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The genus *Cytheropteron* Sars, 1866 (Crustacea: Ostracoda) in the Pliocene – Early Pleistocene of the Mount San Nicola Section (Gela, Sicily)

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ABSTRACT: The systematics and the distribution of the genus *Cytheropteron* Sars 1866 is studied in the Plio-Pleistocene Section of Monte San Nicola. Fifteen taxa have been identified, 7 of which are described as new: *Cytheropteron (Aversovalva) denticulatum*, *C. fraudulentum*, *C. omega*, *C. (A.) pinarense gillesi*, *C. scalprum*, *C. sulcifer*, *C. vanharteni*.

INTRODUCTION

Cytheropteron Sars 1866 (Cytheruridae, Cytheropterinae - following Hartmann and Puri 1974, type-species *Cythere latissima* Norman 1865) is a world wide marine genus inhabiting all depths of present seas. Its depth distribution varies from species to species and some of them are reliable depth and/or climatological markers. The genus is reported fossil from the Lower Jurassic onwards and commonly occurs especially from Miocene to Recent.

Within the Mediterranean Basin the Recent species have been described primarily by G.W. Mueller (1894), and Bonaduce, Ciampo and Masoli (1976). In the late Cainozoic of the area, of fundamental importance are the papers of Colalongo and Pasini (1980) and Ciampo (1986, 1988) dealing with the Plio-Pleistocene and the Miocene.

The present paper concentrates on the study of the systematics and the stratigraphical distribution of *Cytheropteron* in the Mount San Nicola Section (Gela, Sicily) which spans from the Pliocene from M Pl 4 and the first part of the Pleistocene.

The section is 175m thick and comprises at the base the top of the Trubi Formation, followed conformably by the Monte Narbone Formation and subsequently by the clayey-sandy Pleistocene sediments. The section, its lithology, biostratigraphy based on planktonic foraminifera, and vertical distribution of the *Cytheropteron* species are given in text-figure 1. The samples studied have been collected each two meter intervals.

The palaeobathymetry of the sediments has been estimated at about 1000m for the Trubi and the Monte Narbone Formations and decreasing to 400-500m in the Pleistocene (Bonaduce and Sprovieri 1985).

For a more detailed description of the section see Bonaduce and Sprovieri 1985. Most of the species have been previously described and illustrated, sometimes insufficiently. Because of this, most of the known species are illustrated and 7 new taxa, *Cytheropteron (Aversovalva) denticulatum*, *C. fraudulentum*, *C. omega*, *C. (A.) pinarense gillesi*, *C. scalprum*, *C. sulcifer*, *C. vanharteni* are described and illustrated with SEM micrographs and some with drawings made using the light microscope (Visopan) in transmitted light.

SYSTEMATICS

The genus *Cytheropteron* is well defined by Van Morkhoven (1963). The subgenus *Aversovalva* Hornibrook 1952, which differs from the typical *Cytheropteron* due to the reversed height of RV and LV (LV higher than RV), the presence of an elongated furrow above the hinge in the LV and to details of the hinge, in our opinion deserves only subgeneric status and consequently is included here in *Cytheropteron*.

The classification followed in the present paper is that of Hartmann and Puri (1974).

In the section, 15 taxa of *Cytheropteron* were identified: *C. bifidum*, *C. (A.) denticulatum*, *C. fraudulentum*, *C. latum*, *C. monoceros*, *C. omega*, *C. (A.) pinarense gillesi*, *C. pseudoalatum*, *C. scalprum*, *C. sulcatum*, *C. sulcifer*, *C. testudo*, *C. trapezium*, *C. vanharteni*, *C. venustum*.

The specimens illustrated are housed in the Bonaduce Ostracode Collection (B.O.C.), Paleontological Department of the University "Federico II" of Naples.

Subclass OSTRACODA Latreille 1806
Order PODOCOPIDA G.W. Mueller 1894
Suborder PODOCOPA Sars, 1866
Superfamily CYTHERACEA Baird 1850
Family CYTHERURIDAE G.W. Mueller, 1894
Subfamily CYTHEROPTERINAE Hanai 1957
Genus *Cytheropteron* Sars 1866

Cytheropteron bifidum Colalongo and Pasini
Plate 1, figures 1-3; plate 3, figure 5

Cytheropteron bifidum COLALONGO and PASINI 1980, pp. 82, 84, pl. 11, figs. 1-9. — CIAMPO 1988, pl. 2, fig. 5. — MOSTAFAWI 1989, pl. 2, fig. 47. — *Cytheropteron miobifidum nomen nudum* BENSON, RAKIC et BIED and BONADUCE 1991, listed in fig. 5.

Remarks: This species, described and illustrated from the Pleistocene and cited also from the Pliocene of the Vrica Section (Calabria), shows some degree of variability. In fact in some specimens the oblique ridge connecting the postero-dorsal angle with the posterior attachment of the ala can show a reduced development and be partly substituted by an oblique alignment

of foveolae. The foveolae covering most of the valve's surface are sometimes of larger size than those shown in the original material. Moreover the LV (not represented in the original figures) appears constantly slightly different in the ornamentation as far as the dorsal margin is concerned. The subdorsal rim parallel to the margin seems frequently absent and the dorsal marginal area is not depressed. Moreover, the LV shows a more subrectangular shape in lateral view (pl. 1, fig. 1). The cited variability has been observed also in the richer and better preserved material from the borehole of Ain el Beida (Rabat, Morocco) where the species occurs in the Tortonian, Messinian and early Pliocene (Bonaduce and Benson, in preparation) and cited under the name of *C. miobifidum nomen nudum*. The species is cited also from the Pliocene of Southern Italy (Ciampo 1988) and from the Neogene of Rhodes, Greece (Mostafawi 1989).

Internal characters: The species shows (pl. 3, fig. 5) a very small antero-ventral vestibule from which 7 grouped marginal pore-canals (4 of which false) extend. The upper anterior inner lamella is crossed by 7 marginal pore-canals (3 of which false). The posterior and postero-ventral inner lamella is well developed and crossed by marginal pore-canals more or less regularly distributed, the top 2 of which are bifurcating.

Level of the figured specimens: M Pl 5, Stn. 23.

Size: L = 0.39mm (pl. 1, fig. 1).

Distribution: *C. bifidum* occurs all along the section, better represented in M Pl 4 and M Pl 5. It is absent in the interval corresponding to M Pl 6, possibly due to the reduced oxygen in the environment (particular abundance of pyrite).

