

Pliocene brachiopods from north-western Africa

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ABSTRACT

Seven species of Pliocene brachiopods belonging to the genera *Aphelesia* Cooper, 1959, *Terebratulina* Müller, 1776, *Gryphus* Megerle von Mühlfeld, 1811, *Terebratulina* d'Orbigny, 1847, *Megathiris* d'Orbigny, 1847 and *Megerlia* King, 1850 have been recognised in an old collection from Algeria and Morocco, held in the Muséum national d'Histoire naturelle, Paris. This is the first record of *Gryphus* from North Africa, while *Aphelesia* and *Megerlia* are reported for the first time from Morocco. This brachiopod fauna displays close affinity with those from the Mediterranean province where assemblages of similar composition are associated with shallow water, high-energy environments.

KEY WORDS

Brachiopoda,
Pliocene,
Mediterranean province,
north-western Africa,
Algeria,
Morocco.

RÉSUMÉ

Brachiopodes pliocènes de l'Afrique nord-occidentale.

Sept espèces de brachiopodes pliocènes, provenant d'Algérie et du Maroc, ont été déterminées dans les collections du Muséum national d'Histoire naturelle de Paris. Elles appartiennent aux genres *Aphelesia* Cooper, 1959, *Terebratulina* Müller, 1776, *Gryphus* Megerle von Mühlfeld, 1811, *Terebratulina* d'Orbigny, 1847, *Megathiris* d'Orbigny, 1847 et *Megerlia* King, 1850. *Gryphus* est mentionné ici pour la première fois en Afrique du Nord et *Aphelesia* et *Megerlia* au Maroc. Cette faune de brachiopodes présente de grandes affinités avec celles de la province méditerranéenne où des assemblages de composition similaire sont associés à des environnements de faible profondeur et haute énergie.

MOTS CLÉS

Brachiopoda,
Pliocène,
province méditerranéenne,
Afrique nord-occidentale,
Algérie,
Maroc.

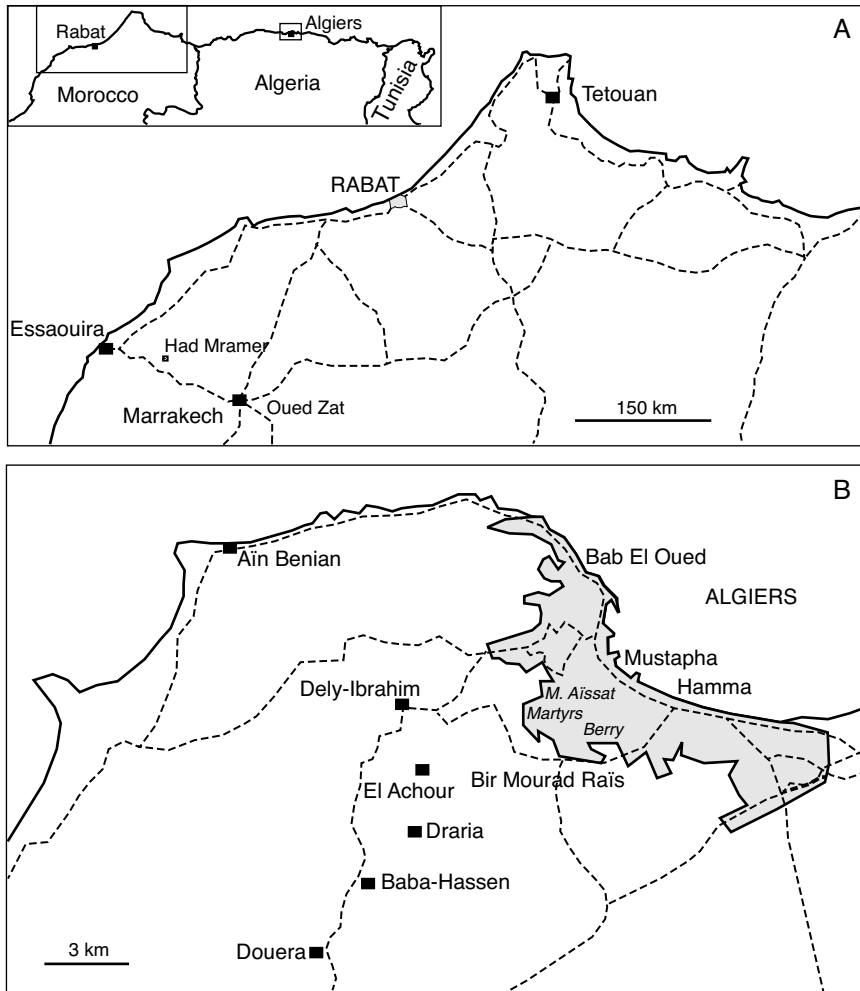


Fig. 1. — Localities from which the brachiopods were collected, in Morocco (A) and Algeria (B).

INTRODUCTION

The brachiopod fauna from the Neogene of the Mediterranean region has drawn the attention of many researchers in Italy, France, Spain, and Greece since the last century. Pliocene brachiopods, however, are described in detail only from Italy (Gaetani & Saccà 1984, 1985a, b; Saccà 1986; Benigni & Robba 1990; Taddei Ruggiero 1994, 1996), and Spain (Pajaud 1976, 1977; Encinas 1992; Calzada 1997; Bitner & Martinell 2001). Very little has been published

on the Pliocene brachiopods from North Africa, with the exception of a short note by Dautzenberg (1909) who described a new species of ribbed rhynchonellid from the Algiers region. The presence of brachiopods in Algeria and Morocco was, however, mentioned by authors working on geology or other faunal groups (Welsch 1888; Fischer & Oehlert 1891; Ficheur 1896a-d; Dalloni 1915; Lecointre 1926; Yassini 1973, 1979; Ben Moussa 1994; Haddadi-Hamdane 1996). This paper presents the first detailed study of Pliocene brachiopods from

TABLE 1. — Distribution of the investigated brachiopods in particular outcrops. Abbreviations (in brackets old names as used on the original labels): **Dr**, Draria; **Al**, Algiers; **Ha**, Hamma; **Mu**, Mustapha; **Mi**, Mustapha inférieure; **Ms**, Mustapha supérieure; **Ma**, boulevard des Martyrs, Algiers (boulevard Bru); **Ab**, between Mustapha Aïssat (colonne Voirol) and Bir Mourad Raïs (Birmandreis); **Mb**, between Mustapha inférieure and Bir Mourad Raïs; **Be**, rue du Berry, Algiers (Kodja-Berry); **Do**, Douera; **De**, Dely-Ibrahim; **Ba**, Bab El Oued; **An**, Ain Benian (Guyotville); **Ac**, El Achour; **Eb**, between El Achour and Baba-Hassen; **Te**, Tetouan; **Hd**, Had Mramer (Meramer); **Za**, Oued Zat.

