# *TARA*: A STUDY ON THE CANARIAN ASTRONOMICAL PICTURES

## Part II: The *acano* chessboard

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# *TARA*: A STUDY ON THE CANARIAN ASTRONOMICAL PICTURES
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## Abstract

In the first part of this paper (SEAC Conference'95) I studied the archaeological, ethnohistorical and linguistic evidences that led me to propose that in 14th-15th centuries the Berber populations of Grand Canary Island systematically recorded numerical, astronomical and calendrical data by mean of certain geometrical figures named ***tara***, painted in white, red and black on wood planks and on the walls of certain caves. One main conclusion was the use of a chessboard of 3 vertical x 4 horizontal squares (that I name ***acano***) to represent 12 moons.

In this second part I study for first time the ***acano*** as a lunar calendar and show how to number its squares to force the solstitial, equinoctial and eclipse moons to move across the board with very simple and stable patterns. These patterns provide a safe and clear mnemonic guide for performing on the ***acano*** an easy calculus of seasonal and eclipse moons over extended periods of time, just using the difference in days of the lunar year with either the solar year or the eclipse year to perform an elementary saw function on the squares. This calculus establish the octaeteris, the metonic cycle and the 135-moon eclipse cycle as basic periods of the ***acano***.

It is well known that the Canarians observed the summer solstice and had important festivals on the crescent moon that followed, so to complete the evidence I present two notices from ancient written sources supporting that they measured one and half eclipse year as 520 days.

The proposed calculus on the ***acano*** would reveal an unsuspected high level of Canarian mathematical astronomy and pose the question of the origin of this set of techniques.

## Dedication

It is a happy coincidence that a number of important notices on Canarian astronomy come from the writings of the Canarian doctor Tomás Marín de Cubas (1643-1705), who study medicine and taught astrology at this Salamanca University. To him is dedicated this painted paper.

## The *acano* chessboard

In the first part of this paper I concluded that in 14th-15th centuries the Canarians (Berber populations of Grand Canary) systematically recorded numerical, astronomical and calendrical data by mean of certain geometrical figures named ***tara***, painted in white, red and black on wood planks and on the walls of certain caves. One main conclusion was the use of a painted chessboard of 3 vertical x 4 horizontal squares to represent a count of 12 moons. Since written sources use to call ***acano*** or ***achano*** the Canarian lunar year, I am going to take the freedom of naming also ***acano*** this particular chessboard.

*Figure 1. Two versions of a black-and-red* acano

## The Painted Cave of Gáldar

The main archaeological evidence on the use of the ***acano*** chessboard as a lunar count comes from the decoration of the left and central panels of the Painted Cave of Gáldar (Grand Canary Island). An artificial cave located very close to the 'palace' of the *guanartemes* or 'kings' of (northern half of) the island in the centuries preceding the Spanish conquest of the island, occurred on late 15th century.

