Revista Mexicana de Astronomía y Astrofísica

Revista Mexicana de Astronomía y Astrofísica
ISSN: 0185-1101
rmaa@astro.unam.mx
Instituto de Astronomía
México

Montero García, Ismael Arturo
NOTES ABOUT ALTA VISTA IN CHALCHIHUITES, ZACATECAS
Revista Mexicana de Astronomía y Astrofísica, vol. 47, noviembre, 2016, pp. 37-50
Instituto de Astronomía
Distrito Federal, México

Available in: http://www.redalyc.org/articulo.oa?id=57150516009

How to cite
Complete issue
More information about this article
Journal's homepage in redalyc.org

redalyc.org
Scientific Information System
Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal
Non-profit academic project, developed under the open access initiative

RevMexAA (Serie de Conferencias), **47**, 37–50 (2016)

NOTES ABOUT ALTA VISTA IN CHALCHIHUITES, ZACATECAS

Ismael Arturo Montero García[1,2]

RESUMEN

El Trópico de Cáncer es un paralelo situado en la latitud 23°26'15"; esta línea imaginaria cruza el norte de México desde el extremo sur de la Península de Baja California hasta el Golfo de México, pasando por los estados de Baja California Sur, Sinaloa, Durango, Zacatecas, San Luis Potosí, Nuevo León y Tamaulipas. El Trópico de Cáncer delimita el punto más septentrional en el que el Sol puede ocupar el cenit al mediodía, lo cual ocurre durante el solsticio de verano. En este día los rayos solares caen verticalmente sobre la superficie terrestre a lo largo de esta latitud, lo cual se supone fue significativo para los sacerdotes/astrónomos de la antigüedad dedicados a observar el aparente movimiento del Sol. Sucede que Alta Vista, en Zacatecas, corresponde al punto extremo septentrional donde este fenómeno puede suceder, la fecha del paso cenital difiere según la latitud de cada emplazamiento, y diferentes especialistas en arqueoastronomía destacan cómo las culturas indígenas de la antigüedad, al menos desde el periodo Clásico, valoraban esta apreciación para la elaboración de sus calendarios. Por otra parte, la investigación aporta nuevos elementos para la discusión ya que presenta un calendario de horizonte a través de las cimas conspicuas de la Sierra Prieta desde los emplazamientos arqueológicos de cerro El Chapín y Cerro Pedregoso, además de la prospección arqueológica del Picacho El Pelón.

ABSTRACT

The Tropic of Cancer is a parallel located at the latitude of 23°26'16". This imaginary line extends across northern Mexico from the southernmost point of the Baja California Peninsula, to the Gulf of Mexico, passing through the states of Baja California Sur, Sinaloa, Durango, Zacatecas, San Luis Potosí, Nuevo León and Tamaulipas. The Tropic of Cancer marks the northernmost position of the sun at its midday zenith, which takes place in the Summer solstice. On this day, the sun's rays hit the earth's surface vertically along the entire length of this latitude, which was supposed to be significant for the priest/astronomers of ancient times, who dedicated themselves to observing the apparent movements of the sun. It so happens that Alta Vista in Zacatecas, corresponds to the westernmost peak where this phenomenon can occur, although the date of the zenith's course differs depending on the latitude of each position and so various archaeoastronomical specialists stress how the ancient indigenous cultures, at least those dating from Mexico's Classical period, valued this finding in developing their calendars. On the other hand, the research contributes new elements for discussion because it presents a calendar of the horizon, based on of the highest peaks of the Sierra Prieta mountain range ranging from the archaeological sites of El Chapín, Cerro Pedregoso, to the excavations at El Picacho Pelón (peak El Pelón).

Key Words: archaeoastronomy

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

1. INTRODUCTION

On the occasion of the 26th *Reunión de Mesa Redonda de la Sociedad Mexicana de Antropología*, in July of 2011, I visited Zacatecas in order to know the Alta Vista archaeological site, in Chalchihuites. The readings of Broda (1983) and Aveni (1991) motivated me to arrive until the Tropic of Cancer[3] where a prehispanic ceremonial center was raised and lined according to solar astronomy.

The Tropic of Cancer is a parallel now (2012) located in the latitude 23°26'15.7" at north of the Earth Equator; this imaginary line delimits the northernmost point in which the sun reaches the zenith at noon, astronomical phenomenon that takes place during the Summer Solstice. In the Summer Solstice sunrays fall vertically on the ground along the Tropic of Cancer, and we can also infer that this was an important event to the ancient priests/astronomers dedicated to observe the solar movement. Alta Vista is the most extremely northern point where this phenomenon occurs (Figure 1), since from

[1]Universidad del Tepeyac (arturo@montero.org.mx).

[2]I want to thank to Daniel Flores for having give me the opportunity to present this article, the archaeologist Patricia Monreal Martinez, of Alta Vista, for her support in site and the archaeologist Adriana Medina Vidal for her opportune comments for this work.

[3]It is called "of Cancer" because in the ancient times, when the summer solstice happened in the northern hemisphere, the Sun was in the constellation of Cancer. Today is in Gemini.

Fig. 1. Location of the archaeological site Alta Vista, Zacatecas, highlighting the Tropic of Cancer for 2012.

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

another place it is impossible to sight a zenith passage throughout the year. It is different at the south of the Tropic of Cancer, where the zenith passage occurs twice a year; the date of this event changes according to the latitude of each emplacement. Several specialists in archaeoastronomy emphasize the importance of this kind of observations to the ancient Indian cultures in the elaboration of their own calendars.

In 2008, I was invited by some colleagues to the Seminary of Archaeoastronomy (ENAH/UNAM)[4] and decided to visit Alta Vista once again, but this time in the Summer Solstice; after that, the next Spring Equinox, in 2009, the prospection from different emplacements in the region[5] was made; this article follows these two last journeys.

In Río Colorado valley, Alta Vista was the most important ceremonial center of the Chalchihuites archaeological tradition;[6] this culture inhabited the Northwestern of Zacatecas, the South of Durango and the bottom of the Eastern slope of Sierra Madre Occidental, from the year 200 to 1100 A. C.

Alta Vista, a city with a precise orientation, was built in 470 A. C, and reached its peak between 700 and 750 A. C. This area was a center of extraction and distribution of mineral resources, and also a route to the north for Mesoamerican trading business, linking societies from distant areas as far away as Central Mexico and the place known as American Southwestern (Medina and García, 2008). Almost 800 mines are known (ibid.) and, from these, a variety of rocks and mineral stones as hematite, cinnabar, rhyolite, flint, limonite, a range of blue-green semiprecious stones (*chalchihuitl*), and perhaps even smooth pigment stones, were extracted; mining, was certainly an important activity from 300 to 800 A. C. It is considered that, between 850 and 900 A. C., Alta Vista ceased its interaction with other Mesoamerican cultures and started a period of constant wars with neighboring towns, we can deduce this fact from the increase of evidence of human sacrifices and fires that possibly caused the abandonment of the ceremonial center; however, the occupation lasted more in some villages on the region (Medina and García, 2008).

