

The genus *Henryhowella* Puri, 1957 (Crustacea, Ostracoda) in the Atlantic and Mediterranean from Miocene to Recent

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SUMMARY – The systematics, the ecology and the paleoecology of the plicate forms of the genus *Henryhowella* Puri, 1957 from the Miocene to Recent of the Mediterranean basin and Atlantic are investigated. The research allowed the finding in both Atlantic and Mediterranean of *H. parthenopea* n. sp. which is described and illustrated, the systematic definition of *H. sarsii* sarsii (G.W. Müller, 1894) and the related subspecies *H. sarsii profunda* n. ssp., both of which are described and illustrated. All the previous taxa are compared with the type species *H. asperima* (Reuss, 1850) and each other. Another form found in Late Tortonian of Sicily is dubitatively attributed to *H. asperima* and compared with topotypic specimens of the type-species. The ecological and paleoecological data allowed to define the bathymetrical range of the 3 forms found as follows: *H. parthenopea* n. sp. ranges from 40 to 170 m depth, *H. sarsii* sarsii from 110 to about 400 m and *H. sarsii profunda* n. ssp. which pertains to the bathyal environment. The age distribution of all the forms identified and illustrated is given.

RIASSUNTO – [Il genere *Henryhowella* Puri, 1957 (Crustacea, Ostracoda) nell'area mediterraneo-atlantica dal Miocene al Recente] – Vengono studiate la sistematica, l'ecologia e la paleoecologia delle forme plicate del genere *Henryhowella* Puri, 1957 dal Badeniano al Recente del Mediterraneo e dell'Atlantico. Viene descritta ed illustrata *H. parthenopea* n. sp. rinvenuta sia in Mediterraneo che in Atlantico. Viene discussa la sistematica di *H. sarsii* sarsii (G.W. Müller, 1894) e della sottospecie *H. sarsii profunda* n. ssp., entrambe descritte ed illustrate. I taxa studiati sono stati confrontati con la specie-tipo *H. asperima* (Reuss, 1850). Un'altra forma, rinvenuta nel Tortoniano superiore della Sicilia viene dubitativamente attribuita ad *H. asperima*. I dati ecologici delle forme recenti e le deduzioni paleoecologiche di quelle fossili hanno permesso di definire la distribuzione batimetrica dei 3 taxa: *H. parthenopea* n. sp. rinvenuta da 40 a 170 m, *H. sarsii* sarsii da 110 a circa 400 m e *H. sarsii profunda* n. ssp., esclusiva del batiale. Di tutte le forme identificate viene riportata la distribuzione stratigrafica.

INTRODUCTION

The marine genus *Henryhowella* Puri, 1957 (Trachyleberididae, Trachyleberidinae), type-species *Cythere evax* Ulrich & Bassler, 1904, described from the Miocene of the U.S.A., ranges from Eocene to Recent. The genus is worldwide distributed mostly deeper than 100 m and in the Recent occurs down to the deepest part of the bathyal.

Henryhowella is characterized by valves of subrectangular shape in lateral view and frequently ornamented by a reticulation generally masked by very numerous superimposed spines and tubercles. Three longitudinal plications of the carapace are evident in the posterior half of the valve in most of the species.

Anteriorly the reticulation is generally arranged in rows parallel to the margins. The spines or the tubercles occur on the muri of the differently shaped foveolae and are more massive on the plications, sometimes fused together to form uninterrupted alignments.

The inner lamella is well developed especially anteriorly with a narrow vestibule; marginal pore-canal simple and straight; hinge amphidont-heterodont with anterior tooth of the RV constituted by a lower distal part and a protruding proximal one, posterior tooth knob-like and smooth, groove crenu-

lated; eye-spot present in relatively shallow-water forms but obscured by the ornamentation; its occurrence in deep-water forms is still a problem to be solved.

The systematics of the *Henryhowella* species is rather difficult because the secondary ornamentation masks the reticulation and only specimens from which it has been abraded or in which it is poorly developed can be carefully studied.

Dingle *et al.* (1990) provide a detailed discussion of the type species of *Henryhowella*. *Henryhowella evax* (Ulrich & Bassler, 1904) is a junior synonym of *H. asperima* (Reuss, 1850) which consequently should be considered the type-species. These authors point out also that some species, among which the previously cited ones, show a waved posterior morphology while other species currently attributed to the genus appear regularly inflated and without the mostly subhorizontal plicate posterior shape. At the present state of art Dingle *et al.* (1990) prefer to accept the current interpretation of the genus for which in *Henryhowella* can be accommodated all the species with or without posterior plications and the horizontal ornamentation. For the time being we accept their opinion.

Most of the fossil and Recent forms of *Henryhowella* showing the "plicate" morphology have

been attributed, sometimes doubtfully, to *H. asperri-*
ma and we considered necessary to provide a more
detailed systematic study. The recent detailed illustra-
tions and description of *Henryhowella asperri-*
ma from topotypic material carefully accomplished by Kempf
& Nink (1993) have been of invaluable help.

The present paper deals especially with the Recent
forms of the Mediterranean Sea and Atlantic, togeth-
er with their bathymetrical distribution with some
remarks on their stratigraphy. Their variability has
also been taken into consideration by using a large
number of specimens.

As suggested by Ruggieri (1962) the genus needs
a careful and accurate revision at specific level, utiliz-
ing SEM micrographs which allow the study of the
smallest details. In the present paper we try to follow
his suggestions. To give a more complete future refer-
ence and a better comparison between the different
species, *H. asperri-*
ma from topotypic material and few
other forms from fossil material are illustrated and
discussed.

MATERIAL

The samples studied can be subdivided into 2
groups: 1) pertaining strictly to the Recent and 2)
from the Middle Miocene (Badenian) to the
Pleistocene.

The samples taken into consideration fundamen-
tally are the top-cores (2.5 cm) collected in the Gulf
of Naples (Puri *et al.*, 1964; fig. 8) corresponding to
367 samples from near-shore down to a depth of
about 1000 m.

The Gulf of Naples seems ideal for the present
study because this mostly volcanic area underwent
many eruptions at least from 79 A.D. up to 1945
which produced a large amount of ashes which cov-
ered with a more or less thick layer all the bottom of
the Gulf and the surrounding land. Consequently we
are reasonably sure that we are dealing with Recent
sediments. The only risk in the Gulf is the contami-
nation from shallower assemblages into the deeper
ones in the areas where the two major canyons occur.
To avoid the risk to amplify artificially the real bathy-
metrical distribution of *Henryhowella* we did not take
into consideration the samples collected along the
canyons and on steep slopes.

Another set of 70 samples corresponds to the top
of the piston cores collected during the Vema cruise
from Port Said to Gibraltar to get a wider picture of
the distribution of *Henryhowella* in different areas
and especially in deeper waters (maximum depth
1600 m). Four additional samples from the Gulf of
Taranto have also been studied from top-cores col-
lected in deep water, at 491 m, 943 m, 840 m, 830 m
depth respectively (Moncharmont *et al.*, 1985).

The Adriatic Sea has not been taken into consid-
eration because of the effect of the Quaternary
glacial-interglacial regressions and transgressions

which produced the mixing of ostracod assemblages
of different age, artificially amplifying the distribu-
tion depth of the species found.

