

<i>Bollettino della Società Paleontologica Italiana</i>	23 (3)	1984	515-543	10 pls.	Modena, Gennaio 1986
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## The genus *Tenedocythere* (Ostracoda, Podocopida) of the Mediterranean Miocene to Recent especially from Italy.

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KEY WORDS — Crustacea (Ostracoda), Taxonomy, Miocene-Recent, Mediterranean basin.

**SUMMARY** — The review of the ostracode genus *Tenedocythere* mostly from Italian outcrops from Miocene to Recent, resulted in the recognition of 11 new species and 1 subspecies which are described and illustrated. These are: *Tenedocythere birestis* n. sp., *T. cataphracta* n. sp., *T. cordiformis* n. sp., *T. cruciata* n. sp., *T. furcata* n. sp., *T. furcata gradata* n. ssp., *T. obsoleta* n. sp., *T. parallela* n. sp., *T. perplexa* n. sp., *T. scabriuscula* n. sp., *T. scalprata* n. sp., *T. subulata* n. sp. Moreover, most of the previously known congeneric species are re-illustrated and comparatively discussed. On the basis of the known elements, it seems likely that the genus *Tenedocythere* colonized the Mediterranean during Miocene from the indo-pacific area and from there subsequently reached the Atlantic. After the radical destruction of the Mediterranean fauna at the end of Miocene (« salinity crisis »), this genus reentered into the Mediterranean from the Atlantic. A new species of *Pokornyyella*, *P. devians* is described in the appendix.

**RIASSUNTO** — [Il genere *Tenedocythere* (Ostracoda, Podocopida) dal Miocene ad oggi nel Mediterraneo, con particolare riguardo all'Italia] — La revisione del genere *Tenedocythere*, basata in gran parte su campioni provenienti da località italiane datati dal Miocene all'Attuale, ha permesso l'individuazione di 11 specie ed una sottospecie nuove. Esse sono: *Tenedocythere birestis* n. sp., *T. cataphracta* n. sp., *T. cordiformis* n. sp., *T. cruciata* n. sp., *T. furcata* n. sp., *T. furcata gradata* n. ssp., *T. obsoleta* n. sp., *T. parallela* n. sp., *T. perplexa* n. sp., *T. scabriuscula* n. sp., *T. scalprata* n. sp., *T. subulata* n. sp. Inoltre viene reillustrata e discussa comparativamente la maggior parte delle specie congeneriche note. Sulla base degli elementi noti, sembra verosimile che il genere *Tenedocythere* abbia colonizzato il Mediterraneo durante il Miocene, provenendo dalla regione indo-pracifica. Dal Mediterraneo, sempre durante il Miocene, sarebbe poi passato in Atlantico. Dopo la radicale distruzione della fauna mediterranea alla fine del Miocene (« salinity crisis »), il genere sarebbe ripetutamente riertrato dall'Atlantico nel Mediterraneo, approfittando di intervalli climaticamente favorevoli. In appendice viene descritta una nuova specie di *Pokornyyella*, *P. devians* n. sp.

### INTRODUCTION

The advent of the Scanning Electron Microscope in the study of ostracodes changed considerably their systematics by restricting the species concept. It allowed the study and the use of elements previously unknown or badly known, in particular the type and structure of the normal pore-canals which proved to be of remarkable importance for systematic purposes.

The present paper deals with the study of the genus *Tenedocythere* Sissingh, 1972 which was recorded in the Mediterranean basin from Miocene to Recent investigating the possible phylogenetic and paleogeographic origin of *Tenedocythere*.

The taxon *Tenedocythere* was erected as a subgenus of *Quadracythere* Hornibrook 1952 by Sissingh 1972 (p. 126), type species *Cythere prava* Baird 1850.

The original diagnosis of the subgenus is as follows: « A subgenus of *Quadracythere* characterized by a lateral surface with some longitudinal ridges, a smooth posterior tooth in the right valve and anterior marginal pore-canals without thickened median parts ».

Subsequent investigations (Holden, 1976; Ruggieri *et al.*, 1977) suggested the following conclusions:

1) *Tenedocythere* is not a subgenus of *Quadracythere*, due to substantial differences.

2) *Tenedocythere* shows peculiar characters that are adequate for a generic separation. However, a number of representatives of this genus show clear affinities with the genus *Pokornyyella* Oertli (Ruggieri *et al.*, 1977).

The differences between *Tenedocythere* and *Quadracythere* are of different ranks, and fundamentally reside in the following characters:

a) the normal pore-canals of *Tenedocythere* end with a sieve-disk that is peripherally well defined, showing a principal simple hole in a sub-central position (Pl. 2, fig. 7). The disks regularly occupy the entire deepest part of each foveola and are bordered by a peripheral sulcus that is generally well evident. We propose the name of « parma » (from the latin *parma* = round shield), for these structures to discriminate them from other disks that are not so well defined.

On the contrary, in *Quadracythere truncula*, type species of the genus *Quadracythere*, the normal pore-canals end with a cribrate structure that is remarkably more complex. The pierced disk itself shows an irregularly conical shape at the apex in which a roundish opening occurs (Pl. 2, fig. 9). The full structure occupies only a restricted part of the bottom of each foveola and each foveola can shelter more than one normal pore-canal.

b) *Tenedocythere* shows a general shape which is reminiscent of certain *Aurila* (*Cimbourila*) in that it has a ventro-lateral carina that gives rise to a moderately large « solea » tending to rise in the proximity of the margin (cfr. Ruggieri, 1975). A large and very protruding « sledge » occurs in the central part of the solea. The lateral surface is regularly swollen and hides the ventro-lateral carina in ventral view (Pl. 3, fig. 8).

On the contrary, *Quadracythere* shows a general shape that is more similar to that of *Cytherop-teron* (Pl. 1, fig. 1), due to the presence of a very large and flat solea that extends as a bar parallel to the margin until the eye-spot area (Pl. 1, fig. 1). In *Quadracythere* the ventro-lateral carina ends roughly against the lowest part of the anterior margin.

c) The fundamental scheme of the ornamentation of the lateral surfaces in *Tenedocythere* and *Qua-*

*dracythere* is radically different, as can be observed in Plate 1, figs. 1, 4.

d) In dorsal view *Tenedocythere* shows a rather complicated outline due to a depression in the muscle-scars area and an ear-shaped projection at some distance before the posterior end (Pl. 3, figs. 4, 5).

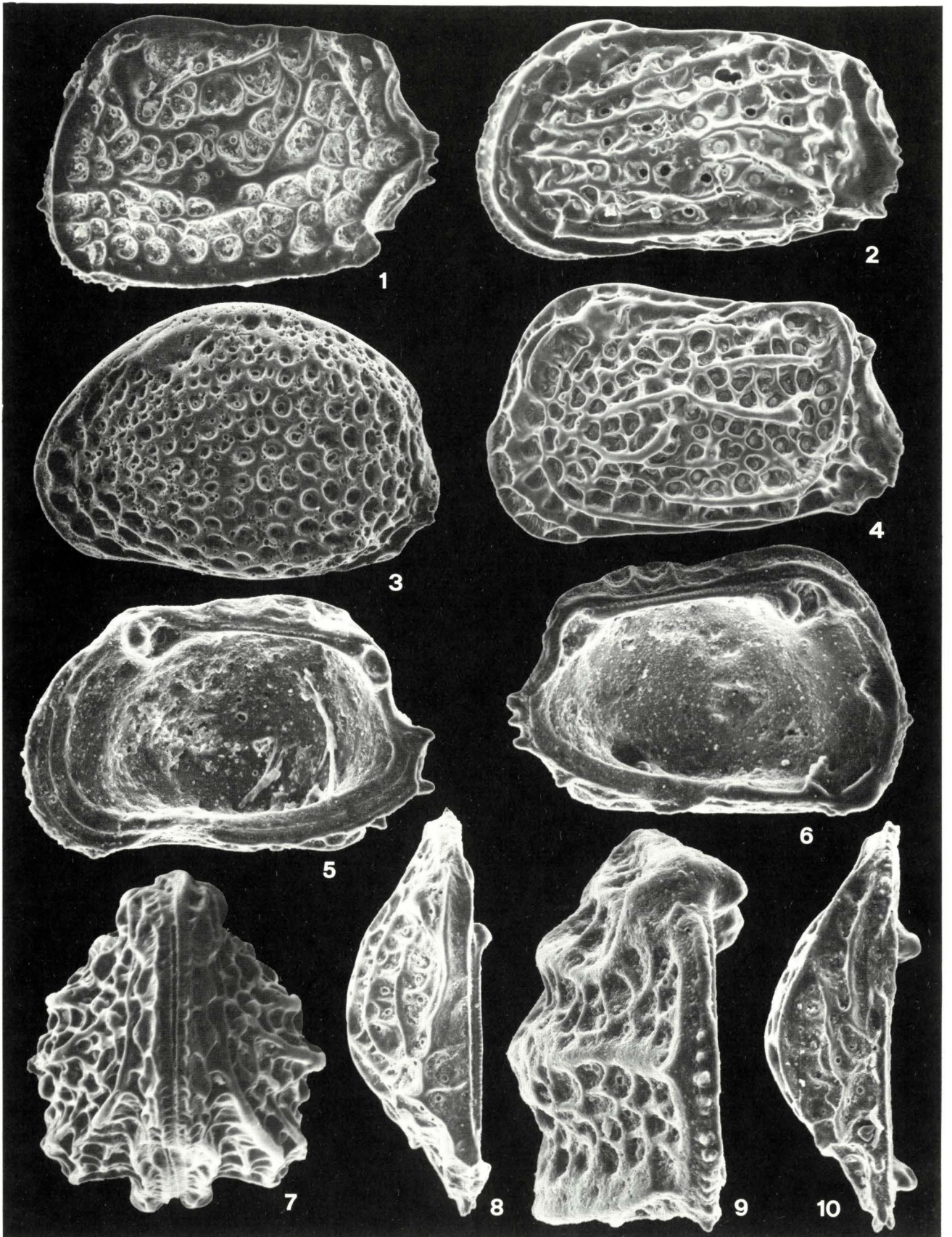
On the contrary, *Quadracythere* shows an almost regular arch (Pl. 1, fig. 8).

The relationship with *Pokornyyella* has been previously discussed (Ruggieri, Russo & Bossio, 1977, p. 129-130): *Pokornyyella* shows unquestionable links with *Tenedocythere* in the characters of the normal (Pl. 2, fig. 4) and marginal pore-canals. However it appears more ear-shaped and does not show the arrangement of the foveolae and ridges that arise the typical ornamentation of *Tenedocythere*. Nevertheless, strongly ornamented specimens of *Pokornyyella* may recall certain species of *Tenedocythere* feebly ornamented.

As far as the origin of the genus *Tenedocythere* is concerned, the problem does not appear to be excessively complicated. The genus is tightly connected with *Pokornyyella* Oertli 1956 already represented in the European Eocene and quite frequent in the Oligocene. On the other hand during Miocene *Pokornyyella* appears largely diffused all along the equatorial band, in neritic or preferably epineritic environments. On the contrary, *Tenedocythere* is so strictly linked to *Pokornyyella* that uncertainty may arise as to which of the two genera to attribute some species. *Tenedocythere* is known to have lived during Miocene (apart from the Mediterranean species object of the present paper) only in the Pacific (Midway Islands, from Lower Miocene to Recent, Holden 1976). It seems consequently logical to presume that *Tenedocythere* colonized the Mediterranean by means of « pioneer » species of indo-pacific origin which ap-

#### EXPLANATION OF PLATE 1

- Fig. 1 - *Quadracythere truncula* (Brady). LV, Recent, New Zealand, Hind Station, *legit et determ.* N.B. Hornibrook, O.C.R. S1. 208/10a (x 111).
- Fig. 2 - *Cythere bavarica* Lienenklaus. LV, Early Miocene, Ottenburger Dotter, *legit et determ.* W. Witt, B.O.C., 419 (x 106). The species is a representative of a still unnominate genus, allied with *Pokornyyella*, but more away from this last one than *Tenedocythere*.
- Fig. 3 - *Pokornyyella deformis* (Reuss). Topotype, LV, Badenian, Nüssdorf (Wien), Point GR 351, S1. B.O.C. 421 (x 89).
- Fig. 4 - *Tenedocythere prava* (Baird). LV, Recent, Gulf of Naples, Stn. 98, B.O.C. 420 (x 93).
- Fig. 5 - *Quadracythere truncula* (Brady). RV from inside, Recent, New Zealand, Hind Station, *legit et determ.* N.B. Hornibrook, O.C.R. S1. 208/10b (x 111).
- Fig. 6 - *Quadracythere truncula* (Brady). LV from inside (the same specimen as in fig. 1) (x 111).
- Fig. 7 - *Tenedocythere prava* (Brady). Carapace in anterior view, Recent, Gulf of Naples, Stn. 98, B.O.C. 420 (x 111).
- Fig. 8 - *Quadracythere truncula* (Brady). LV in dorsal view (the same specimen as in fig. 1) (x 111).
- Fig. 9 - *Quadracythere truncula* (Brady). RV in anterior view (the same specimen as in fig. 5) (x 171).
- Fig. 10 - *Quadracythere truncula* (Brady). RV in ventral view (the same specimen as in fig. 5) (x 111).



peared rather late in the Mediterranean and are represented only by one species in the « Leithakalk » (*Amphistegina* Marls) of the Vienna basin. It is noted that during the Early Miocene of Bavaria, a genus up to now unnamed, typically represented by *Cythere bavarica* Lienenklaus (Pl. 1, fig. 2; Pl. 2, fig. 8) existed which is unquestionably linked to both *Pokornyella* and *Tenedocythere*. Since this genus seems more remote from *Pokornyella* than *Tenedocythere*, it cannot be placed as a possible ancestor of the latter. Therefore, the most likely hypothesis remains the immigration of *Tenedocythere* from the Indo-Pacific area. At the end of Paleogene and the beginning of Miocene, the Mediterranean was notoriously the preferential route of penetration by fauna of warm Indo-Pacific origin into the Atlantic (Adams, 1967; Ruggieri, 1967). It appears probable that at the beginning of Miocene, *Tenedocythere* was able to also colonize the central western Atlantic coasts, but it cannot be excluded that this colonization occurred later, when the genus had already reached exceptional densities within the Mediterranean and when connections with the Indian Ocean were already closed while those with the Atlantic were still accessible. One thing is sure: at the end of Miocene when the Mediterranean marine fauna was destroyed by the « salinity crisis » (Ruggieri, 1961a), the genus had already found a « sanctuary » in the Atlantic. From such a « sanctuary », this genus since the beginning of Pliocene and throughout Pleistocene, performed several intrusions into the Mediterranean, taking advantage of favourable climatic phases. These climatic phases allowed, even during Pleistocene, the re-entry of species which already disappeared during Early Pliocene, as observed for some species of mollusks (Ruggieri *et al.*, 1982). For this reason an alternation of different species is noted for the Mediterranean Pliocene and Pleistocene ending during the Emilian stage (Early Pleistocene) by the repeated appearance of the one living species, *Tenedocythere prava*, the present representative of the genus in the

basin.