Species	Algeria														Morocco				
	Dr	Al	Ha	Mu	Mi	Ms	Ma	Ab	Mb	Be	Do	De	Ba	An	Ac	Eb	Te	Hd	Za
<i>Aphelesia bipartita</i> (Brocchi, 1814)	x	x		x	x	x		x			x		x				x		
<i>Terebratula terebratula</i> (Linnaeus, 1758)	x		x	x	x		x		x	x	x	x			x	x	x		
<i>Terebratula</i> sp.																			
<i>Gryphus</i> sp.					x									x					x
<i>Terebratulina retusa</i> (Linnaeus, 1758)	x			x		x													
<i>Megathiris detruncata</i> (Gmelin, 1790)				x															
<i>Megerlia eusticta</i> (Philippi, 1836)				x	x		x												x

North Africa. This study extends the geographical ranges of some genera, and may be of use in further investigations on the Mediterranean biogeographical province. The investigated material was collected in the late 19th and early 20th centuries by various researchers and the collection has been kept since then in the Département Histoire de la Terre, Muséum national d'Histoire naturelle in Paris, France (LP-MNHN) with only preliminary determinations. The material is moderately preserved with many specimens damaged or crushed, and is dominated by the species *Terebratula terebratula* (Linnaeus, 1758). The total number of specimens is 151.

GEOLOGICAL SETTING

Pliocene marine deposits mostly occur along the coasts of Morocco and Algeria. They are well developed in a number of basins on the Atlantic side of Morocco, principally around Marrakech and Rabat (Wernli 1979; Alvinerie *et al.* 1992; Barbieri & Ori 2000), but also near Tangier (Ben Moussa 1994; Pouyet *et al.* 1999). Smaller basins are situated on the Mediterranean coast, for example around Tetouan (Ben Moussa 1994)

(Fig. 1A). In Algeria, marine Pliocene deposits occur in two major coastal basins: one in the western part, the Chelif basin (Perrodon 1957; Belkebir & Anglada 1985) and the other around Algiers (Yassini 1973, 1979; Saoudi 1989) (Fig. 1B).

The lower Pliocene sediments are mostly deep-sea marls (blue marls) with rich microfaunas, whereas the middle and upper Pliocene are represented by shallow water deposits such as sandy marls, sands, conglomerates, biocalcarenites, and calcareous sandstones where coralline algae and macro-invertebrates such as molluscs, brachiopods, bryozoans, echinoids are generally abundant (Perrodon 1957; Belkebir & Anglada 1985; Saoudi 1989; Ben Moussa 1994; Haddadi-Hamdane 1996; Hamdane & Moissette 1997). A glauconite-rich layer often occurs near the top of the lower Pliocene blue marls, especially in the Sahel of Algiers (Yassini 1975; Saoudi 1989).

SYSTEMATICS

A new supra-ordinal classification of the Brachiopoda (Williams *et al.* 1996) has been used here, together with a new classification of

TABLE 2. — Measurements (in mm) of *Aphelesia bipartita* (Brocchi, 1814). Abbreviations: L, length; T, thickness; W, width.

Specimen number	L	W	T
B.38683	24.9	26.8	17.3
B.38681	22.1	21.1	11.4
B.38645 (figured)	20.7	22.6	14.7
B.38645 (figured)	17.8	17.2	12.0
B.38648 (figured)	15.4	17.3	8.8

Mesozoic and Cenozoic Rhynchonellida, adopted for the forthcoming updated edition of the Treatise (Manceñido & Owen 1996, 2001). Since most investigated species are well known, only some more important and/or recent synonymies are given.

Phylum BRACHIOPODA Duméril, 1806
 Subphylum RHYNCHONELLIFORMEA
 Williams, Carlson, Brunton, Holmer & Popov, 1996

Class RHYNCHONELLATA Williams, Carlson, Brunton, Holmer & Popov, 1996
 Order RHYNCHONELLIDA Kuhn, 1949

Superfamily PUGNACOIDEA Rzhonsnitskaya, 1956
 Family BASILODAE Cooper, 1959
 Subfamily APHELESIINAE Cooper, 1959

Genus *Aphelesia* Cooper, 1959

TYPE SPECIES. — *Anomia bipartita* Brocchi, 1814, by original designation of Cooper (1959: 41).

Aphelesia bipartita (Brocchi, 1814)
 (Fig. 2; Table 2)

Aphelesia bipartita – Cooper 1959: 41, 42, pl. 7, figs 12-22; pl. 8, figs 13-18; pl. 22, figs 18-25. — Gaetani & Saccà 1985b: 363-365, text-figs 2, 3, pl. 17, figs 1-3; pl. 19, figs 1-3. — Bitner & Martinell 2001: 179, 181, fig. 3A-H.

MATERIAL EXAMINED. — 22 complete specimens, one ventral valve, and three dorsal valves from Algeria: LP-MNHN B.38645-B.38648, B.38658, B.38662, B.38663, B.38667, B.38668, B.38670, B.38671, B.38674, B.38681, B.38683; two ventral valves from Morocco: LP-MNHN B.38315 (for distribution in particular sites see Table 1).

OCCURRENCE. — This species is recorded from the Miocene and Pliocene deposits of the Mediterranean region.

REMARKS

Aphelesia bipartita is one of the commonest brachiopods and the only rhynchonellid in the investigated material. This species has been well described and illustrated by previous authors (Cooper 1959; Gaetani & Saccà 1985a, b; Bitner & Martinell 2001). It is well known from the Pliocene of Italy (Gaetani & Saccà 1985a, b; Taddei Ruggiero 1996) and Spain (Brébion *et al.* 1971; Bitner & Martinell 2001). Davidson (1864) and Pedley (1976) also recorded this species from the Miocene deposits of Malta, and Meznerics (1943) from the Miocene of Hungary.

A. bipartita has a subtriangular outline and a smooth surface with incipient costation on the anterior margin. The shell is strongly dorsibiconvex with broadly uniplicate anterior commissure. It was already reported, under the name *Rhynchonella bipartita*, from the Pliocene deposits of Algeria, by Welsch (1888) and Ficheur (1896a), but this is the first record of this species from Morocco.

The only other rhynchonellid from the Pliocene of the Algiers region was a new species described from only two specimens by Dautzenberg (1909), *Rhynchonella lamothei*. This coarsely ribbed species is unlike any other Tertiary rhynchonellid, and as nothing is known about its interior, it is difficult to evaluate that determination (see also Cooper 1959: 66).

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, by subsequent designation of Lamarck (1799: 89).

