Seven-stone antas, Portugal and Spain

Juan Belmonte, Luís Tirapicos and Clive Ruggles[1]

1. Identification of the property

1.a Country/State Party: Portugal; Spain

1.b State/Province/Region:

Alandroal, Arraiolos, Estremoz, Évora, Mora, Reguengos de Monsaraz, and Redondo municipalities, **Évora district,** central Alentejo region, Portugal

Castelo de Vide, Crato, Elvas, Nisa, and Ponte de Sor municipalities, **Portalegre district**, central Alentejo region, Portugal

Ourique municipality, **Beja district**, Baixo Alentejo region, Portugal

Santiago do Cacém municipality, **Setúbal district**, Baixo Alentejo region, Portugal

Agualva, Loures, and Sintra municipalities, **Lisboa district**, Grande Lisboa region, Portugal

Barcarrota, Jerez de los Caballeros and Mérida municipalities, **Badajoz province**, Extremadura region, Spain

Cedillo and Valencia de Alcántara municipalities, **Cáceres province**, Extremadura region, Spain

Aroche and Rosal de la Frontera municipalities, **Huelva province**, Andalusia region, Spain

1.c Name: 186 individual names as listed in Table 3.1 below.

1.d Location:

The seven-stone antas identified in Table 3.1 occupy 186 separate locations concentrated in the central Alentejo region, Portugal, and the provinces of Badajoz and Cáceres, Extremadura region, Spain. Their latitudes vary from 37.8º to 39.6° N, their longitudes vary from 8.2° to 7.0° W, and their elevations range from c. 200m to 580m above mean sea level.

The Portuguese sites are mostly located within the limits of the Évora and Portalegre districts, an area to the south and west of Elvas, close to the Spanish frontier, and just below the latitude of Lisbon.

1.e Maps and Plans:

See Figs 3.1 and 3.2.

1.f Area of the property:

Seven-stone antas are distributed over an area approximately 100km east to west, from about 50km from the coast near Lisbon to the Spanish border provinces, and a little over 200km from south to north, from Ourique to the River Tejo (Fig. 3.1).

[1] JB wishes to express his gratitude to Juan Pedro Hilanderas, Concejal de Cultura of the Valencia de Alcántara municipality for his support in locating the necessary documentation to produce this report and to Margarita Sanz de Lara for her photographs. On the Portuguese side, LT wishes to thank Cândido Marciano da Silva and Leonor Rocha for sharing their thoughts and an unpublished manuscript on the topics addressed in this report.

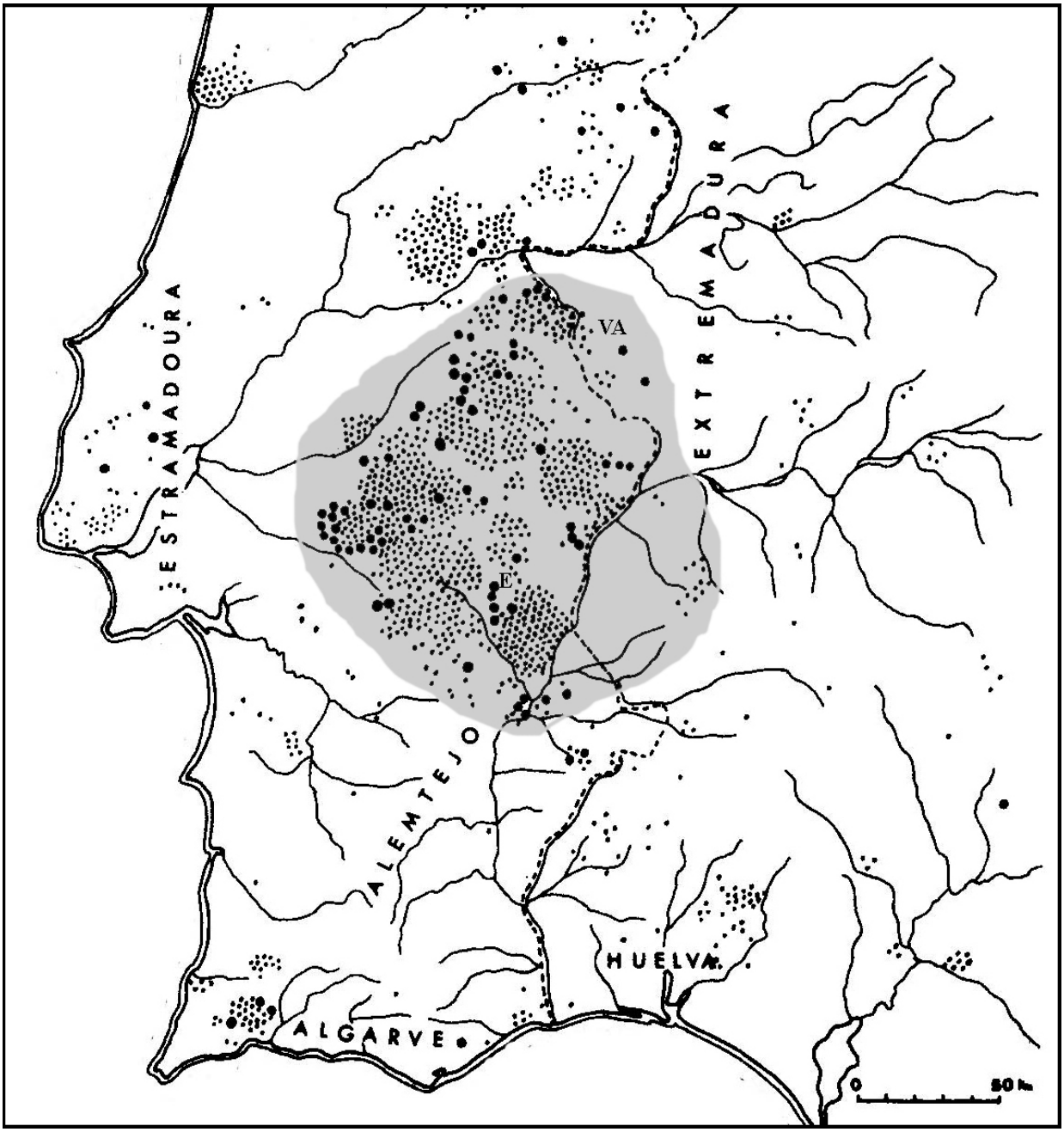

Fig. 3.1. The neighbouring regions of Alentejo (Portugal) and Extremadura (Spain) where seven stone antas can be found. The vast majority are in Portugal (notice the huge concentration around Évora, E in the map), hence the common name of *Antas Alentejanas* by which they are also known. The Spanish town of Valencia de Alcántara (VA) is also shown on the map. Adapted from Belmonte and Hoskin (2002), fig. 2