Neither during Pliocene, nor least of all during Pleistocene, did favourable conditions occur again as in the Sahelian Miocene when the genus reached the highest densities both in number of species and number of individuals.

It is significant that during the same age the coral-reefs in the Mediterranean were exceptionally expansive, together with the foraminiferal genus *Borelis* which exhibited analogous environmental needs.

#### GENERAL FEATURES OF *TENEDOCY THERE*

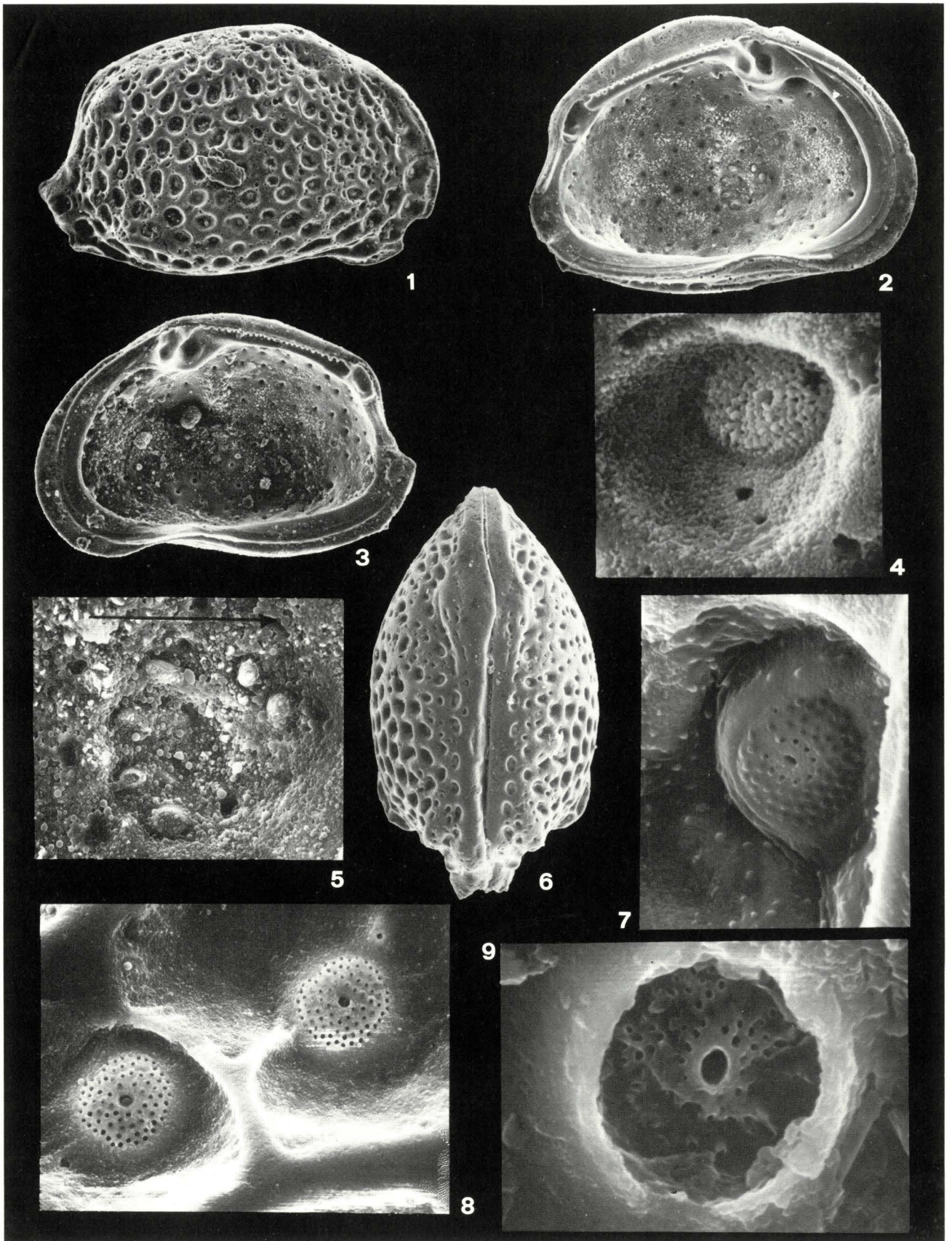
The genus *Tenedocythere* can be defined as follows: from medium to medium-large in size, subrectangular shape in lateral view, a low and denticulate caudal process and heavily reticulated ornamentation, strongly dominating antero-posterior ridges and a peripheral ridge that is frequently lacking posteriorly, a large and evident eye-tubercle that is inserted in the marginal ridge. In dorsal view, the carapace shows a depression at about the mid length region. The muscle-scar pattern consists of a subvertical row of 4 subrectangular scars, preceded by 2 suboval anterior scars. The hinge of the right valve consists of a strong anterior tooth followed by a deep socket and by a groove that is crenulated only on its dorsal side and ends posteriorly with a large reniform tooth.

The marginal pore-canal is simple, subrectilinear, widely tubular in the proximal 2/3, the distal 1/3 being very narrow. They are somewhat irregularly distributed (Text-fig. 3). The normal pore-canal occurs in the pore-conuli and on the bottom of the fossae, with wide, sharp finely cribrate disks (parmae).

Within the genus, some features show a different rank of value from a systematic point of view (Text-fig. 2). The more constant features include the pore-conuli, whose position appears to be a group of fixed stars. The other characters change in location, orientation, and importance from species to species.

#### EXPLANATION OF PLATE 2

- Fig. 1 - *Pokornyella deformis* (Reuss). Topotype. RV, Badenian, Amphistegina mergel, Nüssdorf (Wien) B.O.C. 421 (x 89).  
 Fig. 2 - *Pokornyella deformis* (Reuss). Topotype. LV from inside (x 89).  
 Fig. 3 - *Pokornyella deformis* (Reuss). Topotype. RV from inside (x 89).  
 Fig. 4 - *Pokornyella deformis* (Reuss). Topotype. Detail of a normal pore-canal, (x 1430).  
 Fig. 5 - *Pokornyella deformis* (Reuss). Topotype. Muscle-scars of a left valve (x 318).  
 Fig. 6 - *Pokornyella deformis* (Reuss). Topotype. Carapace in dorsal view (x 106).  
 Fig. 7 - *Tenedocythere prava* (Baird). Detail of a normal pore-canal. Recent, Gulf of Naples, Stn. 98 (x 1852). Note that the most of pori is occluded by organic matter.  
 Fig. 8 - *Cythere bavarica* Lienenklaus. Detail of two normal pore-canal in separated fossae. Early Miocene, Ottenburger Dotter (x 852). There is no evidence of a peripheral sulcus around the porous plate.  
 Fig. 9 - *Quadracythere truncula* (Brady). Detail of a normal pore-canal. Recent, New Zealand, Hind Station, O.C.R. Sl. 208/10a (x 4407).



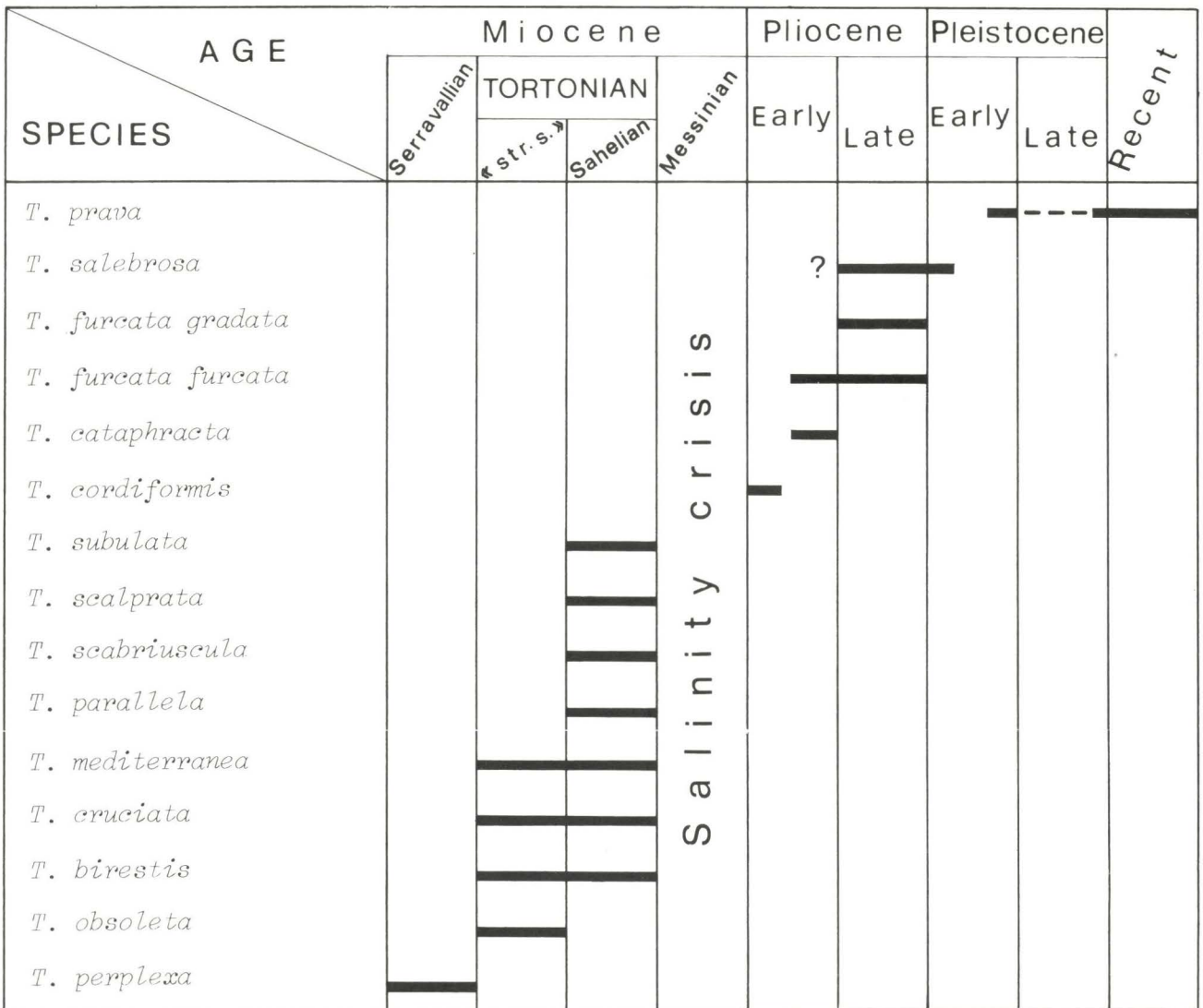
A second character includes the « primary ridges » which are present in all of the species (sometimes only as « vestigial ») but may be of different shape, size, location and orientation. A third character includes the « secondary ridges » which can be present or absent and may differ in number, position and shape of meshes from species to species. Most of the fossae shelter one large sieve-type normal pore-canal that is peculiarly defined by a peripheral circular sulcus (parma).

TAXONOMIC CRITERIA

Many authors have debated about the relationship between ostracode sculpture and taxonomy at the different ranks of taxa. One of the most important

papers (Liebau, 1971) dealt with the homologous sculpture pattern in Trachyleberididae. The network pattern of different species belonging to different genera and families was investigated by comparing the position and shape of the primary (ribs, « macroreticulation », pore-conuli) and secondary elements of the ornamentation (« microreticulation », pits). Each of the investigated elements was considered of some genetic and systematic value at different levels; homologous elements in the different taxa were considered genetically related.

Benson (1972) examined the forms previously assigned to the genus *Bradleya* and erected two new genera: *Agrenocythere* and *Poseidonamicus*. The reticulation change was investigated utilizing the location of the pore-conuli (considered genetically more



Text-fig. 1 - Stratigraphical distribution of the studied species of *Tenedocythere*. Note the bloom of endemisms within the original primary Mediterranean fauna in corispondence with the Sahelian, followed by the destruction of the species during the Messinian salinity crisis and finally the gradual repopulation by other forms of Atlantic origin during the Pliocene-Pleistocene.

stable structures) as « fixed stars ». The evolution of the ornamentation through geological time was underlined.

Okada (1981, 1982) in his study on the structure of the reticulate carapaces in ostracodes states: « The cuticle formation in close relation to cell-boundaries clearly indicates that each polygon of the carapace reticulation is formed by one epidermal cell. The cell-polygon correspondence suggests that ostracode reticulation is important for elucidation of the phylogenetic and ontogenic development of multicellular organisms at the cell level ».

We will use the same method relying mainly on the position and orientation of ridges to investigate the forms belonging to the genus *Tenedocythere* from Miocene to Recent in the Mediterranean basin in the attempt to reclassify them.

A more detailed study of the change of the reticulation and related evolutionary problems will follow in another paper in collaboration with Dr. R.H. Benson of the Smithsonian Institution.

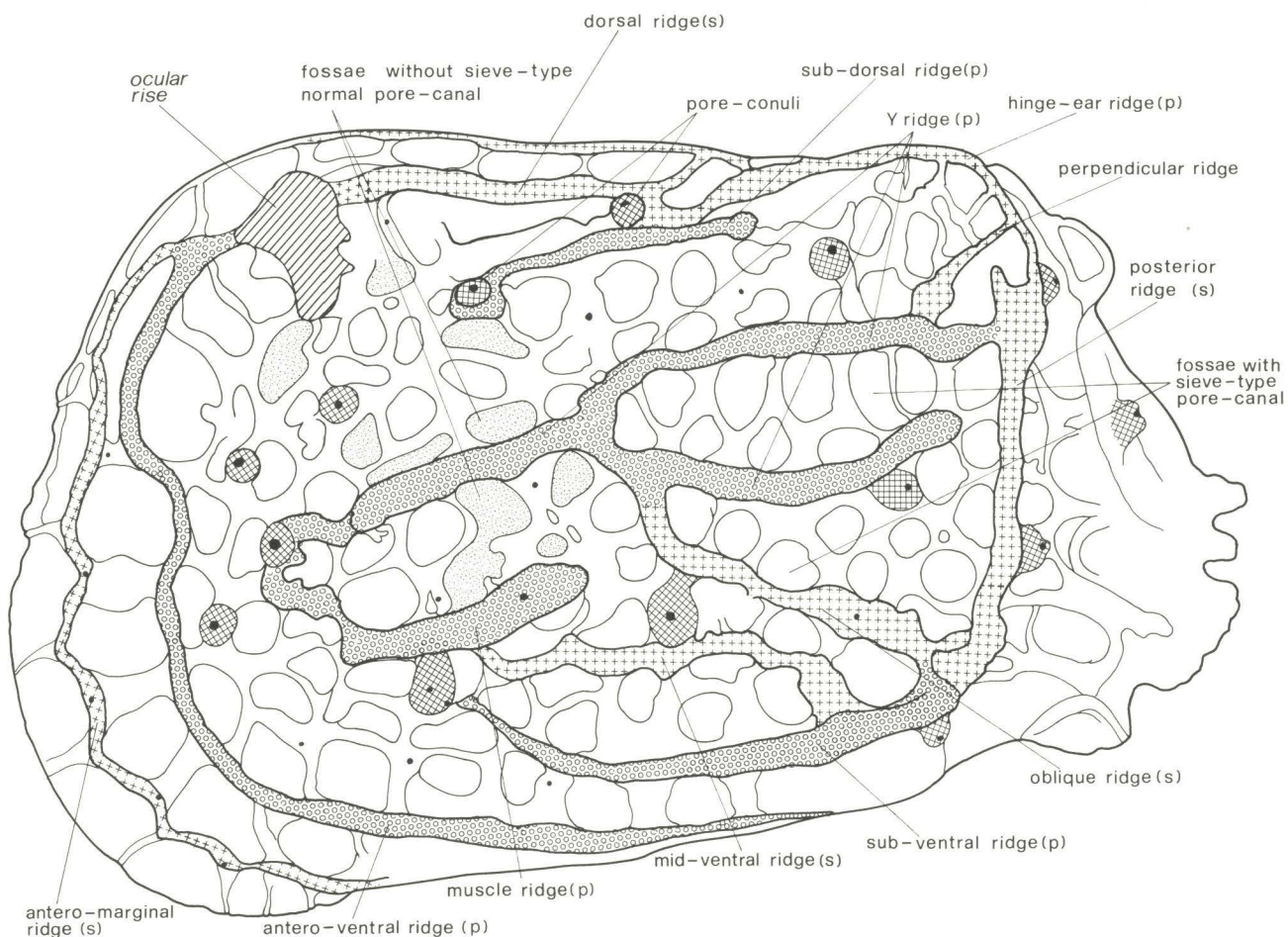
We suggest that the change in position and in number of meshes can be used to trace evolutionary change in space and time. This idea is not new and has already been applied by Benson (1972, 1974, 1977) and Liebau (1977).

