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New species of *Pararotalia* Le Calvez, in Pliocene sediments of the Lower Valsesia and Western Liguria

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ABSTRACT – The aim of this note is to describe *Pararotalia padana* n. sp., found in Pliocene outcrops of the Lower Valsesia and Western Liguria. The new species differs from the previously known *Pararotalia* species, such as *P. armata* (d'Orbigny, 1826) by possessing different size, number and shape of chambers and ornamentation.

RIASSUNTO – [Nuova specie di *Pararotalia* Le Calvez, in sedimenti pliocenici della Bassa Valsesia e della Liguria Occidentale] – Si propone di istituire *Pararotalia padana* n.sp. per esemplari di *Pararotalia* rinvenuti in affioramenti pliocenici della Bassa Valsesia e della Liguria Occidentale. Queste forme si differenziano da specie note di *Pararotalia* per alcuni caratteri; la specie morfologicamente più simile è *P. armata* (d'Orbigny, 1826) dalla quale i nostri esemplari si distinguono per dimensioni, forma delle camere ed ornamentazione.

INTRODUCTION

Peculiar specimens of foraminifera belonging to the genus *Pararotalia* were detected in some Pliocene outcrops of the Lower Valsesia and Western Liguria (Italy) (Text-fig. 1). Accurate analysis enabled us to assign these specimens to *Pararotalia padana* n. sp., in that they differ from the known species for several characters.

The genus *Pararotalia* was erected by Le Calvez, 1949, type-species *Rotalina inermis* (Terquem), 1882, (fide Ellis & Messina, Vol. 49) who distinguished it from the genus *Rotalia* Lamark, 1804 on the basis of the different form and position of the aperture. Subsequently, Loeblich & Tappan, 1957 (fide Ellis & Messina, Vol. 49) emended *Pararotalia* Le Calvez, giving a more detailed description, on the basis of new taxonomic parameters such as the feature of the umbilical area and particularly of the umbilical plate, including also *Rotalia armata* d'Orbigny, 1826 in this genus.

In their new description of the genus "*Pararotalia*", Loeblich & Tappan (1987) provided new details as:

- presence of a septal flap doubling the septa
- aperture: interiomarginal, extending obliquely into the apertural face
- intercameral foramen: areal, due to attachment of an imperforate toothplate that extends to the distal margin of the aperture.

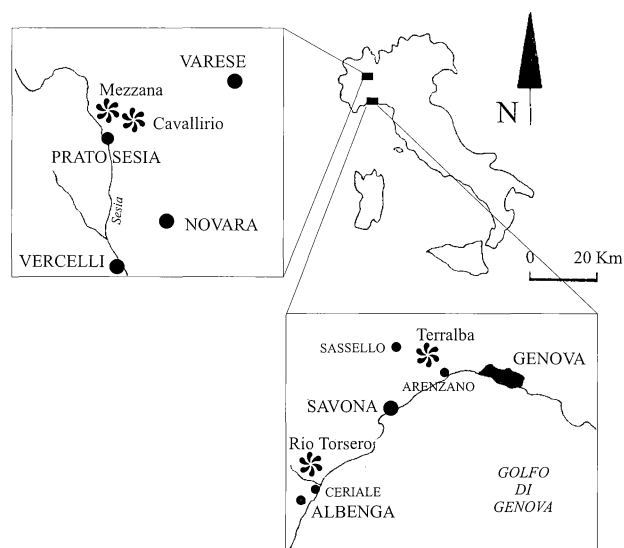
The main differences of *Pararotalia* (Hottinger *et al.*, 1991) with respect to other rotaliid genera (e.g. *Rotalia*, *Ammonia* and *Neorotalia*) are:

- presence of a toothplate with a free edge
- absence of an umbilical plate (as e.g. in *Rotalia*)
- absence of a foramenal plate connected to a cover plate (as e.g. in *Ammonia*)

