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Short taxonomic notes on deep-sea ostracods from the Massignano GSSP for the Eocene/Oligocene boundary (Central Italy)

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ABSTRACT – Deep-sea *Ostracoda* from the Massignano GSSP for the Eocene/Oligocene boundary (Central Italy) are discussed from a systematic point of view. Apart from the genus *Krithe*, which could not be specifically identified owing to the poor preservation of the fauna, a total of 17 species belonging to 13 genera (one of which remains undetermined) were identified. Previously known species include *Agrenocythere ordinata* (Deltel), *Argilloecia angulata* (Deltel), *Argilloecia* sp. 1 (= *Argilloecia* sp./293 Kollmann), *Dutoitella eocenica* (Benson), *Legitimocythere presequenta* (Benson), and *Trachyleberidea pisinensis* (Kollmann). Remaining taxa are left in open nomenclature or assigned to informal group. Taxonomic comments, SEM illustrations and a fundamental synonymy are provided.

RIASSUNTO – [Brevi note tassonomiche sulle ostracofaune profonde della Sezione di Massignano, GSSP per il limite Eocene/Oligocene (Italia centrale)] – Viene studiata da un punto vista sistematico l'ostracofauna della Sezione di Massignano (Italia centrale), GSSP per il limite Eocene/Oligocene. Escludendo il genere *Krithe*, per il quale, dato il non ottimo stato di conservazione della fauna, non è stato possibile intraprendere uno studio a livello specifico, sono state riconosciute complessivamente 17 specie appartenenti a 13 generi (uno di questi è rimasto indeterminato). Tra le specie note dalla letteratura sono state identificate: *Agrenocythere ordinata* (Deltel), *Argilloecia angulata* (Deltel), *Argilloecia* sp. 1 (= *Argilloecia* sp./293 Kollmann), *Dutoitella eocenica* (Benson), *Legitimocythere presequenta* (Benson) e *Trachyleberidea pisinensis* (Kollmann). Le rimanenti specie sono rimaste a nomenclatura aperta o attribuite a gruppi informali. Sono forniti oltre l'illustrazione, commenti tassonomici ed una sinonimia fondamentale.

INTRODUCTION

Latest Eocene-earliest Oligocene, deep-water ostracods from the Massignano Global Boundary Stratotype Section and Point (GSSP), Central Italy, were recently studied by the present authors from a palaeoecological perspective, to investigate the psychrospheric event in the Tethys (Dall'Antonia *et al.*, 2003). The present paper is a short taxonomic note on the systematics of the Massignano fauna.

As discussed in Dall'Antonia *et al.* (2003), ostracod assemblages of the GSSP for the Eocene/Oligocene boundary are rather poor and only moderately well preserved. For example, large specimens are usually broken into small fragments and details of the ornament in the more ornate valves are often obscured by unremovable calcareous matrix. Apart from hinge details, internal features of the valves are customarily indistinct.

The poor state of preservation precluded a specific study of the genus *Krithe* and prevented the erection of new taxa. Nevertheless, the analysis of the Massignano fauna allowed new observations on Palaeogene deep-sea ostracods to be made.

The present paper offers taxonomic comments and SEM iconography of ostracods from the Massignano Section, which are hoped to improve our knowledge of the systematics of Tethyan deep-sea Palaeogene faunas. To date, these faunas, especially those from Italy, have received only little attention and are still

imperfectly known. The main contributions on this topic are by Kollmann (1962), Ascoli (1969), Pokorný (1975, 1977, 1980, 1981), and Monostori (1977, 1982, 1985a, b, 1987, 1996).