Text-figure 2 shows a drawing of *Tenedocythere prava* with the location of the pore-conuli, of the « primary ridges » (p), of the « secondary ridges » (s), of the reticulation, and other characters. The same glossary will be used in the following descriptions.

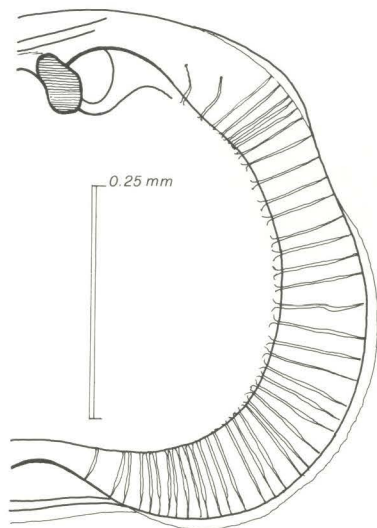
#### SYSTEMATICS

This section deals not only with the description of the new species and subspecies of *Tenedocythere* and with additional data characterizing the species previously described, but also with their stratigraphic distribution.

The Miocene stratigraphy adopted in the present paper deliberately differs from the previous one essentially in the following:



Text-fig. 2 - Sketch of a left valve of *Tenedocythere prava* with principal (p) and secondary (s) ridges, position of the fossae with and without normal sieve-type pore-canals and of the pore-conuli.



Text-fig. 3 - Anterior marginal area of a left valve of *Tenedocythere prava* from inside (transparency).

a) We have utilized the term «Badenian», still normally used by the Middle-European stratigraphers, for the material of the Leithakalk of the Vienna Basin, pertaining at the time to the Paratethys. It seems that at least the «Leithakalke» from which our samples have been taken can be correlated with Serravallian.

b) On the basis of the malacofaunas and ostracofaunas, the uppermost Tortonian (roughly corresponding to the *Globorotalia suterae* Zone) represents a clearly identified stratigraphic unit at least in the Mediterranean area, for which one of the Authors (Ruggieri, 1955) already re-exhumed the term «Sahelian» (*sensu* Brives, 1897). While the Sahelian, an

expression of the deep biological modifications which occurred in the Mediterranean, fits within a Late Miocene, the same cannot be stated for the remaining Tortonian, which appears to be strictly related to the Serravallian. In the past, when the definition of Messinian was wider, Sahelian has been considered as an Early Messinian.

From this derives our somehow «heretical» use of the expression «Middle Miocene». It does not imply disagreement on what has been worked out during various meetings in order to arrange the Neogene stratigraphy of the Mediterranean, but only the adoption of a stratigraphy which can express in a more immediate way the changes of the biological environment of the organisms we are dealing with. Evidently, the present stratigraphy is focused on a specific aim and, as such, it is proposed for the attention of the researchers who work on the Neogene shallow water benthos.

#### TENEDOCY THERE PRAVA (Baird, 1850)

Pl. 1, figs. 4, 7; Pl. 2, fig. 7; Pl. 3, figs 1-9;  
Pl. 9, fig. 6; Pl. 10, fig. 7

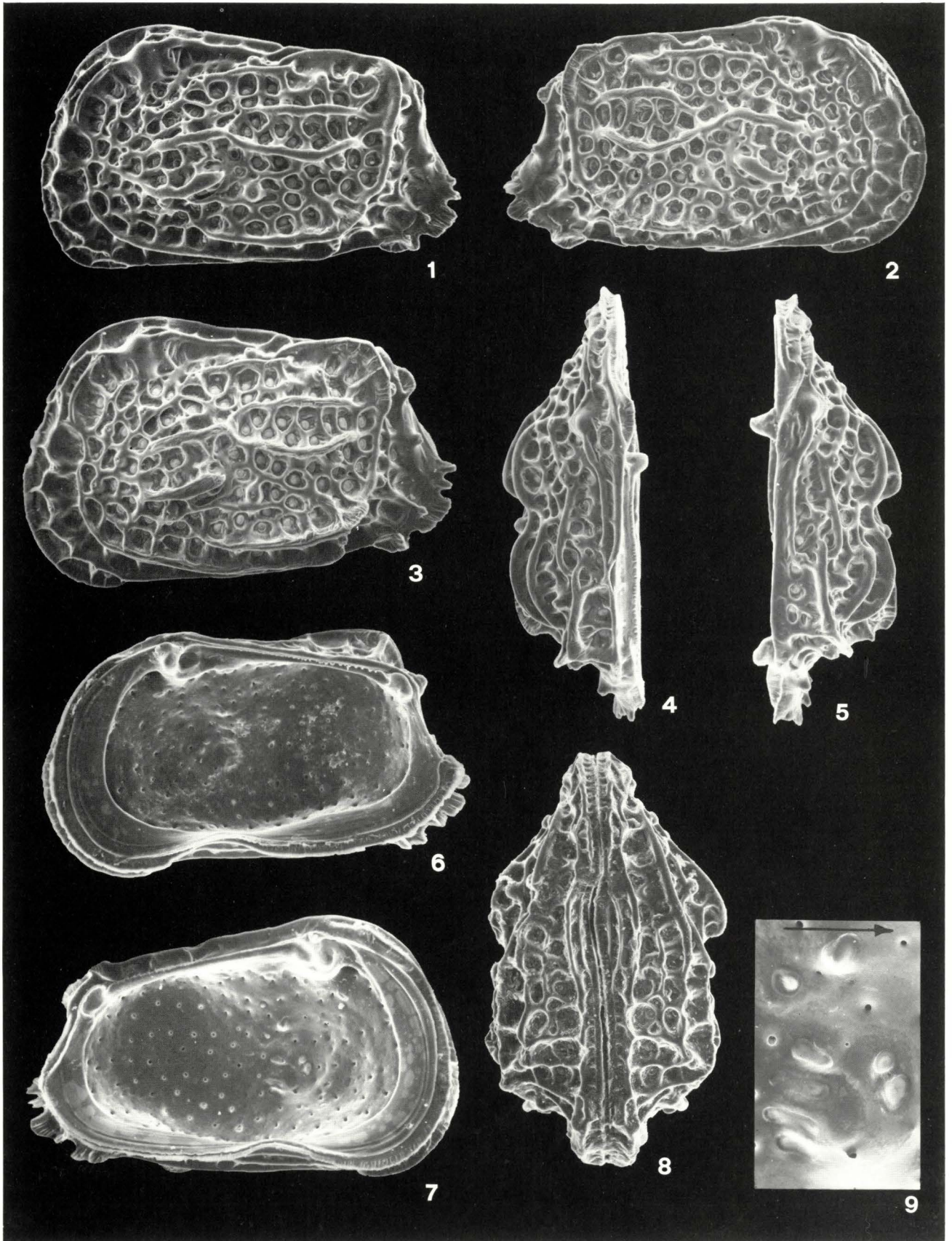
- 1850 *Cythere prava* BAIRD, p. 256, Pl. 18, figs 13-15.  
1894 *Cythereis prava* G.W. MÜLLER, pp. 376-377, Pl. 29, figs 22, 27.  
1942 *Cythereis polygonata* ROME, pp. 25, 26, Pl. 7, figs. 58, 59.  
1964 «*Cythereis*» *prava* PURI, BONADUCE and MALLOY, p. 114, Text-fig. 27.  
1971 *Quadracythere prava* BARBEITO-GONZALES, pp. 280-281; Pl. XIV, figs. 1a, 2a, 3a.  
1972 *Quadracythere (Tenedocythere) prava* SISSINGH, pp. 126-127, Pl. 10, fig. 4.  
1975 *Quadracythere (Tenedocythere) prava* BREMAN, p. 63, Pl. 9, fig. 126.  
1975 *Tenedocythere prava* BONADUCE, CIAMPO and MASOLI, p. 46, Pl. 23, figs. 1-4.  
1981 *Jugosocythereis prava* MOSTAFAWI, p. 157, Pl. 10, figs 10-11.

#### EXPLANATION OF PLATE 3

##### *Tenedocythere prava* (Baird). Recent

- Fig. 1 - ♂, LV, Gulf of Naples, Stn. 98, B.O.C. 420 (x 85).  
Fig. 2 - ♂, RV, Gulf of Naples, Stn. 98 (x 93).  
Fig. 3 - ♀, LV, Gulf of Naples, Stn. 98 (x 97).  
Fig. 4 - LV in dorsal view, Gulf of Naples, Stn. 98 (x 97).  
Fig. 5 - RV in dorsal view, Gulf of Naples, Stn. 98 (x 97).  
Fig. 6 - RV from inside, Gulf of Naples, Stn. 98 (x 93).  
Fig. 7 - LV from inside, Gulf of Naples, Stn. 98 (x 93).  
Fig. 8 - Carapace in ventral view, Recent, Tunisia (x 93).  
Fig. 9 - Muscle-scars of a left valve, Gulf of Naples, Stn. 98 (x 276).





*Remarks* — *Tenedocythere prava* has been originally described by Baird from Greece and subsequently both soft parts and carapace were redescribed by Müller (1894). It has been cited by many authors from Recent sediments in the Mediterranean Sea. It shows a high degree of similarity with *T. furcata* n. sp.

*Tenedocythere prava* appears to be the relic representative of the genus in the Mediterranean; in fact all the other species of this genus seem to have disappeared during the Pleistocene. The highest number of species occurred during the Middle Miocene, when the coral-reefs were still thriving in the Mediterranean. On the basis of the available data, it seems likely that *T. prava* entered in the Mediterranean during the Emilian (Lower Pleistocene), in coincidence with the migration of a number of warm Atlantic species (see Ruggieri *et al.*, 1982).

*Distribution* — At present *Tenedocythere prava* is restricted to the near-shore environment in the Mediterranean and is represented by a large number of specimens on the so called « coralligenous » which more or less corresponds to the coral-reef environment.

It is also present as thanatocoenosis on detritus of « coralligenous » being possibly transported along escarpments by grain flows and/or by currents.

From the available data the geographic distribution appears quite broad:

Monaco	(10-28 m)
Gulf of Naples	(20-100 m)
Tunisia (Tunis-Gabès)	(0-2 m)
Lybia (Tripoli)	(beach sand)
Aegean Sea (Greece)	(near shore)
Ionian Sea (Gulf of Taranto)	(34-57 m)
Tyrrhenian Sea (Liguria)	(22-85 m)
Adriatic Sea (Apulia)	(0-10 m)
Malta (Valletta)	(18-100 m)
Lebanon (Beirut)	(53 m)
Crotone (Cosenza)	(beach sand)
Noto Marina (Siracusa, Sicily)	(beach sand)
Mondello (Palermo)	(beach sand)
Tor Vendicari (Siracusa)	(beach sand)

It appears that this species is mostly restricted to the southern part of the Mediterranean basin, suggesting its warm water origin.

Size of the figured specimens

(Pl. 3, fig. 1: L ♂ = 0.915 mm)

(Pl. 3, fig. 3: L ♀ = 0.815 mm).

*Repository* — B.O.C. 420.

*Occurrence and age* — Basis of the Upper Emilian Transgression: Loc. Pizzo di Core (Castelvetrano: Trapani) Point GR 2872.

Upper Emilian: Loc. Vittoria (Gela), Km 298 road Gela-Ragusa, Point GR 3025; Different samples from the clays along the Rada di Augusta road; Loc. Botro Magno, Gravina (Apulia), Point GR 1084; Loc. Rende (Cosenza), Point GR 177.

Sicilian: Loc. Viale del Fante (Palermo), Point GR 2170; Loc. Castellammare del Golfo, Point GR 1683.

Post Sicilian: Drilling at locality Sperone (Palermo), Point GR 2006.

Crotonian: Loc. Crotone (Calabria), Point GR 339.

#### TENEDOCYTHERE FURCATA n. sp.

Pl. 4, figs. 1-5

1979 *Jugosocythereis prava* BASSIUNI, pp. 115-116, Pl. 21; figs. 1-2, (*nec* Baird, 1850).

*Etymology* — From latin *furcatus* = forked.

*Holotype* — A left valve (O.C.R. 3036a) (Pl. 4, fig. 1).

*Paratype* (figured) — A right valve (Pl. 4, fig. 2); some carapaces (O.R.C. 3036b, c); many carapaces and valves (Sl. 3941).

*Type-locality* — Contrada Cerausi (Serradifalco, Caltanissetta, Sicily), Point GR 2960.

*Type-level* — Late Pliocene.

*Diagnosis* — A species of *Tenedocythere* that is very similar to *T. prava* for the general ornamenta-

#### EXPLANATION OF PLATE 4

Fig. 1 - *Tenedocythere furcata* n. sp.. Holotype, ♂ LV, Late Pliocene, Cerausi (Sicily), Point GR 2960, O.C.R. S1. 3036a (x 93).

Fig. 2 - *Tenedocythere furcata* n. sp.. Paratype, ♂ RV, O.C.R. S1. 3036b (x 93).

Fig. 3 - *Tenedocythere furcata* n. sp.. Hypotype, ♀ LV, Pliocene, S. Cusumano (Sicily), Point GR 2100, O.C.R. S1. 3034 (x 93).

