TAINO ASTRONOMY

Breezy Ocaña Flaquer
San Diego State University. NASE - Dominican Republic

1. Introduction

The Tainos were the pre-Columbian inhabitants who lived in the Greater Antilles and some of the islands of the Lesser Antilles. They had knowledge of astronomy, which they used to understand what time of year they were in, which allowed them to be organized with respect to climate and agriculture. However, the impact of the conquest, which was very abrupt, caused the Taino culture to disappear in less than 100 years. It is thanks to recent work by archaeologists that we have been able to recover information based on the legacies mainly of Fray Ramón Pané [12], but also of Cristóbal Colón [3], Pedro Mártir de Anglería [10], Bartolomé de Las Casas [8] and Gonzalo Fernández de Oviedo [11]. In this document we collect information mainly from Dr. Sebastián Robiou-Lamarche [15], [14], [13]. We will also mention on certain occasions, knowledge or beliefs of the Caribs, who were the pre-Columbian inhabitants of the Lesser Antilles [15].

1.1 Brief Introduction to Astronomy

In order to understand the importance of certain events, we need a brief introduction to astronomy. We know that the Earth revolves around the Sun, and it takes a year to complete this all the way around. Throughout that year, we can see different stars and different constellations at night. Not because they change places, but rather because when the Earth changes its position, our nights show different areas of the sky, as can be seen in figure 1. This apparent movement of the constellations in the sky, throughout the night and over the years, is something that the Taínos, the Caribs and in fact all the natives, knew very well. Their myths arose, their beliefs always related to the sky, but they also managed to have an impressive meteorological prediction, just by observing the positions of the different constellations; just as they also organized the sowing depending on their understanding of the sky. But even more, they ruled their marine voyages (in the case of cultures that had a lot of contact with the sea) and their wars, all this based on the sky. During the reading of this article, we will see different examples of this, and how astronomy was of great importance for these cultures.

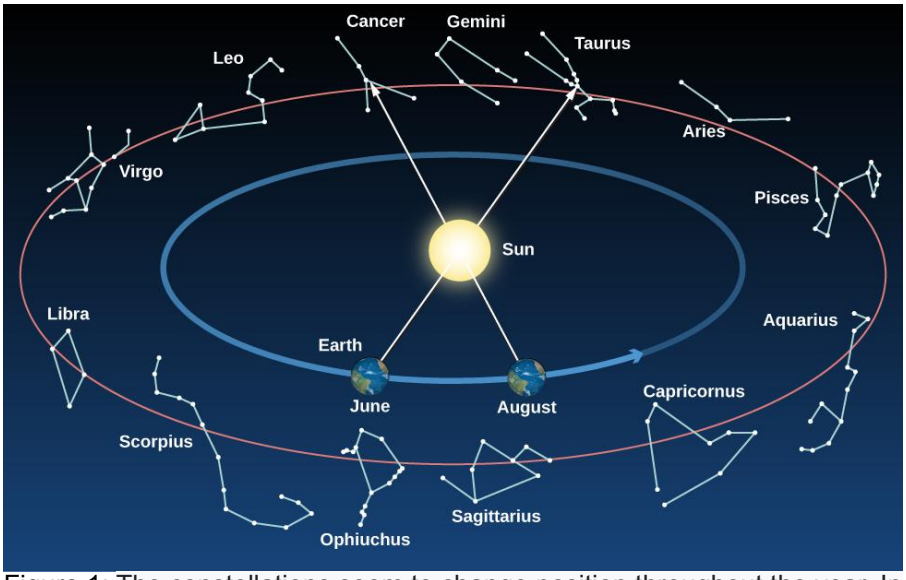

Figure 1: The constellations seem to change position throughout the year. In this image we see how in June, at night, we can see in the sky, for example the Scorpion. On that same date, we cannot see Taurus because it is in the sky at the same time as the Sun. However, while the Earth continues its annual journey, 6 months later, we can see, for example, Taurus and not Scorpio.
('https://pressbooks.online.ucf.edu/astronomybc/chapter/2-1-the-sky-

