

Occurrence of fossil and Recent *Microceratina* Swanson 1980 (Ostracoda, Eucytherurinae) in the Mediterranean

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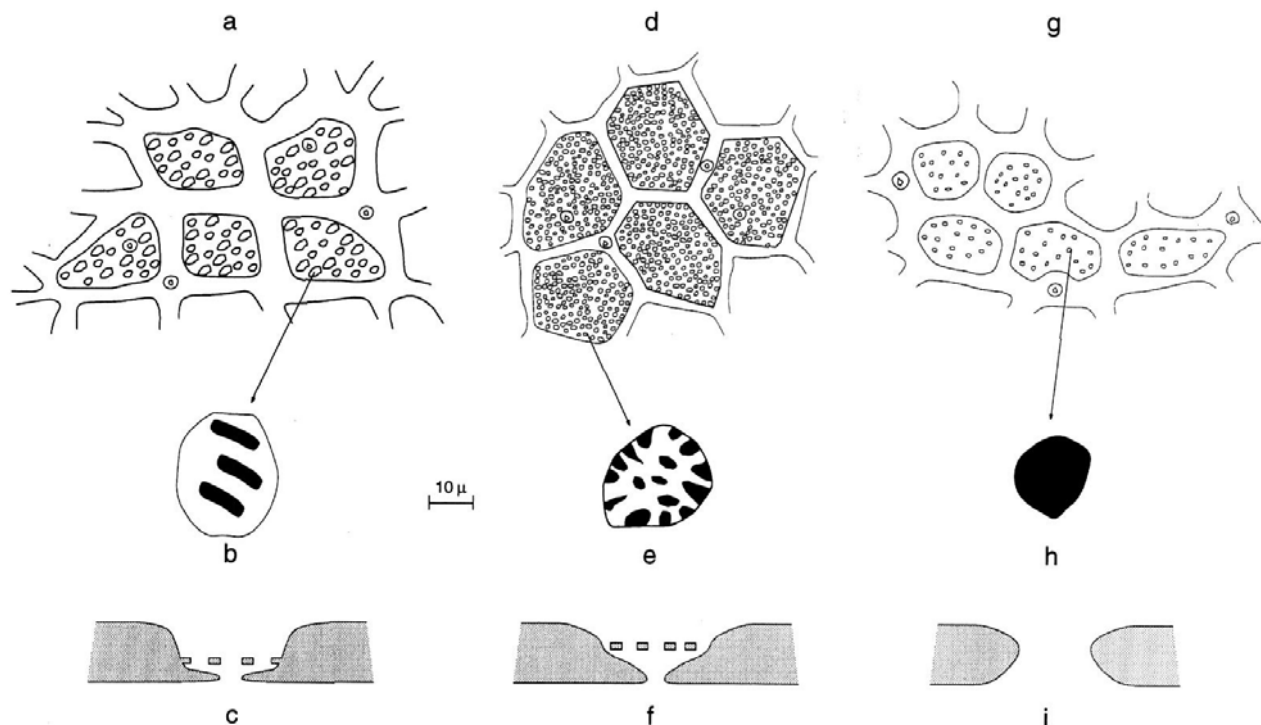
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ABSTRACT: The systematics and distribution of *Microceratina* Swanson 1980 are studied. Five species have been referred to this genus: *Microceratina quadrata* Swanson 1980 (type species), *Microceratina foveolata* (Colalongo and Pasini 1980) nov. comb., *Microceratina polygonia* (Colalongo and Pasini 1980), *Microceratina pseudoamfibola* (Barbeito-Gonzalez 1971) nov. comb. and *Microceratina reticulata* (Bonaduce, Ciampo and Masoli 1975). With the exceptions of the type species, which have been found in littoral sediments in Southern New Zealand and Southeastern Australia, and of *M. polygonia*, recovered in two sites of the North Atlantic, the genus *Microceratina* seems to be mainly distributed in the Mediterranean area, from the Tortonian to Recent.

INTRODUCTION

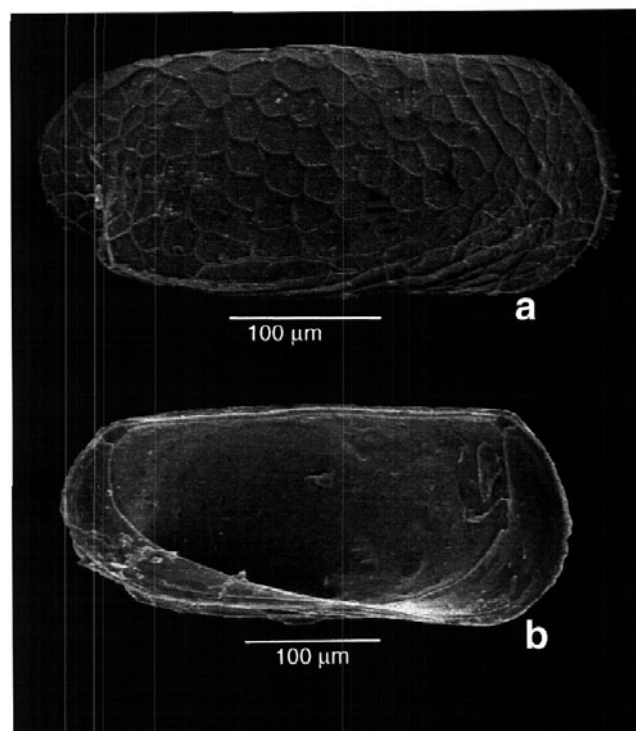
During the summer of 1997, while sampling seawater from the coastline around Capo Palinuro (Tyrrhenian Sea, Campania, southern Italy), some sediment samples were taken from within a submarine cave. In these sediments were found several valves of the ostracode *Eucytherura? pseudoamfibola* Barbeito-Gonzalez 1971, of a genus belonging to the family Cytheruridae Müller 1894.