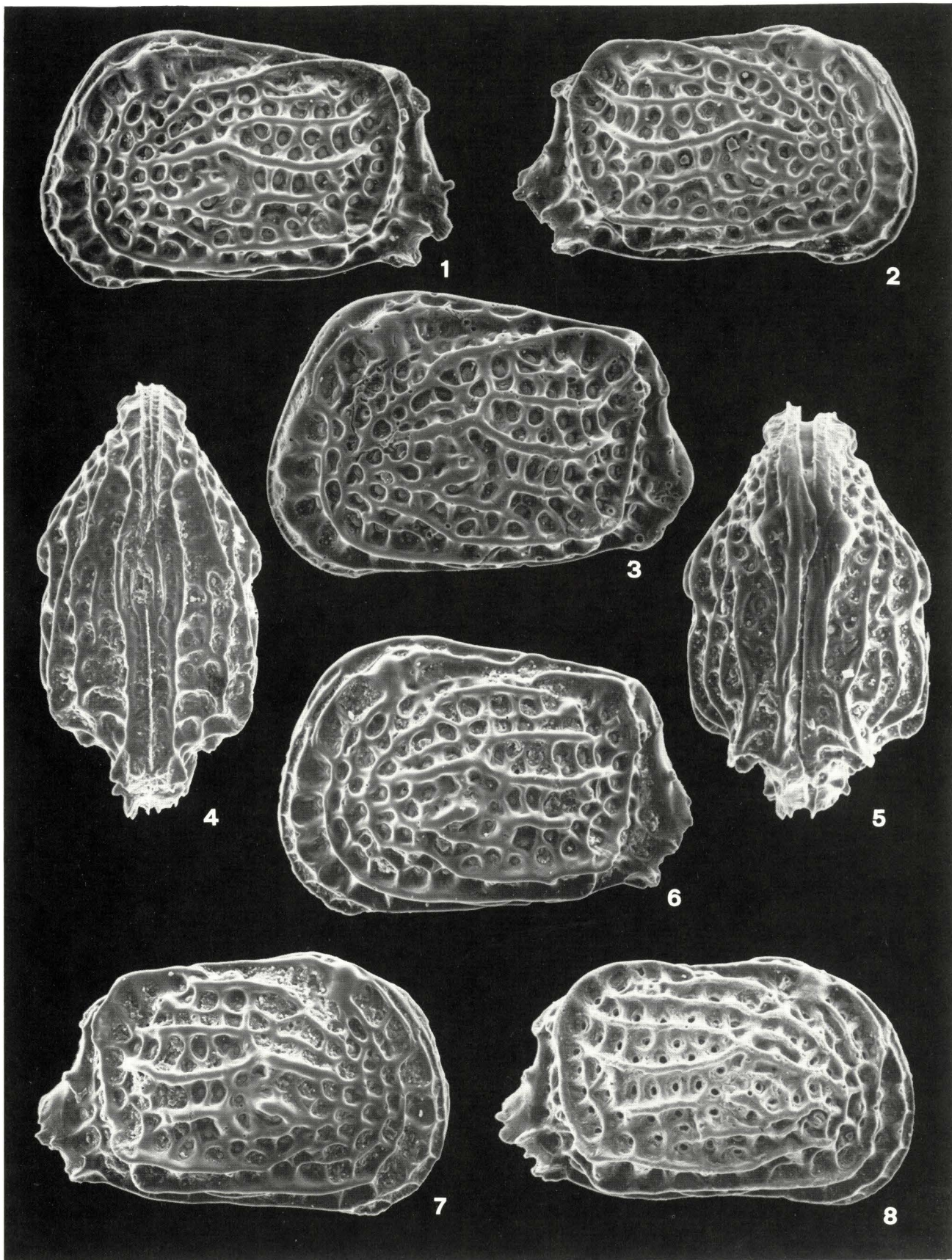
Fig. 4 - *Tenedocythere furcata* n. sp.. Paratype, ♂ Carapace in ventral view, O.C.R. S1. 3036b (x 89).

Fig. 5 - *Tenedocythere furcata* n. sp.. Paratype, ♀ Carapace in dorsal view, O.C.R. S1. 3036c (x 89).

Fig. 6 - *Tenedocythere furcata gradata* n. subsp.. Holotype, LV of complete carapace, Late Pliocene, Rio Riorzo (Cstellarquato, Piacenza), Point GR 34, O.C.R. S1. 3037 (x 93).

Fig. 7 - *Tenedocythere furcata graduata* n. subsp., RV, the same specimen as in fig. 6 (x 93).

Fig. 8 - *Tenedocythere salebrosa* (Uliczny). RV, Early Pleistocene, Castellanselmo (Pisa), Point GR 417, O.C.R. Sl. 428 (x 94).



tion, characterized by an additional horizontal posterior mid-ventral ridge.

*Description* — This species, subrectangular in lateral view, shows a prominent hinge-ear and posterior ridges that run parallel to the ventral margin and reach the antero-midventral area where they disappear within the anterior regularly distributed reticulation. The mid-ventral ridge, subparallel to the ventral ridge, is connected with the muscle-ridge just below the muscle-scars area, ending anteriorly with a hook-shaped thickened extremity. The y-shaped ridge shows both the parallel arms of the « y » ending separately against the hinge-ear ridge. The sub-dorsal ridge runs obliquely from the posterior third down to the area below the eye-tubercle, without any interruption. An intermediate short ridge lies in between the subdorsal and the upper arm of the y-ridge.

Size of the figured specimen (Pl. 4, fig. 1):

$$L \text{ ♂} = 0.825 \text{ mm.}$$

*Affinities* — This species is very close to *T. prava* and seems to be its ancestor. The more evident differences include: the subdorsal ridge which splits into two parts in *T. prava*, whereas in *T. furcata* it is unsplit; the presence of the horizontal mid-ventral ridge connected with the muscle-ridge in *T. furcata*. In *T. prava*, the mid-ventral ridge is substituted posteriorly by a regular reticulation and by a poorly defined oblique ridge. The two arms of the y-shaped ridge blend into one another before reaching the hinge-ear in *T. prava*, whereas they reach it independently in *T. furcata*, running subparallel each other. This species can be split into 2 subspecies: *T. furcata furcata* described above, *T. furcata gradata* described below.

*Occurrence and age* — Pliocene: S. Cusumano near Salaparuta (Trapani), Point GR 2100; Loc. Varco Ramata (Enna), Point GR 2533.

Upper part of Early Pliocene — Late Pliocene: Gallina (Reggio Calabria).

Late Pliocene: Contrada Cerausi (Serradifalco: Caltanissetta, Sicily), Point GR 2960.

Late Pliocene-Pleistocene: Hatay, Samandagi, Kosalan, Koyu (Turkey).

TENEDOCYTHERE FURCATA GRADATA n. ssp.

Pl. 4, figs. 6, 7

*Etymology* — From latin *gradatus* = graded.

*Holotype* — A carapace (O.C.R. Sl. 3037) (Pl. 4, figs 6, 7).

*Type-locality* — Rio Riorzo (Castellarquato, Piacenza), Point GR 34.

*Type-level* — Late Pliocene.

Other localities: unknown elsewhere.

*Description* — This subspecies differs from *T. furcata furcata* by the step-like features of the subdorsal ridge and by the shorter arms of the y-ridges that bend backward, and do not reach the hinge-ear. In lateral view, the valves appear more stocky but this may be due to sexual dimorphism.

Size of the figured specimen (Pl. 4, fig. 6): L = 0.817 mm.

*Affinities* — This subspecies is also similar to *T. cordiformis* n.sp. for the shape and general running of the ridges. It differs by the absence of a ridge between the subdorsal ridge and the upper part of the y-shaped arms. Moreover, the hinge-ear ridge appears less regularly arched than in *T. cordiformis*.

TENEDOCYTHERE SALEBROSA (Uliczny, 1969)

Pl. 4, fig. 8; text-fig. 4

1969 *Quadracythere prava salebrosa* n. ssp. ULICZNY, p. 70, Pl. 4, figs. 3, 4.

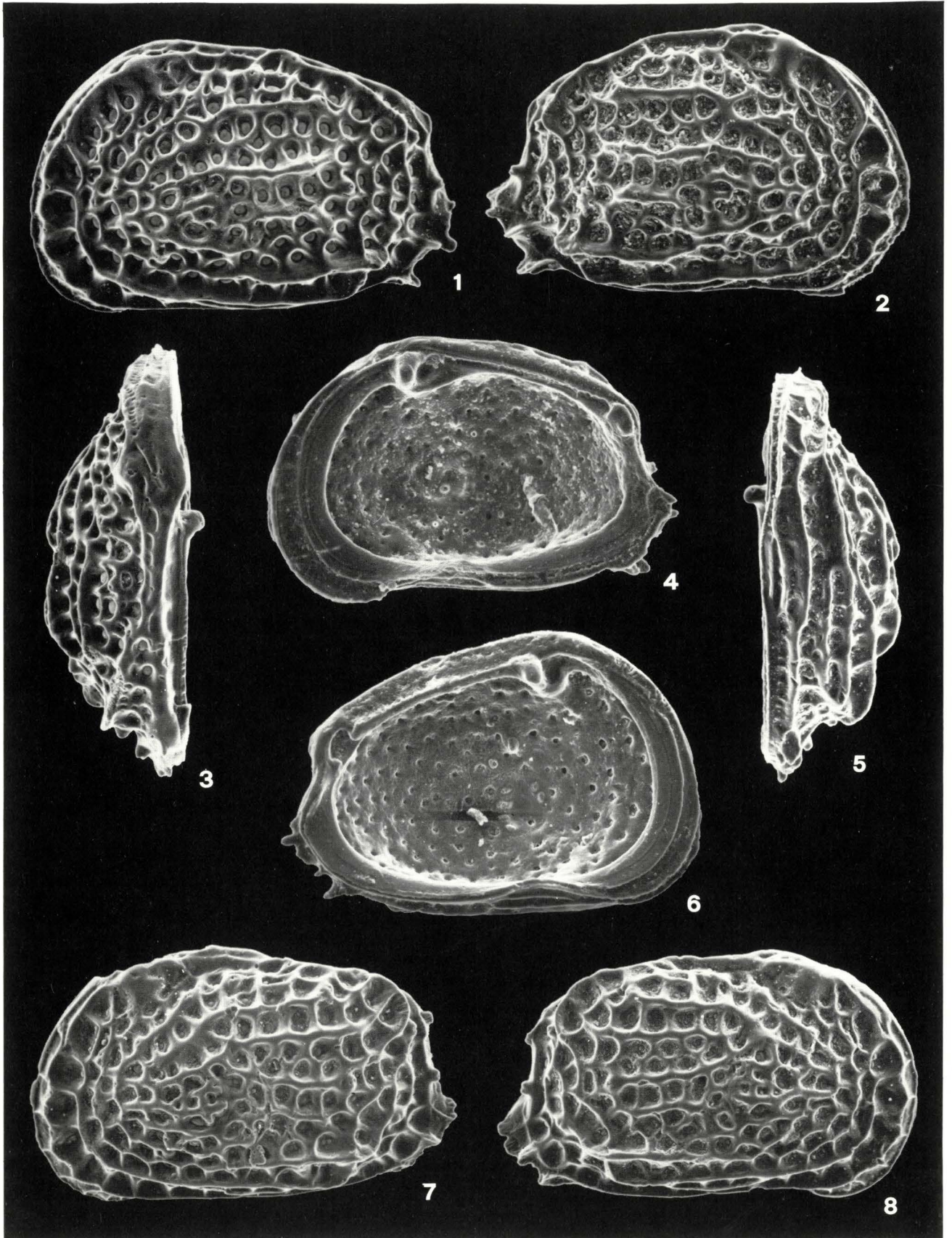
1972 *Quadracythere (Tenedocythere) salebrosa* SISSINGH, p. 127, Pl. 10, fig. 5.

nec 1982 *Quadracythere salebrosa* CARBONNEL, Pl. 6, figs. 1, 2.

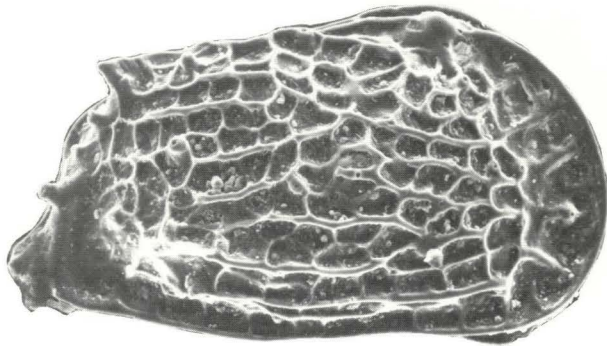
*Remarks* — Uliczny (1969, pp. 70-71) described this form as subspecies of *Tenedocythere prava*; he does not give a very diagnostic figure. From the de-

#### EXPLANATION OF PLATE 5

- Fig. 1 - *Tenedocythere scalprata* n. sp.. Holotype, LV, Sahelian, Salemi (Sicily), Point GR 3360, O.C.R. S1. 3363a (x 97).  
 Fig. 2 - *Tenedocythere scalprata* n. sp., Paratype, RV, O.C.R. S1. 3363b (x 97).  
 Fig. 3 - *Tenedocythere scalprata* n. sp.. Paratype, LV in dorsal view, O.C.R. S1. 3363b (x 97).  
 Fig. 4 - *Tenedocythere scalprata* n. sp.. Paratype, RV from inside, O.C.R. S1. 3363b (x 93).  
 Fig. 5 - *Tenedocythere scalprata* n. sp.. Paratype, LV in ventral view, O.C.R. S1. 3363b (x 97).  
 Fig. 6 - *Tenedocythere scalprata* n. sp., Paratype, LV from inside, O.C.R. S1. 3363b (x 93).  
 Fig. 7 - *Tenedocythere parallela* n. sp.. Holotype, LV, Sahelian, Salemi (Sicily), Point GR 3412, O.C.R. S1. 3675 (x 93).  
 Fig. 8 - *Tenedocythere parallela* n. sp.. Paratype, RV, O.C.R. S1. 3415 (x 93).



scription, we have been able to identify this taxon from Pliocene material collected at Stavromenos (Crete).



Text-fig. 4 - *Tenedocythere salebrosa* (Uliczny, 1969). Juvenal RV, Balestrate. Point GR. 2779. Lower Pliocene, x 120.

Size of the figured specimen (Pl. 4, fig. 8):  
L = 0.795 mm.

*Affinities* — This species is similar to *T. cordiformis* for the running of the ridges. It differs by the subdorsal ridge which is split into 2 and in the running of the upper arm of the y-ridge which appears to continue anteriorly. Moreover, the eye-spot is lower and surrounded by a prominent ring. *T. salebrosa* differs deeply from *T. prava* in the general scheme of the horizontal ridges and in many other details of the ornamentation.

*Repository* — B.O.C. 430.

*Occurrence and age* — Pliocene: Stavromenos (Crete, Greece); Cephalonia (Greece).

Early Pleistocene (Santeranian): Castellanselmo (Pisa), Point GR 417.

TENEDOCY THERE CORDIFORMIS n. sp.

Pl. 9, fig. 1

*Etymology* — From latin *cor*=heart.

*Holotype* — A carapace (O.C.R., Sl. 3942).

*Type-locality* — Empoli, Point GR 1025.

*Type-level* — Early Pliocene.

Other localities: unknown elsewhere.

*Diagnosis* — A species of *Tenedocythere* characterized by very strong ridges that extend to the anterior part of the valves.