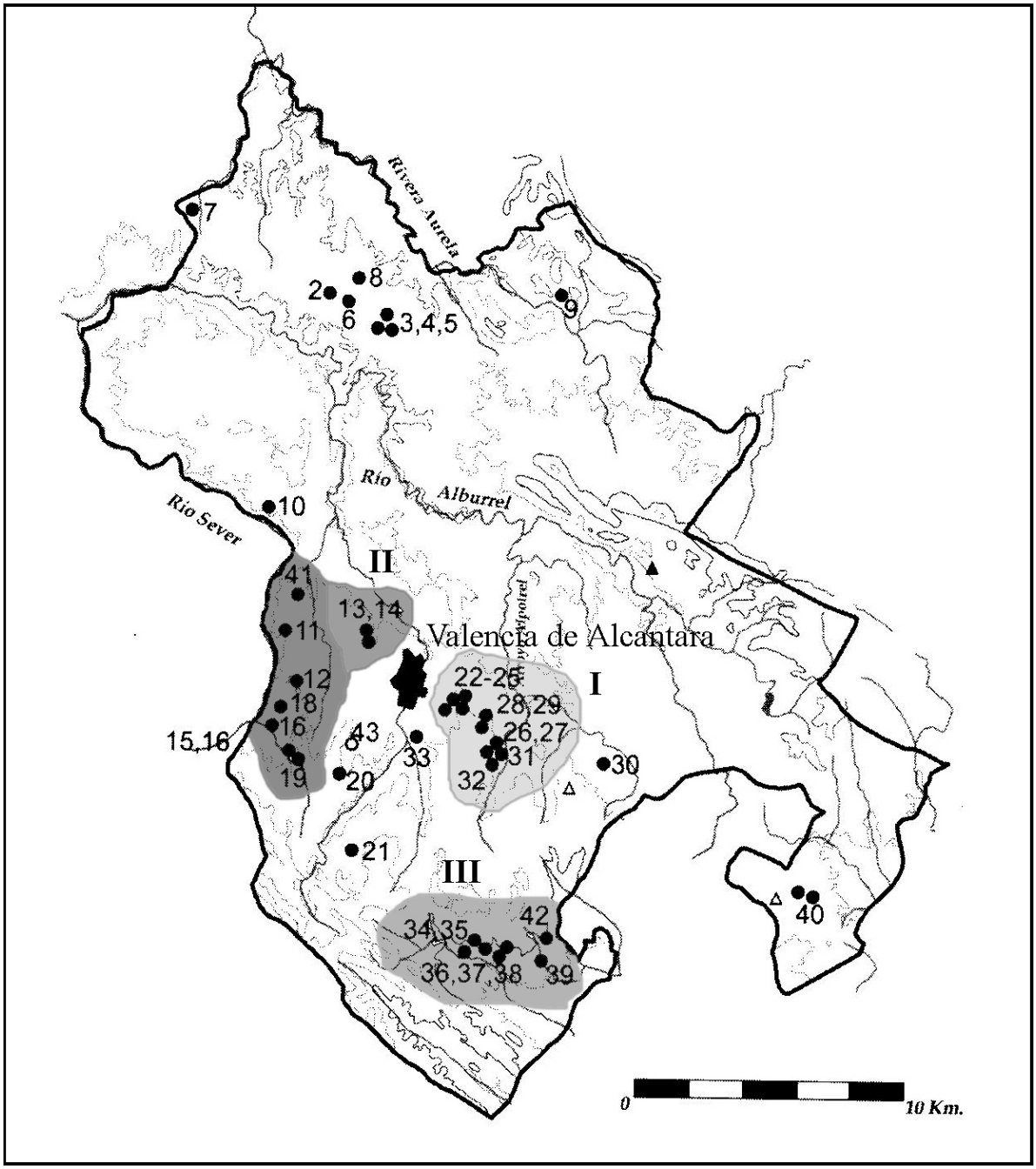

Fig. 3.2. Map of the Valencia de Alcántara municipality showing the areas discussed below where well-preserved groups of seven-stone antas, conforming to the 'standard' design and orientation pattern, are located. These are (I) Collados de Barbón, (II) Río Sever banks and (III) the granite outcrop of Santa María de la Cabeza (in light, dark and middle tone grey respectively). Dolmens 2 to 9 were built of schist and poorly preserved. The river Sever forms the frontier between Spain and Portugal. A handful of antas can be found on its west (Portuguese) bank. For details see Table 3.2. After Bueno Ramírez and Vázquez Cuesta (2008)

2. Description

2.a Description of the property

General description

The seven-stone antas are a distinctive form of megalithic tomb. The 177 examples whose principal orientation has been reliably determined all, without exception, face within the arc of sunrise—the part of the horizon where the sun rises at some time during the year (or moonrise) (see Fig. 3.7). The extraordinary consistency in an orientation pattern that extends over hundreds of kilometres provides an exceptionally clear indication of its astronomical origin.

They were built over a wide area extending over the present-day regions of Alentejo in Portugal, where most of the antas are located, and Extremadura in Spain (see Fig. 3.1). The main concentrations of sites within the group, including the best preserved and some of the most impressive monuments, are around the towns of Évora (Portugal) and Valencia de Alcántara (Spain).

The name *anta* is the Portuguese term for dolmen and will be loosely used as a synonym throughout this case study, although the Spanish counterparts are normally denoted as dolmens in the corresponding archaeological or tourist literature.

The seven-stone antas can easily be described as standard corridor dolmens but their most impressive features are that

(i) they were constructed using a surprisingly consistent architectural design (see Figs 3.3, 3.4, 3.5) over an extended period of time (hence their common name); and

(ii) they manifest a pattern of orientations that place them among the oldest monuments on Earth with indisputable astronomical orientations.

Fig. 3.3. Tapias 1 (no. 143 in Table 3.1), a good example of a seven-stone anta, well preserved, in the vicinity of Valencia de Alcántara. Spain. Photograph courtesy of Margarita Sanz de Lara

Form and construction

The seven-stone antas (dolmens) were mostly constructed using tall blocks of granite, typically 3m or more in height. In some areas to the north the builders used smaller blocks of schist but as a result these examples are mostly in a poor state of preservation. Seven-stone antas are distinguished from other megalithic tombs found in the same and neighbouring regions by two factors. The first is the presence of a passage—shorter or longer depending on the date of construction: the seven-stone antas are thought to have been constructed from c. 4000 BC onwards, with longer corridors appearing around 3200 BC.

The second factor is their distinctive method of construction. This involved erecting a backstone and then leaning three uprights in succession on each side so as to form a chamber typically some 4m to 5m in diameter with a clearly defined entrance to which a passage of smaller orthostats was attached (see Fig. 3.4). In very few cases, an eighth orthostat, acting as a sort of front stone, has been preserved; it is unknown if this component was more frequent than the present state of preservation of many monuments may indicate (see Fig. 3.5). In any case, the dominant feature is the seven-orthostat chamber, as the name suggests.

Among the Alentejo antas are a few exceptional monuments, in particular the Anta Grande do Zambujeiro, a huge dolmen with a chamber 6m high and orthostats measuring nearly 8m. Another is the complex monument at Olival da Pega 2 (Reguengos de Monsaraz), excavated by Victor S. Goncalves in the 1990s, where a corridor 16m long was found. The excavations here demonstrated various reutilizations and structures added at different times.

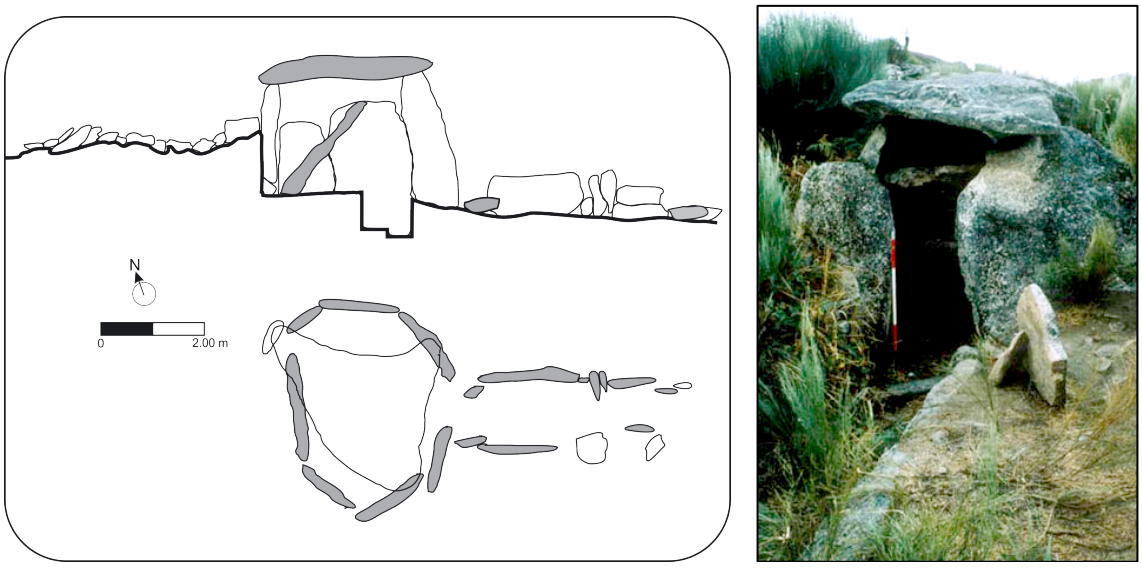

Fig. 3.4. Huerta de las Monjas (no. 3 in Table 3.1), a typical long-corridor seven-stone anta on the eastern bank of the river Sever. Plan (left) adapted from Bueno Ramírez (1988). Photograph (right) courtesy of Margarita Sanz de Lara.

Fig. 3.5. Anta de la Marquesa, also known as Mellizo (no. 101 in Table 3.1), a good example of a short-corridor seven-stone anta with the addition of an eighth orthostat blocking the corridor. Photograph © Clive Ruggles

Landscape

Most of the region in which the seven-stone antas are found comprises low hills with scattered granite outcrops, the latter being where the quarries are usually located. However, to the north-east, in the Spanish sector and on the Portuguese side close to the border, the terrain is scarped by small mountain ranges and large granite outcrops (see Fig. 3.6).