Figure 2: In this image we can see the Sun and the Earth, not to scale, where the Earth's Equator is shown together with the plane of the ecliptic and where the difference of 23.5 degrees between them can be seen. Image Credit: Wikipedia

Another movement of the Earth, which is worth noting, is the movement of nutation. Let us imagine a line that goes from the Sun to the Earth. We will call it the plane of the ecliptic. When we intercept this plane of the ecliptic with the terrestrial equator, we observe that there are 23.5 degrees between them, as can be seen in figure 2. This implies that between the axis perpendicular to the plane of the ecliptic, and the North-South axis of the Earth, there is a difference of 23.5 degrees. The North-South axis of the Earth has a motion like the motion of a top, as shown in Figure 3, and this is the motion of nutation.

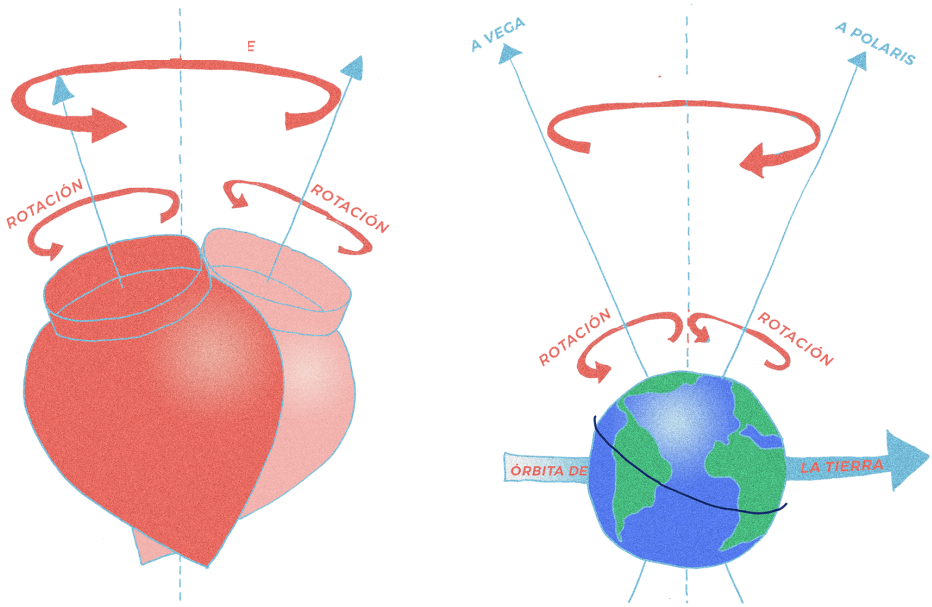

Figure 3: On the left we see a top, with a nutation movement. It can be seen that the top rotates on its own axis and that at the same time, this axis rotates around a perpendicular axis to the ground. This is like the nutation movement of the Earth. Image Credit: Natalia Gubin

This movement is so slow that we cannot really appreciate it; it completes a cycle in 26,000 years. The North axis of the Earth points directly to the Pole star, and when the Earth rotates on its own axis, it seems that the stars, in the Northern Hemisphere, all rotate around the Pole (as can be seen in image 4). Actually, it is the Earth that when rotating on its own axis and having an inclination that points to the Polar, makes the Polar appear fixed in the sky and that the rest of the stars rotate around it. It is important to note that this position varies in relation to the latitude of the area where the observer stands. At the North Pole, the observer would see the Polar at the zenith, at the Equator it would be located on the horizon, and in the Southern Hemisphere it cannot be seen. In the Dominican Republic, being in the Tropic of Cancer, with an approximate latitude of 18.7 degrees, the observer can see it, all year round and at an altitude of 18.7 degrees, as shown in figure 4. Thanks to this inclination, while the Earth travels around the Sun, it receives sunlight in a perpendicular way in different parts. The Sun arrives perpendicularly only to the area of the tropics, and this perpendicularity changes from latitude to latitude during the year. The rays are traveling from the Tropic of Cancer, to the Equator, to the Tropic of Capricorn and back to the Equator.