*Description* — The valves are subrectangular in lateral view with the antero-dorsal margin sloping more gently than in most of the other species belonging to the genus. The hinge-ear ridge is regularly arched and slopes down vertically to continue in the ventral ridge. This in turn reaches the anterior part of the shell where it runs parallel to the anterior and the antero-dorsal area, encircling completely the central area. The two arms of the y-shaped ridge do not reach the hinge-ear but end at a certain distance from it. The mid-dorsal ridge reaches the anterior arm of the y-shaped ridge and blends into it. The mid-ventral horizontal ridge blends into the muscle-ridge forming an anterior hook that is markedly step-like in shape at about mid length. The ventral ridge continues anteriorly, reaching the eye-tubercle and fusing with it. A short ridge connects the eye-tubercle with the anterior extremity of the continuous subdorsal ridge where it blends into the anterior arm of the y-shaped ridge.

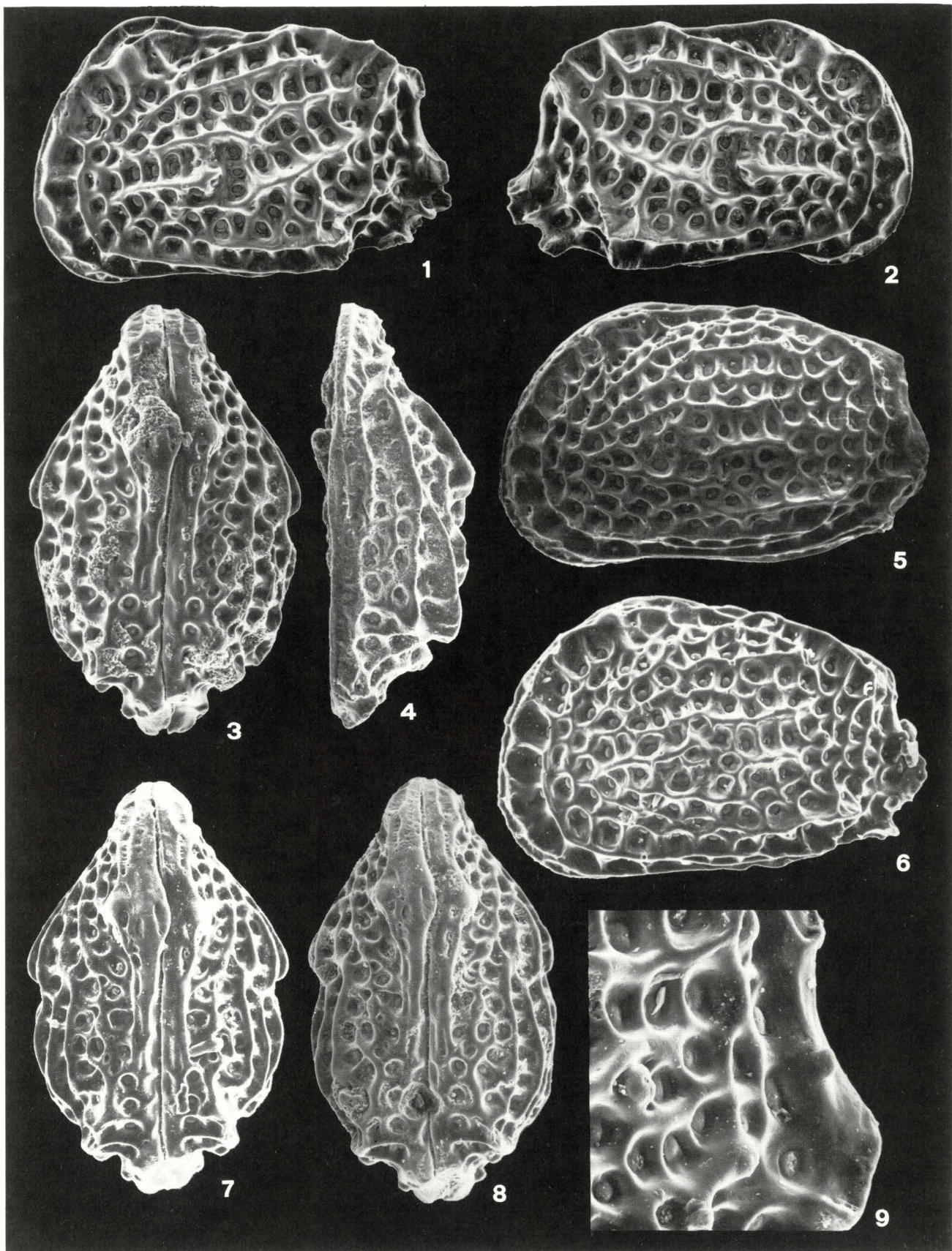
Size of the figured specimen (Pl. 9 fig. 1):

L ♀ = 0.785 mm.

*Affinities* — See *T. salebrosa* and *T. cataphracta* n.sp.

EXPLANATION OF PLATE 6

- Fig. 1 - *Tenedocythere cruciata* n. sp.. Holotype, LV, Tortonian, Benestare (Reggio Calabria), Point GR 966, O.C.R. S1. 3652 (x 89).  
 Fig. 2 - *Tenedocythere cruciata* n. sp., Hypotype, RV, Sahelian, C. da Abbadia (Petràlia Sottana, Palermo), Point GR 2275, O.C.R. S1. 3374 (x 89).  
 Fig. 3 - *Tenedocythere cruciata* n. sp.. Hypotype, Carapace in dorsal view, Sahelian, Cozzo S. Pantaleo (Sicily) Point GR 3971, B.O.C. 422 (x 97).  
 Fig. 4 - *Tenedocythere cruciata* n. sp.. Hypotype, LV in ventral view, Sahelian, Cozzo S. Pantaleo (Sicily) Point GR 3971, B.O.C. 422 (x 93).  
 Fig. 5 - *Tenedocythere subulata* n. sp.. Holotype, LV, Sahelian, Cozzo Tutusino (Sicily), Point GR 3668, O.C.R. S1. 3673 (x 97).  
 Fig. 6 - *Tenedocythere scalprata* n. sp., LV of the small form, Sahelian, Cozzo S. Pantaleo (Sicily), Point GR 3971, B.O.C. 423 (x 111).  
 Fig. 7 - *Tenedocythere mediterranea* (Ruggieri). ♀ Carapace in dorsal view, Sahelian, Cozzo S. Pantaleo (Sicily) Point GR 3971, B.O.C. 424 (x 93).  
 Fig. 8 - *Tenedocythere mediterranea* (Ruggieri). ♂ Carapace in dorsal view, Sahelian, Cozzo S. Pantaleo (Sicily) Point GR 3971, B.O.C. 424 (x 93).  
 Fig. 9 - *Tenedocythere mediterranea* (Ruggieri). Detail of the ornamentation of the LV (posterior) (x 237).



## TENEDOCYTHERE CATAPHRACTA n. sp.

Pl. 9, fig. 2

*Etymology* — From latin *cataphractus* = armored.*Holotype* — A left valve (O.C.R. no. 3943).*Type-locality* — S. Cusumano (Nuova Salaparuta), Point GR 2100.*Type-level* — Early Pliocene.

Other localities: unknown elsewhere.

*Diagnosis* — A species of *Tenedocythere* that is characterized by strong longitudinal and posterior ridges and a very regularly arched hinge-ear.*Description* — In lateral view, the valves are stocky with a posterodorsal margin that is regularly arched. The hinge-ear does not overlap the margin and the y-ridge is very prominent with an anterior arm that is well developed in length. The anterior part is characterized by the presence of a well defined ridge corresponding to the continuation of the mid-ventral ridge that fuses with the eye-spot. The hinge-ear ends anteriorly at about half way down the valve with an abrupt inclination against the horizontal subdorsal ridge. A long sub-horizontal ridge reaches the anterior part of the valve between the subdorsal and the y-shaped ridge ending in correspondence with the poreculus located below the eye-spot.

Size of the figured specimen (Pl. 9, fig. 2):

L = 0.817 mm.

*Affinities* — This species is very similar to *T. cordiformis* n.sp. in its shape and the general disposition of the ridges. It differs mainly in the subdorsal ridge which is interrupted whereas in *T. cordiformis* it slopes down anteriorly without interruption. Moreover, the ridge located above the y-ridge runs directly to the anterior of the valve, whereas in *T. cordiformis* it slopes down and fuses with the anterior arm of the y-ridge.

## TENEDOCYTHERE PERPLEXA n. sp.

Pl. 7, figs. 5, 7, 8

1978 *Quadracythere (Tenedocythere) sulcatopunctata* - BRE-STENSKA and JIRICEK, Pl. 8, fig. 7 (? *nec* Reuss, 1850).*Etymology* — From latin *perplexus* = perplexed.*Holotype* — 1 left valve ♀ (B.O.C. 417).*Paratypes* — 1 right valve ♀ and one carapace (B.O.C. 418, 427).*Type-locality* — Nüssdorf (Vienna): Amphistegina-Mergel, Grüne Kreuze, Point GR 351.*Type-level* — Amphistegina-Mergel, Leithakalke (Badenian).

Other localities: Kostel bei Mahren (Moravia) — Leithakalke.

*Diagnosis* — A species of *Tenedocythere* with a characteristic oblique concave ridge running from the postero-dorsal hinge-ear to the posterior end of the ventral keel. It is also characterized by the ornamentation tending to upturn in the postero-dorsal angle.*Description* — Beside the above ridge described, this species shows in lateral view a second ridge which starts from the hinge-ear region and crosses the mid-posterior and subsequently the area below the muscle-scars and ends mid-ventrally parallel to the ventral margin. The y-ridge is not distinct and only its anterior part can be clearly detected.

Size of the figured specimen (Pl. 8, fig. 5):

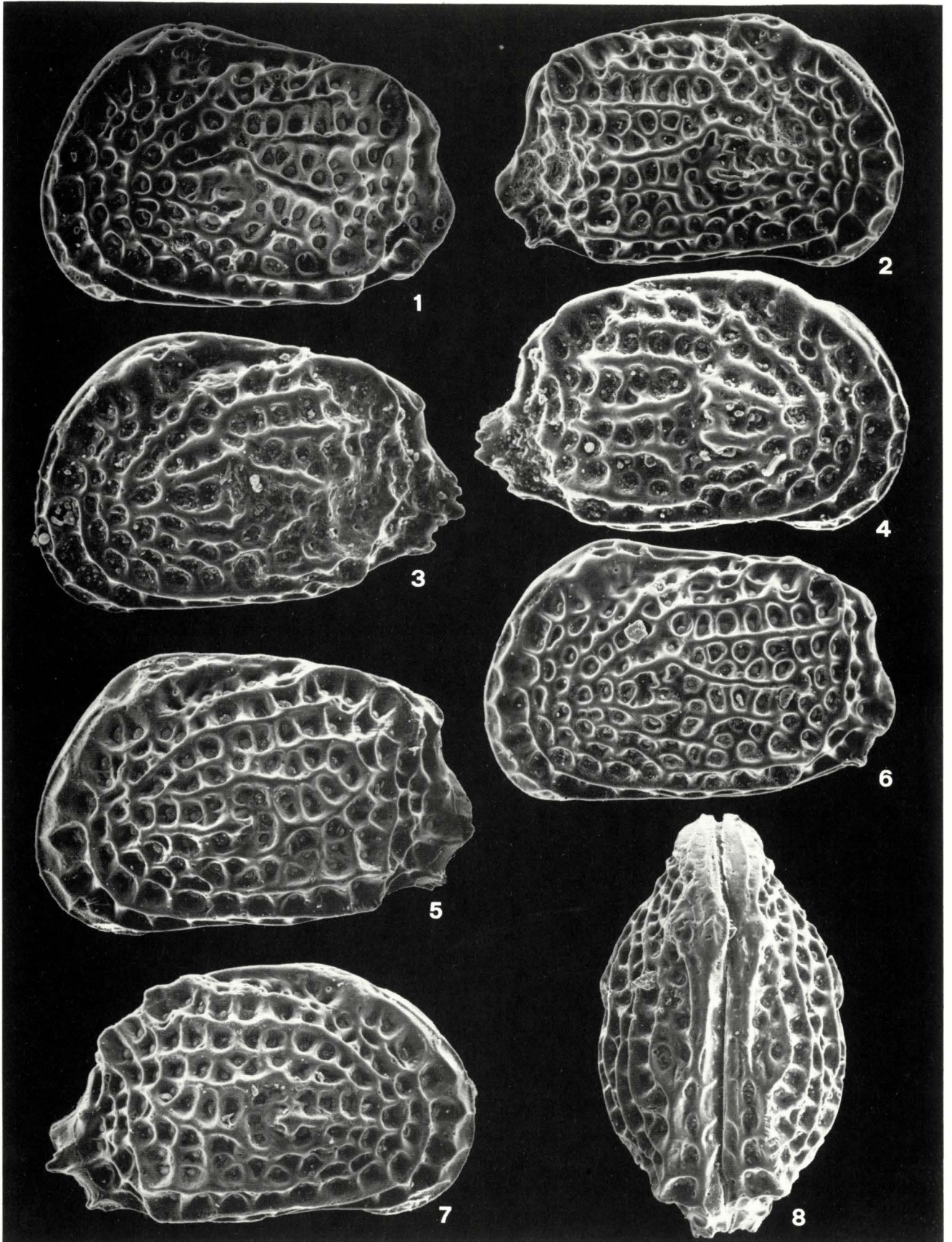
L = 0.840 mm.

*Affinities* — This species shows some similarity with *T. cruciata* n.sp. in the disposition of the ridge connecting the hinge-ear and the posterior end of the ventral keel and of the ridge which upturns posteriorly from the mid-ventral to the hinge-ear.

## EXPLANATION OF PLATE 7

- Fig. 1 - *Tenedocythere mediterranea* (Ruggieri). Hypotype, ♀ LV, Tortonian, Benestare (Reggio Calabria), Point GR 966, O.C.R. 3944 (x 97).
- Fig. 2 - *Tenedocythere mediterranea* (Ruggieri). ♀ RV, Sahelian, Cozzo S. Pantaleo (Sicily), B.O.C. 425 (x 93).
- Fig. 3 - *Tenedocythere mediterranea* (Ruggieri). LV, Tortonian, Montebanzzone Sarsetta (Modena, N-Italy), B.O.C. 426 (x 97).
- Fig. 4 - *Tenedocythere mediterranea* (Ruggieri). RV, Tortonian, Montebanzzone Sarsetta (Modena, N-Italy), B.O.C. 426 (x 97).
- Fig. 5 - *Tenedocythere perplexa* n. sp.. Holotype, LV, Badenian, Nüssdorf (Wien), Point GR 351, B.O.C. 417 (x 97).
- Fig. 6 - *Tenedocythere mediterranea* (Ruggieri). ♂ LV, Sahelian, Cozzo S. Pantaleo (Sicily), B.O.C. 425 (x 93).
- Fig. 7 - *Tenedocythere perplexa* n. sp.. Paratype, RV, B.O.C. 418 (x 97).
- Fig. 8 - *Tenedocythere perplexa* n. sp.. Paratype, Carapace in dorsal view, B.O.C. 427 (x 89).





It differs in having a less « crested » general appearance and the hinge-ear ridge which does not overlap the margin in lateral view.