In this paper we have carried out a systematic study of this species, which, after a detailed morphological observation, is shown not to belong to *Eucytherura* Müller 1894 but to *Microceratina* Swanson 1980, a genus here included in the Subfamily Eucytherurinae Puri 1974 (emend. Maddocks and Steineck 1987). In addition, some other species of the Subfamily Eucytherurinae from the Neogene-Recent of the Mediterranean region, provisionally attributed by Bonaduce et al. (1975) and Colalongo and Pasini (1980) to "*Bythoceratina*," are here referred to *Microceratina*.



TEXT-FIGURE 1

Schematic drawings showing pore cluster morphology. a-c. loop-hole-type in *Microceratina reticulata* (Bonaduce, Ciampo and Masoli); d-f. slit-type in *Microceratina pseudoamfibola* (Barbeito-Gonzalez) nov. comb.; g-i. *Xylocythere turnerae* Maddocks and Steineck.



TEXT-FIGURE 2

Microceratina pseudoamfibola (Barbeito-Gonzalez) nov. comb., holotype deposited at the Zoologischen Museums, Hamburg University, K-29231; a. lateral view; b. inner view.

SYSTEMATICS

Subclass OSTRACODA

Order PODOCOPIDA Sars 1866

Superfamily CYTHERACEA Baird 1850

Family CYTHERURIDAE Müller 1894

Subfamily EUCYTHERURINAE Puri 1974 (emend. Maddocks and Steineck 1987)

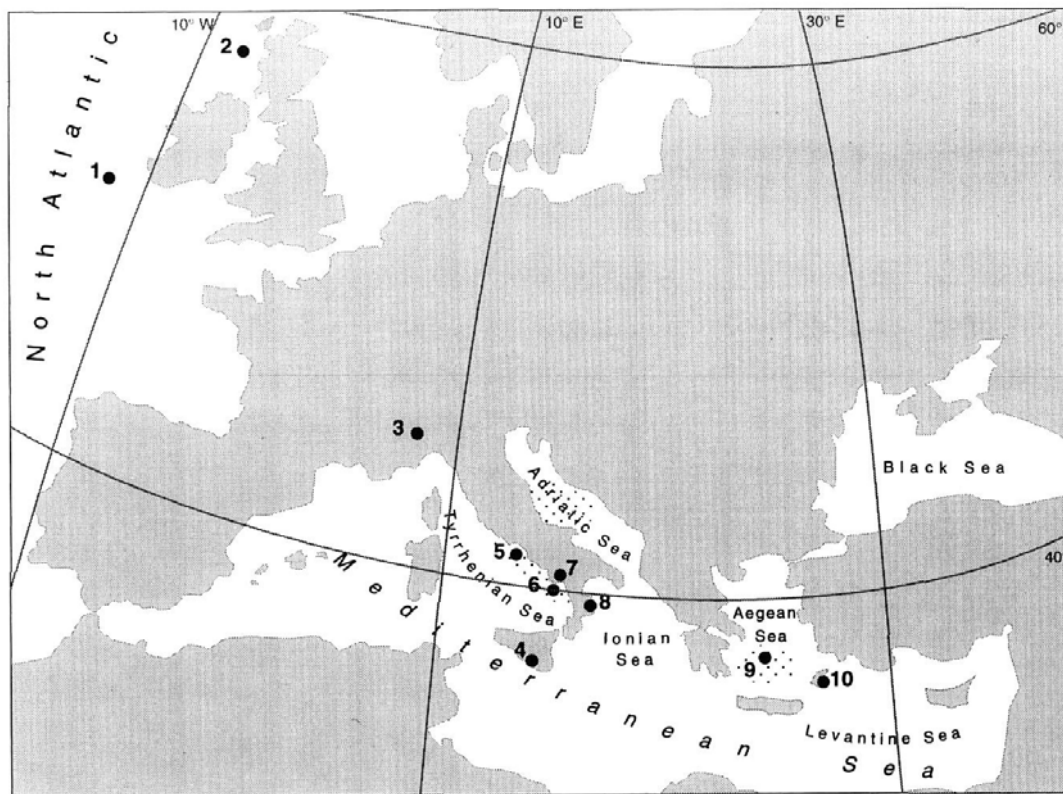
Genus *Microceratina* Swanson 1980

Type species: *Microceratina quadrata* Swanson 1980 (pl. 1, figs. 1-3)

Other species: *Microceratina reticulata* (Bonaduce, Ciampo and Masoli 1975) (pl. 1, figs. 7-10), *Microceratina polygonia* (Colalongo and Pasini 1980) (pl. 1, figs. 5-6), *Microceratina foveolata* (Colalongo and Pasini 1980) (pl. 1, fig. 4) and *Microceratina pseudoamfibola* (Barbeito-Gonzalez 1971) (pls. 2, 3).

