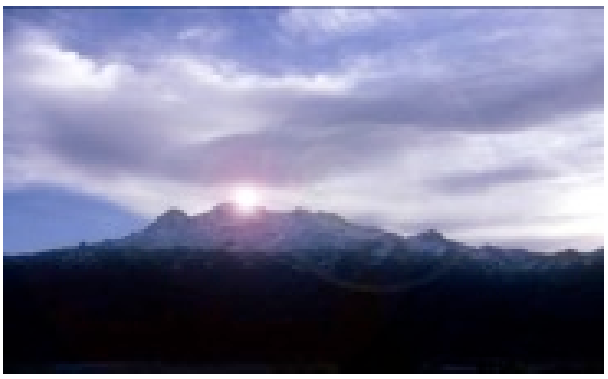

Fig. 4. Sunrise, in the area of the chest of Iztaccíhuatl volcano in the summer solstice.

the site where archaeological materials were discovered by the Mexican Alpine Club; in addition to collecting information on the thermal variations of the area and physical alterations in the blood composition suffered during prolonged stays at high altitude. Given that the archaeological site is located at an elevation of 5,256 meters, it's considered to be the one located at the highest altitude (Montero, 1988). No archaeological materials were found, but it was possible to identify geomorphological elements linking the site with water features and a possible path to the top of the mountain used in pre-Hispanic times (Montero, 1988:338). It is noteworthy to mention that out of these materials thesis projects were developed at the Escuela Nacional de Antropología e Historia, Instituto Nacional de Antropología e Historia.

In the southern and western flanks archaeological materials of the classic, post classic, colonial and modern periods were found; these detections took place in 2003, in the ascents by the undersigned.

3. THE CAVE OF THE WITCHES OR ALCALICÁN

The Cave of The Witches or Alcalicán is located at 19°07'30" N and 98°41'45" W, at an elevation of 3,200 meters, bordering to the North by The Ocho hill and to the South by the The Venacho hill. The cave itself is a rock shelter which is located in the Alcalican ravine. In the Spring (March 21) and Autumn (23 September) equinox, the sun rises between the The Ocho and The Atzomoni hills marking the above ravine.

For some sources the Spring equinox would be within the second month designated Tlacaxipehualiztli "flaying people"; according to fray Bernardino de Sahagún, a month dedicated to Huitzilopochtli and Xipec Totec: The captives were handed over to the priests, this led them to the stone of sacrifice where he killed and skinned them (Sahagun, 1982: 101). Similarly, fray Diego Duran refers that they celebrated an idol who had three names, which were Totec, Xipe and Tlatlauhqui Tezcatl (Duran, 1984:95) in her honor sacrifices were performed: "*Las ofrendas de ese día eran papel, hule, copal* [. . .] *los llevaban a los montes, donde tenían sus cuevas y adoratorios y sacrificaderos y mezquitas llenas de ídolos, pequeños, de piedra y barro, los cuales vestían*" (Duran, 1984: 244).

The autumn equinox would cover the thirteenth month called Tepeilhuitl "festival of the hills"; fray Bernardino de Sahagún mentions that: "They made these pictures in honor of the high mountains where the clouds gathered, and in memory of those who had died in water or were lightning casualties" (Sahagún, 1982:138). Likewise, fray Diego Durán refers to our study area and notes that rituals were performed in mountains and canyons; further that "*la principal fiesta se hacía en el Volcán y Sierra Nevada, y a los demás principales cerros de la tierra y así le llamaban Tepilhuitl [fiesta de cerros]*" (Durán, 1984:279). They were placed on altars and worshiped as gods of the hills offering them food and incense.

In the descriptions of the cave we find the archaeologist José Luis Lorenzo who visited the Cave of Witches and noted: the Cave of Alcala gives shelter to a small shrine in which there is a cross, decorated with the colors of the Blessed: blue and white that match the goddess Iztaccíhuatl. In recent lootings that took place, small incense burners made of ceramic, painted white and blue with the image of a female being were found there. In that site, on the third day of May a magical-religious grand ceremony at night is performed for the people to come from distant places to grab the *nahual* (Lorenzo, 1957). Later works carried out on Las Cruces and Alcalican, by Carmen Cook (1966) also referred to religious corporations. Also Altamira (1972) and Jose Luis Beteta (1976) agree with this concept in relation to the Cave of the Witches by mountaineers; there are outstanding lengthy descriptions like the one by Arturo Montero (1988) and other works by López and Mondragon (1998) that have presented descriptions of the place.

