

PLIOCENE BRACHIOPODS FROM THE ESTEPONA AREA (MÁLAGA, SOUTH SPAIN)

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ABSTRACT

Four brachiopod species (one rhynchonellid and 3 terebratulids) from Lower Pliocene sandy deposits of the Estepona area in the Málaga province (Andalusia, southern Spain) are described: *Aphelesia bipartita* (Brocchi), *Terebratula terebratula* (Linnaeus), *Gryphus* sp., and *Megerlia eusticta* (Philippi). *M. eusticta* is restricted to the Pliocene, but *A. bipartita* and *T. terebratula* are also regarded as characteristic Pliocene species, although they are reported from the Miocene as well. The investigated assemblage differs from all other Spanish Pliocene assemblages mostly in the absence of such genera as *Megathyris*, *Argyrotheca* and *Terebratulina*. The assemblages of similar composition to that from the Estepona area are associated with shallow water, high-energy environments and sandy facies through the whole Mediterranean region.

Keywords: Brachiopoda, Zanclean, Lower Pliocene, systematics, Málaga, Andalusia, South Spain, western Mediterranean.

RESUMEN

Se describen cuatro especies de braquiópodos (un rinconélido y 3 terebratúlidos) identificados en los depósitos de arenas del Plioceno Inferior del área de Estepona (Málaga, Andalucía): *Aphelesia bipartita* (Brocchi), *Terebratula terebratula* (Linnaeus), *Gryphus* sp. y *Megerlia eusticta* (Philippi). *M. eusticta* tiene una distribución restringida al Plioceno; *A. bipartita* y *T. terebratula*, aunque son especies características del Plioceno, se conocen también del Mioceno. La asociación estudiada difiere de las restantes conocidas del Plioceno español, especialmente por la ausencia de géneros tales como *Megathyris*, *Argyrotheca* y *Terebratulina*. Asociaciones de composición similar a la del área de Estepona están asociadas a ambientes de alta energía en aguas poco profundas y de facies arenosas en toda la región mediterránea.

Palabras clave: Brachiopoda, Zancleanse, Plioceno Inferior, sistemática, Málaga, Andalucía, España, Mediterráneo occidental.

INTRODUCTION

Pliocene brachiopods of Spain have been mentioned or listed by a number of authors in studies of molluscan faunas (see Faura and Sans, 1916; Brébion *et al.*, 1971, 1978; González Donoso and Porta, 1977; Martinell and Villalta, 1977), but more detailed studies are rare. Pajaud (1976, 1977) recognized 2 and 8 species in the brachiopod assemblages from the regions of Alicante and Almería, south-eastern Spain, respectively. From the Empordà basin, Catalonia, north-eastern Spain, an

assemblage of 5 brachiopod species was described by Encinas (1992; see also Encinas and Martinell, 1992). Recently the first occurrence of *Megerlia eusticta* (Philippi) in the Pliocene of Spain was reported by Calzada (1997) from the Almería region.

Brachiopods in Pliocene strata are also recorded from other Mediterranean countries. Being common and diversified, they have been the subject of intensive paleontological and paleoecological studies in recent years (*e.g.*, Elliott, 1960; Dermitzakis, 1969; Tavani, 1969; Anfossi *et al.*, 1983; Gaetani and Saccà, 1984,

