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ARCHAEOASTRONOMY IN BRONZE AGE SITES OF LA MANCHA (SPAIN)

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ABSTRACT

We present archaeoastronomical results of an interdisciplinary project to study Bronze Age sites of the so-called *Cultura de las Motillas* in the Spanish region of La Mancha. We find that winter solstice sunrise was of special importance in the funerary – and perhaps religious – practises of these peoples. The impressive megalithic monumental complex of Castillejo del Bonete shows a remarkable marker of the winter solstice sunrise on the most peculiar mountain of its horizon as well as alignments with this and other singular solar events as equinox and summer solstice. There seems to be a correspondence between the orientations of some of the main architectural structures of the monument and the general arrangement of two of the main galleries of a natural cave that lies just beneath it. Markers and orientations to the winter solstice sunrise seem to be present in other nearby contemporary sites such as the necropolis of Cerro Ortega and the *motilla* of El Azuer. Castillejo del Bonete stands as the first evidence of a clear solar marker in a megalithic site of the Iberian Peninsula, indicating that the precise location of the monument was carefully chosen. The alignments defined by several of its structures further reinforce its astronomical symbolism.

KEYWORDS: Archaeoastronomy, Bronze Age. Late Prehistory, Iberian Peninsula, Monumental Barrow, Motilla, La Mancha, Winter Solstice.

1. INTRODUCTION. *CULTURA DE LAS MOTILLAS*

La Mancha is a natural and historical region that occupies a large fraction of the Spanish autonomous community of Castilla-La Mancha, located close to the centre of the Iberian Peninsula. Although our knowledge about the Late Prehistory of La Mancha is rather reduced – mainly because of the paucity of studies – the megalithic phenomenon has been very rarely reported in this region (e.g. Benítez de Lugo Enrich *et al.* 2014a). We are involved in an interdisciplinary project to study the archaeology, hydrogeology, palaeobotany and archaeoastronomy of the culture that developed the first attested settlements in the La Mancha – the so-called *Cultura de las Motillas* – during the Bronze Age (III-II millennia BCE, Mejías Moreno *et al.* 2015). Unlike the previous Neolithic and Chalcolithic periods, the research on this culture has been certainly remarkable over the past four decades (e.g. Molina *et al.* 2005; Aranda *et al.* 2008; Benítez de Lugo Enrich *et al.* 2014b). During the Bronze Age, La Mancha suffered a crisis of extreme aridity due to an abrupt climate change, known in the scientific world as 4200 cal. BP Event (2350-1850 BCE, Magny *et al.* 2009), which affected other major cultures from Mesopotamia to China. The peoples of La Mancha built large fortified settlements around deep wells – called *motillas* – in order to get control of the underground water resources. Certainly the *motillas* can be considered one of the oldest systems of relatively large exploitation of underground water in Europe. Despite the relative large amount of information we have about the *motillas*, very little is known about the funerary practises of these peoples because few excavations have been carried out in the scarce necropolises dated of this period.

In this paper we present the results of the first archaeoastronomical study ever made in archaeological sites belonging to the *Cultura de las Motillas*. These sites are three necropolises - Castillejo del Bonete, Cerro Ortega and Bocapucheros - and one *motilla* - Motilla de El Azuer, all of them located in the province of Ciudad Real

2. METHODOLOGY

The fieldwork was carried out in September 2014. The instruments used were a precision compass, a handheld clinometer, a theodolite, a global positioning device (GPS) and a digital camera. The methodology used in the data collection is described in detail in Esteban and Moret (2006), and summarized briefly below.

The GPS was used to obtain the geographic coordinates of the sites, as well as for timing the measurements of the position of the solar disc to correct for the zero level of the horizontal angles provided by the theodolite. This was made centering the solar disc in the reticle of the viewfinder of the theodolite several times – usually three – during each visit to the site. We also used this instrument for measuring the azimuth and height of the topographic features on the horizon around the sites, which accuracy is 0.05° in both cases. Height measurements were corrected for the atmospheric refraction effect near the horizon. The orientation of the man-made stone structures was measured with a precision compass, which provides an uncertainty of about 1°. The magnetic declination was determined on each site by comparing the horizontal angle given by the compass with the azimuth provided by the theodolite for different topographic features.