Figure 4: In this photo we can see the Pole Star in the center, and we see how, as the hours go by at night, the other stars seem to revolve around this "Central Star". This image was taken in Oregano Grande, between Azua and San Juan, in the Dominican Republic. Photo credit: Manuel Grullón

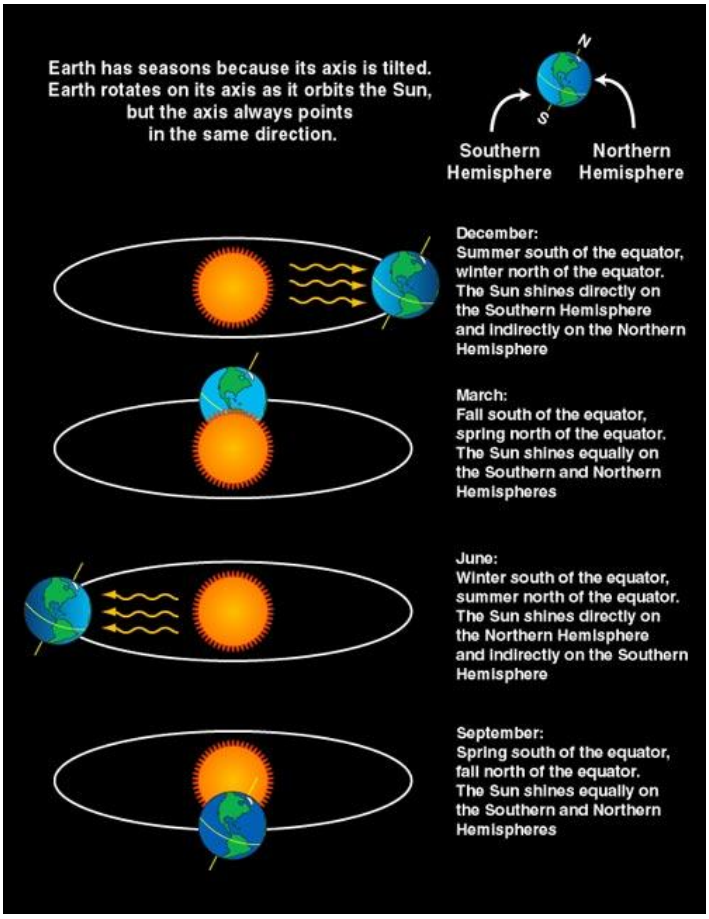

Figure 5: The seasons of the year are opposite for the Northern and Southern hemispheres. When in the North it is Summer, in the South it is Winter and therefore the Solstices and the Equinoxes are also opposite. Credit: 'https://spaceplace.nasa.gov/seasons/'

The December Solstice happens when the Sun is at the lower end of the Tropic of Capricorn and is called the Winter Solstice in the Northern Hemisphere. On that day, the Sun reaches the limit of its journey to the South and begins its journey back to Equator, reaching it during the March equinox (known as the spring equinox in the Northern hemisphere and the autumn equinox in the South). It continues traveling and reaches the upper end of the Tropic of Cancer on the day that for the Northern Hemisphere is the longest of all, the June Solstice (or Summer for the North and Winter for the South). Then, it returns for the September equinox, to the Equator. It is important to note that the seasons of the year, between the Northern and Southern hemispheres, are opposite, and that is due to the inclination of the Earth to which we have been referring, and it is evident in image 5.

During this tour, the Sun's rays pass perpendicularly through the Dominican Republic twice a year, once in mid-May, when we are close to reaching the Summer Solstice, and another at the end of July, when the Sun returns to the Equator. These two days are of great astronomical importance because they are the days where the Sun passes directly through the Zenith, in other words, the days where the Sun is at its highest point in the sky.