Emended diagnosis: pore clusters made by slit- or loop-hole-type pores opened at the bottom of each pit.

Description: carapace small, elongate quadrate. Dorsal margin straight, ventral margin upswept posteriorly. Anterior and posterior margins rounded; lateral surface flattened at the anterior and posterior ends, inflated centrally. Median sulcus poorly marked. Caudal process weakly developed. Reticulate, with shallow, fairly strong, polygonal reticulæ with finely punctate sola. Normal pore canals open, simple sensillum pores opening onto the muri or within the sola; they may also develop on conuli. Corresponding to each pit there are loop-hole-



TEXT-FIGURE 3

Distribution of *Microceratina* in North Atlantic and Mediterranean areas. Legend: black circles correspond to sampled localities as follows: 1. Porcupine Basin (Late Pleistocene); 2. offshore northwest Scotland (Recent); 3. Mussotto (Late Tortonian); 4. Falconara (Late Tortonian); 5. Bay of Naples (Recent); 6. Palinuro (Recent); 7. Cala Bianca (Early Pleistocene); 9. Naxos-Paros (Recent); 10. Rhodes (Early Pleistocene); dotted areas show the recent distribution of genus *Microceratina* in the Mediterranean.

TABLE 1

Comparative table of key morphological characters of the genera belonging to subfamily Eucytherurinae Puri 1974.

	Lateral shape	Ornamentation	Eye tubercle	Muscular scars	Muscular tubercle	Hinge	Marginal pore canals	Normal pore canals
<i>Eucytherura</i> (Upper Cretaceous-Recent)	Subquadrate with evident caudal process.	Strong reticulations all over the valves. Several ridges are present.	Present and prominent.	Four muscular scars arranged in a row.	Present.	Merodont antimerodont. Smooth knob-like cardinal teeth. Straight finely or clearly crenulated groove and bar.	Few, simple, straight.	Simple sensillum pores located on the muri of the reticulation or elevated as pore-conuli. Clusters of pores without setae in each solum.
<i>Renicytherura</i> (Lias-Recent)	Subrectangular with strong caudal process.	Strong reticulations. Dorsal and ventral ridges.	Present.	Four muscular scars arranged in a row.	Slightly developed.	Merodont antimerodont. Smooth cardinal teeth; finely crenulated groove and bar with larger denticles at the ends of the cardinal area.	Few, simple, straight.	Simple sensillum pores located on the muri of the reticulation or elevated as pore-conuli. Clusters of pores without setae in each solum.
<i>Tumidocytherura</i> (Aptian-Miocene)	Subrectangular with subrounded caudal process.	Strong reticulations and remarkable ventral keel.	Slightly developed.	Four muscular scars arranged in a row.	Slightly developed.	Merodont antimerodont. Finely crenulated bar and groove.	Few, simple, straight.	Simple sensillum pores located on the muri of the reticulation or elevated as pore-conuli. Clusters of pores without setae in each solum.
<i>Vesticocytherura</i> (Dogger-Paleocene)	Trapezoidal.	Strong reticulations. Median and ventral ridges. Alignment of knobs instead of the dorsal ridge.	Present.	Four muscular scars arranged in a row.	Feeble.	-	Few, simple, straight.	Simple sensillum pores located on the muri of the reticulation or elevated as pore-conuli. Clusters of pores without setae in each solum.
<i>Typhlocythere</i> (Early Pleistocene-Recent)	Subovate with little caudal process.	Strong reticulations.	Absent.	Four muscular scars arranged in a row.	Absent.	Merodont antimerodont. Well developed cardinal teeth; strongly crenulated groove and bar with larger denticles at the ends of the cardinal area.	Few, simple, straight.	Simple sensillum pores located on the muri of the reticulation or elevated as pore-conuli. Clusters of pores without setae in each solum.
<i>Typhloeucytherura</i> (Lower Pleistocene)	Subrhomboidal.	Deep punctae with spines.	Absent.	Four muscular scars arranged in a row.	Absent.	Merodont antimerodont. Subtriangular anterior tooth, elongated and trilobated posterior one; strongly crenulated groove and bar with larger denticles at the ends of the cardinal area.	Few, simple, straight.	Simple sensillum pores located on the muri of the reticulation or elevated as pore-conuli. Clusters of pores without setae in each solum.
<i>?Laoconella</i> (Recent)	-	Reticulations and pits arranged in concentric rows.	Absent.	-	-	Well developed anterior tooth. Crenulated bar and groove.	-	-
<i>Xylocythere</i> (Late Oligocene-Recent)	Subtriangular.	More or less strong reticulations and posterior and median spines.	Absent.	Four muscular scars arranged in a row.	Absent.	Merodont antimerodont. Kidney shaped grooved cardinal teeth; strongly crenulated groove and bar at the ends of the cardinal area, smooth in the central portion.	Few, simple, straight.	Simple sensillum pores located on the muri of the reticulation or elevated as pore-conuli. Clusters of pores without setae in each solum.
<i>Microceratina</i> (Late Miocene-Recent)	Elongate, subrectangular with rounded anterior and posterior.	More or less evident polygonal reticulations with pitted sola.	Absent.	Four muscular scars arranged in a row.	Absent.	Merodont antimerodont. Oval or stout (crenulated or not) anterior tooth, elongated (crenulated or not) posterior one. Finely crenulated groove and bar.	Few, simple, straight.	Simple sensillum pores located either on the muri or inside the sola of the reticulation or elevated as pore-conuli. Clusters of loophole-type or slit-type pores without setae in each solum.