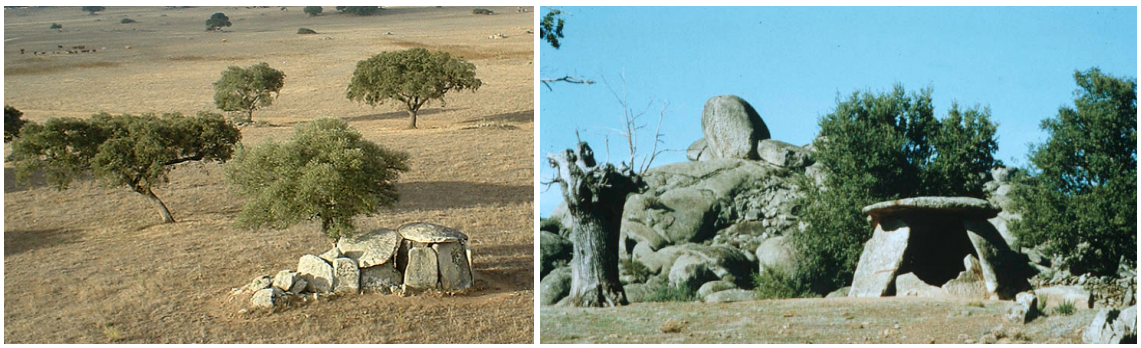

Fig. 3.6. The typical landscapes where seven-stone antas can be found: the plains of central Alentejo (left) and the granite outcrops of the north-east (right), including the Spanish sector close to Valencia de Alcántara. Photographs © Luís Tirapicos (left) and Juan Belmonte (right)

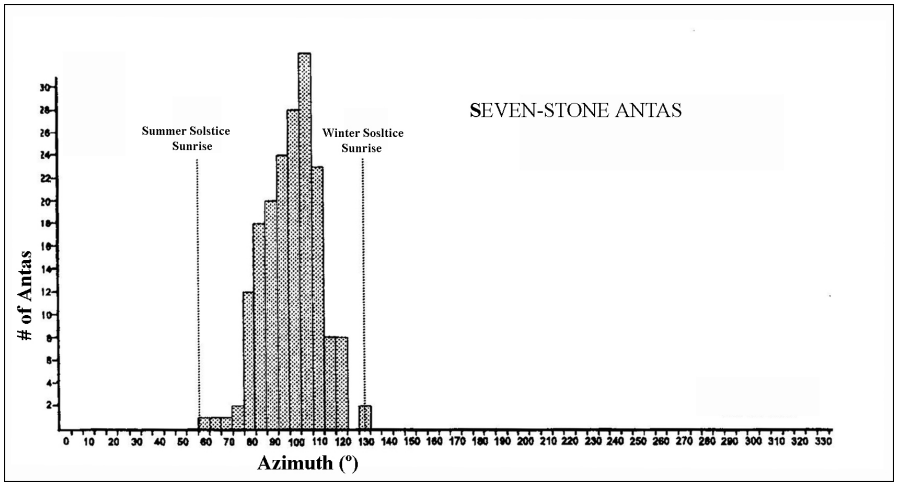

Fig. 3.7. Orientation histogram of 177 seven-stone antas as obtained by Hoskin and collaborators after several years of fieldwork in the region. How every single monument fits within the sector of sunrise (or moonrise) is clearly illustrated. The strength of this evidence makes the seven-stone antas the oldest group of monuments for which there is incontrovertible proof of their connection to astronomy. Adapted from Hoskin 2001, p. 98.

Orientation

The orientation of each of these monuments can be determined (according to the state of preservation) either from the alignment of the stones forming the corridor or from the direction perpendicular to the backstone, or both. All of them point towards the eastern half of the horizon, within about 25° of due east. Such a strong consistency in orientation could not have been achieved using topographic referents such as conspicuous distant mountain peaks: the Alentejo region, in particular, is a very flat area. This implies that the target used to determine the orientations was a celestial object.

The range of the 177 measured orientations corresponds almost exactly to the range of possible rising positions of the sun. In other words, every tomb in the group without exception is oriented within the arc of sunrise, corresponding to about one sixth of the available horizon (Figs. 3.7, 3.8). In almost all cases the orientations fall between azimuths of 61° (29° north of east) and 122° (32° south of east); there are two exceptions, which are oriented more towards the south (azimuth 128°–129°), but these are within a deep valley with a higher eastern horizon, and so still face sunrise. This remarkable statistic provides the strongest possible indication of an association between these tombs and the sun. If the tombs were oriented to face sunrise on the day when construction began, then the distribution of azimuths would suggest that this took place predominantly in the spring or autumn, but the fact that orientations span the entire solar rising range implies that in some cases construction was commenced in the middle of summer or winter. The ‘exactness of fit’ between the range of tomb orientations and the arc of sunrise suggests that the tombs were aligned with a precision of about 1–2 degrees (2–4 solar diameters). This is indeed the easiest explanation applying Ockham´s Razor.

It is possible to argue that the moon rather than the sun was used to determined the orientations, since any possible solar orientation can also be interpreted as a lunar one (the lunar rising arc on the horizon being somewhat wider than the solar one). In 2004, using the data collected by Hoskin and collaborators, Cândido Marciano da Silva proposed a new interpretation explaining the orientations of the antas. According to da Silva’s statistical analysis the entrance of seven-stone antas of Alentejo, and neighbouring regions, may have been oriented to the full moon rise near the vernal equinox – when the positions of the rising sun and

moon “cross-over” on the horizon. This idea can be further supported by historical and ethnographical sources. It must be emphasized, however, that the solar explanation fits the observed orientation data closely and simply, and the fact that scientific debate continues about the precise nature of the astronomical target does not in any way cast doubt upon the assuredly astronomical character of the alignments of the seven-stone antas.

Inventory

Table 3.1 lists the 177 seven-stone antas listed by Hoskin (2001, Table 6.2), for 173 of which measured orientations were obtained by Hoskin (2001), together with an additional 9 sites in the Valencia de Alcántara area identified more recently. The sites are ordered by their direction of orientation (azimuth). Where necessary, the name has been corrected from that provided by Hoskin. The latitude and longitude is given correct to the nearest 1" (approx. 25m) where available (sources C, D, R as below); otherwise the latitude is given to the nearest 0.1° (approx. 150m) as provided by Hoskin (H). Azimuth, altitude and orientation data are also taken from Hoskin’s table; T under azimuth indicates that, although the exact orientation was unmeasurable, this dolmen faced a "typical direction" (i.e., in the solar rising range) according to Hoskin (2001: 232).

Table 3.1. List of seven-stone antas.

Column headings
No. = Reference number in this case study
N4 = Number shown in Fig 3.2
Group = Group as shown in Fig. 3.2
Dist/Prov = District [Portugal] or Province [Spain]
Lat = Latitude (N) in degrees to the nearest 0.1°, supplied where more accurate information unavailable
Lat N = Latitude (N) in deg/min/sec, to the nearest second
Long W = Longitude (W) in deg/min/sec, to the nearest second
S = Source for co-ordinate information (see key below)
az = (true) azimuth in degrees
alt = horizon altitude in the direction of orientation, in degrees
dec = astronomical declination in the direction of orientation, in degrees

Sources for co-ordinate information
B = Juan Belmonte
C = Calado 2004, converted from Coordenadas Militares (Lisbon datum)
D = de Oliveira 1997 and/or Google Earth
H = Hoskin 2001, Table 6.2
R = Clive Ruggles, hand-held GPS, 2005