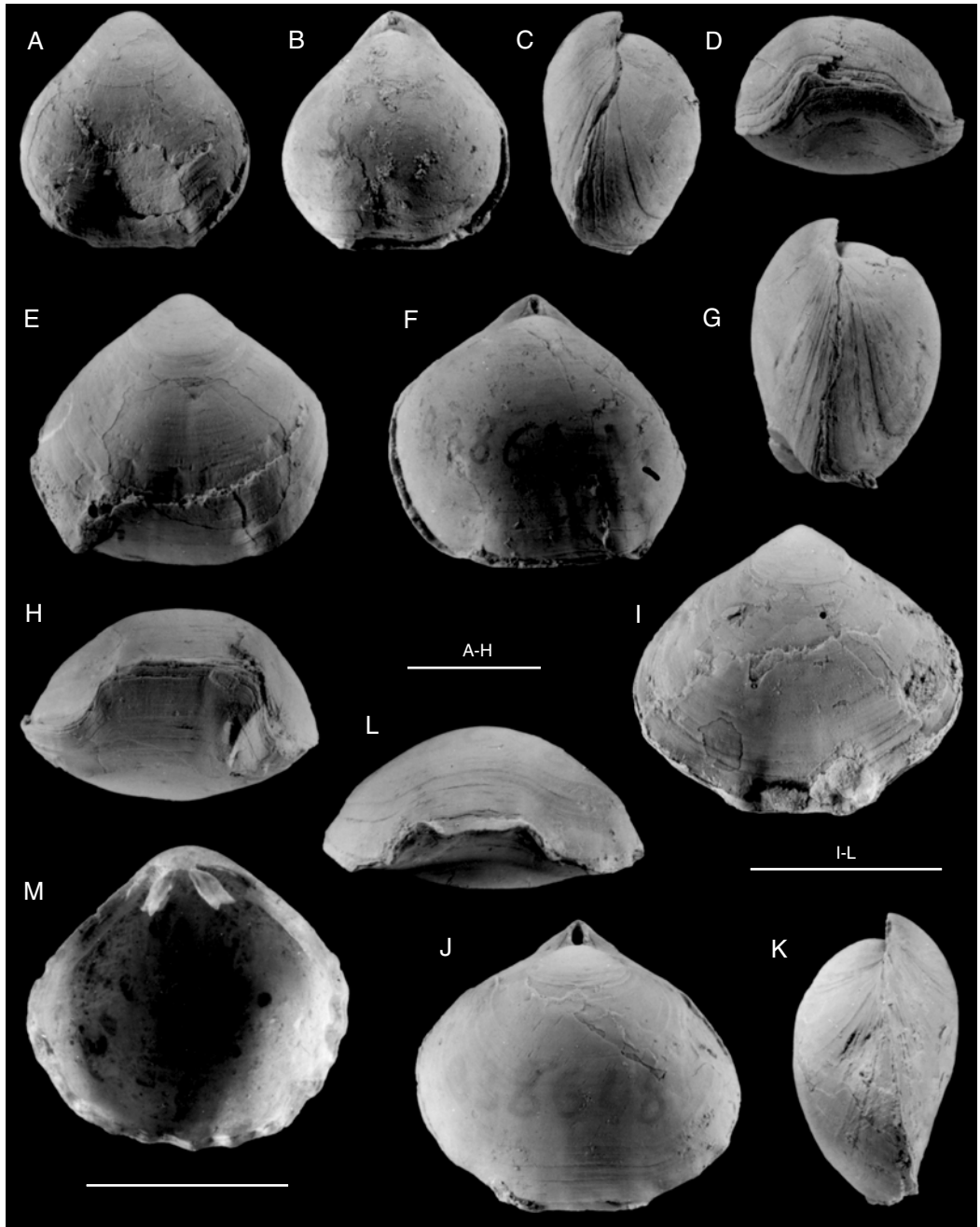


FIG. 2. — *Aphelesia bipartita* (Brocchi, 1814); **A-H**, ventral, dorsal, lateral and anterior views of complete specimens, Draria, Algeria (LP-MNHN B.38645); **I-L**, ventral, dorsal, lateral and anterior views of complete specimen, Mustapha supérieur (Algiers), Algeria (LP-MNHN B.38648); **M**, interior view of dorsal valve, Bab El Oued, Algeria (LP-MNHN B.38658). Scale bars: 1 cm.