The first report[7] about this archaeological site was published in *El Imparcial*, on Sunday 25th of October, of 1908.

> *El señor Manuel Gamio, ayudante del Departamento de Arqueología del Museo Nacional, ha comunicado por telégrafo a la Secretaría de Instrucción Pública que, en la localidad denominada Chalchihuites, se han hecho descubrimientos arqueológicos importantes, encontrándose monumentos enteramente desconocidos que comprenden salones, sepulcros, escalinatas, pasillos, todo lo cual ocupa un área de más de un kilómetro. Estos descubrimientos*

[4] I acknowledge the transcendental conversations in the field that allowed the preparation of this work, and the pleasant company of the colleagues Jesús Galindo, Julieta Medina, Enrique Aguilar and Víctor Torres.

[5] During this season in camp, the collaboration of the archaeologist Osvaldo Murillo and Jesús Martínez, archaeology trainee of ENAH was relevant.

[6] For a detailed study about the Chalchihuites see Berrojalbiz, 2006.

[7] For more details see Manuel Gamio, in García, 1998.

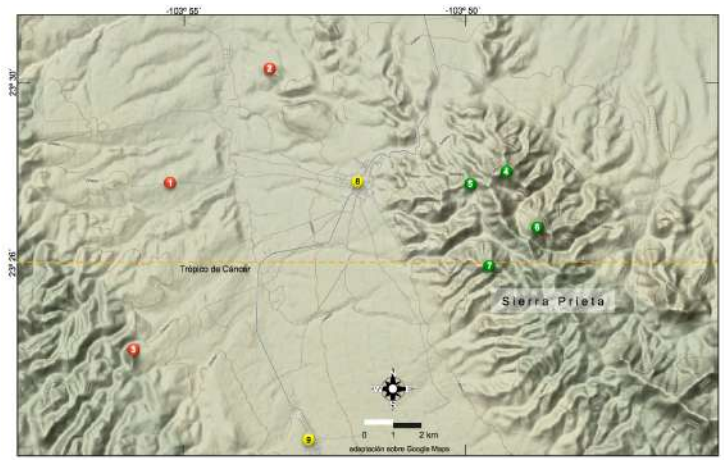

Fig. 2. The region near Alta Vista: 1) Alta Vista archaeological site; 2) Cerro Pedregoso archaeological site; 3) El Chapín mountain archaeological site; 4) summit of La Gloria mountain (2875 m); 5) summit of peak El Pelón (2790 m); 6) summit of peak Montoso (2955 m); 7) summit of Cerro Alto (2885 m); 8) Chalchihuites, Zacatecas village, and 9) José María Morelos village, Zacatecas.

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

serán explorados y estudiados con la atención que reclaman.

One of the most enthusiastic researchers interested in the Alta Vista site was John Charles Kelley, who explored the region since the 1950's (Medina and García, 2010:55). He suggested the thesis that the establishment of Alta Vista occurred around the 450 A.D. as a result of the presence of groups which came from Teotihuacan. Kelley defined Alta Vista as "The place where the Sun turns around", because it is the most extreme place in Mesoamerica where the Sun can reach the zenith at noon; this phrase was retaken by Kelley from his experience with the Pueblos and the Navajos (Kelley et al., 1975). Kelley realized how the mountain range Chalchihuites[8] served as a solar calendar of horizon. To him, the importance of Alta Vista was its location along the Tropic of Cancer, where the same day in Summer Solstice takes place the zenith passage of the Sun, as it was mentioned before. This is the reason why Kelley speculated that the Teotihuacans had looked for this place before (Medina and García, 2010:207).

2. ALTA VISTA, AN EXCEPTIONAL SITE

In Mesoamerica, the days of the zenith passage of the Sun are distributed through all the year in the months of April, May, June, July and August according to the geographic latitude from where the observer is watching; within this range, we selected the June 21st. To be able to observe the zenith passage of the Sun during an equinox we must be located on the line of the Earth Equator, but if we want to observe it during the Winter Solstice we have to be in the Tropic of Capricorn, in the Southern hemisphere. This drove us to our central point: the articulation of the summer solstice and the zenith passage in the same day and in the same latitude.

Surprisingly, if we consider the fact that the architectural prehispanic site of Alta Vista is linked to the zenithal/solstitial phenomenon described here, there is no evidence of a relevant element within the urban design, in terms of material culture, which highlights this undeniable issue, but only one petroglyph at 6.4 km SW (195°Z) of Alta Vista, on the top of the mountain *El Chapin*, which proves it. We are referring to a dotted cross that, in the specialized literature, is associated to Teotihuacan; it is associated with astronomy, even though its designs have not been interpreted, yet. In fact, according to Aveni, Hartung and Kelley [1982], an observer standing on this site will see the Sun rise over the peak El Pelón, the same top that works as a landmark to the equinox for those located in Templo del Sol, in Alta Vista (see for more detail of the area, see Figure 2).

Charles Kelley (1975, cited by Aveni 1991:259) suggests that the Teotihuacan priests/astronomers in their searching for the place "where the Sun turns around" managed to locate the approximate area for it. After that, they were able to observe the position of Alta Vista from the mountain El Chapin, placing it so that the mountain calendar allows by itself an

[8]Sierra Prieta for this work, as it appears in f13b34 of INEGI. The reader should take the necessary caution, because the name for this place is different in every publication.

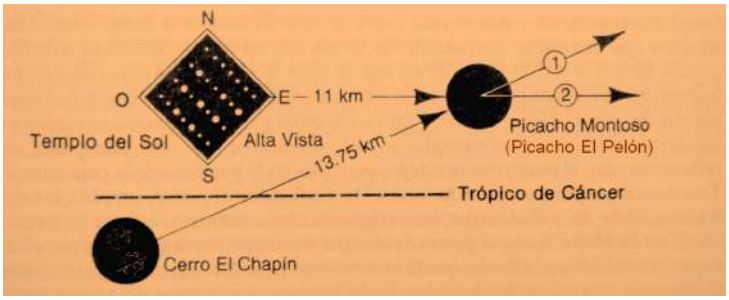

Fig. 3. Schematic view of solar alignment from Alta Vista and its surroundings, 1) From the dotted crosses, El Chapín mountain at sunrise in Summer solstice and 2) From Templo del Sol in Alta Vista at sunrise in the equinox, diagram of P. Durban, in Aveni [1991:261]. In this diagram the peak Montoso, has been confused with peak El Pelón, which we have marked in parenthesis to warn the reader.