No.	N4	Name	Group	Municipalty	Dist/Prov	Country	Lat	Lat N			Long W			S	az	alt	dec
1		Dehesa Bollai 1		Jerez de los Caballeros	Badajoz	Spain	38.3							H	61	1	+23
2		Contada		Elvas	Portalegre	Portugal		38	57	57	7	18	46	D	64	1	+20½
3	17	Huerta de las Monjas	Río Sever banks	Valencia de Alcántara	Cáceres	Spain		39	24	18	7	18	8	B	70	4	+18
4	13	Lanchas 1	Río Sever banks	Valencia de Alcántara	Cáceres	Spain		39	25	19	7	15	57	R	76	0	+10½
5		Gonçala 2		Mora	Évora	Portugal		38	56	40	8	0	27	C	77	0½	+10
6		Remendo 1		Mora	Évora	Portugal		38	53	17	7	58	51	C	79	1	+9
7		Pero d'Alba		Castelo de Vide	Portalegre	Portugal		39	28	13	7	27	10	D	79	2½	+10
8	35	Datas 1	Santa María	Valencia de Alcántara	Cáceres	Spain		39	19	57	7	13	36	R	81	3½	+9
9		Sobral		Castelo de Vide	Portalegre	Portugal		39	24	1	7	29	26	R	81	6½	+11
10		Coureilos 3		Castelo de Vide	Portalegre	Portugal		39	26	40	7	28	11	R	81	0½	+7
11		Pedra d'Anta		Ourique	Beja	Portugal	37.8							H	82	0	+6
12		Caeira 3		Mora	Évora	Portugal		38	53	5	7	57	13	C	82	0	+6
13	15	Tapada del Anta 1	Río Sever banks	Valencia de Alcántara	Cáceres	Spain		39	23	48	7	18	1	B	82	2	+7½
14		Herdade do Duque		Reguengos de Monsaraz	Évora	Portugal		38	27	6	7	26	26	C	82	0	+6
15		Patalim		Évora	Évora	Portugal		38	37	12	8	4	32	C	82	0	+6
16		Coureilos 2		Castelo de Vide	Portalegre	Portugal		39	26	39	7	28	12	R	82	0	+6
17		Torrão 1		Elvas	Portalegre	Portugal		38	58	30	7	16	17	D	82	–0½	+5½
18		Coureilos 4		Castelo de Vide	Portalegre	Portugal		39	26	42	7	28	19	R	82	0	+8
19		Caeira 4		Mora	Évora	Portugal		38	53	3	7	57	9	C	83	0	+5
20		Cré 1		Mora	Évora	Portugal		38	51	51	7	58	15	C	83	3	+5½
21	39	La Morera	Santa María	Valencia de Alcántara	Cáceres	Spain		39	19	2	7	11	17	B	83	0	+5
22		Olival do Monte Velho		Elvas	Portalegre	Portugal	39.0							H	84	3	+6½
23		Silval		Évora	Évora	Portugal		38	40	59	8	2	27	C	84	0	+4½
24		Coureilos 1		Castelo de Vide	Portalegre	Portugal		39	26	35	7	28	12	R	84	0	+4½
25		Paredes		Évora	Évora	Portugal		38	39	46	8	2	21	C	84	1	+5
26		Defesinhas 1		Elvas	Portalegre	Portugal		38	47	10	7	10	23	D	84	0	+4½
27		Cré 2		Mora	Évora	Portugal		38	52	5	7	58	23	C	85	0½	+4

No.	N4	Name	Group	Municipalty	Dist/Prov	Country	Lat	Lat N			Long W			S	az	alt	dec
28		Bota 1		Évora	Évora	Portugal		38	29	54	7	54	36	C	85	0	+3½
29		Camino de los Bombonas		Barcarrota	Badajoz	Spain	38.5							H	86	2	+4
30		Hermosina		Barcarrota	Badajoz	Spain	38.5							H	86	2	+4
31		Currais do Galhordas		Castelo de Vide	Portalegre	Portugal		39	27	49	7	32	34	D	86	2½	+4½
32	23	Zafra 2	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	24	21	7	13	16	R	86	0	+2½
33	29	Tapias 2	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	24	15	7	12	36	B	86	5	+6
34		Claros Montes 1		Arraiolos	Évora	Portugal		38	53	21	7	54	40	C	86	1½	+4
35		Dehesa de la Muela		Mérida	Badajoz	Spain	39.1							H	87	1	+2½
36		Caeira 1		Mora	Évora	Portugal		38	52	33	7	56	57	C	88	–0½	+1
37	20	La Barca		Valencia de Alcántara	Cáceres	Spain		39	23	28	7	16	4	B	88	0½	+1½
38		Pinheiro do Campo 1		Évora	Évora	Portugal		38	36	9	8	5	13	C	88	1	+2
39	31	Huerta Nueva	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	23	39	7	11	53	B	89	0½	+1
40	19	(La) Miera	Río Sever banks	Valencia de Alcántara	Cáceres	Spain		39	23	37	7	17	46	B	89	4	+3
41		Freixo de Cima 1		Évora	Évora	Portugal		38	24	39	7	51	18	C	89	0½	+1
42		Pavia		Mora	Évora	Portugal		38	53	39	8	1	2	D	89	0	+0½
43		Gonçala 6		Mora	Évora	Portugal	38.9							H	89	4	+3
44		Figueirinha 2		Mora	Évora	Portugal		38	56	47	8	0	12	C	90	1½	+0½
45		Portela		Mora	Évora	Portugal	38.9							H	90	0½	+0½
46		Farisoa 4		Reguengos de Monsaraz	Évora	Portugal	38.4							H	91	0	–1
47		Cabeção		Mora	Évora	Portugal	38.9							H	91	0	–1
48		Entreáguas		Estremoz	Évora	Portugal		38	47	7	7	37	53	C	91	1½	0
49		Aldeia da Mata		Crato	Portalegre	Portugal		39	18	3	7	42	39	D	91	0	–1
50		São Lourenço 1		Crato	Portalegre	Portugal	39.2							H	91	0	–1
51		Rana		Barcarrota	Badajoz	Spain	38.5							H	91	1	–0½
52		Tapadões		Crato	Portalegre	Portugal	39.2							H	91	0	–1
53		Pombal		Castelo de Vide	Portalegre	Portugal		39	26	19	7	27	25	D	92	3	0
54		Torre das Águias 1		Mora	Évora	Portugal		38	52	18	8	6	52	C	92	1	–1

No.	N4	Name	Group	Municipalty	Dist/Prov	Country	Lat	Lat N			Long W			S	az	alt	dec
55		Pasada del Abad		Rosal de la Frontera	Huelva	Spain	38.0							H	93	1	–2
56		Herdade da Anta		Évora	Évora	Portugal	38.6							H	93	1	–2
57		Cré 3		Mora	Évora	Portugal		38	52	4	7	58	42	C	93	1	–2
58	24	Zafra 3	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	24	4	7	13	18	B	93	4	0
59		Monte dos Frades		Elvas	Portalegre	Portugal	39.0							H	93	–0½	–3
60		Aguiar		Évora	Évora	Portugal	38.6							H	94	0½	–3
61		Torre das Águias 2		Mora	Évora	Portugal		38	52	27	8	6	53	C	94	1½	–2½
62		Adua 1		Mora	Évora	Portugal		38	54	18	8	1	33	C	94	0	–3½
63		Caeira 2		Mora	Évora	Portugal		38	53	31	7	56	55	C	94	0½	–3
64		Sauza 4		Évora	Évora	Portugal	38.6							H	94	0½	–4½
65		Tajeno		Barcarrota	Badajoz	Spain	38.5							H	95	2½	–1
66		Serrinha		Crato	Portalegre	Portugal	39.0							H	95	2	–3
67		Vale d'Anta		Redondo	Évora	Portugal	38.6							H	95	0	–4½
68	25	Zafra 4	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	23	59	7	13	16	B	95	5	–1
69		Claros Montes 2		Arraiolos	Évora	Portugal		38	53	30	7	54	58	C	95	2	–3
70		Cebolinhos 3		Reguengos de Monsaraz	Évora	Portugal		38	23	27	7	29	10	C	95	0	–4½
71		Gonçala 1		Mora	Évora	Portugal		38	56	23	8	1	2	C	95	0	–4½
72		Bota 2		Évora	Évora	Portugal		38	30	11	7	54	37	C	95	0	–4½
73		Colmeeiro		Redondo	Évora	Portugal		38	41	32	7	38	9	C	96	0½	–4½
74		Alcalaboza		Aroche	Huelva	Spain	37.9							B	96	4	–2½
75		San Blas		Barcarrota	Badajoz	Spain	38.5							B	96	2	–3½
76		Cabeças		Évora	Évora	Portugal		38	40	59	7	53	46	C	96	–0½	–5½
77		Vale Carneiro 1		Reguengos de Monsaraz	Évora	Portugal		38	23	12	7	27	57	C	98	–0½	–7
78		Sardinha		Elvas	Portalegre	Portugal	38.8							H	98	1	–6
79		Sauza 3		Évora	Évora	Portugal	38.6							H	98	1	–6
80		Paço 1		Redondo	Évora	Portugal		38	46	13	8	13	31	C	98	0½	–6
81		Monte Abraão		Sintra	Lisboa	Portugal	38.8							H	98	0	–6½