3. THE MONUMENTAL COMPLEX OF CASTILLEJO DEL BONETE

This impressive monument dates from the last quarter of the third millennium BC (Benitez de Lugo Enrich *et al.* 2014a). It comprises a monumentalized cave with a series of ground-level structures such as megalithic corridors and tumuli associated with funerary remains and votive deposits. It consists of several tumuli - the largest one of about 20 m of diameter – with radial corridors, some of them connecting tumuli. It is located in Terrinches (in the province of Ciudad Real) on the top of a hill with a dramatic view of the southern half of the horizon. High peaks of the mountain ranges of Alcaraz and Segura can be seen to the southeast from the site. After measuring the azimuth and height of different topographic features of the horizon, we check their possible relationship with rising or settings of the most important celestial bodies, finding an exceptional event: the sunrise at winter solstice takes place over the centre of the top of the most striking mountain visible from the site: Peña del Cambrón. This mountain is 1550 m high, located about 30 km away and has a curious rectangular profile, with a flat top and very steep edges – the width of the flat summit is 1.8° (see Figure 1). We observed the sunrise from the site on December 22, 2014 - winter solstice - taking the photograph shown in Figure 1. In this figure, we also compare the position of the solar disc at present-day winter solstice sunrise (with a declination of δ = -23.45°) and the expected position at 2000 BCE (δ = -23.9°), as it would de observed by the builders of Castillejo del Bonete.

Calculations made for 2000 BCE indicate that the time interval elapsed since the southern edge of the sun touches the northern edge of the Peña del Cambrón until the winter solstice is about 18 days. That is, the Sun travels for 18 days the flat summit of the mountain, moving slowlier southward as it