Cytheropteron (Aversovalva) denticulatum Aiello, Barra and Bonaduce **n. sp.**

Plate 1, figures 14, 15; plate 3, figure 7

Cytheropteron n. sp. 1 BONADUCE and SPROVIERI 1985, pl. 1, fig. 5.

Etymology: From latin *denticulatus* = denticulate.

Holotype: LV (pl. 1, figs. 14, 15). Stn. 30. B.O.C. 2142.

Hypotypes: LV (pl. 3, fig. 7). Stn. 36. B.O.C. 2158; 2 RV, Stn. 3, B.O.C. 2159.

Type-level: M Pl 5.

Diagnosis: A species of *Cytheropteron* characterized by its triangular shape in lateral view, the anterior denticulations, some 4-5 riblets parallel to each other departing from the posterior attachment of the ala towards the postero-dorsal and substituted by large foveolae in the upper part of the valve. In dorsal view the carapace is peculiarly hexagonal and with alar process ending posteriorly in an obtuse and stocky spine. The anterior area is completely smooth, followed, towards the center, by small rounded foveolae. Caudal process subacuminate.

Internal characters: The anterior inner lamella shows a shallow arched vestibule which shows an irregular running (pl. 3, fig. 7). Anterior marginal pore-canals few and a little sinuous intercalated with some false.

Affinities: The proposed species differs from *C. striatum* Ciampo 1986 in the presence, between the posterior part of the alar process and the postero-dorsal margin, of the 4-5 flat, rope-like riblets which disappear towards the margin and are substituted

by a large-meshed subpolygonal reticulation. *C. striatum* shows all the central area ornamented only by polygonal and large reticulation. This species is also similar to *Aversovalva atlantica* Whatley and Coles 1987 and to *A. hydrodynamica* Whatley and Coles 1987 especially in the type of ornamentation and in the presence of anterior denticulations. It differs chiefly due to the triangular shape in lateral view instead than subrectangular, in the more acutely rounded anterior margin and in the more protruding caudal process.

Remarks: This species, up to now registered only in the Pliocene, possibly derives from the Tortonian *C. striatum*.

Size: L = 0.39mm (pl. 1, fig. 14).

Distribution: This species is relatively common and occurs only from the base of the section (M Pl 4) to the second half of M Pl 5.

Cytheropteron fraudulentum Aiello, Barra and Bonaduce **n. sp.**
Plate 2, figures 4-6; plate 3, figure 8

Cytheropteron sp. 2 CIAMPO 1986, pl. 13, figs. 10, 11.

Cytheropteron aff. *C. rotundatum* G.W. MUELLER. Bonaduce and Mascellarò (in Moncharmont Zei et al. 1985) pl. 1, fig. 3.

Etymology: From latin *fraudulentus* = fraudulent.

Holotype: LV (pl. 2, fig. 4). Stn. 70. B.O.C. 2149.

Hypotypes: 2 RV (pl. 2, figs. 5, 6). Stn. 80. B.O.C. 2150; RV (pl. 3, fig. 8), Stn. 78, B.O.C. 2160.

Type-level: M Pl 6.

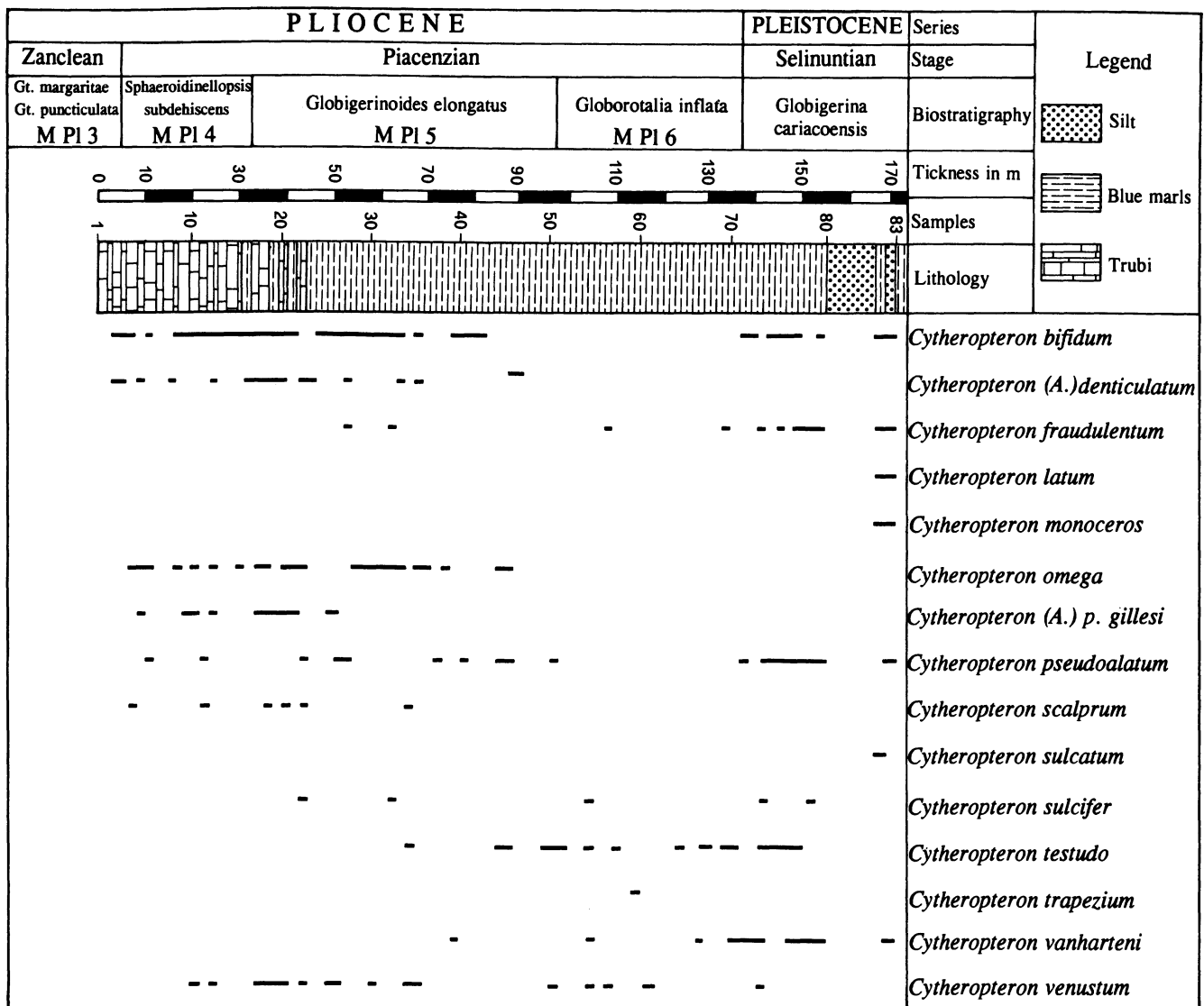
Diagnosis: This species is characterized by valves relatively elongated in lateral view, with prominent alar process thickened at the periphery which ends in a conical spine. Surface of the valves ornamented by an evident subdorsal rib which extends from the anterior to the posterior cardinal angle. After mid-length, a second rib bifurcates obliquely downwards disappearing before the mid-height of the valve. A small triangular depressed area is defined after the bifurcation of the rib. An irregular rib surrounds the upper part of the ala defining a triangular area which is evident in both lateral and dorsal views. The posterior extremity of the ala appears regularly arched and is devoid of any denticulation.