No.	N4	Name	Group	Municipalty	Dist/Prov	Country	Lat	Lat N			Long W			S	az	alt	dec
82		Olheiros		Castelo de Vide	Portalegre	Portugal		39	28	34	7	27	17	D	99	10½	0
83		Zambujalinho		Évora	Évora	Portugal		38	40	18	7	46	6	C	99	–0½	–8
84	14	Lanchas 2	Río Sever banks	Valencia de Alcántara	Cáceres	Spain		39	25	23	7	16	4	B	100	5	–4½
85		Gonçala 4		Mora	Évora	Portugal		38	56	26	8	1	10	C	100	0½	–8
86		Vale de Moura 1		Évora	Évora	Portugal		38	31	39	7	51	32	C	100	1	–7½
87	37	Cajirón 1	Santa María	Valencia de Alcántara	Cáceres	Spain		39	19	37	7	12	32	B	100	0½	–7½
88		Silveira		Redondo	Évora	Portugal		38	40	32	7	31	8	C	100	1	–7½
89		Lapita		Barcarrota	Badajoz	Spain	38.5							H	101	1½	–8
90		Paço das Vinhas		Évora	Évora	Portugal		38	37	24	7	52	43	C	101	0	–9
91		Horta do Zambujeiro		Redondo	Évora	Portugal		38	37	51	7	35	5	C	101	0½	–8½
92		Monte Ruivo		Elvas	Portalegre	Portugal	38.8							H	101	0	–9
93		Gáfete 1		Crato	Portalegre	Portugal	39.4							H	101	0	–9
94	38	Cajirón 2	Santa María	Valencia de Alcántara	Cáceres	Spain		39	19	46	7	12	20	B	101	5½	–5
95	22	Zafra 1	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	24	21	7	13	28	B	101	6½	–4½
96		Anta Grande dos Antões		Mora	Évora	Portugal		38	54	31	8	0	31	C	101	0½	–8½
97		Cebolinhos 2		Reguengos de Monsaraz	Évora	Portugal		38	23	27	7	29	3	C	101	0	–9
98		Pão Mole		Alandroal	Évora	Portugal		38	41	57	7	18	43	C	102	4	–7
99		Candeeira		Redondo	Évora	Portugal		38	42	16	7	33	11	C	102	1	–9
100		Torre das Arcas 1		Elvas	Portalegre	Portugal		38	51	50	7	13	4	D	102	–0½	–10
101	34	Anta de la Marquesa	Santa María	Valencia de Alcántara	Cáceres	Spain		39	19	47	7	13	8	B	102	0	–9½
102		Gáfete 2		Crato	Portalegre	Portugal	39.4							H	102	0	–9½
103		Lacara		Mérida	Badajoz	Spain	39.0							H	102	0	–9½
104		Casas do Canal		Estremoz	Évora	Portugal		38	46	18	7	36	23	C	103	2	–9
105		Farisoa 1		Reguengos de Monsaraz	Évora	Portugal		38	23	2	7	31	51	C	103	–0½	–11
106		Azaruja 2		Évora	Évora	Portugal	38.6							H	103	1	–9½
107		Azaruja 1		Évora	Évora	Portugal	38.6							H	103	0	–10½
108		Gorginos 3		Reguengos de Monsaraz	Évora	Portugal	38.4							H	103	0	–10½

No.	N4	Name	Group	Municipalty	Dist/Prov	Country	Lat	Lat N			Long W			S	az	alt	dec
109		Barrosinha 1		Évora	Évora	Portugal		38	37	55	7	46	32	C	103	0	–10½
110		Olival da Pega 2		Reguengos de Monsaraz	Évora	Portugal		38	27	6	7	23	56	R	103	2½	–8½
111		Bernardo		Ponte de Sor	Portalegre	Portugal	39.3							H	104	0½	–11
112		Anta do Crato		Crato	Portalegre	Portugal	39.3							H	104	2½	–9½
113		Anta Grande do Zambujeiro		Évora	Évora	Portugal		38	32	21	8	0	52	D	104	0½	–11
114		Monte Novo 2		Reguengos de Monsaraz	Évora	Portugal		38	23	36	7	31	46	C	104	0	–11½
115		Anta Grande, Olival da Pega		Reguengos de Monsaraz	Évora	Portugal		38	27	5	7	24	4	R	104	3	9
116		Freixo de Cima 2		Évora	Évora	Portugal		38	24	49	7	51	23	C	104	0½	–11
117		São Gens		Nisa	Portalegre	Portugal		39	27	0	7	40	30	D	104	1	–10½
118		Farisoa 5		Reguengos de Monsaraz	Évora	Portugal		38	23	24	7	31	59	C	104	0	–11½
119		Dom Miguel		Elvas	Portalegre	Portugal		38	59	19	7	19	48	D	104	2	–9½
120	11	Fragoso	Río Sever banks	Valencia de Alcántara	Cáceres	Spain		39	26	23	7	18	0	B	105	3½	–9½
121		São Rafael 1		Elvas	Portalegre	Portugal	38.8							H	105	1	–11½
122		Farisoa 2		Reguengos de Monsaraz	Évora	Portugal		38	23	10	7	31	59	C	105	0	–12
123		Matanga		Ponte de Sor	Portalegre	Portugal	39.3							H	105	–0½	–12½
124		Sauza 1		Évora	Évora	Portugal	38.6							H	105	1	–11½
125		Milano		Barcarrota	Badajoz	Spain	38.5							H	105	6	–8
126		Monte das Oliveiras		Mora	Évora	Portugal	38.9							H	105	1	–11
127		Pau		Évora	Évora	Portugal		38	38	23	7	46	44	C	106	–0½	–13
128		Santa Luzia		Alandroal	Évora	Portugal		38	35	32	7	18	50	C	106	0½	–12½
129	36	Datas 2	Santa María	Valencia de Alcántara	Cáceres	Spain		39	20	2	7	13	37	R	106	5½	–9
130		Briços		Mora	Évora	Portugal		38	52	11	8	5	53	C	106	1½	–11½
131		Cebolinhos 1		Reguengos de Monsaraz	Évora	Portugal	38.4							H	106	0	–13
132		Vidigueiras 2		Reguengos de Monsaraz	Évora	Portugal		38	23	9	7	30	20	C	106	0	–13
133		Galvães		Alandroal	Évora	Portugal	38.7							H	107	2½	–11½

No.	N4	Name	Group	Municipalty	Dist/Prov	Country	Lat	Lat N			Long W			S	az	alt	dec
134		Sauza 2		Évora	Évora	Portugal	38.6							H	107	0½	–13
135		Gonçala 3		Mora	Évora	Portugal		38	56	38	8	0	32	C	108	1	–13½
136		Pedra Branca		Santiago do Cacém	Setúbal	Portugal	38.1							H	108	1	–13½
137		Defesinhas 2		Elvas	Portalegre	Portugal	38.8							H	108	0	–14½
138	—	Sobral		Elvas	Portalegre	Portugal		38	40	15	7	55	43	C	108	0	–14½
139		Pombal 5		Elvas	Portalegre	Portugal	38.9							H	109	1	–14½
140		Azinheiras		Évora	Évora	Portugal		38	32	20	7	52	59	C	109	–0½	–15½
141		Paço 1		Reguengos de Monsaraz	Évora	Portugal		38	23	54	7	27	47	C	109	1	–14½
142		Pena Clara 1		Elvas	Portalegre	Portugal	38.9							H	109	0	–15
143	28	Tapias 1	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	24	15	7	12	41	B	110	2	–14
144		Lapeira		Mora	Évora	Portugal		38	53	22	8	0	41	C	110	0	–16
145		Gonçala 5		Mora	Évora	Portugal	38.9							H	110	1	–15
146		Carrascal		Agualva	Lisboa	Portugal	38.8							H	110	1	–15
147		Vale de Rodrigo 3		Évora	Évora	Portugal		38	30	9	8	3	46	C	110	0	–16
148		Forte das Botas		Elvas	Portalegre	Portugal	38.8							H	111	1½	–15½
149		Conto do Zé Godinho		Castelo de Vide	Portalegre	Portugal		39	28	52	7	31	0	R	111	2	–15
150		Quinta das Longas		Elvas	Portalegre	Portugal	38.9							H	111	0	–16½
151		Carcavelos		Loures	Lisboa	Portugal	38.9							H	111	2	–15
152		Monte dos Negros		Elvas	Portalegre	Portugal	38.9							H	112	0	–17½
153		Palacio		Barcarrota	Badajoz	Spain	38.5							H	112	4½	–14
154		Vale de Moura 2		Évora	Évora	Portugal		38	31	7	7	50	53	C	112	0	–17½
155		Vale de Rodrigo 2		Évora	Évora	Portugal		38	29	44	8	3	35	C	112	0	–17½
156		Hospital		Redondo	Évora	Portugal		38	39	43	7	36	3	C	113	0½	–18
157		Farisoa 7		Reguengos de Monsaraz	Évora	Portugal		38	23	11	7	31	31	C	113	0	–18
158		Gorginos 1		Reguengos de Monsaraz	Évora	Portugal		38	24	19	7	30	38	C	113	0	–18
159		São Rafael 2		Elvas	Portalegre	Portugal	38.8							H	114	0	–19
160	18	Corchero	Río Sever banks	Valencia de Alcántara	Cáceres	Spain		39	24	49	7	17	25	B	114	0½	–18½