*Remarks* — Our material comes from the type-locality of a species of *Tenedocythere* described by Reuss 1850 under the name of *Cypridina sulcatopunctata* (p. 75, Pl. 10, fig. 8). It is possible that our specimens correspond to topotypes of the Reuss' species. However, taking into account the fundamental differences between Reuss' figure and our specimens, we prefer to erect a new species.

TENEDOCY THERE CRUCIATA n. sp.

Pl. 6, figs. 1-4; Pl. 9, fig. 7

1972 *Quadracythere* (*Tenedocythere*) *mediterranea* - SISSINGH, p. 126, Pl. 10, fig. 3 (*nec* Ruggieri 1962)

*Etymology* — From latin *cruciatus* = cross-shaped.

*Holotype* — A left valve (O.C.R. 3652a) (Pl. 6, fig. 1), Point GR 966.

*Paratype* — A right valve (O.C.R. 3652b), Point GR 966.

*Type-locality* — Benestare, Point GR 966.

*Type-level* — Miocene (Tortonian).

*Diagnosis* — A species of *Tenedocythere* characterized by sharp-cornered valves in lateral view and by the oblique running of the posterior part of the mid-ventral ridge which blends into the hinge-ear ridge just below the hinge-ear itself, and by the reduction of one of the arms of the y-shaped ridge.

*Description* — In lateral view, the valves are rectangular and sharply cornered. The principal and secondary ridges are very prominent. The hinge-ear

ridge is almost angularly arched, and overlaps the margin; it abruptly slopes down to cut off the beak posteriorly. The mid-ventral ridge is very long and horizontal anteriorly and oblique after the muscle-scars area. From there it runs up to blend into the hinge-ear ridge. The y-shaped ridge is reduced to the upper and anterior arms that form a continuous undulated ridge. The posterior end of the muscle-ridge is cross-shaped just before the muscle-scars region.

Size of the figured specimen (Pl. 6, fig. 1):

L = 0.875 mm.

*Affinities* — This species is particularly well characterized by the disposition of the ridges. It shows some similarity with *T. perplexa* n.sp. for the peculiar development of the ridges and the cross-shaped muscle-ridge. The details of the differences are given under *T. perplexa*.

*Occurrence and age* — Tortonian: Gavdos (Greece); Casanova Calisese (Forlì), Point GR 805; Benestare, Point GR 966.

Sahelian: Cozzo S. Pantaleo (Ciminna, Palermo), Point GR 3971; Cozzo Tutusino, Point GR 3668; Verdalice (Trapani), Point GR 2702; Crete (Greece); Abbadia (Palermo), Point GR 2275; Malta, Section 7, C-3.

TENEDOCY THERE BIRESTIS n. sp.

Pl. 8, figs. 1-3; text-fig. 5

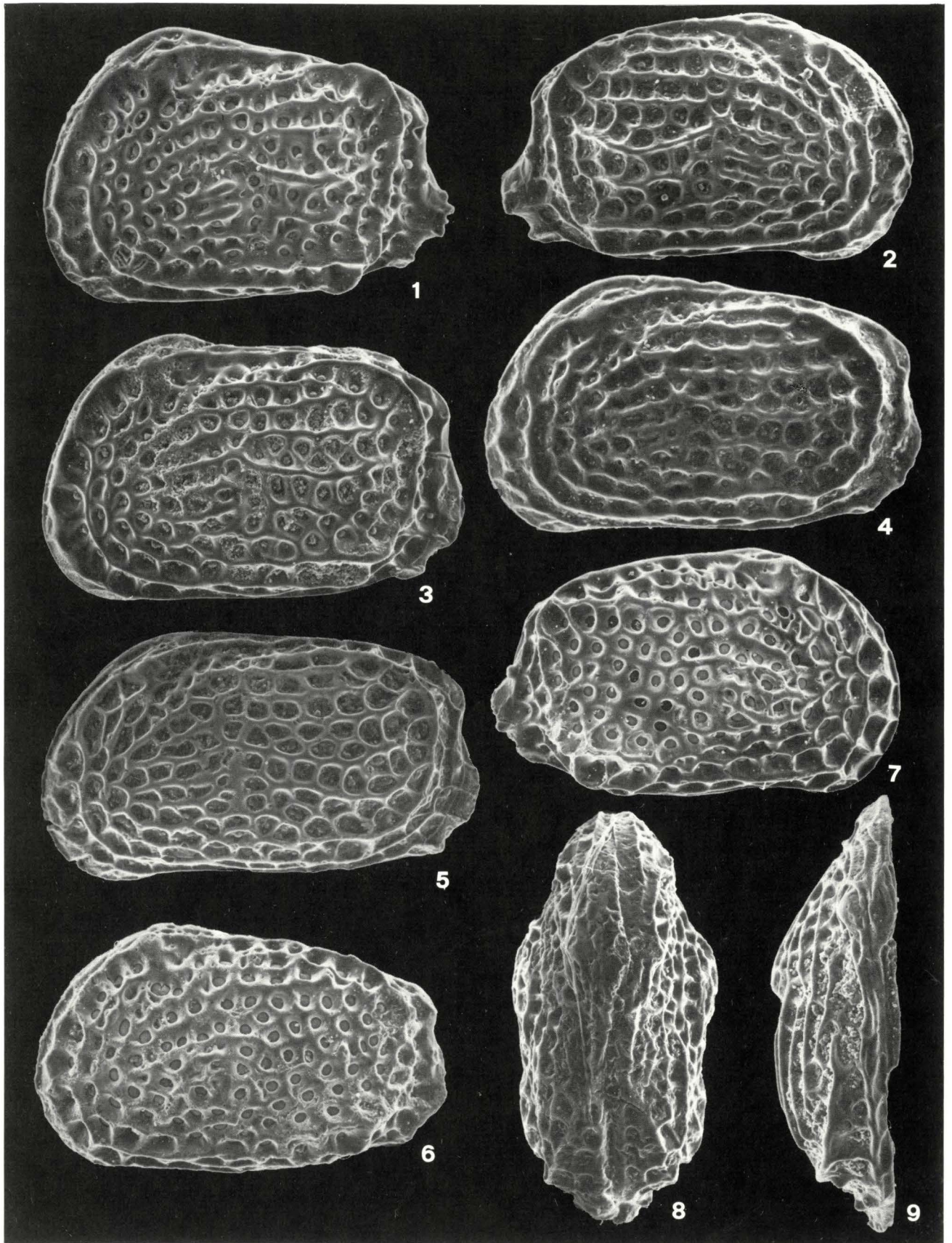
1968 *Procythereis sulcatopunctatus*, Russo, p. 25, tav. 3, fig. 2a, b.

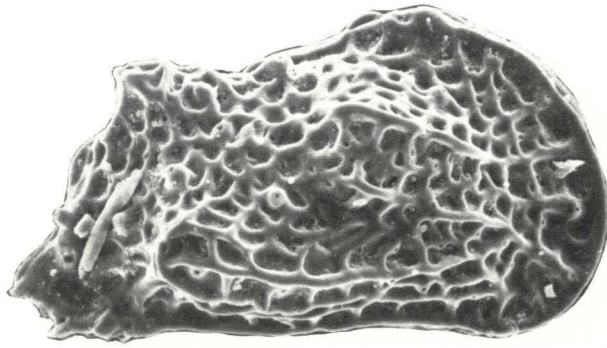
*Etymology* — From latin *bis* = two and *restis* = cable.

*Holotype* — A left valve ♀ (O.C.R. Sl. 3776a) (Pl. 8, fig. 1).

EXPLANATION OF PLATE 8

- Fig. 1 - *Tenedocythere birestis* n. sp.. Holotype, ♀ LV, Sahelian, C. da Abbadia (Petràlia Sottana, Sicily), Point GR 2275, O.C.R. Sl. 3776a (x 97).  
 Fig. 2 - *Tenedocythere birestis* n. sp.. Hypotype, ♂ RV, Tortonian, Montebanzone Sarsetta (Modena, N-Italy), B.O.C. 428 (x 93).  
 Fig. 3 - *Tenedocythere birestis* n. sp.. Hypotype, ♀ LV of complete carapace, Sahelian, Cozzo S. Pantaleo, B.O.C. 433 (x 93).  
 Fig. 4 - *Tenedocythere obsoleta* n. sp. Holotype, ♀ LV, Tortonian, Montebanzone Sarsetta (Modena, N-Italy), B.O.C. 413 (x 101).  
 Fig. 5 - *Tenedocythere obsoleta* n. sp. Hypotype, ♂ LV, Tortonian, Montegibbio R. 3 - R 12 (Modena, N. Italy), B.O.C. 429 (x 101).  
 Fig. 6 - *Tenedocythere scabriuscula* n. sp.. Holotype, LV, Sahelian, Balze di Rocca Limata (Landro, Sicily), Point GR 3874, O.C.R. Sl. 3881 (x 97).  
 Fig. 7 - *Tenedocythere scabriuscula* n. sp.. Paratype, RV, O.C.R. Sl. 3880 (x 97).  
 Fig. 8 - *Tenedocythere scabriuscula* n. sp.. Hypotype, Carapace in dorsal view, Sahelian, Contrada Tudiotta (Sicily), Point GR 3666, O.C.R. 3667b (x 97).  
 Fig. 9 - *Tenedocythere scabriuscula* (Uliczny). ♂ LV in dorsal view, Pliocene, Stavromenos 3 (Crete), B.O.C. 430 (x 111).





Text-fig. 5 - *Tenedocythere birestis* n. sp. Juvenal RV. Abbadia, Sahelian, x 180.

*Paratypes* — Some valves (O.C.R. Sl. 3775; Sl. 3776b, c).

*Type-locality* — Abbadia (Petralia Sottana), Point GR. 2275.

*Type-level* — Sahelian.

*Diagnosis* — A species of *Tenedocythere* that is characterized by two parallel short ridges before the muscle-scars area.

*Description* — The left valve of the ♀ is rectangular and the right valve is almost regularly arched dorsally. The hinge-ear ridge is quite prominent and continues obliquely without interruption into the posterior and subsequently horizontally into the subventral ridge. The subdorsal ridge is not prominent; the midventral ridge is well developed and split into 2 parts: the posterior part is clearly step-like in shape, in the left valve and the anterior one is short and parallel to the muscle-ridge.

Size of the figured specimen (Pl 8, fig. 1):

L = 0.780 mm.

*Affinities* — The species is similar to *T. mediterranea* for its general shape and ornamentation. It differs by the presence of the short ridge parallel to the muscle-ridge and by the more distinct posterior ridge.

*Occurrence and age* — Lower Tortonian: Sarsetta, Montebanzone (Modena).

Sahelian: Abbadia (Petralia Sottana, Point GR 2275) (O.C.R. Sl. 3775, 3776); S. Giovanni in Galilea, Point GR 1935 (O.C.R. Sl. 3650); Vigoleno, (Piacenza); Spain (Samples 2, 17).

TENEDOCY THERE PARALLELA n. sp.

Pl. 5, figs. 7, 8

*Etymology* — From latin *parallelus* = parallel.

*Holotype* — A left valve (O.C.R. 3675) (Pl. 5, fig. 7).

*Paratypes* — 1 right valve (O.C.R. 3415) (Pl. 5, fig. 8); many valves and carapaces (O.C.R., Sl. 3415).

*Type-locality* — Salemi, Contrada Carbinarusa, Point GR 3412.

*Type-level* — Sahelian.

Other localities: unknown elsewhere.

*Diagnosis* — A species of *Tenedocythere* characterized by its subrectangular shape and subhorizontal and poorly prominent ridges.

*Description* — The valves show the presence of a thin but distinct subdorsal ridge parallel to the top arm of the y-shaped ridge. Below this ridge the mid-ventral ridge runs parallel to the lower arm and disappears anteriorly in the muscle-scars area after a smooth curve and posteriorly into the reticulation. The ventral and subventral ridges are very thin and straight.

Size of the figured specimen (Pl. 5, fig. 7):

L = 0.895 mm.

*Affinities* — This species is similar to *T. birestis* n. sp. It differs by the less distinct hinge-ear ridge and by the absence of the posterior ridge which in *T. birestis* is quite well developed. Moreover, it lacks the typical abruptly interrupted muscle-ridge.

TENEDOCY THERE MEDITERRANEA (Ruggieri, 1962)

Pl. 6, figs. 7-9; P. 7, figs. 1-4, 6; Pl. 9, fig. 5

1962 *Quadracythere* (?) *sulcatopunctata mediterranea* RUGGIERI, p. 30, Pl. 3, figs. 1-4.

1964 *Quadracythere* (?) *sulcatopunctata mediterranea*, DIECI and RUSSO, p. 65, tav. 11, figs 1-2a, b.

1968 *Procythereis sulcatopunctatus mediterraneus*, RUSSO, p. 26, tav. 3, figs 3a-c; tav. 10, figs. 2, 4.

*Remarks* — Ruggieri (1962) erected *T. mediterranea* as a subspecies of *T. sulcatopunctata* (Reuss). According to Ruggieri (1962, p. 31) the subspecies shows characters intermediate between *T. sulcatopunctata* and *T. prava* (Baird). *T. mediterranea* shows a large variability in that some specimens (Pl. 7, fig. 3) show a more *Aurila*-like shape and a stronger ornamentation in both the ridges and the reticulation.

Size of the figured specimens (Pl. 7, fig. 1):

L = 0.825 mm.

*Occurrence and age* — Early Tortonian: Sarsetta, Montebanzzone (Modena).

Late Tortonian: Montegibbio (Modena). Point R3, R12; Benestare. Point GR 966.

Tortonian: Enna. Point GR 1378.

Sahelian: Malta, section 4, c. 672 and c. 673; Carmona, MS 22; S. Giovanni in Galilea (Forlì). Point GR 1935; Balze di Barbara near Portella del Morto (Caltanissetta), Point GR 2547.

TENEDOCYTHERE SCALPRATA n. sp.

Pl. 5, figs. 1-6; Pl. 6, fig. 6

*Etymology* — From latin *scalprum* = sickle.

*Holotype* — A left valve (O.C.R. 3363a) (Pl. 5, fig. 1).

*Paratypes* — Many valves and carapaces (O.C.R. 3363b,c; 3940).

*Type-locality* — Salemi, Point GR 3360.

*Type-level* — Sahelian.

*Diagnosis* — A species of *Tenedocythere* that is characterized by the absence of the subdorsal ridge, by the very reduced hinge-ear ridge, and by 5 sickle-like ridges that run parallel to the anterior margin.

*Description* — In lateral view this species shows a gently curved antero-dorsal margin, a poorly prominent hinge-ear ridge that disappears in the posterior area within the reticulation. The anterior of the valves shows a series of sickle-like ridges that run parallel to the margin. The subdorsal ridge is substituted by the reticulation and the top arm is disconnected from the lower arm in the y-shaped ridge forming two independent subparallel ridges.

Size of the figured specimen (Pl. 5, fig. 1):

L. = 0.815 mm.

*Affinities* — This species is similar to *T. perplexa* n. sp. for the disposition of the y-ridge and the mid-ventral ridge. It differs by the absence of the subdorsal ridge and by the running of the posterior part of the mid-ventral ridge.

*Remarks* — A smaller form of the same species (L=0.706) has been found at S. Pantaleo (Pl. 6, fig. 6).