Internal characters: The anterior inner lamella shows a narrow vestibule of falciform shape from which 4 marginal, straight pore-canals depart. The top-part of the vestibule shows 3 false short pore-canals (pl. 3, fig. 8).

Remarks: The proposed species differs from *C. inornatum* Brady and Robertson 1872, as figured by Whatley and Masson 1979 and Athersuch et al. 1989 especially due to the lack of the oblique ribs departing from the posterior attachment of the ala and reaching the postero-dorsal. It is also close to *C. garganicum* Bonaduce, Ciampo and Masoli 1976 from which it differs in the shape of the ala more flat and backward directed instead than conical and almost perpendicular to the valve's surface. Both forms may show a spine at the end of the ala.

Size: L = 0.45mm (pl. 2, fig. 4).

Distribution: This species is very rare and scattered in a few samples in M Pl 5 and M Pl 6 and is present, with relative abundance and continuity, in the early Pleistocene.



TEXT-FIGURE 1
 Monte San Nicola Section: lithostratigraphy, biostratigraphy and distribution of the *Cytheropteron* species.

Cytheropteron latum G.W. Mueller
 Plate 1, figures 16, 17

Cytheropteron latum G.W. MUELLER 1894, p. 300, pl. 20, figs. 3, 9; pl. 21, figs. 10-14. — G.W. MUELLER 1912, p. 273, figs. 77, 78. — PURI BONADUCE and GERVASIO 1969, pl. 2, fig. 9. — BREMAN 1975, p. 73, pl. 11, fig. 169. — BONADUCE CIAMPO and MASOLI 1976, p. 95, pl. 53, figs. 9-14. — ARUTA 1983, p. 117, pl. 3, figs. 6-8. — MOSTAFAWI 1989, pl. 2, fig. 46.

Remarks: Whatley and Masson (1979) report the presence of this species from the Atlantic Quaternary - Recent and suggest the possibility of its evolution from either *C. crassipinnatum* Brady and Norman 1888 or *C. pseudocrassipinnatum* Whatley and Masson 1979 in the Mediterranean basin after the invasion of one of these Atlantic species probably during a glacial maximum. The speciation event should have been consequence of a climatic amelioration. Relatively recent data show that *C. latum* was present in the Mediterranean during the Late Miocene

and Pliocene (Aruta 1983) and in the Atlantic during the Tortonian - Pliocene (Bonaduce and Benson, unpublished data). These findings seem to contradict the previous hypothesis if related to the Quaternary glacial - interglacial events. Our specimens have been compared with topotypic material of the Gulf of Naples.

Level of the figured specimens: Early Pleistocene, Stn. 82, Stn. 83.

Size: L = 0.41mm (pl. 1, fig. 16).

Distribution: present only in the Early Pleistocene, very rare.

Cytheropteron monoceros Bonaduce, Ciampo and Masoli

Cytheropteron monoceros BONADUCE, CIAMPO and MASOLI 1976, pp. 95, 96, pl. 56, figs. 1-7. — BREMAN 1975, p. 74, pl. 12, fig. 179.-

WHATLEY and MASSON 1979, pp. 239 - 240, pl. 5, figs. 9-11, 14, 15. — COLALONGO and PASINI 1980, p. 56, pl. 16, figs. 9-10. — MALZ and JELLINEK 1984, p. 124, pl. 1, fig. 3. — BONADUCE MASOLI and PUGLIESE 1988, pl. 1, fig. 5
Cytheropteron ? *crassipinnatum* Brady and Norman. PURI, BONADUCE and MALLOY 1964, fig. 42.

Remarks: This species, described from the Recent of the Adriatic Sea, is cited by Breman (1975) from the same area, by Puri, Bonaduce and Malloy (1964) from the Gulf of Naples and by Malz and Jellinek (1984) from the Plio - Pleistocene of Greece. Whatley and Masson (1979) cite its occurrence in the Recent along the western coasts of Great Britain. Bonaduce, Masoli and Pugliese (1988) give its distribution on the Tunisian Shelf at depths between 114 and 300m. Ruggieri (1980) finds the species in the Italian Pleistocene. The oldest occurrence is registered in the Tortonian - Pliocene of Morocco (Bonaduce and Benson, unpublished data).

Distribution: This species is represented by one only specimen of Pleistocene age.

***Cytheropteron omega* Aiello, Barra and Bonaduce n. sp.**
Plate 2, figures 7-9

Cytheropteron syntomoalatum WHATLEY and COLES 1987, pl. 2, fig. 27, nec pl. 2, figs. 25, 26, 28, 29.
? *Cytheropteron* 2914 DINGLE, LORD and BOOMER 1990, p. 263, figs. 9 e-f.

Etymology: from the greek omega = the last letter of the greek alphabet.

Holotype: LV (pl. 2, fig. 7). Stn. 21. B.O.C. 2151.

Paratypes: 5 valves (2 of which are figured in pl. 2, figs. 8, 9). B.O.C. 2152.

Type-level: M Pl 5.

