

ORIENTATIONS OF TOMBS IN THE LATE-MINOAN CEMETERY AT ARMENOI, CRETE

MARIA PAPATHANASSIOU, Athens University,
MICHAEL HOSKIN, Churchill College, Cambridge, and
HELEN PAPADOPOULOU,
Rhethymnon Department, Greek Ministry of Culture and Science

The Cemetery at Armenoi

The village of Armenoi lies some ten kilometres south of the port of Rhethymnon on the north coast of Crete, in a hilly region situated on a north–south axis of the island. The region is bordered by areas where the Minoan civilization is known to have flourished, notably Mastabas-Rhethymnon¹ and the plain of Agios Vasilios.² Near the village, on a low eminence just west of Mt Vrysinas, is a very remarkable Late Minoan cemetery, with numerous tombs cut deep into the ‘kouskouras’ limestone bedrock. Curiously, it is not known where the people buried here actually lived — surface surveys and two test excavations, at nearby Kastalos and Somatas, have failed to locate what must have been a substantial settlement.

Excavation of the Armenoi tombs (by Dr Iannis Tzedakis) began in 1969,³ and the cemetery (which extends over an area of some 35 acres) now ranks as the greatest of the Late Minoan II–IIIB Period (1450–1190 B.C.). The earliest of the tombs so far dated is no. 200, which was in use during the second half of the fifteenth century B.C.,⁴ but this tomb is exceptional, being underground but of corbelled ‘tholos’ construction. All the rest are chamber tombs cut into the bedrock (Figures 1 and 2), and date from the late fifteenth, and more especially from the fourteenth and thirteenth centuries. So far, 216 tombs have been excavated.⁵ Some forty more tombs are known, and the final total might reach as high as three hundred.

The site was carefully planned, with paved paths and some levelling of the ground. Here and there the grain of the rock proved difficult to work, and a tomb was left unfinished. These unfinished tombs give clear evidence of the sequence of construction. First, the dromos (consisting of a ramp or steps) was cut into the rock, with carefully-fashioned sides that incline inwards a little as they rise from their base; these sides are normally straight and parallel and so the typical dromos has a very well-defined orientation. When the dromos was complete, the outline of the entrance was incised into the rock-face at the end of the dromos, and the chamber (usually circular or horse-shoe in shape) cut away. A dromos is typically between 1m and 2.5m in width and between 3.5m and 7m in length (although some are longer — one prestige tomb has a dromos no less than 16 metres long). Occasionally a niche is built into a sidewall.

The tombs appear to have served for family burials, and in some the remains



FIG. 2. The dromos and entrance to Tomb 171.



FIG. 1. The dromos and entrance to Tomb 52.

of as many as sixteen skeletons were found. When a new body was introduced, bones from previous burials were pushed to one side to make room. The remains from over five hundred skeletons at Armenoi demonstrate that the legend that the Minoans were of small stature is quite false;⁶ but their lifespan was surprisingly brief: for those who survived childhood, the average age at death was 31 years for men and 28 for women.⁷ Votive offerings in the tombs are remarkable for their quantity and variety, and indicate a sophisticated civilization with trade links throughout the island and beyond.⁸ This view is supported by the quality of the sarcophagi, the grave-stelae, and other objects and inscriptions associated with the tombs.⁹

Tomb Orientations

Because of the quality and durability of the stonework of the dromoi, most tombs have an orientation (defined as the direction of the dromos outwards from the chamber) that can be measured to an accuracy of better than one degree. A handful of tombs that are in poor condition, or where construction is incomplete, have orientations that can be measured to less accuracy. Only one tomb (no. 178) is anomalous and has no defined axis.