1a-c) or slit-type pores (text-fig. 1d-f) visible only externally, while internally they correspond only to a single pore. Even if they show morphological similarities with sieve-type pores they do not bear any seta. Inner lamella with narrow fused zone and well developed vestibula at end margins. Marginal pore canals straight, simple, few. Antimerodont hinge straight or gently arched; in the RV the terminal elements are ovate or elongated. The median element is a narrow, locellate groove. Terminal sockets widely open ventrally in the LV. Adductor muscles form a row of four elongated scars with an oval antennal scar. Eye tubercle absent.

Discussion: Swanson (1980) tentatively referred *Microceratina* to the Bythocytheridae, the muscle scars being not clearly visible. In the description of the type species *Microceratina quadrata* he briefly mentions the pores which open inside the sola. These pores are clearly illustrated by Yassini and Jones (1995: figs. 135-137, 139) and are very similar to the pore clusters described by Maddocks and Steineck (1987) as a diagnostic character for the subfamily Eucytherurinae (Family Cytheruridae). Inside this subfamily Maddocks and Steineck include the following genera: *Eucytherura* Müller 1894, *Renicytherura* Gründel 1981, *Tumidocytherura* Gründel 1981, *Vesticocytherura* Gründel 1964, *Typhlocythere* Bonaduce, Ciampo and Masoli 1976, *Typhloeucytherura* Colalongo and Pasini 1980, *Xylocythere* Maddocks and Steineck 1987, and, doubtfully, *Laocoonella* De Vos and Stock 1956. Table 1 shows the high level of similarity of these genera which differ from each other in their general outline, the development of their ornamentation (more or less strong and spiny) and some aspects of hingement. Among the several characteristics they share are the enigmatic pore-clusters represented by "clusters of pores occupying each solum of the exterior reticulated ornament, all or most of which penetrate the carapace, producing on the interior a pattern of clustered perforations that directly corresponds to the exterior reticulated ornament, without accompanying setae" (Maddocks and Steineck 1987, p. 321).

According to Maddocks and Steineck (1987), some species from the Mediterranean area with peculiar pore openings (referred by Bonaduce, Ciampo and Masoli 1975 and Colalongo and Pasini 1980 to "*Bythoceratina*") should be referred to a different genus to be included in the Subfamily Eucytherurinae. A critical revision of these species leads us to refer them to *Microceratina*.

Although *Microceratina* shares most of its features with other Eucytherurinae genera, it has more complex pores that can be homologized with the pore clusters of Maddocks and Steineck (1987) and Van Harten (1993). While in other taxa the pores of the pore-clusters are open (text-fig. 1g-i), in *Microceratina*, externally, they are covered by a calcareous lamella, which is pierced by 3 or 4 parallel buttonhole-like openings [loop-hole-type of pores (text-fig. 1a-c)] or by 11-15 irregular openings [slit-type pores (text-fig. 1d-f)].

Given our emended diagnosis of *Microceratina*, the species *Microceratina quadratamacroreticulata* Yassini and Jones 1995, *Microceratina quadratamicroreticulata* Yassini and Jones 1995 and *Microceratina* sp. 2 Whatley and Downing 1983 are not included in this genus, because they show open pores. While they must be assigned to a different genus, in our opinion, they still belong to the Eucytherurinae.

Microceratina pseudoamfibola (Barbeito-Gonzalez 1971), **n. comb.**

Plates 2, 3, text-figures 1d-f, 2

Eucytherura? *pseudoamfibola* BARBEITO-GONZALEZ 1971, p. 302, Pl. 27, figs. 1b, 2b, 3b, 4b, 5b. - CIAMPO 1976, pp. 4, 5, Pl. 4, figs. 12, 13.

Holotype: K-29231, Zoologische Museum, Hamburg University.

Material: 24 RV, 23 LV, 71 instars. All the specimens are housed in the Gliozzi's ostracode collection (G.O.C. 24/1-4, 19-22).

Occurrence: Recent sediments, Grotta Sulfurea di Cala Fetente (Tyrrhenian Sea, Campania, southern Italy).

Dimensions (mm): length 0.37-0.41; height 0.14-0.19; S/2 0.14-0.17.

Emended description: Very thin shelled. Subhastate in dorsal view, the carapace is strongly inflated, particularly posteriorly. Centrally there is a very shallow median sulcus. End margins laterally compressed and salient. Subrectangular in lateral view. Dorsal margin slightly convex and continuous with posterior margin without angle. Antero-dorsally with obtuse cardinal angle. Anterior margin broadly rounded. The ventral margin with shallow oval incurvature. Maximum height centrally. Valves inflated, particularly postero-ventrally. In the mid-dorsal area a shallow median depression is visible. The anterior margin near

