Rivista Italiana di Paleontologia e Stratigrafia
(*Research in Paleontology and Stratigraphy*)
vol. 122(2): 109-234. **July 2016**

EOCENE, OLIGOCENE AND MIOCENE NATICID GASTROPODS OF NORTHERN ITALY

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To cite this article: Robba E., Pedriali L. & Quaggiotto E. (2016) - Eocene, Oligocene and Miocene naticid gastropods of Northern Italy . *Riv. It. Paleont. Strat.,* 122(2): 109-234.

Key words: Taxonomy, Gastropoda, Naticinae, Poliniceinae, Sininae, Paleogene, Miocene, Northern Italy.

Abstract. The present paper covers 77 species and six subspecies of naticid gastropods occurring in the Eocene, Oligocene and Miocene units of Northern Italy; all are described and commented on in the systematic account. Forty-two taxa are identified as formerly described ones; of these, 16 are associated with a generic name different from the previous one, and four are ranked at a different taxonomic level. Twenty-four taxa are proposed as new and the rest likely represent undescribed species, but more, better preserved material is required in order to establish their identity and to name them. Of the 83 taxa considered, 17 are assigned to the genus *Cochlis* Röding, 1798, one belongs in *Cryptonatica* Dall, 1892, another belongs in *Tanea* Marwick, 1931, 11 are members of the genus *Tectonatica* Sacco, 1890, three are included in *Ampullonatica* Sacco, 1890, one belongs in *Eunaticina* Fischer, 1885, 20 are assigned to *Euspira* Agassiz in J. Sowerby, 1837, three belong in *Neverita* Risso, 1826, five belong in *Payraudeautia* Bucquoy, Dautzenberg & Dollfus,1883, two agree with the characters of *Pliconacca* Cossmann & Martin in Martin, 1914, four are members of *Polinices* Montfort, 1810, two belong in *Sigatica* Meyer & Aldrich, 1886, four belong in *Sigaretotrerma* Sacco, 1890, and nine have the characters of the genus *Sinum* Röding, 1798. All genera are discussed in terms of type species designation, distinctive characters and subfamilial affiliation (when different from the current one). The character analysis has shown that the measurable elements of the protoconch along with its microsculpture (if any) are diagnostic in many species of all subfamilies. The features of the outer surface of the calcareous operculum proved to be diagnostic in the Pliocene and Recent naticine species. In the present case, the operculum of only four *Cochlis* species is known, readily differentiating them from one another. The umbilical characters, i.e. umbilicus width and presence/absence and strength of inner spiral structures, proved to be of variable utility in identifying species. The inner umbilical characters are never species-diagnostic in the case of the naticine taxa, particularly those of *Cochlis*. The inner structures, primarily presence/absence, number and strength of cordlets or threads on the umbilical bottom, are more effective in distinguishing poliniceine taxa. The umbilical callus can be used diagnostically for a limited number of naticine and poliniceine taxa. The exterior sculpture of the teleoconch (absent in the naticine and in most poliniceine taxa) is well developed in all the sinine species. In the case of *Sigaretotrema* and *Sinum*, the sculptural characters proved to be relevant in species recognition. The color pattern is diagnostic in most of the taxa in which this character is preserved. The shell morphology and the apertural characters are relevant only in a few cases. In the absence of diagnostic elements, a combination of all characters can help in recognizing species.

Introduction

The present paper, following another three devoted to the Pliocene naticids of Italy (Pedriali & Robba 2005, 2008a, 2009), examines the Eocene through Miocene naticids and aims to complete the treatment of Italian Tertiary naticids. It covers 77 species and six subspecies (11 of them also dealt with in the cited papers on the Pliocene Naticidae). Of these, 21 occur in the Eocene, 13 in the Oligocene, and 29 in the Miocene. The rest range from Eocene to Oligocene (one), from Oligocene to Miocene (six), from Miocene to Pliocene (seven), and from Miocene to Pleistocene/Recent (five); *Neverita olla* (de Serres, 1829) is the most widely distributed species, collected from Early Oligocene to Pliocene. The Tertiary naticid taxa of Italy identified so far result to be 103 in total (Pedriali & Robba 2005, 2008a, 2009, and present paper). Other species proposed or referred to in the literature (e.g. *Natica achatensis* Recluz, 1841, *N. canovae* Oppenheim, 1901, *N. ottiliae* Penecke, 1885, *N. scapulata* Oppenheim, 1901, *N. viatrix* Vinassa de Regny, 1898) were neither found in the collections examined, nor were

Received: July 15, 2015; accepted: February 7, 2016

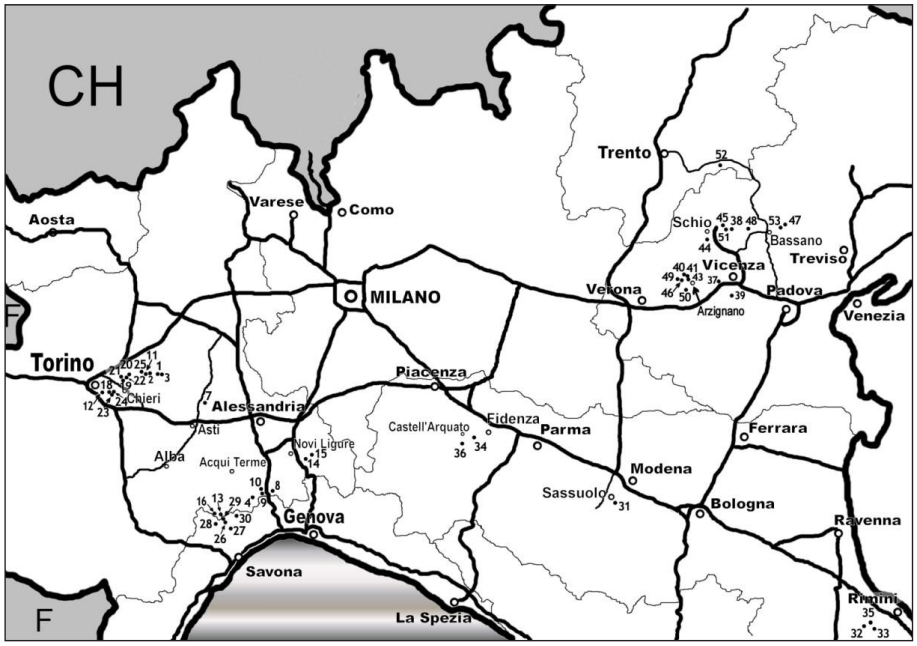


Fig. 1 - Sketch map of Italian naticid localities; locality numbers are those in the Appendix.

they recovered during field work. Further research might increase the total number of naticid taxa indicated above for the Tertiary of Italy.

This study is based on about 5.000 specimens collected from 53 localities of Northern Italy, mostly in Piedmont and Veneto, a few in Liguria and Emilia-Romagna (Fig. 1); brief information on the Italian localities is provided in the Appendix. Additional material relevant to the research, from the Eocene of Great Britain and France, along with specimens from the Miocene of France and The Netherlands, was incorporated. Pertinent naticids in the vast Bellardi-Sacco collection (Museo di Geologia e Paleontologia dell'Università di Torino) and in other public and private collections (see the list in the Systematic account) were examined. Despite the fair to poor preservation of the studied shells, several specimens with preserved apical whorls and/or still retaining the color were present in this large collection. Consequently, the shell characters of most species could be observed and analyzed in terms of range of variation and diagnostic value.

Forty-two taxa (out of 83) are identified as formerly described ones, introduced in the course of the 19th and earliest 20th century; of these, 16 are associated with a generic name different from the previous one, and four are ranked at a different taxonomic level. Twenty-four taxa are herein proposed as new and the rest (17) almost certainly represent undescribed species, but more, better preserved material is required in order to establish their identity and to name them.

Of the eighty-three taxa considered herein, seventeen are assigned to the genus *Cochlis* Röding, 1798, one belongs in *Cryptonatica* Dall, 1892, another belongs in *Tanea* Marwick, 1931, eleven are members of the genus *Tectonatica* Sacco, 1890, three are included in *Ampullonatica* Sacco, 1890, one belongs in *Eunaticina* Fischer, 1885, twenty are assigned to *Euspira* Agassiz in J. Sowerby, 1837, three belong in *Neverita* Risso, 1826, five belong in *Payraudeautia* Bucquoy, Dautzenberg & Dollfus,1883, two agree with the characters of *Pliconacca* Cossmann & Martin in Martin, 1914, four are members of *Polinices* Montfort, 1810, two belong in *Sigatica* Meyer & Aldrich, 1886, four belong in *Sigaretotrerma* Sacco, 1890, and nine have the characters of the genus *Sinum* Röding, 1798.

Morphology and character analysis

For a review of the naticid characters, along with information on the significance accorded to them by different workers, reference can be made to Pedriali & Robba (2005, 2009). The terms indicating the parts of the naticid shells as well as the standard measurements are those adopted by the just cited authors and are shown in Fig. 2. Tables are included in the supplementary file.

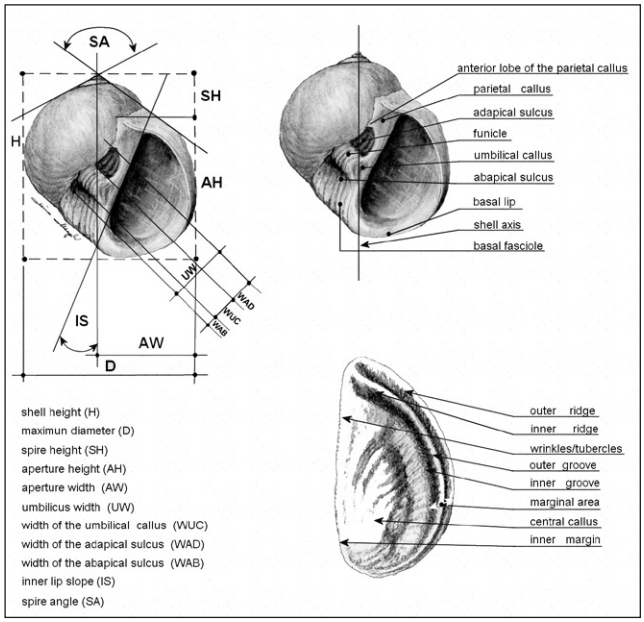


Fig. 2 - Standard measurements and illustrated glossary of the terms used for parts of naticid shell and operulum (from Pedriali & Robba 2005).

Protoconch

Pedriali & Robba (2005) considered the protoconch small when the average value of the diameter falls within a 0.5-1.0 mm range, and regarded a protoconch of 1.226 mm in diameter as medium-sized. The diameter of the initial half-whorl was said to be very small (less than 0.1 mm), small (0.1-0.2 mm), medium-sized (0.3-0.4 mm), and large (greater than 0.4 mm). Based on both the Pliocene taxa (Pedriali & Robba 2005, 2008a, 2009) and those covered herein, the above classification is refined as follows. According to the value of its diameter, the protoconch can be small (0.5-1.0 mm), medium-sized (1.0-1.5 mm), large (1.5-2.0 mm), and very large (greater than 2.0 mm). The diameter of the first half-whorl can be very small (less than 0.1 mm), small (0.1-0.2 mm), medium-sized (0.2-0.4 mm), and large (greater than 0.4 mm).

The plots of Figs. 3-8 show the values (mostly average values) of the characteristic elements of the protoconch pertaining to the taxa dealt with in this paper, which have measurable larval shells (70 out of 83). Most of the considered taxa have a small to medium-sized larval shell, a few (*Euspira piccolii*, *Sigatica eleonorae* and *Sinum cryptostomoides*) have a large protoconch (Figs. 4, 5), and only *Eunaticina* sp. has a very large protoconch (Fig. 4). The diameter of the first half-whorl ranges from very small to medium-sized, whereas it is large only in *Sigatica eleonorae* (Figs. 3-5). Eleven taxa

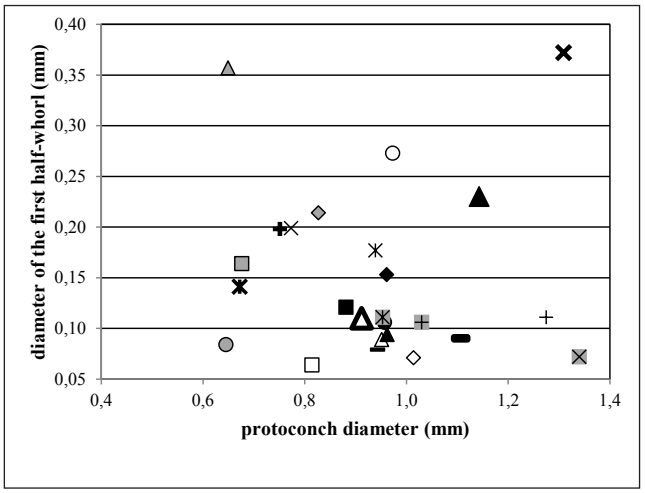


Fig. 3 - Relationship between diameter of the first half-whorl of the protoconch and protoconch diameter in the naticine taxa; solid diamond: *Cochlis craccoi*; open diamond: *C. degrangei*; gray-shaded diamond: *C. epigloafuniculata*; solid circle: *C. epiglopardalis*; open circle: *C. epiglottina epiglottina*; gray-shaded circle: *C. mortoni*; solid triangle: *C. neglecta*; open triangle: *C. pseudovittata*; gray-shaded triangle: *C. raropunctata raropunctata*; solid square: *C. sallomacensis*; open square: *C. separata*; gray-shaded square: *C. tigrina*; multiplication sign: *Cryptonatica noe*; gray-shaded multiplication sign: *Tanea dillwyni koeneni*; bold multiplication sign: *Tectonatica albertii*; cross: *T. astensis*; gray-dashed cross: *T. burtoni altavillensis*; bold cross: *T. consimilis*; asterisk: *T. dertomamilla*; gray-shaded asterisk: *T. miocolligens*; bold asterisk: *T. pasinii*; dash: *T. rupeliana*; bold dash: *T. tectula*; large solid triangle: *Tectonatica* sp. 1; large open triangle: *Tectonatica* sp. 2.

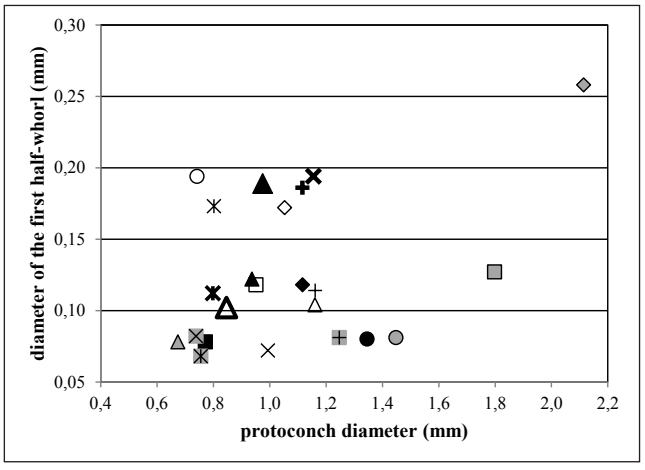


Fig. 4 - Relationship between diameter of the first half-whorl of the protoconch and protoconch diameter in the poliniceine taxa; solid diamond: *Ampullonatica pseudorepressa*; open diamond: *Ampullonatica* sp.; gray-shaded diamond: *Eunaticina* sp.; solid circle: *Euspira gianoi*; open circle: *E. giuntellii*; gray-shaded circle: *E. grossularia*; solid triangle: *E. helicina helicina*; open triangle: *E. latecallosa*; gray-shaded triangle: *E. molarensis*; solid square: *E. notabilis*; open square: *E. perforata*; gray-shaded square: *E. piccolii*; gray-shaded multiplication sign: *E. pulchella*; multiplication sign: *E. submamillaris*; bold multiplication sign: *E. subobturata*; cross: *E. umbilicocarinata*; gray-shaded cross: *E. umbilicolunata*; bold cross: *Euspira* sp. 2; asterisk: *Euspira* sp. 4; gray-shaded asterisk: *Euspira* sp. 5; bold asterisk: *Euspira* sp. 6; large solid triangle: *Neverita maga*; large open triangle: *N. olla*.

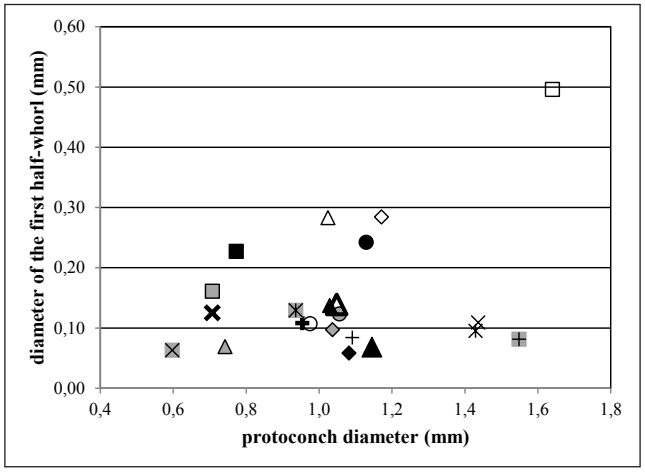


Fig. 5 - Relationship between diameter of the first half-whorl of the protoconch and protoconch diameter in other poliniceine and sinine taxa; solid diamond: *Payraudeautia bituberculata*; open diamond: *P. crassicorda*; gray-shaded diamond: *P. fasciolata*; solid circle: *P. zarantonelloi*; open circle: *Pliconacca plicatulaeformis*; gray-shaded circle: *P. tortonensis*; solid triangle: *Polinices proredemptus*; open triangle: *P. redemptus*; gray-shaded triangle: *P. submamilla*; solid square: *Sigatica claudiae*; open square: *S. eleonorae*; gray-shaded square: *Sigaretotrema checchii*; multiplication sign: *S. clathratum deshayesi*; gray-shaded multiplication sign: *S. michaudi*; bold multiplication sign: *Sigaretotrema* sp.; cross: *Sinum borellense*; gray-shaded cross: *S. cryptostomoides*; bold cross: *S. patulum*; asterisk: *S. paviai*; gray-shaded asterisk: *Sinum* sp. 1; large open triangle: *Sinum* sp. 2; large solid triangle: *Sinum* sp. 3.

(*Cochlis epigloafuniculata*, *C. epiglottina*, *C. raropunctata raropunctata*, *C. tigrina*, *Cryptonatica noe*, *Tectonatica albertii*, *T. consimilis*, *Euspira giuntellii*, *Neverita maga*, *Payraudeautia zarantonelloi* and *Polinices redemptus*) have paucispiral protoconchs reflecting non-planktotrophic larval development; all the other examined taxa possess a multispiral larval shell of two to over three whorls and their larval development is inferred to be planktotrophic (Figs. 6-8).

From the plots published by Pedriali & Robba (2005, 2008a, 2009), it appears 1) that there is a direct correlation between the protoconch diameter and the number of protoconch whorls, and 2) that the size of the initial half-whorl changes inversely with relation to the number of protoconch whorls. The measurements of the specimens considered in the present paper fit with those reported by these authors (graphs omitted). These relationships are reflected by the direct correlation between the PD/DHW ratio and the number of protoconch whorls (Figs. 6-8).

Pedriali & Robba (2005, 2008a, 2009) pointed out that the protoconch shows little variation within a species, since the range of whorl numbers varies by no more than 0.25 whorls and the diameters (protoconch and first half-whorl) vary by less than 20%. This outcome is confirmed herein by the 95% confidence intervals that could be calculated for 48 of the 83 taxa considered (see data in the systematic account). It is worth noting that in the case of several species (35) the protoconch was missing or only one was measurable. Nevertheless, considering that the cited rule is based on a considerable number of Tertiary species, we consider it likely to be valid for the Naticidae in general. It follows that a difference of at least 20-25% in diameter (protoconch and/or initial half-whorl) as well as a half whorl difference in the number of whorls are sufficient to separate species (see also Pedriali & Robba 2005).

The matrices in Tabs. 1-12 consider the same taxa of Figs. 3-8 and are mostly based on average values; single measurements were also incorporated. From these matrices, it appears that the difference in the number of protoconch whorls (Tabs. 1, 4, 7, 10) is diagnostic (significant values in bold type) for several species pairs as are the percent difference in protoconch diameter (Tabs. 2, 5, 8, 11) and the percent difference in diameter of the first half-whorl (Tabs. 3, 6, 9, 12). Since genera have quite distinctive characters, the comments below are presented separately for each genus including at least two species/subspecies.

The values of the characteristic elements of the larval shell (Tabs. 1-3) are diagnostic for six taxa of the naticine genus *Cochlis* (*C. craccoi*, *C. epigloa-*

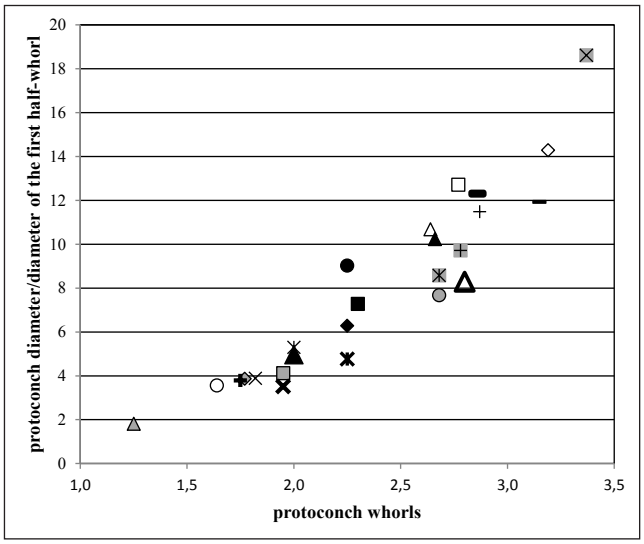


Fig. 6 - Relationship between protoconch diameter/diameter of the first half-whorl ratio and protoconch whorls in the naticine taxa; symbols as in Fig. 3.

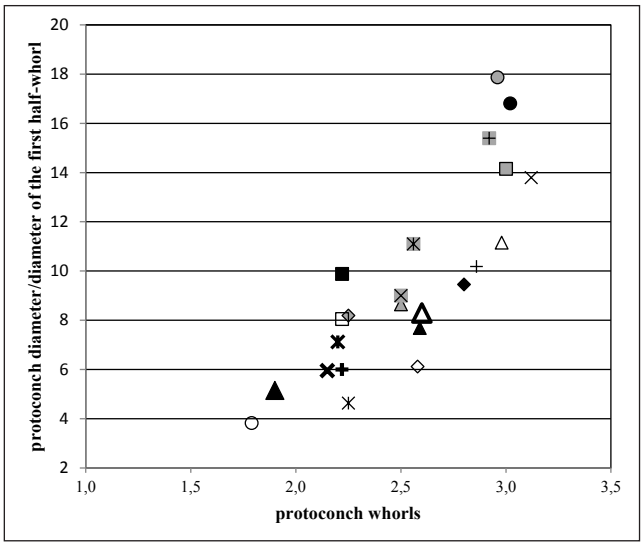


Fig. 7 - Relationship between protoconch diameter/diameter of the first half-whorl ratio and protoconch whorls in the poliniceine taxa; symbols as in Fig. 4.

funiculata, *C. epiglottina epiglottina*, *C. mortoni*, *C. raropunctata raropunctata* and *C. tigrina*). Exceptions are *C. degrangei* whose average values for protoconch whorls, protoconch diameter and diameter of the first half-whorl do not differ significantly from those of *C. separata*; the same happens with the group *C. epiglopardalis*, *C. neglecta* and *C. pseudovittata*, and with the pair *C. epiglopardalis-C. sallomacensis*.

The characteristic elements of the protoconch (Tabs. 4-6) are diagnostic for five taxa of the naticine genus *Tectonatica* (*T. albertii*, *T. consimilis*, *T. dertomamilla*, *T. pasinii* and *Tectonatica* sp. 1). No significant difference resulted for the group *T. astensis*, *T. burtoni altavillensis* and *T. tectula*, for the group *T. burtoni altavillensis*, *T. miocolligens* and *Tectonatica* sp. 2. The protoconch characters fail to distinguish *T. miocolligens* from *T. tectula*, *T. rupeliana* from *T. tectula* and *T. tectula* from *Tectonatica* sp. 2.