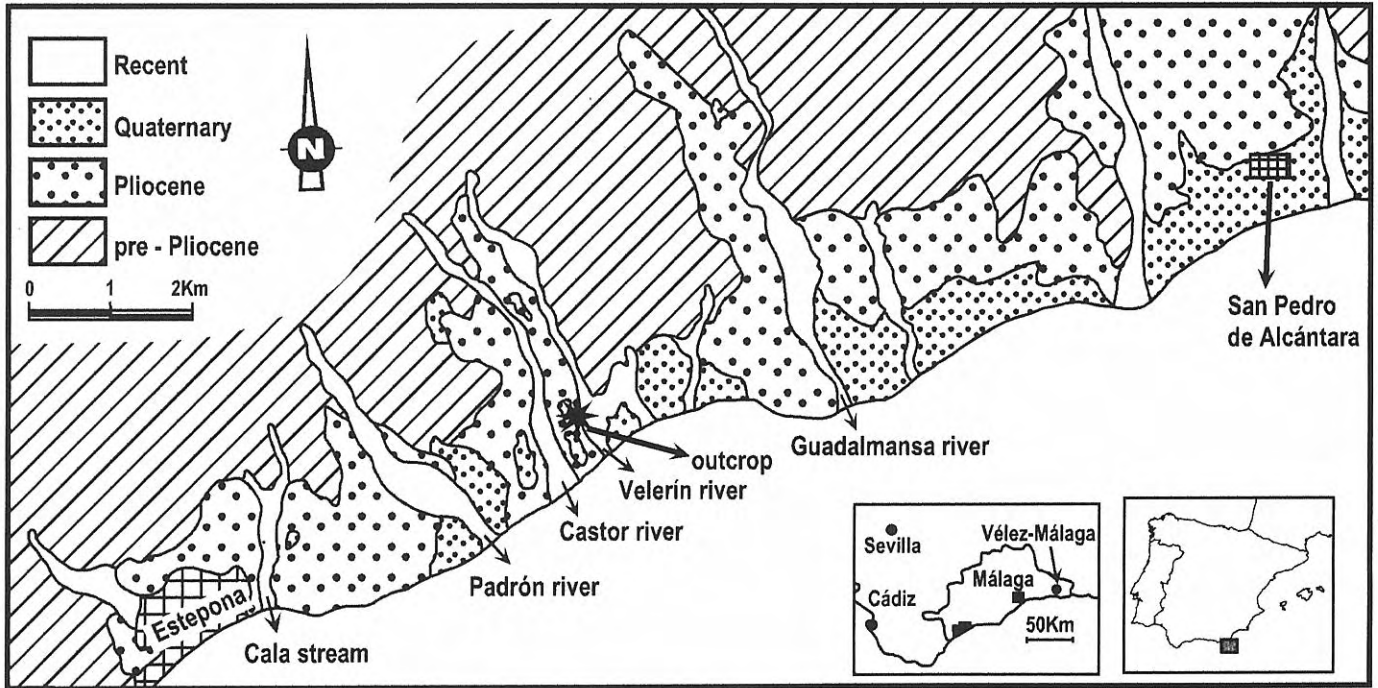


Figure 1. Geographical and geological location of the studied outcrop.

1985a, b; Georgiades-Dikeoulia, 1984; Gaetani, 1986; Saccà, 1986; Barrier *et al.*, 1987; Spano, 1989; Benigni and Robba, 1990; Taddei Ruggiero, 1994, 1996).

This paper presents the first description of the Pliocene brachiopod assemblage outcrops in the Velerín region, located in the Estepona area (Málaga, Andalusia, southern Spain). Until recently, the only record of brachiopods from this area was that of González Donoso and Porta (1977) who gave a list of four species: *Terebratula* sp., *Griphus* sp. [sic], *Megathiris* sp., and *Megerlia truncata* (Linnaeus). The investigated assemblage is also composed of four species, but a slight difference in composition is observed. The genus *Megathiris* is absent, while *Megerlia* is represented by another species, *M. eusticta*, and an additional element is *Aphelesia bipartita* (Brocchi). González Donoso and Porta (1977) presented neither illustrations nor descriptions, and it is difficult to estimate the accuracy of their determinations. Thus, it is possible that this is the same assemblage as described here despite apparent differences in taxonomic composition.

All specimens described herein are housed in the Institute of Paleobiology of the Polish Academy of Sciences (Warszawa) under the collection number ZPAL Bp.XLIV.

GEOGRAPHICAL AND GEOLOGICAL SETTINGS

There are two major marine Pliocene areas in the Málaga coastal region: the larger one, situated between Estepona and San Pedro de Alcántara towns, and a smaller one to the west near Vélez-Málaga, respectively (Fig. 1). The Pliocene deposits of the region outcrop

along a band of variable width along the coast and lie discordantly over the Alpujárride, Maláguide and El Campo de Gibraltar Complexes, or over transgressive Neogene formations of the Grupo de la Viñuela (Chamón *et al.*, 1978; Sanz de Galdeano *et al.*, 1993).

The Pliocene sediments constitute a transgressive sequence in the Estepona-San Pedro de Alcántara area, in which two groups may be recognized. The lower one is represented by canalized conglomerates interbedded with intermittent layers of sands, and an upper one is represented by sands (Muñiz-Solís and Guerra-Merchán, 1994) (Fig. 2). The brachiopod fauna studied comes from the Velerín outcrop, in the Estepona area (Figs. 1, 2) and occurs in sandy sediments.

Despite the interest aroused by the study of the Málaga Pliocene beds, few studies have been carried out until recently. See Vera-Peláez (1996) and Lozano-Francisco (1997) for further information.