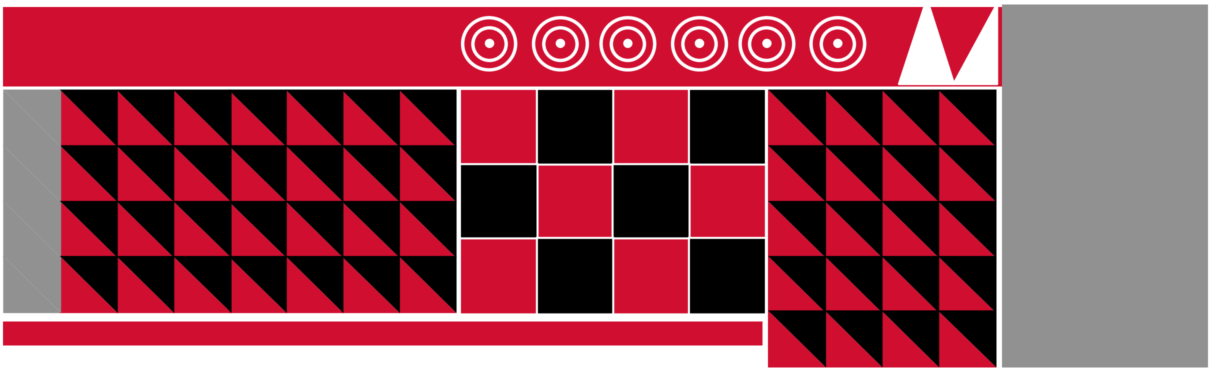

*Figure 2. Left panel (4.2 x 1.2 m)*

The cave was casually found in 1873, declared National Archaeological Monument in 1949 and National Monument in 1972. It is known that there were other painted caves in the island with similar decorations but this is the only one preserved, so its great archaeological importance.

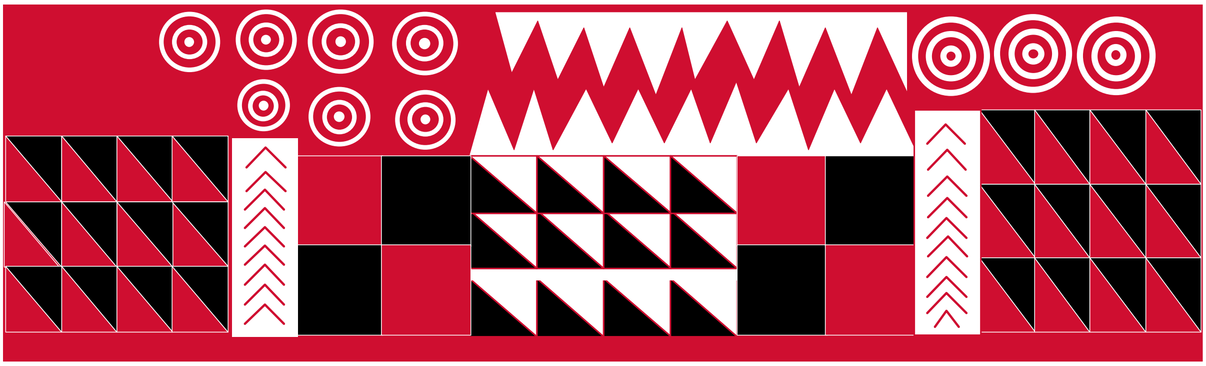

*Figure 3. Central panel (5.0 x 1.3 m)*

At present the site around the cave is being object of a deep archaeological study formerly directed by late Prof. C. Martín de Guzmán and now by Dr. J. Onrubia Pintado. Their researches have confirmed the extraordinary archaeological richness of the site, stratigraphical data using some 30 radiocarbon dates having proved a continuous occupation of the site during at least the whole nine centuries preceding the Spanish conquest, that is to say, from early 7th to late 15th century AD. The chronology of the Painted Cave itself remains unknown, most likely comprising at least the last two centuries preceding the Spanish conquest.

## Lunar counts

Let an ***acano*** of 3 x 4 squares painted in red and black represents a count of 12 moons (synodic months). Certainly its pattern codes a cultural classification of the moons that elegantly synthesises the basic arithmetic of number 12.

By colour they are classified as red or black, the pattern suggesting that colour alternates from moon to moon, that is, odd moons are black and even moons are red or vice versa. By columns they are divided into 4 groups of 3 moons what immediately suggests a solar division according to equinoxes and solstices. Their division by files in 3 groups of 4 moons is less clear although there are examples in other African calendars.

In any case, the 12 moons must be counted on the ***acano*** in a certain order that needs to be investigated. Naturally, this order was culturally determined so, potentially, may vary from the most natural to the most unexpected one. As a matter of fact, basic combinatory establish that there are exactly 12! different ways of numbering the ***acano***, that is to say, some 500 millions possibilities. In this paper I have try to deal only with the most simplest assumptions.