2. Mythology

In this section, we will detail some of the mythologies from the Tainos, and we will see how they are related to Astronomy.

2.1 The Origin of the Taínos

According to the Taínos, the world began in a cave, which is located in San Cristóbal, in the Dominican Republic and which bears the name of Cacivajagua (which means the black cave [4]). In that cave lived some beings that could not be in contact with the Sun and therefore never left the cave during the day. But one day, the Sun came in contact with them, and from there arose the trees, the birds, the Earth and the Taínos.

2.2 The Constellation of Orion and the Origin of the Fishes and the Sea

At the beginning of December, when the constellation Orion appears in the evening sky (after sunset), and does so in the East, implying that it is visible all night, it indicates for the Taínos the end of the rainy season, and the beginning of the dry season. This sky also coincides with the time of year when the most important fish in the indigenous diet were caught at the mouths of the rivers. And for a good omen, for this fishing, the Tainos had a ritual, where they recreated the myth of the creation of the fish and the sea.

The story of the origin of the sea and fish is contained in the myth of Yayael [14]. According to Taino mythology, Yaya (which means "high spirit") was a deity, without origin. His son, called Yayael, was killed by his father, Yaya, who hung his bones in a pumpkin inside his bohio (Taíno dwelling), and from those bones the fish and the sea were born. To augur well with fishing, the Taínos hung the pumpkin when they could observe the constellation of Orion at dusk. Christopher Columbus himself, in his diary, mentioned on his first and second trips, which took place in autumn, that he saw pumpkins with bones in the bohios.

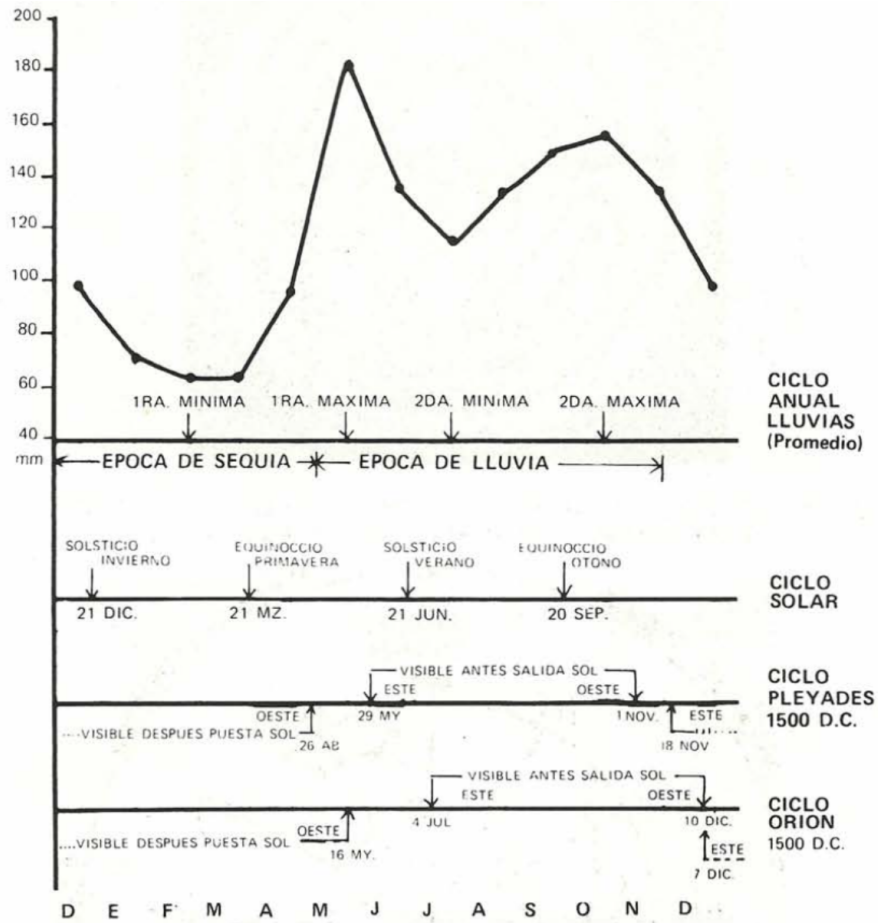

Figure 6: Representation of the annual cycle of rains and its relationship with the constellations of Orion, Ursa Major and the Pleiades.[14]