As far as the fossil material is concerned we stud-
ied samples from different areas and ages as follows:

From Morocco

1 - Early Pliocene of Ain el Beida Quarry (Rabat,
Morocco), 33°59'N; 6°46'W; 25 m above the Quarry
base.

2 - Early Pliocene of the Salé Briqueterie (Rabat,
Morocco), 34°04'N; 6°47'W; topmost sample of the
Quarry, 35 m above the base.

3 - Messinian of the Section of Dar Bel Hamri
(Morocco), 34°09'N; 5°56'W; 2 m above the Oued
Beth level.

From Italy

1 - Tortonian of the Falconara Section (Southern
Sicily), 37°07'N; 14°04'E.

2 - Late Pliocene of Riace (Reggio Calabria,
Calabria), 38°26'N; 16°30'E.

3 - Late Pliocene of Rio Torsero (Liguria),
44°03'N; 8°10'E.

4 - Plio-Pleistocene of Monte S. Nicola (Gela,
Sicily), 37°08'N; 14°13'E.

5 - Early Pleistocene of Acqua dei Corsari
(Southern Sicily), 38°05'N; 13°26'E.

SYSTEMATICS

In a recent paper Bonaduce *et al.* (in press) afford-
ed the problem of the distribution of *Henryhowella* in
the Recent of the Gulf of Naples identifying two dif-
ferent species, provisionally called *Henryhowella* sp. 1
and *Henryhowella* sp. 2. The differences between
them have been partly described but no attempt was
made to attribute them to previously known species
and detailed descriptions and comparison were not
accomplished. This is done in the following.

We went over most of the literature referred to
the plicate *Henryhowella* forms and part of it has not
been taken into consideration because of the poor
illustrations which did not allow for a specific attri-
bution.

Order PODOCOPIDA G.W. Müller, 1894

Suborder PODOCOPINA Sars, 1866

Superfamily CYTHERACEA Baird, 1850

Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948

Subfamily TRACHYLEBERIDINAE Sylvester-Bradley,
1948

HENRYHOWELLA ASPERRIMA (Reuss, 1850)

Pl. 1, figs. 1-2

1850 *Cypridina asperri-*
ma REUSS, p. 74, pl. 10, fig. 5 a-b.

1993 *Henryhowella asperri-*
ma (Reuss) - KEMPF & NINK, pp. 95-
114, figs. 1-30.

?1960 *Henryhowella asperri-*
ma (Reuss) - BOLD van den, p. 169,
pl. 4, fig. 10; pl. 8, fig. 2.

?1994 *Henryhowella* cf. *asperri-*
ma (Reuss) - GUERNET &
MOULLADE, pp. 268, 270, pl. 3, figs. 8-11, 14.

Remarks – The accurate redescription and perfect illustrations of Kempf & Nink (1993) from topotypic material of the Vienna Basin allow us to perform a correct comparison with the other species found. Anyway the species from the same topotypic area is reillustrated.

Size (in mm) – LV: L = 0.85; H = 0.56 (Pl. 1, fig. 1).
RV: L = 0.77; H = 0.49 (Pl. 1, fig. 2).

Distribution – This species does not seem to occur in the Recent of the Mediterranean and Atlantic.

Badenian (Miocene) of Vienna Basin (Reuss, 1850; Kempf & Nink, 1993; present paper).

HENRYHOWELLA ? ASPERRIMA (Reuss, 1850)
Pl. 1, figs. 3, 4

Remarks – This form found in the Late Tortonian of the Falconara section (South-Eastern Sicily) appears very close to *H. asperrima* as far as the shape in lateral view is concerned. In fact it shows a regularly rounded anterior margin and a very similar organization in the reticulation. It differs chiefly in the length which is possibly due to the different sex and in the weaker development of the tubercles, a fact which is probably due to ecological factors.

If the identification as *H. asperrima* will result correct the stratigraphic distribution will range from the Badenian to the Late Tortonian.

Size (in mm) – LV: L = 0.87; H = 0.49 (Pl. 1, fig. 3).
RV: L = 0.90; H = 0.48 (Pl. 1, fig. 4).

Distribution – Late Tortonian of Falconara (Sicily).

HENRYHOWELLA PARTHENOPEA n. sp.
Pl. 3, figs. 1-11, 13, 14; pl. 4, figs. 11, 12; pl. 5,
figs. 3-5, 9, 10, 12.

1962 *Henryhowella asperrima* (Reuss) - RUGGIERI, pp. 19-20, pl. 1, figs. 16-19.

1966 *Henryhowella asperrima* (Reuss) - COLALONGO, pl. 11, fig.

Etymology – From Parthenope, Latin name of the town of Naples.

Holotype – A female carapace (Pl. 3, figs. 1, 3).
B.O.C. 2332.

Paratypes – 20 valves and 1 carapace (1 male carapace figured, Pl. 3, figs. 4, 5). B.O.C.2333.

Type locality – Gulf of Naples, sample C139-1, depth 110 m.

Age – Recent.

Diagnosis – A species of *Henryhowella*, plicate type, characterized by the LV of the female in lateral view with anterior margin obliquely rounded, with maximum length below the mid height, dorsal margin a little concave, subtruncated posteriorly. The dorsal margin is overlapped at both extremities by very protruding groups of large bottle-shaped spines. Both valves very depressed. Ornamentation constituted by large reticulation and by differently sized spines and tubercles on the muri of the foveolae. The distribution of the larger tubercles (or spines) is diagnostic. In dorsal view anterior subtruncated and posterior subacuminate. Males more elongated. LV in lateral view posteriorly more truncated and RV more acuminate.

Description – In lateral view LV subrectangular with anterior margin obliquely rounded so that the maximum length occurs below the mid height, posterior extremity truncated in the female and more acuminate in the male; ventral margin weakly concave before the mid-length, feebly upturning at the posterior extremity. All the periphery of the valves is surrounded by spines and tubercles which overlap all the margins. The antero-dorsal and postero-dorsal areas show a concentration of bottle-shaped well developed tubercles, sometimes fused each other, which do not carry pore-canals at their extremity. In most of the specimens the apex of the tubercles ends with a series of small spines perpendicular to the axis

The remaining part of the valve surface is covered by relatively thin spines of varying length and thickness. When the spines and tubercles are abraded or scarcely developed it is possible to detect a marked and defined from subrounded to polygonal reticulation on the muri on which the spines and tubercles are distributed. The anterior reticulation is arranged in rows parallel to the margin, while posteriorly they do not seem to show any peculiar distribution. The valves appear particularly flattened inside the margins resulting in a reduced width (Pl. 3, figs. 2, 6), as can be observed in dorsal view, especially in specimens in which the spiny-nodose ornamentation is abraded or poorly developed (Pl. 3, fig. 10).

Muscle-scars – A subvertical row of 4 scars preceded by an approximately V-shaped one (Pl. 5, fig. 12).

Marginal pore-canals – Typical of the genus.

Normal pore-canals – Sieve-type generally occurring near the base of the tubercles on the muri of the foveolae while the extremity of spines and tubercles are always not pierced.

Size (in mm) – LV female: L = 0.78; H = 0.47 (Pl. 3, fig. 1).