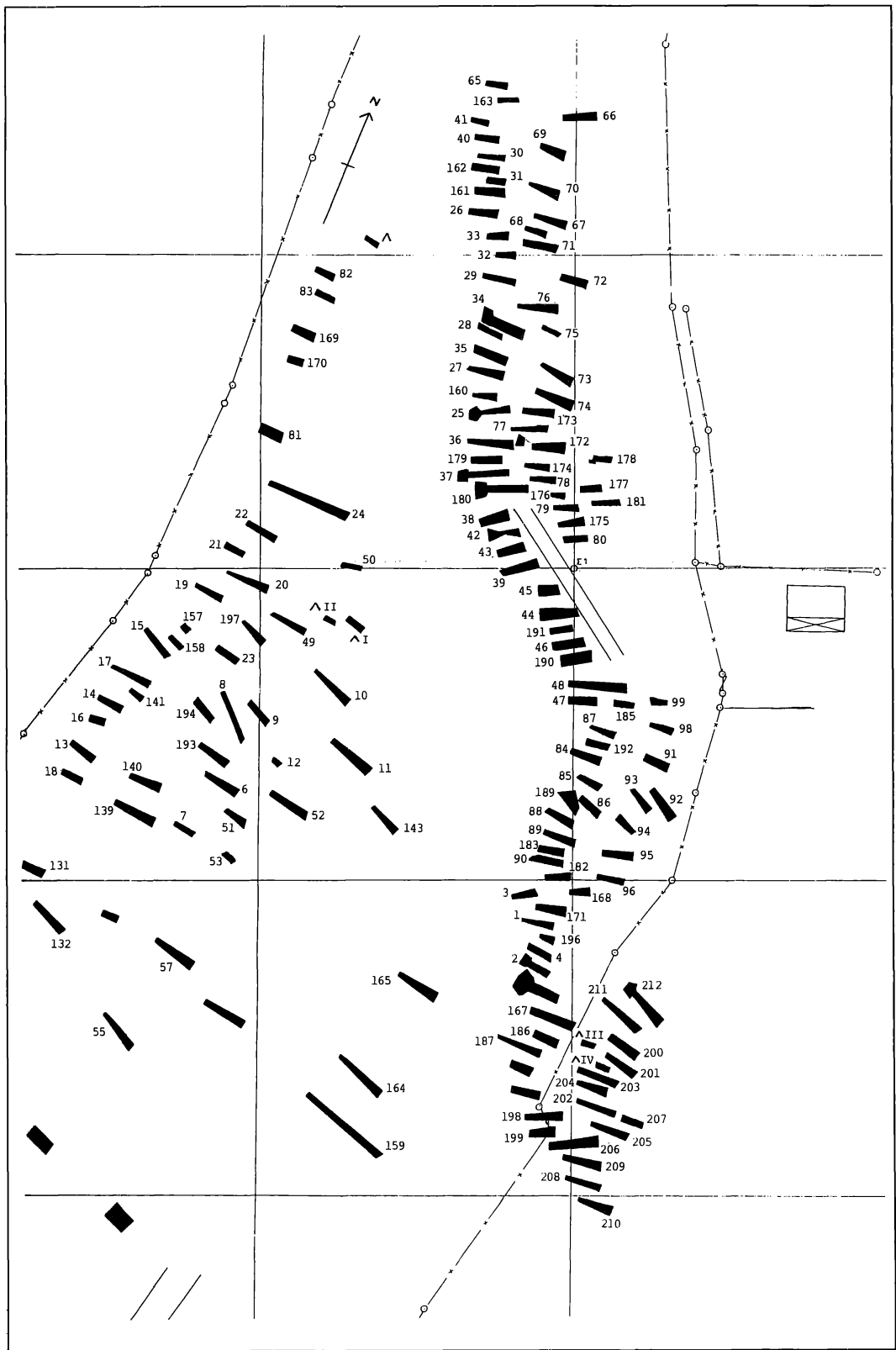
In July 1991 Papathanassiou and Hoskin measured the orientations of over a hundred of the excavated tombs, both complete and incomplete, and in September Papathanassiou revisited the site and took part in the measurement of a similar number, so that in total the orientations of 209 tombs or intended tombs — almost all of those so far excavated — have been determined. The results are given in Table 1. As the rock is limestone and there is no likelihood of magnetic anomalies, the measurements were taken with prismatic compasses whose accuracy had been established elsewhere by observations between survey positions of known location. The magnetic variation (just under $2\frac{1}{2}^{\circ}$ west) was obtained from detailed maps of the region's magnetic contours.

The excavated tombs occur in three zones. The first zone (which we term Zone A and which is shown in Figure 3) consists of the land along the foot of the eastern slope of the eminence; all the tombs in Zone A lie close to the part of the boundary fence that extends to left and right of the entrance to the site (and indeed some lie just outside the fence). The majority of these 105 tombs are tightly-packed in an irregular double row that extends roughly from north to south, but with a 'kink' in the middle that runs briefly from north-west to south-east.

Zone B (Figure 3), which adjoins Zone A above and to the west, consists of the upper eastern slope and, more especially, the crest of the eminence. The 45 tombs here are much more scattered.

Zone C (Figure 4) lies a short distance away to the south, on the southern slope of the eminence. Here there is a cluster of 59 tombs.

As shown in Table 1 and Figure 5, the tombs, *without a single exception*,¹⁰ face in a generally easterly direction: their azimuths range from 52.5° to 133° — at either extreme just a few degrees beyond the range of sunrise. This encouraged us to consider the possibility that the tombs were laid out to face sunrise — or,