Diagnosis: A species of *Cytheropteron* characterized by LV in lateral view elongated with dorsal margin almost straight and caudal process peculiarly elongated. The RV is, as in most species of *Cytheropteron*, arched and with caudal process feebly upturned. The extremity of the ala is acuminate ending with an acute conical spine. In proximity of the posterior attachment of the ala a well protruding lamellar protrusion occurs, easily detectable especially in dorsal view (pl. 2, fig. 8). Posterior subdorsal rib of omega - shape reversed upside down. Some specimens show a higher L/H ratio than those illustrated.

Remarks: The proposed new species pertains to the group of *Cytheropteron* which comprises *C. garganicum* Bonaduce, Ciampo and Masoli 1976, *C. fraudulentum* n. sp. and *C. ruggierii* Pucci 1955 as far as the shape in lateral view and the presence of the subdorsal posterior rib and the oblique stria running from the postero-dorsal towards the antero-ventral margin are concerned. At the side of differences in details of the ala, it is characterized chiefly by the subdorsal rib which shows the peculiar shape of the greek letter omega (ω) oriented upside down. It is also similar to a paratype of *C. syntomoalatum* Whatley and Coles 1987 (pl. 2, fig. 27) which does not appear conspecific with the holotype and with the other paratypes illustrated (pl. 2, figs. 25, 26, 28, 29). The specimen illustrated by Whatley and Coles differs only in the more elongated shape in lateral view and can be considered conspecific with the present species.

Size: L = 0.41mm (pl. 2, fig. 7).

Distribution: This species occurs only and with continuity from the base of M Pl 4 to the end of M Pl 5. If this restricted distribution will be confirmed in other sections, the species is hopefully of stratigraphic importance, as far as its first appearance is concerned.

***Cytheropteron (Aversovalva) pinarense* van den Bold *gillesi* Aiello, Barra and Bonaduce n. subsp.**
Plate 2, figures 10-12

Cytheropteron (Aversovalva) lancei Carbonell (misspelling for Carbonnel). CIAMPO 1980, pl. 2, fig. 9
Cytheropteron aff. *C. lancei* Carbonnel. BONADUCE and SPROVIERI 1985, pl. 1, fig. 7.

Etymology: For Dr. Gilles Carbonnel, Lyon, France, for his outstanding contribution to the ostracodology.

Holotype: LV (pl. 2, fig. 10). Stn. 10. B.O.C. 2153.

Hypotypes: 5 valves (2 of which are figured in pl. 2, figs. 11, 12). Stn. 21. B.O.C. 2154.

Type-level: M Pl 4.

Size: L = 0.44mm (pl. 2, fig. 12).

Remarks and affinities: *Cytheropteron (A.) pinarense* van den Bold 1946 originally described from the Oligocene of the Caribbean occurs in the same area up to Early Miocene. It is also doubtfully cited from the Quaternary of the Pacific, Indian Ocean and Mediterranean (Whatley and Ayress 1988). Our specimens differ slightly from the types in the posterior alar spine which diverges laterally from the continuation of the ala while in the original specimens it is continuous with the rim of the ala (van den Bold, pers. comm., 1994). Moreover from the original drawing in dorsal view of *C. pinarense* the ala does not seem to reach the anterior margin and consequently the shape appears anteriorly more acuminate. *C. pinarense* is notably larger in size (L = 0.57mm). The differences do not justify the creation of a new species, in agreement with the opinion of van den Bold (cited comm.). We prefer to keep them separate at subspecies level.

The proposed new subspecies is also similar to *Cytheropteron (Aversovalva) lancei* Carbonnel 1969 described from the Burdigalian of the Rhone (France). It differs chiefly due to the presence of the posterior intermediate spine which never occurs in *C. (A.) lancei*. Moreover it shows a clear rough reticulation at the upper base of the alar process, a character which does not occur in *C. (A.) lancei*. It is also very close to *C. cf. lancei* Colalongo and Pasini 1980 from which it differs due to the laterally less expanded and less arched blade - like alar process, and to its anterior development which reaches the anterior margin instead than ending at a notable distance from it.

The specimens figured by Colalongo and Pasini (1980) are here designated as holotype (pl. 10, fig. 9) and paratype (pl. 10, fig. 8) of *Cytheropteron (Aversovalva) colalongoi* n. sp.

We are particularly grateful to Dr. Gilles Carbonnel (Lyon, France) and to Dr. Win van den Bold (Utrecht, The Netherlands) for their invaluable suggestions.

Distribution: *C. (A.) pinarense gillesi* n. ssp. shows in our samples a relatively abundant frequency restricted to M Pl 4 and the first half of M Pl 5. The form is figured by Ciampo 1980 and cited with the range Late Tortonian - Early Messinian of the

area of Ragusa (Sicily). It occurs in the Tortonian - Early Pliocene of the Atlantic Moroccan Sections (Bonaduce and Benson, unpublished data).

Cytheropteron pseudoalatum Colalongo and Pasini
Plate 2, figures 1-3; plate 3, figures 1-2

Cytheropteron pseudoalatum COLALONGO and PASINI 1980, pp. 92-94, pl. 8, fig. 8; pl. 9, figs. 1-5.

Remarks: Our specimens agree with the original description and illustration given from the Pleistocene of the Vrica Section (Calabria, Italy). This species differs from *C. volantium* Whatley and Masson 1979 especially in lacking punctate ornament on the posterior valve's extremity and in the larger size (*C. volantium* L = 0.49-0.52mm).

Internal characters: The anterior inner lamella is characterized by a narrow feebly arched vestibule from which some 5-6 marginal almost straight pore-canals depart, intercalated with some false ones. The posterior inner lamella shows a very small subtriangular vestibule (pl. 3, figs. 1, 2).

Level of the figured specimens: Early Pleistocene, Stn. 80, Stn. 83.

Size: L = 0.70mm (pl. 2, fig. 3).

Distribution: Rare occurrences in scattered samples from the base of M Pl 4 to the first beginning of M Pl 6. Absent in all the remaining part of M Pl 6, it reappears with continuity from the base of the Pleistocene, relatively more common.

Cytheropteron scalprum Aiello, Barra and Bonaduce **n. sp.**
Plate 1, figures 4-6

Etymology: From latin *scalprum* = chisel.

Holotype: LV (pl. 1, fig. 4). Stn. 35. B.O.C. 2136.

Hypotypes: 2 valves (1 of which is figured in pl. 1, figs. 5-6). Stn. 21. B.O.C. 2137; LV. Stn. 4. B.O.C. 2162.