In our exploration of the shelter modern, but not pre-Hispanic materials, were located; on the other hand, there were signs of witchcraft rituals.

4. THE YOLOXOCHITL MOUNTAIN

The Yoloxochitl hill is located within the municipality of Amecameca. It has an elevation of 3,900

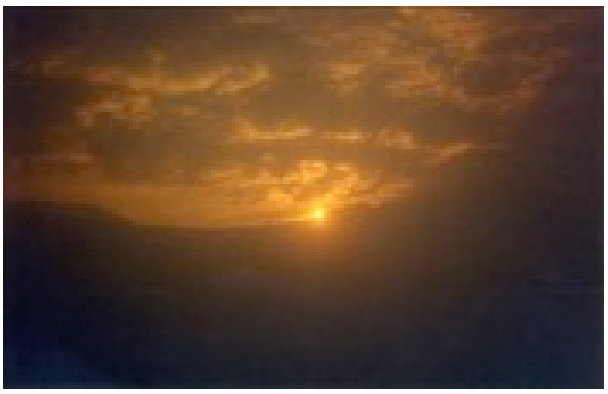

Fig. 5. Sunrise, the foothills of Mount Yoloxochitl, Winter Solstice.

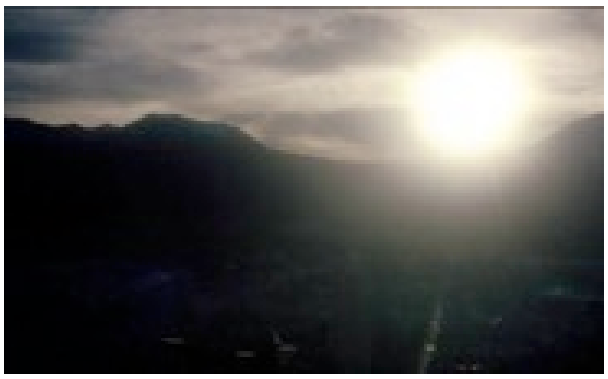

Fig. 6. The illumination of a village street of Amecameca with the first rays of the winter solstice.

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meters, and is located South of Popocatepetl. In the foothills of this hill, the Winter solstice can be seen.[4] A curious phenomenon happens at sunrise, La Soledad street gradually gets illuminated fully, after a few minutes it goes on to illuminate Colonel Silvestre Lopez street. The direction of the first sun rays of the Winter solstice, could have served for drafting the urbanization of Amecameca.

The Winter solstice included the sixteenth month called *Atemoztli* "water flows down" of which fray Bernardino de Sahagun says: "*En este tiempo los sápatras de los Tlaloque andaban muy devotos [...] La otra gente, por amor del agua, hacían votos de hacer las imágenes de los montes [...] como es el Volcán, la Sierra Nevada y la Sierra de Tlaxcala* (Sahagún, 1982:147-148)". Likewise, fray Diego Duran commented that they celebrated the coming of Huitzilopochtli to the world. They pretended that a child would descend from the sky on this day and this child was called "water" (Duran, 1984:287). The celebration was pleading for water for Spring, sacrifices were made through self-flagellation to obtain blood, either from the tongue, ears or other body parts, as well as fasting. This event was preceded by fasting.

In the exploration of the area no material traces were detected, perhaps due that the vegetation made and detection difficult. However, data from the residents of Amecameca is available on the performance of rituals (among other, chicken sacrifices) to a cross that is located on top of that hill.

5. TOMACOCO OR RABBIT STONE

The Tomacoco or Rabbit Stone is located on the edge of the old hacienda and mill of Tomacoco, at the geographic coordinates of 19°07'05" N and 98°44'06" W, at an elevation of 2,660 meters. This place is located about 4.5 km from the hill of Sacromonte. The monument is raised over a rock, it is made of reddish-gray andesite and has approximate dimensions of 5m long, 3m wide and 2.50m high. It presents an elaborate carving of Aztec symbols, together with other pictures from different times. Also, at the top it has holes in the form of so-called "Teotihuacan marker." A few meters from the this stone monolith another stone was found with this type of marker, in the area there are other rocks of different sizes.