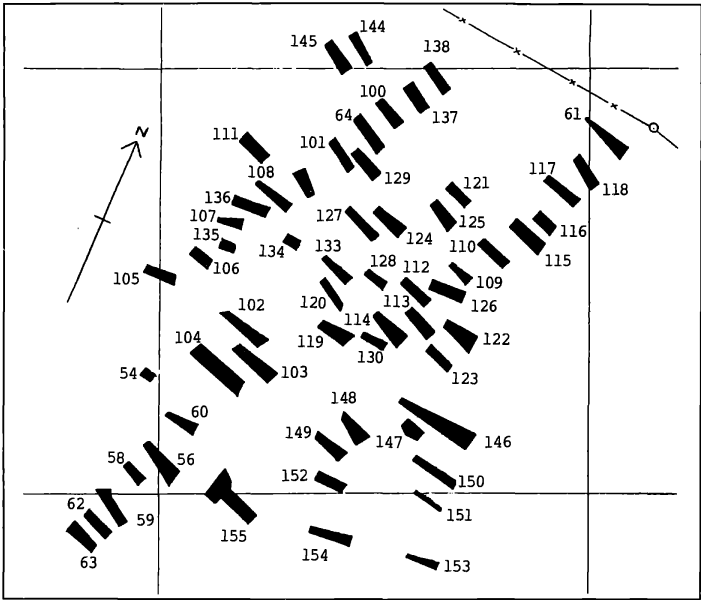


FIG. 4 The tombs of Zone C.

possibly, moonrise. The eastern skyline is dominated by the outline of nearby Mt Vrysinas, which rises to 858 metres. Between 80° and 120° azimuth, the skyline as seen from the cemetery (Figure 6) is never less than 8° above the horizontal, and the peak occurs at 107.5° azimuth where the skyline is some 9°40' above the horizontal. This of course has a substantial effect on the azimuth of the rising sun. At the equinoxes, for example, the sun rises with azimuth 95.7° rather than 90°.

The Sanctuary of Mt Vrysinas

On the peak of Mt Vrysinas are the ruins of a sanctuary of the Middle Minoan period (early second millennium). It is one of the greatest — if not the greatest — of the peak sanctuaries.¹¹ Today the principal feature of the ruins is a rectangular wall, some 19m by 20m, which now has an Orthodox chapel in its midst. Papathanassiou and Hoskin measured the directions of the sides of the rectangle; the results are given in Table 2. The measurements were, as before, made by compass, but here the correctness of the compass bearings could be tested on distant mountains of known position.

Outside the rectangular structure, on three sides the ground falls away sharply, but towards the south-east the sanctuary ruins continue along the ridge. From what is known of similar sanctuaries elsewhere in Crete, this suggests that the sanctuary was oriented in a south-easterly direction. If so, it faced towards a point on a distant mountain behind which celestial bodies rose

FIG. 3. (*opposite*). The tombs of Zone A (the double row to the right of the plan, extending from Tomb 65 in the north to Tomb 210 in the south) and Zone B.

TABLE 1. Orientations of the tombs at Armenoi.

| | | | | | | | |
|--------|--------|----|--------|-----|--------|------|--------|
| Zone A | | | | | | | |
| 1 | 81.5° | 48 | 75.0° | 94 | 110.5° | 190 | 57.5° |
| 2 | 98.0 | 65 | 81.0 | 95 | 75.0 | 191 | 57.5 |
| 3 | 56.0 | 66 | ~ 68.5 | 96 | 83.0 | 192 | 84.5 |
| 4 | 103.0 | 67 | 87.5 | 98 | 82.5 | 196 | ~ 84.5 |
| 25 | 65.0 | 68 | 89.5 | 160 | 72.0 | — | 95.0§ |
| 26 | 76.5 | 69 | 90.5 | 161 | 72.5 | — | 94.5† |
| 27 | 81.0 | 70 | 92.5 | 162 | 78.5 | — | 81.0† |
| 28 | ~ 93.0 | 71 | 81.5 | 163 | 75.0 | 198 | 67.5 |
| 29 | 83.0 | 72 | 85.5 | 167 | 91.5 | 199 | 65.5 |
| 30 | 76.0 | 73 | 100.5 | 168 | 70.5 | 200 | 106.5 |
| 31 | 78.0 | 74 | 92.5 | 171 | 81.0 | 201 | 102.0 |
| 32 | 73.5 | 75 | 101.0 | 172 | 72.5 | 202 | 92.0 |
| 33 | 71.5 | 76 | 71.5 | 173 | 75.5 | 203 | 93.0 |
| 34 | 97.5 | 77 | 71.5 | 174 | 77.0 | 204 | 85.0 |
| 35 | 93.5 | 78 | 75.5 | 175 | 60.5 | 205 | 87.5 |
| 36 | 74.0 | 79 | 73.5 | 176 | 78.5 | 206 | 65.0 |
| 37 | 67.5 | 80 | 58.5 | 177 | 67.5 | 207 | 89.0 |
| 38 | ~ 53.5 | 84 | 89.0 | 178 | — | 208 | 82.5 |
| 39 | 52.5 | 85 | 96.0 | 179 | 69.0 | 209 | 84.0 |
| 40 | 78.5 | 86 | 111.5 | 180 | 69.5 | 210 | 89.0 |
| 41 | 84.5 | 87 | 88.0 | 181 | 69.5 | 211 | 111.5 |
| 42 | ≈ 61.5 | 88 | 100.0 | 182 | 68.0 | 212 | 120.0 |
| 43 | ≈ 56.5 | 89 | 92.5 | 183 | 83.0 | ΔIII | 86.5 |
| 44 | ≈ 64.0 | 90 | 83.0 | 185 | 77.5 | ΔIV | 92.0 |
| 45 | ≈ 64.0 | 91 | 94.5 | 186 | 95.0 | — | 91.5* |
| 46 | 63.5 | 92 | 125.5 | 187 | 93.0 | | |
| 47 | 72.5 | 93 | 123.0 | 189 | 109.0 | | |