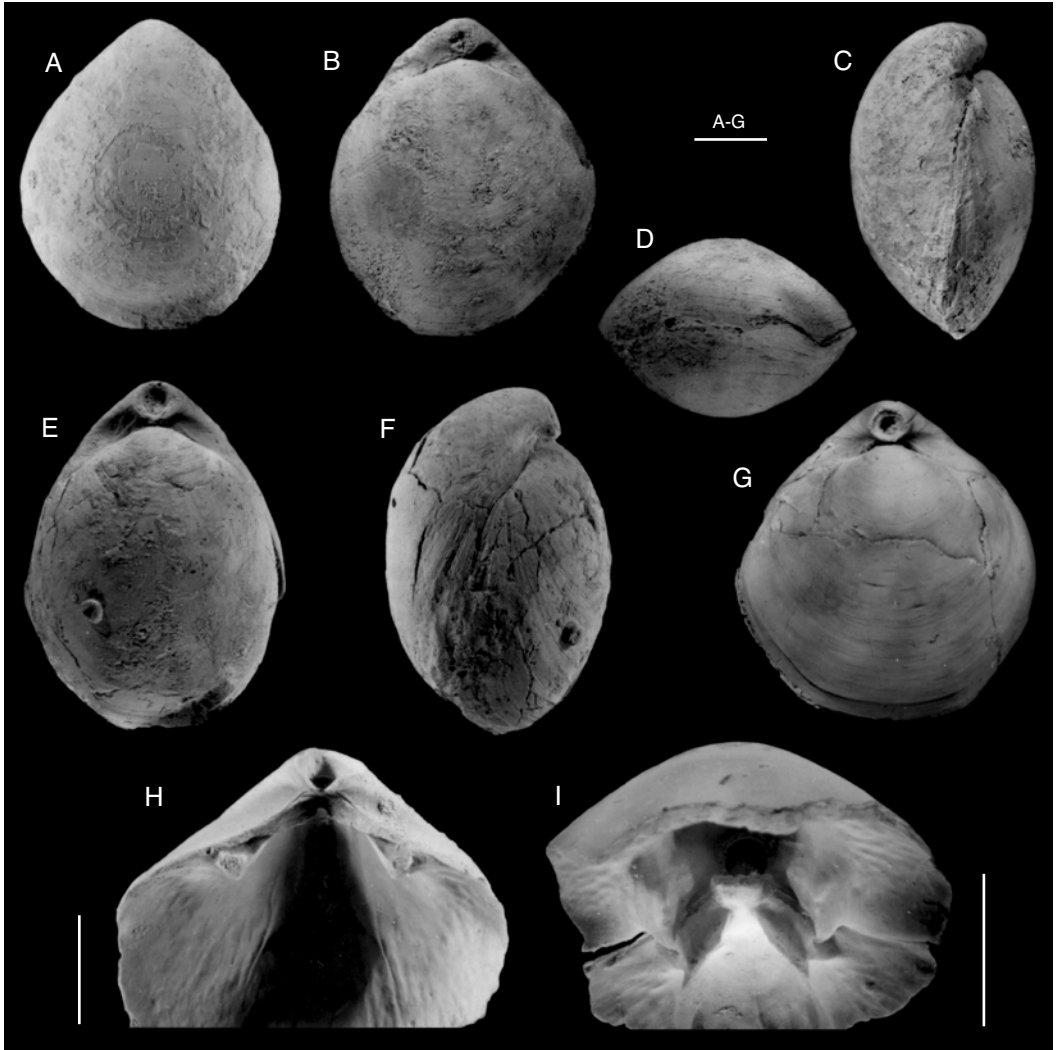


FIG. 3. — *Terebratula terebratula* (Linnaeus, 1758); **A-F**, Douera, Algeria (LP-MNHN B.38650); **A-D**, ventral, dorsal, lateral and anterior views of complete specimen; **E, F**, dorsal and lateral views of complete specimen; **G**, dorsal view of complete specimen, Draria, Algeria (LP-MNHN B.38654); **H, I**, Algiers, between Mustapha inférieur and Bir Mourad Raïs, Algeria (LP-MNHN B.38675); **H**, inner view of the ventral valve, visible is concave symphytium and massive teeth; **I**, inner view of complete specimen, showing a prominent cardinal process and narrow outer hinge plates. Scale bars: 1 cm.

Terebratula terebratula (Linnaeus, 1758)
(Fig. 3; Table 3)

Terebratula calabra Seguenza, 1871: 64, pl. 5, figs 5-8. — Gaetani & Saccà 1985a: 7-9, text-figs 5-7, pl. 1, figs 7-12; pl. 3, figs 6-10. — Taddei Ruggiero 1994: 206, pl. 1, figs 3-5.

Terebratula terebratula – Bitner & Martinell 2001: 181, fig. 3M-T. — Lee *et al.* 2001: 89-91, figs 6-9.

MATERIAL EXAMINED. — 33 complete specimens, 17 ventral valves, and 9 dorsal valves from Algeria: LP-MNHN B.38649-B.38657, B.38671, B.38672, B.38674-B.38680, B.38682, B.38684, B.38685; 10 complete specimens, two ventral valves, and five dorsal valves from Morocco: LP-MNHN B.38314, B.38315 (for detailed localities see also Table 1).

OCCURRENCE. — This species is known from the late Miocene and Pliocene of the Mediterranean region.

REMARKS

This large species (max. length 53.1 mm) is the commonest brachiopod in the studied material. It is also very common in the Pliocene deposits throughout the Mediterranean region (Pajaud 1976, 1977; Gaetani & Saccà 1985a; Encinas 1992; Encinas & Martinell 1992; Taddei Ruggiero 1994, 1996; Bitner & Martinell 2001; Lee *et al.* 2001). The investigated specimens, although poorly preserved, often broken and/or crushed, correspond well to those described by the previous authors. The shell is variable in outline, from elongate oval to subcircular (see Fig. 3E, G). The shell surface is smooth with numerous growth lines visible. The valves are nearly equal in depth. The anterior commissure varies from slightly uniplicate to sulcinate. This species has a large, circular, permesothyrid foramen and partly visible symphytium. The brachidium has not been preserved in any specimens but cardinalia with a prominent cardinal process and narrow outer hinge plates (Fig. 3I) are typical of the genus. The nomenclatural problem of the large *Terebratula* species and the validity of the name *T. terebratula* were already discussed (Gaetani & Saccà 1985a; Lee & Brunton 1998; Bitner & Martinell 2001). In their recent paper Lee *et al.* (2001) summarised the long and complex history of *T. terebratula* from 1616, and presented the relationships of species currently included in *Terebratula*.

This species was already noted, under different names (*T. ampulla* Brocchi, 1814, *T. biplicata* Brocchi, 1814, *T. sinuosa* Brocchi, 1814), from Algeria and Morocco by other authors (e.g., Welsch 1888; Fischer & Oehlert 1891; Ficheur 1896c, d; Dalloni 1915; Lecointre 1926; Yassini 1973, 1979; Ben Moussa 1994).

Terebratula sp.

(Figs 4A-L; 5C, D; Table 4)

MATERIAL EXAMINED. — Eight complete specimens from Morocco: LP-MNHN B.38316 (see also Table 1).

TABLE 3. — Measurements (in mm) of *Terebratula terebratula* (Linnaeus, 1758). Abbreviations: L, length; T, thickness; W, width.

Specimen number	L	W	T
B.38675	50.2	37.4	26.5
B.38650 (figured)	49.2	36.5	32.5
B.38650 (figured)	42.8	36.0	25.5
B.38652	44.2	37.6	28.8
B.38654 (figured)	43.0	41.1	23.8

TABLE 4. — Measurements (in mm) of *Terebratula* sp. Abbreviations: L, length; T, thickness; W, width.

Specimen number	L	W	T
B.38316 (figured)	18.8	16.6	11.3
B.38316	17.7	16.6	9.4
B.38316 (figured)	15.1	13.6	9.1
B.38316 (figured)	13.9	13.0	7.6

OCCURRENCE. — The genus *Terebratula* is very common in the Late Tertiary of the Mediterranean.

DESCRIPTION

The shell is of small size (max. length 19.8 mm), with a subcircular to oval outline and maximum width about midvalve. The valves are ventribiconvex and smooth, marked only by numerous growth lines. The beak is erected, truncated by a large, circular, permesothyrid foramen. The symphytium is only slightly visible. The lateral commissure is curved ventrally. The anterior commissure is sulcinate. The internal structures are unknown.

The ultrastructural analysis shows that the shell consists of two layers. The primary layer, up to 40 µm thick, is composed of acicular crystallites. The secondary layer is made up of fibres subparallel to the shell surface (Fig. 5C, D).

REMARKS

The unknown internal morphology prevents determination to the specific level. The specimens display externally many characters typical of the genus *Terebratula*, but are smaller than *T. terebratula* described above. The latter species has also a lesser degree of anterior folding. The shell built of two layers is characteristic of the