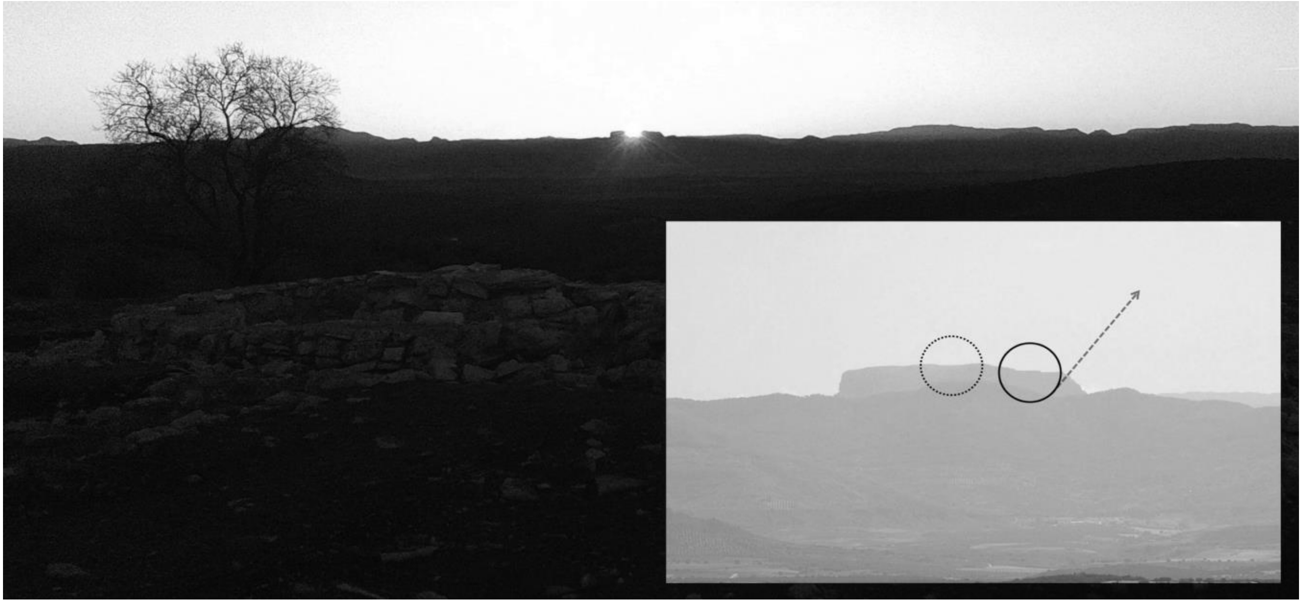

Figure 1. Winter solstice sunrise of 2014 (December 22nd) from the megalithic monumental complex of Castillejo del Bonete. The solar disc appears on the central part of Peña del Cambrón (photo: Oppida). Inset: Detail of the profile of Peña del Cambrón. The dashed circle indicates the size and position of the rising sun during the present-day winter solstice. The solid circle shows that position around 2000 BC, the approximate date of construction of the monument. The grey dotted arrow represents the path of the south edge of the solar disk. Note that the sun touched the right edge of the mountain at winter solstice. North is to the left.

Table I. Orientations defined in structures of the monumental complex of Castillejo del Bonete.

Structure	Azimuth (°)	Height (°)	Declination (°)	Astronomical Event
Corridor no. 1	235±3	−0.3±0.1	−27±3	Winter solstice sunset
Enclosure no. 4	61±2	1.0±0.1	+23±2	Summer solstice sunrise
Corridor A	269±2	1.0±0.1	−0±2	Equinox sunset
Corridor B	127±3	−0.1±0.2	−28±3	Winter solstice sunrise?
Corridor no. 2	335±2	1.0±0.1	+46±2	-

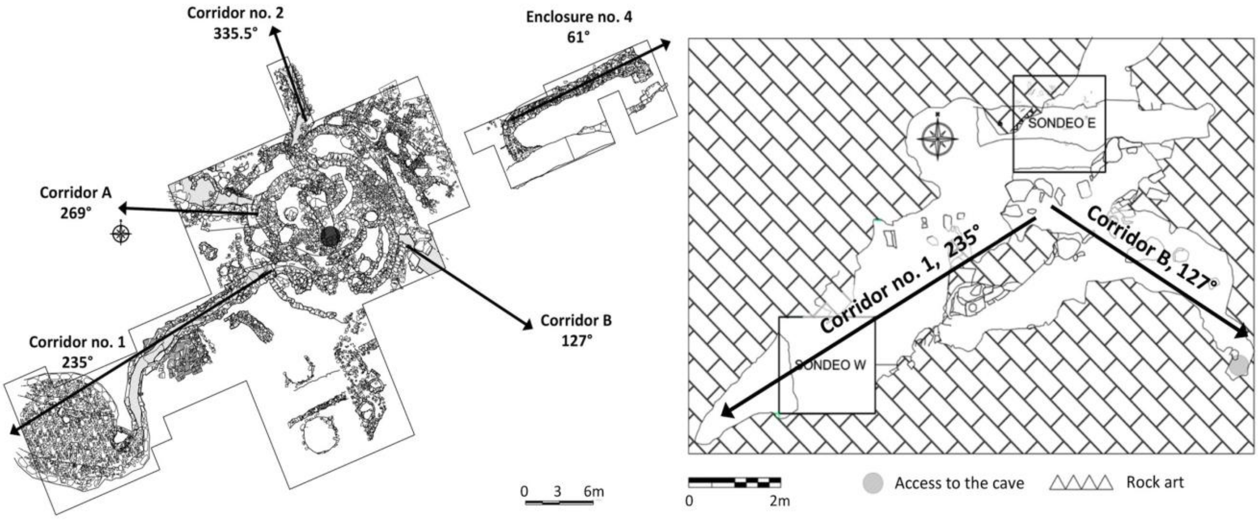

Figure 2. Left: Plan of the megalithic monumental complex of Castillejo del Bonete including the azimuth of the orientations of some of its structures. The black circle at the centre indicates the access to the cave. Right: Plan of the cave located under the tomb. Two of the galleries show the same general orientations than corridors B and no. 1, related to the sunrise and sunset at the winter solstice, respectively. North is up and east to the right. The grey circle at the right edge of the plan of the cave indicates the position of the access to the cave (plans by Enrique Mata and Norberto Palomares).