The age of the greater part of the Malacitan marine Pliocene has been established as Zanclean on the basis of the study of foraminiferans, calcareous nannoplakton, ostracods and molluscs (González Donoso and Porta, 1977; Aranki, 1987; Aguirre, 1995; Vera-Peláez, 1996; Lozano-Francisco, 1997).

SOME TAPHONOMICAL CONSIDERATIONS

The Velerín outcrop (Fig. 1), which is up to 30 m thick, is located near the border of the Pliocene basin and coarse detritic facies prevail in it (lower group of Muñiz-Solís and Guerra-Merchán, 1994). Velerín is characterized by the conglomeratic facies with canalized bottoms and imbricated pebbles at the base (Fig. 2).

Locally, massive sands, sands with pebbles or cross-bedded sands are intercalated.

This outcrop is especially rich in molluscan fossils, some of them with traces of their original coloration. Nevertheless, the skeletal remains of the site have mostly undergone some transport and reworking prior to burial, as is evident in other parts of the basin. As a result, molluscan fossils usually show poor preservation (disarticulation, abrasion, some breaking, etc.). However the brachiopods at Velerín are excellently preserved, all articulated with no breakage, and were not transported or reworked.

Overall, the preliminary taphonomical studies of the outcrops revealed different degrees of faunal reworking, although without significant displacement. Only one of them (Parque Antena outcrop) has been studied in detail from a taphonomical point of view (Guerra-Merchán *et al.*, 1996). Fossils at this site perhaps show the best preservation in the whole basin, with very little transport of the skeletal remains.

SYSTEMATIC DESCRIPTION

PHYLUM BRACHIOPODA Duméril, 1806

SUBPHYLUM RHYNCHONELLIFORMEA Williams
et al., 1996

CLASS RHYNCHONELLATA Williams *et al.*, 1996

ORDER RHYNCHONELLIDA Kuhn, 1949

Superfamily RHYNCHONELLOIDEA d'Orbigny,
1847

Nomenclatural note: As recently indicated by Manceñido *et al.* (1993), the family-group names based on the genus *Rhynchonella* should be attributed to d'Orbigny, not Gray.

Family **Basiliolidae** Cooper, 1959

Subfamily **Aphelesiinae** Cooper, 1959

Genus *Aphelesia* Cooper, 1959

Type species: *Anomia bipartita* Brocchi, 1814.

Aphelesia bipartita (Brocchi, 1814)

Figs. 3A-H

1814 *Anomia bipartita* Brocchi, 469, pl. 10, fig. 7.

1959 *Aphelesia bipartita* (Brocchi); Cooper, 41-42, pl. 7, figs. 12-22; pl. 8, figs. 13-18; pl. 22, figs. 18-25.

1985a *Aphelesia bipartita* (Brocchi); Gaetani and Saccà, 5, text-fig. 2, pl. 7, figs. 1-4.

1985b *Aphelesia bipartita* (Brocchi); Gaetani and Saccà, 363-365, text-figs. 2-3, pl. 17, figs. 1-3; pl. 19, figs. 1-3.

Dimensions (in mm):

	Length	Width	Thickness
ZPAL Bp.XLIV/1	20.0	19.3	11.0
ZPAL Bp.XLIV/2	19.2	21.1	11.8
ZPAL Bp.XLIV/4	19.6	22.6	11.7

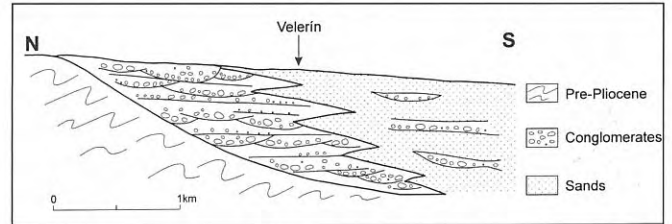


Figure 2. Simplified diagram of the stratigraphy of the Pliocene of the Estepona area with indication of the situation of Velerín outcrop.

Material: Eight complete specimens.

Remarks

The investigated specimens resemble very closely those described and illustrated by Cooper (1959) and Gaetani and Saccà (1985a, b). The shell is subtriangular to subpentagonal in outline and dorsibiconvex. The anterior commissure is uniplicate with a broad fold on the dorsal valve. The shell surface is smooth with very incipient costation on the anterior margin and numerous growth lines. The foramen is small, hypothryid with conjunct deltidial plates. The pedicle collar is sessile. The internal features observed in one slightly damaged specimen show characters typical of the genus. The teeth are supported by well-developed dental plates. Outer and inner hinge plates are absent, as is also the cardinal process. There is a low median ridge on the dorsal valve. The crura are broken.