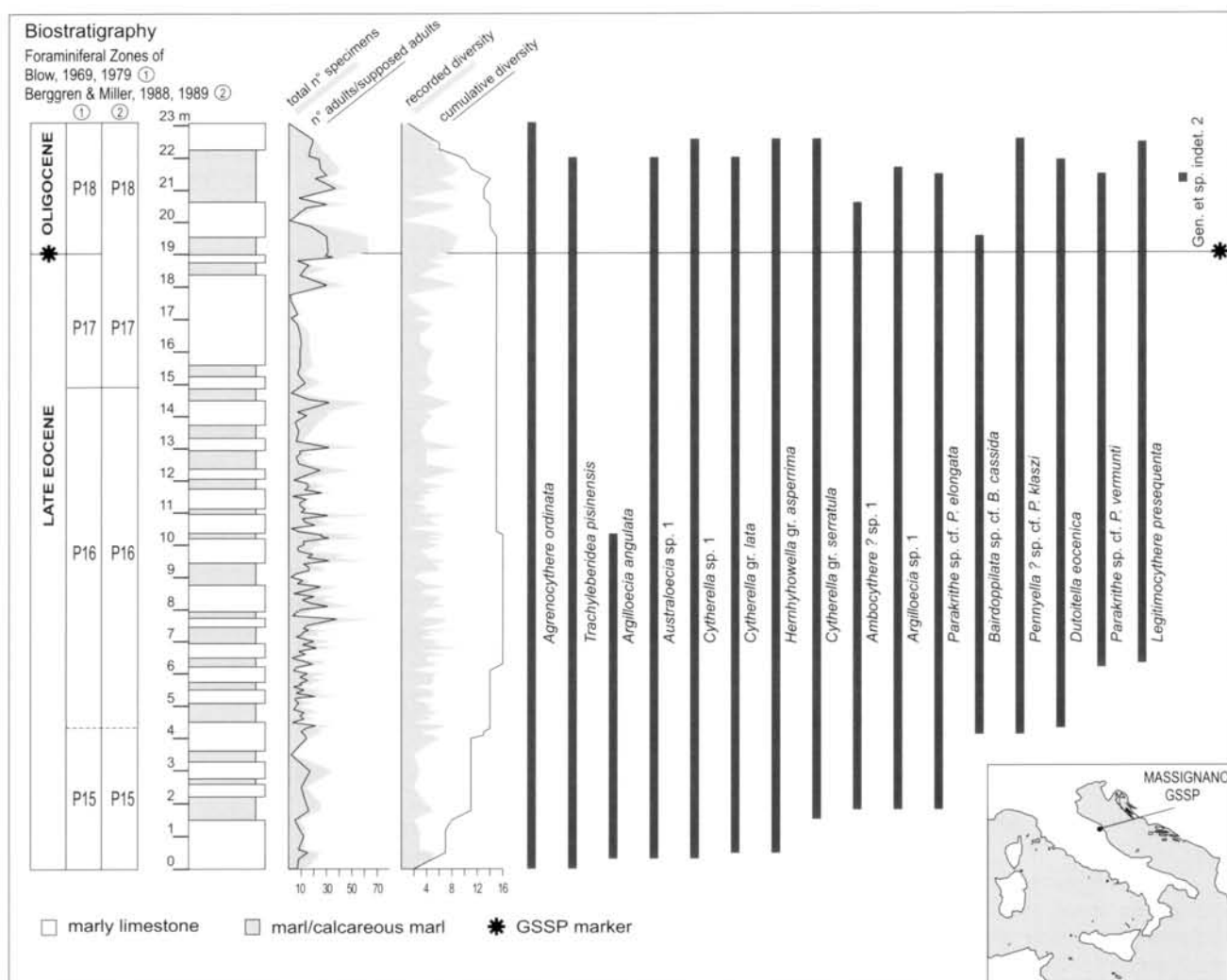
MATERIALS AND METHODS

The Massignano Section (Text-fig. 1) is located in the Umbria-Marche basin (Central Italy) and consists of a 23 metre-thick pelagic carbonate succession, which spans the latest Eocene-earliest Oligocene interval (Premoli-Silva & Jenkins, 1993). The 148 samples (each of ca. 150 g) on which this study is based are those analyzed by Dall'Antonia *et al.* (2003), to which the reader is referred for more detailed information on lithology, biostratigraphy and sampling of the Massignano GSSP.

Apart from *Krithe*, a total of 17 species were identified. The total range of ostracod species recorded in the Massignano Section is given in Text-fig. 1 (the authors refer to Dall'Antonia *et al.*, 2003 for the detailed numerical distribution of the ostracod fauna).

Previously known species include *Agrenocythere ordinata* (Deltel), *Argilloecia angulata* (Deltel), *Argilloecia* sp. 1 (= *Argilloecia* sp./293 Kollmann), *Dutoitella eocenica* (Benson), *Legitimocythere presequenta* (Benson) and *Trachyleberidea pisinensis* (Kollmann).

Each of the above-mentioned species is dealt with, although the main interest has been focused on *Agrenocythere* and *Argilloecia*.



Text-fig. 1 - Location, lithology and biostratigraphy of the Massignano GSSP (from Coccioni & Galeotti, 2002) and total ranges of ostracod species. Abundance and diversity of the ostracod fauna are also reported (from Dall'Antonia *et al.*, 2003).

For the genera *Cytherella* and *Henryhowella*, which still await for a critical systematic revision, we adopted an informal nomenclature. The taxa identified were referred to as follows: *Cytherella* gr. *lata* Brady, *Cytherella* gr. *serratula* (Brady) and *Henryhowella* gr. *asperrima* (Reuss). Remaining species were compared to previously described species or left in open nomenclature. Gen. et sp. indet. 2, being represented only by one carapace, is illustrated but not treated further.

SYSTEMATICS

The SEM-illustrated specimens are housed in the Dipartimento di Scienze della Terra, Università di Pisa, Italy (Ostracoda Collection of Prof. A. Bossio - C.O.B. collection; Catalogue numbers 300-321). Abbreviations

used: C = articulated carapace, LV = left valve, RV = right valve.

Class OSTRACODA
Order PODOCOPIDA Müller, 1894
Suborder PLATYCOPINA Sars, 1866
Family CYTHERELLIDAE Sars, 1866
Genus CYTHERELLA Jones, 1849

CYTHERELLA gr. SERRATULA (Brady, 1880)
Pl. 1, figs 3-5

1880 *Cythere? serratula* BRADY, p. 77, pl. 43, fig. 7a-d.
1962 *Cytherella* sp./138 + 461 KOLLMANN, p. 207, pl. 2, figs 1-7 (cum syn.).

Material - About 140 valves and 14 carapaces.

Dimensions (mm) –

female RV (C.O.B. 317) L = 1.01, H = 0.60

male C (C.O.B. 318) L = 1.05, H = 0.63

female C (C.O.B. 319) L = 0.90, W/2 = 0.21

Remarks - This large-very large, thick-shelled, species can be included in the *Cytherella serratula* group because of its elongate, subrectangular outline, with straight or slightly concave dorsal and ventral margins, broadly rounded anterior end, which is bordered by a narrow flange, and presence of diffuse tubercles at the more narrowly rounded posterior end. Distinctive characters of *C. serratula* have been recently discussed by Aiello *et al.* (1996). The species recovered in the Massignano Section is characterized by a marked external depression at the site of the central muscle scars and a squat dorsal outline, with subtruncate anterior and posterior ends. Specimens recorded by Kollmann (1962) as *Cytherella* sp./138 and *Cytherella* sp./461 from the Lutetian of Croatia are herein considered as female and males dimorphs respectively.