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

easy way to determine the date of the Summer Solstice and therefore it is possible to use it to locate the Tropic of Cancer. Then, they built in Alta Vista the initial architectural unit, incorporating within its architecture some calendrical symbolic features, in such a way that they oriented its quoins to the cardinal points thanks to the equinoctial alignment with the peak El Pelón; this orientation, by the way, is not very common in Mesoamerica (Figure 3). Nowadays, this hypothesis is one of the most important lectures for the visitors in the Alta Vista Museum, stressing at the same time the importance of the mining process in the region [Schiavetti, 1994].

There is a building known *El Laberinto* which proves that in Alta Vista the zenith/solstice phenomenon does not take place but the equinoctial one does take place. It is located next to the *Templo del Sol* or *Salón de las Columnas*, which includes a long corridor with masonry walls that have a series of rounds and pillars with different angles; more specialized inspections have proven many additions and corrections which were made along this corridor. It is proven that the prolongation of this corridor to the top of the peak El Pelón aligns itself to the equinoctial sunrise. It happens that, the Sun over the horizon, behind the peak El Pelón, directly lights the labyrinth with a sunbeam, that is why it is called "the solar road", and it is the reason why thousands of visitors come during the Spring Equinox. The official guide of INAH stresses the precision necesary to draw and build this structure for it to work as calendric instrument. Despite these approaches, once on the site we decided to do the calculations for 2010 A.D. and 500 A.D. Then the question arises whether it corresponds to the astronomic equinox or to the middle equinox. On Table 1 the possibility that the middle equinox was the phenomenon that determined such diagram is shown.

The middle equinox is the result of dividing in two the number of days between both solstices; this model differs in two days from the astronomical equinox [Montero, 2005:82]. If the axis of geographic reference that makes the equinox concur with Alta Vista is the peak El Pelón, we ask ourselves if there was enough archaeological evidence on its top to back up its prominence in the ancient worldview. Led by guides of the INAH in Alta Vista[9], we climbed to the top and discovered severely fragmented and eroded remains of ceramics and obsidian in the area, thus preventing to consider them as diagnostic material. However, as they were discovered on the top of the peak and their prehispanic identity, they prove the importance of this site which until present times preserves its relevance due to its road with stairs that is topped with a cross of more than four meters high. This cross is annually venerated on different dates; it highlights the catholic mass celebrated on May 3rd. Standing on the top we can appreciate that during the equinox, the shadow of the peak projects over the Chalchihuites valley, pointing to the Alta Vista site (Figure 4). Now, we wonder whether this top had been conditioned to celebrate the Sun in its correlation with the sites on the foothills with a symbolic shadow consideration.

Moreover on the equinox, the peak El Pelón also marks the Winter solstice, and to be able to observe it we must move from Alta Vista and visit to the top of Cerro Pedregoso where there are mounds and prehispanic sites. This is how by gathering the information of the sites of Alta Vista, Cerro Pedregoso and Cerro El Chapín, the researchers Aveni, Hartung and Kelley [1982] present us a precise geometry which combines solstices and equinoxes from the same top (Figure 5).

[9]Salvador Rodríguez Ríos and Federico Rodríguez Ríos.

TABLE 1

OBSERVATIONS FROM CEREMONIAL CENTER AT ALTA VISTA

Place of observation		Alta Vista (ceremonial center)	
	Location	φ 23°28'43.6" λ−103°56'44.5"	13 Q 607685 m E−2596841 m N
	Altitude	2160 m	Datum WGS84

Conspicuous place		Top of the peak El Pelón		
	Location	φ 23°28'34.7" λ−103°50'19.0"	13 Q 618604 m E−2596728 m N Datum WGS84	
		Altitude 2790 m	Distance 10,950 m Z=90°45' h=3°17'	
			Solar position from Alta Vista	
	Date	20 / March / 2010 (astronomical equinox)	Z=91°30'	Difference 45'
	Date	22 / March / 2010 (middle equinox)	Z=90°38'	Difference 07'
	Date	21 / September / 2010 (middle equinox)	Z=90°45'	Difference 0'
	Date	18 / March / 500 (astronomical equinox)	Z=91°32'	Difference 47'
	Date	20 / March / 500 (middle equinox)	Z=90°41'	Difference 04'
	Event: Minor variations in the coincidence of the center of the solar disk to the top peak El Pelón seek relevance to middle equinox.			

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

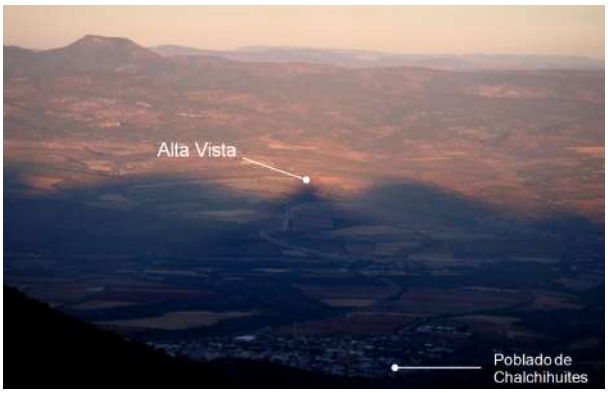

Fig. 4. The shadow of the peak El Pelón is projected in the valley of Chalchihuites and points on Alta Vista during the Spring equinox.

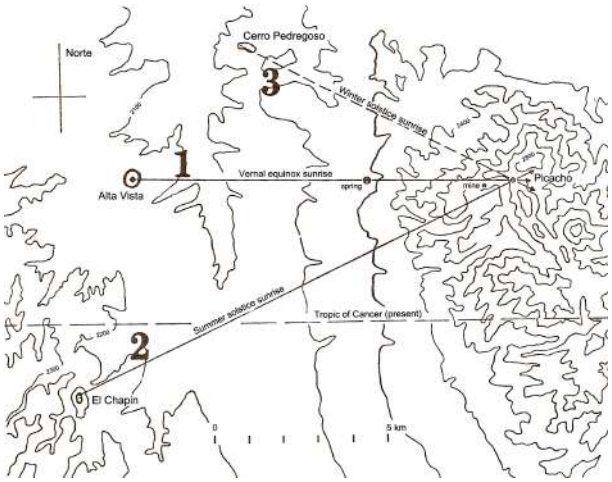

Fig. 5. Alignments to the peak El Pelón proposed by Aveni, Hartung and Kelley (1982: Fig. 5): 1) at sunrise during the equinox from El Laberinto, the light crosses a small lake and a turquoise mine; 2) sunrise at the Sumer solstice observed from the archaeological site Cerro El Chapin, and 3) a hypothetical alignment toward sunrise at the Winter solstice from the archaeological site Cerro Pedregoso. The position of the Tropic of Cancer is highlighted.