†Tomb between Tombs 187 and 198.
*Tomb between Tombs 28 and 35.
§Tomb between Tombs 2 and 167.

| | | | | | | | |
|--------|--------|----|-------|-----|-------|-----|---------|
| Zone B | | | | | | | |
| 6 | 101.0° | 19 | 97.5° | 81 | 92.5° | 164 | 112.5° |
| 7 | 99.0 | 20 | 95.5 | 82 | 95.0 | 165 | 102.0 |
| 8 | 133.0 | 21 | 95.5 | 83 | 91.5 | 169 | 96.0 |
| 9 | 119.0 | 22 | 96.5 | 131 | 99.0 | 170 | 89.0 |
| 10 | 115.0 | 24 | 92.5 | 132 | 117.5 | 193 | 106.5 |
| 11 | 109.0 | 49 | 100.5 | 139 | 98.5 | 194 | 119.0 |
| 13 | 104.5 | 50 | — | 140 | 92.0 | 197 | — |
| 14 | 97.5 | 51 | 105.0 | 141 | 108.0 | Δ | 101.5 |
| 15 | 121.5 | 52 | 102.0 | 143 | 114.0 | ΔI | 124.0 |
| 16 | 88.0 | 53 | 109.5 | 157 | 121.5 | ΔII | ~ 107.0 |
| 17 | 97.0 | 55 | 121.5 | 158 | 116.5 | — | 101.5* |
| 18 | 99.0 | 57 | 105.5 | 159 | 112.0 | | |

*South-east of Tomb 57.

with declination of about -26° : a little too far south for the midwinter sunrise, though well within the range of moonrise. We remark that no notable stars rose behind the mountain: Sirius, the stars of Orion, and the Pleiades rose further to the east, while α and β Cen and the Southern Cross rose further to the south. Although the sanctuary had fallen into disuse more than two centuries before construction of the Armenoi tombs began, it is highly likely that the mountain would have retained its religious significance.¹² It is interesting that the orientation of the earliest known tomb, no. 200, the tholos tomb, is 106.5° ,

TABLE 1 — concluded

| | | | | | | | |
|--------|--------|-----|---------|-----|--------|-----|----------|
| Zone C | | | | | | | |
| 54 | 107.0° | 106 | 110.0° | 121 | 114.0° | 138 | 121.5° |
| 56 | 118.0 | 107 | 82.5 | 122 | 104.5 | 144 | 130.0 |
| 58 | 119.5 | 108 | 95.5 | 123 | 112.5 | 145 | 127.5 |
| 59 | 127.5 | 109 | 117.0 | 124 | 113.0 | 146 | 102.0 |
| 60 | 101.0 | 110 | 112.5 | 125 | 122.5 | 147 | 117.5 |
| 61 | 111.5 | 111 | 116.5 | 126 | 99.0 | 148 | 97.5 |
| 62 | 117.5 | 112 | 111.5 | 127 | 113.5 | 149 | 92.0 |
| 63 | 113.0 | 113 | 115.0 | 128 | 101.0 | 150 | 103.0 |
| 64 | 122.5 | 114 | 118.0 | 129 | 121.5 | 151 | 102.5 |
| 100 | 118.0 | 115 | 114.0 | 130 | 100.5 | 152 | 97.0 |
| 101 | 124.0 | 116 | ~ 109.0 | 133 | 114.5 | 153 | 97.0 |
| 102 | 107.5 | 117 | 113.0 | 134 | ~ 99.5 | 154 | 83.0 |
| 103 | 112.0 | 118 | 126.5 | 135 | 92.0 | 155 | ~ 115.0 |
| 104 | 113.0 | 119 | 101.0 | 136 | 92.0 | 156 | ~ 113.0* |
| 105 | 93.0 | 120 | 119.5 | 137 | 124.0 | | |

*Near Tomb 155.
Representative directions: Zone A: 82.2°; Zone B: 104.9°; Zone C: 110.0°. Overall: 95.0°. (Equinox sunrise: 95.7°.)

TABLE 2. The orientations of the sides of the rectangular wall of the peak sanctuary of Mt Vrysinas (latitude 35.31°N), with declinations corrected for refraction.

| Azimuth | Altitude | Declination |
|---------|-------------|-------------|
| 32.5° | − 60′ (sea) | + 42.0° |
| 122.5° | + 30′ | − 26.0° |
| 212.5° | − 30′ | − 44.4° |
| 302.5° | − 40′ | + 25.1° |

and that the tomb may therefore have been directed towards the sanctuary on the peak (azimuth 107.5°).