If an imaginary line is drawn between the church and the Tomacoco stone, and would make it run on, its extension would reach the foothills of Mount Venacho; this point observed from the Sacromonte, matches the beginning of the pre-Hispanic year which according to a chronicle by fray Bernardino de Sahagún is February 12th.

This date would be within the first month called Atlacahualo. Fray Bernardino de Sahagún commented that "*hacían gran fiesta a honra de los dioses del agua [...] Para esta fiesta buscaban muchos niños de teta [...] A estos niños llevaban a matar a los montes altos*" (Sahagún, 1982:98). Also fray Diego Durán indicates that the pre-Hispanic New Year was celebrated in March; however, February would be in the eighteenth month, which marks the end of the year, where the gods Xilomaniztli, Izcalli and Tlaloc were honored. The second event was the commemoration of Tlaloc and Matlalcueye, which were two hills. In this commemoration they would kill a boy and a girl in honor of these two hills, after this ceremony, planting would begin (Durán, 1984:292).

In addition, the area of petroglyphs is known because the presence of the stone called "*Tomacoco*". An example of this is the visit to the area by explorer

[4]The winter solstice is when the sun goes to the south end of the sky and the days are long and cold, it is the dry season.

Fig. 7. The Rabbit Stone or Tomacoco.

Fig. 8. At the top of the stone rabbit there is an astronomical marker; a few meters there is another marker.

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Dupaix, who mentioned it during his second expedition to territiores of New Spain in 1806; thereafter it appears in the publication "Atlas of Mexican antiquities in 1834", and in 1887 Alfredo Chavero refers to it in "Mexico through the centuries". We find further references by Enrique Juan Palacios in 1931, Walter Krickeberg in 1969, Nicholson in 1972, Parsons in 1982, and in 1989, Leonardo Lopez Lujan, and Noel Morelos. Most of these authors attempt to explain the carvings on the stone in terms of the takeover by an Aztec ruler.

In several visits to the site, highly fragmented ceramic and lytic pre-Hispanic material was detected. Given that the last time I visited the area the land near these stones had been started to be divided into lots the land and a couple of houses have already been built up perhaps a systematic survey in the area would be necessary to be able to determine ceramic types, before it ends up being destroyed.

It is striking that this area with rocky outcrops revealed a series of carvings that correspond to different time periods. The site is worshiped by groups called Mexicaneros, who perform a ceremony on the Winter solstice, where they sing and bathe in a makeshift temazcal, also, they tie strips of paper in the branches of a tree near the stone, and forest flowers placed on top of this stone (López and Mondragón 1998: 134).

6. THE VENACHO MOUNTAIN

The Venacho hill located between Iztaccíhuatl and Popocatepetl formations, stands in front of the Municipality of Amecameca, at an elevation of 3,700 meters.

The Sun is seen on the hilltop Venacho two days of the year, on 4 March and 8 October. This sighting becomes relevant given that the front door and altar of the church of Sacromonte face this landmarke. The day on which the Sun shines on the summit it fully illuminates the entrance of the church. One must not forget that the church of Sacromonte is built on a cave that had to be oriented to the same hill (López and Mondragón, 1998:134).

Within these dates, March 4th falls within the second month Tlacaxipehualiztli "fayling of people" already mentioned in dealing with the Alcalican cave. The date of October 8th falls on the twelfth month called Teotleco "arrival of the gods"; according to fray Bernardino de Sahagun "*este mes enramaban unos altares que ellos llaman momoztli [. . .] A los tres días que andaban enramando, llegaba el dios que llamaban Telpochtli y Tlamatzíncatl*" (Sahagún, 1982:136), and like so, other gods would continue to arrive. Also, to fray Diego Durán that date would be within the month of Pachtontli (twelfth month) when was also the private celebration to the god Huitzilopochtli (Duran, 1984:277). The most celebrated and solemn celebration of all this land, and in particular the Texcocans and Mexicans was to the idol called Huitzilopochtli (Duran, 1984:17).

Such an elevation holds a cross at the summit, as well as candles and dead birds; due to the conditions of the area caused by a possible eruption of Popocatepetl, we were unable to prospect the area.