If we pay attention to Figure 5, it is interesting to consider Alta Vista as a different model of what we usually find in Mesoamerica when we talk about horizon calendric markers. Generally, we consider an emplacement or building as the unique and ideal place to observe, and assume that from this place it is possible to watch a defined horizon where the movement of the Sun and other celestial bodies through the year takes place[10].

So, we determine a fixed point, an ideal observatory from which it is possible to display an empiric astronomical horizon. This model can be called "one site as observatory" (Figure 6, left) that is different from Alta Vista, where there are "many sites as observatories"; in such a way that we are refering to three different emplacements (Figure 6, right): the first one at north, Cerro Pedregoso, to see the sunrise over the peak El Pelón in the Winter solstice;

[10]See *Observadores del cielo en el México antiguo* of Anthony Aveni [1991:282-357], with detailed examples of Mesoamerican observatories.

TABLE 2

OBSERVATIONS FROM TEMPLO DE LOS CRÁNEOS, ALTA VISTA

Place of observation		Templo de los Cráneos, Alta Vista		
	Location	φ 23°28'43.6" λ−103°56'44.5"	13 Q 607685 m E−2596841 m N	
	Altitude	2160 m		
	Datum	WGS84		
Conspicuous place		Top of Cerro Alto		
	Location	φ 23°27'02.8" λ−103°50'12.2"	13 Q 618821 m E−2593901 m N	Datum WGS84
		Altitude 2885 m	Distance 11,560 m Z=105°30'	h=3°35'
			Sun position from Alta Vista	
	Date	February 12th, 500AD	Z=106°05'	Difference 35'

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

the second, for the sunrise in the Spring and Autumn equinox, being in Alta Vista at 5 km southwest of Cerro Pedregoso; and finally, the sunrise in the Summer Solstice, at 6.4 km southwest of Alta Vista, the site Cerro El Chapin. Then, we can see how this model is a prominent summit in the landscape that gains symbolic importance personifying the axis mundi of a worldview in which a summit, and not an urban space, is the point of attraction and reverence that obliges to build different perimeter emplacements according to the astronomical event that wants to highlight. Now, we ask ourselves if this pattern is repeated in Mesoamerica or if it only is present in Alta Vista.

According to the model of the last figure, the urban plane of Alta Vista leads us to look for the whole horizon of Sierra Prieta, and not only to focus our attention on the peak El Pelón. In the first review, we have paid special attention to the calendar dates that are relevant to Mesoamerica; the preliminary results are encouraging since they reach a register for *Templo de los Cráneos*. Let's consider that an observer aligned behind the entrance to the temple will see that, over a column of the *Plaza Principal*, *Cerro Alto* (where today is the crossing of the Tropic of Cancer) the Sun aligns itself and appears during the break of dawn of February 12th and October 29th,[11] causing an interesting effect with the shadow of the column that goes into the temple. Figure 7 and the next table illustrate this event.

Other two summits caught our attention: the Montoso Peak and the Gloria Mountain. For the

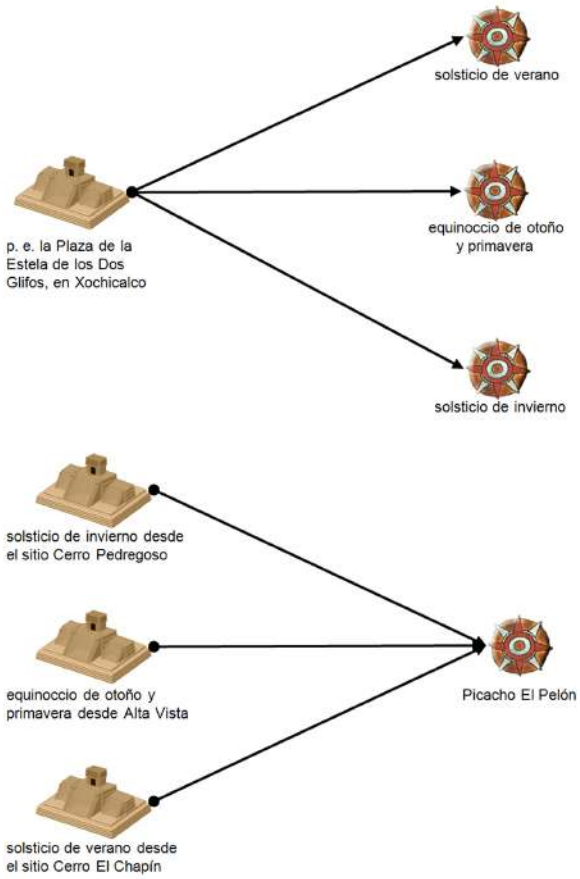

Fig. 6. Alternative proposed models. Upper panel: the usual system with a site for the observation of the horizon as in Xochicalco (Morante, 1990). Lower panel: the case of Alta Vista where several sites are aligned as astronomical observatories to specific points on the horizon.

[11] The date of February 12 is significant, as it corresponds to the beginning of the Mexica year according to Sahagún (1985: 77), once the Gregorian correction was made on the Western calendar. For further references for the case of the Templo Mayor, see Galindo, 2001.

TABLE 3

OBSERVATIONS FROM PLAZA PRINCIPAL, ALTA VISTA

Place of observation	Plaza Principal, Alta Vista		
	Location	φ 23°28'43.6" λ−103°56'44.5"	13 Q 607685 m E−2596841 m N
	Altitude 2160 m	Datum WGS84	
Conspicuous place	Top of Picacho Montoso		
	Location	φ 23°27'02.8" λ−103°50'12.2"	13 Q 618821 m E−2593901 m N Datum WGS84
		Altitude 2955 m	Distance 12,800 m Z=97°49' h=3°14'
			Sun position from Alta Vista
	Date	March 5th and October 10th, 2010	Z=97°55' Difference 06'
Conspicuous place	Top of La Gloria		
	Location	φ 23°28'49.8" λ−103°50'00.4"	13 Q 619130 m E−2597195 m N Datum WGS84
		Altitude 2875 m	Distance 11,460 m Z=88°48' h=3°36'
			Sun position from Alta Vista
	Date	March 27th and September 16th, 2010	Z=88°38' Difference 10'

Fig. 7. Southeast view from the Templo de los Cráneos.

first one there is also an important calendric date which differs just in one day from March 4th and its return on the 9th of October. These dates on the Altiplano Central have been used to divide the year into five sections of 73 days each one [see Montero, 2009]. For the second case, the dates of March 27th and September 16th don't seem to concur with any relevant record.