Type-level: M Pl 5.

Diagnosis: A species of *Cytheropteron* characterized by valves relatively short and stocky, LV dorsally arched, RV obliquely straight, alar process massive and poorly protruding ending posteriorly with an arch. At mid-length, the upper base of the ala shows a clear depression. Surface of the valves smooth along the anterior margin and ornamented by deep and large foveolae in the central area and of decreasing size towards the anterior margin. The foveolae are aligned in almost vertical rows in the area between the posterior attachment of the smooth ala and the posterodorsal margin. In dorsal view valves swollen in the central part and acuminate at the extremities.

Size: L = 0.43mm (pl. 1, fig. 6).

Affinities: This species is similar to *C. retrosulcatum* Colalongo and Pasini 1980 in the type of ornamentation. It differs due to the more pyriform shape, the broadly rounded anterior margin, the different alar shape in dorsal view and the lack of the posterior subvertical striae ending with the subdorsal rib.

Distribution: This very rare species occurs in scattered samples from the base of M Pl 4 to the first half of M Pl 5.

Cytheropteron sulcatum Bonaduce, Ciampo and Masoli

Cytheropteron sulcatum BONADUCE CIAMPO and MASOLI 1976, pp. 97-99, pl. 57, figs. 1-8; text-fig. 37. — BREMAN 1975, p. 74, pl. 12, fig. 178. — CIAMPO 1986, pl. 13, fig. 8.

Cytheropteron sp. H PURI, BONADUCE and MALLOY, 1964, fig. 44.
Cytheropteron inornatum Brady and Robertson 1872. MOSTAFAWI 1989, pl. 2, fig. 45.

Remarks: Whatley and Masson 1979 consider *C. sulcatum* to be a junior synonym of *C. inornatum* Brady and Robertson 1872, and Mostafawi (1989) accepts their opinion. Athersuch, Horne and Whittaker (1989), in their redescription of *C. inornatum* from the Recent of Scotland, compare this species with *C. sulcatum* and they prefer to regard them as separate species due to the more squat and more pronounced ala and caudal process of *C. sulcatum* "at least until such time as their male copulatory appendages can be compared". For the time being we prefer, not because one of us (G. Bonaduce) erected *C. sulcatum*, to follow the opinion of Athersuch et al. because of the cited differences. The species shows a stratigraphical range from the Late Tortonian (Ciampo 1986) of the Mediterranean to the Recent. It occurs in Recent of the Gulf of Naples as *Cytheropteron* n. sp. H (Puri, Bonaduce and Malloy 1964) and on the Tunisian Shelf (Bonaduce, Masoli and Pugliese 1988) is cited in assemblages deeper than 40m.

Distribution: This very rare species occurs only in one sample of the Pleistocene.

Cytheropteron sulcifer Aiello, Barra and Bonaduce **n. sp.**
Plate 1, figures 7-9; plate 3, figure 3

Cytheropteron venustum Bonaduce, Ciampo and Masoli. COLALONGO and PASINI 1980, p. 56, pl. 19, figs. 5-6.

Etymology: from latin *sulcifer* = with sulci.

Holotype: LV (pl. 1, fig. 7). Stn. 33. B.O.C. 2138.

Hypotypes: 2 valves (1 of which is figured in pl. 1, figs. 8, 9). Stn. 83. B.O.C. 2139; LV. Stn. 23. B.O.C. 2163.

Type-level: M Pl 5.

Diagnosis: A species of *Cytheropteron* characterized by the regularly arched dorsal margin in the RV and posteriorly sinuous in the second half of the LV. Anterior margin acutely rounded and caudal process well developed and upturned especially in the RV. Alar process well expanded laterally and bordered by a rope-like thickening all along and with posterior end furnished with a conical spine outwards directed. The ala appears depressed in the upper part at about mid-length. Posterior extremity of the ala with a stocky well defined protrusion. Anterior part of the valve smooth, central part covered by rounded foveolae from very small to medium-sized towards the center. Posterior with numerous subvertical rope-like ribs parallel to each other departing from the posterior attachment of the ala, all of which truncated orthogonally by a short rope-like ridge. Postero-ventral extremity confusely reticulated. The areas between the subvertical ridges are occupied by a line of rounded foveolae.

Internal characters: The anterior inner lamella shows the presence of a rather developed and deep vestibule, whose anterior boundary runs parallel to the margin. From the vestibule few regularly spaced short marginal pore-canals depart (pl. 3, fig. 3).

Size: L = 0.46mm (pl. 1, fig. 7).

Affinities: This species is very similar to *C. punctatum* Brady 1868 as figured by Whatley and Masson 1979 in the general shape and type of ornamentation. It differs chiefly due to the lack of pits on the anterior part of the valves, the shape in dorsal view and the less massive alar process. It has been identified by Colalongo and Pasini (1980) as *C. venustum* Bonaduce, Ciampo and Masoli 1976 from which it differs especially due to the presence of the rope-like subvertical ridges (compare with *C. venustum*: pl. 1, fig. 12-13). A closer species is *C. retrosulcatum* Colalongo and Pasini 1980 from which it differs due to the higher valves in lateral view and especially in the lack of the longitudinal depressed area all along the margin of the ala. The two species are closely related. *C. sulcifer* n. sp. is similar to *C. ionicum* Colalongo and Pasini 1980 in shape in both lateral and dorsal view and in the lack of pits in the anterior part of the valve. It differs chiefly due to the presence of the subvertical ribs departing from the posterior attachment of the ala.

Distribution: This very rare and scattered species occurs from M Pl 5 to the topmost part of the section (Early Pleistocene).