CYTHERELLA gr. LATA Brady, 1880

Pl. 1, figs 7-8

1880 *Cytherella lata* BRADY, p. 173, pl. 44, figs 5a-c.1962 *Cytherella* aff. *navetensis* van den Bold/139 + 462 - KOLLMANN, p. 212, pl. 4, figs 1-8 (*cum syn.*).*Material* - 18 valves and 14 carapaces.*Dimensions* (mm) –

RV (C.O.B. 312) L = 0.86, H = 0.56

C (C.O.B. 313) L = 0.87, W/2 = 0.21

Remarks - Valves large and moderately thick-shelled. Lateral outline sub-ovate (especially the RV), with gently arched postero-dorsal slope. Anterior and posterior ends rounded. A thin, narrow flange extends along the anterior margin and, although less evident, also along the postero-ventral margin. Dorsal outline inflated, with convex sides and greatest width just behind the middle. These features render this species somewhat similar to a number of Cainozoic and Recent species, e.g. *Cytherella lata* Brady, 1880, *Cytherella confusa* Lienenklaus, 1900, *Cytherella navetensis* van den Bold, 1960, *Cytherella consueta* Deltel, 1964 and *Cytherella russoi* Sissingh, 1972.

CYTHERELLA sp. 1

Pl. 1, fig. 6

Material – About 100 valves and 20 carapaces.*Dimensions* (mm) –

female C (C.O.B. 304) L = 0.67, H = 0.41

Remarks – Medium-sized, thin-shelled and subrectangular in lateral view. Antero-ventral, anterior

and antero-dorsal margin with relatively wide flange; ventral margin peculiarly sinuous, especially in the female RV. Ornament consisting of diffuse tubercles at the posterior end and faint striae parallel to the anterior margin (the extension of the striate ornament is variable). Although the small size may militate against their being adult, it was possible to observe a distinct sexual dimorphism (males are proportionally more elongate and compressed than females). Female specimens strongly resemble *Cytherella* sp. "Type morphologique 3" of Guernet (1982, p. 45, pl. 1, fig. 3) from the middle Eocene of the Bahamas and males are very close to *Cytherella* sp. of Pokorný (1981, pl. 1, fig. 6) from the Palaeogene of Moravia (Czech Republic).

Suborder PODOCOPINA Sars, 1866

Superfamily BAIRDIACEA Sars, 1866

Family BAIRDIIDAE Sars, 1866

Genus BAIRDOPILATA Coryell, Sample & Jennings, 1935

BAIRDOPILATA cf. B. CASSIDA (van den Bold, 1946)

Pl. 1, fig. 12

1946 *Bairdia cassida* VAN DEN BOLD, p. 70, pl. 1, fig. 7a-b.*Material* - 2 adult, 3 juvenile valves.*Dimensions* (mm) –

RV (C.O.B. 316) L = 1.26, H = 0.70

Remarks - This material has been tentatively assigned to *Bairdopilata cassida* (van den Bold) known from the Palaeocene-Pliocene of the Western Central Atlantic (van den Bold, 1946, 1957, 1960; Steineck *et al.*, 1984 *cum bib.*) and the middle Eocene-late Oligocene of the North Atlantic (Whatley & Coles, 1991).

Superfamily CYPRIDACEA Baird, 1845

Family PONTOCYPRIDIDAE Müller, 1894

Genus ARGILLOECIA Sars, 1866

ARGILLOECIA ANGULATA (Deltel, 1964)

Pl. 1, fig. 2

1962 *Argilloecia* sp./294 KOLLMANN, p. 200, pl. 1, figs 9-10.1964 *Protoargilloecia angulata* DELTEL, p. 146, pl. 2, figs 32-34.1979 *Argilloecia angulata* (Deltel) - DUCASSE & PEYPOUQUET, pl. 5, fig. 6.1983 *Protoargilloecia angulata* Deltel forme "acuminée" - DUCASSE, p. 278, pl. 1, figs 9-19 (*cum syn.*).1984 *Argilloecia angulata* (Deltel) - STEINECK, BREEN, NEVINS & O'HARA, pl. 7, fig. K; pl. 9, fig. G.1985 *Protoargilloecia angulata* Deltel - DUCASSE, GUERNET & TAMBAREAU, pl. 88, fig. 14.1987 *Protoargilloecia angulata* Deltel - COLIN, p. 117, pl. 3, figs 6a-b.1996 *Protoargilloecia angulata* Deltel - RODRIGUEZ-LAZARO & GARCIA-ZARRAGA, pl. 1, fig. 7.

Material – 1 valve and 6 carapaces.

Dimensions (mm) –

C (C.O.B. 308) L = 0.57, H = 0.27

Remarks – The species, originally described from the Lutetian of the Aquitaine (Deltel, 1964) has been more recently discussed by Ducasse (1983), who recognized two distinct morphotypes referred to as “forme acuminée” and “forme dodue”. In our opinion only the former can be considered conspecific with the type material of *A. angulata*, whereas the latter is clearly a different species, which is discussed below as *Argilloecia* sp. 1. The present species was originally assigned to the genus *Protoargilloecia* Maldelstam, 1955. However, in contrast to the “inner structureless inner lamella (which) is barely discernible at the anterior end” typical of *Protoargilloecia* (Maldelstam, 1955, p. 24, translated from the Russian by Ellis & Messina Catalogue of Ostracoda, Supplement 1, 1964), it displays “A l'avant,... un vestibule très profond” (Deltel, 1964, pp. 146-148). As a consequence we prefer to assign Deltel's species to the genus *Argilloecia* following the opinion of certain authors such as Whatley & Coles (1991, fig. 4, p. 124).

Distribution – Aquitaine: late Paleocene-early Miocene (Deltel, 1964; Moyes, 1965; Ducasse, 1983; Ducasse *et al.*, 1985), Basque Basin: early Palaeocene-middle Eocene (Rodriguez-Lazaro & Garcia-Zaraga, 1996), North Atlantic: late Palaeocene-Recent (Ducasse & Peypouquet, 1979; Whatley & Coles, 1991), Eastern Central Atlantic-Senegal: early Palaeocene (Colin, 1987), Western Central Atlantic-Caribbean: Oligocene (Steineck *et al.*, 1984), Croatia: middle Eocene (Kollmann, 1962), France: Early Oligocene (Charollais *et al.*, 1980).

Oldest and youngest records – Early Palaeocene-Recent.