*Occurrence and age* — Sahelian: Laghetto del Timpone S. Tommaso near Salemi, Point GR 3360; Clays just below the bioherma at Salemi, Point GR

3411; Malta, Sect. 4, c.35, c.672 and 673; Cozzo S. Pantaleo 3 (small form), Point GR 3971.

TENEDOCYTHERE SUBULATA n. sp.

Pl. 6, fig. 5; Pl. 10, fig. 1

*Etymology* — From latin *subula* =awl.

*Holotype* — A carapace (O.C.R. Sl. 3673) (Pl. 6, fig. 5).

*Type-locality* — Cozzo Tutusino (Caltanissetta, Sicily), Point GR 3668.

*Type-level* — Miocene, Sahelian.

Other localities: Balze di Rocca Limata (Landro, Sicily), Point GR 3874.

*Diagnosis* — A species of *Tenedocythere* that is regularly swollen and is characterized by a poorly marked hinge-ear that does not overlap the margin. It also displays a more *Pokornyella*-like habitus.

*Description* — In lateral view, the dorsal margin is gently arched in the left valve and the antero-ventral margin is very protruded. The hinge-ear ridge is very flat and poorly marked and almost disappears posteriorly within the reticulation. The subventral ridge is short and ends before mid-length. The muscle ridge meets the horizontal mid-ventral ridge at a right angle. The y-shaped ridge is transformed into subparallel ridges which do not reach the hinge-ear ridge posteriorly. The subdorsal ridge is distinct in the anterior part of the valves.

Size of the figured specimen (Pl. 6, fig. 5):

L = 0.815 mm.

*Affinities* — This species shows some similarity with *T. scalprata* n. sp. for the orientation of the modified y-ridge. It differs by the longer subventral ridge and by the absence of the muscle-ridge hook.

TENEDOCYTHERE OBSOLETA n. sp.

Pl. 8, figs. 4, 5

1968 *Procythereis* sp., Russo, p. 27, tav. 3, figs 5a, b; tav. 10, fig. 5.

*Etymology* — From latin *obsoletus* =obsolete.

*Holotype* — A left valve (B.O.C. no. 413) (Pl. 8, fig. 4).

*Paratype* — A left valve (B.O.C. no. 414).

*Type-locality* — Sarsetta, Montebanzzone (Modena).

*Type-level* — Early Tortonian.

*Diagnosis* — A species of *Tenedocythere* characterized by the regularly arched posterior ridge and the scarcely prominent horizontal ridges.

*Description* — In lateral view the valves protrude markedly antero-ventrally and postero-dorsally. The surface of the valves is characterized by a regular reticulation. The principal and secondary ridges are poorly developed. The sub-peripheral hinge-ear and the posterior and sub-ventral ridges appear regularly arched and almost equally developed throughout the surface of the valve. The hinge-ear ridge disappears anteriorly within the reticulation at about mid-length. The other ridges run horizontally and are difficult to detect.

Size of the figured specimen (Pl. 8, fig. 4):

L = 0.795 mm.

*Occurrence and age* — Early Tortonian: Sarsetta, Montebaranzone (Modena).

Late Tortonian: Montegibbio (Modena), Point R3, R12.

TENEDOCY THERE SCABRIUSCULA n. sp.

Pl. 8, figs. 6-9; Pl. 9, fig. 8

*Etymology* — From latin *scaber* = rough.

*Holotype* — A left valve (O.C.R. 3881) (Pl. 8, fig. 6).

*Paratype* — A complete carapace (O.C.R. S1. 3880) (Pl. 8, fig. 7).

*Type-locality* — Balze di Rocca Limata, Point GR 3874.

*Type-level* — Sahelian.

Other localities: Point GR 3666; GR 3765; GR 3668.

*Diagnosis* — A species of *Tenedocythere* that is characterized by its rough surface and by two stocky swellings in each valve. The swellings are more evident in dorsal view.

*Description* — In lateral view, the valves appear subtriangular with a well protruded anteroventral area. The postero-dorsal ridge is weakly developed and abruptly interrupted postero-dorsally. The ventral ridge disappears gradually posteriorly. The posterior part, particularly depressed at mid-length, is roughly reticulated. The other ridges appear irregular, and very poorly defined. In dorsal view the valve shows two large swellings, one before and one after the mid-length. The central depression is very light and the carapace appears particularly stocky and swollen in dorsal view.

Size of the figured specimen (Pl. 8, fig. 6):

L = 0.786 mm.

*Affinities* — The general shape of *T. scabriuscula* in lateral view is similar to that of *T. birestis* n. sp. and both species have a short muscle-ridge and a mid-ventral ridge that is splitted into two parts. *T. scabriuscula* differs by the absence of evident ridges and by the characteristic shape in dorsal view.

*Occurrence and age* — Sahelian: C. da Tudiotta, Resuttano (Sicily), Point GR 3666; Cozzo Tutusino, S. Caterina Villarmosa (Sicily), Point GR 3668.

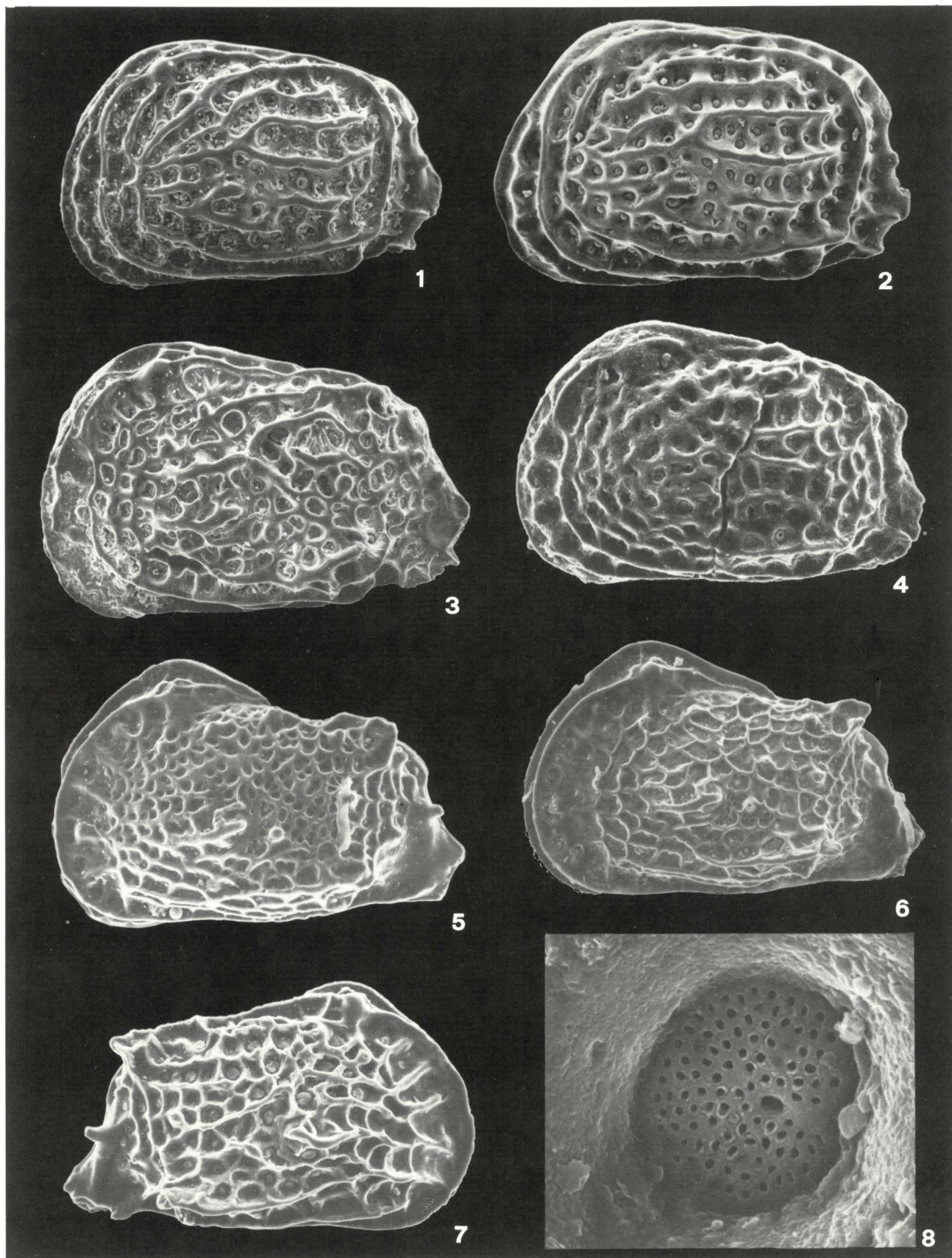
TENEDOCY THERE sp. A

Pl. 9, fig. 3

One valve of *Tenedocythere* is characterized by a short horizontal ridge between the two arms of the y-ridge and by the undulating subventral ridge. Those characters make it very close to *T. prava* associated with the general shape and the ornamentation of the anterior part of the valves. Because the valve was

#### EXPLANATION OF PLATE 9

- Fig. 1 - *Tenedocythere cordiformis* n. sp.. Holotype, ♀ LV, Early Pliocene, Empoli (Tuscany), Point GR 1025, O.C.R., S1. 3942 (x 89).  
 Fig. 2 - *Tenedocythere cataphracta* n. sp.. Holotype, ♀ LV, Pliocene, S. Cusumano (Sicily), Point GR 2100, O.C.R., S1. 3943 (X 93).  
 Fig. 3 - *Tenedocythere* sp. A. LV, (?) Pleistocene, Isle of Gyalí (Greece), B.O.C. 431 (x 89).  
 Fig. 4 - *Tenedocythere* sp. B. LV, (?) Recent, Strophades (Greece), B.O.C. 432 (x 106).  
 Fig. 5 - *Tenedocythere mediterranea* (Ruggieri). Juvenile LV, Sahelian, Malta Stn. 35 I (x 111).  
 Fig. 6 - *Tenedocythere prava* (Baird). Juvenile LV, Recent, Gulf of Naples: Stn. 98 (x 106). It is on such instar that Rome described the « new species » *Cythereis polygonata*.  
 Fig. 7 - *Tenedocythere cruciata* n. sp.. Paratype, Juvenile RV, Tortonian, Benestare (Reggio Calabria), Point GR. 966, O.C.R. S1. 3652c (x 121).  
 Fig. 8 - *Tenedocythere scabriuscula* n. sp.. Hypotype, Detail of a normal pore-canal, Sahelian, Contrada Tudiotta (Sicily), Point GR 3666, O.C.R. S1. 3667a (x 2110).



found together with *T. prava* it may be an anomalous specimen of the latter species.

*Locality* — Gyali (Greece). ? Pleistocene.

*Repository* — B.O.C. 431.

TENEDOCY THERE sp. B

Pl. 9, fig. 4

Only one valve of this species, probably new, was found. It appears characterized by the lack of anterior horizontal ridges, by the reduced hinge-ear ridge and by the particularly small size ( $L=0.699$  mm).

*Locality* — Strophades (Greece).

*Age* — ? Recent.

*Repository* — B.O.C. 432.

APPENDIX I

Because of the cited relationship between *Tenedocythere* and *Pokornyyella*, a new species of *Pokornyyella* that seems to be in some way particularly related to *Tenedocythere* is described below.

POKORNYELLA DEVIANS n. sp.

Pl. 10, figs. 2-6, 8

? 1972 *Aurila* sp. 2 SISSINGH, p. 119, Pl. 9, fig. 9.

*Etymology* — From latin *devians* = deviating.

*Holotype* — A complete carapace (O.C.R. S1. 3883).

*Paratypes* — 2 complete carapaces (O.C.R. S1. 3884).

*Type-locality* — Balze di Rocca Limata, Point GR 3874.

*Type-level* — Sahelian.

*Diagnosis* — A species of *Pokornyyella* that is characterized by its subrectangular shape and by the strong posterior hinge-ear ridge.

*Description* — The ornamentation of this species shows intermediate characters between *Pokornyyella* and *Tenedocythere*. In fact, the anterior part of the valves corresponds to *Pokornyyella* with mostly concentrically arranged foveolae of different size whereas the posterior part is very similar to *Tenedocythere* with the large foveolae arranged in oblique rows and a very distinct hinge-ear ridge (Pl. 10, figs. 3, 4). In dorsal view, the carapaces are moderately inflated in the middle and the posterior swelling is subtruncated. The sexual dimorphism is very accentuated. The anterior and posterior margins are very gently pitted (Pl. 10, figs. 6, 8). A similar fine pitting is also recorded in the anterior and posterior margins of *Pokornyyella deformis* (Reuss). On the contrary, the latter character is always lacking in the true *Tenedocythere* species known so far.

Size of the figured specimens:

♀ (Pl. 10, fig. 3):  $L = 0.644$  mm

♂ (Pl. 10, fig. 4):  $L = 0.666$  mm

♀ (Pl. 10, fig. 5):  $L = 0.679$  mm

*Affinities* — The new species differs from both *Pokornyyella deformis* (Reuss) and *Pokornyyella italica* (Ruggieri, Russo and Bossio) by its more rectangular shape in lateral view, by the very distinct postero-dorsal ridge and by its peculiar shape in dorsal view.

ACKNOWLEDGEMENTS

The authors are grateful to Mr. Giorgio Dafnis, responsible of the Electron Microscopy Laboratory of the Zoological Station of Naples for his invaluable help on taking micrographs, to Mr. Mario Di Genova who patiently inked the drawings and to Ms Gisella Princivalli who repeatedly typed the manuscript; and to Dr. N. de B. Hornibrook (Wellington,

EXPLANATION OF PLATE 10

Fig. 1 - *Tenedocythere subulata* n. sp.. Hypotype, ♀ LV, Sahelian, Balze di Rocca Limata (Landro, Sicily), Point GR 3874, O.C.R. S1. 3879 (x 101).

Fig. 2 - *Pokornyyella devians* n. sp.. Paratype, ♀ RV of a complete carapace, Sahelian (Landro, Sicily), Point GR 3874, O.C.R. S1. 3884a (x 111).

Fig. 3 - *Pokornyyella devians* n. sp.. Holotype, ♀ LV of a complete carapace, O.C.R., S1. 3883 (x 121).

Fig. 4 - *Pokornyyella devians*, n. sp.. Paratype, ♂ LV, O.C.R. S1. 3884b (x 115).