Throughout this text, we have partially reviewed the eastern horizon of Alta Vista (Figure 8); where we can also see that the emplacement's potential is extended. Of course, a systematic study would provide us data that would allow us to increase our knowledge about the ancient worldview. However, we still have to research the western orographic profile, the inside alignments of the urban plane and the integration of other celestial bodies as Venus and the Moon.

3. CERRO PEDREGOSO

The data obtained from the archaeological site Cerro Pedregoso made necessary for us to visit the site. On March of 2009, led by San Jose de Buenavista neighbors, we studied the area.

We refer to a rocky and shrubby narrow summit, where the evidence of walls, squares, lytic and ceramics can be found everywhere. The ignorance of the archaeological traditions of the region prevents me from identify details about temporality and culture of the site's occupation; nevertheless, because of the work on Proyecto Arqueológico Valle del Río Suchil [Córdoba, 2007] we know that it was a civic/religious center for the culture Chalchihuites, and that it was occupied since the Classic Period.

With this prospect in mind, our target was to cartographically record the emplacement to make the necessary studies to confirm the horizon from where the Sun rises over the peak El Pelón in the Winter solstice (Figure 9).

From the summit of Cerro Pedregoso the prominence of the peak El Pelón stands out. According to Aveni, Hartung and Kelley (1982), this top is a marker along the horizon for the Winter solstice.

When we carried out the necessary calculations we found that the summit of the peak El Pelón par-

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

Fig. 8. The profile of the Sierra Prieta as a marker horizon for Alta Vista.

TABLE 4

OBSERVATIONS FROM CERRO PEDREGOSO

Observation site	Cerro Pedregoso (principal structure at the south hillside)		
	Location	φ 23°30'45.8" λ−103°54'51.7"	13 Q 610838 m E−2600697 m N
	Altitude	2200 m	
	Datum	WGS84	

Conspicuous place	Top of the peak El Pelón		
Location	φ 23°28'34.7" λ−103°50'19.0"	13 Q 618604 m E−2596728 m N Datum WGS84	
	Altitude 2790 m	Distance 8,730 m Z=117°10'	h=3°52'
		Position of the Sun from Cerro Pedregoso	
Date	December 21st, 2010 (winter solstice)	Z=117°39'	Difference 29'
Date	December 19th, 500 AC (winter solstice)	Z=117°53'	Difference 43'
Event	The day of the winter solstice, the Sun appears from the south of the peak El Pelón, however it does not reach its summit; the Sun reaches the summit nine days before, when the center of the solar disk runs just behind the peak's top.		

Fig. 9. Summit of Cerro Pedregoso.

tially corresponds to the Winter solstice, as it is shown in Table 4.

If we pay attention to the calculation memory data in Figure 10, we will notice the hypothetic path of the sunrise beam for the Winter solstice as seen from the largest structure of the site that is located under the summit at the south hillside[12]. So, according to our calculations, the Sun rises over the

[12]We hope can prove this propose in camp.

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

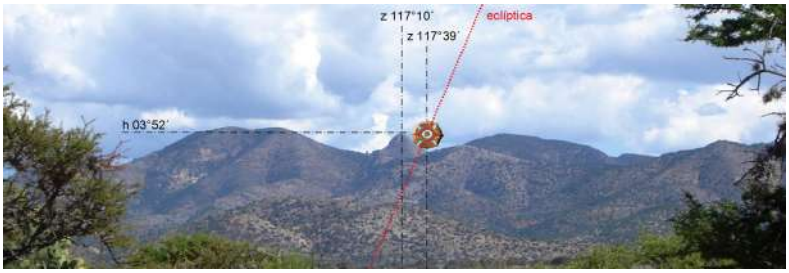

Fig. 10. The direction of the hypothetical sun rise on the Winter solstice from the archaeological site Cerro Pedregoso to the peak El Pelón.

top of the peak El Pelón on December 12th and not on the Winter solstice, but changing the site of observation to be the summit of Cerro Pedregoso, the sunrise matches with the Winter solstice.

4. EL CHAPIN MOUNTAIN

The morning of June 22nd of 2008, the day of the Summer solstice, we were excited witnessing the ancestral geometric accuracy. We climbed up to El Chapin, since in that day the Sun rises over a plain, which is not prominent. Moreover, in Alta Vista there is no architectonic evidence that highlights the Sumer solstice.

From El Chapin Mountain, it is necessary to search for the peak El Pelón between the mountains since it is not the highest summit on the orographic profile (see Figure 12). On the other hand, none of the dotted cross' axes, that supports the archaeoastronomic texts, points to the peak El Pelón, nor the cross' axes match any of the cardinal points, like in the Templo del Sol of Alta Vista. Furthermore, in the area of the top of El Chapin mountain, the archaeological evidence, with the exception of some petroglyphs, is limited in ceramics and architecture; in spite of the symbolic aspect that could be the access to the summit through a close up crack on its southern hillside and a cave in the eastern slope with the entrance at east.

Later on, we outlined an orographic profile and linked it to one of the dotted crosses of El Chapin, that highlights the orientation of the western axis on August 13th. This alignment is relevant due to its importance as shown in the architecture of Teotihuacan [Jesús Galindo, 2001:34, and Enrique Aguilar, oral communication 2010] and its articulation with the Mesoamerican calendars which includes the division of the year in two groups: one of 105 days and other of 260 days (Figure 11).