ARGILLOECIA sp. 1

Pl. 1, fig. 1

1962 *Argilloecia* sp./293 KOLLMANN, p. 199, pl. 1, figs 7, 8.

1983 *Protoargilloecia angulata* Deltel “forme dodue” - DUCASSE, p. 278, pl. 1, figs 1-8 (*cum syn.*).

Material – 11 valves and 5 carapaces.

Dimensions (mm) –

C (C.O.B. 307) L = 0.60, H = 0.33

Remarks – Carapace relatively short and high, with strongly arched dorsal margin and subrounded posterior, with apex just below mid-height. Ducasse (1983) included in the present species the specimens considered by Deltel (1964) as female dimorphs of *Argilloecia angulata* (Deltel), a species characterized by “extrémité postérieure acuminée”. Indeed, Deltel (1964) does not mention any variation in the shape of the posterior end related to sexual dimorphism and, unfortunately, gives no illustration of the observed dimorphs. From what is discussed above, we believe that female dimorphs of *A. angulata* in Deltel (1964) cannot be positively assigned to the “forme dodue” of Ducasse (1983). The present species is reported with certainty from the middle Eocene-late Oligocene of Aquitaine and Central Europe (see below). *Argilloecia kissamovensis* Sissingh, 1972, known from the Miocene-Pliocene of the Mediterranean (Sissingh, 1972; Barra *et al.*, 1996; Dall'Antonia *et al.*, 2001), despite the different stratigraphical age, is very similar and possibly conspecific with the present species. Similarities between the two species relate to both general shape and size, but data available from the literature do not allow a comparison of the inner features and our material is not suitable for this purpose.

Distribution – Aquitaine: middle Eocene-late Oligocene (Ducasse, 1976, 1983), Croatia: middle Eocene (Kollmann, 1962), France: early Oligocene (Charollais *et al.*, 1980).

Oldest and youngest records – Middle Eocene-late Oligocene.