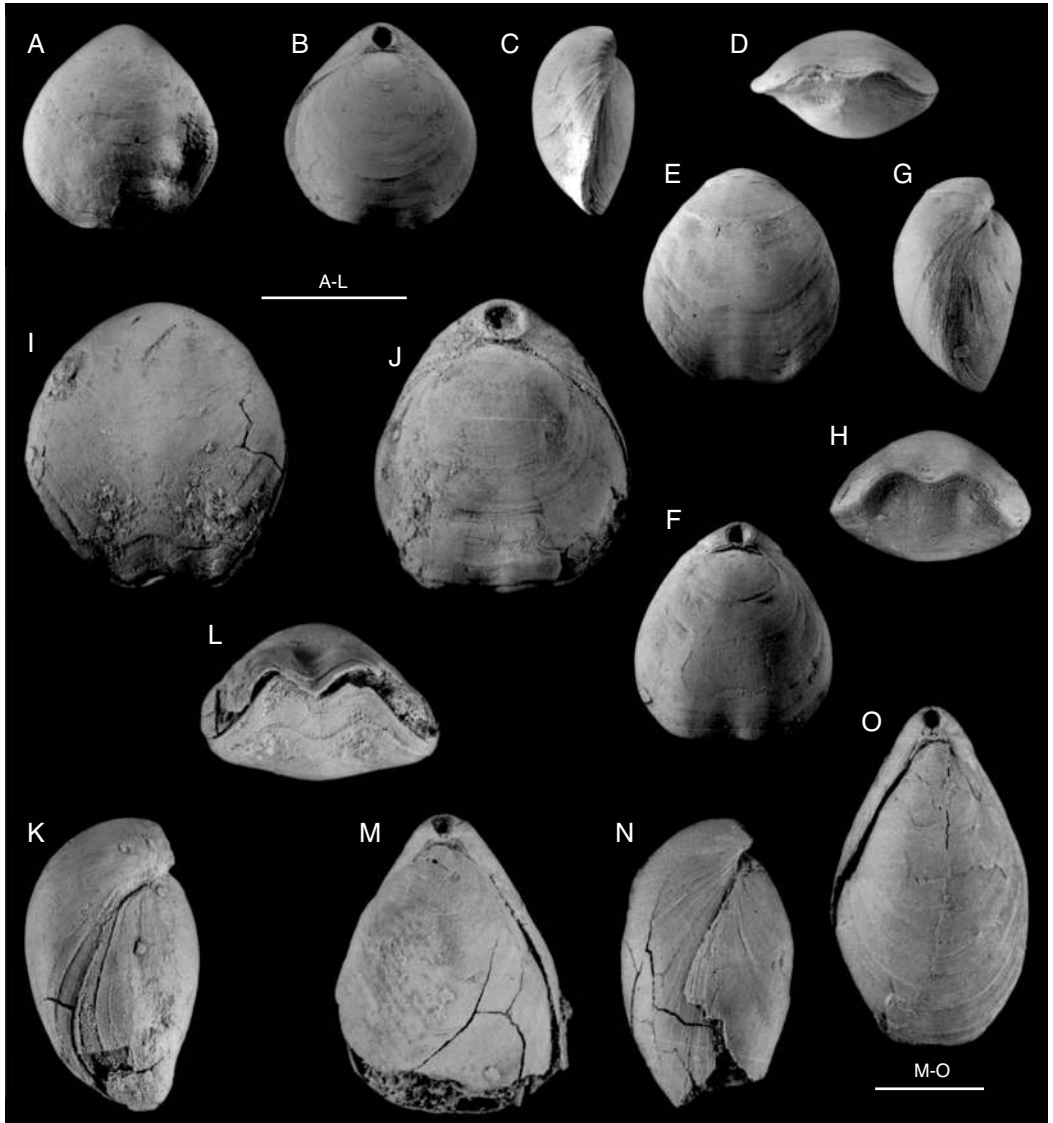


FIG. 4. — **A-L**, *Terebratula* sp., ventral, dorsal, lateral and anterior views of complete specimens, Had Mramer, Morocco (LP-MNHN B.38316); **M-O**, *Gryphus* sp.; **M, N**, dorsal and lateral views of complete specimen, Mustapha inférieur (Algiers), Algeria (LP-MNHN B.38671); **O**, dorsal view of complete specimen, Aïn Benian, Algeria (LP-MNHN B.38666). Scale bars: A-L, 1 cm; M-O, 5 mm.

genus *Terebratula* (Taddei Ruggiero 1983; Gaetani & Saccà 1985a).

In the Pliocene assemblage from the Murge area, southern Italy, Taddei Ruggiero (1996) reported the occurrence of similar specimens with adult forms reaching only 10-15 mm length which she determined as *Terebratula* sp. The absence of

detailed description and/or illustrations does not allow comparison with the specimens under study. Cooper (1983) created a new genus and species, *Maltaia maltensis*, for the specimens from the Miocene of Malta which resemble *Terebratula* but are smaller and strongly biplicate (see also Davidson 1864). The investigated specimens

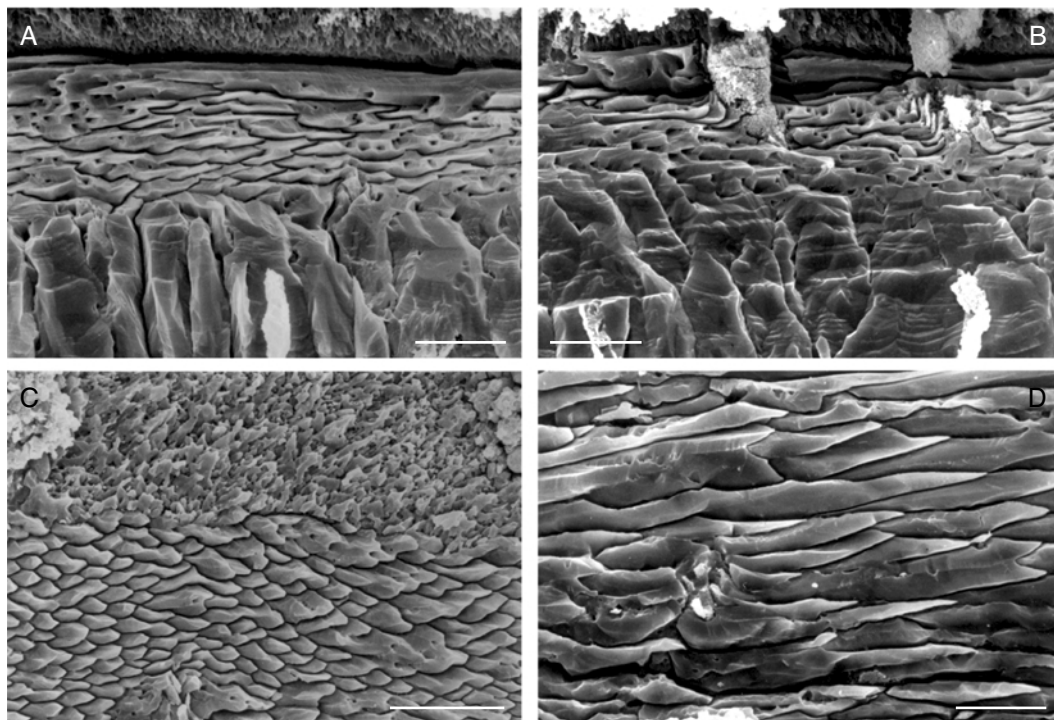


FIG. 5. — **A, B**, *Gryphus* sp. (LP-MNHN B.38671), SEM micrographs; **A**, transverse section of the entire shell showing the acicular primary layer (top) underlain by the secondary layer of anvil-shaped fibres, passing into the prismatic tertiary layer; **B**, section of the shell showing two puncta filled with pyrites, fibres near the canals bent outward; **C, D**, *Terebratula* sp. (LP-MNHN B.38316), SEM micrographs; **C**, transverse section of the shell showing the boundary of the acicular primary and fibrous secondary layers; **D**, section of the secondary layer showing fibres in oblique and longitudinal section, visible (left) modification of fibres near a punctum. Scale bars: 20 μ m.

differ, however, considerably from *Maltaia maltensis* in shell outline, as well as in smaller size and gentle anterior folding.