RV female: L = 0.77; H = 0.46 (Pl. 3, fig. 3).

Variability – This species shows a rather constant principal ornamentation. It varies in the more or less massive tubercles and in the spines which can be more or less long and thick. The size of the numerous specimens examined shows a certain variability even when collected from the same sample.

Affinities – The proposed new species can be compared with *H. asperrima* Reuss from which it differs due to the lateral more slender aspect in both males

and females, to the posterior extremity more truncated, to the less inflated carapaces especially in the central area and to the more acuminate posterior extremity in dorsal view, to the presence of the antero-dorsal and postero-dorsal bouquets of tubercles, to the feebly oblique instead of regularly rounded anterior margin, and to the smaller size.

H. parthenopea n. sp. is relatively close to *H. sarsii* in the general shape and type of ornamentation. It differs chiefly in the constantly smaller size, in the more concave dorsal margin, in the bigger L/H ratio, and in the peculiar rows of independent spines occurring in the anterior part of the valves. Moreover, the valves are more flattened as can be ascertained especially in dorsal view, and show a depressed area which encircles the central part of the valves.

Bathymetrical distribution – From 40 to 170 m (Bonaduce *et al.*, in press).

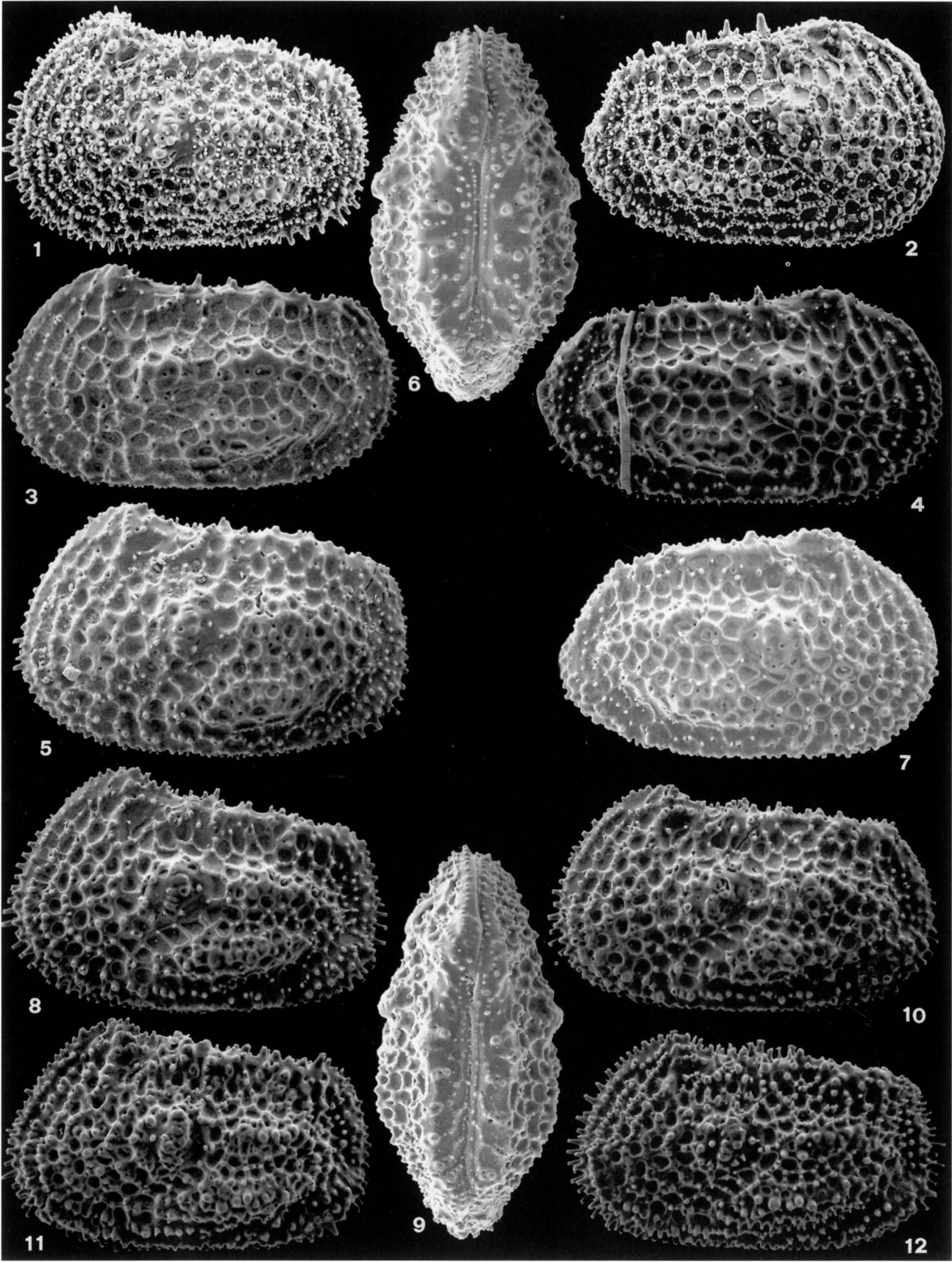
Remarks – Ruggieri (1962) in his paper on the Tortonian ostracods of Enna describes and figures the present species, attributed to *H. asperrima*. Following his remarks he noted that in his material two forms occur: a larger and a smaller one. He figures the smaller one which corresponds perfectly to the proposed new species. He suggested that the smaller specimens and the differences between the large form and the smaller one could justify a separation of the two forms into different species. Ruggieri (1962) does not figure the “large form”, and consequently we cannot attribute it to any of the taxa previously described or described in the present paper.

Distribution – Tortonian of Enna (Sicily) (Ruggieri, 1962).

Messinian of the Section of Dar Bel Hamri (Morocco) (present paper).

EXPLANATION OF PLATE 1

- Figs. 1-2 - *Henryhowella asperrima* (Reuss), Tegel of Soos, Badenian, B.O.C.2352.
1) LV, hypotype, (x 78).
2) RV, hypotype, (x 85).
- Figs. 3-4 - *Henryhowella ? asperrima* (Reuss), Falconara, Late Tortonian, B.O.C.2353.
3) LV, (x 82).
4) RV, (x 82).
- Fig. 5 - *Henryhowella sarsii profunda* n. ssp., Capo Rossello (Agrigento, Sicily), Pliocene, Stn. GB90-33. Holotype, LV female, B.O.C.2354, (x 82).
- Figs. 6-7 - *Henryhowella sarsii profunda* n. ssp., M. San Nicola (Gela, Sicily), Stn. 34, Pliocene, B.O.C.2355.
6) Hypotype, CC female in dorsal view, (x 78).
7) Hypotype, RV female, (x 82).
- Figs. 8-10 - *Henryhowella sarsii profunda* n. ssp., Morocco, Stn. M21, Early Messinian.
8) LV female, B.O.C.2356, (x 82).
9) CC male in dorsal view, B.O.C.2356, (x 75).
10) LV male, B.O.C.2357, (x 82).
- Figs. 11-12 - *Henryhowella sarsii profunda* n. ssp., Morocco, Stn. ABQ2-27, Pliocene.
11) LV female, B.O.C.2358, (x 82).
12) LV male, B.O.C.2359, (x 82).