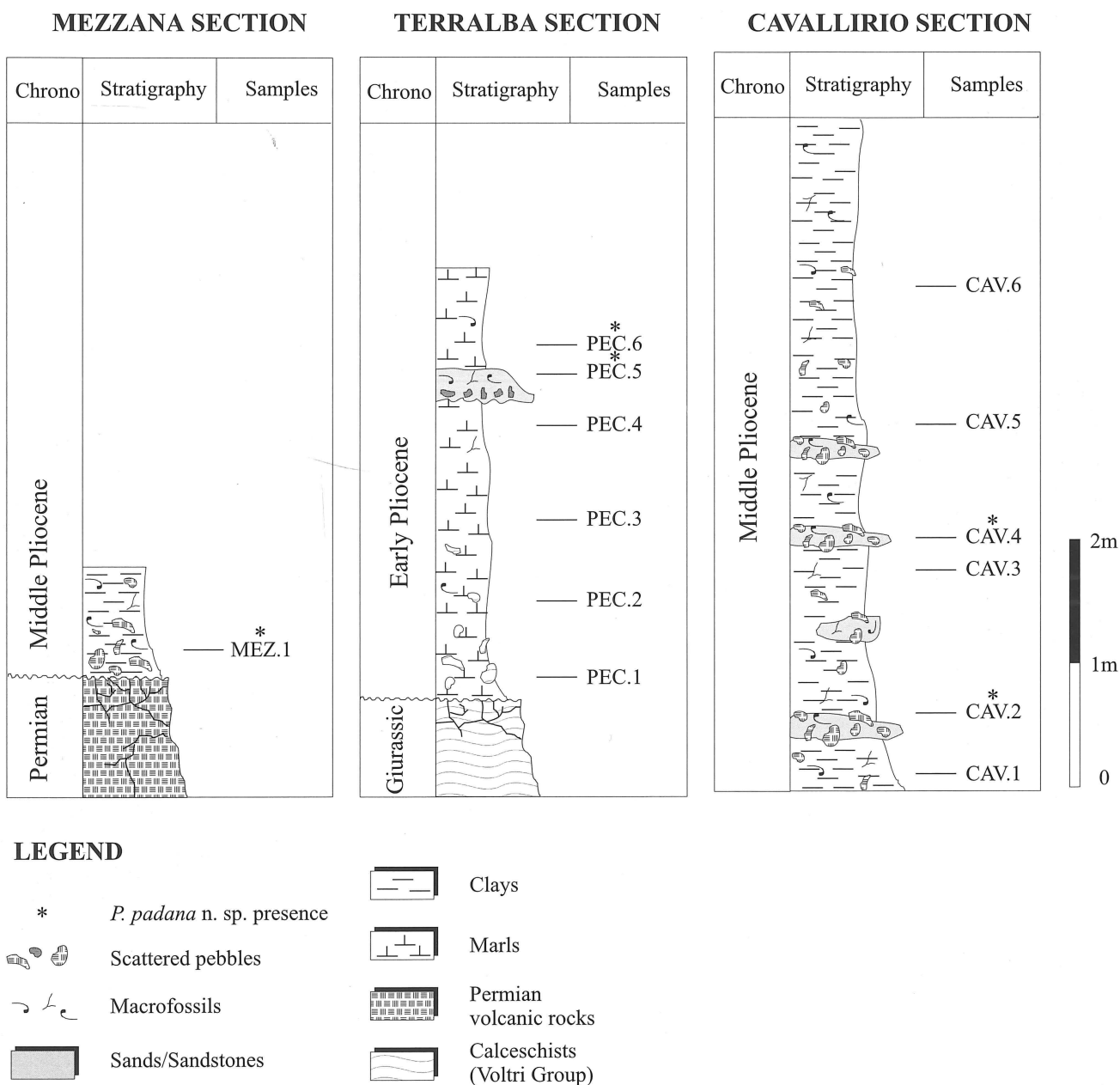
- absence of an enveloping canal system (as e.g. in *Neorotalia*).

MATERIALS AND METHODS

The analysed samples were collected from five different sections cropping out in the Lower Valsesia (Cavallirio, Mezzana) and Western Liguria (Terralba, Rio Torsero, Lido di Albano). Each sample (about 250g) was washed and granulometrically sorted through sieves of four mesh size: 40 mesh (425 µm), 80 mesh (180 µm), 120 mesh (125 µm), and 200



Text-fig. 1 – Location map of the studied sections.



Text-fig. 2 – Stratigraphic logs of the studied sections.

mesh (75 μ m). For every fraction it was at first defined the Organogenic Component/Inorganic Component (OC/IC) ratio; the most frequent and significative species of planktonic and benthic

foraminifera (out of a standard number of 300 specimens per fraction) were then determined and eventually it was calculated the Plankton/Plankton+Benthos (P/P+B) ratio and the abundance of *P. padana* and