No.	N4	Name	Group	Municipalty	Dist/Prov	Country	Lat	Lat N			Long W			S	az	alt	dec
161		Corticeira		Estremoz	Évora	Portugal		38	45	28	7	36	24	C	116	10	–13
162		Vidigueiras		Redondo	Évora	Portugal	38.6							H	116	0½	–20
163		Casas Novas		Redondo	Évora	Portugal		38	41	1	7	38	1	C	117	2	–19½
164		Torre das Arcas 2		Elvas	Portalegre	Portugal	38.9							H	118	–0½	–22
165		Valmor		Elvas	Portalegre	Portugal		38	50	25	7	11	16	D	118	1	–21
166		Vidigueiras 1		Reguengos de Monsaraz	Évora	Portugal		38	23	40	7	31	9	C	118	0	–22
167		Roca Amador		Barcarrota	Badajoz	Spain	38.5							H	121	2½	–22
168		Melriça		Castelo de Vide	Portalegre	Portugal		39	25	59	7	30	7	R	121	2½	–22
169		Barrosinha 2		Évora	Évora	Portugal		38	37	59	7	46	14	C	122	–0½	–25½
170		Avessadas		Elvas	Portalegre	Portugal	38.8							H	122	0	–25
171		Pinheiro do Campo 2		Évora	Évora	Portugal		38	35	50	8	4	57	C	122	0	–25
172		Tierra Caída 2		Cedillo	Cáceres	Spain		39	38	42	7	31	26	R	128	9	–21½
173		Tierra Caída 1		Cedillo	Cáceres	Spain		39	38	41	7	31	25	R	129	10	–21½
174		Monte Novo 1		Reguengos de Monsaraz	Évora	Portugal		38	35	50	8	4	57	C	T	0	
175		Monte Novo 4		Reguengos de Monsaraz	Évora	Portugal		38	23	40	7	31	45	C	T	0	
176		Vale Carneiro 5		Reguengos de Monsaraz	Évora	Portugal		38	23	12	7	31	29	C	T	0	
177		Paço 2		Redondo	Évora	Portugal		38	23	36	7	27	51	C	T	0½	
178	26	Barbón 1	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	23	29	7	12	25	B	Unmeasured		
179	27	Barbón 2	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	23	28	7	12	30	B	Unmeasured		
180	21	El Palancar		Valencia de Alcántara	Cáceres	Spain		39	21	15	7	15	25	B	Unmeasured		
181	12	Changarilla	Río Sever banks	Valencia de Alcántara	Cáceres	Spain		39	25	38	7	18	3	B	Unmeasurable		
182	41	El Caballo	Río Sever banks	Valencia de Alcántara	Cáceres	Spain		39	26	43	7	17	36	B	Unmeasurable		
183	40	El Torrejón		Valencia de Alcántara	Cáceres	Spain		Unavailable							Unmeasurable		
184	32	Huerta Látigo	Collados de Barbón	Valencia de Alcántara	Cáceres	Spain		39	23	20	7	12	2	B	Unmeasurable		
185	30	San Antón		Valencia de Alcántara	Cáceres	Spain		39	23	24	7	9	36	B	Unmeasurable		
186	33	Tapada del Puerto		Valencia de Alcántara	Cáceres	Spain		39	23	38	7	14	20	B	Unmeasurable		

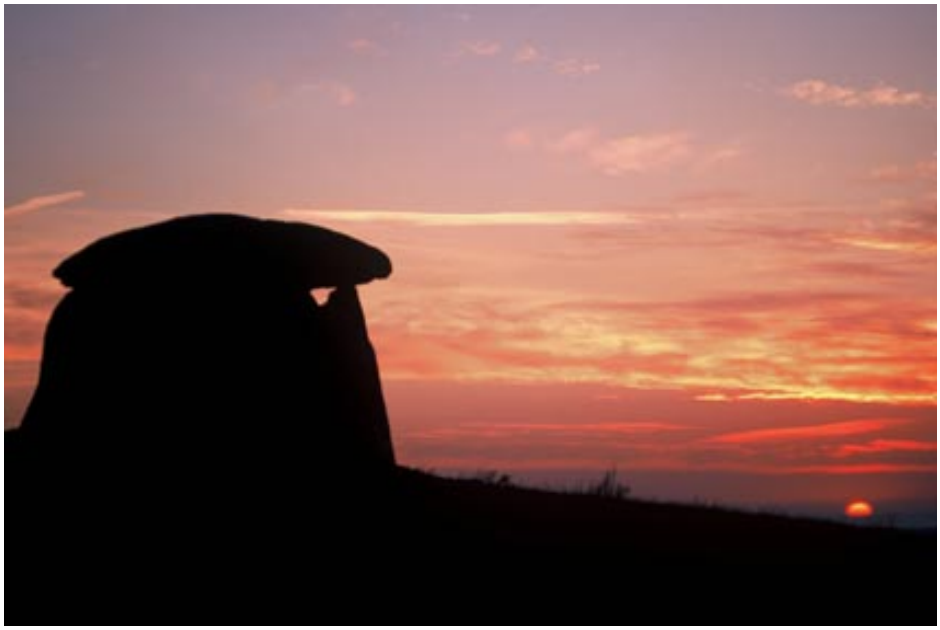

Fig. 3.8. Aldeia da Mata, Crato (no. 49 in Table 3.1) facing the rising sun. Photograph © Luís Tirapicos

2.b History and development

Seven-stone antas were built in the southwest of the Iberian Peninsula over a period of about one thousand years spanning the 4th millennium B.C. for the burial of people belonging to a pastoralist culture.

The dolmen cluster is very consistent, with all the monuments being built with seven huge slabs of granite (orthostats) up to 3.5m high, of which the largest is the so-called backstone, which by architectural logic would be the first slab to have been put in place (Figs 3.3–3.6). The resulting polygonal chamber was approached by a corridor of variable length that can be used to date the structures: short corridor dolmens date from the beginning of the fourth millennium (c. 4000 B.C.), while the long corridor dolmens are, on average, about 800 years younger. The structures were continually reutilized: they remained "in use" until the beginning of the Bronze Age, towards the end of the 3rd millennium B.C., and perhaps much later. The whole structure would have been covered by a huge mound of earth and pebbles, which has nearly completely disappeared in the vast majority of cases.

The Alentejo region is exceptionally rich in megalithic remains (enclosures, menhirs, dolmens, etc.). According to recent surveys by Manuel Calado and Jorge de Oliveira (Calado 2004; de Oliveira 1997) the number of megalithic funerary monuments in the region exceeds 1000, with the number of seven-stone antas exceeding 800.

These monuments were used as collective tombs, and it is likely that they were sacred places associated with a cult of ancestors and/or some tutelary divinity. Excavations at some of the dolmens not only uncovered artefacts such as arrowheads and ceramics but also highlighted a series of fragments, and some complete copies, of what have been called plate-idols, decorated with extremely abstract representations of a deity related to a funerary cult, and which may have had calendrical connotations (see Fig. 3.9). Additionally, it is possible that the dolmens served as reference points in the landscape, marking the territory of the community in question.