***Cytheropteron testudo* Sars**

Plate 2, figures 13-18; plate 3, figure 6

Cytheropteron testudo Sars 1870, p. 29. — BRADY and NORMAN 1889, p. 219, pl. 21, figs. 1, 2. — Sars 1928, pp. 230-231, pl. 106, fig. 1. — RUGGIERI 1952, p. 18, pl. 6, figs. 4, 5; pl. 8, fig. 8. — COLALONGO 1966, p. 110, pl. 12, figs. 5, 6. — CIAMPO 1971, p. 32, pl. 4, figs. 1, 2. — SISSINGH 1973, p. 39, pl. 1, fig. 10. — BREMAN 1975, p. 74, pl. 12, fig. 174. — COLALONGO and PASINI 1980, p. 56, pl. 19, fig. 7. — TSAPRALIS 1981, p. 112, pl. 11, figs. 3, 4. — WHATLEY and DOWNING 1983, pp. 371-372, pl. 5, fig. 2. — BONADUCE and SPROVIERI 1985, pl. 1, fig. 1. — BONADUCE and MASCELLARO in Moncharmont et al. 1985, pl. 1, fig. 6. — GUILLAME, PEYPOUQUET and TETART 1985, pl. 106, figs. 9, 10. — ? WHATLEY and COLES 1987, pl. 3, fig. 1. — MOSTAFAWI 1989, p. 130, pl. 2, fig. 48. — WHATLEY and AYRESS 1988, pl. 1, figs. 7 a. — ? WHATLEY and AYRESS 1988, pl. 1, figs. 7 b, 8 a-b.

Remarks: This species, described from the Recent of the North Sea, has been cited from the Atlantic and the Mediterranean in the age range Pleistocene - Recent and considered as one of the markers of the Plio-Pleistocene boundary in the Mediterranean

basin at the first beginning of the climatic deterioration. A relatively recent paper (Bonaduce and Sprovieri 1985) demonstrates that in the Mediterranean the species occurs from the Late Pliocene onwards and that its first occurrence can be correlated with the Pliocene “glacial event” at about 2.4 My. The illustrations show specimens from the Recent of the Skagerrak, considered topotypic, from the Elofson Collection (pl. 2, figs. 16-18) and from the Pliocene of the present section for comparison (pl. 2, figs. 13-15). Our specimens differ slightly in lateral view from the illustrated Recent ones in the anteriorly more angular dorsal margin, in the more pronounced anterior depression; and in the more acuminate posterior extremity corresponding to the more developed caudal process, particularly evident in dorsal view. The differences observed in our opinion may correspond to geographical “races” as response to different environmental conditions and consequently we are not in agreement with Jenkins (1987) who considers *C. testudo* of the Mediterranean Pleistocene misidentified. The last occurrence of *C. testudo* in the Mediterranean corresponds to the last glaciation (Bonaduce and Mascellaro 1985). Whatley and Coles (1987) cite its occurrence in the Atlantic from the Early Pliocene onwards. The illustration shows the lack of the longitudinal ribs at the upper base of the alar process. Because of this the identification is considered doubtful. Whatley and Ayress (1988) illustrate from the Quaternary of both the Atlantic and Pacific three forms, one of which (pl. 1, figs. 7 a) in our opinion is *C. testudo*. A second form (pl. 1, figs. 8 a-b) corresponding to the form illustrated by Whatley and Coles (1987) and a third one (pl. 1, fig. 7 b), are considered of doubtful identification. We noted the very small size of both the cited Atlantic and Pacific forms (from 0.29 to 0.35mm).

Internal characters: The anterior inner lamella shows a relatively deep and sack - shaped vestibule restricted to the lower part of the valve (pl. 3, fig. 6).

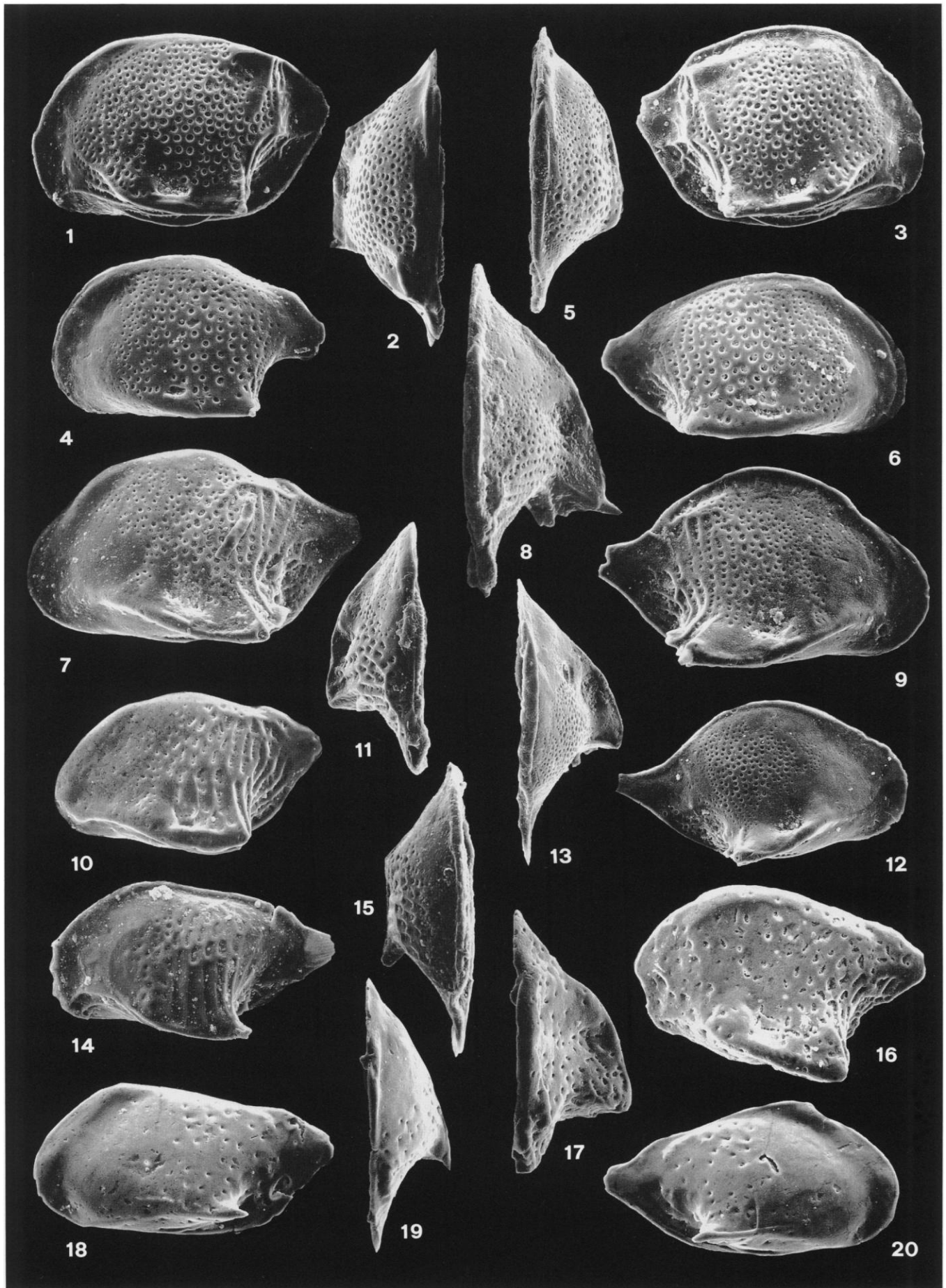
Level of figured specimens: M Pl 5, Stn. 50; M Pl 6, Stn. 51.