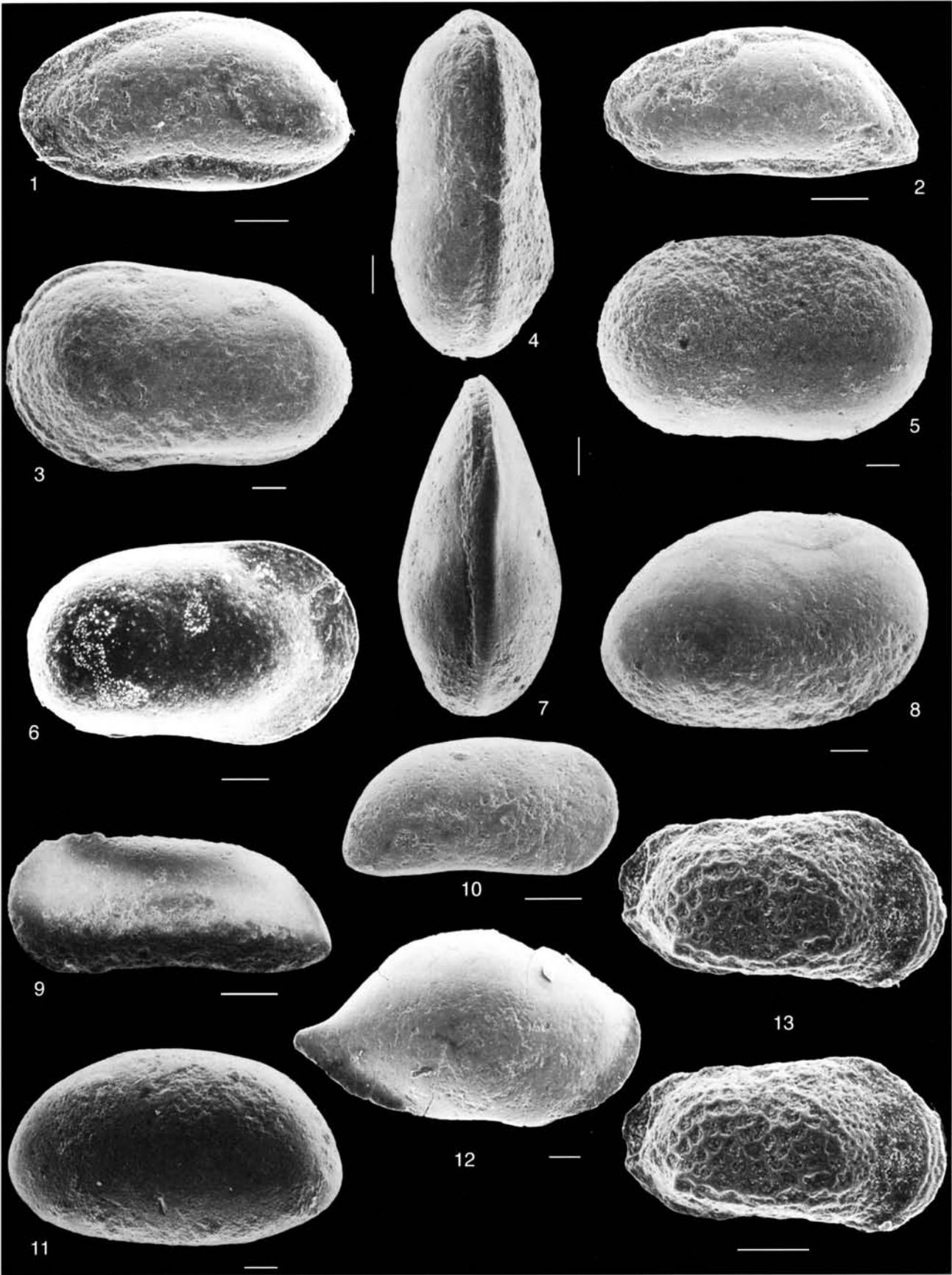
Genus AUSTRALOECCIA McKenzie, 1967

AUSTRALOECCIA sp. 1

Pl. 1, fig. 11

EXPLANATION OF PLATE 1

- Fig. 1 - *Argilloecia* sp. 1. C left view C.O.B. 307 h-sample 6.80 m.
 Fig. 2 - *Argilloecia angulata* (Deltel, 1964). C left view C.O.B. 308 h-sample 5.50 m.
 Figs 3-5 - *Cytherella* gr. *serratulata* (Brady, 1880). 3) male C left view C.O.B. 318 h-sample 6.60 m; 4) female C dorsal view C.O.B. 319 h-sample 12.80 m; 5) female RV C.O.B. 317 h-sample 8.10 m.
 Fig. 6 - *Cytherella* sp. 1. female C right view C.O.B. 304 h-sample 7.20 m.
 Figs 7-8 - *Cytherella* gr. *lata* Brady, 1880. 7) C dorsal view C.O.B. 313 h-sample 5.80 m; 8) RV C.O.B. 312 h-sample 19.50 m.
 Fig. 9 - *Parakrithe* sp. cf. *P. elongata* van den Bold, 1960. C left view C.O.B. 306 h-sample 7.35 m.
 Fig. 10 - *Parakrithe* sp. cf. *P. vermunti* (van den Bold, 1946). C right view C.O.B. 305 h-sample 21.30 m.
 Fig. 11 - *Australoeccia* sp. 1. LV C.O.B. 311 h-sample 21.00 m.
 Fig. 12 - *Bairdoppilata* sp. cf. *B. cassida* (van den Bold, 1946). RV C.O.B. 316 h-sample 21.00 m.
 Fig. 13 - (Stereo pair) Gen. et sp. indet. 2. C right view C.O.B. 315 h-sample 21.30 m.
 All views external lateral unless otherwise stated. Scale bars = 100 μ m.



Material – 2 adult, 5 juvenile valves and 1 juvenile carapace.

Dimensions (mm) –
LV (C.O.B. 311) L = 1.00, H = 0.60

Remarks – The paucity of the material coupled with the general difficulties in speciating *Australoechia* did not allow to attempt a specific identification.

Superfamily CYTHERACEA Baird, 1850
Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948
Subfamily TRACHYLEBERIDINAE Sylvester-Bradley,
1948
Genus AGRENOCYTHERE Benson, 1972

AGRENOCYTHERE ORDINATA (Deltel, 1964)
Pl. 2, figs 1, 2, 4

- ? 1962 *Bradleya?* sp./448 KOLLMANN, p. 204, pl. 6, fig. 10.
1964 *Bradleya ordinata* DELTEL, p. 187, pl. 5, figs 126-127.
1977 *Agrenocythere bensoni* POKORNY, p. 384, text-figs 1-5; pl. 1.
1977 *Agrenocythere schornikovi* POKORNY, p. 390, text-figs 1, 3; pls. 2-3.
1982 *Agrenocythere aculeataformis* MONOSTORI, p. 58, pl. 6, fig. 2.
1985b *Agrenocythere bensoni* Pokorny - MONOSTORI, p. 191, pl. 5, figs 1-2.
1985 *Agrenocythere ordinata* (Deltel) - DUCASSE, GUERNET & TAMBAREAU, pl. 79, figs 3-5.
1996 *Agrenocythere ordinata* (Deltel) - MONOSTORI, p. 49, pl. 17, figs 7-8; pl. 18, figs 1-3.
1996 *Agrenocythere ordinata* (Deltel) - RODRIGUEZ-LAZARO & GARCIA-ZARAGA, pl. 1, fig. 18.
1997 *Agrenocythere?* cf. *ordinata* (Deltel) - GUERNET & MOLINA, p. 38, fig. 5.1.
2003 *Agrenocythere ordinata* (Deltel) - DALL'ANTONIA, BOSSIO & GUERNET, fig. 3.1.

Material – About 100 adult (most reduced to fragments), 800 juvenile valves and a few carapaces.

Dimensions (mm) –
RV (C.O.B. 300) L = 1.20, H = 0.64
LV (C.O.B. 301) L = 1.00, H = 0.55

Remarks – Unfortunately *Agrenocythere* specimens are not usually well preserved. Adult valves especially are incomplete, so that it is difficult to carry out a detailed topological analysis of the reticular pattern in the Massignano material. However, our material is very similar to *Agrenocythere ordinata* (Deltel, 1964), although it generally exhibits less prominent *bullar series*.

The synonymy used here is basically that proposed by Monostori (1996), who included in Deltel's species *Agrenocythere bensoni* Pokorny, 1977 ["POKORNY's new species is obviously conspecific with *ordinata* of Deltel" (Monostori, 1996, p. 49)], and *Agrenocythere aculeataformis* Monostori, 1982. We note that *Bradleya?* sp./448 of Kollmann (1962) from the circalittoral or bathyal Lutetian of Croatia, is probably conspecific with Deltel's species, but the single broken valve fig-

ured does not allow a positive assignment. In addition, the study of *Agrenocythere* specimens from the Massignano GSSP led us to the conclusion that *A. bensoni* Pokorny and *A. schornikovi* Pokorny are most likely synonymous. The latter seems to be merely a variant characterized by the subdivision of the reticulae, especially in the anterior field, into rounded pits or secondary meshes. Such a conclusion derived from the following observations: 1) the type material of both *A. bensoni* and *A. schornikovi* comes from the same type-locality and stratum (Eocene of Moravia) and the latter is reported exclusively from this horizon (Pokorny, 1977); 2) *A. schornikovi*-type specimens co-occur with *A. ordinata*-type specimens in most of the examined samples, but they are usually less numerous; 3) as for the *A. ordinata*-type, most of the *A. schornikovi*-type specimens are juveniles and adults are rare; 4) in *A. schornikovi*-type specimens the degree of mesh subdivision varies (see also Pokorny, 1977, p. 392) as does the strength of the muri forming the *castrum*; 5) intermediate specimens between *A. schornikovi*-type and *A. ordinata*-type are not rare. As discussed above, *A. ordinata*, originally described from the middle Eocene of Southern Aquitaine, has a long stratigraphical range from the late Palaeocene to the late Oligocene (see below).