This species is common and well known in the Late Tertiary in the Mediterranean region, but has not previously been described from Spain, apart from a record from the Pliocene strata of the Elche region (Brébion *et al.*, 1971). Pajaud (1976, 1977) described a new rhynchonellid genus and species, *Phapsirhynchia sanctapaulensis*, from the Lower Pliocene of the Alicante and Almería regions in southern Spain. However, according to Llombart and Calzada (1982) and Gaetani and Saccà (1985b) there is no reason to erect this new genus, and Pajaud's species should be assigned to the genus *Aphelesia*. The species *A. sanctapaulensis* (Pajaud, 1976) differs from the investigated specimens in having more distinct ribs on the anterior margin, and narrow, high uniplication (see pl. 3, fig. E in Pajaud 1976).

Aphelesia bipartita was also reported from the Miocene of Hungary by Meznerics (1943). She described as well a new species *Hemithiris acuta*, which is very similar to *A. bipartita*. Examination of the collection kept in the Hungarian Museum of Natural History by one of the authors did not allow deciding of validity of those determinations. The material of *A. bipartita* is very badly preserved, and the specimens are smaller and more elongate than typical *A. bipartita*. In turn, the specimens described as *H. acuta* display a great similarity to *A. bipartita*, and probably this species may be synonymous with *A. bipartita*.

The specimens under study differ from *A. pseudobipartita* (Sacco, 1902), the species known from the Pliocene of Italy, in being much larger and having