An example of this phenomenon has been mentioned by the astronomer Jesus Galindo who refers to cycles of 73 days: "*La alineación del Templo Mayor hacia la salida solar sucede en dos fechas que guardan la misma relación en las cuentas respecto al solsticio de 4 de marzo y 9 de octubre*" (Galindo, 2003:54). In this case it produces a very colorful effect in any of the days of the alignment when it is possible to watch the solar disk touching the hori-

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Fig. 9. Entrance to the Church of the Sacromonte, March 4 and Oct. 8.

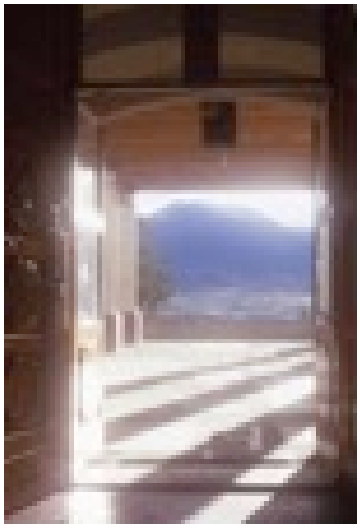

Fig. 10. Church entrance of the Sacromonte, the mountain Venacho observed in the background.

zon framed by buildings, streetlights and sidewalks of the streets that run along the axis of symmetry of the Templo Mayor (Idem).

7. COMMENTS

This paper has attempted to show that the mountain of Sacromonte has been worshiped since pre-Hispanic times to date and that the sunrise observation follows the different landmarks on the horizon during the seasonal changes throughout the year.

Such social knowledge might have lead to accumulation of a surplus of food, which in turn gave rise to population growth and social development in all aspects.

Therefore, the systematic observation of the Sun allowed them to mark the beginning and end of the pre-Hispanic calendar. With it, the start of festivities, and harvests, among other social events, could be controlled.

From the above, we can say that some pre-Hispanic sites were located at specific points that allowed them to measure time. From the identified archaeological remains, it appears that this knowledge was adopted by groups very early in central Mexico.

Also, the use and interpretation of this knowledge is preserved, because in the places where the equinoxes or solstices were marked archaeological and modern remains related to mountain worship have been found. It is worth mentioning that along the ascents to these places some carvings were found in the form of crosses, and flowers; however, at that

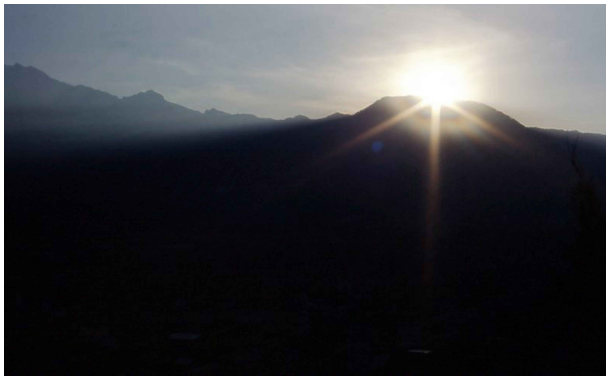

Fig. 11. Sunrise, October 8th and March 4th, at the Venacho hill.

time they were not recorded systematically; and at present I consider that they could have been marks on the road to guide pilgrims to specific locations on the mountains.

It is noteworthy that for the Summer solstice the festival was dedicated to a female divinity, and it is precisely in this period when the Sun is observed on a woman-shaped volcano. So, in developing the mythical-religious ideology it is possible that real geographic elements were used to give greater support and credibility to its construction.

The urban layout of Amecameca also corresponds to an astronomical orientation according to the Winter solstice. It is remarkable that an imaginary line drawn along the first sun rays of the Winter solstice, would traverse an area with rocky outcrops that have petroglyphs featuring different prepara-

tion techniques. This is the case of the depth and thickness of lines and the diversity of symbols, which indicate different time periods and that this site has been the subject of rituals by different groups.

Last, it is to be noted that the issue of location and orientation of archaeological sites relative to the celestial bodies allows us to get closer to understanding time tracking in pre-Hispanic cultures in addition to detecting possible relationships with pre-Hispanic sites around them.

Archaeology, as many other disciplines, needs the support of other sciences such as astronomy, to be able to better comprehend and interpret archaeological sites.

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