approaches the winter solstice. During the last days before solstice, the sun almost stops moving only 0.1° in that period touching the southern edge of the mountain just at the solstice (see Figure 1). Afterthat moment, the sun reverses the sense of its movement on the summit, taking another 18 days to abandon completely the flat summit of the mountain. We believe that an observer experienced in counting the days elapsed between the successive passes of the sun between the edges of Peña del Cambrón might have been able to estimate the exact day of the winter solstice. Therefore, this striking coincidence may have been used as a calendrical marker of the winter solstice and/or an indicator of a funerary ritual in that moment of the year.

Besides the analysis of the horizon that surrounds Castillejo del Bonete, we also took bearings of the longest and more linear corridors and tumuli walls, in the sense from the centre out of the main tumulus. The results – included in Table 1 and graphically shown in Figure 2 – are of great interest and suggest an astronomical planning of the monument.

- Corridor no. 1, the longest excavated corridor, has a long rectilinear initial structure that curves linking with tumulus no. 2. The straight part of the corridor seems to point – with an uncertainty of 2°–3° – to the point the horizon where the winter solstice sunset occurs (see Figure 3).
- The north and south walls of Enclosure no. 4 are parallel and oriented similarly to Corridor no. 1 but about 6° apart. The north wall – the best-preserved one – faces the summer solstice sunrise with great precision (uncertainty between 1°–2°).
- The walls of Corridor A are not parallel, the south wall – the longer and best preserved one – is highly rectilinear and is oriented in the east-west line (within an uncertainty of between 1°–2°). Therefore, it could be related to the sunset at the equinoxes or dates close to them.
- Corridor B is rather badly preserved, but its few standing elements are oriented towards the Peña del Cambrón, the point on the horizon where the winter solstice takes place.
- Corridor no. 2 is oriented northerly, about 25° apart from true north (uncertainty between 1°–2°). Changing the sense of the bearing, from the north edge to the corridor to the centre of the main tumulus, we find a curious alignment with a peaked mountain located close to the south: El Yelmo, one of the highest in the mountain range of Segura. It is interesting to comment – but in the field of speculation – that the rising of the stars Rigil Kentaurus (α Cen) and Acrux (α Cru) occurred around that mountain at the time of construction of the monument (2000 BCE). These are the main stars of the constellations of Centaurus and Southern Cross and are among the brightest ones in the southern hemisphere. Today they are no longer visible from the latitude of Castillejo del Bonete due to the precession of the equinoxes.

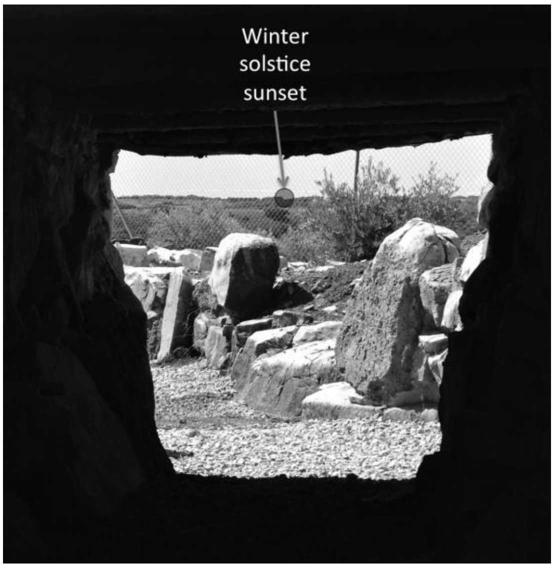

Figure 3. Photo taken from the initial part of Corridor no. 1 and looking to the southwest horizon. The circle represents the position and size of the solar disc at the winter solstice sunset of 2000 BCE. The end of the corridor is no longer aligned with this astronomical event, twisting to bind to the nearby tumulus no. 2.