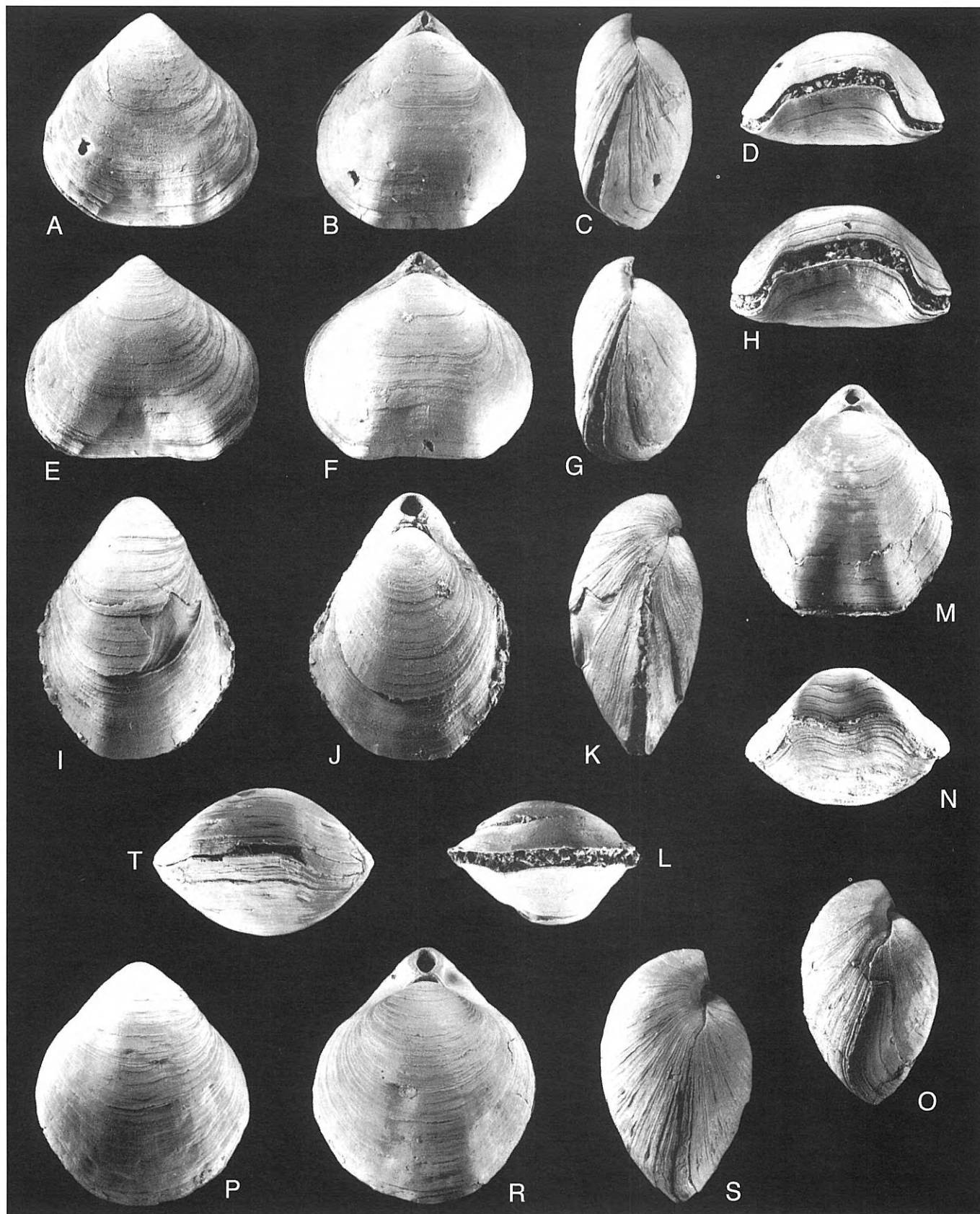


Figure 3. A-H. *Apelesia bipartita* (Brocchi), complete specimens, ZPAL Bp.XLIV/1-2, x 2; A, E - ventral views; B, F - dorsal views; C, G - lateral views; D, H - anterior views. I-L. *Gryphus* sp., complete specimen, ZPAL Bp.XLIV/13, x 2; I - ventral view, J - dorsal view, K - lateral view; L - anterior view. M-T. *Terebratula terebratula* (Linnaeus), complete specimens, ZPAL Bp.XLIV/9-10, x 1; M, R - dorsal views; N, T - anterior views; O, S lateral views; P - ventral view. All specimens from Velerín.

much less distinct ribs on the margin (Gaetani and Saccà, 1985b).

Occurrence

Aphelesia bipartita is reported from the Miocene of Hungary (Meznerics, 1943) and Malta (Pedley, 1976), and from the Pliocene of Spain (Brébion *et al.*, 1971) and Italy (Gaetani and Saccà, 1985a, b).

ORDER TEREBRATULIDA Waagen, 1883

SUBORDER TEREBRATULIDINA Waagen, 1883

Superfamily TEREBRATULOIDEA Gray, 1840

Family Terebratulidae Gray, 1840

Subfamily Terebratulinae Gray, 1840

Genus *Terebratula* Müller, 1776

Type species: *Anomia terebratula* Linnaeus, 1758.

Terebratula terebratula (Linnaeus, 1758)

Figs. 3M-T

1976 *Terebratula terebratula* (Linnaeus); Pajaud, 100-102, text-fig. 1, pl. 3, figs. A-C.

1977 *Terebratula terebratula* (Linnaeus); Pajaud, 6, pl. 2, figs. C-E.

1982 *Terebratula terebratula* (Linnaeus); Llombart and Calzada, 190-192, pl. 1, figs. 1-2.

1992 *Terebratula terebratula* (Linnaeus); Encinas, 88-94, pl. 6, figs. A-F; pl. 9, figs. A-B; pl. 10, fig. A.

1992 *Terebratula terebratula* (Linnaeus); Encinas and Martinell, 504.

Dimensions (in mm; figured specimens):

	L	W	T
ZPAL Bp.XLIV/9	42.2	36.3	25.4
ZPAL Bp.XLIV/10	45.6	39.1	27.4

Material: Four complete specimens.

Remarks

The investigated specimens correspond very well to those described from the Pliocene deposits of Spain by Pajaud (1976, 1977) and Encinas (1992). They differ, however, from Pajaud's specimens in being smaller. *Terebratula terebratula* is a large species, with smooth surface and nearly equally biconvex shell. The lateral commissure varies from nearly straight to gently curved toward ventral side, while anterior commissure can be slightly uniplicate to sulcinate. The beak is short, suberect to erect with a large, circular foramen of permesothyrid type. The symphytium is partly visible.

The nomenclatural problem of the so-called large *Terebratula* species has been pointed out by several authors (compare Calzada, 1978; Llombart and Calzada, 1982; Gaetani and Saccà 1985a). Gaetani and Saccà (1985a) in their revision distinguished three *Terebratula* species: *T. sinuosa* (Brocchi, 1814) from the Miocene, *T. calabra* Seguenza, 1871 from the Pliocene, and *T. scillae* Seguenza, 1871 from the Pleistocene. They placed the

specimens from the Pliocene of Spain described by Pajaud (1976, 1977) into the synonymy of *T. calabra*. Gaetani and Saccà (1985a) indicated that some specimens from Italy described as *T. terebratula* are probably synonymous with *T. scillae* as the deposits from where those specimens come are of the Pleistocene age. Because the type species of the genus *Terebratula* was not officially recognized (see Buckman, 1907), the priority of the name *terebratula* was not valid in their opinion.