Late Miocene of Ashtart well (Gulf of Gabès, Tunisia) (Bonaduce *et al.*, 1992).

Mio-Pliocene of South-West Spain (Ruiz & Gonzalez-Regalado, 1996).

Early Pliocene of Salé Briqueterie (Rabat, Morocco) (present paper).

Late Pliocene of Le Castella (Colalongo, 1966).

Early Pleistocene of Southern Spain (Aranki *et al.*, 1992).

Early Pleistocene of Acqua dei Corsari (Southern Italy) (present paper).

Pleistocene of Zakynthos (W. Greece) (Tsapralis, 1981).

Recent of Adriatic Sea (Bonaduce *et al.*, 1976).

Recent of the Tunisian Shelf (Bonaduce *et al.*, 1988).

Recent of Capbreton (Gulf of Gascogne, Atlantic) (Guillaume *et al.*, 1985).

Recent of Gulf of Naples (Tyrrhenian Sea) (Bonaduce *et al.*, in press).

HENRYHOWELLA SARSII SALSII (G.W. Müller, 1894)
Pl. 2, figs. 1-10; pl. 3, fig. 12; pl. 4, figs. 9-10; pl. 5,
figs. 1, 2, 6-8, 11.

1894 *Cythereis sarsii* G.W. MÜLLER, p. 370. pl. 8, fig. 8; pl. 31,
figs. 17-20; pl. 36, fig. 19.

1964 *Henryhowella sarsi* (G.W. Müller) - PURI *et al.*, fig. 57.

1966 *Henryhowella asperrima* (Reuss) - COLALONGO, pl. 11,
figs. 4, 6, 7.

1976 *Henryhowella asperrima asperrima* (Reuss) - BREMAN, pp.
59-60.

1976 *Henryhowella sarsi* (G.W. Müller) - BONADUCE *et al.*, pl.
31, figs. 2, 5.

1979 *Henryhowella sarsii* (G.W. Müller) - YASSINI, pp. 364, 383,
pl. 7, figs. 12-14.

1980 *Henryhowella asperrima* (Reuss) - YASSINI, p. 102, pl. 6,
figs. 6, 8, 10.

in press *Henryhowella* sp. 2 BONADUCE *et al.*, pl. 1, figs. 5-9.

?1961 *Henryhowella ruggierii* OERTLI, pl. 4, fig. 40a.

?1981 *Henryhowella asperrima* (Reuss) - UFFENORDE pl. 2, fig. 15.

Remarks – G.W. Müller (1894) described and illustrated this species from the Recent of the Gulf of Naples. His illustration shows a rectangular valve with a very spiny ornamentation which corresponds to a juvenile. Bonaduce *et al.* (in press) in a paper

related to the distribution of the genus *Henryhowella* in the Recent of the Gulf of Naples, found two species of this genus, provisionally called *Henryhowella* sp. 1 and *Henryhowella* sp. 2, one of which is certainly *H. sarsii*, but they were not able to solve the problem of which of the two should be attributed to *H. sarsii* leaving the two species in open nomenclature.

Mc Kenzie & Bonaduce (1993) redescribed the soft parts of a specimen of *Henryhowella* from the Gulf of Naples, that they called *H. sarsi*, following the common opinion that the genus was represented only by this species in the Gulf of Naples. We took a SEM picture of one of the valves of the specimen utilized for the description of the soft parts (Pl. 3, fig. 13) which resulted to be a young instar of one of the two species, fact which did not help in solving the problem.

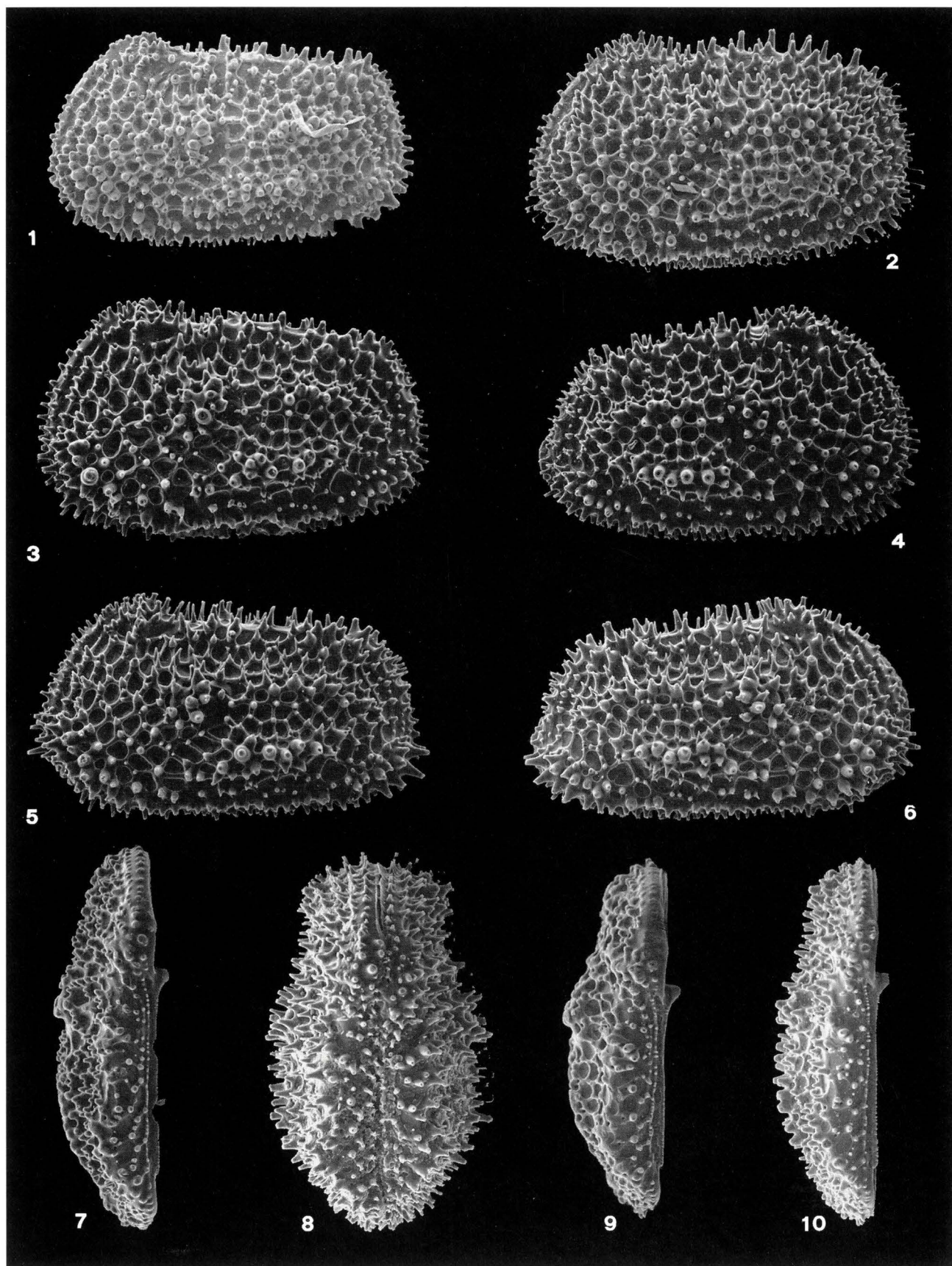
We think to have solved the problem through the comparison of the young instars of the two species, which resulted of different shape in lateral view through the examination of the samples in which only one of the two species was present and comparing both with the illustration given by Müller. In fact the young instars of *Henryhowella* sp. 1 are triangular in lateral view (Pl. 3, fig. 13), while in *Henryhowella* sp. 2 they are rectangular (Pl. 3, fig. 12) as that illustrated by Müller. Consequently, with reasonable certainty, *Henryhowella* sp. 2 corresponds to *H. sarsii* which is redescribed below.