To illustrate the situation Figure 4 shows three different counts defined by the arrows. The first count is vertical, the second one is horizontal, and the third one is diagonal[1]. How to choose the correct one, if any?

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[1] Each numbered ***acano*** only represents one possible numeration compatible with the pattern defined by the set of arrows aside. Each pattern could be equally read from bottom to top and/or right to left.

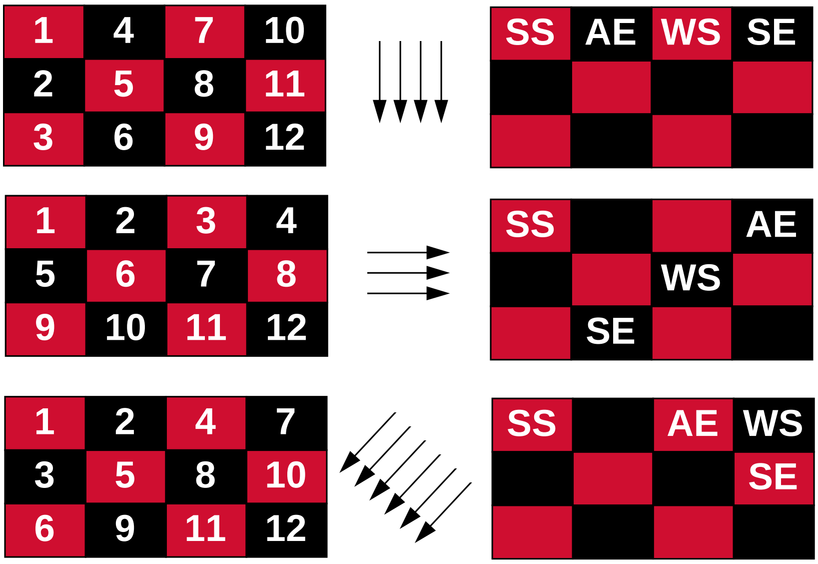

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*Figure 4. Three patterns of counts*

Certainly, there are several criteria we can try to reduce the search. For example:

1. If colour alternates from moon to moon I would retain the first possibility and disregard the other two.
2. The second criterion locates the solstitial and equinoctial moons assuming they are 3-month spaced. Certainly, I would expect the four stations of the sun nicely disposed on the pattern. Figure 4 shows on the right the seasonal moons generated by each count assuming that summer solstice occurs in the first moon. On this base I would retain again the vertical count and reject the other two.

I have tried with these criteria a number of patterns and all of them points to the vertical count as the best choice. Furthermore, it is the only one compatible with the most natural solar division of the ***acano*** by columns. On this base I am going to centre my study on this particular count[2].

## Solar counts

A first property of the vertical count is that solstitial and equinoctial moons are forced to be aligned on the ***acano***. Once you know where is one, you know where are all. This is very good for tracking the movement of the seasonal moons across the lunar calendar.

Indeed, in round numbers, 12 moons are 11 days shorter than a solar year, so in a lunar calendar solar dates occurs 11 days later each year. For this reason seasonal moons jump each 2-3 years to the next square of the ***acano***. Each time a seasonal moon jumps, the other three jump behind since they are never less than 3-moon spaced, so they are kept aligned.

If we follow the movement of the seasonal moons through a whole round of the summer solstice across the ***acano*** we get the basic calendar of Figure 5 adjusted to the Metonic cycle

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[2] It is worth noting that most of Lybic-Berber alphabetical inscriptions of the Canary Islands are written in vertical lines.

(19 solar years ≈ 19 lunar years + 7 moons). Note that the equivalence “8 solar years ≈ 8 lunar years + 3 moons”, base of the *octaeteris*, measures the pass of the sun through a column[3].