The Pattern of Tomb Orientations

We return to our consideration of the tombs at Armenoi, and ask ourselves, first, what was a ‘representative direction’ (r.d.) of the orientations in the cemetery as a whole? In accordance with a practice of statisticians where angles are concerned,¹³ we define this to be θ , where

$$\tan \theta = \Sigma \sin \theta_i / \Sigma \cos \theta_i.$$

The r.d. proves to be 95.0°, or within less than a degree of the equinox sunrise (95.7°), which shows that the tomb orientations are distributed with equal emphasis north and south of the equinox sunrise — as of course are the positions of sunrise, and of moonrise, throughout the years.

It is interesting that this is by no means the case with the separate zones. For Zone A the r.d. is 82.2°: surprisingly, although half the total measurements come from Zone A, this r.d. for Zone A is nearly 13° north of the r.d. overall — reflecting the fact that in the ‘kink’ the slope into which the tombs are cut faces somewhat north of due east, and here there was no doubt an incentive for the builders to reduce their labour by orienting the tombs similarly.

TABLE 3. Azimuths of tombs facing north of midsummer sunrise or south of midwinter sunrise.

(a) Tombs facing north of midsummer sunrise (az. 62.7°):

| | |
|-----|-------|
| 3 | 56.0° |
| 38 | ~53.5 |
| 39 | 52.5 |
| 42 | ≈61.5 |
| 43 | ≈56.5 |
| 80 | 58.5 |
| 175 | 60.5 |
| 190 | 57.5 |
| 191 | 57.5 |

The condition of Tombs 38, 42 and 43 is indifferent and the orientations are approximate only. However, the orientation of Tomb 39, which is the furthest north of all, is well-defined and was repeatedly measured with special care. Note that all these tombs are in Zone A, and all except Tomb 3 are in the ‘kink’. Tombs 38 and 39 face north of the major lunar standstill (az. 55.7°).

(b) Tombs facing south of midwinter sunrise (az. 126.1°):

| | |
|--------|--------|
| Zone B | |
| 8 | 133.0° |

| | |
|--------|--------|
| Zone C | |
| 59 | 127.5° |
| 118 | 126.5 |
| 144 | 130.0 |
| 145 | 127.5 |

Tomb 8 faces south of the major lunar standstill (az. 132.0°).

For Zone C, where the tombs are on a south-facing slope and the builders therefore had an incentive to orient their tombs south of east, the 59 tombs face much further south: the r.d. is 110.0°. But in Zone B, the higher ground where the land is flatter and the labour involved less dependent upon the choice of orientation, the r.d. of the 45 tombs is 104.9°. *If* the tombs were intended to face sunrise (or moonrise), then this variation between zones may be the result of a search for directions that *both* faced sunrise or moonrise *and* offered economy of labour.

Comparison of Tomb Orientations with Sunrise and Moonrise

How does the range of orientations compare with the range of positions of sunrise, and of moonrise? The azimuths of the solstitial sunrises, and of moonrise at the major standstills, will be found in Table 3. Comparison of this with Table 1 shows that of the 209 tombs (and unfinished ‘cuts’), no fewer than 195 faced the sunrise at sometime in the year.

The remaining 14 azimuths are listed in Table 3. Nine tombs are oriented too far north ever to face sunrise; of these, seven faced moonrise at some stage in the moon’s cycle, while the remaining two (nos. 38 and 39) are oriented too far north even for the moon (but only by some 2° and 3° respectively). Only five tombs are oriented too far south ever to face sunrise; of these, four faced moonrise at some stage in the moon’s cycle, while the fifth (no. 8) is oriented too far south for the moon (but by only 1°).