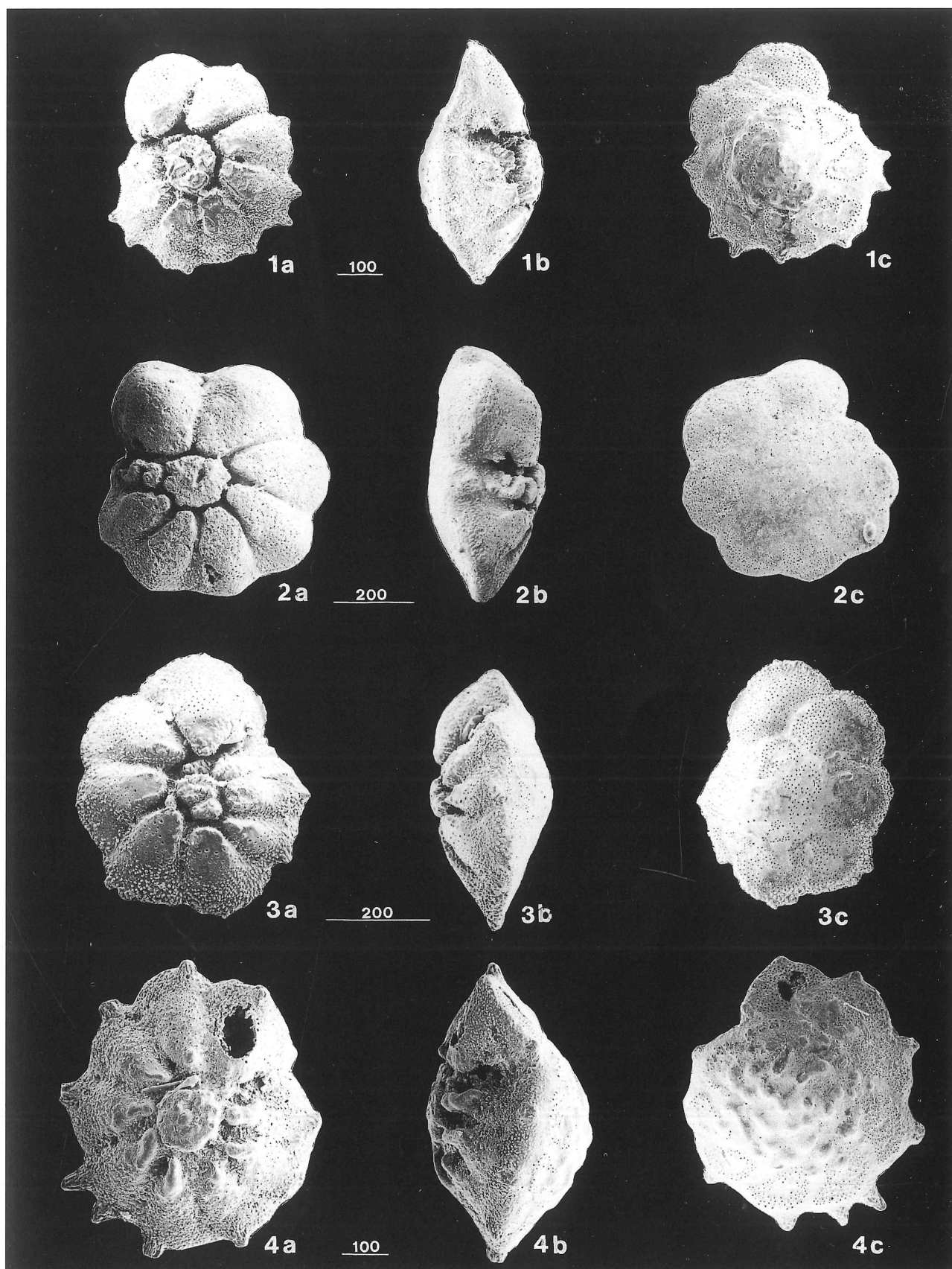
EXPLANATION OF PLATE 1

Figs. 1-4 - *Pararotalia padana* n. sp.

1) Holotype, sandy layer in clays, Cavallirio Section, CAV. 4 sample, Middle Pliocene, Cavallirio valley, Prato Sesia (NO).

2-4) Paratypes, as above.

The scale bars are in micron.



the *Ammonia beccarii* gr. Moreover, *P. padana* n. sp. was studied at the S.E.M. for evidencing the morphological and microstructural features with taxonomic significance.

GEOLOGICAL SETTING

From the beginning of the Pliocene, marine sediments filled the Po plain depressions and the creek valleys of the southern slope of the Alps, variously affected by erosion during the prominent sea-level fall of the Messinian.

In the Lower Valsesia, where the Cavallirio and Mezzana sections are located, Pliocene sediments lie mainly on Permian volcanics. These sediments are composed of marly siltites and blue-grey sands followed by yellow clays and sandstones (Franchi *et al.*, 1975). For these sediments there is no formal lithostratigraphic scheme (Govi, 1975). In the Arenzano - Genoa area, where the Terralba and Lido di Albaro sections are located, the pre-Pliocene substratum is represented by the Voltri Group Unit (Terralba) and by the "Calcari di Monte Antola" Formation (Lido di Albaro) (Vanossi *et al.*, 1991). The Pliocene outcrops comprise grey and blue-grey clays, sometimes alternating with coarse-grained sandy layers, referred to the "Argille di Ortovero" Formation.

The Rio Torsero section, located in the Albenga Basin, is situated on the "Flysch ad Helminthoidi" complex, and more precisely on the Albenga Succession and Castellermo "Serie". The section contains blue-grey sandy clays as dominant lithology, passing upward to macrofossil-rich sandstones and conglomerates (Emanuelli, 1997).

LITHOLOGICAL AND PALEONTOLOGICAL DESCRIPTION

All the analysed samples are characterised by extremely diversified micropaleontological components, with planktonic and benthic foraminifera, mollusc fragments, echinoids, bryozoa, ostracods, and plant remains.

CAVALLIRIO SECTION

The section, 6 m thick, is located along the Rio

Cavallirio near the Baragiotta village (Novara Province, Text-fig. 1). It is composed by sandy clays with numerous organogenic fragments and porphyric clasts related to the substratum (Text-fig. 2).