Subfamily GRYPHINAE Sahni, 1929

Genus *Gryphus* Megerle von Mühlfeldt, 1811

TYPE SPECIES. — *Anomia vitrea* Born, 1778, by original designation of Megerle von Mühlfeldt (1811: 64).

Gryphus sp.

(Figs 4M-O; 5A, B; Table 5)

MATERIAL EXAMINED. — Three complete specimens from Algeria: LP-MNHN B.38666, B.38671 (see also Table 1).

OCCURRENCE. — The genus *Gryphus* is known from the Eocene to the Recent. From the Pliocene it is recorded from Italy and Spain. Today it lives in the Mediterranean Sea and the Atlantic Ocean at depths from 70 to 2663 m.

DESCRIPTION

The small shell is elongate, biconvex and smooth except for numerous distinct growth lines. The lateral commissure is straight or nearly straight, and the anterior commissure is rectimarginate. The beak is short, suberect to erect, truncated by a small, epithyrid foramen. Deltidial plates conjunct forming a partially visible symphytium. Internal characters unknown.

The shell displays ultrastructure typical of the genus *Gryphus*, i.e. composed of three layers (Fig. 5A, B) (MacKinnon & Williams 1974;

TABLE 5. — Measurements (in mm) of *Gryphus* sp. Abbreviations: L, length; T, thickness; W, width.

Specimen number	L	W	T
B.38666 (figured)	14.2	8.4	—
B.38671	12.5	10.0	5.1(?)
B.38671 (figured)	—	9.2	7.4

Taddei Ruggiero 1983; Gaetani & Saccà 1984, 1985a; Benigni 1985). The primary granular layer is thin (14–25 µm thick) and built of acicular crystallites perpendicular to the shell surface. The secondary fibrous layer is 25–42 µm thick. The fibres are well developed, 11.2–12.7 µm wide and 3.4–3.7 µm thick. They are of anvil-like shape, arranged in sheaves nearly parallel to the surface of the shell. Around each punctum the fibres are deflected outwards (Fig. 5B). The tertiary layer is much thicker (63–87 µm) than the first two layers and is made up of large calcitic prisms perpendicular to the shell surface. The total thickness of the shell is 111–145 µm.

REMARKS

The investigated material is limited and the specimens are damaged and/or crushed, making measurements difficult. Externally, the specimens display characters consistent with those given in the diagnosis of the genus *Gryphus* (Cooper 1983), as does the presence of the tertiary prismatic layer. The tertiary layer, if present, is considered as a diagnostic generic character because it occurs in all species of a genus (MacKinnon & Williams 1974; Taddei Ruggiero 1983; Gaetani & Saccà 1984, 1985a; Benigni 1985) and enables the genera *Terebratula* and *Gryphus* to be readily distinguished.

The specimens under study differ strongly from the Pliocene species *G. sphenoides* (Philippi, 1844) which is much larger and has a large foramen (Gaetani & Saccà 1984, 1985a). In size the specimens are similar to *G. minor* (Philippi, 1836), another Pliocene species, differing in shell outline and smaller foramen (Gaetani & Saccà 1985a).

This is the first record of *Gryphus* from North Africa.

Superfamily CANCELLOTHYRIDOIDEA

Thomson, 1926

Family CANCELLOTHYRIDIDAE Thomson, 1926

Genus *Terebratulina* d'Orbigny, 1847TYPE SPECIES. — *Anomia retusa* Linnaeus, 1758, by subsequent designation of Brunton *et al.* (1967: 176).*Terebratulina retusa* (Linnaeus, 1758)

(Fig. 6A–F; Table 6)

Terebratulina retusa — Logan 1979: 37–43, text-fig. 8, pl. 3, figs 1–18. — Gaetani & Saccà 1985a: 15, 16, pl. 7, figs 5–10; pl. 9, figs 6–9. — Taddei Ruggiero 1994: 208, pl. 2, figs 1–3.

MATERIAL EXAMINED. — Six complete specimens, one ventral valve, and one dorsal valve from Algeria: LP-MNHN B.38659–B.38661 (see also Table 1).

OCCURRENCE. — This species is one of the best known brachiopods. In the fossil record it is known from the Neogene of Europe. Today it is widely distributed, occurring in the north-eastern North Atlantic and the Mediterranean Sea. The known depth range of *T. retusa* is from 3 to 1478 m.

REMARKS

This species is rare, occurring only in three outcrops in Algeria (see Table 1). Its presence in Algeria was mentioned by Fischer & Oehlert (1891) and Ficheur (1896d). *Terebratulina retusa* is a small species, variable in outline (see Fig. 6A, E). The shell is covered with numerous, rather coarse, nodular, radial ribs, 24–48 in number. Small, triangular deltidial plates are disjunct. The investigated specimens are smaller than those hitherto described (Brunton & Curry 1979; Logan 1979; Gaetani & Saccà 1985a). In the Pliocene this species is known from Italy (Gaetani & Saccà 1985a; Gaetani 1986; Barrier *et al.* 1987; Benigni & Robba 1990; Taddei Ruggiero 1994) and Spain (Pajaud 1977; Encinas 1992; Encinas & Martinell 1992). In modern seas it is widely distributed, from warm waters of the Mediterranean Sea (Logan 1979) to cold waters of the North Atlantic (Brunton & Curry 1979; Cooper 1981; Curry 1982; Logan 1993). It has a very wide depth range, but occurs most commonly between 100 and 500 m (Curry 1982).