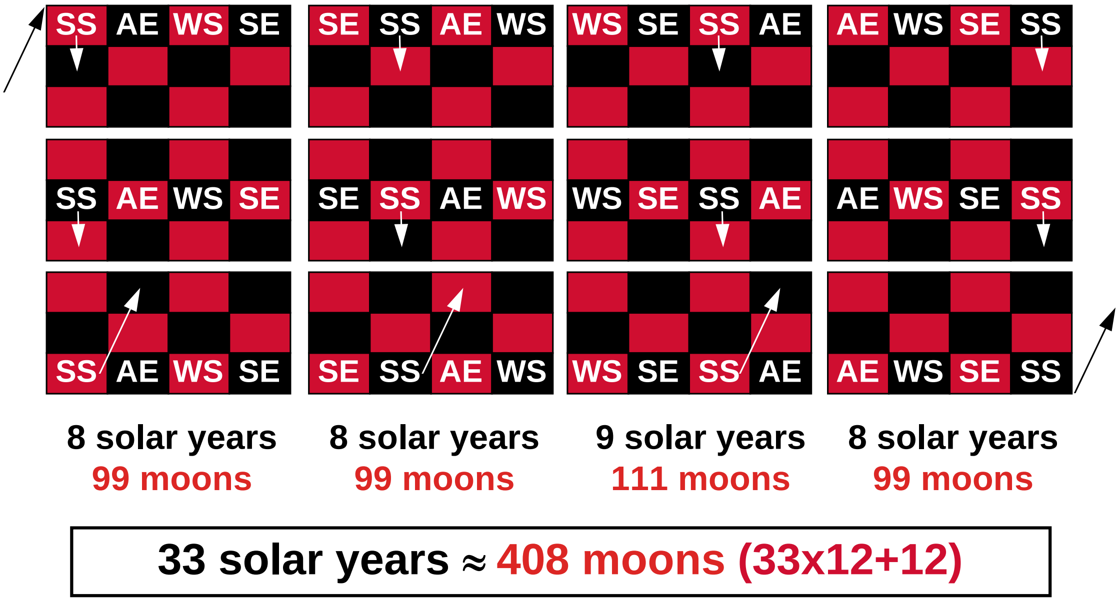

*Figure 5. Lunisolar calendar*

It is true that this basic calendar must be adjusted from time to time since not always summer solstice jumps in first place and, on the long run, the whole pattern shifts. But using this basic scheme as a guide you know how things work and where are the critical points.

As a matter of fact, to record a date on the ***acano*** you only need to write a number from 1 to 30 on one of its squares. The selected square fixes the moon while the number fixes the day of the moon counted, let us say, from new to new. Accordingly, it is possible to record unambiguously on a single ***acano*** the 33 successive dates fixing a whole round of the summer solstice through the lunar year. What is of the utmost importance is that this can be accomplished either through the years by actual observation, either at any desired moment by performing an easy arithmetical exercise on the ***acano***.

Indeed, once recorded on the ***acano*** the date of a particular summer solstice, we obtain the dates of the next summer solstices simply adding 11 days by year to the previous number. Each time the accumulated shift is greater than 29 or 30 days, we jump to the next square, reduce the shift by 29 or 30 days, write the new date on the square and continue the count. Actually, this exercise can be done even mentally for a number of years.

This is a very easy and natural way for computing on the ***acano*** a reliable ephemeris for the summer solstice for a number of years. Such ephemeris would provide the backbone of the lunisolar calendar. This basic calendar can be easily adjusted for the other three seasonal moons with an estimation of the number of days between equinoxes and solstices[4]. The same calculus provides ephemerides for the stars and even for the planets, provided their shifts are known. This working model can be easily adjusted from time to time by mean of actual

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[3] 8 solar years ≈ 8 lunar years + 3 moons ≈ 5 Venus synodic revolutions.

[4] Note that this calculus lies at the roots of Babylonian ephemerides (Neugebauer 1975 I).

observation on well located points of the ***acano*,** or just using longer and more accurate cycles.

On the other hand, it is well known that Canarians observed the summer solstice and had important festivals just on the moon that followed, so certainly they were in a very good position to measure the 11-day difference between lunar and solar years.