Five samples were analysed for their foraminiferal content. The abundant washed residue yield an OC/IC ratio equal to $1/4$. The organogenic residue is mainly composed of benthic foraminifera ($P/P+B=15\%$) such as *Cibicides*, *Elphidium* and Miliolids. In addition, there are mollusc fragments, echinoids and crinoids, bryozoa, ostracods, sponge spicules and plant remains. In these samples, *P. padana* n. sp. is common with well-preserved specimens. It is frequent in the fine-grained (120 mesh) and coarse-grained (40 and 80 mesh) fractions, and is the third most common taxon (about the 10% of total benthic) after the genus *Elphidium* and *Cibicides*. The *Ammonia beccarii* gr. is subordinate and does not exceed 3% of the total benthic in the 40 and 80 mesh fractions. Based on the presence of macrofossils *Typhinellus sowerbyi*, *Eulimella subalpina*, and *Thala obsoleta*, the Cavallirio section can be dated to the Middle Pliocene (Lanfranchini, 1997).

MEZZANA SECTION

This small outcrop is located NE of the Baragiotta village along the Rio Mezzana (Text-fig. 1). It comprises blue-grey sandy clays, rich in fossils and with scattered porphyric clasts (Text-fig. 2).

One sample was analysed for its foraminiferal content. It yields an OC/IC ratio equal to $1/5$. The organogenic residue is composed by benthic foraminifera such as *Elphidium*, the most abundant, *Cibicides*, *Melonis* and in suborder by mollusc fragments, echinoids, crinoids and ostracods. In the benthic foraminiferal assemblage, *P. padana* n. sp. is frequent in the 40 mesh fraction, whereas the *Ammonia beccarii* gr. is very rare. On the basis of the macrofaunas, these sediments have been dated to the Middle Pliocene (Lanfranchini, 1997).

TERRALBA SECTION

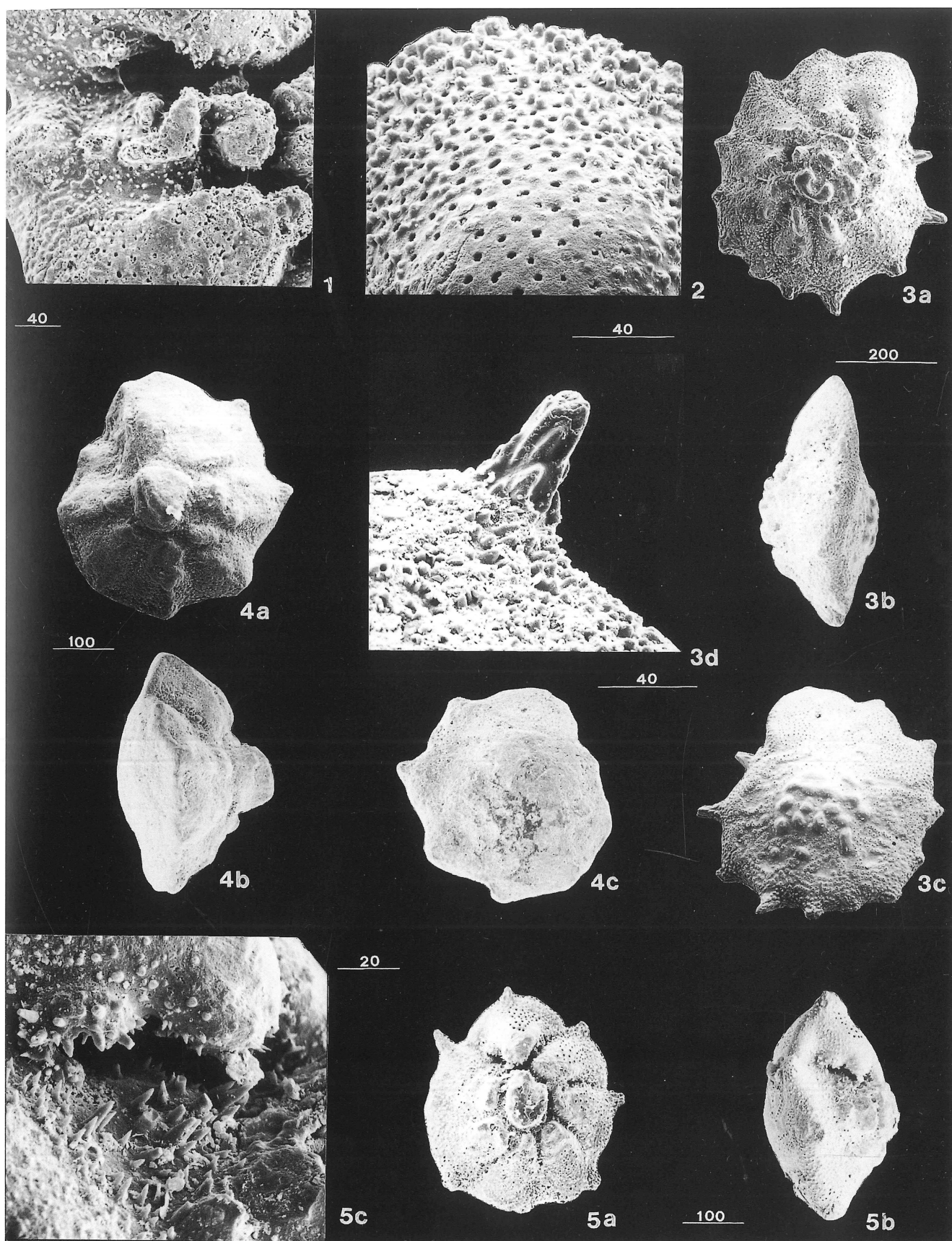
This section is located E of Rio Lissolo near the Terralba village (Genoa Province), (Text-fig. 1).