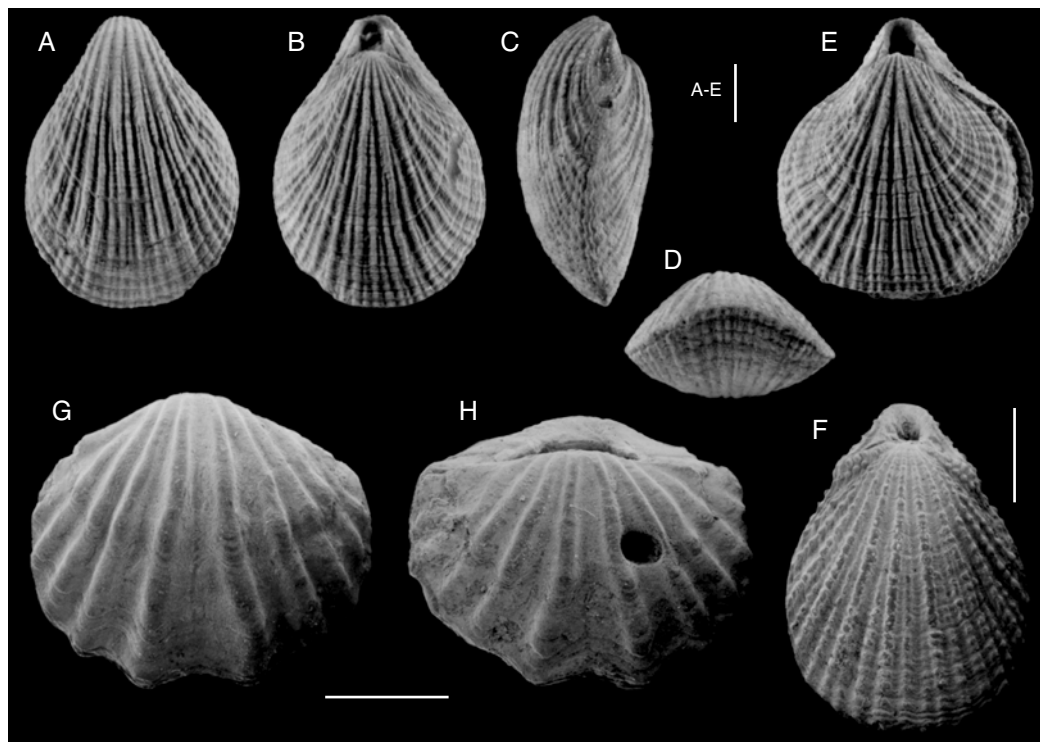


FIG. 6. — **A-F**, *Terebratulina retusa* (Linnaeus, 1758), Mustapha (Algiers), Algeria (LP-MNHN B.38659); **A-D**, ventral, dorsal, lateral and anterior views of complete specimen; **E, F**, dorsal views of complete specimens; **F**, SEM micrograph of juvenile specimen; **G, H**, *Megathiris detruncata* (Gmelin, 1790), SEM micrographs of ventral and dorsal views of complete specimen, Mustapha (Algiers), Algeria (LP-MNHN B.38665). Scale bars: 2 mm.

Suborder TEREBRATELLIDINA
Muir-Wood, 1955

Superfamily MEGATHYRIDOIDEA Dall, 1870
Family MEGATHYRIDIDAE Dall, 1870

Genus *Megathiris* d'Orbigny, 1847

TYPE SPECIES. — *Anomia detruncata* Gmelin, 1790, by original designation of d'Orbigny (1847: 269).

Megathiris detruncata (Gmelin, 1790)
(Fig. 6G, H)

Megathiris detruncata – Logan 1979: 55-59, text-figs 15, 16; pl. 6, figs 1-13. — Gaetani & Saccà 1985a: 17, 18, pl. 9, figs 10-12; pl. 10, figs 11-14. — Bitner 1990: 135-138, text-figs 3, 4; pl. 3, figs 1-8; pl. 6, figs 1-7. — Taddei Ruggiero 1994: 208, pl. 3, figs 6-9.

MATERIAL EXAMINED. — One complete specimen from Algeria: LP-MNHN B.38665.

OCCURRENCE. — This species appears in the fossil record in the Eocene and lives now in the Mediterranean Sea and in the Lusitanian and Mauritanian regions of the Atlantic Ocean, as well as in the Caribbean Sea. Its depth range is from 5 to 896 m.

MEASUREMENTS. — Length 4.8 mm, width 5.7 mm, thickness 2.9 mm.

REMARKS

This rare micromorphic species is easily recognisable from its transversely oval outline, wide, straight hinge line, large triangular foramen, and a few broad ribs. It is very common and widespread in the Tertiary deposits throughout Europe. In the Miocene of the Paratethys it is one of the commonest species (Dreger 1889;

TABLE 6. — Measurements (in mm) of *Terebratulina retusa* (Linnaeus, 1758). Abbreviations: L, length; T, thickness; W, width.

Specimen number	L	W	T
B.38660	13.5	10.2	6.5
B.38659 (figured)	10.4	9.4	5.4
B.38659 (figured)	10.7	7.8	4.8
B.38659 (figured)	7.5	5.4	3.3

Meznerics 1943; Barczyk & Popiel-Barczyk 1977; Bitner 1990; Popiel-Barczyk & Barczyk 1990). In the Mediterranean region it is very common in the Miocene (Davidson 1870; Sacco 1902; Julien 1940; Calzada 1978; Llompарт & Calzada 1982) and the Pliocene (Pajaud 1977; Gaetani & Saccà 1985a; Encinas 1992; Taddei Ruggiero 1994, 1996). Today this species is very common in the Mediterranean Sea (Logan 1979), and also occurs in the eastern North Atlantic (Brunton & Curry 1979; Logan 1983, 1988, 1993). Cooper (1977) also noted this species from the Caribbean Sea.

M. detruncata was recorded from Algeria by Fischer & Oehlert (1891), and Ficheur (1896b) reported the presence of the genus *Argiope* which is an earlier name for both *Megathiris* and *Argyrotheca*.

Superfamily KRAUSSINOIDEA Dall, 1870
 Family KRAUSSINIDAE Dall, 1870

Genus *Megerlia* King, 1850

TYPE SPECIES. — *Anomia truncata* Linnaeus, 1767, by original designation of King (1850: 145).

Megerlia eusticta (Philippi, 1836)
 (Fig. 7; Table 7)

Megerlia eusticta — Gaetani & Saccà 1985a: 16, 17, text-fig. 11, pl. 10, figs 1-9; pl. 11, figs 6-12. — Calzada 1997: 31, 32, figs 1-3. — Bitner & Martinell 2001: 182, 183, fig. 4A-K.

MATERIAL EXAMINED. — 19 complete specimens, two ventral valves, and one dorsal valve from Algeria:

LP-MNHN B.38664, B.38669, B.38673; five complete specimens from Morocco: LP-MNHN B.38317.

OCCURRENCE. — This species is restricted to the Pliocene of the Mediterranean region.

REMARKS

Megerlia eusticta is the third commonest species in the studied material but was found only in four localities (see Table 1). Limited to the Pliocene of the Mediterranean it was already described from Italy and Spain (Gaetani & Saccà 1985a; Benigni & Robba 1990; Taddei Ruggiero 1996; Calzada 1997; Bitner & Martinell 2001). Its small, rounded shell, delicate ornamentation of faint striae (Fig. 7I, J), short beak truncated by a large foramen make it easily recognisable among Pliocene species. Ficheur (1896a, b, d) noted the genus *Megerlia* in the Pliocene of Algeria but without specific determination. This is the first record of this species from Morocco.