Some specialists consider *H. sarsii* as an ecophenotype of *H. asperrima* which developed the peculiar characters because of the ecological conditions. Against this opinion, the constancy of the cited characters through space and time seems to support the idea that we are dealing with a different species which, very probably, evolved from *H. asperrima*. We have to add that in the SEM micrographs the typical characters are not so evident in lateral view and that the examination in dorsal view is needed. The specific characters are more evident with a binocular microscope.

Integrated description – A species of plicate-type *Henryhowella* characterized by LV subrectangular in

EXPLANATION OF PLATE 2

- Figs. 1, 2, 7 - *Henryhowella sarsii sarsii* (G.W. Müller), M. San Nicola (Gela, Sicily), Early Pleistocene.
1) LV female, Stn. 79, B.O.C.2360, (x 78).
2) LV male, Stn. 79, B.O.C.2361, (x 72).
7) LV male in dorsal view, Stn. 71, B.O.C.2362, (x 75).
- Figs. 3-6, 8-10 - *Henryhowella sarsii sarsii* (G.W. Müller), Gulf of Naples, Recent.
3) LV female, Stn. C62-1, B.O.C.2334, (x 82).
4) RV female, same specimen of fig. 3, (x 82).
5) LV male, Stn. C67-1, B.O.C.2335, (x 82).
6) RV male, same specimen of fig. 5, (x 82).
8) CC female in dorsal view, Stn. C77-1, B.O.C.2336, (x 82).
9) LV female, abraded specimen in dorsal view, Stn. C67-1, B.O.C.2363, (x 82).
10) LV male in dorsal view, Stn. C139-1, B.O.C.2364, (x 78).



lateral view with posterior extremity subvertically truncated, ventral margin feebly convex with posterior extremity clearly upturning, dorsal almost straight, anterior obliquely rounded. Dorsal, median and subventral subhorizontal alignments constituted by bottle-shaped tubercles, mostly fused with each other.

Antero-ventral area protruding due to the presence of numerous bottle-shaped tubercles fused with each other.

The remaining surface is reticulate and spiny with spines concentrically arranged anteriorly and irregularly distributed in the posterior half and departing from the muri of the reticulation. From the muri generally long spines depart which at the top show or not a number of secondary peripheral spines which give them a flower appearance. The top of the principal spines does not show any opening and the normal sieve-type pore-canals are located on the muri of the reticulation.

In some specimens the principal spines are shorter and without the secondary ones; in other cases they are reduced to well developed tubercles. Most of these tubercled specimens are an artifact due to the abrasion of the valve surface and this fact can be ascertained in finding the top of the spines pierced while in well preserved specimens the principal spines are close at the top (Pl. 5, figs. 7, 8). On the antero-dorsal area they form rows parallel to the anterior margin, while in the antero-ventral they are fused together forming a bunch which overlaps the margin. The postero-dorsal extremity shows the same arrangement.

The antero-ventral and postero-dorsal bunches are detectable even in damaged specimens because their basis is always detectable resulting in an evident protrusion.

Carapace in dorsal view inflated and truncated anteriorly and posteriorly with a depression at about mid-length due to the interruption of the spines

along the median ridge between the muscle-scars area and the posterior (Pl. 2, figs. 7-10). The constant presence of a cluster of fused protruding bottle-shaped tubercles characterizes the antero-ventral area in both sexes of all the specimens examined, while the upper part of the anterior margin is ornamented by concentrically arranged rows of thin spines which overlap the margin.

RV less abruptly truncated posteriorly than the LV and more regularly rounded anteriorly. Males relatively longer than females (Pl. 2, figs. 5, 6).

Muscle-scars – A vertical row of 4 scars preceded by a V-shaped one.

Marginal pore-canals – Typical of the genus.

Normal pore-canals – Sieve-types generally occurring near the base of the tubercles, on the muri of the reticulation (Pl. 5, fig. 11).

Size (in mm) – LV female: L = 0.87; H = 0.54 (Pl. 2, fig. 3).

RV female: L = 0.83; H = 0.52 (Pl. 2, fig. 4).

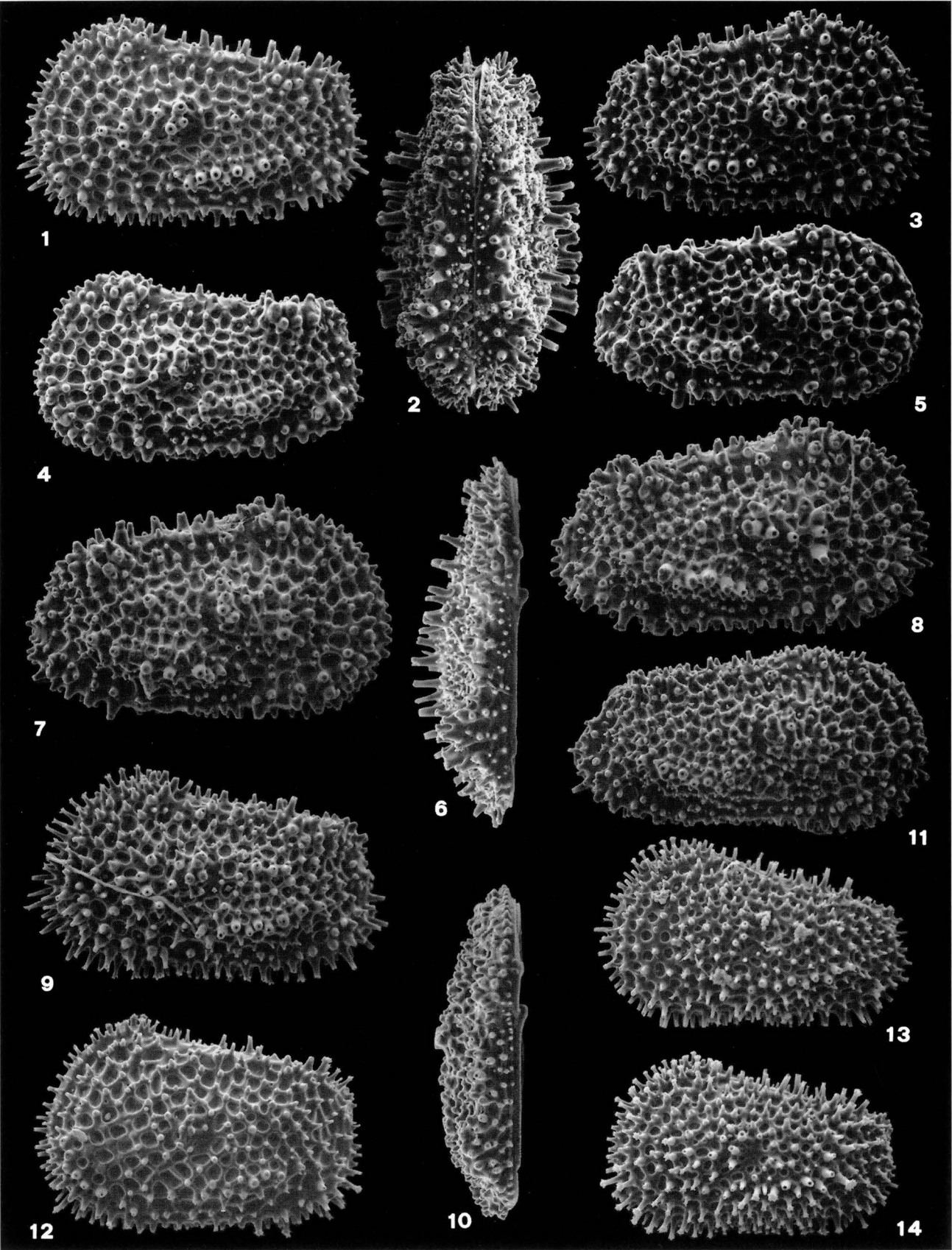
Affinities – *H. sarsii sarsii* differs from *H. asperrima* mostly by the oblique shape of the anterior margin in the LV instead of regularly rounded as in *H. asperrima* and by the peculiar antero-ventral, postero-ventral and postero-dorsal bunches of partly fused spines which in the latter do not occur showing even anteroventrally regular parallel rows of isolated spines.