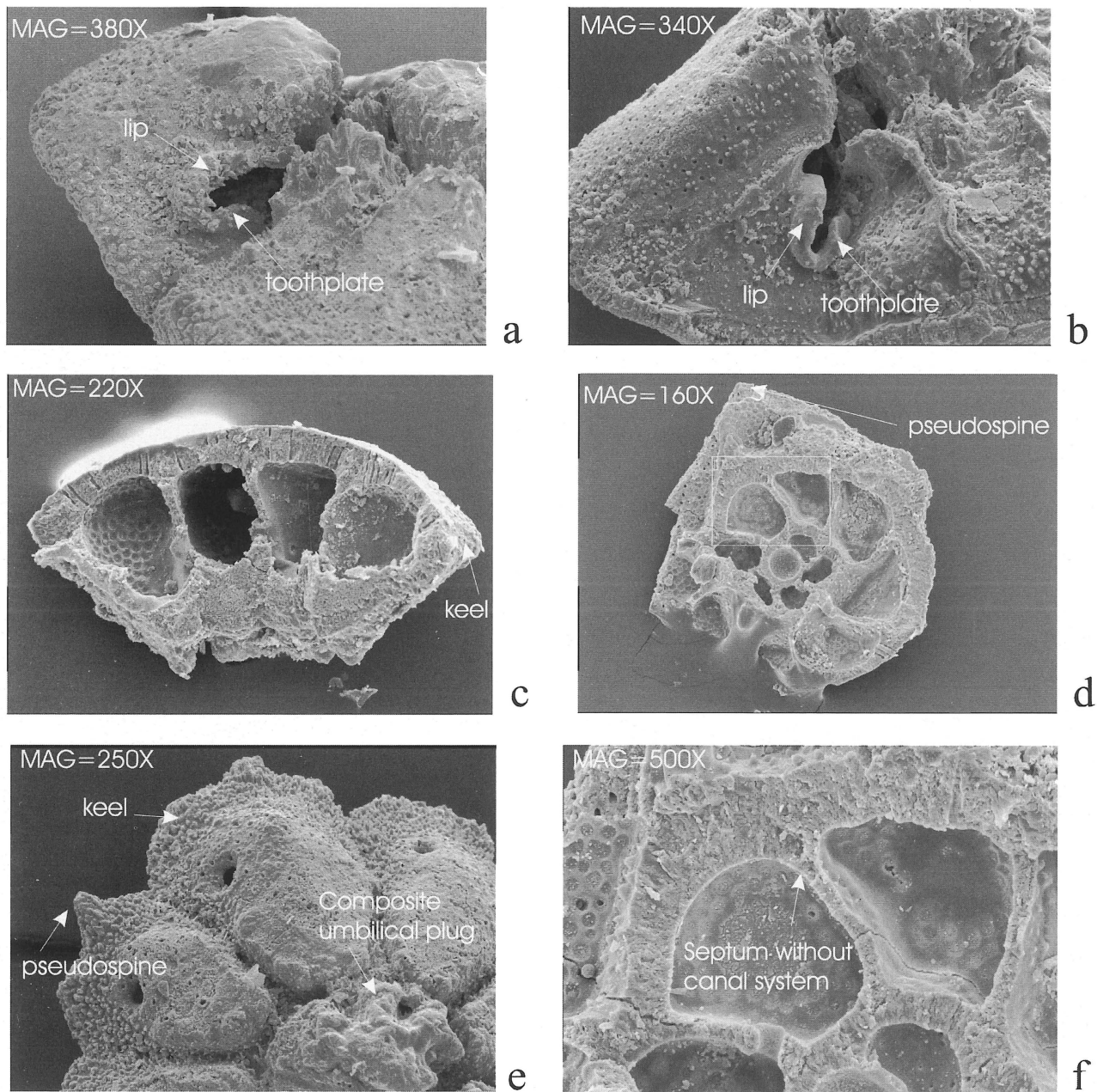
EXPLANATION OF PLATE 2

Figs. 1-5 - *Pararotalia padana* n. sp.

- 1) Paratype, detail of the aperture (see pl. 1, fig. 2a).
- 2) Paratype, detail of the wall structure (see pl. 1, fig. 3a).
- 3) Intraspecific variability: species with 9 chambers and pustules on the spiral side, silty-clays, Mezzana section, MEZ.1 sample, Prato Sesia (NO), 3d) detail of the pseudospine.
- 4) Intraspecific variability: species with 7 chambers, coarse-grained layers in clays, Terralba section, PEC5 sample, MPL1 Zone, Early Pliocene, Terralba (GE).
- 5) Intraspecific variability: species with a prominent spiral side, sandy-marls, Rio Torsero section, RT2 sample, Ceriale (SV), 5c) detail of the aperture.

The scale bars are in micron.