The alignment of the dotted cross caught our attention after we had performed the calculation for

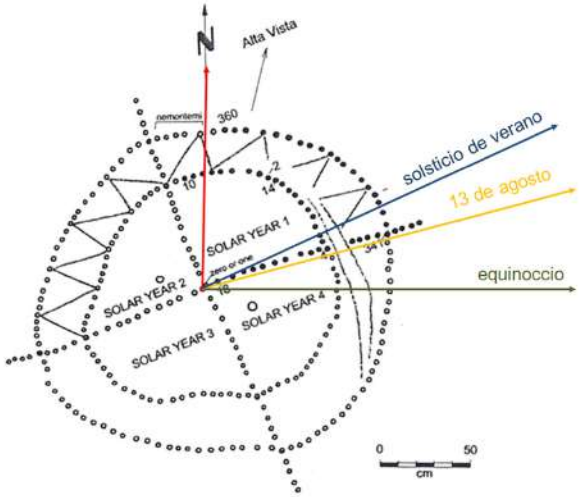

Fig. 11. Adjustment of the illustration by Ellen J. Charles Kelley and Kelley Abbott [2000: 192] to highlight the Summer solstice alignments and August 13 along the azimuth of 75°03'.

the sunrise over Cerro Alto, one of the highest summits of Sierra Prieta. In Alta Vista, as we mentioned before, the Sun rises over this mountain on February 12th, however, if we watch from Cerro el Chapin it rises on August 13th. This event truly makes Cerro Alto a calendric axis mundi, which had not been considered before, since it records two important dates from different places, gaining a similar functionality as the peak El Pelón, not in an astronomical way, but as a calendar. Obviously, the question remains whether these alignments are the result of a coincidence or the result of an ancient practice of adjustment and searches to highlight a symbolic building of the universe, in the landscape (see Figure 12 and Table 5).

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

Fig. 12. The northern profile of the Sierra Prieta from the archaeological site Cerro El Chapin as a landmark on the horizon. Currently the Tropic of Cancer crosses near the summit of Cerro Alto. Photo courtesy of Enrique Aguilar, 2008.

TABLE 5

OBSERVATIONS FROM EL CHAPIN MOUNTAIN

Observation site		El Chapin mountain (dotted cross)	
	Location	φ 23°25'22.4" λ−103°57'42.5"	13 Q 606065 m E−2590716 m N
	Altitude	2370 m	
	Datum	WGS84	

Conspicuous place		Top of the peak El Pelón		
	Location	φ 23°28'34.7" λ−103°50'19.0"	13 Q 618604 m E−2596728 m N	Datum WGS84
		Altitude 2790 m	Distance 13,860 m	Z=64°48' h=1°44'
			Sun position from El Chapín	
	Date	June 21st, 2010	Z=65°08'	Difference 20'
		(zenith passage and summer solstice)		
	Date	June 20th, 500 AD	Z=64°55'	Difference 07'
		(zenith passage and summer solstice)		
	Event	Its precision is amazing, it is more accurate if we go back in the past.		

Conspicuous place		Top of Cerro Alto		
	Location	φ 23°27'02.8" λ−103°50'12.2"	13 Q 618821 m E−2593901 m N	Datum WGS84
		Altitude 2885 m	Distance 13130 m Z=76°18'	h=2°15'
			Sun position from El Chapín	
	Date	August 13th, 2010 - April 29th, 2010	Z=75°03'	Difference 45'
	Event	The coincidence with the dotted cross in alignment with this direction, is amazing. (see Figure 10)		

Conspicuous place		Top of Picacho Montoso		
	Location	φ 23°27'45.5" λ−103°49'17.3"	13 Q 620367 m E−2595228 m N	Datum WGS84
		Altitude 2955 m	Distance 14,990 m Z=72°48'	h=2°24'
			Sun position from El Chapín	
	Date	May 6th, 2010 - August 6th, 2010	Z=72°56'	Difference 08'
	Event	No any particular one, just a search for the date for this prominence in the horizon.		

5. TROPIC OF CANCER

If the Teotihuacan people traveled north from the center of Mexico, following the hypothesis of Kelley, more than 700 km to look for the "turn of the Sun", what we call today Tropic of Cancer, and marked it leaving a dotted cross on the top of El Chapin, is it possible to consider this cross as the most northern recorded in Mexico? No, this is not the case. There is, at least, one more record further north , and another one in the region of La Breña, near to the country Tuitán, Durango (Ganot et al., 1997:272, Fig. 144). It is a petroglyph, although today its interpretation is controversial among the ones who accept it and the ones who question the hypothesis

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

that near the dotted cross is the record of a supernova explosion in the year 1054[13]. Another question that remians to be answered is since Alta Vista is located on the Tropic of Cancer, is this site the most northern of the observatories in the region? As in the first question, we find an emplacement northernmost than this one, with Mesoamerican cultural elements, we refer to El Zape (Ganot et al., 1991). The archaeological evidence shows the complexity of this site as a register of equinoxes and the days of solstice when the Sun is in its extreme displacement, both at the south aand at the north, using the projection of the sun through the cracks that shines on petroglyphs and walls with an outstanding accuracy:

> *La parte del observatorio que señala el día en que el sol se encuentra en su máximo desplazamiento hacia el norte (solsticio de verano), se muestra en la grieta número 2; en su interior, en la pared posterior, se encuentran varios grabados, tres son líneas verticales y uno circular con un diámetro casi vertical que rebasa la circunferencia. La de mayor dimensión, marca con exactitud el límite de la roca iluminada por los rayos solares dentro de la grieta durante el ocaso. El grabado circular y la segunda cuña están alineados verticalmente y fueron utilizados como una "mira" para que un observador colocado en la parte inferior de la grieta viendo hacia arriba, al mediodía, en esa misma fecha, pueda ver pasar el sol casi por el centro del círculo. La posibilidad de tener dos formas para determinar un mismo acontecimiento, pudiera explicarse tomando en cuenta que en este tiempo ya se inició la época de lluvias y con frecuencia, por las tardes, el horizonte se encuentra cubierto de nubes, lo que no permitiría la observación del ocaso* (Ganot, et al., 1997:241).

The record of a dotted cross at the northernmost place in Tuitán, and the presence of another solar observatory in El Zape show that the variables given to Alta Vista are not necessarily a singularity, but may be a common cultural constant in the region. In addition to just recording markers that point to solstices and equinoxes, we must focus our attention in the zenith passage associated to the Sumer solstice and the calendar, so we can understand the approach of Kelley to Alta Vista's own peculiarity.

Nevertheless, we still have not found any archaeological evidence that highlights the zenith passage

Fig. 13. Year symbol interpreted as a gnomon according Digby (1974). A. Tenango monolith. B. Tula idol. C. Xico female figure. D. Castillo de Teayo figure.

in Alta Vista. It could have been with a stele that shows the absence of a shadow, or a dark chamber, as in Xochicalco, Monte Alban or, even, in Teotihuacan. On the other hand, along Sierra Prieta, where the peak El Pelón rises, we do not have a precision marker for the Sumer solstice, i. e., a "critical horizon" that, because of its closeness to the observation point, allows to adjust the observation of the Sun;A distance between the observation point and conspicuous horizon of at least 2 km, allows for very precise adjustments. only with this method we would obtain that a variation of some meters, from the point of observation, would result, at least, in one degree of difference, which would allow the priests/astronomers to practice an adjustment to accurately locate the Sun along a critical horizon, like it has been shown in the case of El Nevado de Toluca, in the Epiclassic (Montero, 2005:245). Since we had a distance of 11 km between the Templo del Sol and the peak El Pelón, the "ideal profile" for the observation had to be complemented with the walls of El Laberinto. Pitifully this direction points to the equinox and not to the Sumer solstice, however, if the walls of El Laberinto allow the absence of a shadow during the zenith passage we will find that these do not have the verticality nor the orientation required to adjust it with exactness.