Finally, in our opinion available SEM micrographs of relatively well preserved specimens (e.g. Ducasse *et al.*, 1985) and reticular maps (Pokorny, 1977) of Deltel's species allow us to question the conspecificity between *A. ordinata* and *A. antiquata* Benson, 1972. The latter species is primarily known from the Palaeogene of Western Central Atlantic-Caribbean (van den Bold, 1960; Benson, 1972; Steineck, 1981; Steineck *et al.*, 1984), but it is also reported from the Eocene of Northern Italy (Ascoli, 1969 as *A. hazelae*, see Benson, 1972). Indeed, the Italian Eocene specimen figured by Benson (1972) in fig. 54A-B, despite the more massive appearance (especially with respect to the *bullar series*), strongly resembles *A. ordinata* in overall organization of the reticulum, *castrum* morphology (strong importance of the transverse rib comparable to the cross-bar of the H configuration) and presence of a short, prominent rib in the postero-medial region.

However, it is necessary to carry out a thorough re-examination of the material published to date and probably also of additional material before interrelationships between *A. ordinata* and *A. antiquata* are understood.

Distribution – Aquitaine: early Eocene-late Oligocene (Deltel, 1964; Ducasse *et al.*, 1985), Basque Basin: early Eocene (Rodriguez-Lazaro & Garcia-Zaraga, 1996), North Atlantic: late Palaeocene-late Eocene (Whatley & Coles, 1991), Southern Spain: late Palaeocene (Guernet & Molina, 1997), Czech Republic: early-middle Eocene-? early Oligocene (Pokorny, 1977), Hungary: middle Eocene-early Oli-

gocene (Monostori, 1982, 1985b, 1996), Croatia questionable: middle Eocene (Kollmann, 1962).

Oldest and youngest records – Late Palaeocene-late Oligocene.

Genus DUTOITELLA Dingle, 1981

DUTOITELLA EOCENICA (Benson, 1977)
Pl. 2, fig. 5

- 1977 *Atlanticythere ? eocenica* BENSON, p. 877, pl. 1, fig. 7.
1989 *Dutoitella eocenica* (Benson) - COLES & WHATLEY, p. 98, pl. 4, figs 3-5.
1996 *Dutoitella* sp. 2 - RODRIGUEZ-LAZARO & GARCIA-ZARAGA, pl. 1, fig. 17.
2003 *Dutoitella eocenica* (Benson) - DALL'ANTONIA, BOSSIO & GUERNET, fig. 3.3.

Material – About 30 adult, 1 juvenile valves and 10 adult, 2 juvenile carapaces.

Dimensions (mm) –
C (C.O.B. 309) L = 0.78, H = 0.46

Remarks – In the best preserved specimens the posterior field is characterized by a very faint reticulation, whereas the anterior field seems to be non-reticulate. Size of adults ranges from 0.71 to 0.80 mm. These features agree well with those of the North Atlantic Palaeogene specimens described by Coles & Whatley (1989).

Distribution – South Atlantic: middle Eocene (Benson, 1977), North Atlantic: middle Eocene-late Oligocene (Coles & Whatley, 1989; Whatley & Coles, 1991), Basque Basin: middle Eocene (Rodriguez-Lazaro & Garcia-Zaraga, 1996). The present is the first record of the species in the Central Tethys.

Oldest and youngest records – Middle Eocene-late Oligocene.

Genus HENRYHOWELLA Puri, 1957

HENRYHOWELLA gr. ASPERRIMA (Reuss, 1850)
Pl. 2, fig. 9

- 1850 *Cypridina asperrima* REUSS, p. 74, pl. 10, figs 5a-b.

Material – About 150 adult, 200 juvenile valves and 35 adult, 5 juvenile carapaces.

Dimensions (mm) –
LV (C.O.B. 310) L = 0.86, H = 0.54

Remarks – The taxonomy of the genus *Henryhowella* is still very problematical (e.g. Dingle *et al.*, 1990; Kempf & Nink, 1993; Bonaduce *et al.*, 1999; Guernet & Bellier, 2000; Dall'Antonia & Bossio, 2001). Our adult specimens possess a reticulate-spinose ornament

with three posterior plications and can be included in the *H. asperrima* group.

Genus LEGITIMOCY THERE Coles & Whatley, 1989

LEGITIMOCY THERE PRESEQUENTA (Benson, 1977)
Pl. 2, fig. 3

- 1977 *Acanthocythereis ? presequenta* BENSON, 1977, p. 877, pl. 2, fig. 5.
1989 *Legitimocythere presequenta* (Benson) - COLES & WHATLEY, p. 101, pl. 4, figs 3-5 (*cum syn.*).
1996 *Legitimocythere aff. presequenta* (Benson) - RODRIGUEZ-LAZARO & GARCIA-ZARAGA, pl. 1, fig. 19.
2001 *Legitimocythere presequenta* (Benson) - MAJORAN & DINGLE, p. 214, pl. 1, fig. 16.
2002 *Legitimocythere presequenta* (Benson) - MAJORAN & DINGLE, p. 149, fig. 3.21.
2003 *Legitimocythere presequenta* (Benson) - DALL'ANTONIA, BOSSIO & GUERNET, fig. 3.2.
non 2000 *Legitimocythere presequenta* (Benson) - GUERNET & BELLIER, p. 264, pl. 3, figs 2-3 [= *Dutoitella* cf. *D. eocenica* (Benson)].

Material – About 50 valves and 13 carapaces.