## Eclipse counts

Now it is a pleasure to answer the insightful question that Dr. Arnold Lebeuf posed me after the Sibiu Conference, when he noted me that, since red is the colour of the eclipsed moon and black is the colour of the eclipsed sun, I should look for eclipses in the Cave's decoration. What I promised him.

Indeed, as Prof. Neugebauer (1975 I: 525) stated, *"it is probably one of the oldest empirical discoveries in astronomy that lunar eclipses are spaced regularly in 6-month intervals with an occasional 5-month gap between very small eclipses."*. So the second notable property I have discovered in the vertical count is that eclipse moons are forced to be paired and move backward on the **acano** with the concise pattern of Figure 6. Furthermore, this pattern is based on a 135-moon eclipse cycle decomposed by three 5-moon jumps, the eclipse moons traversing the ***acano*** in twice 135 moons. Figure 6 displays a standard count of the 270 moons fixing on the ***acano*** the whole 46 possible eclipse moons.

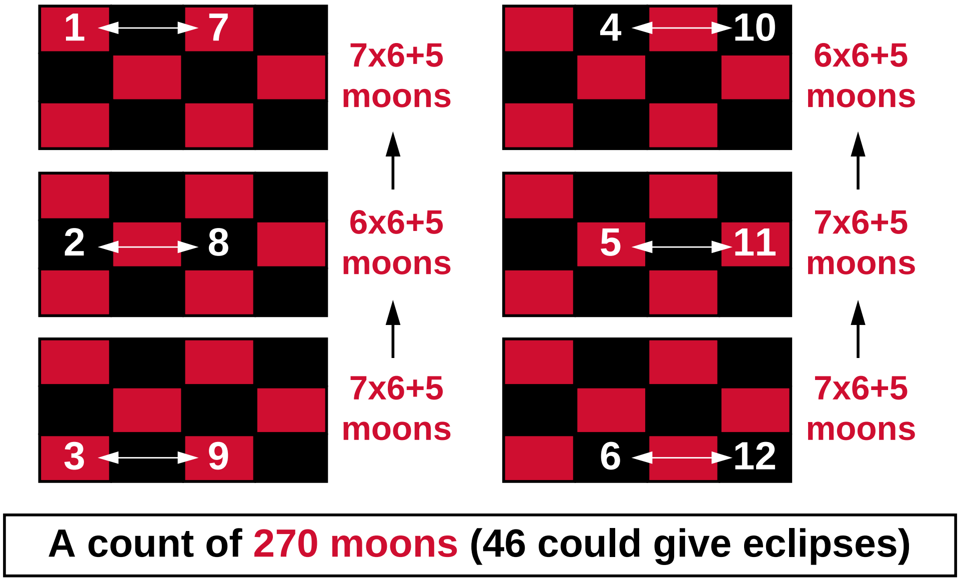

*Figure 6. Eclipse calendar*

As Aaboe (1972) has shown, this ancient 135-moon eclipse count, most likely known in Babylon and Egypt and certainly known in China and Mesoamerica, can be easily derived with a simple arithmetical scheme from a good estimation of the eclipse year and the eclipse limits.

As a matter of fact, the calculus proposed by Aaboe (1972) can be performed on the ***acano*** in a much more simple and effective way. Indeed, once the eclipse year is measured and the date of a central eclipse is recorded, one can easily compute on the ***acano*** the dates of the successive solar passages by the nodes simply each time jumping 6 moons and subtracting 3 o 4 days. This calendar can be easily adjusted from time to time by actual observation of eclipses. Note that the date of a solar passage by a node locates on the ***acano*** the solar and lunar eclipses occurring at that node, provides a measure of their respective magnitudes and help to separate the eclipse limits of the sun from those of the moon. This calculus also provides a simple and graphic method for searching eclipse cycles. The 24-half moon ***acano*** is especially suited for the record and graphic calculus of eclipses.