Size: L = 0.56mm (pl. 2, fig. 13).

PLATE 1

All magnification $\times 135$. RV = right valve; LV = left valve; CC = complete carapace.

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|-------|---|-------|---|
| 1-3 | <i>Cytheropteron bifidum</i> Colalongo and Pasini, Stn. 23, B.O.C. 2135. 1, LV; 2, LV in dorsal view; 3, RV. | 12-13 | <i>Cytheropteron venustum</i> Bonaduce, Ciampo and Masoli. Stn. 20, B.O.C. 2141. 12, RV; 13, RV in dorsal view. |
| 4-6 | <i>Cytheropteron scalprum</i> n. sp. 4, holotype, LV, Stn. 35, B.O.C. 2136; 5, hypotype, RV in dorsal view, Stn. 21, B.O.C. 2137; 6, same specimen of fig. 5 in lateral view. | 14-15 | <i>Cytheropteron (Aversovalva) denticulatum</i> n. sp. 14, holotype, LV, Stn. 30, B.O.C. 2142; 15, same specimen of fig. 14 in dorsal view. |
| 7-9 | <i>Cytheropteron sulcifer</i> n. sp. 7, holotype, LV, Stn. 33, B.O.C. 2138; 8, hypotype, RV in dorsal view, Stn. 83, B.O.C. 2139; 9, same specimen of fig. 8 in lateral view. | 16-17 | <i>Cytheropteron latum</i> G.W. Mueller. 16, LV, Stn. 83, B.O.C. 2143; 17, RV in dorsal view, Stn. 82, B.O.C. 2144. |
| 10-11 | <i>Cytheropteron trapezium</i> Colalongo and Pasini. 10, LV, Stn. 60, B.O.C. 2140; 11, same specimen of fig. 10 in dorsal view. | 18-20 | <i>Cytheropteron vanharteni</i> n. sp. 18, holotype, LV, Stn. 78, B.O.C. 2145; 19, hypotype, RV in dorsal view, Stn. 79, B.O.C. 2146; 20, hypotype, RV, Stn. 79, B.O.C. 2146. |



Distribution: *C. testudo* occurs from the second half of M Pl 5 to the Early Pleistocene, relatively abundant from the base of M Pl 6 onwards.

Cytheropteron trapezium Colalongo and Pasini
Plate 1, figures 10, 11

Cytheropteron trapezium COLALONGO and PASINI 1980, pp. 98, 100, pl. 13, figs. 4-8.

Remarks: This species has been originally described from Pleistocene sediments of the Vrica Section (Calabria, Italy). In our section it has been found only once in a sample at about the middle of M Pl 6.

Level of the figured specimens: M Pl 6, Stn. 60.

Size: L = 0.39mm (pl. 1, fig. 10).

Cytheropteron vanharteni Aiello, Barra and Bonaduce n. sp.
Plate 1, figures 18-20; plate 3, figure 4.

Etymology: For Dr. Dick Van Harten, Vrije University of Amsterdam, Holland.

Holotype: LV (pl. 1, fig. 18). Stn. 78. B.O.C. 2145.

Hypotypes: 3 valves (pl. 1, figs. 19, 20). Stn. 79. B.O.C. 2146; pl. 3, fig. 4. Stn. 77. B.O.C. 2165.

Type-level: Early Pleistocene.

Diagnosis: A species of *Cytheropteron* of subtriangular shape in lateral view, with dorsal margin straight and oblique, anterior margin acutely rounded, well developed caudal process almost in continuation of the dorsal margin, alar process poorly developed and backwards directed, ending posteriorly with a spine, which gives an acute lanceolate shape in dorsal view. Surface of the valves smooth anteriorly and with scattered, rare but well defined pits in the second half.

Internal characters: The anterior inner lamella appears well developed and shows the presence of a very narrow vestibule

from which some 5 marginal pore - canals depart with intercalated numerous false ones (pl. 3, fig. 4).

Size: L = 0.40mm (pl. 1, fig. 18).

Affinities: This species, due to the peculiar shape, ornamentation and type of ala cannot be compared with any other known to us.

Distribution: It occurs largely scattered and rare in the second half of M Pl 5 and M Pl 6. It becomes more frequent and continuously recorded in the Early Pleistocene.

Cytheropteron venustum Bonaduce, Ciampo and Masoli
Plate 1, figures 12, 13

Cytheropteron venustum BONADUCE, CIAMPO and MASOLI 1976, pp. 100, 101, pl. 54, figs. 9, 10; pl. 56, figs. 8-12. — BREMAN 1975, p. 73, pl. 11, fig. 170. — CIAMPO 1986, pl. 13, fig. 7. — *Cytheropteron venustum* Bonaduce, Ciampo and Masoli. COLALONGO and PASINI 1980, p. 56, pl. 19, figs. 5-6.

Remarks: This species, described from the Recent of the Adriatic Sea, has been cited from the Recent of the same area by Breman (1975) and by Ciampo from the Late Tortonian of different Italian sections. Our specimens have been compared with the type and paratypes.

Level of figured specimens: M Pl 5, Stn. 20.

Size: L = 0.41mm (pl. 1, fig. 12).

Distribution: It occurs, rarely frequent from the second half of M Pl 4 to the beginning of the Pleistocene, generally more continuously recorded in the first half of M Pl 5.