H. sarsii sarsii differs from *H. parthenopea* n. sp. especially due to the fact that the latter is much more depressed inside the margins instead of more or less regularly inflated, characters which occur in both sexes.

Distribution – Early Pliocene of Algiers (Algeria) (Yassini, 1980).

EXPLANATION OF PLATE 3

- Figs. 1-6 - *Henryhowella parthenopea* n. sp., Gulf of Naples, Recent.
 1) Holotype, LV female, Stn. C139-1, B.O.C.2332, (x 82).
 2) Hypotype, CC female, Stn. C77-1, B.O.C.2337, (x 82).
 3) Holotype, RV female, same specimen of fig. 1, B.O.C.2332, (x 82).
 4) Paratype, LV male, B.O.C.2333, (x 82).
 5) Paratype, RV male, same specimen of fig. 4, B.O.C.2333 (x 82).
 6) Hypotype, LV male in dorsal view, Stn. C140-1, B.O.C.2365, (x 82).
- Figs. 7-8 - *Henryhowella parthenopea* n. sp., Acqua dei Corsari, Early Pleistocene.
 7) RV female, B.O.C.2366, (x 82).
 8) RV male, B.O.C.2367, (x 82).
- Figs. 9-10 - *Henryhowella parthenopea* n. sp., Salé Briqueterie (Morocco), Pliocene, sample G.B. 36.
 9) LV female, B.O.C.2368, (x 82).
 10) LV female in dorsal view, B.O.C.2369, (x 82).
- Fig. 11 - *Henryhowella parthenopea* n. sp., Dar Bel Hamri (Morocco), Messinian, RV male, B.O.C.2370, (x 82).
 Fig. 12 - *Henryhowella sarsii sarsii* (G.W. Müller), Gulf of Naples, Stn. C10-1 (355 m), Recent, LV instar, B.O.C.2371, (x 126).
 Fig. 13 - *Henryhowella parthenopea* n. sp., Gulf of Naples, Stn. B7-b, Recent, LV female, instar of the specimen studied by McKenzie & Bonaduce (1993) for soft parts, B.O.C.2372, (x 82).
 Fig. 14 - *Henryhowella parthenopea* n. sp., Gulf of Naples, Stn. C120-1, Recent, LV female, instar, B.O.C.2373, (x 82).



Pleistocene of Le Castella (Calabria) (Colalongo, 1966).

Early Pleistocene of M. San Nicola (Gela, Sicily) (present paper).

Recent of Gulf of Naples (Tyrrhenian Sea) (Puri *et al.*, 1964).

Recent of Adriatic Sea (Bremen, 1976; Bonaduce *et al.*, 1976).

Recent of Bay of Bou Ismail (Algeria) (Yassini, 1979).

Recent of Gulf of Naples (Tyrrhenian Sea) (Bonaduce *et al.*, in press).

Recent of Gulf of Taranto (Ionian Sea) (present paper).

HENRYHOWELLA SARSII (G.W. Müller, 1894)

PROFUNDA n. ssp.

Pl. 1, figs. 5-12; Pl. 4, figs. 1-8.

1975 *Henryhowella asperrima* (Reuss) - BRESTENSKA, p. 393, pl. 7, figs. 1-6.

1978 *Henryhowella asperrima* (Reuss) - ROSENFELD & BEIN, p. 18, pl. 1, fig. 23.

1978 *Henryhowella asperrima* (Reuss) - BENSON, pl. 1, fig. 3.

1978 *Henryhowella asperrima* (Reuss) - BRESTENSKA & JIRICEK, pl. 8, fig. 8.

1979 *Henryhowella asperrima* (Reuss) - DUCASSE & PEYPOUQUET, pl. 3, fig. 1.

1981 *Henryhowella* ex. gr. *H. asperrima* (Reuss) - STEINECK, p. 346, pl. 2, fig. 1.

1987 *Henryhowella asperrima* (Reuss) - WHATLEY & COLES, pl. 5, figs. 9-11.

Etyymology – From Latin *profundus* = deep.

Holotype – A left female valve (Pl. 1, fig. 5). B.O.C.2354.

Hypotypes – 1 female carapace (Pl. 1, fig. 6) and 1 right female valve (Pl. 1, fig. 7). M. San Nicola Section (Gela, Sicily), Stn. 34, Pliocene, MPI 5 B.O.C.2355.

Type locality – Capo Rossello (Agrigento, Sicily), Stn. GB90-33.

Age – Pliocene.

Description – A new subspecies of *Henryhowella sarsii* characterized anteriorly by 2-3 rows of tubercles or spines generally well separated from each other and in dorsal view by both the extremities relatively acuminate. It differs from the type-species especially by the lack of the antero-ventral and postero-ventral bunches of spines fused together, a character which allows the distinction between the two subspecies especially in dorsal view.

Size (in mm) – LV female: L = 0.87; H = 0.55 (Pl. 1, fig. 5).

RV female: L = 0.83; H = 0.51 (Pl. 1, fig. 7).

Remarks – Oertli (1961) describes the species *H. ruggierii* n. sp. from the Late Aquitanian of the Bricco della Croce (Piedmont) which in some of the pictures reported is rather close to the proposed new subspecies. Russo (1966) figures *H. ruggierii* from the Langhian of the Valle del Pescale. This form, later cited in Russo & Bossio (1976) from the Serravallian-Langhian of the same area, shows well defined reticulations and reduced tuberculations and is close to *H. sarsii profunda* n. ssp. from which *H. ruggierii* differs especially in the different shape in lateral view mostly due to the anterior margin regularly rounded instead than obliquely truncated.