Tabs. 7-9 (poliniceine taxa) show that *Ampullonatica* sp. is readily differentiated from *A. pseudorepressa* by its significantly greater diameter of the first half-whorl. The considered protoconch characters distinguish *Euspira piccolii* and *E. submamillaris* from one another and from all the other *Euspira* taxa. Exceptions are: 1) *E. gianoi* differs from all except for *E. grossularia* and *E. umbilicolunata*; 2) *E. giuntellii* is differentiated from all, but not from *Euspira sp. 4*; 3) *E. helicina helicina* does not differ significantly from *E. latecallosa*, *E. perforata*, *E. umbilicocarinata* and *Euspira* sp. 6; 4) *E. molarensis*, *E. notabilis*, *E. pulchella* and *Euspira* sp. 5 have similar protoconch characters. Lastly, for the species pair *Neverita maga-N. olla*, the examined characters of the larval shell distinguish the two species adequately.

From Tabs. 10-12, it appears that the examined characters of the larval shell are significant elements in distinguishing the species of the poliniceine genera *Polinices* and *Sigatica* from one another. The same happens for the species of the genus *Payraudeautia* (also poliniceine), with the sole exception of the pair *P. crassicorda-P. zarantonelloi*. The other two poliniceine species *Pliconacca plicatulaeformis* and *P. tortonensis* have similar protoconch characters and cannot be differentiated on this basis. For the sinine genus *Sigaretotrema*, the characters of the larval shell distinguish species efficiently. As regards the genus *Sinum*, the following remarks can be made: 1) *S. borellense* differs significantly from all the other species except for *Sinum* sp. 3, 2) *S. cryptostomoides* also from all the other, but not from *S. paviai*, 3) *S. patulum* has protoconch characters that differ from those of *S. paviai*, *Sinum* sp. 2 and *Sinum* sp. 3, and 4) *Sinum* sp. 1 is differentiated from *S. cryptostomoides*, *S. paviai* and *Sinum* sp. 3. Tab. 13 summarizes the differences between species on the basis of measurable characters of the larval shell.

Bandel (1999), dealing with the protoconch of the naticids, affirmed that "the embryonic whorl is normally ornamented with simple tubercles and the larval shell is covered by more or less visible spiral lirae". He also remarked that "the larval shell

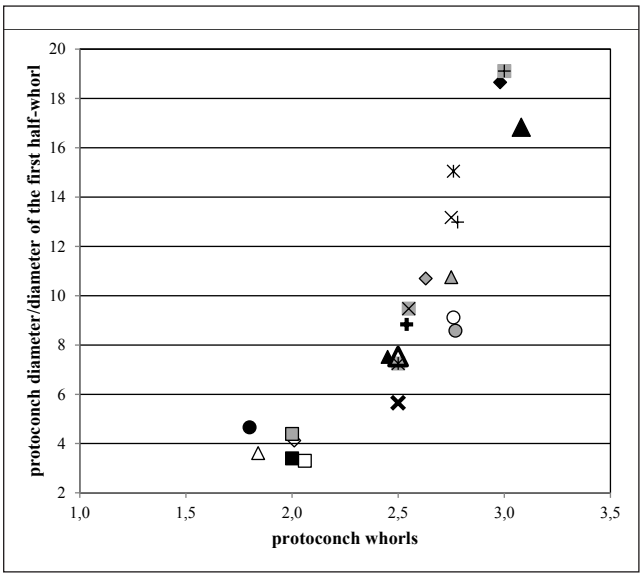


Fig. 8 - Relationship between protoconch diameter/diameter of the first half-whorl ratio and protoconch whorls in other poliniceine and sinine taxa; symbols as in Fig. 5.

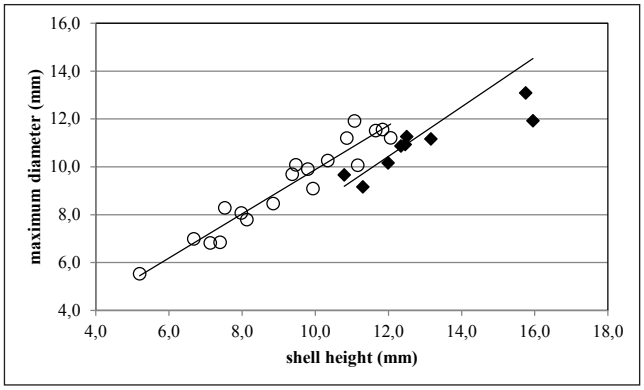


Fig. 9 - Relationship between maximum diameter and shell height (species of *Tectonatica*); open circles: *T. albertii* and *T. burtoni altavillensis* combined; solid diamonds: *T. pasinii*.

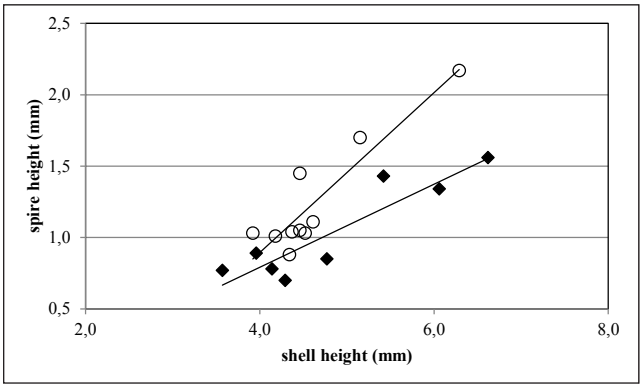


Fig. 10 - Relationship between spire height and shell height (species of *Tectonatica*); open circles: *T. tectula*; solid diamond: *T. consimilis*.

consists of quite a lot of organic material and after metamorphosis usually acquires a more or less corroded appearance"; this fact was also reported for many gastropod families by Hickman (2004, p. 206). We recovered several shells of Tertiary naticids with well preserved protoconchs, either smooth or bearing spiral microsculpture, which may consist of threads or rows of granules restricted to the apical whorl, or of threads present on subsequent whorls, throughout or only over the last whorl. Taking into account Bandel's and Hickman's remarks cited above, we think that the unsculptured protoconchs are to be considered really smooth when excellently preserved (mostly Pliocene to Recent material), or apparently smooth in all other instances (Eocene to Miocene material). The protoconch microsculpture seems to occur rarely in the species of *Cochlis* and was never observed in the species of the other naticine genera considered here (*Cryptonatica, Tanea, Tectonatica*). Instead, it is more common in the poliniceine and sinine species, in particular those of *Euspira* and *Sinum*. Pedriali & Robba (2009, pp. 375, 378) stated that the microsculpture of the larval shell (presence/absence, location on the larval shell, morphological details) may constitute an additional distinctive character of the protoconch, useful in distinguishing species. Concerning the present material, the ornamentation of the protoconch is useful in the case of a few Miocene taxa; it was never recorded in the Eocene and Oligocene ones, most probably because of lack of preservation. Tab. 14 lists those taxa whose protoconch retains the microsculpture (or is certainly smooth) and shows the differences between species based on this character.

The present study fully confirms the conclusion of Pedriali & Robba (2009, p. 378), i.e. that the larval shell is a most relevant element for distinguishing species within each genus, even if not constantly species-diagnostic. The measurable characters of the protoconch are equally effective in all the three subfamilies dealt with in this paper (see Tab. 13).

Teleoconch

The diagnostic value of the teleoconch characters of naticids was amply discussed by Pedriali & Robba (2005, 2008a, 2009) largely on the basis of statistical analyses. These authors questioned the taxonomic importance accorded to most teleoconch characters in major accounts of naticids published during the last decades (Cernohorsky 1971; Kilburn 1976; Marincovich 1977; Majima 1989). In the following, measurable characters suitable for statistical analysis are considered along with other qualitative (non measurable) features in order to verify once more the conclusions reported on in the papers of Pedriali & Robba cited above. Since genera have quite distinctive characters (see comments in the systematic account), the statistical treatment of species was executed separately for each genus. The coefficients of correlation for each considered pair of characters were significant for all the studied taxa (r = 0.74-0.96). For brevity, only the relevant scatters will be presented; pairs or single characters not discussed herein are of scarce relevance in species recognition.

Shell shape. As already stated by Pedriali & Robba (2005), the shell shape can be defined statistically on the basis of the relations between 1)

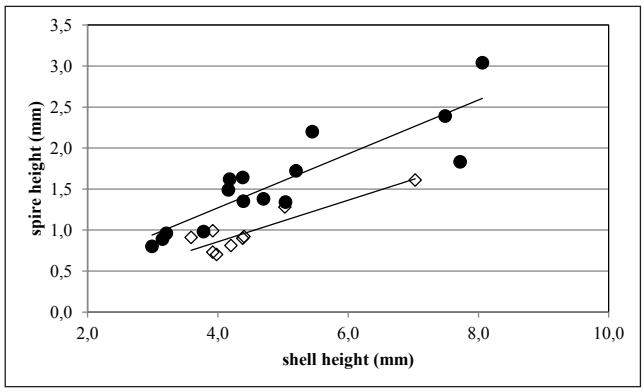


Fig. 11 - Relationship between spire height and shell height (species of *Euspira*); solid circles: *E. gianoi*; open diamonds: *E. grossularia*.

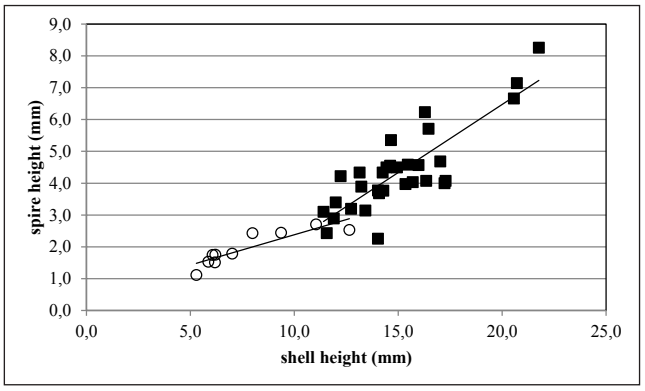


Fig. 13 - Relationship between spire height and shell height (species of *Pliconacca*); solid squares: *P. plicatulaeformis*; open circles: *P. tortonensis*.

maximum diameter and shell height, 2) spire height and shell height, and 3) by the values of the spire angle.

The relation between maximum diameter and shell height proved to be useless in distinguishing species except for one case. In *Tectonatica*, the regression line for *T. pasinii* and that for *T. albertii* and *T. burtoni altavillensis* combined have similar slope, but significantly different elevation (Fig. 9). This means that, for a given height of the shell, *T. pasinii* attains a smaller diameter (or has a comparatively taller shell) than both *T. albertii* and *T. burtoni altavillensis*.

In *Tectonatica*, the plot of spire height against the height of the shell shows that the regression lines for *T. tectula* and *T. consimilis* have a remarkably different slope (Fig. 10). *T. tectula* can be distinguished from *T. consimilis* by having a more elevated spire, which grows much faster with increasing shell height. For this same relationship in

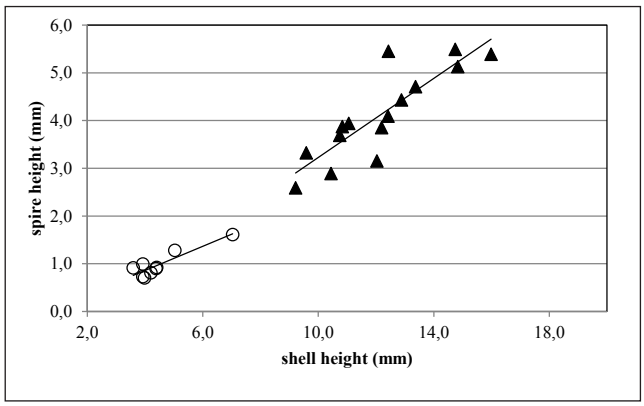


Fig. 12 - Relationship between spire height and shell height (species of *Euspira*); open circles: *E. grossularia*; solid triangles: *E. umbilicolunata*.

Euspira, it appears that *E. grossularia* differs from *E. gianoi* in that it has a lower spire (Fig. 11). The same occurs if *E. grossularia* is compared to *E. umbilicolunata*; moreover, the spire of *E. umbilicolunata* grows more rapidly with increasing shell height (Fig. 12). In *Pliconacca*, the plot of spire height against the height of the shell shows that the lines for *P. tortonensis* and *P. plicatulaeformis* have a different slope (Fig. 13); the spire of *P. plicatulaeformis* grows much faster with increasing shell height than that of *P. tortonensis*, which attains a smaller size.

The spire angle varies considerably in the taxa considered herein and can hardly serve to differentiate the species and the subspecies within each genus since respective 95% confidence intervals largely overlap in most cases. From Tab. 15 it will be seen that the spire angle helps in distinguishing *Tectonatica miocolligens*, *T. pasinii* and *T. rupeliana* from the other *Tectonatica* taxa, but not from one another. In *Euspira*, *E. giuntellii* is readily separated on the basis of the spire angle from *E. gianoi*, *E. helicina helicina*, *E. notabilis*, *E. pulchella*, *E. submamillaris* and *E. umbilicolunata*. In *Sinum*, *S. oligopolitum* can be distinguished from *S. borellense* and *S. patulum*. This character fails to distinguish species of *Cochlis*, *Neverita*, *Payraudeautia*, *Pliconacca*, *Polinices*, *Sigatica* and *Sigaretotrema*.

Aperture. In order to define quantitatively the aperture, Pedriali & Robba (2005) used the relationships between 1) aperture width and aperture height, 2) aperture height and height of the shell, 3) aperture width and maximum diameter, and 4) the values of the inner lip slope.

In *Pliconacca*, the relationship between aperture width and aperture height distinguishes *P. torto-*

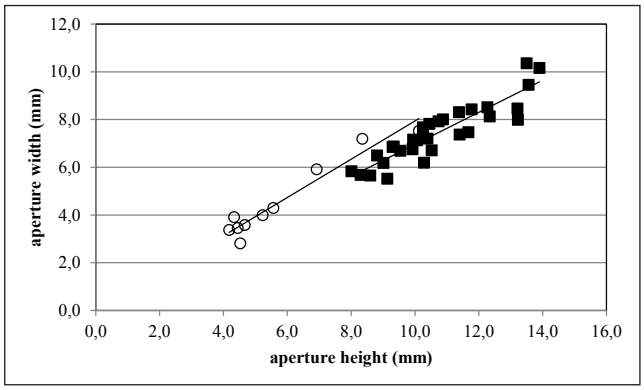


Fig. 14 - Relationship between aperture width and aperture height (species of *Pliconacca*); solid squares: *P. plicatulaeformis*; open circles: *P. tortonensis*.

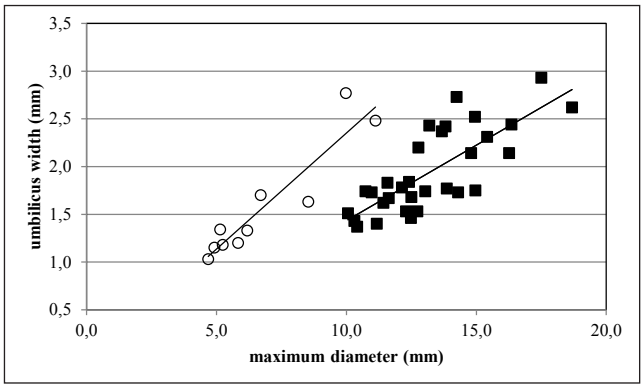


Fig. 16 - Relationship between umbilicus width and maximum diameter (species of *Pliconacca*); open circles: *P. tortonensis*; solid squares: *P. plicatulaeformis*.

nensis from *P. plicatulaeformis* since their regression lines have significantly different elevations (Fig. 14). For a given height, the width of the aperture is greater in *P. tortonensis* than in *P. plicatulaeformis*.

The inner lip slope (inclination of the inner lip to the shell axis) appears to be scarcely important in distinguishing species, since the 95% confidence intervals (Tab. 16) in most cases largely overlap and do not allow any reliable separation. However, a few exceptions are to be noted. In *Tectonatica*, the confidence interval of *T. dertomamilla* only slightly overlaps those of *T. consimilis* and of *T. pasinii*, most specimens of which have values of the inner lip slope greater than those of *T. dertomamilla*. Something similar occurs in *Pliconacca*; most specimens of *P. plicatulaeformis* have values of the inner lip slope greater than those of *P. tortonensis*. In *Sinum*, the inclination of the inner lip differentiates both *S. borellense* and *S. oligopolitum* from *S. patulum* and *Sinum* sp. 3, but not the species of each pair from one another. This character proved to be useful also in the case of two Pliocene species of *Sinum* (cf. Pedriali & Robba 2009, p. 380). It seems that the inclination of the inner lip could be more effective in separating species in *Sinum* than in all the other genera considered herein.

The parietal callus is of little use in species recognition; it is thick, subrectangular in almost all taxa and the anterior lobe is present in many species, absent in many others. However, the parietal callus is species-diagnostic in the case of *Payraudeautia bituberculata*, which is readily differentiated from the other species of the genus by its parietal callus with a rounded knob at both ends (see remarks in the systematic account).

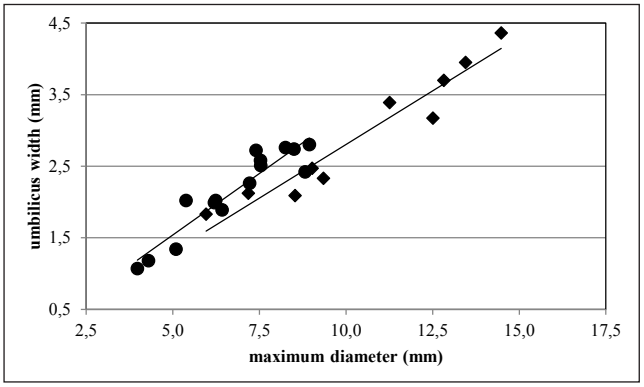


Fig. 15 - Relationship between umbilicus width and maximum diameter (species of *Payraudeautia*); solid circles: *P. crassicorda*; solid diamonds: *P. zarantonelloi*.

Umbilical characters. The statistical analysis focused on the relationships between 1) umbilicus width and maximum diameter and 2) width of the umbilical callus and maximum diameter.

The first relationship proved to be useful in a few cases. In *Payraudeautia*, when the umbilicus width is regressed against maximum diameter (Fig. 15), it appears that the regression lines for *P. crassicorda* and *P. zarantonelloi* have rather similar slope, but significantly different elevation. This means that most specimens of *P. crassicorda*, for a given size of the shell, have a wider umbilicus than those of *P. zarantonelloi*. In *Pliconacca* (Fig. 16), the regression lines for *P. tortonensis* and *P. plicatulaeformis* have different slope and markedly different elevation, i.e. *P. tortonensis* has a significantly wider umbilicus than *P. plicatulaeformis*.

The plot of width of the umbilical callus against maximum diameter in species of *Cochlis*

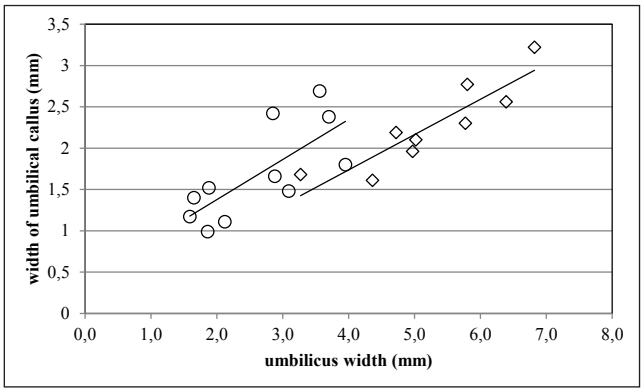


Fig. 17 - Relationship between width of umbilical callus and umbilicus width (species of *Cochlis*); open circles: *C. degrangei*; open diamonds: *C. infelix*.

shows that *C. degrangei* can be distinguished from *C. infelix* by the greater elevation of the regression line (Fig. 17); for a given size of shell, the umbilical callus of *C. degrangei* is significantly broader than that of *C. infelix*.

On the basis of Tab. 17, which summarizes the inner umbilical characters, the following notes can be made.

1. In *Cochlis*, these characters are never species-diagnostic. However, their combination readily differentiates *C. mortoni* from *C. separata*. The strength of the funicle can serve for distinguishing *C. craccoi*, *C. epiglottina epiglottina*, *C. neglecta*, *C. pseudovittata*, *C. sallomacensis* and *Cochlis* sp. 1 (funicle cord-like, thick and prominent) from *C. degrangei*, *C. epigloafuniculata*, *C. infelix*, *C. rossii* and *Cochlis* sp. 2 (funicle broad and depressed).

2. In *Ampullonatica*, the inner spiral sculpture of *Ampullonatica* sp. easily differentiates it from *A. pseudorepressa* and *A. repressa*.

3. In *Euspira*, the inner spiral sculpture separates *E. perforata*, *E. piccolii* and *Euspira* sp. 3 from one another and from all the other *Euspira* taxa. The characters of the inner spiral furrow are relevant in identifying *E. subobturata*, *E. umbilicocarinata*, *Euspira* sp. 1, *Euspira* sp. 4 and *Euspira* sp. 6, but fail to distinguish *E. subobturata* from *Euspira* sp. 1 and *Euspira* sp. 4 from *Euspira* sp. 6. The funicle is scarcely useful: at most its absence can serve in separating *E. molarensis*, *E. perforata*, *E. piccolii* and *Euspira* sp. 3 from the other *Euspira* taxa.

4. In *Payraudeautia*, the inner umbilical characters combined are distinctive and readily separate the species from one another.

5. In *Pliconacca*, *P. tortonensis* is differentiated from *P. plicatulaeformis* because of its spiral furrow bounded abaxially by a groove.

6. In *Sigatica*, the number and strength of the inner spiral cordlets serves for differentiating *S. claudiae* from *S. eleonorae*.

7. In *Sigaretotrema*, the pair *S. checchii* and *Sigaretotrema* sp. differs from the pair *S. clathratum deshayesi* and *S. michaudi*, which are characterized by the presence of inner spiral threads; this same character does not distinguish the taxa of the latter pair from one another.

The umbilical callus, absent in all the sinine taxa, is rather thick to thick in the naticine and in the poliniceine species. Focusing on its shape and its demarcation (if any) from the parietal callus (Tab. 18), the following remarks can be made.

1. In *Cochlis*, *C. epigloafuniculata* is distinguished from all the other taxa of the genus listed in Tab. 18 because of the shape of its umbilical callus and the absence of demarcation from the parietal callus. The combination of the two cited characters differentiates *C. degrangei*, *C. tigrina* and *Cochlis* sp. 2 from one another and from the other *Cochlis* taxa. *C. craccoi* and *C. epiglopardalis*, which have a semicircular umbilical callus separated from the parietal callus by a shallow notch, are differentiated from *C. epiglottina epiglottina*, *C. mortoni*, *C. neglecta*, *C. pseudovittata* and *Cochlis* sp. 1, also with semicircular umbilical callus, but with a deep, narrow notch in between it and the parietal callus. The depressed, arched umbilical callus separated from the parietal callus by a shallow notch distinguishes *C. infelix*, *C. raropunctata raropunctata* and *C. rossii* from the other *Cochlis* taxa. *C. sallomacensis* and *C. separata*, both with a roundly triangular umbilical callus, can be distinguished from one another because of their different notches (broad and shallow in *C. sallomacensis*, narrow and deep in *C. separata*); the characters of the umbilical callus differentiate these two taxa also from the others. From the above, it appears that the umbilical callus is species-diagnostic in a few *Cochlis* taxa. In most cases, it serves for distinguishing a group of taxa from another group.

2. In *Tectonatica*, the umbilical callus is never species-diagnostic since it varies slightly in shape and extent in most taxa. However, the large, semicircular umbilical callus of *T. consimilis* and *T. tectula* readily separates these species from all the others of the genus, but not from one another. Further, *T. miocolligens* and *Tectonatica* sp. 2 are the sole taxa

whose umbilical callus is demarcated from the parietal callus by a notch.

3. In *Euspira*, the umbilical callus, obsolete in a few species, exhibits little difference in shape, being slenderly triangular or subtriangular in most species, roundly triangular in a few; its abapertural outline can be straight, arched, reverse S-shaped, or reverse J-shaped. Accordingly, this character appears to scarcely useful in distinguishing species. The unique exception concerns *E. latecallosa*, whose unusually wide umbilical callus with convex adaxial outline differentiates it from all the other species of the genus.

4. In *Neverita*, the umbilical callus appears to be species-diagnostic in the case of the three species considered here.