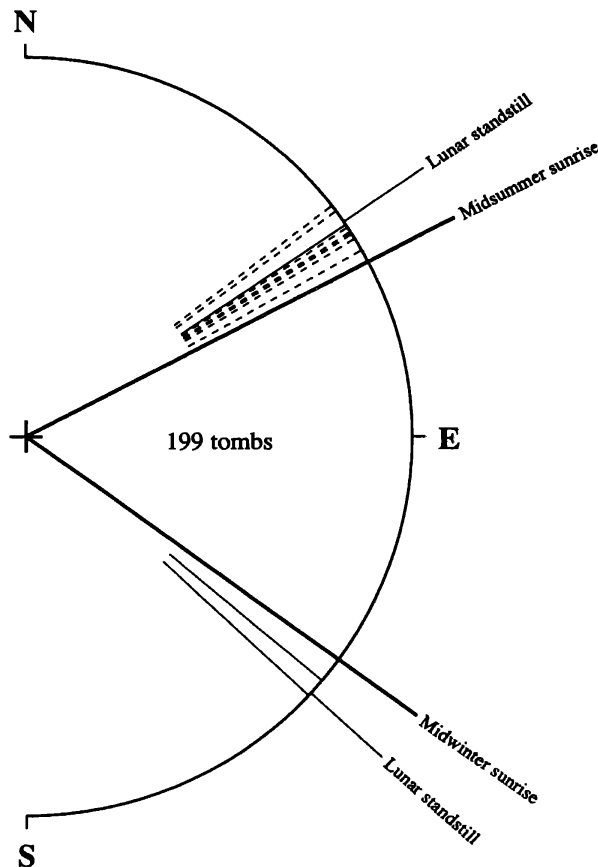


FIG. 5. The orientations of the tombs that face more than 1.5° north of midsummer sunrise or south of midwinter sunrise. Those tombs that are in the 'kink' are indicated by broken lines.

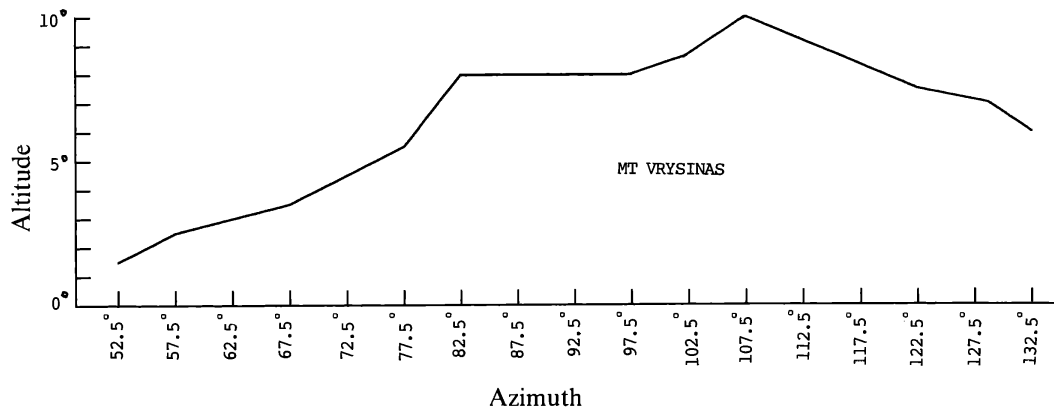


FIG. 6. The profile of Mt Vrysinas as seen from the cemetery.