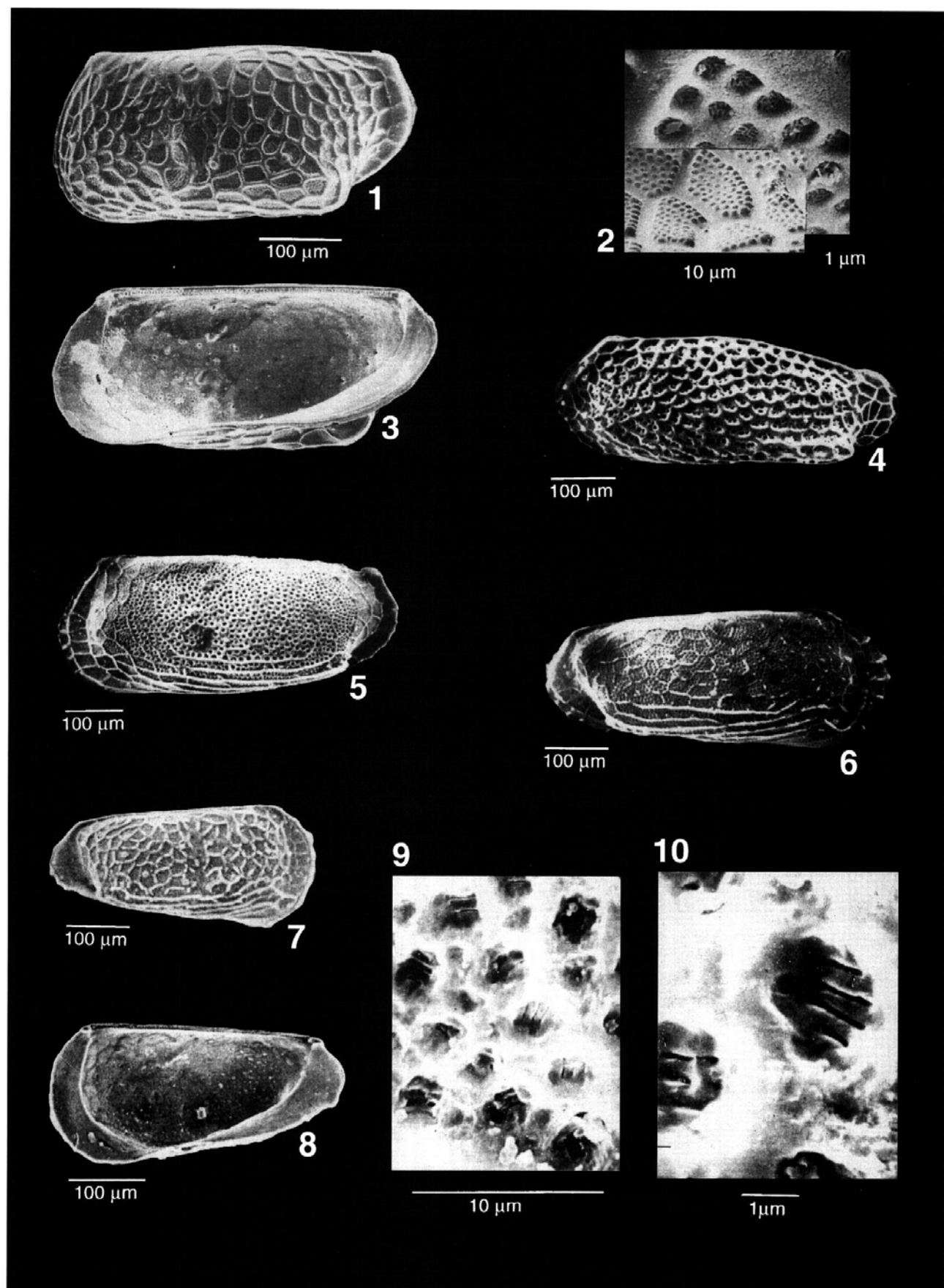
PLATE 1

1-3 *Microceratina quadrata* Swanson. 1, LV, lateral view; 2, detail of ornamentation and slit-type pore clusters; 3, RV, internal view. From Yassini and Jones, 1995.

4 *Microceratina foveolata* (Colalongo and Pasini), LV (holotype), lateral view. Duplicated from Colalongo and Pasini, 1980.

5-6 *Microceratina poligonia* (Colalongo and Pasini). 5, VS (holotype), lateral view; 6, VD (paratype), lateral view. Duplicated from Colalongo and Pasini, 1980.

7-10 *Microceratina reticulata* (Bonaduce, Ciampo and Masoli). 7, VD, lateral view; 8, VD, internal view; 9-10, details of ornamentation and loop-hole type pore clusters. Duplicated from Bonaduce, Ciampo and Masoli, 1975.