Since the lack of the formally designated type species of the genus *Terebratula* provoked a lot of problems, Lee and Brunton (1998) undertook an attempt to resolve this confusion. They collected new material from the rediscovered type locality, a calcarenite of Pliocene age, and selected a specimen as neotype for *T. terebratula*. Following it, *Anomia terebratula* Linnaeus, 1758 was officially accepted as the type species of the genus *Terebratula* (Opinion 1959 of the International Commission on Zoological Nomenclature in the Bulletin of Zoological Nomenclature, 57(3), September 2000).

The re-evaluation of the late Cenozoic species assigned to the genus *Terebratula* has been also announced (Lee and Brunton, 2000; D.E. Lee, personal communication). All *Terebratula* species show a great similarity and it is doubtful if the age only can decide about the species attribution as proposed by Gaetani and Saccà (1985a).

Occurrence

Terebratula terebratula is reported from the Miocene of Malta (Pedley, 1976) and Spain (Llombart and Calzada, 1982), and from the Pliocene of Spain (Pajaud, 1976, 1977; Encinas, 1992). Large *Terebratula* species from the Tertiary of other Mediterranean regions (Dermitzakis, 1969; Georgiades-Dikeouli, 1984; Gaetani and Saccà, 1985a; Taddei Ruggiero, 1994, 1996) are also noted under different specific names (see discussion above).

Subfamily Gryphinae Sahni, 1929

Genus *Gryphus* Megerle von Mühlfeld, 1811

Type species: *Anomia vitrea* Born, 1778.

Gryphus sp.

Fig. 3I-L

Material: One complete specimen, measuring 24.2 mm long, 18.5 mm wide, and 12.7 mm thick.

Description

The medium-sized shell is oval, biconvex with the ventral valve more convex than the dorsal one. The shell surface is smooth, ornamented only by numerous growth lines. The lateral commissure is straight, and the anterior commissure is rectimarginate. The short, suberect beak is truncated by a large, circular foramen of epithyrid type. The symphytium is only slightly visible. The internal features are unknown.