Text-fig. 3 - *Pararotalia padana* n. sp. details. a) Enlargement of the aperture - holotype, Cavallirio section, Middle Pliocene, Prato Sesia (NO). b) Enlargement of the aperture - paratype, Cavallirio section, Middle Pliocene, Prato Sesia (NO). c, d, f) Vertical (c) and equatorial (d, f) sections with internal view. Note the absence of canal system (f) - Mezzana section, Middle Pliocene, Prato Sesia (NO). e) Enlargement of the umbilical side - Cavallirio section, Middle Pliocene, Prato Sesia (NO).

EXPLANATION OF PLATE 3

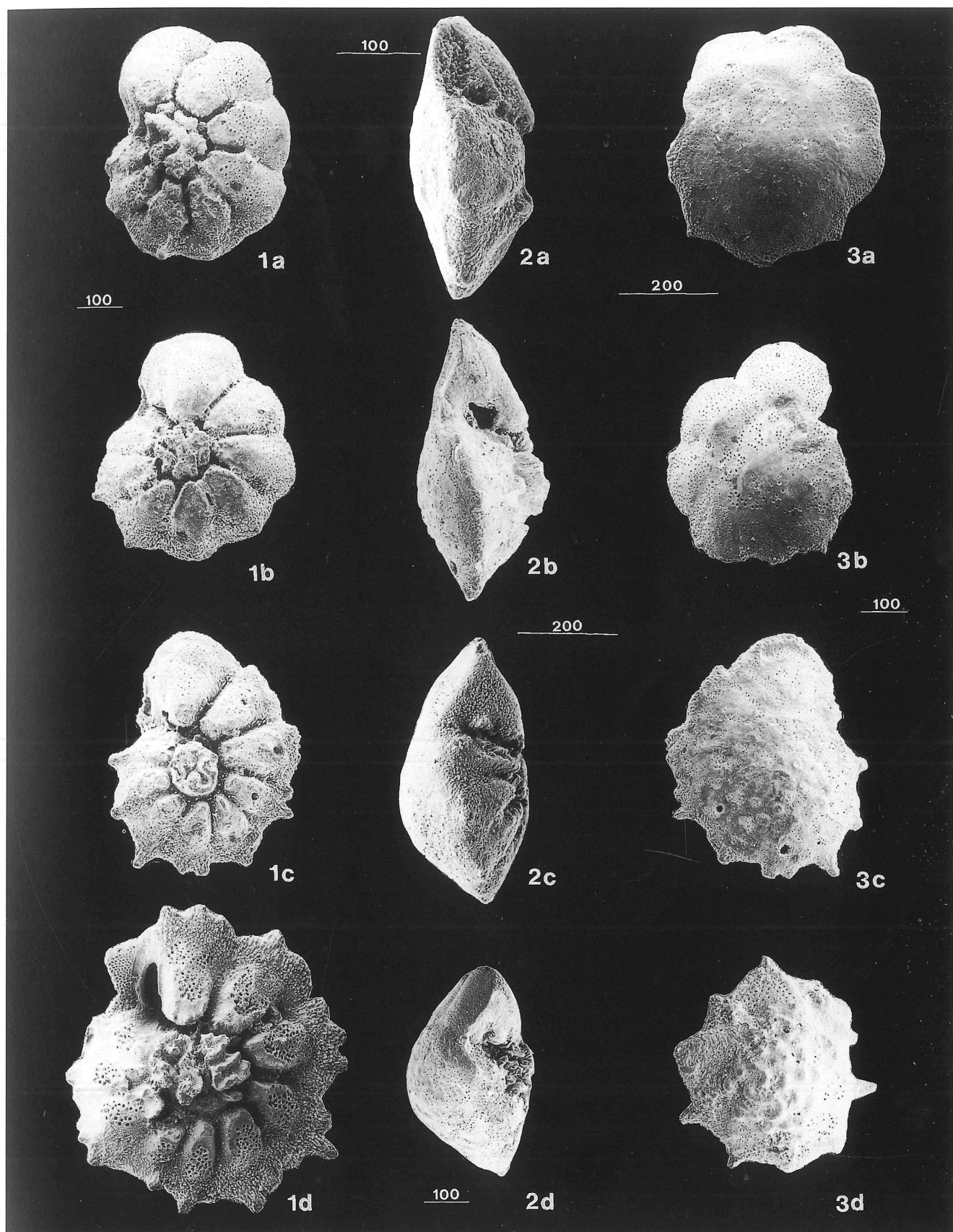
Figs. 1-3 - *Pararotalia padana* n. sp.

1a-d) Intraspecific variability in the contour from a lobate outline, with an extremely thin keel and without pseudospines to a stellate keeled outline with one or more pseudospines per chamber, Cavallirio section, CAV. 4 sample, Prato Sesia (NO).

2a-d) Intraspecific variability in the convexity of the test from species with a less prominent spiral side to specimens with a very prominent one, Cavallirio and Mezzana sections, CAV.4 and MEZ.1 samples, Prato Sesia (NO).

3) Intraspecific variability of the spiral sides showing also specimens without pustules, Cavallirio section, CAV. 4, Prato Sesia (NO).

The scale bars are in micron.



It consists of 4m of marls and clayey marls; at the base, clasts from the substratum are common and a coarser layer (sand and pebbles), rich in infralittoral macrofossils, is present between 2.5 and 3 m (Text-fig. 2). These sediments are referred to the "Argille di Ortovero" Formation, dated in the Ligurian Region to the Early Pliocene (Negri *et al.*, 1997).