2.3 The Polar Star, El Lucero del Centro

Before the Taíno hero, Guahayona, began his mythical journey, he took his brother-in-law Anacacuya for a canoe ride. At one point Guahayona showed Anacacuya a beautiful Cobo (snail) at the bottom of the sea, and when Anacacuya was distracted, observing the Cobo, Guahayona took him by his feet, and threw him into the sea. Anacacuya means "Central Spirit" or "Central

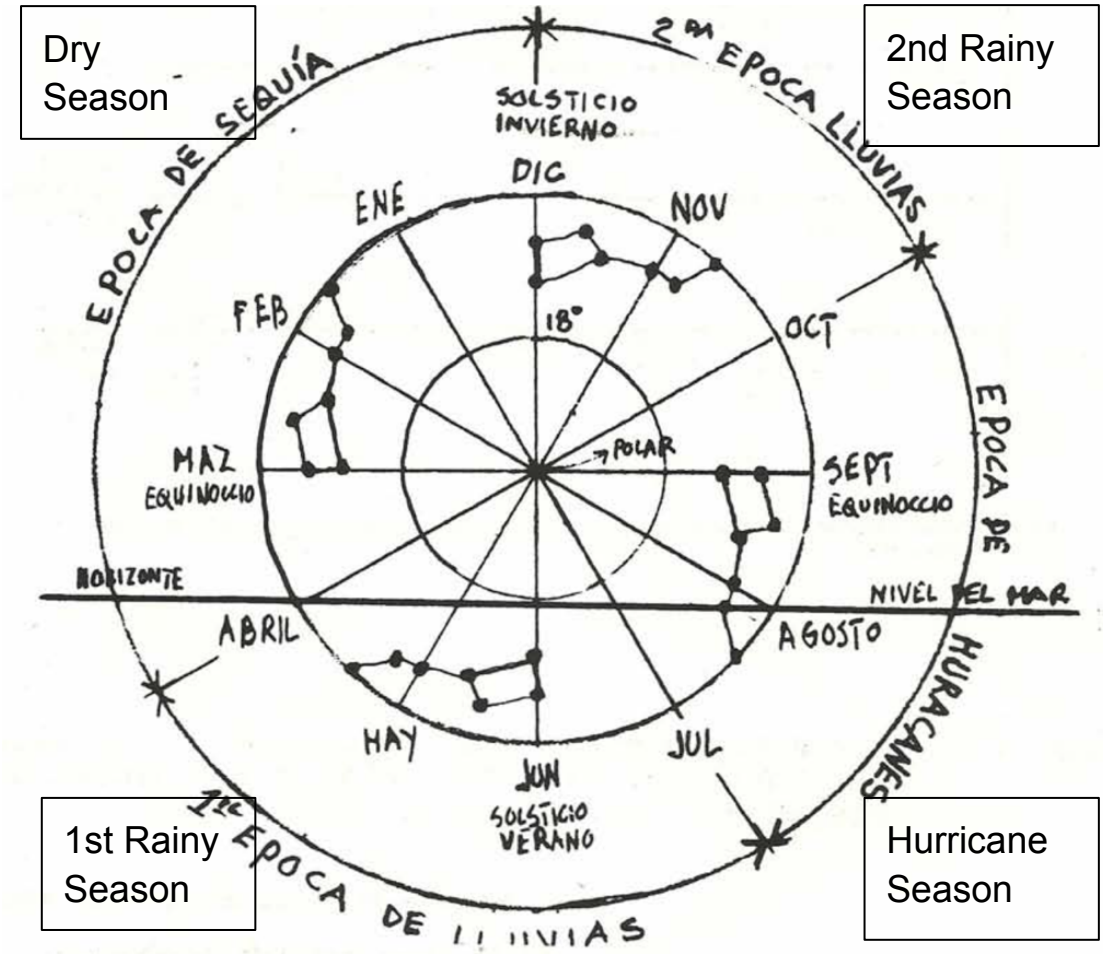

Figure 7: Annual cycle of the Big Dipper around Polaris [14]