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PLATE 2

- 1-3 *Cytheropteron pseudoalatum* Colalongo and Pasini. 1, LV, Stn. 80, B.O.C. 2147, (×91); 2, RV in dorsal view, Stn. 83, B.O.C. 2148, (×91); 3, same specimen of fig. 2 in lateral view, (×91).
- 4-6 *Cytheropteron fraudulentum* n. sp. 4, holotype, LV, Stn. 70, B.O.C. 2149, (×135); 5, hypotype, RV in dorsal view, Stn. 80, B.O.C. 2150, (×135); 6, hypotype, RV, Stn. 80, B.O.C. 2150, (×135).
- 7-9 *Cytheropteron omega* n. sp. 7, holotype, LV, Stn. 21, B.O.C. 2151, (×135); 8, paratype, LV in dorsal view, B.O.C. 2152, (×135); 9, paratype, RV, B.O.C. 2152, (×135).
- 10-12 *Cytheropteron (Aversovalva) pinarense* van den Bold gillesi n. ssp. 10, holotype, LV, Stn. 10, B.O.C. 2153, (×135); 11, hypotype, RV in dorsal view, Stn. 21, B.O.C. 2154, (×135); 12, hypotype, RV, Stn. 21, B.O.C. 2154, (×135).
- 13-18 *Cytheropteron testudo* Sars. 13, LV, Stn. 50, B.O.C. 2155, (×91); 14 RV in dorsal view, Stn. 51, B.O.C. 2156, (×91); 15, RV, Stn. 51, B.O.C. 2156, (×91); 16, LV, North Sea, Elofson's Collection, B.O.C. 2157, (×91); 17 CC in dorsal view, North Sea, Elofson's Collection, B.O.C. 2157, (×91); 18, RV, same specimen of fig. 16, (×91);



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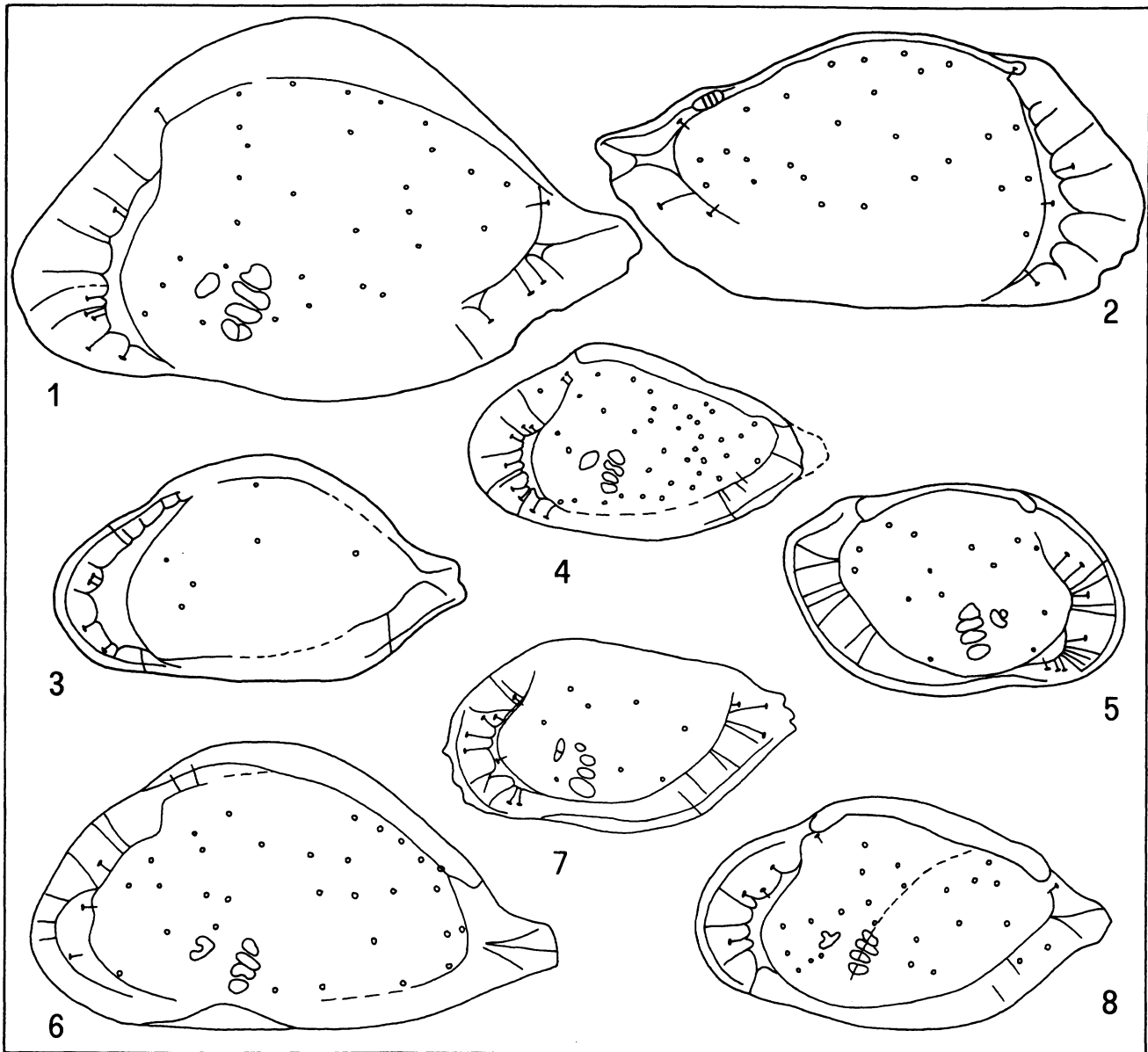


PLATE 3
All magnification $\times 134$

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| <p>1-2 <i>Cytheropteron pseudoalatum</i> Colalongo and Pasini. 1, RV from inside, Stn. 83, B.O.C. 2148; 2, LV from inside, Stn. 80, B.O.C. 2147.</p> <p>3 <i>Cytheropteron sulcifer</i> n. sp. RV from inside, Stn. 83, B.O.C. 2139.</p> <p>4 <i>Cytheropteron vanharteni</i> n. sp. RV from inside, Stn. 77, B.O.C. 2165.</p> | <p>5 <i>Cytheropteron bifidum</i> Colalongo and Pasini. LV from inside, Stn. 23, B.O.C. 2135.</p> <p>6 <i>Cytheropteron testudo</i> Sars. RV from inside, Stn. 55, B.O.C. 2164.</p> <p>7 <i>Cytheropteron (Aversoalva) denticulatum</i> n. sp. LV from inside, Stn. 36, B.O.C. 2158.</p> <p>8 <i>Cytheropteron fraudulentum</i>. RV from inside, Stn. 78, B.O.C. 2160.</p> |
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