Six samples were analysed for their foraminiferal content.

Benthic species prevail on planktonic ones in the 40 and 80 mesh fractions, while plankton and benthos are likewise abundant in the 120 and 200 mesh fractions. Additionally, the coarse-grained layers very commonly yield mollusc, echinoid and bryozoan fragments, as well as ostracods. *Pararotalia padana* n. sp., together with the genus *Elphidium*, is frequent in the 80 mesh fraction (up to 25% of the total benthic assemblage) but only in the coarse layer. The *Ammonia beccarii* gr. is completely absent, but is common in other Ligurian sections.

OTHER AREAS

Other specimens of *P. padana* n. sp. were found in samples from the Rio Torsero section in the Albenga Basin (Savona province) and from Lido di Albarno (GE), stored at University of Genoa, Museum of the Dipartimento per lo Studio del Territorio e delle sue Risorse (Mastrorilli, 1969). All these samples are of Pliocene age.

PARAROTALIA PADANA n. sp.
Pls. 1-3; Text-fig. 3

Holotype – Pl. 1, fig. 1, from the Cavallirio Section, sample CAV. 4, Micropaleontological Laboratory of the Earth Sciences Department, University of Pavia.

Paratypes – Pl. 1, figs. 2-4, from the Cavallirio Section, sample CAV. 4, Micropaleontological Laboratory of the Earth Sciences Department, University of Pavia.

Etymology – From "Pianura Padana" within whose margins the type locality is located.

Type locality – Rio Cavallirio near Baragiotta hamlet of the Prato Sesia village (Novara Province, Italy; Text-fig. 1). Other localities: Rio Mezzana in the homonymous valley near Baragiotta; Terralba near the Arenzano town (GE); Rio Torsero in the Albenga Basin (SV) and samples from Lido di Albarno (GE), stored at the University of Genoa, Museum of the Earth Sciences Department.

Stratotype – Sandy-pebbly layers rich in infralittoral macrofossils – Cavallirio Section (Text-fig. 2) – Middle Pliocene.

Description – Test medium to large, more frequently large in size, trochospiral, consisting of about 2 1/2-3 whorls, biconvex. Margin with a keeled stellate periphery and an acute profile. 7-10 chambers in the last whorl, gradually increasing in size as added, with one or two pseudospines in proximal position near the peripheral margin. Chambers conical-rhomboidal, separated by radial and depressed sutures which are more deeply sunken towards the umbilical area on the umbilical side of the test; on the dorsal side, the chambers are petaloid, separated by gently curved sutures. Ventral side with deep, free umbilicus occupied to a large extent by a fairly thick, composite umbilical plug. Primary aperture interiomarginal-areal extending obliquely into the apertural face, with a toothplate that extends to the distal margin of the aperture, with a small lip (Text-fig. 3 a,b). No canal system has been observed (Text-fig. 3 c-d).