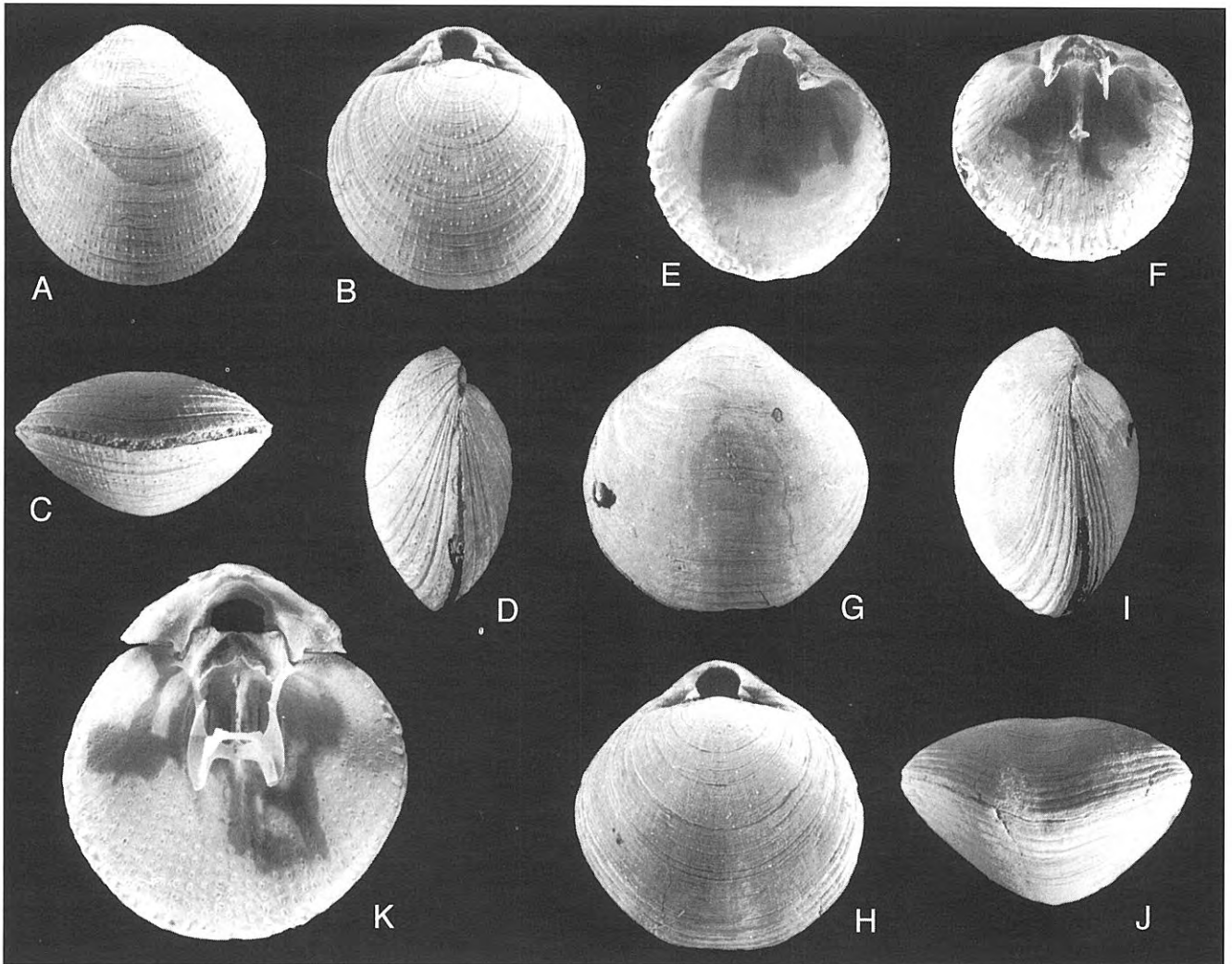


Figure 4. *Megerlia eusticta* (Philippi), Velerín; **A-D.** Complete specimen, ZPAL Bp.XLIV/14, x 3; A - ventral view; B - dorsal view; C - anterior view; D - lateral view. **E-F.** Inner views, ZPAL Bp.XLIV/16, x 3; E - ventral valve; F - dorsal valve. **G-J.** Complete specimen, ZPAL Bp.XLIV/15, x 3; G - ventral view; H - dorsal view; I - lateral view; J - anterior view. **K.** Inner view of dorsal valve, ventral valve partially destroyed to show brachidium, ZPAL Bp.XLIV/17, x 4.5.

Remarks

The limited material prevents detailed investigations and identification to the specific level, however, in external characters the investigated specimen agrees very well with the diagnosis of the genus (Cooper, 1983). The presence of this genus was already noted by González Donoso and Porta (1977: 53), listed with incorrect spelling, *Griphus* sp.

In size, shell outline, type of foramen the studied specimen resembles the Pliocene species *Gryphus sphenoideus* (Philippi, 1844) as described and illustrated by Gaetani and Saccà (1984, 1985a). It differs from *G. minor* (Philippi, 1836), another Pliocene species from Italy, in being much larger (see Gaetani and Saccà, 1985a).

Occurrence

The genus *Gryphus* is recorded from the Pliocene and Pleistocene deposits of Italy (Gaetani and Saccà, 1984,

1985a) and lives at present in the Mediterranean Sea (Logan, 1979; Emig, 1989a, b) and the Atlantic Ocean at depths from 70 to 2663 m (e.g., Brunton and Curry, 1979; Cooper, 1981, 1983).

SUBORDER TEREBRATELLIDINA Muir-Wood, 1955
Superfamily **KRAUSSINOIDEA** Dall, 1870
Family **Kraussinidae** Dall, 1870
Genus *Megerlia* King, 1850

Type species: *Anomia truncata* Linnaeus, 1767.

Megerlia eusticta (Philippi, 1836)
Fig. 4A-K

1836 *Terebratula eusticta* Philippi, 98, pl. 6, fig. 9.

1985a *Megerlia eusticta* (Philippi); Gaetani and Saccà, 16-17, text-fig. 11, pl. 10, figs. 1-9; pl. 11, figs. 6-12.

1997 *Megerlia eusticta* (Philippi); Calzada, 31-32, figs. 1-3.

Dimensions (in mm):

	L	W	T
ZPAL Bp.XLIV/14	12.4	11.9	6.8
ZPAL Bp.XLIV/15	13.8	13.4	8.9
ZPAK Bp.XLIV/18	13.1	12.8	7.9
ZPAL Bp.XLIV/19	13.7	13.8	7.7

Material: 14 complete specimens.