DISCUSSION

Seven species belonging to six genera have been identified in this collection of Pliocene brachiopods from North Africa. Comparison of brachiopod assemblages from Algeria and Morocco indicates three species in common, *Aphelesia bipartita*, *Terebratula terebratula*, and *Megerlia eusticta*. Three species, i.e. *Gryphus* sp., *Terebratulina retusa*, and *Megathiris detruncata* found in Algeria, are not present in Morocco, while *Terebratula* sp. noted from Morocco is not found in Algeria. However, the absence of micro-morphic brachiopods, such as *T. retusa* and *M. detruncata* in Morocco may be due to collecting bias. The genus *Gryphus* is reported for the first time from North Africa, and this is the first record of *Aphelesia* and *Megerlia* in the Pliocene deposits of Morocco.

In terms of paleobiogeographical affinities the brachiopods from Algeria and Morocco are typical of the Pliocene Mediterranean faunal province. It is worth mentioning that other faunas from Algeria and Morocco such as foraminifers,

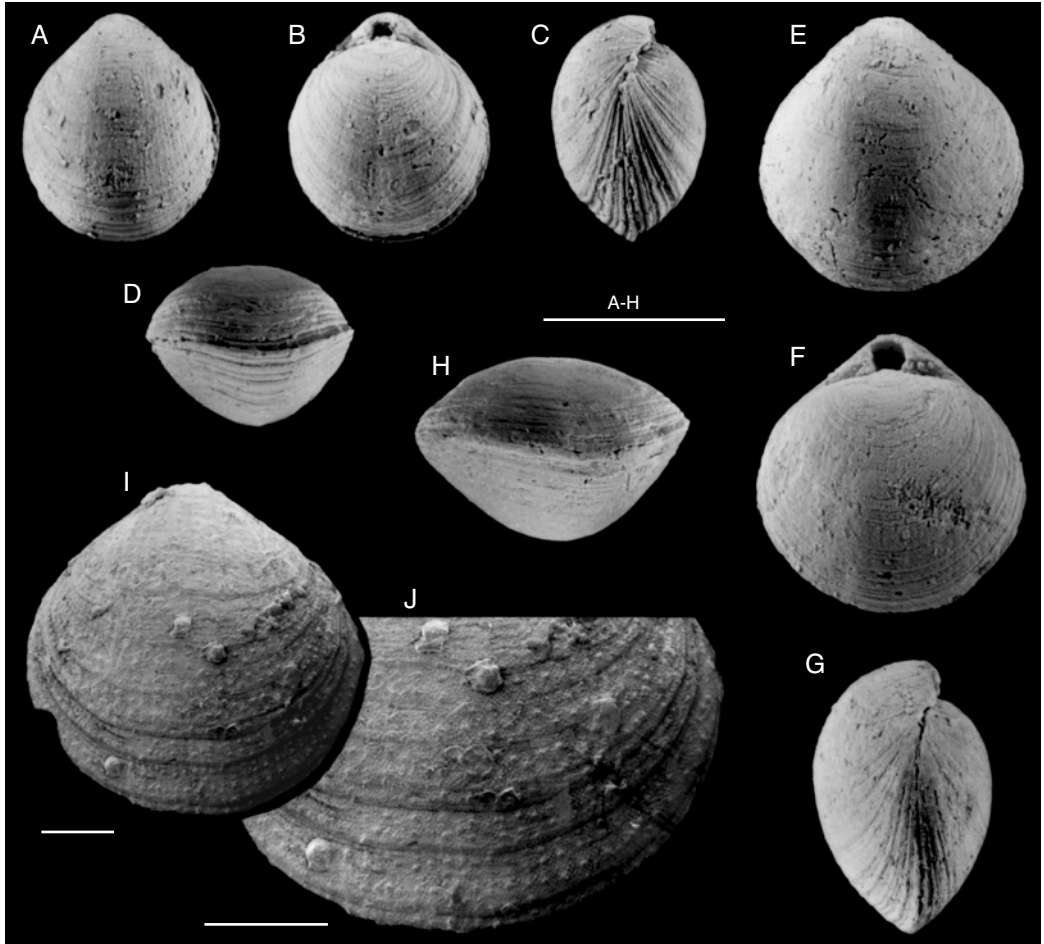


FIG. 7. — *Megerlia eusticta* (Philippi, 1836); A-H, Oued Zat, Morocco (LP-MNH B.38317), ventral, dorsal, lateral and anterior views of complete specimens, (H) anterior view slightly oblique; I, J, between Mustapha Aïssat and Bir Mourad Raï, Algeria (LP-MNH B.38669), SEM micrograph of ventral view of complete specimen (I) and enlarged fragment (J) to show details of ornamentation. Scale bars: A-H, 1 cm; I, J, 2 mm.

ostracods, bryozoans, molluscs (Yassini 1973, 1979; Ben Moussa 1994; Haddadi-Hamdane 1996) also display close affinities with faunas of other Mediterranean regions.

All these brachiopod genera and/or species have also been described from the Pliocene of Italy (Gaetani & Saccà 1985a, b; Gaetani 1986; Saccà 1986; Barrier *et al.* 1987; Benigni & Robba 1990; Taddei Ruggiero 1994, 1996) and Spain (Pajaud 1976, 1977; Encinas 1992; Encinas & Martinell 1992; Bitner & Martinell 2001). Although brachiopods from France have not

been intensively investigated, the presence of typical Mediterranean genera is mentioned from the Pliocene deposits of the Alpes-Maritimes, southern France by Butel (1954), Anglada *et al.* (1972) and Cataliotti-Valdina (1975). Undescribed collections of Pliocene brachiopods from France, examined by one of us (MAB) for comparative reasons, kept in The Natural History Museum, London, include the genera *Aphelesia*, *Terebratula*, *Terebratulina*, *Megerlia*, *Lacazella*. Feki (1970) mentioned the presence of numerous brachiopods in the lower Pliocene of North

TABLE 7. — Measurements (in mm) of *Megerlia eusticta* (Philippi, 1836). Abbreviations: L, length; T, thickness; W, width.

Specimen number	L	W	T
B.38317	14.6	13.7	7.9
B.38317 (figured)	14.4	13.9	9.3
B.38317 (figured)	11.8	10.4	8.2
B.38664	13.3	13.0	7.5
B.38664	12.3	12.4	6.4
B.38669 (figured)	9.5	9.4	6.0

Tunisia. He identified *Terebratula ampulla*, *T. sinuosa* and *Waldheimia peloritana* Seguenza, 1865, i.e. *T. terebratula* and *Dallina septigera* (Loven, 1846) in recent nomenclature.

The assemblages dominated by *Aphelesia bipartita*, *Terebratula terebratula*, and *Megerlia eusticta* are characteristic of shallow water, high-energy environments and sandy facies in Italy and Spain (Gaetani & Saccà 1985a, b; Gaetani 1986; Barrier *et al.* 1987; Taddei Ruggiero 1996; Bitner & Martinell 2001).

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