5. In *Payraudeautia*, *P. bituberculata* and *P. fasciolata* have similar characters of the umbilical callus, which distinguish them from the pair *P. crassicorda* and *P. intricata*, also with similar umbilical callus characters. The umbilical callus is diagnostic in the case of *P. zarantonelloi*.

6. In *Pliconacca*, the umbilical callus is diagnostic in the case of the two species dealt with here.

7. In *Polinices*, the subrectangular umbilical callus distinguishes *P. redemptus* and *P. submamilla* from *P. proredemptus* and *Polinices* sp., which have a subcircular umbilical callus.

Outer surface. Taxa of the naticine genera (*Cochlis*, *Cryptonatica*, *Tanea*, *Tectonatica*) and of most poliniceine genera (*Euspira*, *Neverita*, *Payraudeautia*, *Pliconacca*, *Polinices*) have unsculptured shells, whose outer surface bears only growth lines, changing into subsutural wrinkles in a few species. A faint spiral microstriation occurs on the last whorl in some species of *Cochlis* (*C. epigloafuniculata*, *C. epiglottina epiglottina*, *C. neglecta*, *C. raropunctata raropunctata*, *C. rossii*), of *Euspira* (*E. grossularia*, *E. helicina helicina*, *E. notabilis*, *Euspira* sp. 6), and of *Pliconacca* (*P. tortonensis*).

A spiral sculpture of ribbons, cords and threads is always present in the poliniceine genera *Eunaticina* and *Sigatica*, and in all the sinine species.

In the case of *Sigaretotrema* and *Sinum*, the observed differences in ornamentation details proved to be relevant in species recognition (see remarks on species in the Systematic account).

Pedriali & Robba (2005, 2008a, 2009), dealing with Pliocene naticids, noted that several species have distinctive background color and/or color patterns. Unfortunately, this character is poorly preserved or not preserved at all in many older, Tertiary taxa; nevertheless, we tried to define this character of the shell surface whenever possible. In the case of those taxa ranging also into the Pliocene, the respective color patterns cited by Pedriali & Robba have been considered. The results are shown in Tab. 19. As can be seen, the pre-Pliocene taxa *Cochlis epiglopardalis*, *C. epiglottina epiglottina*, *C. pseudovittata*, *C. sallomacensis* and *C. tigrina* have distinctive color patterns, which distinguish them from one another. In *Tectonatica*, *T. consimilis* can be readily differentiated from the other *Tectonatica* taxa on the basis of its pale brown, quadrangular spots forming spiral rows. In *Euspira*, *E. grossularia*, *E. helicina helicina*, *E. notabilis* and *E. pulchella*, which extend their range subsequent to the Miocene, can be safely identified by respective color patterns (Pedriali & Robba 2009). In the case of the other *Euspira* taxa considered here, the color does not help since it is not preserved, or exhibits similar patterns (*E. gianoi*, *E. submamillaris*, *E. subobturata*, *Euspira* sp. 2). In *Neverita*, *N. antiqua* and *N. olla*, which co-occur in the Early Oligocene, are readily recognized because of their markedly different color patterns. In *Polinices*, the color pattern unambiguously differentiates *P. proredemptus* from *P. redemptus*. The pattern of brown crescent-shaped marks arranged into collabral alignments occurring in *P. redemptus* seems to be peculiar of this species and likely distinguish it from all the other *Polinices* taxa described so far.

Operculum. Pedriali & Robba (2009) noted that the calcareous operculum is constantly species-diagnostic in the case of the Pliocene taxa of the naticine genera *Cochlis* and *Tectonatica*. Concerning the present material, the operculum of most naticine taxa is unknown. Only a few shells of four *Cochlis* species (*C. epiglopardalis*, *C. neglecta*, *C. sallomacensis* and *C. tigrina*) were recovered with the operculum still filling the aperture. These four *Cochlis* species can be readily differentiated from one another and from *C. raropunctata raropunctata* and *C. epigloafuniculata* (opercula described by Pedriali & Robba 2005, 2008a) on the basis of respective opercular characters. Our findings seem to agree with the cited statement of Pedriali & Robba (2009), at least as regards the species of *Cochlis*.

From the character analysis reported above, it appears that the concluding remarks on the

characters of the Pliocene naticids provided by Pedriali & Robba (2009) are largely confirmed and can be extended to the whole Tertiary Naticidae. Basic points are the following.

1. The protoconch shape is useless since it is constant in all naticids. Conversely, its measurable elements (number of whorls, diameter and diameter of the first half-whorl) along with its eventual microsculpture are valuable characters, species-diagnostic in most cases. The larval shell appears to be equally effective in all naticid subfamilies. The protoconch is diagnostic only at the species level, whereas it does not serve in distinguishing genera because identical protoconchs occur in species of different genera.

2. The use of shell morphology, largely adopted by previous authors in defining species, is a much subjective approach, which has led to the misinterpretation of several taxa. Statistical analysis (Pedriali & Robba 2005, 2008a, 2009; present paper) has shown that the shell shape is of scarce value, since it helps to distinguish species only in a few cases.

3. The apertural proportions, the inner lip slope and the parietal callus are of little use in species recognition; in the case of *Sinum*, the inclination of the inner lip seems slightly more effective in separating species.

4. The umbilical characters, i.e. umbilicus width and presence/absence and strength of inner spiral structures, proved to be of variable use in identifying species. The width of the umbilicus (related to maximum diameter of the shell) is useful in very few cases, as is the relationship between width of umbilical callus and maximum diameter. The inner umbilical characters are never species-diagnostic in the case of the naticine taxa, particularly those of *Cochlis*; at most they distinguish one group of species from another. The inner structures, primarily presence/absence, number and strength of cordlets or threads on the umbilical bottom, are more effective in distinguishing poliniceine taxa. The umbilical callus can be used diagnostically for a limited number of naticine and poliniceine taxa.

5. The exterior sculpture of the teleoconch (absent in the naticine and in most poliniceine taxa) is well developed in all the sinine species. In the case of *Sigaretotrema* and *Sinum*, the sculptural characters proved to be relevant in species recognition.

6. The color is the other property of the shell surface; in particular, the color pattern is diagnostic in most of the taxa in which this character is preserved.

7. The calcareous operculum is another relevant character in identifying the naticine species. Pedriali & Robba (2009) noted that the operculum is constantly species-diagnostic in the case of Pliocene taxa, in particular those of *Cochlis* and of *Tectonatica*. Also the opercula dealt with herein (six species of *Cochlis* occurring in the Miocene) differ from one another and likely are species-diagnostic. Unfortunately, specimens are seldom recovered with the operculum *in situ* and this constitutes an obvious constraint in the use of this solid accessory of the shell when Miocene or older material is considered.

8. In summary, the protoconch (all subfamilies) and the operculum (Naticinae) are the most important elements, diagnostic in many species. The other characters can be ranked in descending order of importance as follows: a) sculpture (Sininae), b) color patterns, c) umbilical characters, d) apertural characters (mostly the inner lip slope and the parietal callus), and e) shell morphology. In the absence of the primary characters (lack of preservation), a combination of the others can help in recognizing species.

Systematic paleontology

We follow a traditional (basically typological) classification. The suprageneric arrangement is that adopted in major accounts of naticids published during the last decades (Kilburn 1976; Marincovich 1977; Majima 1989; Kabat 1991; Torigoe & Inaba 2011), with some modifications.

The bulk of the studied material is housed in the Museo di Paleontologia dell'Università, Milano, Italy (MPUM in the following) and in Museo di Archeologia e Scienze Naturali "G. Zannato", Montecchio Maggiore, Italy (MCZ in the following); the rest is kept as reference material in the authors' collection (NP), Università di Milano Bicocca, Dipartimento di Scienze dell'Ambiente e del Territorio e di Scienze della Terra, Sezione Scienze Geologiche e Geotecnologie, Milano, Italy. Other abbreviations for institutions cited in the text as repositories of relevant material are as follows: BGR, Bundesanstalt für Geowissenschaften und Rohstoffe, Berlin, Germany; EM, École des Mines collection (including Deshayes' original fossil specimens) presently curated by Université de Lyon 1, France; IPUM, Museo dell'Istituto di Paleontologia dell'Università di Modena (including Coppi, Doderlein and Foresti collections) presently curated by Dipartimento di Scienze Chimiche e Geologiche, Università di Modena e Reggio Emilia, Italy; MB, Museum für Naturkunde, Berlin, Germany; MCV, Museo Civico D. Dal Lago, Valdagno, Italy; MGC, Museo Geologico G. Cortesi, Castell'Arquato, Italy; MGP-PD, Museo di Geologia e Paleontologia dell'Università di Padova, Italy; MGPT, Museo di Geologia e Paleontologia dell'Università di Torino, Italy (MGPT BS: Bellardi-Sacco collection presently curated by Museo Regionale di Scienze Naturali, Torino); MHNG, Museum d'Histoi-

re Naturelle, Geneva, Switzerland; MPPLF, Museo Paleontologico e Preistorico "P. Leonardi", Università di Ferrara, Italy; MS, Musei Civici di Imola-Museo Scarabelli, Imola, Italy; MZB, Museo di Zoologia, Università di Bologna, Italy; MNHN, Muséum National d'Histoire Naturelle, Paris, France; NHM (formerly BMNH), Natural History Museum, London, Great Britain; NHMW, Naturhistorisches Museum, Wien, Austria; RGM, Nationaal Naturhistorisch Museum, Naturalis, Leiden, Holland. Valuable additional material was lent by Forli collection (MF), Prato, Italy, Giuntelli collection (PG), Nole (Torino), Italy, Lesport collection (L), Sainte-Hélène, France, Magenes collection (PPMM), Milano, Italy, and Petracci collection (PP), Cesena, Italy.

The citations, which are verifiable in that enclose adequate description and/or illustration of species, and other citations referring to material that has been directly examined by the present authors, are included in the synonymies. Other citations, poorly documented or not documented at all, are considered uncertain references and are usually excluded from the synonymies.

Several species covered in previous papers devoted to the Pliocene naticids (Pedriali & Robba 2005, 2008a, 2009) were recovered also from Oligocene to Miocene units. For their description and remarks, reference should be made to the cited papers. Unless otherwise stated, the average values of the dimensions have been recalculated on the basis of cumulated measurements of Pliocene and new Oligocene and/or Miocene specimens.

Symbols for shell dimensions (see Fig. 2) are: DHW, diameter of the first half-whorl of the protoconch; PD, diameter of the protoconch; H, height of the shell; D, maximum diameter; SH, height of the spire; AH, height of the aperture; AW, width of the aperture; UW, width of the umbilicus; WUC, width of the umbilical callus; WAD, width of the adapical sulcus; WAB, width of the abapical sulcus; IS, inner lip slope; SA, spire angle. Unless otherwise stated, for each dimension, ranges in the upper row are 95% confidence intervals, figures in the lower row are average values. In the description of species, the aperture length is the distance between adapical and abapical ends measured in the plane of the aperture; obviously, it does not coincide with the aperture height.

Family Naticidae Guilding, 1834

The family name Naticidae, currently attributed to Forbes (1838), was validly introduced four years earlier by Guilding (1834), who has the authorship of the name (Kabat 2000, p. 352; see also Huelsken et al. 2012).

Subfamily Naticinae Guilding, 1834

The genera included in this subfamily have teleoconchs of variable shape, mostly smooth; the umbilicus is open in most genera, but largely filled by the umbilical callus in some; a variably robust funicle is often present. Most authors concur in considering the presence of a thick, solid calcareous operculum, sometimes with a corneous inner layer, as a distinctive character of the naticine genera (Cernohorsky 1971; Kilburn 1976; Marincovich 1977; Majima 1989; Wilson 1993; Kabat 1998; Pastorino 2005; Huelsken et al. 2008).

Genus *Cochlis* Röding, 1798

Cochlis Röding, 1798, p. 146. Type species by subsequent designation (Hedley 1916, p. 51): *Cochlis flammea* Röding, 1798 (= *Nerita vittata* Gmelin, 1791), Pliocene (Italy) to Recent (western Mediterranean, East Atlantic).

Remarks. Cernohorsky (1971) and Torigoe & Inaba (2011, p. 69) regarded *Cochlis* as a synonym of *Natica* Scopoli, 1777 evidently relying upon the later designation of *Cochlis albula* Röding, 1798 (= *Nerita vitellus* Linnaeus, 1758 type species of *Natica*) as type species of *Cochlis* made by Iredale (1924, p. 254). Since the earlier type species fixation by Hedley (1916) is valid ((ICZN 1999, Article 69.1 of the Code) and the later fixation by Iredale (1924) is invalid (ICZN 1999, Article 70.2 of the Code), we concur with Oyama (1985) and Kabat (1991) in considering *Cochlis* as a distinct, valid genus. Kabat (1990, p. 10) thoroughly discussed *Natica vitellus* and regarded *Nerita spadicea* Gmelin, 1791 (= *Cochlis albula* according to Torigoe & Inaba 2011) as another synonym of *N. vitellus*.

The distinctive characters of *Cochlis* were outlined by Pedriali & Robba (2005) and are refined herein as follows: 1) protoconch low-turbiniform of 1.25-3.5 smooth whorls, protoconch I with spiral rows of ganules in a few species, 2) teleoconch thin to solid, globose to depressed-globose, body whorl moderately expanded, 3) spire rather depressed to moderately elevated, 4) suture adpressed to channeled, 5) parietal callus thin to thick, short in most species, with poorly developed to indistinct anterior lobe, 6) umbilicus rather small to large, 7) funicle present, thread-like to thick, completely filling the umbilicus in a few species, 8) umbilical callus small to broad, separated from the parietal callus by a reverse J-shaped notch in most species, and 9) outer surface of the operculum with two-three marginal ribs. As already noted by Pedriali & Robba (2005), the characters of the parietal callus, of the umbilicus, and of the operculum combined constitute the primary diagnostic elements of *Cochlis*. The species belonging in the genus *Natica* are distinguished from those of *Cochlis* in that they have: 1) the anterior lobe of the parietal callus well developed, hindering the adapical part of the umbilicus at various extent, 2) the funicle absent or vestigial, and 3) the umbilical callus absent to weak. The presence of a well-defined funicle (regardless of its strength) distinguishes *Cochlis* from *Natica*. The species of the

genus *Naticarius* Duméril, 1806 have the teleoconch similar to that of *Cochlis*, but their opercula have the outer surface with many ribs instead of two-three.

The operculum of most species, herein included in *Cochlis* on the basis of their umbilical characters (primarily the presence of a well developed funicle), is unknown. Future recovering of specimens with the operculum *in situ* may prove that some of them deserve a different generic assignment.

Cochlis craccoi sp. n.

Pl. 1, figs. 1, 2

Derivation of name: The species is named after Gilberto Cracco, who provided material relevant to the present study.

Holotype: Borelli: MGPT-PU 135052 (Pl. 1, fig. 1).

Paratypes: Borelli: 1 spm., MGPT-PU 135060 (Pl. 1, fig. 2), 1 spm., MGPT-PU 135053, 1 spm., MGPT-PU 135054, 1 spm., MGPT-PU 135055, 1 spm., MGPT-PU 135056, 18 spms., MGPT-PU 135057, 1 spm., MPUM 11209, 12 spms., MGPT-PU 135058, 9 spms., MGPT-PU 135059.

Preservation: Most specimens are well preserved; a few have minor damage.

Type locality: Borelli (see appendix).

Diagnosis: Shell globose with moderately elevated spire and globular last whorl. Umbilicus deep wide to medium-sized. Parietal callus wider adapically; anterior lobe indistinct. Funicle cord-like, moderately thick; umbilical callus moderate, semicircular, separated from parietal callus by broad, shallow notch. Vestige of pale reddish-brown background without any color pattern.

Description. Protoconch small, depressed turbiniform, of 2.20-2.32 gently convex, apparently smooth whorls, first half-whorl small. Teleoconch globose, rather thick. Spire broadly conical, moderately elevated, whorls convex, suture fine, adpressed. Last whorl globular, slightly expanded toward aperture; subsutural shelf indistinct, poorly differentiated in a few specimens. Aperture D-shaped, in prosocline plane, length about twice width; outer lip semicircular, basal lip thickened. Parietal callus moderately thick, wider adapically, with concave abapertural outline; anterior lobe indistinct. Umbilicus deep, large to medium-sized, umbilical wall slightly overhanging interior of umbilicus. Funicle cord-like, moderately thick, thick in a few specimens, separated from umbilical wall by narrow spiral furrow. Umbilical callus moderate, rather thick, semicircular in outline, located at abapical one-third of inner lip, separated from parietal callus by broad, shallow notch. Basal fasciole wide, markedly depressed, nearly smooth. Surface with rather dense, thin growth lines. One specimen retains vestige of uniform pale reddish-brown background apparently without any color pattern. No opercula found.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.145-0.161	0.915-1.007	4.310-5.802	4.070-5.642	0.656-1.472	3.469-4.541	2.449-3.949
0.153	0.961	5.056	4.856	1.064	4.005	3.199
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
1.296-1.760	0.171-0.859	0.224-0.888	0.296-0.616	21°-29°	108°-132°	
1.528	0.515	0.556	0.456	25°	120°	

Remarks. *Cochlis craccoi* exhibits some resemblance to *Cochlis pseudovittata* sp. n. (see below) and *Cochlis raropunctata raropunctata* (Sasso, 1827). *C. craccoi* differs from *C. pseudovittata* in that it has: 1) a probably unsculptured protoconch with significantly greater diameter of the first half-whorl (nearly twice the size), 2) a slightly more globular shell, 3) a proportionally wider umbilicus, 4) an umbilical callus demarcated from the parietal callus by a broad, shallow notch (narrow, moderately deep in *C. pseudovittata*), and 5) a different color without any pattern. *C. craccoi* is readily differentiated from *C. raropunctata raropunctata* because of its protoconch of one more whorl, with significantly greater diameter and markedly smaller diameter of the initial half-whorl (less than half the size), its smaller size (see the respective 95% confidence intervals calculated for shell height and maximum diameter), and its different color without any pattern.

Stratigraphic occurrence. *Cochlis craccoi* sp. n. was recovered only from Tortonian deposits at the type locality.

Cochlis degrangei

(Cossmann & Peyrot, 1919) comb. n.

Pl. 1, figs. 3-5

1919 *Natica degrangei* Cossmann & Peyrot, p. 207, pl. 12, figs. 8-10.

Type material: *Natica degrangei* Cossmann & Peyrot, holotype (the shell figured by Cossmann & Peyrot 1919, pl. 12, figs. 8-10), Saucats, Le Péloua (France), not seen. It is included in the Degrange Touzin collection, most probably in the Université de Bordeaux 1 in Talence, or in the Museum of Bordeaux (Didier Merle, personal communication 2014). We obtained excellent photographs of two paratypes housed in MNHN, i.e. F-J05677, Saucats, Le Péloua (France) and F-J05678, Saucats, Pont-Pourquey (France); the latter is figured herein (Pl. 1, fig. 3).

Material examined: Albugnano: 7 spms., PG 84, 2 spms., NP 9926; Borelli: 8 spms., MGPT-PU 135061, 2 spms., MPUM 11210, 3 spms., NP 9929, 50 spms., MGPT-PU 135062, 1 spm., MPUM 11211, 1 spm., NP 9927, 1 spm., MPUM 11212 (Pl. 1, fig. 5); Léognan, Le Coquillat (France): 11 spms., NP 9928, 1 spm., MPUM 11213, 1 spm., PPMM 40818, 2 spms., private collection; Valle Ceppi: 1 spm., MGPT-PU 135268, 4 spms., MGPT-PU 135063, 1 spm., MGPT-PU 135064, 2 spms., PG 85, 1 spm., MGPT-PU 135065, 11 spms., NP 9930, 5 spms., MPUM 11214, 1 spm., MGPT-PU 135066, 1 spm., MGPT-PU 135067, 47 spms., MGPT-PU 135068; Valle Vergnana: 1 spm., MZB 43816 (Pl. 1, fig. 4).

Description. Protoconch medium-sized, low-turbiniform, of 3-3.3 gently convex whorls, tip very small; one specimen exhibits remnants of spiral cordlets on last whorl. Teleoconch hardly exceeding 1 cm in height, oval, taller than wide, moderately thick. Spire conical, rather elevated, whorls convex, suture very slightly channeled. Last whorl broadly oval, subsutural shelf indistinct, periphery nearly at midline. Aperture ovately D-shaped, in slightly prosocline plane, length about 1.6 times width; outer lip semicircular, inner lip gently arched. Parietal callus moderately thick, subrectangular, with slightly concave abapertural outline; anterior lobe indistinct. Umbilicus medium-sized, elongated, wider in a few specimens, umbilical wall moderately steep. Funicle broad, rather depressed, extended abapically and largely filling umbilicus, separated from umbilical wall by narrow, comma-shaped spiral furrow. Umbilical callus rather thick, narrow, elongate, with gently arched adaxial outline, separated from parietal callus by narrow, shallow notch. Basal fasciole poorly differentiated, defined by bending of growth markings over slight angulation. Surface with thin growth lines changing into oblique wrinkles subsuturally. No opercula found.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.069-0.073	0.928-1.100	3.589-11.273	3.019-9.903	0.802-3.938	2.583-7.539	1.851-6.175
0.071	1.014	7.431	6.461	2.370	5.061	4.013
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
0.912-4.384	0.549-2.837	0.000-1.252	0.000-0.992	14°-26°	87°-123°	
2.648	1.693	0.544	0.412	20°	105°	

Remarks. The values of the characteristic elements of the protoconch pertaining to *Cochlis degrangei* do not differ significantly from those measured for *Cochlis pseudovittata* sp. n. (see below), but respective larval shells are differently sculptured (spiral threads on the last whorl in *C. degrangei*, spiral rows of granules on protoconch I in *C. pseudovittata*). Further, *C. pseudovittata* has a globular teleoconch, a well developed anterior lobe of the parietal callus (absent in *C. degrangei*), and a smaller umbilicus. *C. degrangei* is superficially similar to *Natica angyglossa* Cossmann & Peyrot, 1919, but *N. angyglossa* has a more globose teleoconch, a wider umbilicus, a weaker funicle, an umbilical callus merging into the parietal callus without any notch in between, and an operculum with one-two weak marginal grooves, similar to that of *Tectonatica prietoi* (Hidalgo, 1873). On the basis of the opercular characters, *N. angyglossa* would rather be assigned to the genus *Tectonatica* Sacco, 1890 than to *Cochlis*.

Cochlis degrangei is readily differentiated from the other Miocene, French and Italian *Cochlis* species by its taller than wide, oval shell, its very slender, semielliptical umbilical callus separated from the parietal callus by a narrow notch, and its markedly narrow, comma-shaped umbilical channel. Unfortunately, no comparison can be made as regards the opercula, which are unknown.

Stratigraphic occurrence. *Cochlis degrangei* (Cossmann & Peyrot, 1919) is known definitely from early Burdigalian units of France; its record from an unspecified location at Saint-Paul-lès-Dax (Cossmann & Peyrot 1919) likely refers to Burdigalian deposits. Italian occurrences are from Burdigalian to Tortonian formations of Piedmont, where the species appears to be less rare than in France.

Cochlis epigloafuniculata (Sacco, 1890)

Pl. 1, figs. 6, 7

1890b *Natica (Natica) millepunctata* var. *epigloafuniculata* Sacco, p. 28.

1891 *Natica (Natica) millepunctata* var. *epigloafuniculata* - Sacco, p. 48, pl. 2, fig. 9.

2008a *Cochlis epigloafuniculata* - Pedriali e Robba, p. 99, pl. 1, figs. 1-6; pl. 2, figs. 14, 21, 22; pl. 3, fig. 12 (*cum syn.*).

Type material: Pedriali & Robba (2008a, p. 99) reviewed the type material of *Cochlis epigloafuniculata*, and described the characters of this species.

Material examined: Rio di Bocca d'Asino: 1 spm., MPUM 11215 (Pl. 1, fig. 7), 1 spm., MZB 60069, 1 spm., MZB 60102 (Pl. 1, fig. 6), 4 spms., MZB 60141; Sant'Agata Fossili: 1 spm., MGPT-PU 135069.

Dimensions of Miocene specimens (mm)

DHW	PD	H	D	SH	AH	AW
0.190-0.238	0.777-0.877	9.655-17.915	9.403-17.987	2.024-4.536	7.131-13.879	5.110-10.810
0.214	0.827	13.785	13.695	3.280	10.505	7.960
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
4.067-6.123	0.903-2.815	0.855-2.815	0.675-2.175	15°-35°	115°-131°	
5.095	1.835	1.835	1.425	25°	123°	

Remarks. No significant difference was noted between the upper Miocene specimens and the Pliocene ones dealt with by Pedriali & Robba (2008a). For description and comments, see Pedriali & Robba (2008a).