4. NECROPOLIS OF CERRO ORTEGA

This Bronze Age necropolis – discovered by chance in 1997 (Barrio Aldea and Maquedano Carrasco 2000) – is located at the bottom of a rocky promontory called Cerro Ortega, in Villanueva de la Fuente (Ciudad Real), only about 11 km apart from Castillejo del Bonete. The tombs are artificial cavities carved on the surface of the wall of the promontory. In the absence of measurable structures except the very collapsed openings of the tombs, we simply determined the general orientation of the rock wall and performed the analysis of the horizon.

The perpendicular to the rock wall just at the point where the tombs are placed is facing an azimuth range comprised between 125° and 128° (Figure 4) that projected to the local horizon and considering its height, includes the point where the winter solstice sunrise occurred at 2000 BCE. This sunrise coincides with the most distant peak of the mountain range of Sierra del Relumbrar that can be seen from the necropolis. As we can see in Figure 4, the rock wall varies its orientation along its entire length, but the tombs are excavated precisely in the zone where the entrance of the graves are roughly oriented towards the winter solstice sunrise. We believe that, although this result by itself might be considered casual, the coincidence with the main astronomical target found in Castillejo del Bonete, suggests that perhaps both necropolis share the same tradition, perhaps the same element in the funereal ritual related to the solar cycle.

5. *MOTILLA* OF EL AZUER

This is one of the most representative *motillas* and the most extensively excavated one. We included it in our study in order to explore the archaeoastronomical potential of this kind of sites. It is a fortified mound built between 2200 and 1500 BCE and it has been recently restored (see Figure 4; Benitez de Lugo, 2010). We could not obtain bearings of their structures because all of them present curvilinear geometry without apparent symmetry axes that may define directions. The site is located in an extended plain, with an excellent view of the distant horizon, which is rather poor in remarkable topographic features. The mountains that are seen from the site are not very high and are mostly located, to the southeast – mountain ranges of Sierra de Alhambra and del Cristo – except a small group to the northwest – Sierra de Malagón. The only result of astronomical interest that we have found in this *motilla* is that the winter solstice sunrise occurs on one of the highest peaks of Sierra de Alhambra, located at about 37 km apart (Figure 4). As in the case of Cerro Ortega, the astronomical relationship found in *motilla* of El Azuer is not striking and could also be the result of chance but seems significant because it is consistent with the findings of the other two sites studied in this paper.

6. DISCUSSION AND CONCLUSIONS

The results of our study at Castillejo del Bonete indicate the high archaeoastronomical interest of this megalithic monumental complex. It presents a striking marker of the winter solstice sunrise on the most conspicuous topographical feature of the horizon, Peña del Cambron. Moreover, the astronomical relevance of the site is reinforced by the orientation of different corridors and enclosures of the complex. It is particularly significant that corridors no. 1 and B - as well as two of the main galleries of the cave extending just below the monument - are oriented towards the winter solstice sunset and sunrise, respectively, exactly the same solar event marked by the sunrise on Peña del Cambrón. On the other hand, the results for the necropolis of Cerro Ortega and motilla of El Azuer, although much less striking, point to the same astronomical event, the winter solstice. It seems reasonable to propose that the winter solstice played an important role in the funerary-perhaps also religious - symbolism of the Bronze peoples of La Mancha. It is well known that winter solstice had enormous significance for other cultures in different epochs. This moment of the year marks the time of year when the length of the day begins to increase with respect to the night. It is when the Sun symbolically defeats the darkness of winter, a time of rebirth of nature.