Dimensions (mm) –
LV (C.O.B. 314) L = 0.83, H = 0.47

Remarks – The presence of unremovable matrix on the valve surface prevented observation of the faint surface reticulation. In addition, owing to poor preservation many specimens do not show a well-developed posterior "hinge-ear" and a prominent tubercle surmounting the central node.

Distribution – South Atlantic: late Palaeocene-Oligocene (Benson, 1977; Majoran & Dingle, 2001), Weddell Sea Antarctica: Oligocene (Majoran & Dingle, 2002), North Atlantic: middle Eocene-Recent (Ducasse & Peypouquet, 1979; Coles & Whatley, 1989), Basque Basin: early Eocene (Rodriguez-Lazaro & Garcia-Zaraga, 1996), Czech Republic: Eocene-early Oligocene (Pokorny, 1981), Southern Spain: late Miocene (Benson, 1976; Berggren *et al.*, 1976), Mediterranean-Balearic Basin: early Miocene (Benson, 1978).

Oldest and youngest records – Late Palaeocene-Recent.

Genus PENNYELLA Neale, 1974

PENNYELLA ? cf. P. KLASZI Colin, 1987
Pl. 2, figs 8, 10

- 1987 *Pennyella ? klaszi* COLIN, p. 121, pl. 10, figs 2a-e.
2003 Genus et species indet. 1 DALL'ANTONIA, BOSSIO & GUERNET, p. 99.

Material – 16 valves and 22 carapaces.

Dimensions (mm) –
female C (C.O.B. 302) L = 0.54, H = 0.33
male C (C.O.B. 303) L = 0.63, H = 0.35

Remarks – This medium-sized species is represented mainly by deformed carapaces. The few loose valves recovered are filled with unremovable matrix, but features of the cardinal area suggest that they are probably not completely adult. The species is characterized by a trachyleberidine outline, with triangular posterior margin, a rather inflated postero-ventral area, a postero-dorsal spine and, finally, a regular reticulation extending over the entire lateral surface. Sexual dimorphism distinct: male proportionally longer and less inflated than females. These features indicate a very close affinity with *Pennyella* ? *klaszi* Colin, described from the early Palaeocene (Danian) of Senegal (Eastern Central Atlantic). The state of preservation of our material does not allow a firm generic and specific assignment.

Genus TRACHYLEBERIDEA Bowen, 1953 emend.
Haskins, 1963

TRACHYLEBERIDEA PISINENSIS (Kollmann, 1962)
Pl. 2, fig. 7

1962 *Cythereis* ? *pinensis* KOLLMANN, p. 205, p. 6, figs 11-13.
2003 *Trachyleberidea pinensis* (Kollmann) – DALL'ANTONIA,
BOSSIO & GUERNET, fig. 3.4.

Material – About 140 adult, 50 juvenile valves and 49 adult, 5 juvenile carapaces.

Dimensions (mm) –
LV (C.O.B. 321) L = 0.71, H = 0.37

Remarks – This poorly known species is characterized by a subrectangular carapace, highest anteriorly. Anterior margin rounded and denticulate, posterior margin thickened and subacuminate triangular with subcentral apex. Dorsal margin faintly arched (convex in the RV and concave in the LV) and slightly convergent posteriorly with the almost straight ventral margin. The marked anterior perimarginal rib extends, although less well developed, backward forming a keel-like projection postero-ventrally. A faint dorso-lateral rib is present. Both these projections end in a short vertical rib. Subcentral node weakly developed. Surface of the valve reticulate; meshes subquadrate and nearly constant in size.

Distribution – Croatia: middle Eocene (Kollmann, 1962), North Atlantic: late Palaeocene-late Oligocene (Whatley & Coles, 1991).

Oldest and youngest records – Late Palaeocene-late Oligocene.

Subfamily BUNTONINAE Apostolescu, 1961
Genus AMBOCYTHERE van den Bold, 1958

AMBOCYTHERE ? sp. 1
Pl. 2, fig. 6

Material – 32 valves and 25 carapaces.

Dimensions (mm) –
female C (C.O.B. 320) L = 0.66, H = 0.39

Remarks – This is probably a new species characterized by a marked costate/reticulate ornament. Male carapace subrectangular (female carapace subtriangular), highest anteriorly. Anterior margin broadly rounded, posterior subtriangular with apex at mid height. Ventral and dorsal margins gently sinuous and converging posteriorly. Primary longitudinal ribs prominent: dorsal rib short, arched and obscuring the postero-dorsal slope; median rib long and oblique; ventral rib connected with the continuous, strong anterior and antero-dorsal perimarginal rib. Posterior and central field characterized by secondary costate and reticulate ornament respectively. Internal features not visible.