Stratigraphic occurrence. *Cochlis epigloafuniculata* (Sacco, 1890) occurs uncommonly in the Tortonian of northern Italy. Pliocene records were from Zanclean and/or early Piacenzian deposits of Piedmont, Liguria and Tuscany (Pedriali & Robba 2008a).

Cochlis epiglopardalis (Sacco, 1890) comb. n.

Pl. 1, figs. 8-12

1864 *Natica pardalis* Doderlein, p. 18 (*nomen nudum*).
1864 *Natica zonata* Doderlein, p. 18 (*nomen nudum*).
1876 *Natica millepunctata* var. *pardalis* Coppi, p. 199.
1890b *Natica (Natica) epiglopardalis* Sacco, p. 29.
1890b *Natica (Natica) epiglottina* var. *zonata* Sacco, p. 29 (*new synonym*).
1891 *Natica (Natica) epiglopardalis* - Sacco, p. 56, pl. 2, fig. 23.
1891 *Natica (Natica) epiglottina* var. *zonata* - Sacco, p. 62, pl. 2, fig. 33.

Type material: *Natica (Natica) epiglopardalis* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 23) and refigured herein (Pl. 1, fig. 8), IPUM 4477 (Doderlein collection), Montegibbio; 4 paralectotypes, IPUM 4409 (Doderlein collection), Montegibbio. There are no specimens in MGPT BS. *Natica epiglottina* var. *zonata* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 33) and refigured herein (Pl. 1, fig. 9), IPUM 4471 (Doderlein collection), Montegibbio (see remarks below).

Material erroneously referred to as *Natica redempta* Michelotti, 1847 in IPUM: Montegibbio: 2 spms., IPUM 4428.

Material erroneously referred to as *Natica pardalis* Doderlein, 1864 in IPUM: Montegibbio: 27 spms., IPUM 4420, 46 spms., IPUM 4470.

Material erroneously referred to as *Natica epiglopardalis* Sacco, 1890 in IPUM: Tortona: 1 spm., IPUM 8297.

Other material examined: Albugnano: 1 spm., PG 88 (Pl. 1, fig. 10), 1 spm., PG 90, 1 spm., PG 91, 1 spm., PG 92, 1 spm., PG 93, 1 spm. (operculated shell), MPUM 11216; Monte dei Cappuccini: 1 spm., MGPT-PU 135070, 2 spms., MGPT-PU 25669; Montegibbio: 6 spms., MPUM 11217, 4 spms., MGC 1416, 12 spms., NP 9933, 1 spm., MPUM 11218 (Pl. 1, fig. 11), 13 spms., NP 9934, 1 spm., NP 9935, 1 spm., MPUM 11219 (Pl. 1, fig. 12), 115 spms., private collection, 13 spms., private collection, 38 spms., private collection, 3 spms., private collection; Rio di Bocca d'Asino: 1 spm., PG 94, 1 spm., MPUM 11220, 1 spm., NP 9940; Stazzano: 2 spms., NP 9941.

Description. Protoconch medium-sized, turbiniform, of 2.10-2.35 convex, apparently smooth whorls, tip small. Teleoconch globose, rather thick. Spire broadly conical, moderately elevated, earlier whorls gently convex, subsequent ones convex; suture adpressed. Last whorl globose, slightly expanded toward aperture; subsutural shelf flat to gently concave, poorly demarcated. Aperture D-shaped, in slightly prosocline plane, length about 1.9 times width; outer lip semicircular, inner lip thickened and reflected toward shell axis abapically. Parietal callus thick, subquadrangular, rather long, moderately expanded adapically; anterior lobe indistinct. Umbilicus medium-sized to small, slit-like in a few specimens; umbilical wall steep. Funicle cord-like and prominent to broad and depressed, separated from umbilical wall by narrow, shallow spiral furrow. Umbilical callus moderate to broad (depending on size of funicle), rather thick, semicircular in outline, ending at abapical one-fourth of inner lip, separated from anterior corner of parietal callus by shallow, reverse J-shaped notch. Basal fasciole broad and markedly depressed. Surface with rather dense growth lines, prosocyrt subsuturally. Many specimens retain remnants of uniform pale brown background with reddish-brown pattern of large, oval to elongately teardrop-shaped spots irregularly arranged into collabral rows. A few specimens (var. *zonata* Sacco) bear three brownish spiral bands. Operculum moderately thick; central callus short, not exceeding one-third of total height; inner margin slightly arched, with distinct, blunt transverse ridges; inner surface almost flat, nucleus not protruding; outer surface flat to slightly concave, with two marginal grooves and two ridges; outer groove broad, shallow, with nearly flat bottom bearing longitudinal rows of granules; inner groove narrow, attenuated; outer ridge moderately prominent, narrowly round-topped; inner ridge a sharp boundary of outer groove, prostrate to overhang inner groove.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.098-0.114	0.917-0.997	11.843-23.827	11.791-23.699	2.434-7.738	8.919-16.579	7.492-14.148
0.106	0,957	17.835	17.745	5.086	12.749	10.820
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
2.252-9.920	0.659-5.175	0.584-2.756	0.000-3.033	16°-24°	104°-140°	
6.086	2.917	1.670	1.499	20°	122°	

Remarks. *Natica pardalis* was introduced by Doderlein (1864) without any description or illustration and is therefore considered a *nomen nudum*. From Doderlein's paper, it appears that the name *N. pardalis* was intended to replace *Natica pseudomaculosa*, a former name used by Doderlein in a manuscript catalogue, but no explanation for this action was provided. Coppi (1876) first published a concise diagnosis of *N. pardalis* (regarded as a variety of *Natica millepunctata* Lamarck, 1822), thus making the name available, and is to be considered the author of this taxon. However, *N. pardalis* Coppi is a junior primary homonym of *Natica pardalis* Philippi, 1852, thence permanently invalid (ICZN 1999, Article 57.2 of the Code). Sacco (1890b), evidently aware of this case of homonymy, introduced the name *Natica epiglopardalis*, and shortly later (1891) explicitly affirmed that *N. epiglopardalis* was the replacement name for *N. pardalis* Doderlein (really of Coppi).

Natica zonata is another *nomen nudum* introduced by Doderlein (1864). The name *zonata* was made available by Sacco (1890b), who first diagnosed *N. zonata* and has the authorship of it. Sacco (1890b, 1891) considered *N. zonata* as a variety of *Natica epiglottina* Lamarck, 1804. We examined the shell (IPUM 4471) figured by Sacco (1891) and can state that, except for the color pattern, this specimen conforms in all characters to *Cochlis epiglopardalis*, with which it co-occurs rarely at Montegibbio. Consequently, we consider *Natica (Natica) epiglottina* var. *zonata* Sacco merely as a color-form of *C. epiglopardalis* and include it in the synonymy of the latter species. Only one specimen labelled *Natica epiglottina* var. *zonata* (manuscript writing of Sacco) is present in IPUM. However, since Doderlein (1864) listed two specimens (one probably lost), this shell is not eligible as the holotype of *N. epiglottina* var. *zonata*, instead, it can be designated as the lectotype.

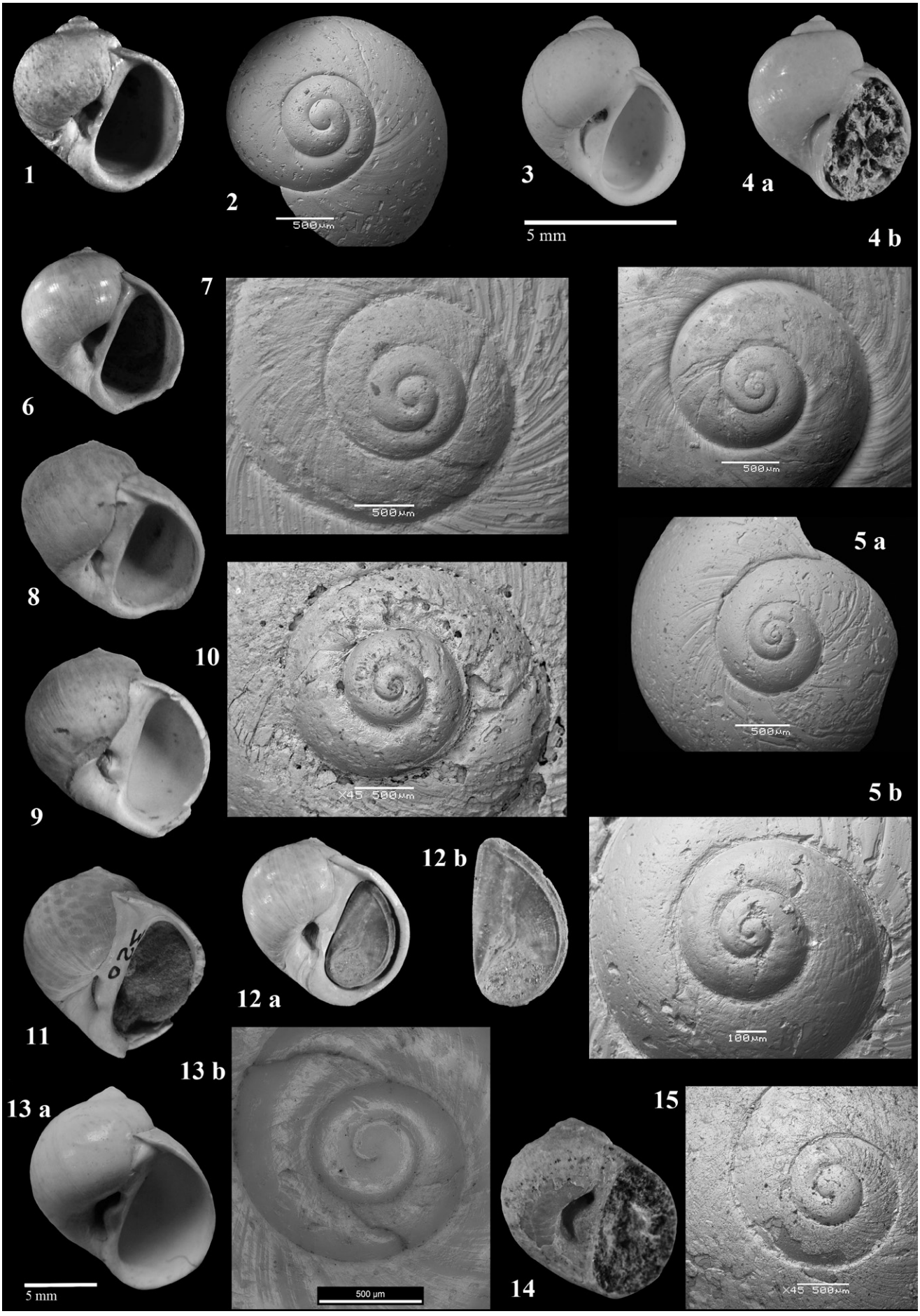
Cochlis epiglopardalis exhibits a remarkable variability as regards the strength of the funicle (less so of the umbilical callus). We noted shells (rather rare) with strong funicle separated from the umbilical wall by a very narrow, semicircular groove, and shells with slender funicle within a medium-sized, widely open umbilicus. A gradual transition between these two extremes is observable.

Cochlis epiglopardalis is closely similar to *Cochlis raropunctata raropunctata* (Sasso, 1827) and probably has been mistaken for it (there seem to be no citations of *C. epiglopardalis* subsequent to its introduction). However, Sacco's species is readily distinguished from *C. raropunctata raropunctata* in that it has a protoconch of 1 more whorl, with significantly greater diameter and smaller diameter of the initial half-whorl (one-third of the size). The operculum of *C. epiglopardalis* is similar to that of *C. raropunctata raropunctata* (both have two marginal grooves and two ridges), but the operculum of *C. epiglopardalis* has a shorter central callus, a flat-bottomed outer groove (concave in *C. raropunctata raropunctata*), and the inner ridge leaning to overhang the inner groove (always raised in *C. raropunctata raropunctata*). Moreover, the specimens with a color pattern of teardrop-like spots are quite distinctive.

Stratigraphic occurrence. *Cochlis epiglopardalis* (Sacco, 1890) was hitherto recorded from Langhian to Torto-

PLATE 1

Fig. 1 - *Cochlis craccoi* sp. n. Borelli. Holotype, MGPT-PU 135052; apertural side (height of shell 6.47 mm).
Fig. 2 - *Cochlis craccoi* sp. n. Borelli. Paratype, MGPT-PU 135060; protoconch.
Fig. 3 - *Cochlis degrangei* (Cossmann & Peyrot, 1919). Saucats, Pont-Pourquey (France). Paratype, MNHN-F-J05678; apertural side.
Fig. 4 - *Cochlis degrangei* (Cossmann & Peyrot, 1919). Valle Vergnana. MZB 43816; a, apertural side (height of shell 12.16 mm); b, protoconch.
Fig. 5 - *Cochlis degrangei* (Cossmann & Peyrot, 1919). Borelli. MPUM 11212; a, protoconch; b, detail of protoconch.
Fig. 6 - *Cochlis epigloafuniculata* (Sacco, 1890). Rio di Bocca d'Asino. MZB 60102; apertural side (height of shell 16.87 mm).
Fig. 7 - *Cochlis epigloafuniculata* (Sacco, 1890). Rio di Bocca d'Asino. MPUM 11215; protoconch.
Fig. 8 - *Cochlis epiglopardalis* (Sacco, 1890). Montegibbio. Lectotype (here designated) of *Natica (Natica) epiglopardalis* Sacco, 1890. IPUM 4477 (Doderlein collection); apertural side (height of shell 26.34 mm).
Fig. 9 - *Cochlis epiglopardalis* (Sacco, 1890). Montegibbio. Lectotype (here designated) of *Natica epiglottina* var. *zonata* Sacco, 1890. IPUM 4471 (Doderlein collection); apertural side (height of shell 29.22 mm).
Fig. 10 - *Cochlis epiglopardalis* (Sacco, 1890). Albugnano. PG 88; protoconch.
Fig. 11 - *Cochlis epiglopardalis* (Sacco, 1890). Montegibbio. MPUM 11218; apertural side showing color pattern (height of shell 15.67 mm).
Fig. 12 - *Cochlis epiglopardalis* (Sacco, 1890). Montegibbio. MPUM 11219; a, apertural side of shell with the operculum *in situ* (height of shell 12.22 mm); b, operculum (height of operculum 7.95 mm).
Fig. 13 - *Cochlis epiglottina epiglottina* (Lamarck, 1804). Grignon (France). Lectotype (here designated) of *Natica epiglottina* Lamarck, 1804. MNHG GEPI 82538; a, apertural side; b, protoconch.
Fig. 14 - *Cochlis epiglottina epiglottina* (Lamarck, 1804). Cava Boschetto. MPUM 11221; apertural side (height of shell 14.77 mm).
Fig. 15 - *Cochlis epiglottina epiglottina* (Lamarck, 1804). Cava Grola. MPUM 11222; protoconch.


1
2
500µm
3
5 mm
4 a
4 b
6
7
500µm
500µm
5 a
8
10
×45 500µm
500µm
9
5 b
12 b
12 a
100µm
11
13 b
13 a
5 mm
500 µm
14
15
×45 500µm

nian deposits of Piedmont and from the late Miocene of Emilia.

Cochlis epiglottina epiglottina
(Lamarck, 1804) comb. n.

Pl. 1, figs. 13-15; Pl. 2, figs 1, 2

1804 *Natica epiglottina* Lamarck, p. 95.
1806 *Natica epiglottina* - Lamarck, pl. 62 (14), fig. 6.
1832 *Natica epiglottina* - Deshayes, p. 165, pl. 20, figs. 5, 6, 11.
1864 *Natica epiglottina* - Deshayes, p. 56.
? 1864 *Natica munda* Deshayes, p. 57, pl. 72, figs. 12, 13.
1888 *Natica (Natica) epiglottina* - Cossmann, p. 159.
1907 *Natica epiglottina* - Cossmann & Pissarro, pl. 9, fig. 61-1.
not 1949 *Natica epiglottina* - Wrigley, p. 11, figs. 1, 2 (not Lamarck, 1804; see remarks below).
1985 *Natica epiglottina* - Brigantini, p. 414, pl. 2, fig. 44.
2012 *Natica epiglottina* - Courville et al., pl. 5, figs. 10, 11, 14.

Type material: *Natica epiglottina* Lamarck, lectotype (here designated): the syntype figured by Favre (1918, pl. 5, fig. 65), and refigured herein (Pl. 1, fig. 13), MNHG GEPI 82538, Grignon (France); 6 paralectotypes, MNHG GEPI 46217, Grignon (France). According to Favre (1918), Lamarck's manuscript catalogue cites 10 specimens, but only 7 of them are present in MNHG.

Other material examined: Cava Albanello: 2 spms., MGP-PD 1213R, 1 spm., MGP-PD 1214R, 1 spm., MGP-PD 1215R, 2 spms., MGP-PD 1216R, 1 spm., private collection, 3 spms., MCZ 4316; Cava Boschetto: 2 spms., NP 9980, 1 spm., MPUM 11221 (Pl. 1, fig. 14); Cava Grola: 1 spm., private collection, 2 spms., NP 9982, 2 spms., NP 9983, 2 spms., NP 9984, 10 spms., NP 9985, 11 spms., private collection, 3 spms., NP 9986, 1 spm., MPUM 11222 (Pl. 1, fig. 15); Fontenay (France): 3 spms., NP 9987; Monte Merlo: 1 spm., NP 9981, 1 spm., NP 9988; Villiers-Saint-Frédéric (France): 1 spm., MPUM 11223 (Pl. 2, fig. 1), 1 spm., NP 9989, 1 spm., MPUM 11224 (Pl. 2, fig. 2), 6 spms., MPUM 11225, 45 spms., NP 9990.

Description. Protoconch small, depressed-turbiniform, averaging 1.64 slightly convex whorls, tip medium-sized, rather flattened. Teleoconch globose to globose-oval, thin to rather thick. Spire broadly conical, rather pointed, moderately elevated, less so in a few specimens; whorls very gently convex; suture slightly incised, almost flush. Last whorl broadly oval, somewhat produced toward aperture, subsutural shelf indistinct, periphery above midline. Aperture ovately D-shaped, in slightly prosocline plane, length almost twice width; outer lip nearly semicircular, thin-edged, inner lip very gently arched. Parietal callus subquadrangular, moderately thick, more so adapically; anterior lobe indistinct. Umbilicus deep, medium-sized, small in a few specimens; umbilical wall rather steep. Funicle cord-like, thick and prominent, separated from umbilical wall by shallow spiral furrow of variable breadth. Umbilical callus large, thick, semicircular in outline, located at mid-abapical part of inner lip, separated from parietal callus by moderately deep, mostly narrow notch. Basal fasciole indistinct. Surface with rather dense, uneven growth lines; excellently preserved French specimens exhibit microscopic spiral striation on last whorl. One specimen from Cava Grola with well spaced, brown, undulating axial lines.

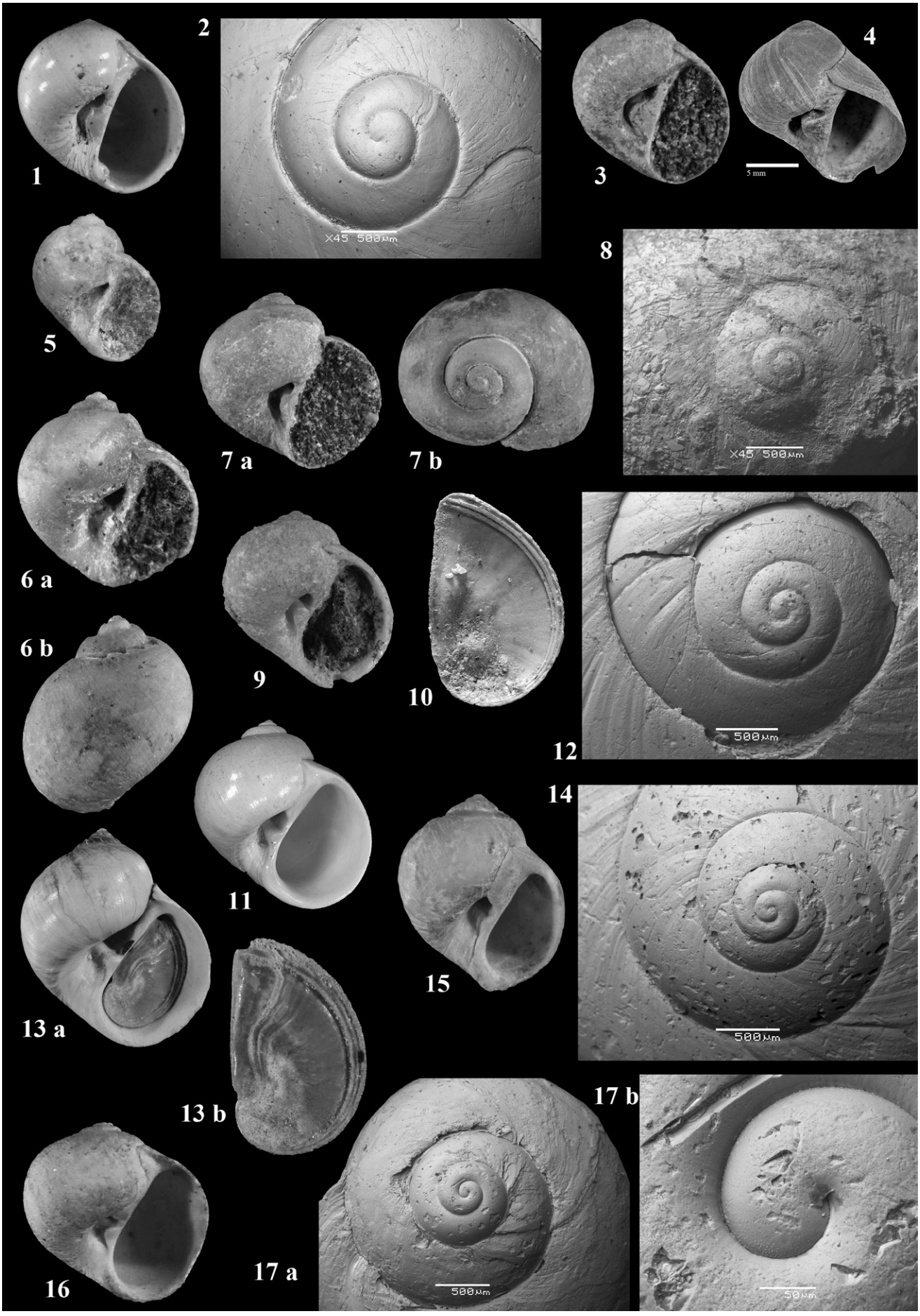
Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.257-0.289	0.889-1.057	2.684-15.996	2.887-14.611	0.367-4.171	1.850-12.090	1.601-7.901
0.273	0.973	9.340	8.749	2.269	6.970	4.751
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
0.538-7.430	0.281-3.705	0.094-1.518	0.041-2.411	7°-27°	100°-128°	
3.984	1.993	0.806	1.185	17°	114°	

Remarks. *Cochlis epiglottina epiglottina* is characterized by its thick funicle, which largely fills the umbilicus (almost completely in some specimens);

PLATE 2

Fig. 1 - *Cochlis epiglottina epiglottina* (Lamarck, 1804). Villiers-Saint-Frédéric (France). MPUM 11223; apertural side (height of shell 11.32 mm).
Fig. 2 - *Cochlis epiglottina epiglottina* (Lamarck, 1804). Villiers-Saint-Frédéric (France). MPUM 11224; protoconch.
Fig. 3 - *Cochlis epiglottina auriformis* (von Koenen, 1891). Case Soghe. MPUM 11262; apertural side (height of shell 12.97 mm).
Fig. 4 - *Cochlis epiglottina auriformis* (von Koenen, 1891). Westeregeln (Germany). Topotype of *Natica epiglottina* var. *auriformis* von Koenen, 1891. MB.Ga.12743.1; apertural side.
Fig. 5 - *Cochlis infelix* (Sacco, 1890). Carpenaro. Neotype (here designated) of *Natica (Natica) infelix* Sacco, 1890. MPUM 11226; apertural side (height of shell 16.18 mm).
Fig. 6 - *Cochlis infelix* (Sacco, 1890). Sassello. MPUM 11227; a, apertural side (height of shell 12.21 mm); b, abapertural side.
Fig. 7 - *Cochlis mortoni* sp. n. Cava Rossi. Holotype, MPUM 11228; a, apertural side (height of shell 21.23 mm); b, apical view.
Fig. 8 - *Cochlis mortoni* sp. n. Cava Albanello. Paratype, MGP-PD 1217R; protoconch.
Fig. 9 - *Cochlis neglecta* (Mayer, 1858). Albugnano. MPUM 11231; apertural side (height of shell 13.19 mm).
Fig. 10 - *Cochlis neglecta* (Mayer, 1858). Le Houga, Carrière (France). Lesport collection 15L0003; operculum (height of operculum 9.30 mm).
Fig. 11 - *Cochlis neglecta* (Mayer, 1858). Lucbardez-et-Bargues, Petit Bargues (France). Lesport collection 15L0002; apertural side (height of shell 17.80 mm).
Fig. 12 - *Cochlis neglecta* (Mayer, 1858). Rio di Bocca d'Asino. MPUM 11233; protoconch.
Fig. 13 - *Cochlis neglecta* (Mayer, 1858). Rio di Bocca d'Asino. PG 87; a, apertural side of shell with the operculum *in situ* (height of shell 21.12 mm); b, operculum (height of operculum 11.20 mm).
Fig. 14 - *Cochlis neglecta* (Mayer, 1858). Uzeste, Gamachot (France). NP 10010; protoconch.
Fig. 15 - *Cochlis neglecta* (Mayer, 1858). Val Sanfrà. MGPT-PU 135077; apertural side (height of shell 15.33 mm).
Fig. 16 - *Cochlis pseudovittata* sp. n. Borelli. Holotype, MGPT-PU 135079; apertural side (height of shell 5.48 mm).
Fig. 17 - *Cochlis pseudovittata* sp. n. Borelli. Paratype, MGPT-PU 135084; a, protoconch; b, detail of protoconch.