On this respect it is worth noting that, although astronomical counts with explicit numbers are certainly rare in Canarian written sources, at least two of them can be related with accurate measures of the eclipse year, what undoubtedly lends some support to the above proposed calculus.

The first one was recorded in 1592 by the Italian engineer Leonardo Torriani in his celebrated description of the Canaries. After him, Guanarteme *'El Bueno'*, one of the last *guanartemes* of Gáldar, said to the Portuguese invader Diego de Silva [c. 1460 AD].

> *… que si nos bastara el haberos ahuyentado infinitas veces de nuestras costas y dado muerte, y muchas veces detenido como prisioneros (como de vuestro obispo Diego López lo sabéis, 520 esplendores de la luna que es nuestro cautivo), podríamos hacer cuenta de que la ira de Dios se ha aplacado contra nosotros…*
>
> Torriani (1978 [1592]: 124)

Note that 520 days is an accurate count of one and half eclipse year. Since apparently the bishop Diego López de Illescas never was retained prisoner in the island, at least for so long time, it seems that Torriani recorded a notable 520-day eclipse count related with a symbolic prison (eclipse) of the invader's religious chief.

The second count was recorded twice by Tomás Marín de Cubas.

> *Contaban el año llamado acano por las lunas, de veinte i nuebe soles, ajustábanlo por el stío onde en la primera luna hacían nuebe días de fiestas i regocijos a el recojer sus cementeras, pintaban en unas tablas de drago i en piedras, i en paredes de las cuebas, con almagra, i rayas, i otros caracteres llamados tara, i onde los ponían tarja a modo de scudos de armas, decían que su origen era de la parte de el sur de África i también señalaban a el oriente; y según decían era mui antigua la población de yslas.*
>
> Marín (1986 [1687]: 77 v.)

> *Contaban su año llamado Acano por las lunaciones de veinte y nueve soles desde el día que aparecía nueva empesaban por el stío, quando el sol entra en Cancro a veinte y uno de junio en adelante la primera conjunción, y por nueve días continuos hazían grandes vailes y convites, y casamientos, haviendo cojido sus sementeras hazían raias en tablas, pared o piedras; llamaban tara, y tarja aquella memoria de lo que significaba.*
>
> Marín (1986 [1694]: 254)

Although the confuse redaction of Marín suggests a 29-day synodic month, note that a 29-day month is easily derived from the earlier 520-day eclipse count (520 ÷18 ≅ 29). So, for example, six 29-day months adds up to 174 days, a good and practical approximation of half eclipse year but a very crude estimation of half lunar year.

## Acknowledgements

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## References

Aaboe A. (1972) “Remarks on the theoretical treatment of eclipses in antiquity”. *Journal for the History of Astronomy* (Chalfont St Giles, England) 3: 105-118.

Álvarez Delgado J. (1949) *Sistema de Numeración Norteafricano*. Madrid, Instituto Antonio de Nebrija (CSIC).

Aveni A. F. ; Cuenca J. (1992-94) “Archaeoastronomical fieldwork in the Canary Islands”. *El Museo Canario* (Las Palmas de Gran Canaria) 49: 29-51.

Barrios García J. (1993) “A pre-16th century Berber solstitial marker on Grand Canary Island”. In W. B. Murray & A. Stoev (eds.), *Proceedings of the IV Oxford Conference on Archaeoastronomy* (Stara Zagora, Bulgaria, 1993). In press.

(1994) “Una nueva lista de numerales bereberes canarios: Cairasco de Figueroa, 1582”. Paper presented at the *I Congreso Internacional Canario-Africano: de la Prehistoria a la Edad Media* (La Laguna, Tenerife, 1994). Unpublished.

(1995) “*Tara*: a study on the Canarian astronomical pictures. Part I. Towards an interpretation of the Painted Cave of Gáldar”. In F. Stanescu (ed.*), Proceedings of the III SEAC Conference* (Sibiu, Romania, 1995). In press.