Star". This fact relates Anacacuya to the Pole Star, which is located in the constellation Ursa Minor and which, as we saw in section 1.1, marks the North Celestial Pole. Let us remember that, as the Earth rotates in its rotational movement, we can notice how all the stars seem to revolve around this central star, as Anacacuya did when Guahayona had him by the feet. From this moment, Guahayona had a point of reference in the sky, which always marked him to the North, and thanks to this he was now able to make maritime trips, important to the Taino culture.

2.4 Venus and Guahayona

Venus is the second closest planet to the Sun in the Solar system. Earth follows. This means that Venus is an internal planet, that is, a planet that is between us and the Sun. This fact means that we can only see it at dusk or dawn, depending on where it is on its way around the Sun. We can never see it late at night, because at that moment we are looking in opposition to the Sun and therefore everything that is close to the Sun is no longer in our field of view. We also cannot see Venus when it is very close to or behind the Sun and therefore is hidden from us for a period of time. Venus is also the third brightest object in the sky, preceded only by the Sun and the Moon.

Guahayona is one of the most important characters in Taino mythology. As we have seen, he was the one who threw Anacacuya into the sea, and who took the women to the island of Matinino. When Guahayona fell ill, after leaving the women, he went to the island of Guanín. There was Guabonito who healed him, and when Guabonito cured him, gave him a new name, Albeborael Guahayona. One interpretation is that Guahayona could have meant "The one that shines by itself" or "The one with its own brilliance" and in this way is identified with Venus, as mentioned above, the most brilliant star, after the Sun and the Moon. Dr. Ribiou-Lamarche further suggests that this mythical cycle of Guahayona has a parallel with the astronomical cycle of Venus [13]. Guahayona could have been idealizing on evening Venus (West) and Albeborael Guahayona on morning Venus (East).

2.5 The Moon

According to the chronicler Oviedo, the Taínos paid attention to the phase of the Moon to sow the Yucca. He commented that to plant the yucca, the Moon can be in a new, full or waxing phase, but never in a waning phase. According to Mártir de Anglería, the Tainos were governed by a lunar calendar.

As for the Caribs, and according to Raymond Breton (Caribbean-French dictionary, 1655) ”The Caribs say that the Moon saw a young woman during her sleep and got her pregnant, forcing her mother to put someone to watch her; this surprised him and to recognize him the mother blackened it with Genipa, which are the spots that the Moon still has today ”. [2]

An anecdote that Las Casas (1951) tells us is that Christopher Columbus, on his fourth trip, arrived in Jamaica. The indigenous people did not want to help him, but Columbus, knowing that that night, February 29, 1504, there would be a lunar eclipse, he warned the Indians that if they do not help, God would send them a sign that night. Lunar Eclipses occur when the full Moon is aligned with the Earth and the Sun, and in perfect opposition to the Sun. The shadow of the Earth is projected into the Moon. Then the moon does not get direct light from the Sun, as usually happens, only the sunlight reflected by the Earth and therefore it is seen red.

2.6 The Pleiades. Taino Agriculture and Astronomy

The disappearance of the evening Pleiades on the western horizon could mark the start date for cassava planting and thus, by the time the heaviest rains arrive between May and June, the cassava plant is already stronger. But not only did the time of year, marked by the Pleiades, matter, but the moon phase was of high importance to decide exactly when to sow. If the Moon was

waning, that is, on the way from full moon to new moon, it would not be possible to sow [14].