1
2
×45 500µm
3
4
5 mm
5
8
×45 500µm
7 a
7 b
6 a
6 b
9
10
12
500µm
11
14
500µm
15
13 a
13 b
16
17 a
500µm
17 b
50µm

the umbilical channel appears as a rather narrow (very narrow in a few specimens), semicircular groove.

Cossmann (1888) regarded *Natica munda* Deshayes, 1864 as a synonym of the present species. On the basis of the description and the figures of *N. munda* published by Deshayes, Cossmann's opinion seems to be correct; however, not having seen the original material of *N. munda*, we include it in the synonymy of *Cochlis epiglottina epiglottina* with doubt.

The Middle Eocene species *Natica epiglottinoides* Deshayes, 1864 is rather similar to *Cochlis epiglottina epiglottina* in teleoconch shape. We examined several shells of Deshayes' species from the Bartonian of Saint-Witz (Le Guépelle) and can state that *N. epiglottinoides* (a species of *Cochlis*) is easily differentiated from *C. epiglottina epiglottina* in that it has: 1) a protoconch with significantly smaller diameter (averaging 0.729 mm) and diameter of the first half-whorl (averaging 0.140 mm), 2) a globose last whorl (that of *C. epiglottina epiglottina* is broadly oval), more depressed in abapertural view, 3) a parietal callus with markedly concave abapertural outline and with a broad, semicircular anterior lobe, and 4) an abapical umbilical sulcus bounded by a distinct angulation (absent in *C. epiglottina epiglottina*). The characters of the parietal callus were already pointed out by Cossmann (1902, p. 63) as a distinguishing element of *N. epiglottinoides*. *Natica specialis* Deshayes, 1864 (also belonging in *Cochlis*), described from Lutetian deposits of Grignon, is another similar species in shell morphology. Examination of specimens from Fleury-la Rivière and Damery has shown that it differs from *C. epiglottina epiglottina* because of its protoconch of about 1 more whorl, with significantly smaller diameter of the first half-whorl, its slight subsutural margining developed on later whorls (absent in *C. epiglottina epiglottina*), and its elongate umbilical callus merging into the anterior corner of the parietal callus and overhanging the most adapical part of the umbilicus.

Wrigley (1949) described and illustrated a shell from the Lower Barton beds (bed A3), referred to as *Natica epiglottina* Lamarck, 1804. We examined some specimens from the same bed A3 in our collection, perfectly conforming to Wrigley's shell, and could note that they differ from *N. epiglottina* because of their two-whorled protoconch with significantly smaller diameter of the initial half-whorl (half the size), their lower spire with flattish whorls, and their umbilicus bounded by a distinct angulation (the umbilicus of *N. epiglottina* has a well rounded border). Wrigley affirmed to have recovered some shells with the operculum "*in situ* in the aperture"; he described the operculum as having the outer surface with "two slightly incised lines equidistant from the outer margin, although in many specimens they are hardly apparent", and published a poor figure of it (fig. 2). According to this description of the operculum, the British specimens seem to belong in the genus *Tectonatica* Sacco, 1890 or *Cryptonatica* Dall, 1892.

Stratigraphic occurrence. *Cochlis epiglottina epiglottina* (Lamarck, 1804) is definitely known from Lutetian deposits of France and northeastern Italy (Veneto).

Cochlis epiglottina auriformis

(von Koenen, 1891) comb. n.

Pl. 2, figs. 3, 4

1891 *Natica epiglottina* var. *auriformis* von Koenen, p. 576, pl. 40, fig. 7.

Material examined: Case Soghe: 1 spm., MPUM 11262 (Pl. 2, fig. 3), 2 spms., private collection, 1 spm., NP 9995.

Description. Protoconch damaged, apparently small and with medium-sized tip. Teleoconch globose-oval, thick, hardly exceeding 13 mm in height. Spire broadly conical, rather low, whorls gently convex, suture incised, adpressed. Last whorl broadly oval, subsutural shelf indistinct, periphery at midline. Aperture D-shaped, in prosocline plane, length about twice width; outer lip semicircular, inner lip straight, thickened abapically. Parietal callus short, rectangular, thick, more so adapically where a blunt knob may develop; anterior lobe absent. Umbilicus deep, moderately wide, umbilical wall steep. Funicle cord-like, broad and prominent, largely filling umbilicus; umbilical channel rather narrow to very narrow, comma-like. Umbilical callus thick, with arched abapertural outline, located at mid-abapical part of inner lip, separated from anterior end of parietal callus by rather deep, narrow, rounded notch. Basal fasciole indistinct. Surface with remnants of uneven growth lines. German specimens from Westeregeln retain a uniform, pale brown background without any pattern.

Dimensions (mm)

DHW	PD	H	D	SH	AH	
-	-	12.970	12.351	3.652	9.319	
AW	**UW**	**WUC**	**WAD**	**WAB**	**IS**	**SA**
6.930	6.929	2.840	1.400	2.061	17°	116°

Remarks. The examined specimens appear to be strikingly similar to *Natica epiglottina* var. *auriformis*, a variety introduced by von Koenen (1891) on the basis of lower Oligocene material from Westeregeln (Northern Germany). The Museum für Naturkunde in Berlin houses five specimens of *N. epiglottina* var. *auriformis* from the same locality cited by von Koenen; they are not identified as the type material and are not recorded as being part of the von Koenen collection (Martin Aberhan, personal communication 2014). However, these shells from Westeregeln are of much relevance since they are to be regarded as topotypes. We obtained some excellent photographs of specimen MB.Ga.12743.1 (Pl. 2, fig. 4) and could note: 1) that the teleoconch of our specimens is identical to that of *N. epiglottina* var. *auriformis* and 2) that their damaged protoconch seems to be closely similar to that of *N. epiglottina* var. *auriformis*. Accordingly, we conclude that the examined material can be safely identified with von Koenen's taxon, which is assigned to the genus *Cochlis* Röding, 1798.

The var. *auriformis* and *Cochlis epiglottina* Lamarck, 1804 are closely similar; the values of the characteristic elements of the protoconch of both taxa are identical, as are their teleoconch shape and umbilical characters. However, the var. *auriformis* has a slightly shorter spire, a much shorter parietal callus, and a uniform, pale brown background (well spaced, brown, undulating axial lines in *C. epiglottina*). These differences are not considered sufficient for consistent specific separation. Consequently, we regard the var. *auriformis* as an allochronous subspecies of *C. epiglottina*, which was introduced nearly one century earlier.

Cochlis epiglottina auriformis is morphologically similar to the coeval *Cochlis* sp. 2, but differs from it in that it has: 1) a shorter and thicker parietal callus with straight abapertural outline (subangular in *Cochlis* sp. 2), 2) a larger umbilicus, 3) a narrower, comma-shaped umbilical channel (bean-shaped in *Cochlis* sp. 2), 4) a more prominent, cord-like funicle, and 5) a differently shaped umbilical callus, separated from parietal callus by a rather deep, narrow and rounded notch (very slight in *Cochlis* sp. 2).

Stratigraphic occurrence. *Cochlis epiglottina auriformis* occurs in lower Oligocene deposits of Northern Germany and Veneto.

Cochlis infelix (Sacco, 1890) comb. n.
Pl. 2, figs. 5, 6

1890b *Natica (Natica) infelix* Sacco, p. 27.
1890b *Natica (Natica) infelix* var. *sasselliana* Sacco, p. 27.
1891 *Natica (Natica) infelix* - Sacco, p. 44, pl. 2, fig. 1.
1891 *Natica (Natica) infelix* var. *sasselliana* - Sacco, p. 45, pl. 2, fig. 2.
1984 *Natica infelix* - Ferrero Mortara et al., p. 27.

Type material: *Natica (Natica) infelix* Sacco, neotype (here designated and illustrated in Pl. 2, fig. 5), MPUM 11226, Carpenaro (see remarks below); 1 syntype, MGPT BS.029.01.001, Sassello, 1 syntype, MGPT BS.029.01.001/01, Cassinelle.

Other material examined: Cassinelle: 2 spms., PG 101; Mioglia: 1 spm., MZB 60147, 6 spms., MZB 60148, 3 spms., PG 99; Sassello: 1 spm., MPUM 11227 (Pl. 2, fig. 6), 1 spm., PG 100; Squaneto: 1 spm., PG 98.

Description. Protoconch poorly preserved, low-turbiniform, apparently of 2.5 whorls, with small tip. Teleoconch rather small, globose-oval, higher than wide, thick. Spire conical, rather low, somewhat stepped, whorls convex, with maximum curvature at adapical one-third; subsutural shelf narrow, gently sloping, obscurely bounded abaxially; suture fine, adpressed. Last whorl rather tall, broadly oval, slightly produced abapically toward aperture; subsutural shelf indistinct. Aperture D-shaped, in very slightly prosocline plane, length 1.8 times width; outer lip regularly arched, basal lip thickened. Parietal callus thick, subrectangular, slightly wider adapically; anterior lobe indistinct. Umbilicus deep, medium-sized, umbilical wall very steep. Funicle broad, depressed, separated from umbilical wall by shallow, rather narrow spiral depression. Umbilical callus thick, with arched abapertural outline, located at mid-abapical part of inner lip, separated from parietal callus by shallow, reverse J-shaped notch. Basal fasciole indistinct. Surface with rather dense, even growth lines.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
-	-	9.377-17.713	8.111-17.507	2.497-5.745	4.976-13.304	4.409-9.797
-	-	13.545	12.809	4.121	9.140	7.103
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
3.210-7.379	1.228-3.304	0.424-2.168	0.798-2.550	10°-30°	96°-132°	
5.296	2.266	1.296	1.674	20°	114°	

Remarks. The figured syntypes of *Natica (Natica) infelix* and of *Natica (Natica) infelix* var. *sasselliana* were said to be respectively in the Museo Geologico of Roma and in the Museo Geologico of Genova (see Sacco 1891, explanation of pl. 2). Inquiries there had negative results and the cited syntypes are deemed to be lost. The syntypes presently in MGPT (see above) are quite poorly preserved and can hardly help in clarifying the identity of the species. Another four specimens (syntypes?) in MGPT, labelled *N. (Natica)* cf. *infelix* (BS.029.001/02, unspecified locality), are of no use because of their even worse preservation. In these circumstances, the designation of a neotype is advisable in order to define Sacco's taxon objectively (ICZN 1999, Article 75 and Recommendation 75A of the Code). The specimen figured by Sacco (1891) was from Dego; other localities reported by Sacco are Sassello and Cassinelle. We designate as the neotype a specimen from Carpenaro (9.5 km northeast of Dego), which agree with the description provided by Sacco and exhibits all the teleoconch characters unequivocally. The lithostratigraphic unit that yielded this specimen is the same cropping out at the localities cited by Sacco. Obviously, Carpenaro becomes the type locality of *N. (Natica) infelix* (ICZN 1999, Article 76.3 of the Code).

The above description is largely based on the neotype. The few examined specimens show a slight variability concerning the height of the spire (lower than that of the neotype) and the inflation of the last whorl (more globose than that of the neotype). On the basis of its teleoconch characters, Sacco's species is herein assigned to the genus *Cochlis* Röding, 1798.

The Miocene species *Cochlis degrangei* (Cossmann & Peyrot, 1919) superficially resembles *Cochlis infelix* in that it has a taller than wide teleoconch and a broad, depressed funicle. However, *C. degrangei* differs from *C. infelix* by its slightly channeled suture, its wider aperture, and its funicle largely filling the umbilicus (Fig. 17). The globose oval, higher than wide teleoconch, the rather low, somewhat stepped spire, and the broad, depressed funicle not filling the umbilicus readily distinguish *C. infelix* from the other Oligocene *Cochlis* species.

Stratigraphic occurrence. *Cochlis infelix* (Sacco, 1890) was hitherto recorded from lower Oligocene deposits of Piedmont and Liguria where it occurs uncommonly.

Cochlis mortoni sp. n.

Pl. 2, figs. 7, 8

Derivation of name: The species is named after Alan Morton (Penrhyncoch, Aberystwyth), who kindly donated many British Eocene specimens relevant to the present study.

Holotype: Cava Rossi, MPUM 11228 (Pl. 2, fig. 7).

Paratypes: Cava Albanello: 1 spm., MGP-PD 1217R (Pl. 2, fig. 8); Cava Rossi: 2 spms., MCZ 4317, 1 spm., MPUM 11229, 1 spm., MCZ 4318, 1 spm., MPUM 11230.

Other material esamined: Cava Grola: 1 spm., private collection; Cava Rossi: 1 spm., NP 9970, 2 spms., private collection, 1 spm., NP 9971, 1 spm., private collection.

Preservation: Moderate to rather fair.

Type locality: Cava Rossi (see appendix).

Horizon: Volcanoclastic layer of late Ypresian to earliest Lutetian age.

Diagnosis: Shell globose; spire rather low, with well convex whorls and narrowly and deeply channeled suture; last whorl globular. Umbilicus deep, medium-sized. Parietal callus broadly rectangular, with rounded anterior edge. Funicle cord-like, thick, largely filling umbilicus in young specimens; umbilical callus large, semicircular, separated from parietal callus by rather narrow and deep notch.

Description. Protoconch small, depressed-turbiniform, of 2.50-2.85 whorls, tip very small. Teleoconch medium-sized, globose, thick. Spire broadly conical, rather low, whorls convex; suture adpressed on first whorl, gradually changing into narrowly and deeply channeled on subsequent ones. Last whorl globose, subsutural shelf indistinct, periphery slightly above midline. Aperture D-shaped, in prosocline plane, length averaging 1.8 times width; outer lip semicircular, inner lip straight, thickened abapically. Parietal callus thick, broadly rectangular, with rounded anterior edge covering most adapical part of umbilicus. Umbilicus deep, medium-sized, rather small in a few specimens, umbilical wall steep. Funicle cord-like, thick and prominent, largely filling umbilicus in young specimens, separated from umbilical wall by shallow spiral furrow of variable breadth (rather wide to very narrow), bounded abaxially by obscure step; furrow with 1-2 rough, longitudinal cordlets visible in larger specimens. Umbilical callus large to very large (depending on size of funicle), thick, semicircular in outline, located at mid-abapical part of inner lip and separated from parietal callus by rather narrow, moderately deep notch. Basal fasciole indistinct. Surface with remnants of fine, dense growth lines.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.078-0.090	0.601-0.689	2.217-19.069	2.522-18.926	0.206-6.182	1.549-13.349	1.256-11.832
0.084	0.645	10.643	10.724	3.194	7.449	6.544
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
0.941-6.685	0.613-3.477	0.324-1.368	0.000-2.001	9°-29°	113°-129°	
3.813	2.045	0.846	0.921	19°	121°	

Remarks. The umbilical characters of the present new species suggest its assignment to the genus *Cochlis* Röding, 1798. The narrow, deeply channeled suture and the broad, rectangular parietal callus with rounded anterior edge constitute the main distinguishing elements of *Cochlis mortoni* and readily separate it from the other Eocene species of the same genus.

Stratigraphic occurrence. *Cochlis mortoni* sp. n. was recovered from upper Ypresian and lower-mid Lutetian units of Veneto.

Cochlis neglecta (Mayer, 1858) comb. n.

Pl. 2, figs. 9-15

1858 *Natica neglecta* Mayer, p. 388, pl. 11, fig. 2.

1882 *Natica benecki* von Koenen, p. 228, pl. 5, figs. 4, 5, 8.

1919 *Natica neglecta* - Cossmann & Peyrot, p. 199, pl. 11, figs. 11-14.

1952a *Natica (Natica) neglecta* - Glibert, p. 76, pl. 6, fig. 4.

1952b *Natica (Natica) neglecta* - Glibert, p. 259, pl. 2, fig. 4.

1969 *Natica neglecta* - Janssen, p. 173, pl. 5, figs. 18-24; text-fig. 12 (*cum syn.*).

1972 *Naticarius tigrinus tigrinus* - Nordsieck, p. 70, pl. 17, fig. 86 (not the operculum).

1972 *Naticarius hoernesi sallomacensis* - Nordsieck, p. 71, pl. 17, fig. 88 (not Tournouer, 1873).

1972 *Naticarius neglectus* - Nordsieck, p. 71, pl. 17, fig. 90.

1984 *Natica neglecta* - Janssen, p. 202, pl. 57, figs. 5-7, 12.

2001 *Natica neglecta* - Lozouet et al., p. 43, pl. 18, fig. 2.

2001 *Natica neglecta* - Wienrich, p. 432, pl. 70, fig. 1; pl. 87, figs. 3, 4; pl. 88, fig. 7.

Type material: *Natica neglecta* Mayer, type material not seen. The Mayer-Eymar collection, housed in Naturhistorisches Museum of Basel (Switzerland), is in a disarray and no types were located so far (Walter Etter, personal communication 2014).

Material erroneously referred to as *Natica pardalis* Doderlein, 1864 in IPUM: Montegibbio: 4 spms., IPUM 4470.

Other material examined: Albugnano: 1 spm., MPUM 11231 (Pl. 2, fig. 9), 1 spm., PG 86; Borelli: 7 spms., MGPT-PU 135071; Le Houga, Carrière (France): 1 spm. (operculum), 15L0003 (Pl. 2, fig. 10); Léognan, Le Coquillat (France): 6 spms., NP 9996; Lucbardez-et-Bargues, Petit Bargues (France): 1 spm., 15L0002 (Pl. 2, fig. 11); Mérignac (France): 9 spms., MPUM 11232, 20 spms., NP 9944, 1 spm. (operculum), NP 9997; Monte dei Cappuccini: 1 spm., MGPT-PU 25668, 1 spm., MGPT-PU 25666; Pietracuta: 3 spms. NP 9945, 1 spm., PP.PC 03/01; Rio di Bocca d'Asino: 1 spm., MPUM 11233 (Pl. 2, fig. 12), 1 spm. (operculated shell), PG 87 (Pl. 2, fig. 13), 1 spm., PG 6b, 1 spm., PG 12a, 1 spm., PG 13b, 1 spm., MZB 60068, 1 spm., MZB 60101, 1 spm., MZB 60105, 1 spm., MZB 60109; Roquefort (France): 11 spms. MPUM 11234, 2 spms., (operculated shells), MF 115D.1.10, 14 spms., NP 9943; Saint-Martin-d'Oney (France): 2 spms., NP 10006; Sant'Agata Fossili: 1 spm., MGPT-PU 135072, 2 spms., MGPT-PU 135073, 1 spm., PG 18e; Uzeste, Gamachot (France): 6 spms., NP 10008, 1 spm., NP 10010 (Pl. 2, fig. 14); Valle Ceppi: 1 spm., NP 9931, 1 spm., MZB 60138, 1 spm., MGPT 135074, 2 spms., NP 9932, 1 spm., MPUM 11235, 1 spm., MGPT-PU 135075, 1 spm., MGPT-PU 135076; Val Sanfrà: 1 spm., MGPT-PU 135077 (Pl. 2, fig. 15), 1 spm., MGPT-PU 135078.

Description. Protoconch small, depressed-turbiniform, of 2.5-2.75 gently convex whorls, tip very small. Teleoconch globose, globose-oval in some specimens, thin to rather thick. Spire conical, moderately elevated, less so in a few specimens, whorls convex, suture fine, adpressed. Last whorl globose, not expanded toward aperture; subsutural shelf poorly defined to indistinct. Aperture D-shaped, in very slightly prosocline plane, length averaging 1.7 times width; outer lip semicircular, basal lip thickened. Parietal callus thick, subquadrangular, wider adapically; anterior lobe indistinct. Umbilicus deep, medium-sized, small in a few specimens; umbilical wall rather steep. Funicle cord-like, thin to moderately thick, separated from umbilical wall by shallow spiral furrow of variable breadth. Umbilical callus small to moderate (depending on size of funicle), thick, semicircular in outline, located at abapical one-third of inner lip, separated from parietal callus by moderately deep notch. Basal fasciole poorly differentiated to indistinct. Surface with rather dense growth lines changing into narrow wrinkles subsuturally; microscopic spiral striation present on last whorl. Some specimens retain remnants of uniform pale brown background apparently without any color pattern. Operculum moderately thick; central callus flat, subtriangular, not reaching half-height of operculum; inner margin very slightly convex, smooth; inner surface flatly convex, nucleus scarcely protruding; outer surface planar, slightly convex in a few specimens, with three marginal grooves and three ridges; median and outer grooves as well as ridges on gently sloping inward shelf; outer and median grooves narrow and shallow, with concave bottom; inner groove deeper than the other two, slightly wider in a few specimens; ridges subequal, round-topped, median one slightly narrower in a few specimens.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.092-0.096	0.912-1.012	11.617-21.381	10.399-19.859	2.693-7.373	7.529-15.401	5.946-12.734
0.094	0.962	16.499	15.129	5.033	11.465	9.340
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
2.737-7.845	0.914-2.410	0.813-3.921	0.000-2.570	14°-34°	91°-123°	
5.291	1.662	2.367	1.262	24°	107°	

Remarks. The present species exhibits a moderate variability as regards the height of the spire and the strenght of the funicle. The Italian shells fully conform to the abundant topotypic material in our collection.

According to the description and the excellent figures originally published, it appears that the teleoconch and the operculum of *Natica benecki* von Koenen, 1882 are hardly distinguishable from those of *Cochlis neglecta*. Consequently, we concur with Glibert (1952a), Janssen (1969) and Wienrich (2001) in considering Koenen's species a synonym of *C. neglecta*.

Except for a slightly wider aperture, the teleoconch of *Cochlis neglecta* is strikingly similar to that of *Cochlis pseudoepiglottina* (Sacco, 1890). However, *C. neglecta* can be differentiated from Sacco's species by its protoconch with significantly greater diameter; further, the operculum of *C. neglecta* has three subequal marginal ridges (see also Janssen 1969 and Wienrich 2001) whereas that of *C. pseudoepiglottina*, also with three marginal ridges, has a sharp, thinner (thread-like in a few specimens) middle ridge (Pedriali & Robba 2005). The three-ridged operculum of the Pliocene to Recent similar species *Cochlis vittata* (Gmelin, 1791) differs from that of *C. neglecta* in that it has thin, equal outer and inner ridges, and a wider, flat-topped middle ridge (see Pedriali & Robba 2005).