Remarks

Megerlia eusticta, reported for the second time from Spain, is a very characteristic and easily recognisable species which displays a small, rounded, strongly ventribiconvex shell. Its surface is delicately ornamented by faint striae, sometimes with small spines (see Fig. 4A-B). The anterior commissure varies from nearly straight to gently unisulcate. The beak is short, erect, truncated by a large, oval to circular foramen of mesothyrid type; the beak ridges are distinct. The deltidial plates are disjunct and minute. The pedicle collar is wide and sessile. The teeth are short. *M. eusticta* has a complex brachial skeleton, consisting of a long loop with a full ring supported dorsally by the median septum (Fig. 4K); inner hinge plates well developed. Muscle scars are well visible on both valves.

The studied specimens are entirely consistent in external and internal morphologies with those hitherto described (Gaetani and Saccà, 1985a; Calzada, 1997), being, however, somewhat smaller than the specimens from Italy.

This species can be easily distinguished from common *Megerlia truncata* (Linnaeus, 1767) by its rounded shape, striate ornamentation, and different umbonal part (see Logan, 1979; Gaetani and Saccà, 1985a; Bitner, 1990).

The investigated specimens are very similar to the specimens from the Pliocene strata of Italy described as *Megerlia echinata* (Fisher and Oehlert, 1891) (Saccà, 1986). Saccà (1986) considers *M. echinata* as an intermediate form between *M. truncata* and *M. eusticta*.

Occurrence

The species *Megerlia eusticta* is restricted to the Pliocene, and it is known from Italy (Gaetani and Saccà, 1985a; Taddei Ruggiero, 1996) and Spain (Calzada, 1997).

THE MEDITERRANEAN PLIOCENE BRACHIOPOD ASSEMBLAGES

The Mediterranean Pliocene brachiopod assemblages are commonly composed of large terebratulids and various micromorphic brachiopods, but their composition at the species level can differ greatly. The species composition is clearly dependent on environmental conditions, and is not associated with the age. Lower and Upper Pliocene brachiopod assemblages are very similar or identical if they occur in the same sediments. The investigated assemblage from Velerín consists of *Terebratula terebratula* (= *Terebratula calabra* in Italian publications, see also discussion on p.

181), *Aphelesia bipartita*, *Megerlia eusticta*, and very rare (only one specimen) *Gryphus* sp. Similar brachiopod assemblages composed of those three species or sometimes with rare additional elements, for instance *Terebratulina retusa*, *Megathiris detruncata* and/or *Megerlia truncata*, are known from Italy both from Lower and Upper Pliocene (Gaetani and Saccà, 1985a, b; Gaetani, 1986; Barrier *et al.*, 1987; Taddei Ruggiero, 1996). The *Terebratula/Aphelesia/Megerlia* assemblage is characteristic for the shallow water, typical circalittoral, sandy facies (Gaetani and Saccà, 1985a, b; Gaetani, 1986; Barrier *et al.*, 1987) which is in agreement with conditions inferred for the Velerín outcrop. *Aphelesia bipartita* and *Megerlia eusticta* seem to be adapted to high-energy sandy bottoms (Gaetani and Saccà, 1985a; Gaetani, 1986; Barrier *et al.*, 1987; Benigni and Robba, 1990). The increase in amount of muddy sediment alters the frequency of these two species. In the clayey units in northern Italy the assemblage is limited to the bioclastic interlayers and is almost dominated by *Terebratula* (Gaetani, 1986).

Taddei Ruggiero (1996) distinguished two circalittoral assemblages in the Upper Pliocene of the Murge area, southern Italy. One of them corresponds in composition to the assemblage discussed above, *i.e.* consists of *Aphelesia bipartita*, *Terebratula calabra*, and *Megerlia eusticta*. It is associated with finely detritic and muddy bottoms. The second assemblage recognized by Taddei Ruggiero (1996) is linked with hard substrate or coarsely detritic bottoms where *Neocrania anomala*, *Megathiris detruncata*, *Argyrotheca cuneata*, *A. cordata*, *Megerlia truncata* are common, while *Megerlia eusticta* and large *Terebratula* are very rare. The latter assemblage is very close to the brachiopod assemblage from the Almería region (SE Spain) described by Pajaud (1977).

In shallow-water littoral environment of the Empordà basin (NE Spain) *Megathiris detruncata* and *Megerlia truncata* dominate in the assemblage (90% of all specimens), and *Terebratula terebratula*, *Terebratulina retusa*, and *Argyrotheca cordata* occur in negligible quantities (Encinas, 1992; Encinas and Martinell, 1992).

The *Dallina/Fallax/Gryphus sphenoides* assemblage characteristic of the bathyal zone, described by Gaetani and Saccà (1984) and Gaetani (1986) from southern Italy, is not known from Spain.

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