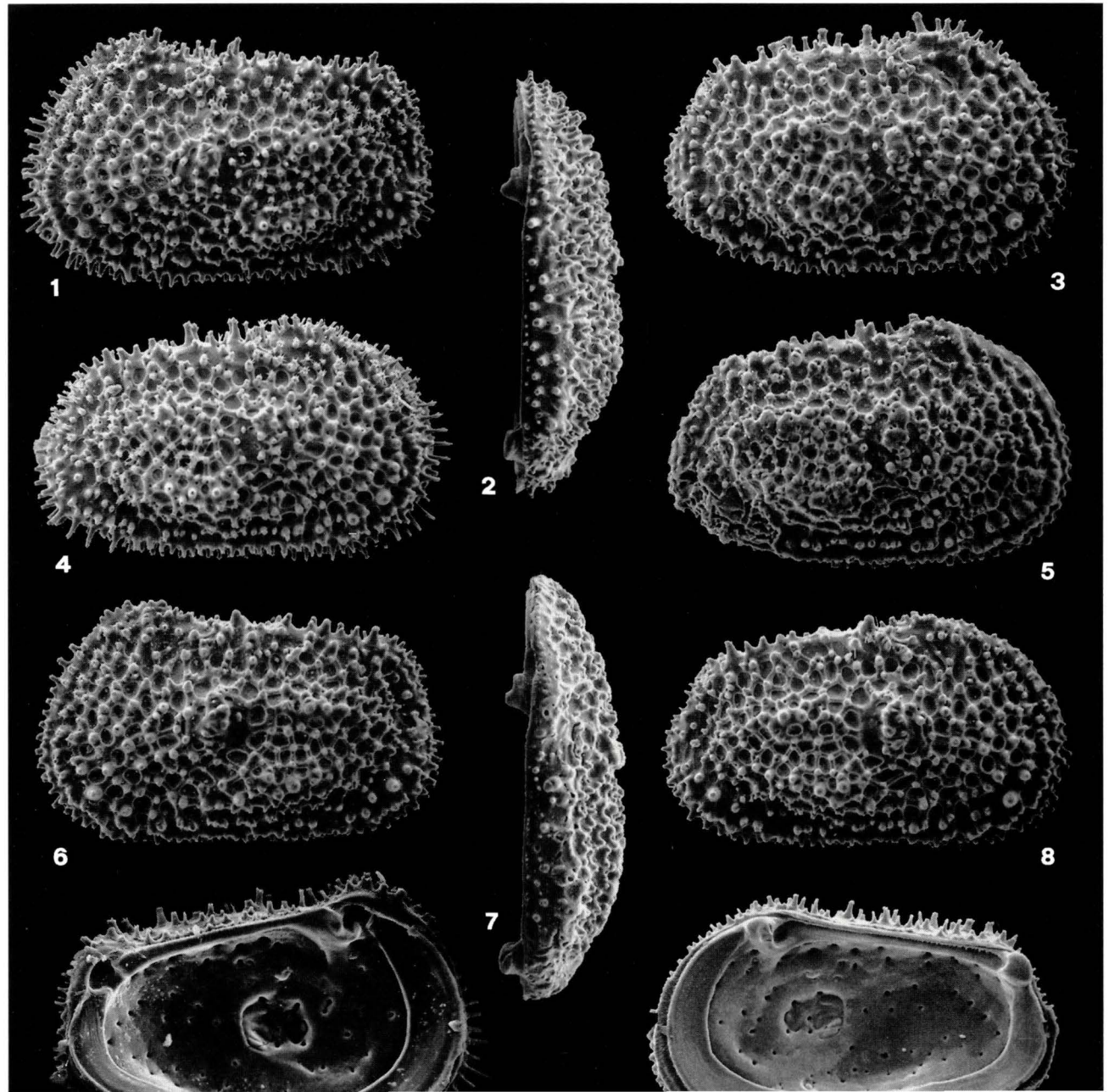
It has to be noted that Colalongo (1966), Sissingh (1972) and Uffenorde (1981) considered *H. ruggierii* a junior synonym of *H. asperrima*.

Distribution – Cainozoic (Ducasse & Peypouquet, 1979)

Middle Miocene of Jamaica (West Indies) (Steineck, 1981).

EXPLANATION OF PLATE 4

- Figs. 1-4 - *Henryhowella sarsii profunda* n. ssp., Western Mediterranean, Peypouquet's specimens, Recent-Quaternary, C.O.4156.
 1) LV male, (x 66).
 2) RV female in dorsal view, (x 69).
 3) RV female, (x 66).
 4) RV male, (x 66).
- Figs. 5-8 - *Henryhowella sarsii profunda* n. ssp., Atlantic, Iberian-Moroccan Bay, Geomar II, 995 m, Peypouquet's specimens, Recent, KS840015, C.O.4357.
 5) RV female, (x 72).
 6) LV male, (x 72).
 7) RV male in dorsal view, (x 72).
 8) RV male, (x 72).
- Figs. 9-10 - *Henryhowella sarsii sarsii* (G.W. Müller), Gulf of Naples, Recent.
 9) LV female, internal view, Stn. C58-1, B.O.C.2374, (x 82).
 10) RV, internal view, Stn. C139-1, B.O.C.2375, (x 75).
- Figs. 11-12 - *Henryhowella parthenopea* n. sp., Gulf of Naples, Recent.
 11) LV female, internal view, Stn. C120-1, B.O.C.2376, (x 82).
 12) RV, internal view, Stn. C102-1, B.O.C.2377, (x 89).



Egerian (Miocene) of Paratethys (Brestenska, 1975).

Badenian of Paratethys (Brestenska & Jiricek, 1978).

Early Messinian (following Benson *et al.*, 1991) of Ain el Beida (Morocco) (present paper).

Late Miocene to Quaternary of Leg 94, DSDP (Whatley & Coles, 1987).

Early Pliocene of Ain el Beida Quarry (Morocco) (present paper).

Pliocene of Capo Rossello (Agrigento, Sicily) (present paper).

Pliocene of M. San Nicola (Gela, Sicily) (present paper).

Zanclean of DSDP Leg 42 A, Balearic Basin (Benson, 1978).

Recent of Eastern Atlantic, off the Sahara Desert (Rosenfeld & Bein, 1978).

Recent of the Ibero-Moroccan Bay (Atlantic) (present paper).

Recent of Western Mediterranean (present paper).

CONCLUSIONS

The detailed study of the systematics of the plicate forms of *Henryhowella* through space and time allowed the splitting of the generally called *H. asperima* (Reuss) into 3 species that is *H. asperima*, *H. sarsii* and *H. parthenopea* n. sp., and *H. sarsii* into 2 subspecies that is *H. sarsii sarsii* (G.W.Müller) and *H. sarsii* (G.W.Müller) *profunda* n. ssp.

From the previous data, it results that *H. asperima* shows well defined differences from *H. sarsii* due to the shape and characters of the ornamentation. The two subspecies *H. sarsii sarsii* and *H. sarsii profunda* n. ssp. differ essentially in the peculiar charac-

ters of the position and development of the nodes and spines which cover the carapace.