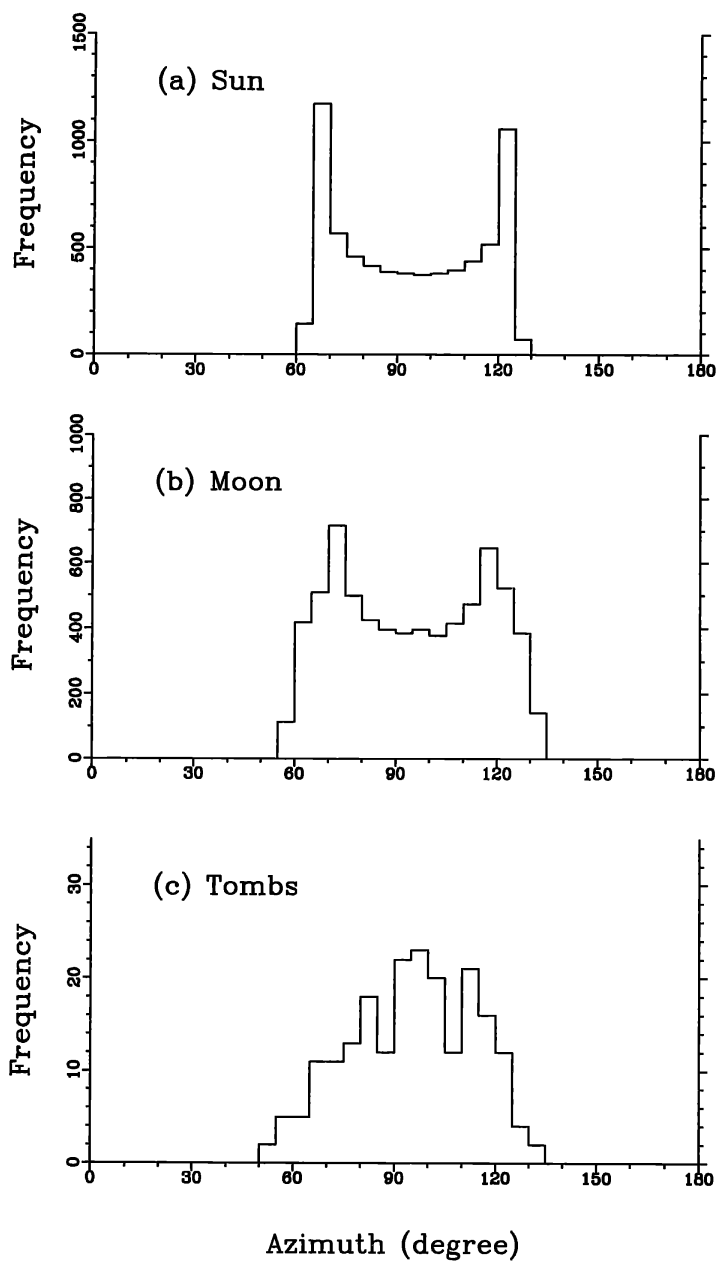


FIG. 7. The frequency with which (a) the Sun and (b) the Moon rise at various azimuths at the latitude of Armenoi (with the simplifying assumption that the horizon altitude has the constant value of 6°), compared with (c) that of the orientations of the tombs. Diagrams (a) and (b) based on data kindly supplied by Dr Curt Rosland.

It is helpful to examine these 14 exceptions zone by zone. In Zone B there is only one exception: Tomb 8, which is the most southerly-facing of all (azimuth 133°, or some 7° south of the winter solstice sunrise of 126.1°). But examination of a chart of the site (Figure 3) suggests that this tomb was inserted slantwise in the space between two other tombs, one of which had been abandoned incomplete.

In Zone C, there are three tombs (nos. 59, 118 and 145) facing just marginally south of the winter solstice, and one tomb (no. 144) whose orientation of 130° is some 4° south of the solstice. We note that many of the tombs in Zone C face well south of east, the r.d. for the zone being as high as 110.0° .

In Zone A are to be found all the nine tombs that face north of the summer solstice sunrise of 62.7° . Of these, no. 3 is geographically an isolated exception whose neighbours face further south. However, the other eight instances all belong to the 'kink' described earlier, where the double row briefly changes direction and runs northwest-southeast. As elsewhere in the double row, the tombs are so crowded that neighbouring tombs are necessarily quasi-parallel; and of the eleven tombs in the kink even the remaining three (nos. 44, 45 and 46) only just avoid being exceptions. In other words, these eight tombs that face north of the summer solstice sunrise are not independent exceptions but are interrelated, belonging as they do to a cluster of eleven tombs all of whose members are constrained by topography to face further north than usual.

If we disregard exceptions of less than 1.5° as being negligible, then we have:

Total number of tombs measured: 209

Number of tombs oriented between the solstices or almost so: 199 (95.2%)

Southerly exceptions: Tomb 8 (by 6.9°), and Tomb 144 (by 3.9°)

Northerly exceptions: Tomb 3 (by under 7°), and seven tombs in the 'kink' (by at most 10.2°)

These data are shown in Figure 5. We suggest that the exceptions are so few and so minor as not to disprove the hypothesis that the tombs were constructed to face directions in which the sun rose at some time in the year. However, the presence on Mt Vrysinas of a sanctuary that seems to have faced moonrise near to the southerly major standstill invites us to consider the possibility that the Armenoi tombs were intended to face moonrise rather than sunrise. In that case, the only southern exception is Tomb 8, and that by a negligible 1° ; the northern exceptions are Tombs 38 and 39 (in the 'kink'), by just over 2° and 3° respectively. Indeed, the fact that the range of azimuths of the tombs in the cemetery is almost exactly the range of azimuths of moonrise inclines us to the opinion that the tombs were laid out to face moonrise.

Whether this suggestion be true or false, the facts are that with four negligible exceptions and ten minor ones (seven of which are interrelated), the 209 Armenoi tombs span the range of sunrise; alternatively, with only three very minor exceptions, they span the range of moonrise. We therefore conclude that the tombs were constructed to face either sunrise or moonrise.

The Distribution of the Orientations

The quantity and uniformity of the tombs at Armenoi, and the precision with which their orientations can be measured, make it possible to use Armenoi to illustrate a technique that may be applied elsewhere to shed light on the annual rhythm of life for those involved in tomb construction. For simplicity we shall

disregard any implications of the topography of the different zones, the crowding of the tombs, and so forth.

Let us suppose that the custom was for tombs to be laid out so that at some time in the year they would face sunrise, and let us consider how this is likely to have been done. There are two obvious ways to ensure that a tomb faces sunrise: by laying out the tomb *in the general direction of where from long experience the sun is known to rise* (that is, roughly in an easterly direction); or by laying out the tomb *to face the actual sunrise on the morning when construction begins*. (Surprisingly, the latter was a common practice in church construction in England in recent centuries.¹⁴)

Since it is easy to calculate the number of days each year that the sun rises near a given place on the eastern skyline, one can readily derive the distribution in azimuth of tomb orientations that would result *if* the second method was invariably used and *if* construction began on random dates throughout the year. The distribution would of course be sharply peaked near the solstices and would have a trough at the equinoxes. The theoretical distribution can then be compared with the actual distribution, to see whether there is evidence to suggest that the builders did in fact work throughout the year, laying out their tombs to face the rising sun.