the border is abruptly flattened to form a narrow flange which is traversed by 6-7 short ridges. The posterior margin is similarly developed. Anteriorly the change of slope of the valve surface is underlined by a broadly rounded keel which runs parallel to that margin. The postero-ventral and mid-ventral surfaces are strongly inflated forming a protuberance which, in the right valve, ends posteriorly with a small alar process (pl. 2, fig. 2). Ornamentation consists of fine reticulation with hexagonal and pentagonal mesh and sola which are finely but densely perforated by up to 70-120 punctae per mesh (pl. 3, fig. 7). Each puncta consists of a slit-type sieve-pore with 11-15 small openings on the external surface (pl. 3, fig. 8). On the inner surface of the valve these puncta are represented by one simple circular opening. The interior of the valve is densely perforated by polygonal fields of pores which mirror the external ornamentation. The sieve-pores are small in the posterior, ventral and anterior surfaces, being larger dorsally, beneath the hinge and in the area surrounding the muscle scars. Sensillum pores evenly distributed. They can be simple or exit on conuli, and are located both inside sola or on the muri (pl. 3, fig. 5). Pore conuli are more evident in the anterior and posterior surfaces. An alignment of 4-6 pore conuli is evident on the anterior and posterior borders. In the median-dorsal area of both valves, 4 mesh with larger punctae and a central or lateral non punctated 'button-like' structure are present; the shape of the upper and the lower mesh is elongate-trapezoidal while the two median are sub-rectangular and coalescent. Interiorly, geometry of the external ornamentation is duplicated. Central muscle scars consisting of four slightly elongated adductor scars arranged in a subvertical row (pl. 3, fig. 3). Antennular scar is variable: wide V-shaped and opened anteriorly, ellipsoidal or divided into two small oval scars. Marginal zone wide anteriorly and posteriorly; fused zone very narrow, the inner lamella forms wide anterior and posterior vestibules which narrow considerably mid-ventrally. The cardinal area is extended for all the dorsal border; hinge of antimerodont type with an elongated slightly crenulated anterior tooth and a stouter, slightly crenulated posterior tooth in the right valve. The medial groove is entirely crenulated (pl. 3, fig. 1). In the left valve the terminal sockets are open ventrally and the cardinal bar is crenulated, with crenulation becoming larger more evidently towards the hinge extremities (pl. 3, fig. 2); posteriorly this bar forms a small denticle. Sexual dimorphism not obvious; some specimens exhibit a proportionally more elongated outline and a more sharp postero-ventral protuberance (pl. 2, figs. 1-2).

Discussion: *Microceratina pseudoamfibola* is similar to several other species: *Microceratina polygonia* (Colalongo and Pasini 1980) and *Microceratina foveolata* (Colalongo and Pasini 1980), from the Early Pleistocene of Vrica (Calabria, southern Italy), and *Microceratina reticulata* (Bonaduce, Ciampo and Masoli 1976) living in the Bay of Naples and in the Adriatic Sea. In comparison with *M. polygonia*, *M. pseudoamfibola* is very similar in its general outline, ornamentation and in the presence of a transversally ridged flange, but *M. pseudoamfibola* differs in being slightly smaller (*M. polygonia*: L=0.51mm; h=0.21mm), in its gently arched dorsal margin, hinge bar less strongly denticulated in the left valve and in the absence of the loophole pores. Also the ventral ridges are weaker, the posterior denticles are less evident and anterior denticles are absent.

In comparison with *M. foveolata*, *M. pseudoamfibola* is similar in shape and in the anterior alignment of the pore conuli, but differs in being slightly smaller (*M. foveolata*: L=0.51mm; h=0.20mm), in its weaker ornamentation, less evidently denticulate median bar and its lack of loophole pores.

In comparison with *M. reticulata*, *M. pseudoamfibola* has a similar dorsal outline, size and hingment, a slightly less developed median sulcus, but differs in its weaker ornament, absence of posterior denticles and posterior spine and in the absence of loophole pores.