Not having archaeological evidence does not mean, necessarily, that a zenithal record cannot be carried out. Actually, they could have used a gnomon[14] which could have been timber or a sophisticated polyhedron similar to the symbol of a year (Digby, 1974), as the one that the priests/ astronomers wore on the head (Figure 13); it could be possible to obtain from the measurement of the shadows a mathematical factor for extreme dates (Pérez-Enríquez, 2001).

[13]The event was visible on Earth even in the light of day in 1054 (see study Flores et al., 2008) see also the discussion in by The magazine Arqueología, Nos. 89:14 and 91: 6.

[14]I prefer the term gnomon, and not the gnomon, being the first the more attached to the Latin and ancient astronomy use etymology.

Fig. 14. The dotted cross at Cerro El Chapin is located φ23°25'22.4" $-\lambda$-103°57'42.5" (datum NAD 27 MEX) and altitude of 2370 m.

The possible use of a gnomon allow us to return to the hypothesis by Kelley, and not just to adopt the insight of a coincidence of variables. So, let's grant to the emplacement in the mountain El Chapin to be the axis of observation for the Summer solstice and let's adopt the use of the gnomon, whereby they could have proved the same day both, the solstice summer and the zenith passage of the Sun; this combination could have allowed them to find what we today call Tropic of Cancer, with a difference of 1.53 kilometers. Aveni (1991:257) talks about it when he mentions that, from the point of view of positional astronomy:

> [...] *a simple vista no debe sorprendernos encontrar un error de 10 a 20 kilómetros en la determinación del punto más septentrional en que el Sol puede alcanzar el cenit. Dos kilómetros en la superficie terrestre equivalen a un minuto de arco (1/30 del diámetro angular del Sol). Más aún: como el Sol es un objeto extendido, no proyectará una sombra fuerte. Finalmente, aunque para resolver el problema se emplee alguna técnica de proyección de sombra o una visión directa de la imagen solar a través de un tubo, se necesita determinar la vertical de manera muy precisa para encontrar el punto exacto.*

However, the dotted cross that look the best at the Sierra Prieta profile, on the top of the mountain El Chapin is located at the latitude 23°25'22.4" (Figure 14), but its position does not match today with the Tropic of Cancer, nor the ancient times.

In spite of our astonishment because of its preciseness, the data is a chimera since historically the

Fig. 15. Crossing the Tropic of Cancer along Highway 83 (shortest route) Zaragoza - Victoria, km 27.8, indicating the annual movement of it between 2005 and 2010.

Tropic of Cancer has changed its position. Indeed, through the centuries the Tropic of Cancer has occupied a different latitude[15] as we can see in the next table, with a range of 50 years per one segment of the Classic Period; and also the dates for its position in Alta Vista nowadays, and El Chapin site.

This variation is very well known in Mexico. In Figure 15, we can see along the Route 83 (short route) Zaragoza - Victoria, km 27.8 (Tamaulipas), in detail this annual displacement for the years 2005 to 2010.

Let's think about the moment near to the foundation of Alta Vista, as suggested by Kelley: the year 500 AD. For this date, we found a difference of 23 km between the dotted cross of El Chapin and the Tropic, such distance is out of the range proposed by Aveni in the last citation (1991:257). Now, let's look for an emplacement northernmost that allows us to find a match between the location of the Tropic of Cancer with any conspicuous summit that admits a precise alignment to the Sumer solstice. The possibility can be noticed in the surroundings of the town Súchil, in the state of Durango, with the mountain El Papantón with 3100 m, this possibility is worth to be taken account due to the fact that in the Súchil river valley at least 23 archaeological sites that correspond to the Chalchihuites culture have been registered.

As a final note, I consider relevant to mention that Alta vista has acquired a new meaning for the population of Chalchihuites. The archaeoastronomy cultural activity promoted by the museum of the site and the archaeological zone has been incorporated in the development of a new identity. There are many expressions of this sense of singularity; but surely, the most eloquent manifestations presented

[15]Calculation performed with the software Epoch_2000 Excel spreadsheet Suite Microsoft Office.

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

TABLE 6

HISTORIC CHANGE OF THE TROPIC OF CANCER

Year	North latitude	Distance to Alta Vista Templo del Sol	Distance to the dotted cross in the mountain El Chapín
300 A.D.	23°39'26.6"	19.7 km South	25.8 km South
350 A.D.	23°39'04.0"	19.0 km South	25.1 km South
400 A.D.	23°38'41.6"	18.4 km South	24.4 km South
450 A.D.	23°38'19.0"	17,7 km South	23.7 km South
500 A.D.	23°37'56.3"	17.0 km South	23.0 km South
550 A.D.	23°37'33.6"	16.3 km South	22.3 km South
600 A.D.	23°37'10.6"	15.6 km South	21.6 km South
1690 A.D.	23°28'46.6"	0 m	6.1 km South
2010 A.D.	23°26'16.8"	4.6 km North	1.5 km South
2114 A.D.	23°25'28.1"	6.1 km North	0 m

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja

to the visitor are the murals painted on the walls of the buildings on the principal streets of the village (Figure 16). These expressions promoted by the local trade, the mountain, the Sun, the archaeological zone, the history and the population acquire collectively an important relevance thanks to the landscape, which allows the community to represent themselves in the space. In this space, Sierra Prieta, the nature is socialized, and the conspicuous elements, as the peak El Pelón, begin to be key and reference points. This is how mountains and celestial bodies, from the past to the present, stimulate a perception where the images of the world find their meaning, a model of spiritual representation: a theory of a cultural universe.

Fig. 16. Ad in streets: archaeology, history and landscape in the identity construction of Chalchihuites, Zacatecas.

6. CONCLUSION

In the archaeological literature, Alta Vista and Cerro El Chapin, at south; and Cerro Pedregoso, at north, stand out because of their astronomical relevance to point to solstices and equinoxes, having as milestone the peak El Pelón. It must be noted that discrepancies in the dates may arise, above all the equinox since in an average calendar of 365.25 days the Sun does not always appear in the same place because there is an annual oscillation of 20 minutes, i.e. 2/3 of solar disk. A naked eye, 1/3 of solar disk is able to see itself with a "lens", because less than 10 minutes of arc is hard to assess. Anyway, the landmarks of the horizon presented here drive us to extend our attention further than the peak El Pelón, and we assume that all the orographic profile of Sierra Prieta is relevant as a complex horizon marker that, not only highlighted the solstices and equinoxes, but also indicated relevant calendar dates that are determinant in the Mesoamerican worldview, as are August 13th, February 12th, March 4th and October 9th.