Alignments and markers toward the sunrise or sunset at the winter solstice are rather common in European megalithic structures such as the megalithic complex of Stonehenge (Wiltshire, UK), whose oldest structures date back to around 2500 BCE and has its symmetry axis oriented to the winter solstice sunset, a moment of the year when large multitudinous celebrations were made according to the latest archaeological data collected in the area (Parker Pearson 2012). Another emblematic site is the impressive megalithic tomb of Newgrange (Donore, Ireland, O'Kelly 1982) built between 3300 and 2900 BCE. Its long corridor shows a perfect alignment towards the sunrise at the winter solstice at the time of its construction.

The Iberian Peninsula is very rich in megalithic monuments. There are many different typologies and their chronology range from sixth to third millennia BCE. The orientation of over one thousand megalithic burial monument have been measured (see Hoskin 2001; González-García 2009) and most of them – specially in the west and south of the Peninsula – show orientations in the range of declinations encompassing the rising points of the sun or the moon. However, the presence of astronomical markers in the horizon surrounding Iberian megalithic monuments has been hardly reported in the literature. In the case of dolmens, the only examples of orientations of corridors toward prominent mountains of the landscape are in Los Millares (Almería) and in the huge Dolmen of Menga in Antequera (Málaga, Belmonte and Hoskin 2002: 72, 78). Of these, only in the case of Menga the orientation may have some astronomical relation, in particular with the moonrise at the northern major lunastice (J.A. Belmonte, private communication). As far as we know, the only clear astronomical marker reported in an Iberian megalithic monument is in the cromlech of Oyanleku (Guipuzcoa), which major axis is facing the remarkable profile of Peña de Aya, where the moonrise at northern major lunastice took place at 3000 BCE (Belmonte and Hoskin 2002: 45-46). As we can see, Castillejo del Bonete stands especially relevant because of the presence of an astronomical marker that is undoubtedly related to the sun.

The apparent absence of astronomical markers in Spanish megalithic monuments contrast with that is found in similar sites of the British Isles, where many stone circles and standing stone complexes show markers of singular positions of the Sun and Moon (e.g. Thom 1967, 1971; Ruggles 1999). In our opinion, this has two possible explanations: a) the megalithic people of the Iberian Peninsula where not concerned with astronomical markers, b) the archaeoastronomical studies of Iberian megaliths have been biased on measuring orientations of dolmen corridors and not in the analysis of their horizons. Although this last possibility may be true in the case of most Hoskin's studies - that were dedicated to collect the maximum number of precise bearings of dolmens and megalithic sepulchres across the Mediterranean - this is not generally the case of later studies made, for example by J. A. Belmonte and A. C. González-García, much concerned on the landscape of monuments. The relevant aspect behind the presence of markers or not in a given prehistoric monument is that it gives clues about the importance of the precise place where the monuments were built. The presence of a marker indicates that the site was selected prior to the construction of the monument because its astronomical significance. In the absence of a marker we can argue that the monument was constructed in a precise place because any non-astronomical reason and its astronomical relation was established *a posteriori*. Therefore, it seems that Castillejo del Bonete was built in a place selected by the presence of the striking marker of the winter solstice sunrise and its astronomical significance was further reinforced through the alignment of some of its structures. Most probably, all these astronomical relations where understood as elements that increased the sacred character of the site, linking chthonic and cosmic elements: funereal monuments, caves and celestial bodies. An intricate complex of symbolic elements whose precise meaning still eludes us.

Figure 4. Left: Google Earth satellite image of the necropolis of Cerro Ortega area. The tombs are carved on a rock wall perpendicular to the point where the winter solstice sunrise occurs. The inset image shows the point where the winter solstice occurred in 2000 BCE. Right: Motilla of El Azuer seeing from the east. The arrow indicates the position where the measurements were made. The inset shows the area of the horizon where the rising of the winter solstice occurred in 2000 BCE, on the highest point of the mountain range of Sierra de Alhambra.