Pedriali & Robba (2005, p. 155), on the basis of the teleoconch characters of specimens described and/or illustrated in the literature, considered *Cochlis pseudoepiglottina* present in the upper Miocene of the Mediterranean area and of Hungary. In the course of the present study, despite the vast upper Miocene material examined, not one specimen proved to belong to *C. pseudoepiglottina*. Most likely, several upper Miocene shells, with the apical whorls abraded or missing and lacking the operculum, formerly assigned to *C. pseudoepiglottina* are *Cochlis neglecta*, which has a closely similar teleoconch. From the above, it results that the presence of *C. pseudoepiglottina* in the late Miocene needs to be confirmed by the recovering of specimens retaining the protoconch and/or the operculum.

Stratigraphic occurrence. *Cochlis neglecta* (Mayer, 1858) is known definitely from the early Miocene of France, The Netherlands, Belgium and Germany, and from the Langhian of Belgium, Germany and Poland. Italian occurrences are from Burdigalian to Tortonian deposits of Piedmont.

Cochlis pseudovittata sp. n.

Pl. 2, figs. 16, 17; Pl. 3, fig. 1

Derivation of name: From Greek *pseudes* = false and *vittata* = the name of the most closely similar species, i.e. *Cochlis vittata* (Gmelin, 1791).

Holotype: Borelli: MGPT-PU 135079 (Pl. 2, fig. 16).

Paratypes: Borelli: 66 spms., MGPT-PU 135080, 12 spms., MGPT-PU 135081, 9 spms., MGPT-PU 135082, 9 spms., MGPT-PU 135083, 1 spm., MGPT-PU 135084 (Pl. 2, fig. 17), 1 spm., MGPT-PU 135085, 1 spm., MGPT-PU 135086, 1 spm., MGPT-PU 135087, 1 spm., MPUM 11239; Rio di Bocca d'Asino: 2 spms., MZB 60139, 1 spm., MZB 60140 (Pl. 3, fig. 1), 1 spm., MPUM 11240; Stazzano: 1 spm., MGPT-PU 135088.

Other material examined: Borelli: 3 spms., NP 9949; Rio di Bocca d'Asino: 6 spms., NP 9948.

Material referred to as *Cochlis vittata* (Gmelin, 1791) by Pedriali & Robba (2005): Borelli: 1 spm., authors' collection (see remarks below).

Preservation: Mostly fair.

Type locality: Borelli (see appendix).

Horizon: Gray, medium sand of Tortonian age.

Diagnosis: Protoconch depressed-turbiniform with sculptured initial whorl. Shell globose to globose-oval, with low to moderately elevated spire and globose last whorl. Umbilicus deep rather small to wide. Parietal callus hindering most adapical part of umbilicus, with subangular anterior lobe; funicle thin to moderately thick; umbilical callus small, semicircular to triangular, separated from parietal callus by narrow notch. Color pale brown with darker subsutural band and lower base; reddish median line on last whorl.

Description. Protoconch small, depressed-turbiniform, of 2.55-2.75 gently convex whorls, tip very small; abapical part of protoconch I with microgranules roughly arranged into spiral rows. Teleoconch globose to globose-oval, rather thick to thick. Spire broadly conical, low to moderately elevated, whorls convex, suture fine, adpressed. Last whorl globose-oval to inflated, moderately produced but not expanded toward aperture; subsutural shelf indistinct. Aperture D-shaped, in prosocline plane, length about 1.6 times width; outer lip semicircular, basal lip thickened. Parietal

callus rather thick, with concave abapertural outline, hindering most adapical part of umbilicus; anterior lobe subangular, ending below umbilical border. Umbilicus deep, rather small, wide in a few specimens; umbilical wall very steep. Funicle thin to moderately thick, separated from umbilical wall by shallow spiral furrow of variable breadth. Umbilical callus small, moderately thick, semicircular to triangular in outline, located at abapical one-third of inner lip, separated from parietal callus by narrow, moderately deep notch. Basal fasciole poorly differentiated. Surface with rather dense growth lines changing into narrow wrinkles subsuturally. Specimens from Rio di Bocca d'Asino retain pale brown background with darker subsuturral band and lower base; vestige of median, reddish spiral line occur on last whorl of a few specimens. Operculum unknown.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.081-0.097	0.887-1.015	4.533-8.957	4.438-7.770	1.294-2.426	3.071-6.699	3.018-4.778
0.089	0.951	6.745	6.104	1.860	4.885	3.898
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
1.030-1.786	0.105-0.497	0.245-0.581	0.406-0.982	19°-31°	100°-132°	
1.408	0.301	0.413	0.694	25°	116°	

Remarks. *Cochlis pseudovittata* is closely similar to the Pliocene to Recent species *Cochlis vittata* (Gmelin, 1791) in shell morphology, but can be differentiated from it because of its larval shell having a significantly greater diameter and a sculptured initial whorl (protoconch I). Moreover, *C. pseudovittata* differs from *C. vittata* in that it has a slightly lower spire with less convex whorls, a different color pattern (*C. vittata* has a reddish-brown reticulated pattern and two-three spiral rows of brown spots), and attains a smaller size.

In a previous paper (Pedriali & Robba 2005), a single shell from the Tortonian of Borelli was assigned to *Cochlis vittata*. Re-examination of this specimen has proven that it is *Cochlis pseudovittata*. Consequently, the supposed appearance of *C. vittata* in the late Miocene (Pedriali & Robba 2005, p. 169) is incorrect. Gmelin's species appears to have replaced *C. pseudovittata* by the early Pliocene.

Stratigraphic occurrence. *Cochlis pseudovittata* sp. n. was recovered only from Tortonian deposits of Piedmont.

Cochlis raropunctata raropunctata (Sasso, 1827)

Pl. 3, figs. 2-4

1827 *Natica raro-punctata* Sasso, p. 477.

1963 *Natica tigrina* - Venzo & Pelosio, p. 82, pl. 34, figs. 37, 38 (not Defrance, 1825).

2005 *Cochlis raropunctata raropunctata* - Pedriali & Robba, p. 155, pl. 3, figs. 10-20; pl. 4, figs. 1-6, 10; pl. 7, figs. 8, 9; pl. 8, figs. 19-25; pl. 9, figs. 14-19; pl. 10, figs. 17-21, 23, 24, I-K (*cum syn.*).

Type material: *Natica raropunctata* Sasso, type material not seen. Pedriali & Robba (2005, p. 156) noted that the syntypes of this species, originally in the Museo Civico di Storia Naturale "G. Doria" in Genova, were not found and are possibly lost.

Material examined: Moncucco Torinese: 2 spms., PG 1a; Montegibbio: 1 spm. (operculum), MPUM 11241 (Pl. 3, fig. 2); Passo dei Meloni: 17 spms., (14 shells, 3 opercula), PP.PMO1/03, 20 spms., MPUM 11242, 21 spms., NP 9962; Pietracuta: 1 spm., PP.PC02/01; Rio di Bocca d'Asino: 2 spms., MZB 25987, 8 spms., MZB 45367, 1 spm., MZB 25986, 6 spms., MZB 29712, 14 spms., PG 25c, 5 spms., PG 27, 8 spms., PG 58, 2 spms., PG 6, 2 spms., PG 9, 1 spm., MPUM 11243, 2 spms., PG 11a, 7 spms., PG 13a, 10 spms., NP 9958, 2 spms., MPUM 11244, 1 spm., MPUM 11245 (Pl. 3, fig. 3), 1 spm., MPUM 11246, 1 spm., MPUM 11247 (Pl. 3, fig. 4), 1 spm., NP 9959, 23 spms., NP 9960, 1 spm., MZB 60142, 2 spms., MZB 60064, 2 spms., MZB 25991, 2 spms., MZB 60066, 24 spms., MZB 60067, 4 spms., MZB 60070, 8 spms., MZB 60106, 1 spm., MZB 60107, 7 spms., MZB 60108, 1 spm., MZB 60143, 1 spm., MPUM 11248, 1 spm. (operculated shell), NP 9961; Sant'Agata Fossili: 3 spms., MGPT-PU 23319, 2 spms., PG 14, 2 spms., PG 59a, 1 spm., PG 18a, 1 spm., PG 73c; Stazzano: 1 spm., MZB 29721, 1 spm., MZB 26893, 4 spms., MZB 29737, 6 spms., MGPT-PU 23409, 1 spm., MGPT-PU 23410; Vigoleno: 57 spms., private collection.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.325-0.389	0.583-0.715	9.365-31.129	9.649-29.833	1.042-6.722	7.802-24.926	4.818-16.282
0.357	0.649	20.247	19.741	3.882	16.364	10.550
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
2.491-12.667	0.549-4.501	0.667-6,671	0.217-2.549	13°-41°	107°-146°	
7.579	2.525	3.669	1.383	27°	125°	

Remarks. The upper Miocene specimens listed above are conspecific with the Pliocene ones dealt with by Pedriali & Robba (2005); for description and comments see the cited authors. Besides the difference in teleoconch characters mentioned by Pedriali & Robba (2005, p. 160), *Cochlis raropunctata raropunctata* can be distinguished from the lower-middle Miocene species *Cochlis tigrina* (Defrance, 1825) also by its protoconch of 0,75 fewer whorls, with significantly greater diameter of the initial half-whorl (twice the size), and by its operculum with different proportions of both gooves and ridges. As discussed by Pedriali & Robba (2005, p.

160), the name *raropunctata* Sasso, 1827 is valid and, being based on Pliocene shells from Western Liguria, is the most suitable one for the present species. The use of the name *tigrina* Defrance, 1825 suggested by Lozouet et al. (2001) for Sasso's species is unjustified (see also the remarks on *C. tigrina*).

Stratigraphic occurrence. *Cochlis raropunctata raropunctata* (Sasso, 1827) appeared in the Tortonian of Italy and spread throughout Southern Europe during the Pliocene. The species occurs rarely in the early Pleistocene and seems to have reached extintion about at the end of this subepoch. As already noted (Pedriali & Robba 2005), the Miocene records outside Italy refer to taxa other than *C. raropunctata raropunctata*, or need to be confirmed.

Cochlis rossii (Oppenheim, 1901) comb. n.
Pl. 3, figs. 5, 6

1901 *Natica rossii* Oppenheim, p. 200, pl. 3, fig. 10.
1985 *Natica rossii* - Brigantini, p. 414, pl. 2, fig. 42.

Type material: *Natica rossii* Oppenheim, type material not seen. The Oppenheim collection is housed in the Hebrew University of Jerusalem (Israel). Inquiries there had negative results.

Material examined: Valle Organa: 5 spms., MGP-PD 31518, 15 spms., MGP-PD 31520, 1 spm., MGP-PD 31523 (Pl. 3, fig. 5), 1 spm., MGP-PD 31521 (Pl. 3, fig. 6), 1 spm., MGP-PD 31522.

Description. Protoconch abraded in all specimens. Teleoconch globose, very thick. Spire obtusely conical, low, less so in a few specimens, earliest whorls nearly flat-sided, subsequent ones gently convex; suture adpressed, almost flush. Last whorl globular, subsutural shelf indistinct, periphery at midline. Aperture D-shaped, in prosocline plane, length about twice width; outer lip regularly arched, abapical part of inner lip and basal lip markedly thickened, everted. Parietal callus thick, rather long, with straight or slightly concave abapertural outline, hindering most adapical part of umbilicus; anterior lobe poorly differentiated to indistinct. Umbilicus deep, rather narrow to narrow, umbilical wall increasingly steep downward. Funicle moderately wide, depressed, ending toward abapical one-fourth of inner lip, separated from umbilical wall by shallow, nearly flat-bottomed spiral furrow. Umbilical callus, moderately thick, rather narrow, slightly arched in outline, separated from parietal callus by wide, very shallow reverse J-shaped notch. Basal fasciole broad, scarcely prominent, coated with callus layer. Surface with rather dense growth lines changing into narrow wrinkles subsuturally; spiral microstriation observable on last whorl of best preserved specimens.

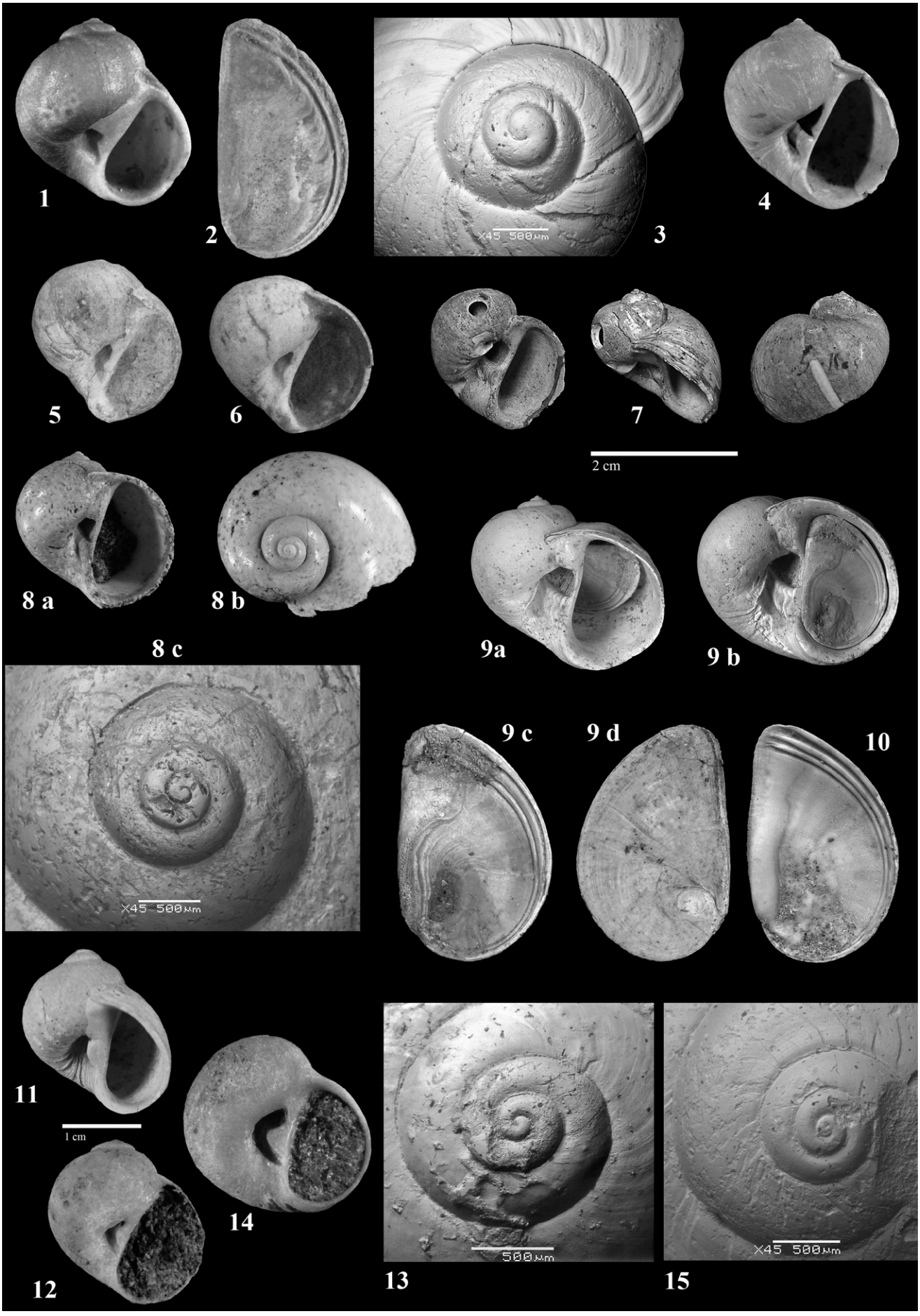
Dimensions (mm)

H	D	SH	AH	AW	UW
15.770	15.379	3.641	12.130	9.631	5.739
9.010	9.358	1.791	7.219	6.510	2.880
WUC	**WAD**	**WAB**	**IS**	**SA**	
1.592	2.461	1.690	20°	130°	
0.981	0.980	0.921	27°	140°	

Remarks. Except for two specimens, the rest of the examined material is badly damaged. Its assignment to Oppenheim's species, based on the original description and rather poor illustration, is made with some reservation. *Natica canovae* Oppenheim, 1901 (no specimens examined) seems to be

PLATE 3

Fig. 1 - *Cochlis pseudovittata* sp. n. Rio di Bocca d'Asino. Paratype, MZB 60140; apertural side (height of shell 10.54 mm).
Fig. 2 - *Cochlis raropunctata raropunctata* (Sasso, 1827). Montegibbio. MPUM 11241; operculum (height of operculum 14.38 mm).
Fig. 3 - *Cochlis raropunctata raropunctata* (Sasso, 1827). Rio di Bocca d'Asino. MPUM 11245; protoconch.
Fig. 4 - *Cochlis raropunctata raropunctata* (Sasso, 1827). Rio di Bocca d'Asino. MPUM 11247; apertural side (height of shell 17.18 mm).
Fig. 5 - *Cochlis rossii* (Oppenheim, 1901). Valle Organa. MGP-PD 31523; apertural side (height of shell 15.77 mm).
Fig. 6 - *Cochlis rossii* (Oppenheim, 1901). Valle Organa. MGP-PD 31521; apertural side (height of shell 9.01 mm).
Fig. 7 - *Cochlis sallomacensis* (Tournouër, 1873). Salles (France). Lectotype (here designated) of *Natica sallomacensis* Tournouër, 1873. MNHN-F-B28542; from left to right: apertural side, lateral side, abapertural side.
Fig. 8 - *Cochlis sallomacensis* (Tournouër, 1873). Monte dei Cappuccini. MGPT-PU 25667; a, apertural side (height of shell 16.14 mm); b, apical view; c, protoconch.
Fig. 9 - *Cochlis sallomacensis* (Tournouër, 1873). Salles, Moulin Débat (France). Lesport collection; a, apertural side of shell with the operculum *in situ* (15L0005, height of shell 31.50 mm); b, basal view; c, outer surface of operculum (15L0006, height of operculum 22.00 mm); d, inner surface of operculum.
Fig. 10 - *Cochlis sallomacensis* (Tournouër, 1873). Sallespisse, Carré, La Coustillière (France). Lesport collection 15L0004; operculum (height of operculum 9.60 mm).
Fig. 11 - *Cochlis separata* (Deshayes, 1864). Cuise-la-Motte (France). Lectotype (here designated) of *Natica separata* Deshayes, 1864. EM 32860a; apertural side.
Fig. 12 - *Cochlis separata* (Deshayes, 1864). Cava Boschetto. MPUM 11251; apertural side (height of shell 12.40 mm).
Fig. 13 - *Cochlis separata* (Deshayes, 1864). Cava Boschetto. MPUM 11252; protoconch.
Fig. 14 - *Cochlis separata* (Deshayes, 1864). Cava Grola. MPUM 11253; basal view (height of shell 8.23 mm).
Fig. 15 - *Cochlis separata* (Deshayes, 1864). Cuise-la-Motte (France). MPUM 11254; protoconch.


1
2
3
4
5
6
7
2 cm
8 a
8 b
8 c
9a
9 b
9 c
9 d
10
11
1 cm
12
13
14
15

the most closely similar species, differing in that has a less globular shell, with higher spire.

Stratigraphic occurrence. *Cochlis rossii* was recovered from Priabonian marly deposits of Veneto.

Cochlis sallomacensis (Tournouër, 1873) comb. n.

Pl. 3, figs. 7-10

1873a *Natica sallomacensis* Tournouër, p. 154.

1873b *Natica sallomacensis* - Tournouër, p. 293, pl. 10, fig. 7.

1919 *Natica sallomacensis* - Cossmann & Peyrot, p. 194, pl. 11, figs. 6-8.

1952b *Natica tigrina* f. *sallomacensis* - Glibert, p. 257, pl. 2, figs. 3c, 3d.

1969 *Natica tigrina hoernesi* forma *sallomacensis* - Janssen, p. 173, pl. 7, figs. 19, 20.

not 1972 *Naticarius hoernesi sallomacensis* - Nordsieck, p. 71, pl. 17, fig. 88 (= *Natica neglecta* Mayer, 1858).

1984 *Natica sallomacensis* - Janssen, p. 204, pl. 57, fig. 8.

2001 *Natica sallomacensis* - Wienrich, p. 433, pl. 88, fig. 1.

Type material: *Natica sallomacensis* Tournouër, lectotype (here designated): the shell figured by Tournouër (1873b, pl. 10, fig. 7) and refigured herein (Pl. 3, fig. 7), MNHN-F-B28542, Salles (France); 2 paralectotypes, MNHN-F-A51515, Salles (France).

Material erroneously referred to as *Natica (Natica) millepunctata* var. *sismondiana* d'Orbigny, 1852 in MGPT: Colli Torinesi: 2 spms., MGPT BS.029.01.003/03.

Other material examined: Monte dei Cappuccini: 1 spm., MGPT-PU 25667 (Pl. 3, fig. 8); Montegibbio: 1 spm., NP 9924, 1 spm., MPUM 11249, 1 spm., MPUM 11250, 1 spm., NP 9925; Salles, Argilas (France): 20 spms., NP 10012, 1 spm. (operculated shell), NP 10013, 1 spm. (operculum), NP 10014; Salles, Moulin Débat (France): 1 spm. (operculated shell), 15L0005/15L0006 (Pl. 3, fig. 9); Sallespisse, Carré, La Coustillière (France): 1 spm. (operculum), 15L0004 (Pl. 3, fig. 10). We also examined an excellent photograph of the specimen from Salles illustrated by Cossmann & Peyrot (MNHN-F-J05669); Valle Ceppi: 1 spm., MGPT-PU 25906.

Description. Protoconch small, turbiniform, of 2.25-2.40 convex whorls, tip small. Teleoconch medium-sized, globose, rather thick. Spire broadly conical, low to moderately elevated, somewhat stepped; whorls convex, subsutural shelf indistinct; shallowly channeled suture develops by second whorl, sutural channel bounded abaxially by obtuse angulation. Last whorl globular, slightly depressed in a few specimens, scarcely expanded toward aperture. Aperture D-shaped, in prosocline plane, length about 1.82 times width; outer lip semicircular, inner lip straight, basal lip thickened, slightly everted adaxially. Parietal callus moderately thick, trapeziform to rectangular, ending above level of basal fasciole; anterior lobe poorly differentiated to indistinct. Umbilicus deep, moderately wide; umbilical wall very steep; interior of umbilicus coated with callus layer extending over basal fasciole. Funicle cord-like, prominent, separated from umbilical wall by narrow to very narrow spiral furrow. Umbilical callus thick, at abapical one-third of inner lip, roundly triangular, separated from anterior corner of parietal callus by reverse J-shaped, shallow sinuation. Basal fasciole flattened, rather narrow, bounded abaxially by very slight step in larger specimens. Surface with uneven growth markings, coarser subsuturally and slightly bent on border of sutural channel. Some specimens from Montegibbio retain pale brown background, with darker band encircling umbilicus. Operculum (see remarks) moderately thick; central callus tongue-shaped, not prominent at all, reaching half-height of operculum; inner margin gently arched, smooth or with blunt transverse wrinkles; inner surface nearly flat, with distinct spiral striation, nucleus not protruding; outer surface planar, with three marginal grooves and three flatly round-topped ridges; inner and median grooves with concave bottom, equally narrow; outer groove arched in cross-section, constantly twice to three times wider than other two; outer and median ridges robust, about of equal strength; inner ridge also robust, but invariably thinner than other two.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.111-0.131	0.827-0.935	10.284-18.672	9.406-18.274	1.120-5.992	8.844-13.000	6.968-10.016
0.121	0.881	14.478	13.840	3.556	10.922	8.492
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
3.900-6.824	0.918-3.158	1.798-3.138	0.000-1.994	11°-31°	113°-137°	
5.362	2.038	2.468	0.856	21°	125°	

Remarks. We examined a vast naticid collection from the Serravallian of Sallespisse, largely dominated by *Cochlis sallomacensis* (300 specimens out of 385). The collection includes several loose opercula, some quite large-sized (up to 25 mm in height), all identical and certainly conspecific. Among the five species present in the naticid assemblage, only *C. sallomacensis* attains a very large size and the aperture of its shell can readily accomodate opercula of the considerable proportions cited. Furthermore, two shells of *C. sallomacensis* from the Serravallian of Salles were recovered with the operculum within the aperture (Pl. 3, fig. 9); these opercula, identical to those of Sallespisse, perfectly fit in the aperture of

the shell and can be considered *in situ*. On this basis, we conclude that the opercula from Sallespisse and those from Salles can be safely assigned to *C. sallomacensis*.