Galand L. (1974-75) “La notion d'ecriture dans les parlers berbères”. *Almogaren* (Hallein, Austria) 5-6: 93-98.

Gast M., Delheure J. (1992) “Calendrier”. In *Encyclopédie Berbère*. Aix-en-Provence, Edisud, vol. 11, pp: 1713-1719.

Gurshtein A. (1995) “Prehistory of zodiac dating: three strata of upper Paleolithic constellations”. *Vistas in Astronomy* 39: 347-362.

Lebeuf A. (1992) “Un fossile d'astronomie babylonienne: l'icone du jugement dernier de Polana (Musée National de Cracovie)”. In S. Iwaniszewski (ed.), *Readings in Archaeoastronomy*. Warsaw, State Archaeological Museum-Warsaw University, pp: 113-126.

(1995) “Astronomía en Xochicalco”. In *La Acrópolis de Xochicalco*. México, Instituto de Cultura de Morelos, pp: 211-287.

Marín de Cubas T. (1986 [1687]) *Historia de la Conquista de las Siete Islas de Canaria*. Manuscript copy by F. Cardona and J. Barrios after the copy of P. Hernández (1937).

(1986 [1694]) *Historia de las Siete Islas de Canaria. Edición de A. de Juan y M.Régulo. Notas arqueológicas de J.Cuenca*. Las Palmas de Gran Canaria, Real Sociedad Económica de Amigos del País.

Martín de Guzmán C., Onrubia Pintado J., Sáenz Sagasti J. I. (1994) “Trabajos en el Parque Arqueológico de la Cueva Pintada de Gáldar”. *Anuario de Estudios Atlánticos* (Madrid-Las Palmas de G. C.) 40: 17-115.

Neugebauer O. (1975) *A History of Ancient Mathematical Astronomy*. Berlin-Heidelberg-New York, Springer Verlag. 3 vols.

Onrubia Pintado J. *et al.* (1995) “La pintura mural prehispánica de Gran Canaria. La Cueva Pintada y el poblado de Gáldar”. Paper presented at the *I Simposio de Manifestaciones Rupestres del Archipiélago Canario y el Norte de Africa* (Las Palmas 1995). Unpublished.

Pâques V. (1956) “Le bélier cosmique. Son role dans les structures humaines et territoriales du Fezzan”. *Journal de la Société des Africanistes* (Paris) 26: 211-253.

Reyes García I. (1995) “Antiguos numerales canarios”. Unpublished.

Siarkiewicz E. (1995) *El Tiempo en el Tonalamatl*. Varsovia, Cátedra de Estudios Ibéricos de la Universidad de Varsovia.

Torriani L. (1978 [1592]) *Descripción e Historia del Reino de las Islas Canarias, antes Afortunadas, con el Parecer de sus Fortificaciones. Traducción del italiano con introducción y notas, por A. Cioranescu*. S/C de Tenerife, Goya.

Van der Waerden B. L. (1974) *Science Awakening II. The Birth of Astronomy*. Leyden-New York, Noordhoff International Publishing-Oxford University Press

Zavadovskij J. N. (1974) “Les noms de nombre berbères à la lumière des études comparées chamito-sémitiques”. In A. Caquot & D. Cohen (eds.), *Actes du I Congrès International de Linguistique Sémitique et Chamito-Sémitique* (Paris, 1969). The Hague-Paris, Mouton, pp: 102-112.

Ziolkowski M., Lebeuf A. (1992) “Les Incas etaient-ils capables de prevoir les eclipses de lune?”. In S. Iwaniszewski (ed.), *Readings in Archaeoastronomy*. Warsaw, State Archaeological Museum-Warsaw University, pp: 71-83.

Ziolkowski M., Sadowski R. (1992) *La Arqueoastronomía en la Investigación de las Culturas Andinas*. Quito, Banco Central de Ecuador- Instituto Otavaleño de Antropología.