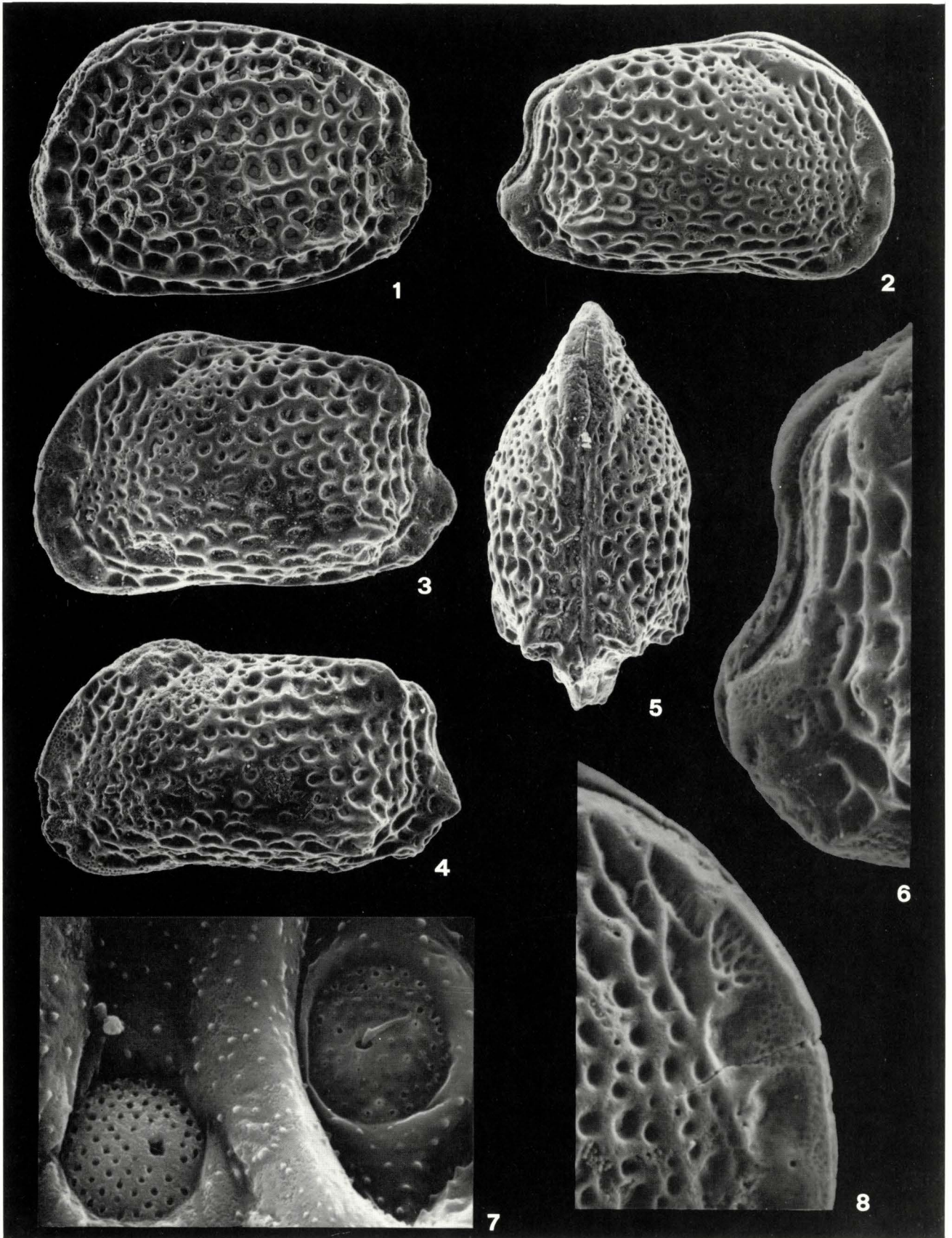
Fig. 5 - *Pokornyyella devians* n. sp.. Paratype, ♀ Carapace in dorsal view, O.C.R. S1. 3884c (x 115).

Fig. 6 - *Pokornyyella devians* n. sp.. (Same specimen as in fig. 2). Detail of the fine pitting of the caudal process (x 348).

Fig. 7 - *Tenedocythere prava* (Baird). Detail of two normal pore-canals, Recent, Gulf of Naples (x 2207). The pore canal on the right has the holes of the sieve disk closed by organic matter.

Fig. 8 - *Pokornyyella devians* n. sp.. (Same specimen as in fig. 2). Detail of the fine pitting of the anterior (x 348).





New Zealand) who formerly sent to the old author a nice collection of types and topotypes from the New Zealand seas. Drs. Giuseppe Torre (Petralia Sottana, Palermo), Mario Unti (Palermo), B. Tsapralis (Athens, Greece) for kindly providing some samples.

This work was supported by grants from Consiglio Nazionale delle Ricerche (Palaeobenthos Group) and the Ministero della Pubblica Istruzione (M.P.I.).

## APPENDIX II

*Point GR 34* - Yellow, fossiliferous sandy clay interbedded with yellow sand of the Late Pliocene on the right side of the Riorzo Stream, upriver of the Castellarquato Village (Piacenza, Italy).

The macrofauna is listed in Ruggieri, 1957, p. 130. It corresponds to the locality 6/II of Ruggieri, 1954.

*Point GR 177* - Blue sandy clay with *Hyalinea baltica* and *Arctica islandica*, outcropping on the right side of the Crati river downhill from Cosenza (Calabria), now dated Early Pleistocene, Emilian II cycle. See Ruggieri, 1952.

*Point GR 339* - « Large Upper Terrace », at the eastern sea-side edge, altitude 150 m, south of the town Crotona (Calabria), near the cemetery; Late Pleistocene, type locality of the Crotonian (Ruggieri *et alii*, 1977). Ostracode fauna listed in Ruggieri, 1973.

*Point GR 351* - Yellow *Amphistegina* marls from Grüne Kreuze, Nüssdorf (suburbs of Vienna), one of the type-localities of the Leithakalke. Age: ? Serravallian (Badenian).

*Point GR 417* - Blue sandy clay with *Arctica islandica*, datable as Early Pleistocene, Santernian, casually brought to light by agricultural labour at the top of hill on the right side of the Morra stream, SW of the village of Castellanselmo (Pisa). Ostracode fauna listed as Point C-8 in Ruggieri, 1964.

*Point GR 1025* - Sandy fossiliferous clay outcropping on the Casanova Calisese (now Villaggio Baviera), north of Sogliano al Rubicone, along the road to Santarcangelo (Forlì). The malacofauna is described in Ruggieri and Davoli, 1984, and dated as Tortonian.

*Point GR 966* - Gray clay with *Borelis melo* datable as Early Sahelian or Late Tortonian (this paper), once exposed at the classical locality of Benestare (Reggio Calabria): Lat. 38°11'16", Long. 3°40'45" E, altitudine 310-320 m. For further details see Ruggieri (1963).

*Point GR 1052* - Sandy fossiliferous clay outcropping on the right bank of the Arno river, in front of Empoli (Tuscany). Age: Early Pliocene.

*Point GR 1084* - Calcarenites with *Hyalinea baltica*, datable as Pleistocene, Emilian II cycle, exposed in the glen called « Botro Magno », at the periphery of Gravina di Puglia.

*Point GR 1378* - Sandy clay with *Heterostegina*, included in a cahotic dominantly clayey complex, exposed on the left side of the Calderari Stream, East of the town of Enna, Age: Tortonian. Ostracode fauna listed in Ruggieri, 1962, as Point GR 10162.

*Point GR 1683* - Soft calcarenites with *Globorotalia truncatulinoides excelsa*, exposed in the lower part of an abandoned quarry, along the coastal national road, directly North of the Motel of Castellammare del Golfo (Trapani, Sicily). Age: Late Pleistocene, Sicilian.

*Point GR 1935* - Fossiliferous sandy clay with *Borelis melo*, eroded by a Bad Land south of the village S. Giovanni in Galilea (Forlì, Northern Italy): Lat. 43°51'49" N, Long. 0°06'42" W, altitude 250 m. Age: Early Sahelian. Preliminary list of the ostracode fauna in Ruggieri, 1972, p. 107.

*Point GR 2006* - Gray clayey sands with abundant macrofauna rich in « northern guests », recovered from a drill core at about 20 m below the surface at the locality « Sperrone » (Southern periphery of Palermo). Age: Sicilian (Uppermost). See Ruggieri, 1971.

*Point GR 2100* - Gray clay, with « clasts » of neritic origin, once exposed at the locality S. Cusumano, during the digging of the foundations of the new village of Salaparuta (Trapani, Sicily). Age: Pliocene.

*Point GR 2170* - White soft calcarenites with *Globorotalia truncatulinoides excelsa*, brought to light by digging for the foundation of the western side of Viale del Fante in Palermo, a little north of the main entrance of the Favoriga Park. Age: Sicilian. See Ruggieri, Buccheri, Greco and Sprovieri, 1976.

*Point GR 2275* - Gray-yellowish sandy clay with macrofossils (*Aporrhais thersites*), Dasycladaceans and *Borelis melo*, badly exposed at C. da Abbadia, SE of Petralia Sottana (Palermo). Age: Sahelian.

*Point GR 2533* - Gray clayey sands exposed along the cut of a secondary road bifurcating at the Km 13 from the road Enna-Piazza Armerina to reach the locality Varco Ramata. Age: Pliocene.

*Point GR 2547* - Clay level interbedded in the *Porites* and *Tarbellastrea* reef at the locality Balze di Barbara, near Portella del Morto (along the road Vallelunga - S. Caterina Villarmosa, Central Sicily). Age: Sahelian. The coral-reef was described by Chevalier, 1961, p. 82, fig. 29.

*Point GR 2702* - Clay with interbedded sandy layers exposed at C. da Verdalice, about 4 Km WSW of the village S. Ninfa (Trapani, Sicily). Age: Sahelian.

*Point GR 2779* - Blue fossiliferous clays outcropping along a small stream in the vicinities of Balestrate (Palermo, Sicily). Age: Early Pliocene.

*Point GR 2872* - Thin transgressive fossiliferous sandy layer with malacofauna characteristic of a prairie, once exposed along a road cut NE of Castelvetrano (Trapani, Sicily) in locality « Pizzo di Core ». Age: Early Pleistocene, Emilian II cycle. For the ostracode fauna and previous bibliography see Ruggieri 1978, p. 168.

*Point GR 2960* - Soft calcarenitic layers interbedded with clay, with malacofauna typical of submarine prairies, exposed at the locality « Cerausi », NW of M. Rabione, near Serradifalco (Caltanissetta, Sicily). Age: Late Pleistocene. Other information in Greco, 1970.

*Point GR 3025* - Yellow calcareous sand which lies unconformably on the Lower Pliocene white marls along the Vittoria ring-road, Km 298 (SE Sicily). Age: Early Pleistocene, Emilian II.

*Point GR 3360* - Dark grey clay with fragments of *Porites*, large-sized *Elphidium* and rare malacofaunas (with *Cripto-*

- plax*) brought to light by the digging for a small artificial lake on the southern slope of Timpone S. Tommaso (Salemi, Sicily). Lat. 37°48'04" N, Long. 0°48'09" E, altitude 180 m. Age: Sahelian.
- Point GR 3411* - Grey clay exposed by digging for foundations, very close (NE) to the *Porites* coral-reef on which grows the village of Salemi (Sicily). Age: Sahelian.
- Point GR 3412* - Grey clay with *Pycnodonte* underlying directly the gypsums layers along the Carbinarusa ditch, about 4 Km W of Salemi (Sicily). Age: Sahelian.
- Point GR 3666* - Clayey sand resting on the basal conglomeratic member of the Sahelian cycle at C. da Tudiotta, 1100 m SW of Masseria Tudiotta, altitude 650 m, sector SW of the map « Resuttano » (260/III/SW), central Sicily. Age: Sahelian.
- Point GR 3668* - Clayey sand below the bioherma of Cozzo Tutusino, 100 m East of the point quoted 860 on the top of the Cozzo Tutusino, sector NE of the map « S. Caterina Villarmosa » (268/IV/NE), Lat. 37°39'49" N, Long. 1°32'46" E, altitude 825 m (central Sicily). Age: Sahelian.
- Point GR 3765* - Clayey sand below the bioherma of Cozzo Tutusino, 380 m East of the point quoted 860 m on top of Cozzo Tutusino, sector NW of the map. « S. Caterina Villarmosa » (268/IV/NW), Lat. 37°39'49" N, Long. 1°33'00" E, altitude 850 m (central Sicily). Age: Sahelian.
- Point GR 3874* - Clay marl which lies over the coralligenous limestone, with coral fragments, mollusks (e.g. *Fustaria jani*, *Cryptoplax* sp.), foraminifers (e.g. large *Elphidium*), and other fossils clearly reworked (Eocene and Cretaceous), outcropping on the Southern slope of Balze di Rocca Limata (area of Landro, map. « S. Caterina Villarmosa », central Sicily). Age: Sahelian.
- Point GR 3971* - Organogenic, yellow, weakly cemented calcarenite, in the section of Cozzo S. Pantaleo, on the road between Ventimiglia and Baucina (Palermo, Sicily). Lat. 37°54'43" N, Long. 1°06'13" E, altitude about 670 m. Age: Sahelian.
- Malta 7* - Marly calcarenite with Algae, near Marfa village, Malta archipelagus. Age: Sahelian. Ostracode fauna listed in Russo e Bossio 1976.
- Montegibbio R3-R12* - Clayey marl rich in macrofossils, exposed on the right of the Rio delle Bagole, south of Ca' del Chierico (Modena). Age: Late Tortonian. Ostracode fauna listed in Dieci e Russo 1964.
- Sarsetta, Montebanzone* - Strip of marl with macrofauna, included in a cahotic clayey complex, near Montebanzone (Modena). Age: Early Tortonian. Ostracode fauna listed in Russo 1968.
- Vigoleno* - *Clavatulula* clay, north of the School, near the village of Vigoleno. Age: Sahelian.
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## ALPHABETIC LIST OF THE SPECIES

- Pokornyella devians* n. sp. - pl. 10, figs. 2-6, 8  
*Tenedocythere biresis* n. sp. - pl. 8, figs 1-3  
*Tenedocythere cataphracta* n. sp. - pl. 9, fig. 2  
*Tenedocythere cordiformis* n. sp. - pl. 9, fig. 1  
*Tenedocythere cruciata* n. sp. - pl. 6, figs 1-4; pl. 9, fig. 7  
*Tenedocythere furcata* n. sp. - pl. 4, figs 1-5  
*Tenedocythere furcata gradata* n. ssp. - pl. 4, figs 6-7  
*Tenedocythere mediterranea* (Ruggieri) - pl. 6, figs. 7-9; pl. 7, figs 1-4; pl. 9, fig. 5

- Tenedocythere obsoleta* n. sp. - pl. 8, figs 4-5  
*Tenedocythere parallela* n. sp. - pl. 5, figs. 7-8  
*Tenedocythere perplexa* n. sp. - pl. 7, figs 5, 7, 8  
*Tenedocythere prava* (Baird) - pl. 1, figs 4, 7; pl. 2, fig. 7; pl.  
3, figs 1-9; pl. 9, fig. 6; pl. 10, fig. 7  
*Tenedocythere salebrosa* (Uliczny) - pl. 4, fig. 8  
*Tenedocythere scabriuscula* n. sp. - pl. 8, fig. 6-9; pl. 9, fig. 8  
*Tenedocythere scalprata* n. sp. - pl. 5, figs 1-6; pl. 6, fig. 6  
*Tenedocythere subulata* n. sp. - pl. 6, fig. 5; pl. 10, fig. 1  
*Tenedocythere sulcatopunctatus* (Reuss) - (see *T. perplexa*)  
*Tenedocythere* sp. A - pl. 9, fig. 3  
*Tenedocythere* sp. B - pl. 9, fig. 4

(manuscript received May 8, 1984  
accepted July 31, 1984)

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