While it is true that the coincidence of Alta Vista with the Tropic of Cancer is suggestive, it is not accurate and its relation is not completely proven since in the plane of the ceremonial center there doesn't appear any orientation to the solstice Summer, or any evidence that highlights the zenith passage of the Sun, as in Xochicalco, Monte Alban or Teotihuacan with dark halls. It is true that such evidence could have disappeared or it just has not yet been discovered, or even that this civilization could have used another technique that we still do not know for such observations. However, more research and archaeoastronomy studies are necessary to continue not only in Alta Vista and its surroundings, but also

in all the Sierra Prieta. No doubt that the sum efforts with more researchers in our area of interest will allow in the future to increase the stock and our admiration for Alta Vista.

REFERENCES

Aveni, Anthony. 1991, "Observadores del cielo en el México antiguo", México, edited by FCE

Aveni, A. F., Hartung, H., & Buckingham, B. 1982, "Alta Vista Chalchihuites: Astronomical implications of a Mesoamerican Ceremonial Outpost al the Tropic of Cancer", American Antiquity, vol. 47, num. 2, 316

Berrojalbiz, Fernando. 2006, "Arte rupestre y paisaje simbólico mesoamericano en el norte de Durango", in Anales del Instituto de Investigaciones Estéticas, núm. 89, 135

Broda, Johanna. 1983, "Arqueoastronomía y desarrollo de las ciencias en el México Prehispánico", in Arturo Moreno (coord.), Historia de la Astronomía en México, edited by Instituto de Astronomía, Mexico, 69

_____. 2000, "Mesoamerican astronomy and the ritual calendar", in Helaine Selin and Sun Xiaochun (coords.), Astronomy across cultures. The History of Non-Western Astronomy, EEUU, Pennsylvania, 225

_____. 2004, "La percepción de la latitud geográfica y el estudio del calendario mesoamericano", Estudios de Cultura Náhualt, vol. 35, 16

Córdoba Tello, Guillermo. 2005, Mecanuscrito by FAMSI online, July 2012, `http://www.famsi.org/reports/05049es/05049esCordovaTello01.pdf`

_____. 2007, Proyecto Arqueológico Valle del Río Suchil, Zacatecas y Durango, temporada

Digby, A. 1974, "Crossed trapezes: A pre-Columbian astronomical instrument", in N. Hammond (coord.), Mesoamerican archaeology: New approaches, EEUU, University of Texas, 271

Flores, Daniel, Hers, Marie-Areti, & Porcayo, Antonio. 2008, "Sobre el trópico en un mar de lava: análisis arqueológico e iconográfico en el septentrión mesoamericano", in Carlo Bonfiglio, Arturo Gutiérrez, Marie-Areti Hers, María Eugenia Olavarría (coords.), Las vías del noroeste II: propuesta para una perspectiva sistémica e interdisciplinaria, edited by Instituto de Investigaciones Antropológicas, México, UNAM, 241

Galindo, Jesús. 2001, "La observación celeste en el pensamiento prehispánico", Arqueología Mexicana, núm. 47, vol. viii, 29

Ganot, Jaime, Peschard, Alejandro, & Lazalde, Jesús. 1991, "Petroglifos de El Zape, Durango: un calendario solar en el norte de México", en Johanna Broda, Stanislaw Iwaniszewski and Lucrecia Maupomé (coords.), Arqueoastronomía y etnoastronomía en Mesoamérica, edited por el IIH- UNAM, Mexico, D. F., 529

Ganot Rodríguez, Jaime & Peschard Fernández, Alejandro Alberto. 1997, "Aztatlán: apuntes para la historia y arqueología de Durango, México", edited by Gobierno del Estado de Durango

García Uranga, Baudelina. 1998, "Chalchihuites", Arqueología Mexicana, num. 30, vol. v, 30

Kelley, J. Charles. 1975, "Alta Vista: Outpost of Mesoamerican empire on the Tropic of Cancer", as lecture in Primera reunión de antropólogos e historiadores de Centroamérica y México, Tegucigalpa, Honduras

Kelley, J. Charles & Abbott Kelley, Ellen. 2000, "The Archaeoastronomical System in the Río Colorado Chalchihuites Polity, Zacatecas: An Interpretation of the Chapín I Pecked Cross Circle", in Michael S. Foster y Shirley Gorenstein (comps.), Greater Mesoamerica EEUU, The University of Utah Press

Kelley, J., Charles, Abbott Kelley, Ellen, et al. 1975, "Preliminary report on excavations and related studies carried out at the archaeological site of Alta Vista (LCBJ3-1), Chalchihuites, Zacatecas, and in adjacent areas", Volume iii: Description of investigations carried out, Materials recovered, and preliminary conclusions, AK

Medina González, José Humberto & García Uranga, Baudelina L. 2008, "Alta Vista - Chalchihuites, Zacatecas", México, INAH, guía oficial del sitio arqueológico

_____. 2010, "A 100 años de su descubrimiento Alta Vista", México, edited by INAH and Gobierno del Estado de Zacatecas

Montero García, Ismael Arturo. 2005, "Los símbolos de las alturas", Doctoral thesis in anthropology, Mexico, Escuela Nacional de Antropología e Historia

_____. 2009, "Arqueoastronomía", en Pilar Luna, Arturo Montero y Roberto Junco (coords.), Las aguas celestiales. Nevado de Toluca, edited by INAH, México, Subdirección de Arqueología Subacuática, 68

Morante López, Rubén B. 1990, "En Xochicalco, el Popocatépetl marca el tiempo", México Desconocido, year xiii, núm. 164, 28

Pérez-Enríquez, Raúl. 2001, "Uso del gnomon para la posible interpretación del año de 260 días", in V Congreso Internacional de Mayistas, (typescript)

Sahagún, Fray Bernardino de. 1985, "Historia general de las cosas de la Nueva España", México, Editorial Porrúa

Schiavetti, Vincent. 1994, "La minería prehispánica de Chalchihuites", Arqueología Mexicana, núm. 6, vol. i, 48

Cantos de Mesoamérica (Mexico City, 10-13 November 2009)
Editors: José Daniel Flores Gutiérrez & Rosalba Nieto Calleja