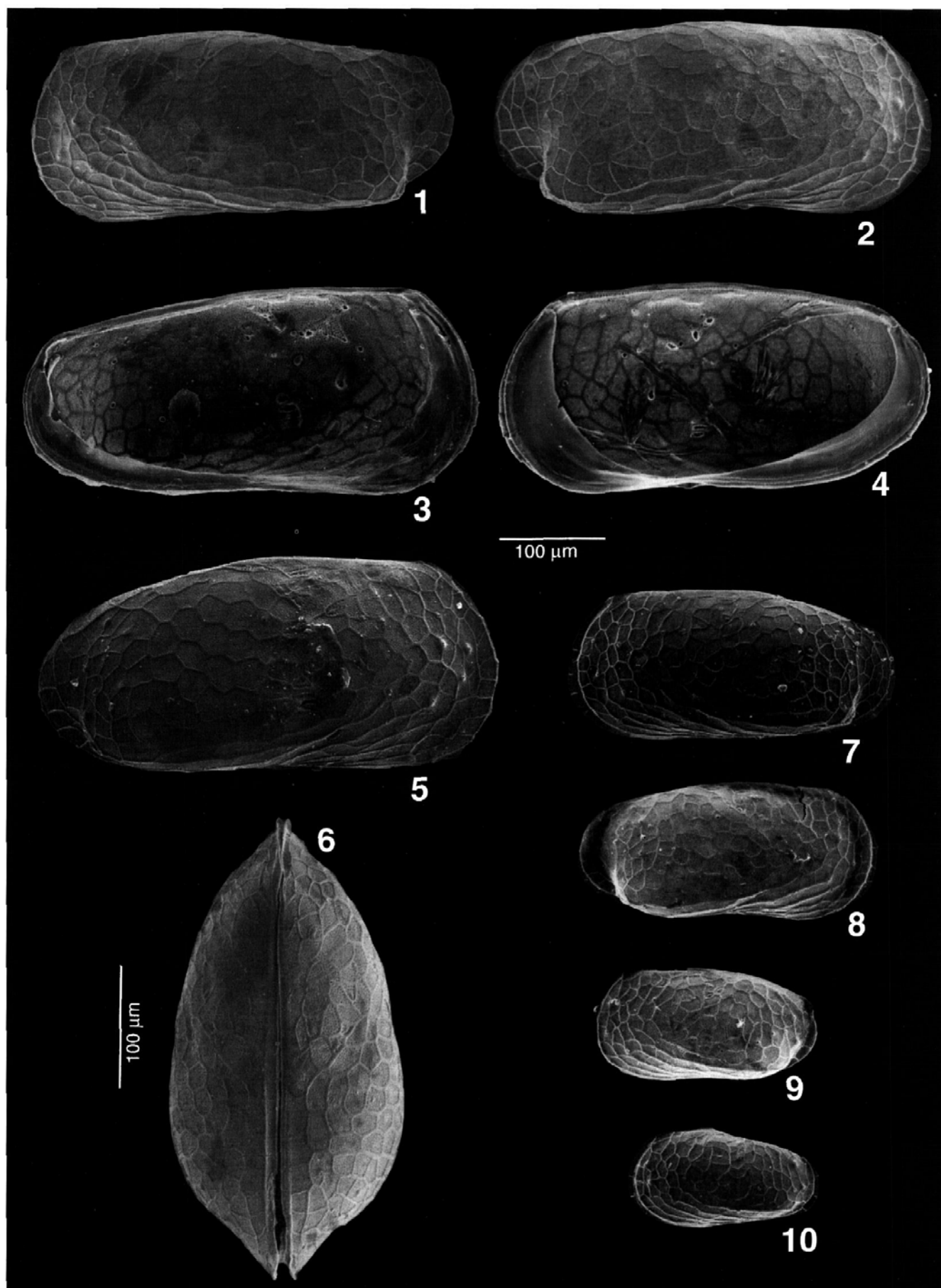
Autoecology: *M. pseudoamfibola* was collected for the first time by Barbeito-Gonzales 1971 from bottom samples between Naxos and Paros islands in Greece. It represented 0.4‰ of the Paros-Naxos samples, 0.1‰ of the Wachsrosenbucht I and 0.3‰ Wachsrosenbucht II of the total number of specimens. These latter samples were taken from the Bay of Wachsrosen, a small and rather close bay on the NW coast of Naxos separated from the open sea by a small islet, the Mantu Island. The morphology of the bay perhaps can explain the temperature and salinity values reported by Barbeito-Gonzales: 0 to 4m depth, 25-40‰ salinity and 3(sic)-35°C; the bottom is covered by *Posidonia oceanica* and *Zostera*. Samples from Naxos-Paros came from a normal marine environment with depths up to 50m. Some of these samples are rich in *P. oceanica*. Unfortunately, Barbeito-Gonzales does not indicate which samples contained *M. pseudoamfibola*.

PLATE 2

1-10 *Microceratina pseudoamfibola* (Barbeito-Gonzales)

- 1 LV, lateral view
- 2 RV, lateral view
- 3 LV, internal view
- 4 RV, internal view

- 5 RV, lateral view
- 6 dorsal view
- 7-10 instars, lateral views.



Ciampo (1976) collected some valves of *M. pseudoamfibola* from Lower Pleistocene sands and clays cropping out at Cala Bianca (Marina di Camerota, Southern Italy). Ostracodes associated with *M. pseudoamfibola* show the evolution from a shallow marine environment to a slightly deeper one.

The specimens of *M. pseudoamfibola* described in this paper were found in samples collected in the 'Grotta Sulfurea di Cala Fetente' from the inner part of the cave, at least 300m away from its submarine entrance. All the specimens occurred with plant detritus of *P. oceanica*. Since no living specimens were found (we only found some soft parts, pl. 3, fig. 4), we suppose that these ostracodes were transported into the cave together with the *P. oceanica* remains.

DISTRIBUTION OF GENUS *MICROCERATINA*

The genus *Microceratina* was erected to accommodate Recent specimens collected from Port Pegasus, Stewart Island, New Zealand. The type species *M. quadrata* occurred rarely between 20 and 52 m. Yassini and Jones (1995), found *M. quadrata* on the inner and middle shelf, New South Wales, Southeastern Australia. Thus far, in Australasia, *Microceratina* is known only from Recent samples. The Middle Miocene *Microceratina* specimens from Victoria (Australia) of Whatley and Downing (1983), in our opinion, must be referred to another genus.

The fossil and Recent distribution of the genus show that the Mediterranean area probably should be considered as its source area since four species have been found here, spanning from Late Tortonian to recent (text-fig. 3).

The oldest specimens come from the Mediterranean area and are referable to *M. poligonia* collected by Ciampo in the Late Tortonian of Falconara, Sicily, southern Italy, and Mussotto in Piedmont, northern Italy, (Ciampo 1986). The same species has been observed in the Early Pleistocene (Santerian) of Vrica, Calabria, southern Italy (Colalongo and Pasini 1980). Specimens of *M. poligonia* are reported also by Coles et al. (1996) from the Late Pleistocene of Western Ireland and from Recent sediments off northwest Scotland and are the first published record of this genus from the North Atlantic.

In the Mediterranean Pleistocene, besides *M. poligonia*, several other *Microceratina* species have been found: *M. foveolata* from the Early Pleistocene (Santerian) of Vrica, *M. reticulata* from the Early Pleistocene of Rhodes (Mostafawi 1989) and *M. pseudoamfibola* from the Early Pleistocene (?Santerian-Emilian) of Cala Bianca, Campania, southern Italy.