The operculum of *Cochlis sallomacensis*, having the outer surface with three marginal ridges and three grooves, somewhat resembles those of *Cochlis neglecta* (Mayer, 1858), *Cochlis pseudoepiglottina* (Sacco, 1890) and *Cochlis vittata* (Gmelin, 17919), which also have three marginal ridges and three grooves. However, the operculum of *C. sallomacensis* can be easily differentiated from that of *C. neglecta* in that it attains a larger size and has: 1) a rather long, tongue-shaped central callus (shorter, subtriangular in *C. neglecta*), 2) the ridges and the grooves in the same plane of the outer surface (outer groove, median groove and ridges on distinctly elevated shelf in *C. neglecta*), 3) a markedly wider outer groove, and 4) an inner ridge thinner than the other two. The operculum of the Pliocene species *C. pseudoepiglottina* differs from that of *C. sallomacensis* by its central callus bending toward the inner margin, its outer and median grooves, and the ridges on an elevated shelf, its sharp median ridge distinctly narrower than the other two, its narrower outer groove, and its inner groove constantly wider and deeper than the other two. The operculum of *C. vittata* also has the outer and median grooves, and the ridges lying upon an elevated shelf; moreover, it is distinguished from that of *C. sallomacensis* because of its thin, similar outer and inner ridges, its wider, flat-topped median ridge, and its grooves of same breadth (see Pedriali & Robba 2005).

Cochlis sallomacensis is morphologically similar to *Natica aquitanica* Tournouër, 1873 (a species also belonging in *Cochlis* Röding, 1798) and the values of the characteristic elements of the protoconch of both taxa do not differ significantly. However, *C. sallomacensis* can be readily distinguished from Tournouër's species by its channeled suture, its more widely open umbilicus, and its differently shaped inner lip calluses (*C. aquitanica* has a rectangular, longer parietal callus fused with the small umbilical callus, without any sinuation in between). *Natica burdigalensis* Mayer, 1864 is another similar species in teleoconch shape, but has a protoconch of 0,5 more whorls, an adpressed suture, and an operculum that is peculiar of the species of the genus *Tanea* Marwick, 1931. For the relationships with *Cochlis tigrina* (Defrance, 1825), see the remarks on this species.

Stratigraphic occurrence. *Cochlis sallomacensis* (Tournouër, 1873) is known from Langhian to Serravallian deposits of France, from the Burdigalian of The Netherlands and the Langhian of Germany. Italian occurrences were from the Burdigalian and Langhian of Piedmont (rare) and from the Tortonian of Montegibbio (Emilia).

Cochlis separata (Deshayes, 1864) comb. n.

Pl. 3, figs. 11-15

1864 *Natica separata* Deshayes, p. 49, pl. 68, figs. 4-6.
1888 *Natica separata* - Cossmann, p. 161.
1907 *Natica separata* - Cossmann & Pissarro, pl. 9, fig. 61-9.

Type material: *Natica separata* Deshayes, lectotype (here designated): the specimen figured by Deshayes (1864, pl. 68, figs. 4-6) and refigured herein (Pl. 3, fig. 11), EM 32860a, Cuise-la-Motte (France); 2 paralectotypes, EM 32860, Cuise-la-Motte (France).

Other material examined: Cava Albanello: 6 spms., MGP-PD 1218R, 5 spms., MGP-PD 1219R, 1 spm., MGP-PD 1220R, 5 spms., MGP-PD 1221R, 8 spms., NP 9972, 2 spms., NP 9973, 3 spms., MCZ 4319; Cava Boschetto: 1 spm., MPUM 11251 (Pl. 3, fig. 12), 2 spms., NP 9974, 1 spm., MPUM 11252 (Pl. 3, fig. 13); Cava Grola: 1 spm., private collection, 1 spm., private collection, 1 spm., NP 9979, 1 spm., MPUM 11253 (Pl. 3, fig. 14), 1 spm., MCV 15/01, 2 spms., private collection; Cava Rossi: 1 spm., MCZ 4320; Monte Merlo: 1 spm., NP 9976; Cuise-la-Motte (France): 1 spm., MPUM 11254 (Pl. 3, fig. 15), 4 spms., NP 9975; Saint Gobain (France): 1 spm., NP 9978; Villiers-Saint-Frédéric (France): 6 spms., NP 9977.

Description. Protoconch small, depressed-turbiniform, averaging 2.77 gently convex whorls, tip very small, slightly sunken. Teleoconch globose-oval, globose in some specimens, rather thick. Spire broadly conical, moderately elevated, less so in a few specimens, whorls convex, with poorly defined or indistinct subsutural shelf, suture adpressed. Last whorl globose, not expanded toward aperture; subsutural shelf very slightly concave, obscurely bounded abaxially in larger specimens. Aperture D-shaped, in moderately prosocline plane, length averaging 1.8 times width; outer lip semicircular, inner lip nearly straight. Parietal callus long, rather thick, with subangular abapertural outline; anterior lobe well developed, roundly angular, at level of umbilical border. Umbilicus deep, rather small, umbilical wall steep, umbilical channel a moderately wide, semicircular furrow. Funicle broad, depressed toward interior of umbilicus, separated from umbilical wall by shallow, flat-bottomed spiral furrow forming slight notch on inner lip; furrow bounded abaxially by distinct step. Umbilical callus moderate,

thick, roundly triangular in outline, located at mid-abapical part of inner lip, separated from anterior lobe of parietal callus by moderately deep, narrow notch. Basal fasciole indistinct. Surface with fine, dense growth lines.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.062-0.066	0.756-0.872	2.891-12.919	2.472-12.644	0.821-3.965	1.688-9.336	1.404-7.308
0.064	0.814	7.905	7.558	2.393	5.512	4.356
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
1.322-3.986	0.592-2.104	0.326-0.802	0.118-1.366	7°-27°	102°-130°	
2.654	1.348	0.564	0.742	17°	116°	

Remarks. *Cochlis separata* is remarkably similar to *Cochlis epiglottinoides* (Deshayes, 1864) in teleoconch characters and could be mistaken for it. However, the protoconch of 0.7 more whorls, with significantly smaller diameter of the first half-whorl (over half the size) unequivocally distinguishes *C. separata* from *C. epiglottinoides*.

Natica microglossa Deshayes, 1864 (a species of *Cochlis*) superficially resembles *Cochlis separata*, but differs from it in that it has a protoconch with significantly greater diameter of the initial half-whorl, a spire with less convex whorls, and a spiral furrow separating the funicle from the umbilical wall, which is narrower, V-shaped, and lacks the step-like abaxial border present in *C. separata*. According to previous authors, the present species exhibits some resemblance also to *Natica epiglottina* Lamarck, 1804. Actually, both taxa share some teleoconch characters, but *C. separata* is readily differentiated from *N. epiglottina* because of its protoconch of one more whorl, with significantly smaller diameter of the first half-whorl (one-fourth of the size).

Stratigraphic occurrence. *Cochlis separata* (Deshayes, 1864) was hitherto known from upper Ypresian and Lutetian units of France. Italian occurrences are from upper Ypresian and lower-mid Lutetian deposits of Veneto.

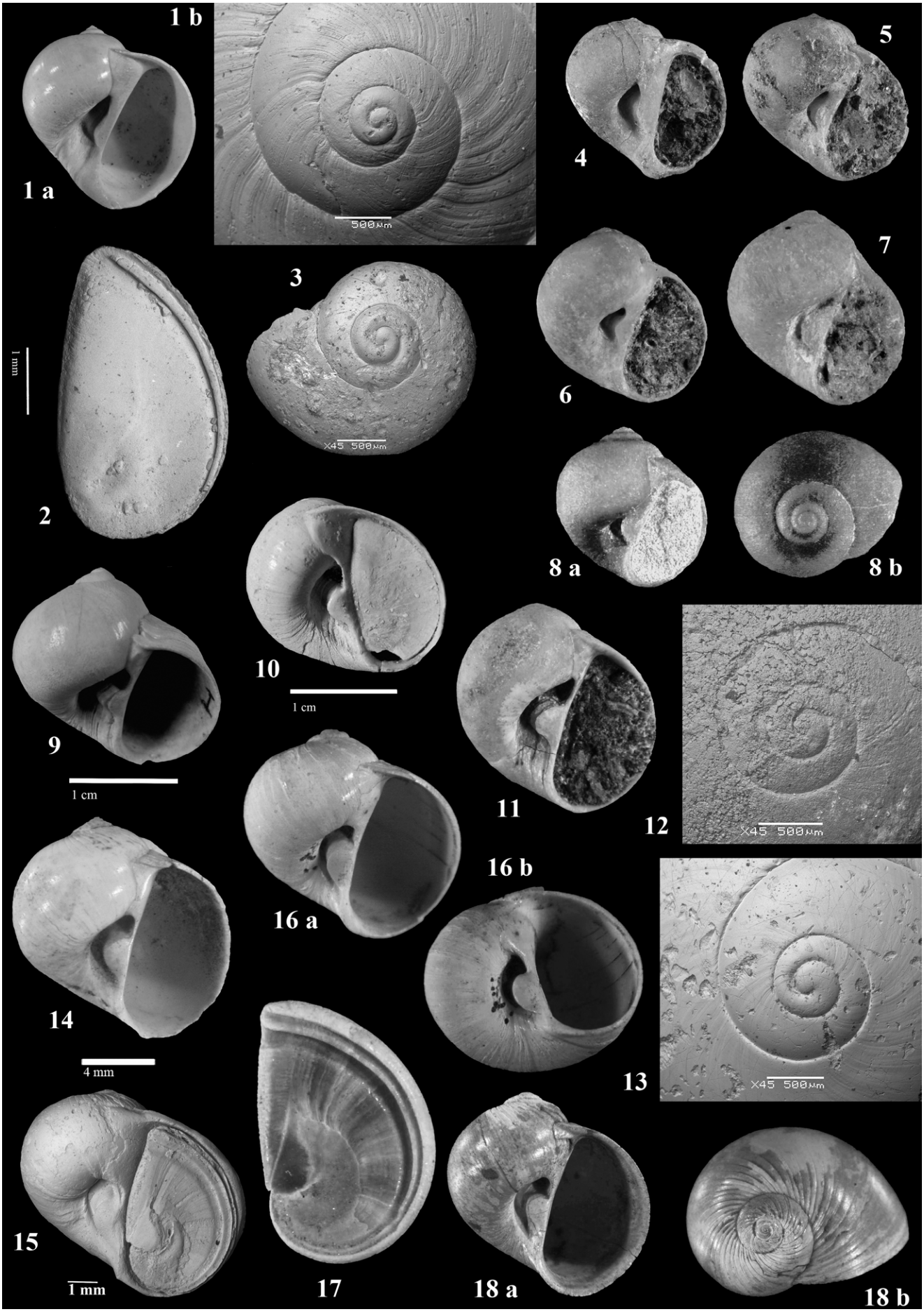
Cochlis tigrina (Defrance, 1825)

Pl. 4, figs. 1-5

1825 *Natica tigrina* Defrance, p. 257.
1828 *Natica tigrina* - Grateloup, p. 155.
1828 *Natica tigrina* vars. a, b, c, d Grateloup, p. 156.
1847 *Natica tigrina* var. A *ampullosa* Grateloup, pl. 9, figs. 10, 11.
1847 *Natica tigrina* var. B *crassiuscula* Grateloup, pl. 9, figs. 12, 13.
1847 *Natica tigrina* var. C *ovata* Grateloup, pl. 9, fig. 14.
1847 *Natica tigrina* var. D *millepunctata* - Grateloup, pl. 10, figs. 2, 3 (not Lamarck, 1822).
1847 *Natica tigrina* var. E *immaculata* Gateloup, pl. 10, fig. 4.
1847 *Natica tigrina* var. F *punctulata* Grateloup, pl. 10, fig. 5.
? 1873a *Natica aquitanica* Tournouër, p. 154.
? 1873b *Natica aquitanica* - Tournouër, p. 292, pl. 10, fig. 6.
1890b *Natica (Natica) millepunctata* var. *sismondiana* - Sacco, p. 28 (not *Natica sismondiana* d'Orbigny, 1852).
1890b *Natica (Natica) millepunctata* subvar. *miorotunda* Sacco, p. 28 (*nomen nudum*).
1890b *Natica (Natica) millepunctata* subvar. *miolonga* Sacco, p. 28 (*nomen nudum*).
1890b *Natica (Natica) millepunctata* subvar. *miodepressispira* Sacco, p. 28 (*nomen nudum*).
? 1890b *Natica (Natica) millepunctata* var. *miocontorta* Sacco, p. 28.
1890b *Natica (Natica) millepunctata* var. *tauropicta* Sacco, p. 28.

PLATE 4

Fig. 1 - *Cochlis tigrina* (Defrance, 1825). Léognan, Le Coquillat (France). MPUM 11255; a, apertural side (height of shell 20.17 mm); b, protoconch.
Fig. 2 - *Cochlis tigrina* (Defrance, 1825). Léognan, Le Coquillat (France). MPUM 11258; operculum.
Fig. 3 - *Cochlis tigrina* (Defrance, 1825). Valle Ceppi. MGPT-PU 108196; protoconch.
Fig. 4 - *Cochlis tigrina* (Defrance, 1825). Val Sanfrà. MGPT-PU 135092; apertural side (height of shell 21.54 mm).
Fig. 5 - *Cochlis tigrina* (Defrance, 1825). Val Sanfrà. MGPT-PU 135093; apertural side (height of shell 24.61 mm).
Fig. 6 - *Cochlis* sp. 1. Cava Grola. MPUM 11260; apertural side (height of shell 12.28 mm).
Fig. 7 - *Cochlis* sp. 1. Ciupio. MGP-PD 11624/a-11664/a; apertural side (height of shell 11.31 mm).
Fig. 8 - *Cochlis* sp. 2. Monte Gloso. MPUM 11261; a, apertural side (height of shell 6.65 mm); b, apical view.
Fig. 9 - *Cryptonatica noe* (d'Orbigny, 1850). Saint-Witz, Le Guépelle (France). Lectotype (here designated) of *Natica noe* d'Orbigny, 1850. EM 32834a; apertural side.
Fig. 10 - *Cryptonatica noe* (d'Orbigny, 1850). Saint-Witz, Le Guépelle (France). Paralectotype. Lot EM 32834; apertural side of shell with the operculum *in situ*.
Fig. 11 - *Cryptonatica noe* (d'Orbigny, 1850). Cava Grola. MPUM 11236; apertural side (height of shell 13.37 mm).
Fig. 12 - *Cryptonatica noe* (d'Orbigny, 1850). Cava Grola. MPUM 11237; protoconch.
Fig. 13 - *Cryptonatica noe* (d'Orbigny, 1850). Saint-Witz, Le Guépelle (France). MPUM 11238; protoconch.
Fig. 14 - *Tanea dillwyni koeneni* (Sacco, 1891). Monte dei Cappuccini. Lectotype (here designated) of *Natica (Cochlis) dillwyni* var. *tauraminor* Sacco, 1904. MGPT BS.029.01.045; apertural side.
Fig. 15 - *Tanea dillwyni koeneni* (Sacco, 1891). Borelli. MGPT-PU 135095; apertural side of shell with the operculum *in situ*.
Fig. 16 - *Tanea dillwyni koeneni* (Sacco, 1891). Borelli. MGPT-PU 135097; a, apertural side (height of shell 8.84 mm); b, basal view.
Fig. 17 - *Tanea dillwyni koeneni* (Sacco, 1891). Borelli. MGPT-PU 135099; operculum (height of operculum 8.77 mm).
Fig. 18 - *Tanea dillwyni koeneni* (Sacco, 1891). Monte dei Cappuccini. MGPT-PU 135100; a, apertural side (height of shell 11.96 mm); b, apical view.


1 b
1 a
500µm
4
5
3
1 mm
×45 500µm
6
7
2
8 a
8 b
10
1 cm
9
1 cm
11
12
×45 500µm
16 b
16 a
14
4 mm
13
×45 500µm
15
1 mm
17
18 a
18 b

1891 *Natica (Natica) millepunctata* var. *sismondiana* - Sacco, p. 45, pl. 2, fig. 3 (not *Natica sismondiana* d'Orbigny, 1852).

1891 *Natica (Natica) millepunctata* var. *miorotunda* Sacco, p. 46.

1891 *Natica (Natica) millepunctata* var. *miolonga* Sacco, p. 46.

1891 *Natica (Natica) millepunctata* var. *miodepressispira* Sacco, p. 46.

? 1891 *Natica (Natica) millepunctata* var. *miocontorta* - Sacco, p. 46, pl. 2, fig. 4.

1891 *Natica (Natica) millepunctata* var. *tauropicta* - Sacco, p. 46, pl. 2, fig. 5.

1904 *Natica (Natica) millepunctata* var. *miorotunda* - Sacco, p. 102, pl. 22, fig. 18.

1904 *Natica (Natica) millepunctata* var. *miolonga* - Sacco, p. 102, pl. 22, fig. 19.

1904 *Natica (Natica) millepunctata* var. *miodepressispira* - Sacco, p. 102, pl. 22, fig. 20.

1919 *Natica pachyope* Cossmann & Peyrot, p. 189, pl. 11, figs. 4, 5 (*new synonym*).

1919 *Natica tigrina* - Cossmann & Peyrot, p. 190, pl. 11, figs. 1, 9, 10.

1952a *Natica tigrina* - Glibert, p. 74, pl. 5, fig. 13.

1952b *Natica tigrina* - Glibert, p. 255 (pars), pl. 2, figs. 3a, b, e, f (not figs. 3c, d = *Natica sallomacensis* Tournouer, 1873).

? 1960 *Natica (N.) tigrina hoernesi* - Baldi, p. 64, pl. 2, figs. 2a, 2c.

not 1969 *Natica tigrina tigrina* - Janssen, p. 171, pl. 6, fig. 25; pl. 7, figs. 1-8 (see remarks below).

not 1984 *Natica tigrina* - Janssen, p. 203, pl. 57, figs. 1-4, 10 (see remarks below).

1984 *Natica millepunctata* var. *sismondiana* - Ferrero Mortara et al., p. 28 (not *Natica sismondiana* d'Orbigny, 1852).

1984 *Natica millepunctata* var. *miorotunda* - Ferrero Mortara et al., p. 28.

1984 *Natica millepunctata* var. *miolonga* - Ferrero Mortara et al., p. 28.

1984 *Natica millepunctata* var. *miodepressispira* - Ferrero Mortara et al., p. 28.

? 1984 *Natica millepunctata* var. *miocontorta* - Ferrero Mortara et al., p. 28.

1984 *Natica millepunctata* var. *tauropicta* - Ferrero Mortara et al., p. 28.

not 1987 *Natica (Natica) tigrina* - Karczewski, p. 131, pl. 34, figs. 4, 7, 9-13 (not Defrance, 1825).

1995 *Natica tigrina* - Baluk, p. 194, pl. 15, figs. 10-14.

2001 *Natica crassiuscula* - Lozouet et al., p. 43, pl. 18, fig. 1.

2006 *Natica tigrina* - Baluk, p. 206, pl. 3, fig. 6.

2007 *Natica tigrina* - Zunino, p. 124 (pars), pl. 1, figs. 10-12.

Type material: *Natica tigrina* Defrance, type material not seen. Cleevely (1983) stated that the Defrance collection housed in the Musée d'Histoire Naturelle of Caen (France) was destroyed during the 2nd world war. According to Dance (1986), some Defrance's specimens should be in the Muséum d'Histoire Naturelle of Geneva (Switzerland), but no shells of *Natica tigrina* are present there (Serret 1986; Lionel Cavin, personal communication 2014). In these circumstances, the shells illustrated by Grateloup (1847) constitute the most relevant reference material; they are curated in the University of Bordeaux 1, but were not located yet (Bruno Cahuzac, personal communication 2014). *Natica (Natica) millepunctata* var. *miorotunda* Sacco, lectotype (here designated): the shell figured by Sacco (1904, pl. 22, fig. 18), MGPT BS.029.01.004, Colli Torinesi; 1 paralectotype, MGPT BS.029.01.004/01, Colli Torinesi (other 2 syntypes, also numbered MGPT BS.029.01.004/01, are unidentifiable). *Natica (Natica) millepunctata* var. *miolonga* Sacco, lectotype (here designated): the shell figured by Sacco (1904, pl. 22, fig. 19), MGPT BS.029.01.005, Colli Torinesi; 2 paralectotypes, MGPT BS.029.01.005/01, Colli Torinesi. *Natica (Natica) millepunctata* var. *miodepressispira* Sacco, lectotype (here designated): the shell figured by Sacco (1904, pl. 22, fig. 20), MGPT BS.029.01.006, Colli Torinesi; 2 paralectotypes, MGPT BS.029.01.006/01, Colli Torinesi (other 2 syntypes, also numbered MGPT BS.029.01.006/01, are unidentifiable. *Natica (Natica) millepunctata* var. *tauropicta* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 2, fig. 5), MGPT BS.029.01.008, Colli Torinesi.

Other material examined: Albugnano: 1 spm., PG 96, 1 spm., PG 97; Léognan, Le Coquillat (France): 1 spm., MPUM 11255 (Pl. 4, fig. 1), 1 spm., MPUM 11256, 19 spms., MPUM 11257, 2 spms., MZB 60121, 9 spms., private collection, 6 spms., PPMM 40819, 1 spm. (operculum), PPMM 40820, 13 spms., private collection, 1 spm. (operculum), private collection, 26 spms., private collection, 1 spm. (operculum), private collection, 117 spms., NP 9965, 2 spms. (operculated shells), NP 9998, 8 spms. (opercula), NP 9999, 1 spm. (operculum), MPUM 11258 (Pl. 4, fig. 2), 4 spms. (opercula), MPUM 11259; Martignas-sur-Jalle (France): 1 spm., NP 10005; Mérignac (France): 4 spms., NP 9963; Monte dei Cappuccini: 3 spms., MGPT-PU 25672; Roquefort (France): 1 spm., NP 9964; Saint-Martin-d'Oney (France): 6 spms., private collection; Uzeste, Gamachot (France): 2 spms., NP 10009; Valle Ceppi: 1 spm., MGPT-PU 135089, 1 spm., MGPT-PU 108196 (Pl. 4, fig. 3), 1 spm., MGPT-PU 107637, 1 spm., MGPT-PU 23862, 1 spm., MGPT-PU 107635, 10 spms., MGPT-PU 23668, 4 spms., MZB 60144, 4 spms., MZB 60145, 4 spms., MGPT-PU 23865, 1 spm., MGPT-PU 135090, 1 spm., MGPT-PU 135091, 1 spm., MZB 60146, 1 spm., MGPT-PU 135352; Val Sanfrà: 1 spm., MGPT-PU 107634, 1 spm., MGPT-PU 107630, 15 spms., MGPT-PU 107633, 1 spm., MGPT-PU 135092 (Pl. 4, fig. 4), 2 spms., MGPT-PU 107638, 1 spm., MGPT-PU 135093 (Pl. 4, fig. 5); Valle Vergnana: 1 spm., MZB 44010.