2.7 The Big Dipper

We know that there is a relationship between the Polar Star and the Big Dipper. We see how this constellation seems to revolve around the Polar, as did Anacacuya when Guahayona took it by the feet and threw it into the sea. We also know that there is a relationship between Ursa Major and Hurricanes. If we observe the apparent movement of the Ursa Major for a year, we notice that it seems to submerge in the sky, "head down" and "feet up" in mid-April. In September it reappears on the eastern horizon at dawn, in the sky of the Dominican Republic. In other words, when the Big Dipper plunges into the water, it coincides with the rainy season and reappears when it is the hurricane season. (See Figure 7.)

2.8 The Hungry and Crying Children

After what happened with Anacacuya, Guahayona begins a mythical journey, and takes all the women with him, but leaves only the men and children behind in the cave. The children, being hungry and not having their mother, cry saying "toa toa", but little by little they are running out of energy and they are transforming into frogs.

These frogs are a symbol of rain, perhaps also related to children's tears. There is a relationship between the Pleiades and the rains. The evening Pleiades disappear on the western horizon at the end of April, also coinciding with the beginning of the rain cycle.

The evening Pleiades reappear in the sky at the end of May and extend in the morning sky until the end of October, throughout the rainy season. This is clearly seen in figure 6.

3. The Caves

The Pomier Caves are of great relevance to the Taino culture because this is where, according to them, life originated (2.1). Some 55 caves are grouped in the Pomier and in more than twenty of them there are rock art and archaeological records; and according to expert studies, there are more than 6,000 prehistoric paintings and around 500 cave engravings 2,000 years old or more. They are paintings and drawings made on the rocks and walls of these caves by the aborigines who inhabited this island, long before the arrival of Christopher Columbus. They are valued as the most important collection of cave and prehistoric art in the Antilles. In 1969 the Caves of Pomier were

declared a National Monument and in 1987, Natural Heritage of the Nation. In 1993 they were incorporated into the system of protected areas and were designated as "Cuevas del Pomier Anthropological Reserve" [9].

For this document, what interests us the most is a cave called Iguanaboina, or Cueva del Punte, from where the Taínos thought that the Sun and the Moon had risen. For this reason, here they kept 2 small stone cemies with their hands tied, known as Máhoru and Boínayel. Máhoru represents the day, the drought and the cacique (maximum authority) and Boínayel represents the night, the waters and the behique (shaman). The balance between these deities was the most important thing to maintain the balance of nature, whether due to extreme drought or great floods [6].

In his inspections of this cave, the Dominican archaeologist and caver Domingo Abreu, had noticed that Márohu and Boinayel were practically untouched by the solar rays that gradually penetrated from the top to the depths of the cavern. However, when visiting the cave during the December Solstice, Márohu and Boinayel, the cemíes that for months remain in the shadows, were touched at their base by sunlight during the December solstice (summer solstice for the Tainos). [7].

4. Ceremonial squares

In Dajabón, Dominican Republic, there was an ellipsoidal plaza called Chaquey. Plaza that, according to the Santiago historical archive [5], was destroyed in the 1980s to build a road that goes from Santiago Rodríguez to Dajabón. Chaquey was formed by a ridge of stones of almost 5 meters interrupted in two types of entrances. According to the plans made in 1955 and the investigations of Dr. Sebastián Robiou Lamarche [14] in 1980, it is believed that the axis of the portals was oriented towards the sunrise on the December Solstice. The direction of the parallel roads that went down to the river were oriented towards the equinoxes, while the pile of stones located in the Northeast area of the square, about 24 x 40 meters, when observed from the center of the western portal, was in the direction of 3 significant astronomical dates: the sunrise on the June Solstice (or Summer in the Northern Hemisphere) and the days of its passage through the zenith and the heliacal departure from the Pleiades. In figure 8 we see a map of what the ceremonial Chacuey Square was like and where these points are clearly marked.