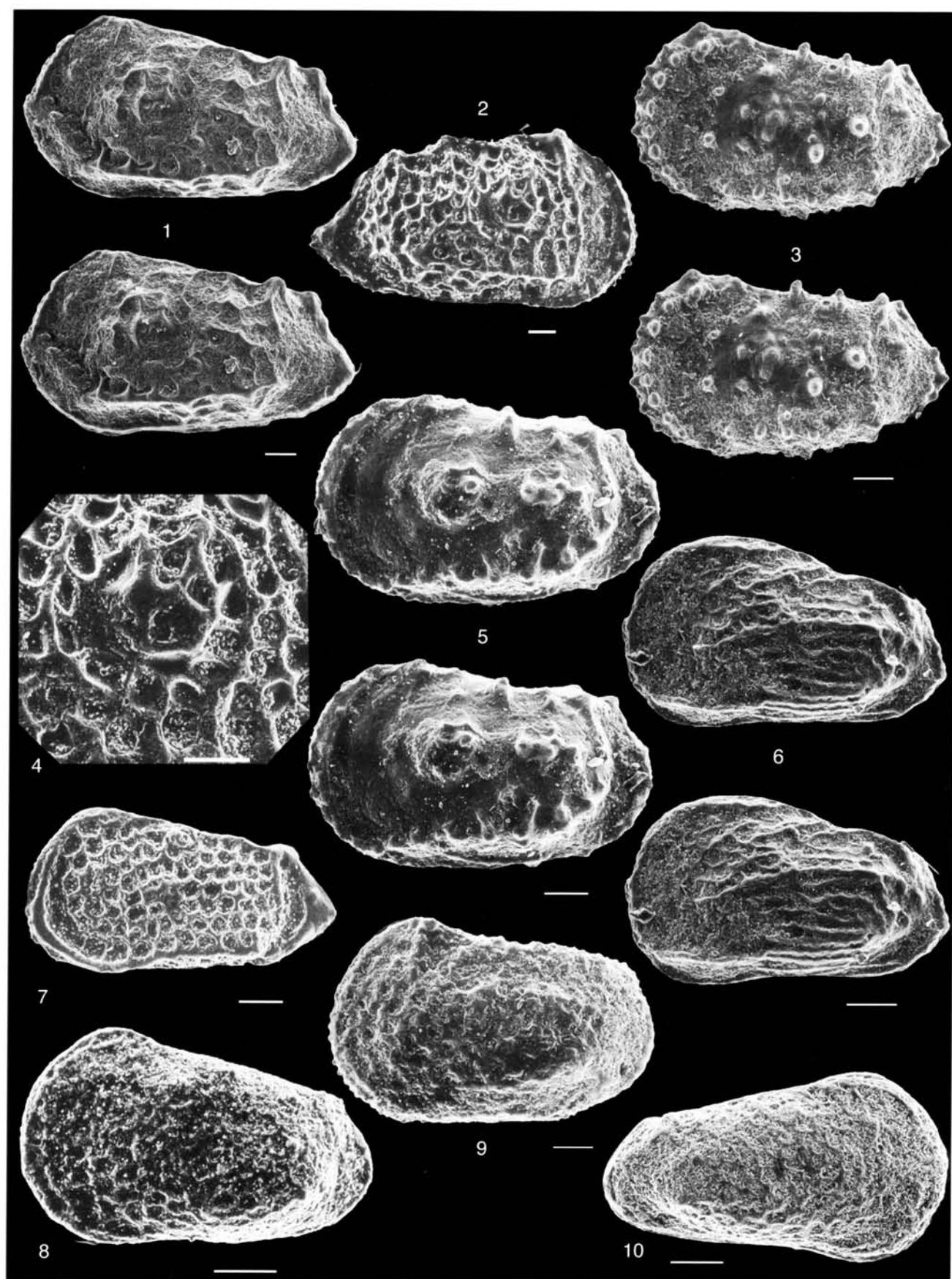
The present form is only tentatively referred to the genus *Ambocythere*, because it displays a more triangular outline in lateral view and a higher posterior apex than most species of *Ambocythere*. The species is somewhat similar to *Ambocythere subreticulata* van den Bold (1958, p. 807, text-figs 13-17) from the Oligocene-Miocene of Caribbean, but differs in the more marked secondary costate/reticulate ornament and presence of an uninterrupted perimarginal anterior-ventrolateral rib.

Family KRITHIDAE Malsbenden, 1960
Genus PARAKRITHA van den Bold, 1958

Representatives of the genus are rare and can be compared in external morphology to two previously

EXPLANATION OF PLATE 2

- Figs 1, 2, 4 – *Agrenocythere ordinata* (Deltel, 1964). 1) (Stereo pair) LV C.O.B. 301 h-sample 16.00 m; 2) RV C.O.B. 300 h-sample 9.00 m; 4) particular of the castrum same specimen of 2.
Fig. 3 – (Stereo pair) *Legitimocythere presequenta* (Benson, 1977). LV C.O.B. 314 h-sample 18.90 m.
Fig. 5 – (Stereo pair) *Dutoitella eocenica* (Benson, 1977). C left view C.O.B. 309 h-sample 7.00 m.
Fig. 6 – (Stereo pair) *Ambocythere* ? sp. 1. female C left view C.O.B. 320 h-sample 18.90.
Fig. 7 – *Trachyleberidea pinensis* (Kollmann, 1962). LV C.O.B. 321 h-sample 14.70 m.
Figs 8, 10 – *Pennyella* ? cf. *P. klaszi* Colin, 1987. 8) female C left view C.O.B. 302 h-sample 11.80 m; 10) male C left view C.O.B. 303 h-sample 8.70 m.
Fig. 9 – *Henryhowella* gr. *asprerima* (Reuss, 1850). LV C.O.B. 310 h-sample 16.80 m.
All views external lateral unless otherwise stated. Scale bars = 100 µm.



described species. The present material is, however, unsuitable for observation of the internal features and the specific assignment proposed herein is only tentative.

PARAKRITHE sp. cf. *P. ELONGATA* van den Bold, 1960
Pl. 1, fig. 9

1960 *Parakrithe elongata* VAN DEN BOLD, p. 160, pl. 6, fig. 6a-b.

Material – 5 valves and 6 carapaces.

Dimensions (mm) –
C (C.O.B. 306) L = 0.59, H = 0.26

Remarks – The present material has been tentatively assigned to *Parakrithe elongata*, known from the Eocene-Miocene of the Caribbean (van den Bold, 1960; Steineck *et al.*, 1984), in view of its elongate outline and subtriangular posterior end.

PARAKRITHE sp. cf. *P. VERMUNTI* (van den Bold, 1946)
Pl. 1, fig. 10

1946 *Cytheridea (Doloccytheridea) vermunti* VAN DEN BOLD, p. 83,
pl. 7, fig. 12a-d.

Material – 2 valves and 2 carapaces.

Dimensions (mm) –
C (C.O.B. 305) L = 0.50, H = 0.24

Remarks – This form has been referred to *Parakrithe vermunti*, reported from the Palaeogene-Pliocene of the Atlantic (van den Bold, 1946; Steineck *et al.*, 1984; Coles & Whatley, 1991), in view of its regularly arched dorsal slope.

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