We found that *H. sarsii sarsii* occurs at shallower depths while *H. sarsii profunda* n. ssp. occurs in the bathyal of both the Mediterranean and the Atlantic from Miocene to Recent. *H. parthenopea* n. sp. is the shallowest species of the group ranging in the Recent of the Mediterranean from 40 to 170 m depth. The two subspecies of *H. sarsii* are possibly ecospecies whose distributions are restricted to more or less defined depth ranges.

The present splitting is considered of importance in estimating paleodepths.

The synonymies reported for each species and subspecies are certainly incomplete and some of them are possibly not correct because we used the illustrations of the previous literature, which sometimes are not adequate for a sure attribution.

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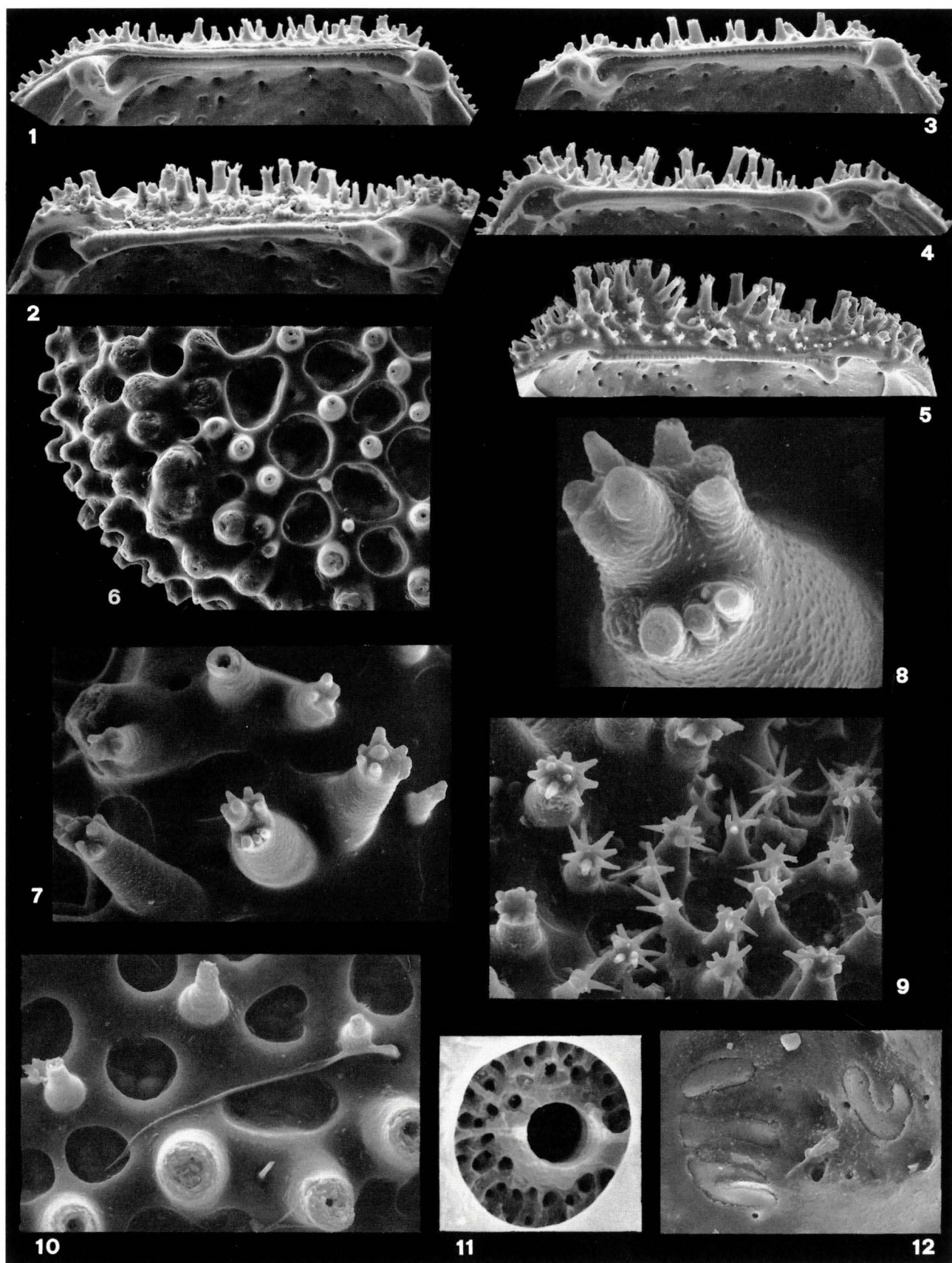
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EXPLANATION OF PLATE 5

- Fig. 1 - *Henryhowella sarsii sarsii* (G.W. Müller), Gulf of Naples, Stn. C139-1, Recent, RV, hinge, same specimen figured in Pl. 4, fig. 10, B.O.C.2375, (x 111).
- Fig. 2 - *Henryhowella sarsii sarsii* (G.W. Müller), Gulf of Naples, Stn. C133-1, Recent, LV, hinge, B.O.C.2378, (x 132).
- Fig. 3 - *Henryhowella parthenopea* n. sp., Gulf of Naples, Stn. C102-1, Recent, RV, hinge, same specimen figured in Pl. 4, fig. 12, B.O.C.2377, (x 121).
- Figs. 4-5 - *Henryhowella parthenopea* n. sp., Gulf of Naples, Stn. C102-1, Recent, 4) LV male, hinge, B.O.C.2379, (x 121). 5) hinge feebly tilted, same specimen of fig. 4, B.O.C.2379, (x 116).
- Fig. 6 - *Henryhowella sarsii sarsii* (G.W. Müller), Gulf of Naples, Stn. C139-1, Recent, LV female, detail of the antero-ventral area with top of the tubercles broken, B.O.C.2380, (x 264).
- Figs. 7-8 - *Henryhowella sarsii sarsii* (G.W. Müller), Gulf of Naples, Stn. C58-1, Recent, RV female in dorsal view. 7) detail of the tubercles showing the absence of openings at the top, B.O.C.2381, (x 601). 8) a well preserved tubercle of the same specimen of fig. 7, B.O.C.2381, (x 2197).
- Fig. 9 - *Henryhowella parthenopea* n. sp., Gulf of Naples, Stn. C77-1, Recent, detail of the posterior extremity of the LV of the complete carapace of fig. 2 of Pl. 3 showing the star-shaped well preserved tubercles, B.O.C.2337, (x 504).
- Fig. 10 - *Henryhowella parthenopea* n. sp., Gulf of Naples, Stn. B7-b, Recent, LV female, instar, detail of the specimen of fig. 13 of Pl. 3 showing a single bristle, B.O.C.2372, (x 748).
- Fig. 11 - *Henryhowella sarsii sarsii* (G.W. Müller), Gulf of Taranto, Stn. 143, Recent, sieve-type normal pore-canal, B.O.C.2382, (x 5948).
- Fig. 12 - *Henryhowella parthenopea* n. sp., Gulf of Naples, Stn. C120-1, Recent, LV female, muscle-scars of the same specimen figured in Pl. 4, fig. 11, B.O.C.2376, (x 406).



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