Finally, *M. poligonia* was recovered in Recent sediments from the Adriatic Sea [Breman 1975 pl. 10, fig. 141 (?*Eucytherura* sp.)], *M. reticulata* was collected in the Adriatic sea (coast of central Italy, north of Gargano) and in the Tyrrhenian sea (Bay of Naples) (Bonaduce, Ciampo and Masoli 1975) and *M. pseudoamfibola* in the Aegean Sea (Barbeito-Gonzalez 1971) and in the Tyrrhenian Sea (this paper).

As far as we know, *Microceratina* seems to include species adapted to different depths. *M. poligonia* has been collected at 650m in the North Atlantic and the fossil specimens of this species have always been collected together with bathyal ostracode assemblages (Coles et al. 1996; Colalongo and Pasini 1980).

M. reticulata was found at depths exceeding 110m in the Bay of Naples and in the Adriatic (Bonaduce, Ciampo and Masoli 1975) while *M. pseudoamfibola* is more littoral, having been collected by Barbeito-Gonzalez at depths ranging from 0 to 50m associated with *Posidonia oceanica* prairie.

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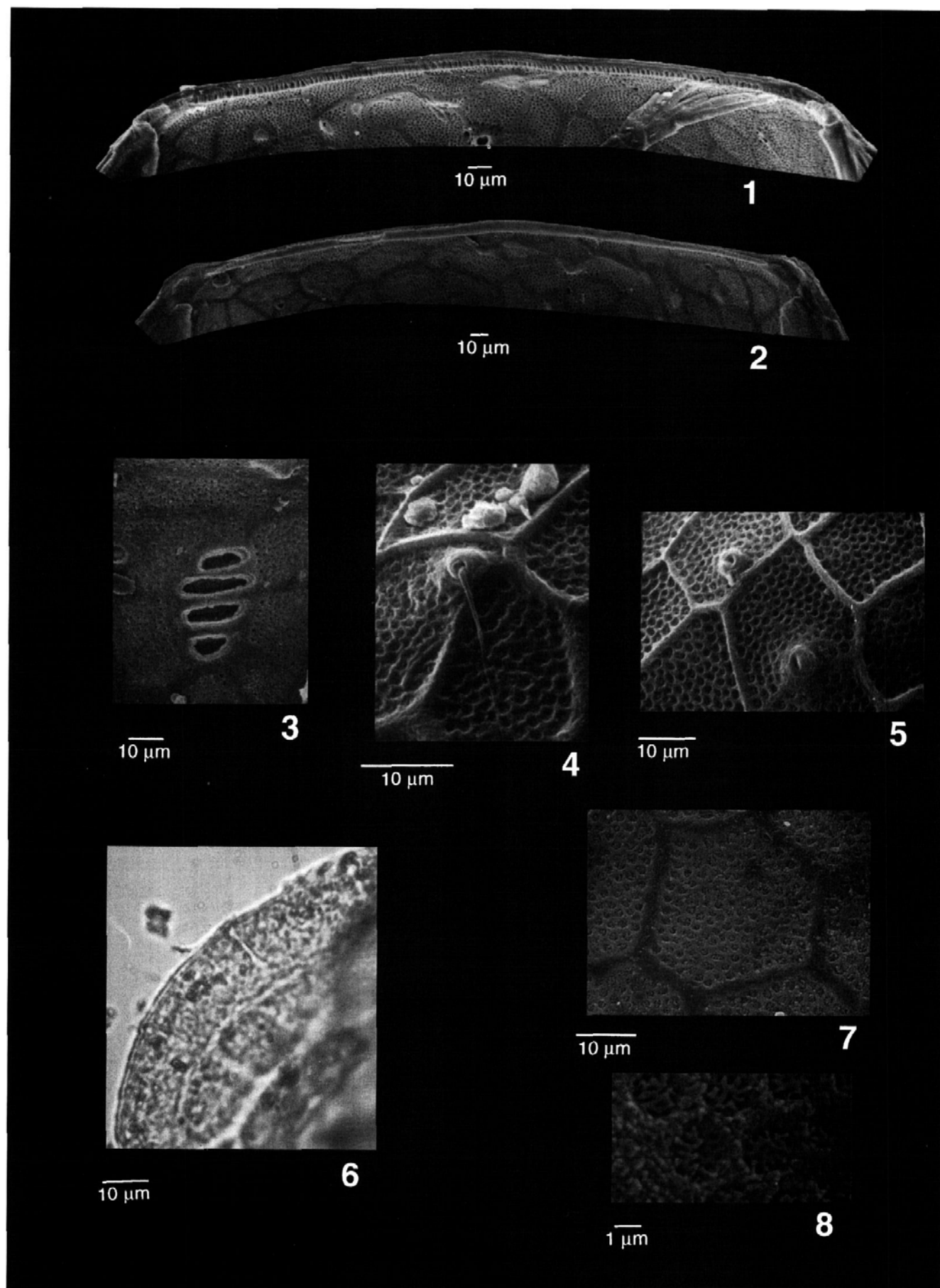
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PLATE 3

1-8 *Microceratina pseudoamfibola* (Barbeito-Gonzales)

- | | |
|-----------------------------------|--------------------------------------|
| 1 RV, detail of the hinge | 5 sensillum pore-conuli |
| 2 LV, detail of the hinge | 6 LV, detail of marginal pore canals |
| 3 RV, adductor scars | 7 detail of the ornamentation |
| 4 sensillum pore-conule with seta | 8 detail of the slit-type pores. |



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