A consistency in the orientation of megalithic enclosures in central Alentejo implies that, like those of the seven-stone antas, these too were astronomically determined (e.g, Pimenta et al. 2009). If, as Calado (2004) has argued, the antas represent a continuity of the basic horseshoe plan of the older enclosures, then an orientation custom based upon celestial targets may have had even deeper roots in the region.

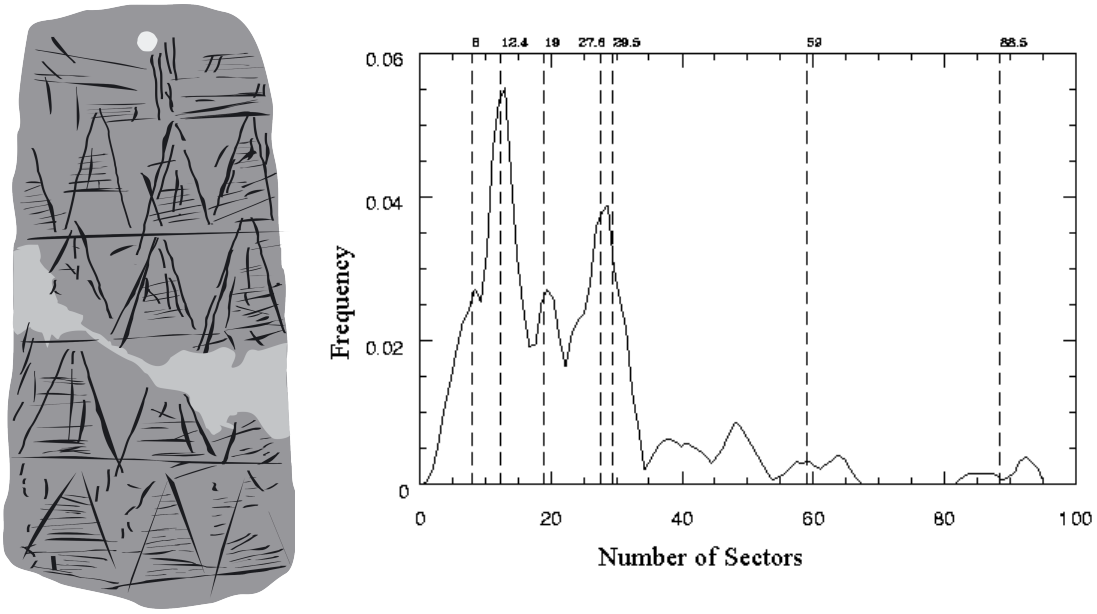

Fig. 3.9. Left: a typical plate-idol found precisely in one of the dolmens of Valencia de Alcántara. Photograph adapted from Bueno (1988). **Right:** Graph showing the number of decorative elements found on 130 plate-idols discovered in megalithic monuments of the south-west of the Iberian Peninsula, including seven-stone antas. There are statistically significant peaks centred at around 12½ and 29½, close to the number of lunar (synodic) months in a seasonal (solar) year and the number of days in a lunar (synodic) month.

In Portugal, the study and protection of the antas dates back to the activities of the *Academia Real da História Portuguesa* (Royal Academy of Portuguese History), created by King D. João V in 1720. In fact, the first inventory produced in Portugal (now lost) was presented to the Royal Academy in 1734, written by Father Afonso da Madre de Deus Guerreiro, and included 315 antas – 66 in the Évora region. Subsequent studies have shown the richness of the megalithic heritage of the country and in particular of the Alto Alentejo Province. At the end of the 19th and beginning of the 20th centuries the work of José Leite de Vasconcellos, Nery Delgado, Carlos Ribeiro, Gabriel Pereira, Emile Cartailhac, Mattos Silva and Filipe Simões made contributions to the inventory and knowledge of the antas of the Évora and Montemor-o-Novo areas. More systematic studies developed in the first half of the 20th century through the identifications, excavations and interpretations of Vergílio Correia and Manuel Heleno. Nevertheless the climax, in the 1940s and 1950s, was the monumental work of Georg and Vera Leisner documenting and studying hundreds of antas in the Alentejo. A more recent archaeological survey has been carried out by Jorge de Oliveira since Hoskin's archaeoastronomical studies were completed in the area. Other recent archaeological studies include those of Victor S. Gonçalves, Philine Kalb, Martin Höck and Mário Varela Gomes. These focus upon local contexts and complement the study of dolmens with the investigation of other megalithic monuments and contemporary (or at least prehistoric) settlements, mainly within the areas of Montemor-o-Novo, Évora and Reguengos de Monsaraz.

The dolmens of the region of Valencia de Alcántara, on the Spanish side of the border, were studied in detail in the 1980s by Jorge de Oliveira and others. Some of them were excavated, this being the main objective of the PhD thesis of Primitiva Bueno, of the University of Alcala de Henares, published in 1988. Further archaeological and restoration work has been carried out since that date.

Interestingly, a century before the quantitative fieldwork of Hoskin and his collaborators, José Leite de Vasconcellos, a Portuguese archaeologist and ethnologist, argued in his book *Religiões da Lusitania*, published in 1897, that the orientations of dolmen entrances, which were "very frequently facing East", were related to a sun cult.

3. Justification for inscription

3.c Comparative analysis

The seven-stone antas found in the central Alentejo region in Portugal and the adjacent border provinces of the Extremadura region in Spain represent one of the largest and best-preserved groups of megalithic monuments in the Iberian Peninsula. The great majority are built with granite slabs, frequently including a corridor. The concentrations around Évora and Valencia de Alcántara are easily located, representative, and contain some of the most impressive individual examples.

Many other groups of European later prehistoric monuments show patterns of orientation that were certainly determined astronomically and in most cases were probably related to the sun (Hoskin 2001, Ruggles 2010).

The range of astronomical declinations of the horizon points towards which the seven-stone antas face is from –24° to +24° (see Table 3.1 and Fig. 3.7). This corresponds to the range of declinations reached by the sun over the course of the year; in other words, each monument is oriented towards a point where the sun rises at some time in the year, with the various monuments effectively covering the entire range. Hence, applying Ockham's Razor, this appears to be very strong indication of a custom of orientating monuments towards sunrise, with no particular preference for specific times within the seasonal year. Among the many groups of European later prehistoric monuments, only the seven-stone antas manifest a clear and consistent practice of orientation related specifically to the rising arc of the sun over the course of a year. They are quite exceptional in this respect.

3.d Integrity and/or authenticity

As regards the astronomical significance of this group of monuments, a critical issue is the extent to which the intended, or original, direction of orientation is accurately represented and well preserved.

The sites are in various states of repair. Some are well preserved (Figs 3.3, 3.5, 3.6). In other cases the chamber has collapsed leaving only the backstone, the stone put in place first, but the direction perpendicular to this backstone still gives a reliable estimate of the orientation (see Fig. 3.10). In other cases just a few stones are preserved, often the backstone or some stones of the corridor, but this still permits a potential measurement of the orientation (see Fig. 3.11).

Some of the Spanish examples, such as Cajirón 2 (see Fig. 3.12), have been reconstructed since their orientations were determined in the 1990s. In Portugal, especially near Évora, Montemor-o-Novo and Castelo de Vide, a limited number of seven-stone antas have been cleaned, excavated and/or restored.

A few of the antas in the Valencia de Alcántara group have been restored but where this has happened it has been done cautiously, using the original slabs found scattered in situ. Thus very little "reconstruction" has taken place and only a few of the stones have been moved back to their "original" position. Where, as at Cajirón 2 (Fig. 3.12), the capstone has been replaced on top of the structure, this has been achieved without altering its overall orientation.

Fig. 3.10 (left). Coureleiros 4 (no. 18 in Table 3.1), as seen in 2005. The chamber has completely collapsed. Photograph © Clive Ruggles **Fig. 3.11 (right).** (La) Miera (no. 40 in Table 3.1). One of the authors (JB) is measuring the horizon altitude in the direction of the only surviving corridor orthostat. This would give a loose, but still valid, orientation of the partly destroyed dolmen. Photograph courtesy of Margarita Sanz de Lara

Fig. 3.12. Cajirón 2 (no. 94 in Table 3.1) before (left) and after (right) excavation and restoration; in this particular case, the reconstruction was carried out with much caution and the orientation of the monument was preserved. Photographs © Juan Belmonte (left) and Clive Ruggles (right)

3.a Potential criteria under which inscription might be proposed

Criterion (iii). The seven-stone antas bear unique testimony to a cultural practice dating back between five and six thousand years whereby tombs were oriented upon the rising position of the sun. In doing so, they bear exceptional witness to prehistoric cultural traditions and beliefs relating death and ancestors to the sun and seasonality.