In addition to the Plaza de Chacuey, in the Dominican Republic there is the circle of the Indians, in San Juan de la Maguana. This is another square that seems to contain astronomical orientations. Dr. Sebastián Robiou Lamarche affirms that the circular construction has a diameter of about 225 meters and is formed by a double row of stones. In its center there is a 1.7 meter high monolith that could probably serve as a crosshair for an alignment towards the sunrise at the Winter Solstice with La Loma del Agua. This central monolith, which was perhaps a symbol of a solar deity, could also serve to mark the days of the passage of the Sun through the zenith [14].

According to the article by José Barreiro [1], the Cuban caver Rasco Fernández and José González studied the Parana caves as a ceremonial center. Astronomical, speleometric and meteorological measurements were taken in an article called "The enigma of the native petroglyphs of Cuba and the Insular Caribbean" and concluded that the indigenous people who arrived in Cuba from Hispaniola (Dominican Republic and Haiti), recreated a

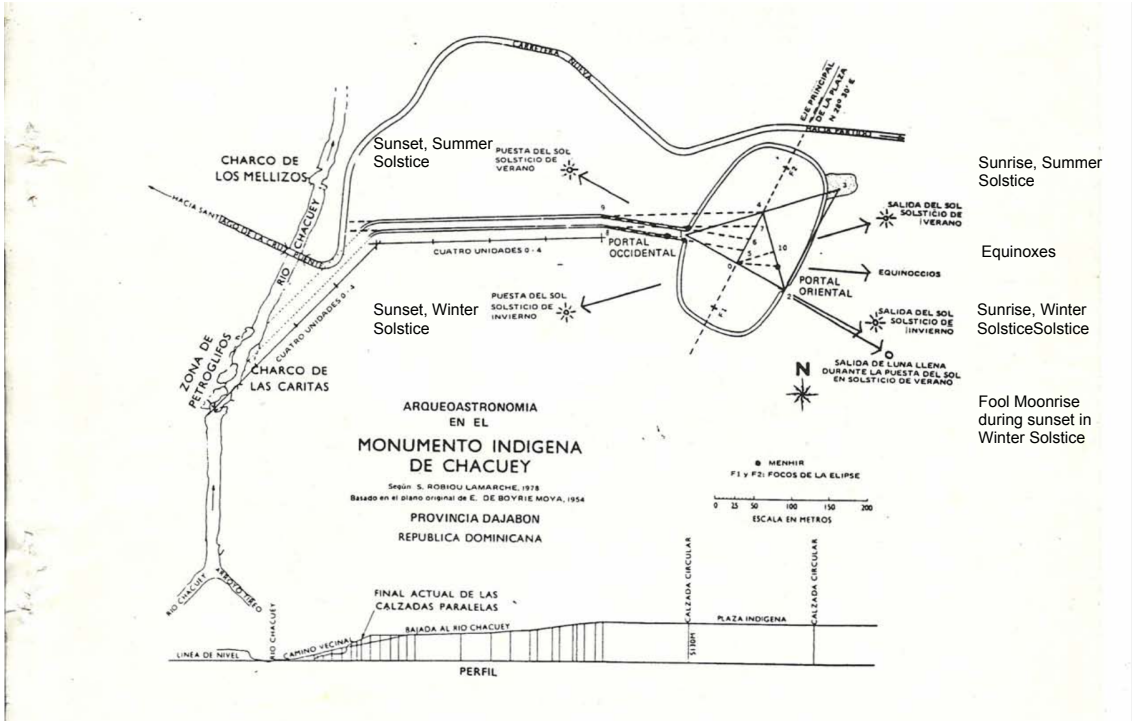

Figure 8: Chacuey Square [14]

“ceremonial center in Cuba where astronomical rites were carried out to identify the arrival of the rainy season”

In conclusion, the Tainos had more astronomical knowledge than previously thought. They governed their customs based on the position of the stars and

with this they could organize their rituals, their travels and their agriculture/ plantings.

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