In the case of a cemetery where it is thought the tombs may have been laid out to face moonrise rather than sunrise, a similar method can be used, the solar year being replaced by the 18.6-year cycle of the moon. The distribution is still peaked near the solstices, but much less sharply so.

The two theoretical distributions and the distribution found at Armenoi are given in histogram form in Figure 7. It will be seen that the required peaks around the solstices are not in fact present at Armenoi, and so it is not the case that the builders worked throughout the year, laying out tombs to face the rising sun or moon. But it would of course be easy to devise a more complex explanation, whereby, for example, some tombs indeed faced sunrise or moonrise while others were simply laid out in an easterly direction, or that little work was done around midwinter and midsummer (because of the weather, or the celebration of festivals). Note that the symmetry of the Armenoi azimuths about the equinox direction may suggest that the builders worked as much in the summer as in the winter — that they were professionals, as indeed the massive scale of the tombs would lead us to expect.

Acknowledgements

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3. Stefan Hiller, *Des minoische Kreta nach der Ausgrabungen des letzten Jahrzehntes* (Österreichische Akademie der Wissenschaften, Vienna, 1977), 203.
4. The tomb contained a stone amulet with a combination of two ideograms in Linear A, dating from the end of Late Minoan IB (c. 1450 B.C.), and pottery from Late Minoan II–IIIA1/A2 (1450–1380). The amulet may well have been a family heirloom, and so its presence does not *prove* that the tomb was in use prior to the middle of the fifteenth century: Helen Papadopoulou, "The tholos tomb of the Late Minoan Cemetery at Armenoi of Rhethymnon: A structural approach", paper (in Greek) read at the 7th International Cretological Conference, Rhethymon, Crete, August 1991, to appear in the Proceedings of the Conference.
5. For brief reports on 107 of these, see Iannis Tzedakis, "Armenoi (Rhethymnon)", *Archaiologikon Deltion*, Chronicles, xxv (1970), 476–7; xxvi (1971), 513–16; xxvii (1972), 639–44; xxix (1973–74), 917–21; and xxxi (1976), 368–72.
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9. On these see for example: Helen Papadopoulou, "Mycenean burial customs in Minoan culture: Grave-stelae from the late Minoan cemetery at Armenoi-Rhethymnon", paper (in Greek) read at the II International Mycenaean Conference, Rome-Naples, October 1991, to appear in the Proceedings of the Conference; Iannis Tzedakis, "Larnakes of the Late Minoan cemetery at Armenoi of Rhethymnon" (in Greek), *Archaiologika analekta ex Athinon*, iv/2 (1971), 216–22; Ingo Pini, *Corpus der Minoischen und Mykenischen Siegel*, v/1 (Berlin, 1975), 197–224.
10. Even Tomb 178, the only tomb without a well-defined axis, faces roughly east.
11. The sanctuary has been excavated, but the excavation has not yet been published. See the brief announcement by Kostas Davaras, "Vrysinas-Rhethymnon", *Archaiologikon Deltion*, xxviii (1973), Chronicles, 583–4 (in Greek). On Cretan peak sanctuaries, including Mt Vrysinas, see the articles (in French) by Paul Faure in *Bulletin de correspondance hellénique*, lxxxvii (1963), 493–508, espec. pp. 504–7; lxxxix (1965), 27–63, espec. pp. 49–51; xci (1967), 114–50, esp. pp. 127, 131; xciii (1969), 174–213, espec. pp. 185–6; and xcvi (1972), 389–426, espec. p. 397.
12. Quantities of clay votive offerings, including hundreds of fragments of what had been figures of bulls, were found here. According to Faure (*op. cit.* (ref. 11, 1965), 51), the deity worshipped on Mt Vrysinas was Dictynna, "mistress of the mountains", identified later with Artemis the huntress and rearer of children, who was associated with the moon in the west of Crete. It is by no means certain that the sanctuary was concerned with worship of a lunar goddess, but its orientation, and the association with Dictynna, make this a possibility.
13. See for example G. S. Watson, *Statistics on spheres* (New York, 1983), 4–6.
14. For example, in the late seventeenth century, according to a contemporary author, "One end of every Church doth point to such a Place, where the Sun did rise at the time the Foundation thereof was laid ...; and by the standing of these Churches, it is known at what time of the Year the Foundations of them were laid" (Sir Henry Chauncy, *The historical antiquities of Hertfordshire* (London, 1700), i, 88; cited by W. B. Dinsmoor, "Archaeology and astronomy", *Proceedings of the American Philosophical Society*, lxxx (1939), 95–173, pp. 101–2.

Interestingly, the wish to orientate a grave to face sunrise on the day of construction is the likely explanation of why the severely classical symmetry of the Cape Observatory in South Africa is marred by the grave of the first astronomer, Fearon Fallows, which occupies a prominent position in front of the building but is askew its line of symmetry.

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