3.b Suggested statement of outstanding universal value

The seven-stone antas are a distinctive form of megalithic tomb constructed more than 5000 years ago. They represent the oldest group of monuments on the planet that provide statistically defensible evidence of practices and beliefs linking monumental constructions with the skies. The 177 examples whose principal orientation has been reliably determined all, without exception, face within the arc of sunrise (the part of the horizon where the sun rises at some time during the year). The extraordinary consistency in an orientation pattern that characterises a set of monuments scattered over hundreds of kilometres provides an exceptionally clear indication of an astronomical relationship so significant to the builders that it was implemented

unswervingly during the construction of hundreds of monuments, possibly over a period spanning several centuries. This offers a unique insight into the minds of the builders of some of the earliest later prehistoric monuments on the planet still conspicuously visible in today's landscape.

4. Factors affecting the property

4.a Present state of conservation

Almost 200 seven-stone antas are known but somewhat fewer than this number are in a sufficiently good state of preservation that alignments studies can be performed. The monuments have been re-used through history, and even today, for purposes varying from pig shelters to Christian chapels (see Fig. 3.13).

About 40% of the granite-built seven-stone antas (dolmens) of Valencia de Alcántara (Spain) are considered to be in either an excellent or a good state of preservation (see Table 3.2); this number rises to 52% when only the dolmens in the 3 groups shown in Fig. 3.2 (I – Collados de Barbón; II – Río Sever banks; III – the granite outcrop of Santa María de la Cabeza) are taken into consideration. Tapias 1, Zafra 3 and Anta de la Marquesa are among the best preserved, and most impressive, dolmens in the Iberian Peninsula.

Fig. 3.13. Left: Pombal (no. 53 in Table 1). Located in the Portuguese countryside, this anta has been used as a pig-shelter, which has in fact ensured its preservation. **Right:** Pavia (no. 42 in Table 1). This anta, in the centre of the village of Pavia, was converted in the 17th century into a Christian chapel, the Capela de São Dinis, which is still in use. Photographs courtesy of Margarita Sanz de Lara.

Table 3.2. State of preservation of the granite-built seven-stone antas of Valencia de Alcántara (Spain). The table presents the reference number and name as in Table 3.1. The site number shown in Fig. 3.2 is also given, in brackets.

	Group			
State of preservation	**Río Sever banks**	**Collados de Barbón**	**Santa María granite outcrop**	**Other**
Excellent	3 (17) Huerta de las Monjas 13 (15) Tapada del Anta 1	58 (24) Zafra 3 143 (28) Tapias 1	101 (34) Anta de la Marquesa 94 (38) Cajirón 2	
Good	4 (13) Lanchas 1 84 (14) Lanchas 2 120 (11) Fragoso	39 (31) Huerta Nueva 68 (25) Zafra 4	8 (35) Datas 1 129 (36) Datas 2	37 (20) La Barca
Moderate	40 (19) (La) Miera 160 (18) Corchero	32 (23) Zafra 2 178 (26) Barbón 1 179 (27) Barbón 2	87 (37) Cajirón 1	180 (21) El Palancar
Poor	181 (12) Changarilla 182 (41) El Caballo	33 (29) Tapias 2 95 (22) Zafra 1 184 (32) Huerta Látigo	21 (39) La Morera	183 (40) El Torrejón 185 (30) San Antón 186 (33) Tapada del Puerto
Destroyed	— (16) Tapada del Anta 2			

4.b.i Developmental pressures

Generally, the monuments are scattered in a rural landscape and there are few developmental pressures. For example, Valencia de Alcántara is a small town of nearly 7000 inhabitants surrounded by a "dehesa" landscape, typical for Extremadura. The climate is mild and the land use is mainly agricultural with a small amount of pastoral (sheep, Iberian pigs and cattle). In the Alentejo there are also some hunting reserves. Field clearance remains a major threat to the conservation of the antas, the destruction of some of which continues to be reported by archaeologists. In some areas it has been estimated that one third of the monuments have disappeared in the last 50 years (Leonor Rocha and Cândido Marciano da Silva – priv. comm.).

4.b.iv Visitor/tourism pressures

Being a set of small, isolated monuments located in a variety of land-use situations, the seven-stone antas face various potential threats, but they are generally safe from the damage that might be caused by large numbers of visitors.

Even in the Valencia de Alcántara area, where the granite-built seven-stone antas constitute one of the major tourist attractions (see below), visitors only put small pressure upon the sites.

5. Protection and management

5.a Ownership

The vast majority of the seven-stone antas are located on privately owned farmland.

5.b Protective designation

In Portugal, the antas are protected as classified archaeological sites by the Ministério da Cultura under Heritage Law no. 107/2001. A number of them have been classified as National Monuments for many years, in most cases since the first half of the 20th century, and the archaeological guide published in 1994 by Ana Paula dos Santos lists 21 such sites.

In Spain, the antas are *Bienes de Interés Cultural* (BIC) protected under Articles 14–25 of Law 16/1985 on Spanish Historical Heritage.

5.h Visitor facilities and infrastructure

Several municipalities have reached agreements with the owners so that free access (*servidumbre de paso*, permission to cross) exists to most of the sites. In particular, this is true for all the dolmens in certain localities, such as Valencia de Alcántara and several villages of Portugal, especially near Évora. Nonetheless, in many other places, notably in Portugal, the antas are only accessible to the public with the landowner's permission.

All of the three groups of well-preserved dolmens within the municipality of Valencia de Alcántara (see Fig. 3.2) are open to visitors, easily reachable (being located close to well established tracks), and clearly marked. High-quality rural tourism is an important source of income in the Valencia de Alcántara area (see, e.g., http://www.virgencabeza.com/espanol/Dolmenes.htm) with environmentally aware visitors. There is a special agreement between the municipality's *Consejería de Cultura* and the landowners so that free access to the dolmens is allowed in every case, providing that visitors apply minimum care and observe basic procedures (close fences, avoid jumping walls, etc.). In some areas, such as the Zafra–Tapias sector, to the east of the village, and in the Aceña de la Borrega area to the south, special tourist routes have been arranged and appropriately marked, making tours with an adequate guide–book a real pleasure for interested visitors. The municipality can arrange visits for groups under special circumstances upon demand.

Fig. 3.14. Sign marking the entrance to one of the four megalithic tours run by the Municipal Museum of Coruche. Photograph © Luís Tirapicos

In Portugal, especially near Évora, Montemor-o-Novo and Castelo de Vide, a limited number of seven-stone antas have been cleaned, excavated and/or restored, and are accessible to the general public. Four tours are managed by the Municipal Museum of Coruche near Montemor-o-Novo (Água Doce, Azinhal, Vale de Gatos e Chapelar, and Martinianos). At one entrance a panel invites visitors to follow four tracks through the numerous antas (about 25) of the region (see Fig. 3.14). However, in the same fence a small sign in red prohibits public entry. In practice, visits are authorized but only in small groups, organized and guided by the Museum.

5.i Presentation and promotion policies

A number of local authorities, including those at Évora, Castelo de Vide, Marvão, Montemor-o-Novo, Cedillo and Valencia de Alcántara, have produced booklets, pamphlets and web pages for tourists and more interested visitors, with information about the nature and whereabouts of some of the sites in their area.

The Historic Centre of Évora, inscribed on the World Heritage list in 1986, is located in the heart of one of the major concentrations of antas in the Alentejo. The region has also seen important investments in rural tourism, in particular near the great lake created by the Alqueva dam, around which the first dark sky reserve in Portugal was established: this was also the first site in the world to receive “Starlight Tourism Destination” certification (http://www.darkskyalqueva.com/en/).

7. Documentation

7.c Most recent records or inventory

Some of the seven-stone antas in both countries have been excavated. The orientations of the seven-stone antas were first systematically measured by Michael Hoskin together with Spanish and Portuguese collaborators between 1994 and 1998, as part of a 12-year fieldwork campaign

measuring the orientations of many hundreds of tombs and temples in the western Mediterranean. An extended scientific bibliography has been produced on the topic.

7.e Bibliography

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