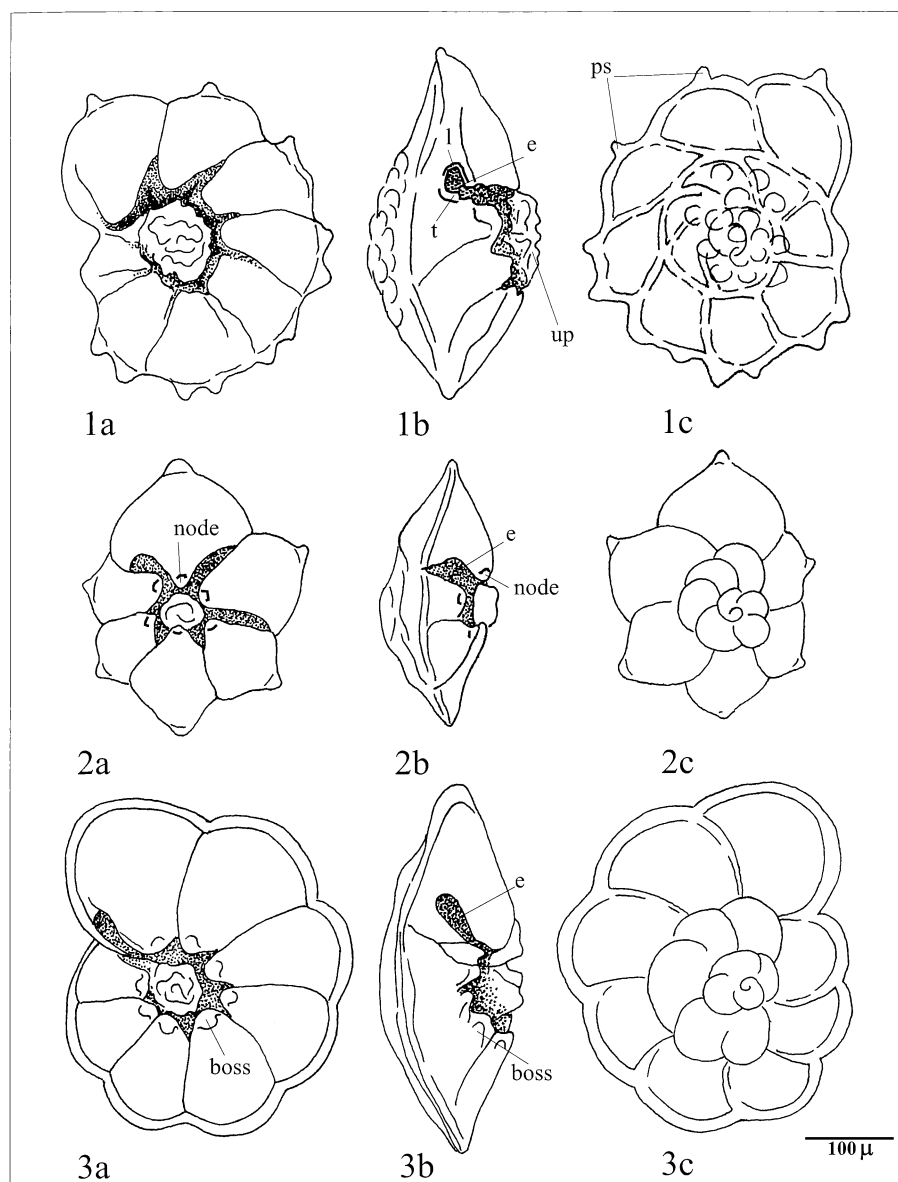
Variability – The main intraspecific variables are:
Coiling: both dextral and sinistral 50:50% (Pl. 1).
Number of chambers: from 7 to 10, with a mean of 8, in the last whorl (Pl. 2, fig. 4 and pl. 3, fig. 1).
Outline: most of the specimens have a stellate, keeled outline with one short pseudospine (Text-fig. 3e; Pl. 2, fig. 3) per chamber. In others specimens, pseudospines are particularly developed and can be two per chamber (Pl. 3, fig. 1d). Commonly these particularly spiny forms also show pustules on the spiral side (Pl. 1, fig. 4a-c; Pl. 2, fig. 3a-c; Pl. 3, fig. 3d). Rare specimens show a more lobate outline, with an extremely thin keel and without pseudospines (Pl. 1, fig. 2a-c; Pl. 3, fig. 1a).
Convexity: the tests are biconvex with a more or less flattened spiral side, and a variable horizontal/vertical diameter ratio (from 0.4 to 0.6), mostly of about 0.5 (Pl. 3, fig. 2).

Remarks – The described features are clearly characteristic of the genus *Pararotalia* (see introduction). The most similar species of the genus *Pararotalia* are *P. armata* (d'Orbigny) and *P. inermis* (Terquem) (Text-fig. 4). *P. padana* differs from *P. armata* (d'Orbigny) in having more chambers in the last whorl (7-10 versus 6-7), a more evident keel with pseudospines and often pustules on the spiral side. Furthermore it is larger than *P. armata* (Text-fig. 4.2a-c) and is not showing the characteristic nodes formed on each chamber at the umbilical shoulder in the latter species.

Pararotalia padana differs from *P. inermis* (Terquem) in having a more stellate outline with pseudospines, less acute periphery and chambers without nodelike elevations at the umbilical shoulders (boss), on the umbilical portion of the chambers (Text-fig. 4.3a-c).

OBSERVATIONS AND CONCLUSIONS

A constant feature of the studied sections is the presence of *P. padana* wherever the generally clayey



Text-fig. 4 - Comparison among *P. padana* n. sp., *P. armata* and *P. inermis* (a = umbilical view, b = lateral view, c = spiral view, e = aperture, l = lip, t = toothplate, up = composite umbilical plug, ps = pseudo-spines). Standardized, uniform magnification: 140X.

1 a-c) *P. padana* n. sp., holotype, pl. 1, fig. 1a-c.

2 a-c) *P. armata* (d'Orbigny), from the original drawings, (Ellis & Messina, vol. 49).

3 a-c) *P. inermis* (Terquem), from the original drawings, (Ellis & Messina, vol. 49).

sediment becomes more coarse-grained. These coarse layers contain mollusc fragments indicating a proximal environment (Lanfranchini, 1997) together with benthic foraminiferal assemblages (*Elphidium* spp., *C. lobatulus*, Miliolids) indicative of warm shallow-waters (Mancin, 1996); this environment is suggested by Hottinger *et al.* (1993) for modern faunas, with a morphology similar to that of *P. padana*, from the Aqaba Gulf (Red Sea) and by Jenkins & Murray (1989) for the similar fossil species (*P. inermis* and *P. serrata*). Moreover, the morphology of *P. padana*, biconvex with a prominent spiral side, is indicative of epifaunal conditions as suggested by studies carried out on the *Ammonia beccarii* gr. from Plio-Pleistocene sediments of the Umbria and Lazio (Parisi & Schiavinotto, 1978; Carboni & Di Bella, 1996).

In conclusion, all the studies performed justify the erection of a new species (*P. padana*) for the peculiar specimens detected. These taxa seem also to have a rather well defined paleoenvironmental and paleoclimatic significance: epifaunal life in warm shallow waters.

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