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REFERENCES

Aranda, G., Fernández, S., Haro, M., Molina, F., Nájera, T. and Sánchez-Romero, M. (2008) Water control and cereal management on the Bronze Age Iberian Peninsula: la motilla del Azuer. *Oxford Journal of Archaeology*, 27 (3), 241-259.

Barrio Aldea, C. and Maquedano Carrasco, R. (2000) La necrópolis calcolítica de Cerro Ortega (Villanueva de la Fuente). In *El Patrimonio arqueológico de Ciudad Real. Métodos de trabajo y actuaciones recientes*, L. Benítez de Lugo (Ed.), Valdepeñas, UNED, 67-86.

Belmonte, J.A. and Hoskin, M. (2002) *Reflejo del Cosmos. Atlas de arqueoastronomía del Mediterráneo antiguo*. Madrid, Equipo Sirius S.L.

Benítez de Lugo Enrich, L. 2010. *Las motillas y el Bronce de La Mancha*, Valdepeñas, Anthropos.
Benítez de Lugo Enrich, L., *et al.* (2014a) Aportaciones hidrogeológicas al estudio arqueológico de los orígenes de la Edad del Bronce de La Mancha: la cueva monumentalizada de Castillejo del Bonete (Terrinches, Ciudad Real, España). *Trabajos de Prehistoria*, 71 (1), 76-94.
Benítez de Lugo Enrich, L., *et al.* (2014b) Castillejo del Bonete (Terrinches, Ciudad Real)**:** complejo tumular prehistórico de la Cultura de las Motillas en el Alto Guadalquivir. *Menga, Revista de Prehistoria de Andalucía*, 5, 151-174.
Esteban, C. and Moret, S. (2006) Ciclos de tiempo en la cultura ibérica: La orientación astronómica en el templo del Tossal de Sant Miquel de Llíria. *Trabajos de Prehistoria*, Vol. 63, no. 1, 167–178.
González-García, A.C. (2009) Statistical Analysis of Iberian Peninsula Megaliths Orientations. In *Cosmology Across Cultures*, J.A. Rubiño-Martín, J.A. Belmonte, F. Prada and A. Alberdi (eds.), ASP Conference Series, 409, 354-358.
Hoskin, M. (2001) *Tombs, temples and their orientations*. Bognor Regis, Ocarina Books.
Magny, M., Vannière, B., Zanchetta, G., Fouache, E., Touchais, G., Petrika, L., Coussot, C., Walter-Simonnet, A.V. and Arnaud, F. (2009) Possible complexity of the climatic event around 4300-3800 cal. BP in the central and western Mediterranean. *The Holocene*, 19, 823-833.
Mejías Moreno, M., Benítez de Lugo, L., López-Sáez, J.A. and Esteban, C. (2015) *Arqueología, Hidrogeología y Medio Ambiente en la Edad del Bronce de La Mancha: la Cultura de las Motillas*. Madrid, Instituto Geológico y Minero de España.
Molina, F., Nájera, T., Aranda, G., Sánchez, M. and Haro, M. (2005) Recent fieldwork at the Bronze Age fortified site of Motilla del Azuer (Daimiel, Spain). *Antiquity*, 79 (306), 223-235.
O'Kelly, M. J. (1982) *Newgrange: Archaeology, Art and Legend*, London, Thames and Hudson.
Parker Pearson, M. (2012) *Stonehenge: Exploring the Greatest Stone Age Mistery*. London & New York, Simon & Schuster.
Ruggles, C. (1999) *Astronomy in Prehistoric Britain and Ireland*. New Haven and London, Yale University Press.
Thom, A. (1967) *Megalithic Sites in Britain*. Oxford, Oxford University Press.
Thom, A. (1971) *Megalithic Lunar Observatories*. Oxford, Oxford University Press.