Description. Protoconch small, low-turbiniform, of 1.8-2 convex and smooth whorls, tip small. Teleoconch large to very large, globose, thick. Spire broadly conical, low to moderately elevated, whorls convex; flat, gently sloping subsutural shelf, bounded abapically by bending of growth lines, develops by third whorl in most specimens; suture fine, adpressed. Last whorl globose, globose-oval in a few specimens, scarcely expanded toward aperture; subsutural shelf as on spire whorls. Aperture D-shaped, in slightly prosocline plane, length about twice width; outer lip semicircular, inner lip straight, basal lip thickened, everted. Parietal callus thick, more so adapically, trapeziform to rectangular, ending above basal fasciole; anterior lobe absent. Umbilicus deep, moderate to wide; umbilical wall steep; interior of umbilicus coated with callus layer extending over basal fasciole. Funicle cord-like and prominent to broad and markedly depressed, largely filling umbilicus in many specimens, separated from umbilical wall by shallow spiral furrow of variable breadth. Umbilical callus thick, located in mid-abapical part of inner lip, roundly triangular and merging into anterior corner of parietal callus with reverse J-shaped outline (depressed funicle), or semicircular, separated from parietal callus by nar-

row, shallow notch (prominent funicle). Basal fasciole broad, scarcely prominent, flattened in larger specimens, bounded abaxially by slight step. Surface with rather dense growth lines. Holotype of *Natica (Natica) millepunctata* var. *tauropicta* Sacco, 1890 retains pale brown background with lighter pattern of undulating collabral stripes changing into collabral rows of oval spots on final half-whorl. Operculum slightly thickened; central callus scarcely prominent, tongue-shaped, reaching half-height of operculum; inner margin smooth or with obscure transverse wrinkles; inner surface flatly convex, nucleus not protruding; outer surface planar with two marginal grooves and two ridges. Juvenile opercula (about 3 mm in height) with broad, flat-topped marginal ridge and vestige of inner groove; at size of about 5 mm, marginal ridge bifurcates, thence outer groove develops separating narrow and sharp outer ridge from robust, round-topped inner ridge. In fully grown opercula: outer groove rather wide to wide, with concave bottom; inner groove deeper and as wide as outer one or slightly wider, also with concave bottom, bounded adaxially by rounded step in some specimens; outer ridge thin, rather sharp; inner ridge moderately thick, round-topped in most specimens, narrower and overhanging inner groove in a few specimens.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.148-0.180	0.636-0.716	5.897-44.461	7.651-41.907	1.376-11.640	3.946-33.570	4.078-26.206
0.164	0.676	25.179	24.779	6.508	18.758	15.142
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
1.556-18.252	0.979-6.939	0.000-6.721	0.122-5.682	11°-31°	102°-134°	
9.904	3.959	3.043	2.902	21°	118°	

Remarks. *Natica tigrina* Defrance, 1825 is different from the Recent Indo-West Pacific species *Cochlis tigrina* Röding, 1798. The species name *tigrina* Defrance is herein combined with the generic name *Cochlis* Röding, 1798 and would be a junior secondary homonym of *C. tigrina* Röding, thence an invalid name (ICZN 1999, Articles 53.3 and 57.3 of the Code). However, since Röding's species was designated as the type of the genus *Paratectonatica* Azuma, 1961 (see Kabat 1991 and Torigoe & Inaba 2011), it appears that the two species in question are not congeneric, and that the name *tigrina* Defrance is a valid name (ICZN 1999, Article 59 of the Code). The name *crassiuscula* (a variety of *N. tigrina* Defrance introduced by Grateloup 1847), proposed by Lozouet et al. (2001) for the lower Miocene, French material, was not intended as a replacement name for *tigrina* Defrance. These authors did not consider the name *tigrina* Defrance invalid, instead they regarded it as the proper one for the Pliocene specimens, because of its wide use with reference to the fossils of that age in the Mediterranean area. This latter opinion is not acceptable (Pedriali & Robba 2005; present paper).

Cochlis tigrina appears to be a rather variable species as regards the elevation of the spire, the amplitude of the umbilicus, the breadth and prominence of the funicle, the extent of the funicle within the umbilicus, and the shape of the umbilical callus. Besides the Italian material, we examined a vast lot of French specimens (including a shell in Cossmann collection, MNHN-F-J05667) and could note that the cited characters exhibit a gradual transition between respective end-forms.

Natica pachyope was introduced by Cossmann & Peyrot (1919) on the basis of material collected at Saint-Jean-de-Marsacq (late Burdigalian) and at Saubrigues (Langhian). We have not seen the original material (included in the Degrange Touzin collection), however, from the excellent illustrations published by Cossmann & Peyrot (1919), it appears that the teleoconch of *N. pachyope* falls within the range of variation of *Cochlis tigrina* (see above) and the operculum is identical to that of *C. tigrina*. On the basis of this evidence, we consider *N. pachyope* a synonym of *C. tigrina*. *Natica aquitanica* Tournouër, 1873 was regarded as a synonym of *C. tigrina* (cited as *Natica crassiuscula* Grateloup, 1847) by Lozouet et al. (2001). We obtained an excellent photograph of the holotype of Tournouër's species (MNHN-F-B27839) and examined a lot of *N. aquitanica* from upper Aquitanian deposits of Saint-Martin-d'Oney. The teleoconch characters of *N. aquitanica* do not warrant specific separation from *C. tigrina* and the values of the characteristic elements of the protoconch of both taxa are identical. However, since the operculum of *N. aquitanica* is unknown, we include the species in the synonymy of *C. tigrina* with doubt. The lower Badenian (Langhian) shell and the operculum recovered near Szokolya (Hungary), illustrated by Baldi (1960) and referred to as *Natica (N.) tigrina hoernesi* Fischer & Tournouër, 1873, seem to conform to those of *C. tigrina*. However, since

we have not examined this material, we prefer to include it in the synonymy of the present species with reservation.

Natica sallomacensis Tournouër, 1873 is closely similar to *Cochlis tigrina* in shell characters, but can be readily distinguished from it in that it has the protoconch with significantly smaller diameter of the first half-whorl, the spire whorls devoid of subsutural shelf, separated by distinctly channeled sutures (those of *C. tigrina* are adpressed), and the funicle placed more abapically. *Cochlis curta* (Erünal-Erentöz, 1958), described from the Serravallian of Turkey, is easily differentiated from *C. tigrina* by its protoconch with significantly smaller diameter of the first half-whorl and by its depressed, markedly low-spired shell (see Landau et al. 2013).

Mayer (1864, p. 166) described the new species *Natica burdigalensis* from lower Burdigalian deposits of Léognan and Saucats, and remarked that it had been "confondue jusqu'à ce jour avec le *N. millepunctata* don't elle est de fait fort voisine" (*N. millepunctata* referred to by Mayer is *Natica tigrina*). Cossmann & Peyrot (1919, p. 193) thoroughly discussed the characters that distinguish *N. burdigalensis* from *N. tigrina*. Our collection includes several shells of *N. burdigalensis* from Léognan, two with the operculum still filling the aperture, and some loose opercula. On the basis of this material, we note that Mayer's species is similar to *C. tigrina* in shell morphology and that the differentiating characters pointed out by Cossmann & Peyrot (1919) are correct. *N. burdigalensis* differs from *C. tigrina* also by its protoconch of 0.75 more whorls, with significantly greater diameter and smaller diameter of the initial half-whorl. The operculum with a broad marginal swelling bearing a narrow longitudinal groove demonstrates that *N. burdigalensis* is not congeneric with *C. tigrina*, instead it belongs in the genus *Tanea* Marwick, 1931.

Fischer & Tournouër (1873) created the new species *Natica hoernesi* based on upper Miocene material from Cabrières. Examination of the photograph of syntype MNHN-F-R06714 has shown that the shell of *N. hoernesi* is more similar to *Cochlis raropunctata raropunctata* (Sasso, 1827) than to *Cochlis tigrina*. However, in the lack of information on the protoconch and the operculum of *N. hoernesi*, we abstain from any conclusion about its relationships.

Sacco (1891) figured a shell referred to as *Natica (Natica) millepunctata* var. *sismondiana* d'Orbigny, 1852. The comparison of Sacco's specimens in MGPT (BS.029.01.003, 003/01, 003/02, 003/03) with a syntype of *N. sismondiana* (MNHN-F-A12745) has shown that they differ markedly from d'Orbigny's taxon. *N. sismondiana* has an umbilicus largely filled by a massive funicle, an abapical, narrow umbilical channel, and a broad umbilical callus fused with the parietal callus, characters that are reminiscent of those of the genus *Polinices* Montfort, 1810. Instead, the specimens in MGPT have a widely open umbilicus and perfectly conform to the characters of *Cochlis tigrina*. It is to be noted that, of the nine specimens in lot BS.029.01.003/03, only six are *C. tigrina*, whereas one belongs to *Pliconacca plicatulaeformis* (Kittl, 1887) and two are *Cochlis sallomacensis* (Tournouër, 1873). The two specimens (MGPT BS.029.01.007 and 007/1) on which Sacco (1890b) based his variety *miocontorta* of *Natica (Natica) millepunctata* Lamarck, 1822 could be *C. tigrina*. However, their poor preservation prevents from a safe specific identification; accordingly, they are included in the synonymy of *C. tigrina* with doubt.

The upper Burdigalian, Dutch shells identified as *Natica tigrina* by Janssen (1969, 1984) superficially resemble Defrance's species in teleoconch shape. However, direct examination of specimens RGM 225954 and RGM 225955 (of Janssen 1984) has shown that their opercula have a broad, swollen marginal area bearing a narrow, deep longitudinal groove and are closely similar to that of *Natica zelandica* Quoy & Gaimard, 1832, type species of the genus *Tanea* Marwick, 1831. On this basis, we conclude that these Dutch specimens are unlike *N. tigrina*. Instead, they represent a species belonging in the genus *Tanea*. Von Koenen (1882, p. 223) introduced the new species *Natica beyrichi* and excellently illustrated it (pl. 5, figs. 1-3). From the figures published by von Koenen (1882), it appears that also *N. beyrichi* belongs in *Tanea* and that it could be a more suitable assignment for the cited Dutch shells. The lower Miocene, Antarctic specimens referred to as *Natica (Natica) tigrina* by Karczewski (1987) are preserved as internal casts and can hardly be assigned to species. The assumption that these specimens are conspecific with the European ones of *Cochlis tigrina* is incorrect.

Stratigraphic occurrence. *Cochlis tigrina* (Defrance, 1825) is definitely known from Aquitanian to Langhian deposits of France and Belgium, from the Langhian of Poland, and from Burdigalian

to Serravallian units of Italy (Piedmont). The species probably occurs also in the Langhian of Hungary and in the Serravallian of Belgium.

Cochlis sp. 1
Pl. 4, figs. 6, 7

Material examined: Cava Albanello: 1 spm., MGP-PD 1222R; Cava Grola: 1 spm., MPUM 11260 (Pl. 4, fig. 6), 1 spm., private collection; Cava Rossi: 1 spm., NP 9991, 3 spms., MCZ 4321; Ciupio: 1 spm., MGP-PD 11624/a-11664/a (Pl. 4, fig. 7).

Description. Protoconch abraded. Teleoconch globose-oval, globose in a few specimens, thick. Spire broadly conical, rather low, whorls increasingly convex during growth, suture adpressed. Last whorl globose, not expanded toward aperture; larger specimens with very slightly concave subsutural shelf obscurely bounded abaxially. Aperture D-shaped, in moderately prosocline plane, length about twice width; outer lip semicircular, inner lip nearly straight. Parietal callus long, rather thick, with slightly angular abapertural outline; anterior lobe small, roundly angular. Umbilicus deep, rather small, umbilical wall steep.

Funicle cord-like, thick and prominent, separated from umbilical wall by shallow spiral depression that is very narrow to moderately wide depending on size of funicle. Umbilical callus thick, semicircular, located at mid-abapical part of inner lip, separated from anterior lobe of parietal callus by moderately deep, narrow notch. Basal fasciole indistinct. Surface with remnants of uneven growth lines.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
-	-	12.281	11.490	3.200	9.082	6.151
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
3.990	1.511	0.959	1.520	25°	111°	

Remarks. The present specimens resemble *Cochlis saparata* (Deshayes, 1864) in teleoconch shape, but they differ from Deshayes' species in having a smaller anterior lobe of the parietal callus, and an abapical sulcus arched in cross section and smoothly merging into the umbilical wall (flat-bottomed and separated from the umbilical wall by a step in *C. separata*). More, better preserved material retaining the protoconch is required in order to clarify their relationships.

Stratigraphic occurrence. *Cochlis* sp. 1 was recovered from upper Ypresian and lower to middle Lutetian deposits of Veneto.

Cochlis sp. 2
Pl. 4, fig. 8

Material examined: Case Soghe: 1 spm., NP 9994; Monte Gloso: 1 spm., MPUM 11261 (Pl. 4, fig. 8).

Description. Protoconch poorly preserved, apparently of 2.75 whorls, tip very small. Teleoconch small, globose-oval, thick. Spire broadly conical, rather low, whorls gently convex, suture adpressed. Last whorl globose, not expanded toward aperture; subsutural shelf indistinct. Aperture D-shaped, in moderately prosocline plane, length about 1.7 times width; outer lip semicircular, inner lip very slightly arched. Parietal callus long, moderately thick, with subangular abapertural outline; anterior lobe indistinct. Umbilicus deep, small, crescent-shaped; umbilical wall steep. Funicle broad, increasingly depressed toward interior of umbilicus, separated from umbilical wall by shallow, rather narrow spiral depression. Umbilical callus thick, with arched abapertural outline, located at mid-abapical part of inner lip, separated from anterior end of parietal callus by very slight notch. Basal fasciole indistinct. Surface with remnants of fine growth lines; one specimen retains vestige of dark brown subsutural band and lowermost base.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
~ 0.071	-	6.651	6.240	1.822	4.830	3.569
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
1.921	0.943	0.260	0.719	14°	109°	

Remarks. The Rupelian species *Cochlis infelix* (Sacco, 1890) somewhat resembles *Cochlis* sp. 2 in shell shape, but differs from it in having a wider umbilicus, a narrower, cord-like funicle, and a smaller, semicircular umbilical callus widely separated from the parietal callus.

Stratigraphic occurrence. *Cochlis* sp. 2 appears to be an uncommon element, occurring in Rupelian deposits of Veneto.

Genus *Cryptonatica* Dall, 1892

Cryptonatica Dall, 1892, p. 362. Type species by subsequent designation (Dall 1909, p. 85): *Natica clausa* Broderip & Sowerby, 1829 (= *Nerita affinis* Gmelin, 1791), Recent, North Atlantic.

Boreonatica Golikov & Kussakin, 1974, p. 294. Type species by original designation: *Natica clausa* Broderip & Sowerby, 1829.

Sulconatica Golikov & Kussakin, 1974, p. 294. Type species by original designation: *Natica janthostoma* Deshayes, 1839 (see also Kabat 1991 and Torigoe & Inaba 2011).

Dall (1892, p. 362) introduced *Cryptonatica* with no type species designation. Petit (1986, p. 38) and Kabat (1991, p. 428), evidently relying upon the subsequent designation made by Cossmann (1896, p. 238), indicated *Natica (Cryptonatica) floridana* Dall, 1892 as the type species of *Cryptonatica*. However, Bouchet & Waren (1993, p. 758) discussed this type species designation and correctly considered invalid Cossmann's action. They reinstated *Natica clausa* Broderip & Sowerby, 1829 (= *Nerita affinis* Gmelin, 1791) as the type species of *Cryptonatica* following the designation subsequently made by Dall himself (1909). This opinion was widely accepted by recent authors (cf. Zhang & Wei 2010; Torigoe & Inaba 2011). According to Kabat (1991), *Crytonatica* Dall, 1921, *Cryptonica* Cossmann, 1925 and *Cryotonatica* Oyama, 1969 are uncorrect spellings; *Cryptonatica* Cossmann, 1925 is an error for *Cryptonerita* Kittl, 1894.

Cryptonatica was considered either as a synonym of *Tectonatica* Sacco, 1890 (Cossmann 1925; Wenz 1941 in 1938-1944; Wrigley 1949), or as a distinct genus (Marincovich 1977; Oyama 1985; Golikov & Sirenko 1988; Majima 1989; Kabat 1991; Bouchet & Waren 1993; Torigoe & Inaba 2011). The relationships between *Tectonatica* and *Cryptonatica* were amply discussed by Pedriali & Robba (2008a, pp. 98, 99), who concluded: 1) that the umbilical characters "hardly provide the ground for separating *Cryptonatica* from *Tectonatica*", and 2) that the operculum is a suitable character in distinguishing the species of *Cryptonatica*, which have the operculum with smooth outer surface, from those of *Tectonatica* (outer surface of the operculum with a distinct groove bounding a wide marginal area).

The Eocene species *Cryptonatica noe* dealt with below, along with an unidentified species from Fleury-la-Rivière (Cave aux Coquillages), France, seem to be the oldest European members of the genus. According to the illustration published by its author (pl. 40, fig. 9b), also the lower Oligocene species *Natica semperi* von Koenen, 1891 belongs in *Cryptonatica*.

Cryptonatica noe (d'Orbigny, 1850) comb. n.

Pl. 4, figs. 9-13

1832 *Natica glaucinoides* Deshayes, p. 166, pl. 20, figs. 7, 8 (not J. Sowerby, 1812).

1850 *Natica noe* d'Orbigny, p. 413, n°1437.

1864 *Natica noae* - Deshayes, p. 55.

1888 *Natica noae* - Cossmann, p. 160.

1907 *Natica noae* - Cossmann & Pissarro, pl. 9, fig. 61-5.

1949 *Natica noae* - Wrigley, p. 12, fig. 3.

2008 *Natica noae* - Quaggiotto & Mellini, p. 48.

Type material: *Natica noe* d'Orbigny, lectotype (here designated): the specimen figured by Deshayes (1832, pl. 20, figs. 7, 8) as *Natica glaucinoides* (see remarks below) and refigured herein (Pl. 4, fig. 9), EM 32834a, Saint-Witz, Le Guépelle (France); 9 paralectotypes, EM 32834, Saint-Witz, Le Guépelle (France).

Other material examined: Cava Albanello: 2 spms., NP 9967; Cava Grola: 4 spms., private collection, 1 spm., MPUM 11236 (Pl. 4, fig. 11), 9 spms., private collection, 4 spms., private collection, 8 spms., private collection, 4 spms., NP 9968, 1 spm., MPUM 11237 (Pl. 4, fig. 12), 1 spm., private collection, 1 spm., NP 9992; Saint-Witz, Le Guépelle (France): 1 spm., NP 9969, 1 spm., MPUM 11238 (Pl. 4, fig. 13).

Description. Protoconch small, turbiniform, very depressed, of 1.75-1.90 slightly convex whorls, tip small. Teleoconch globose to globose-oval, rather thin. Spire broadly conical, rather pointed, short, whorls flatly convex; suture slightly incised, almost flush. Last whorl broadly oval, subsutural shelf indistinct, periphery above midline. Aperture D-shaped, in prosocline plane, length twice width; outer lip nearly semicircular, thin-edged, inner lip straight, slightly thickened and everted abapically. Parietal callus subtrapezoidal, rather short, thin to moderately thick, with obscure adapical tubercle; anterior lobe indistinct. Umbilicus wide, deep, with angular border more distinct abapically; umbilical wall rather steep. Funicle cord-like, thick and prominent, ending at middle of adapertural border of umbilicus, separated from umbilical wall by shallow spiral furrow. Umbilical callus large, thick, prominently semicircular in outline, located at middle part of inner lip, separated from anterior corner of parietal callus by shallow, reverse J-shaped notch. Basal fasciole indistinct. Surface with uneven and unevenly spaced growth lines. Some specimens from Veneto retain vestige of uniform olive-green background. Calcareous operculum with smooth outer surface.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.191-0.207	0.749-0.797	5.505-13.765	5.349-13.821	0.453-3.545	4.659-10.611	3.008-8.512
0.199	0.773	9.635	9.585	1.999	7.635	5.760
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
2.005-7.697	0.544-2.728	0.040-2.360	0.924-2.932	9°-29°	99°-135°	
4.851	1.636	1.200	1.928	19°	117°	

Remarks. *Natica noe* was introduced by d'Orbigny (1850) as replacement name for *Natica glaucinoides* Deshayes, 1834, which is a primary homonym of *Natica glaucinoides* J. Sowerby, 1812 (see also Pacaud 2007, p. 40). The name *glaucinoides* Deshayes is permanently invalid (ICZN 1999, Article 57.2 of the Code). The specimens dealt with by Deshayes when describing his *N. glaucinoides* are the syntypes of *Natica noe*. The original spelling *noe* is correct (the Latin name *Nöe* of the patriarch Noah remains unchanged in all cases) and its correction to *noae* adopted by subsequent workers is unjustified.

The umbilical characters of *Natica noe* fully agree with those of the species currently included in the genus *Cochlis* Röding, 1798. However, on the basis of its operculum with smooth outer surface (see Pl. 4, fig. 10), we think that *Natica noe* is to be assigned to the genus *Cryptonatica* Dall, 1892.

Cryptonatica noe closely resembles *Natica microglossa* Deshayes, 1864 (a species belonging in *Cochlis*) in all teleoconch characters, but can be differentiated from it by its protoconch of 0.5 fewer whorls, with a significantly greater diameter of the first half-whorl. *C. noe* is also similar to *Cochlis epiglottina epiglottina* (Lamarck, 1804) in shell shape and has sometimes been mistaken for it. However, *C. noe* is distinguished from *C. epiglottina epiglottina* because of its protoconch with an inflated initial half-whorl having a significantly smaller diameter. Further, *C. noe* has an angular umbilical border (rounded in *C. epiglottina epiglottina*), a narrower funicle, thence a wider umbilical channel, and an umbilical callus demarcated from the parietal callus by a wider, shallow and reverse J-shaped notch (moderately deep and narrow in *C. epiglottina epiglottina*). Obviously, the operculum stands as the main character in distinguishing *C. noe* from both *N. microglossa* and *C. epiglottina epiglottina*.

Stratigraphic occurrence. *Cryptonatica noe* (D'Orbigny, 1850) was hitherto known from Lutetian and Bartonian deposits of France and from the Bartonian of Great Britain. Italian occurrences are from lower and middle Lutetian units of Veneto.

Genus *Tanea* Marwick, 1931

Tanea Marwick, 1931, p. 98. Type species by original designation: *Natica zelandica* Quoy & Gaimard, 1832, Recent, New Zealand.

Pedriali & Robba (2008) listed the following distinctive characters of *Tanea*: 1) spire moderately to greatly elevated, 2) anterior lobe of the parietal callus small, indistinct in a few species, 3) funicle thick, moderate in a few species, 4) operculum with 1 narrow groove bounding a broad, convex marginal area bearing a median longitudinal furrow. These authors noted that the operculum stands as the primary distinctive element of *Tanea*.

The genus includes several fossil and Recent Indo-Pacific species. The Recent Mediterranean species *Tanea dillwyni* (Payraudeau, 1826) and the Burdigalian to Zanclean species *Tanea dillwyni koeneni* (Sacco, 1891) were so far known outside the Indo-Pacific area. The present study demonstrates that other Miocene, European species (*Natica burdigalensis* Mayer, 1864 and *Natica beyrichi* von Koenen, 1882), along with Burdigalian, Dutch specimens belong in *Tanea*; see also the above remarks on *Cochlis tigrina* (Defrance, 1825).

Tanea dillwyni koeneni (Sacco, 1891)

Pl. 4, figs. 14-18; Pl. 5, fig. 1

1882 *Natica plicatella* - von Koenen, p. 229, pl. 5, figs. 6, 7 (not fig. 9: operculum of *Natica plicatula* Bronn, 1831).

1891 *Natica (Natica) epiglottina* var. *koeneni* Sacco, p. 63.

1904 *Natica (Cochlis) dillwyni* var. *taurominor* Sacco, p. 103, pl. 22, figs. 43, 44.

1984 *Natica dillwyni* var. *taurominor* - Ferrero Mortara et al., p. 31.

2008a *Tanea dillwyni koeneni* - Pedriali & Robba, p. 104, pl. 1, figs. 9-11; pl. 2, fig. 16; pl. 3, figs. 8, 14 (*cum syn.*).

2013 *Tanea koeneni* - Harzhauser et al., p. 360, pl. 1, fig. 9.

Type material: *Natica (Natica) epiglottina* var. *koeneni* Sacco, type material not seen. The holotype (in Geologisches Institut, Göttingen, Germany) was illustrated by Janssen (1969, pl. 7, fig. 22). *Natica (Cochlis) dillwyni* var. *taurominor* Sacco, lectotype (here designated): the shell figured by Sacco (1904, pl. 22, fig. 43) and refigured herein (Pl. 4, fig. 14), MGPT BS.029.01.045, Monte dei Cappuccini; 1 paralectotype, MGPT BS.029.01.046, 20 paralectotypes MGPT BS.029.01.046/01, Monte dei Cappuccini.

Other material examined: Albugnano: 3 spms., PG 95; Borelli: 1 spm. (operculated shell), MGPT-PU 135094, 1 spm., MGPT-PU 135095 (Pl. 4, fig. 15), 2 spms., MPUM 11263, 2 spms., NP 9947, 9 spms., MGPT-PU 135096, 1 spm., MGPT-PU 135097 (Pl. 4, fig.

16), 26 spms. (opercula), MGPT-PU 135098, 1 spm. (operculum), MGPT-PU 135099 (Pl. 4, fig. 17), 1 spm., PG 22; Monte dei Cappuccini: 1 spm., MGPT-PU 25670, 1 spm., MGPT-PU 135100 (Pl. 4, fig. 18), 31 spms., MGPT-PU 25671, 1 spm., MGPT-PU 135101, 1 spm., MGPT-PU 135102 , 1 spm., MGPT-PU 135103 (Pl. 5, fig. 1); Rio di Bocca d'Asino: 2 spms., NP 9946, 1 spm., PG 6a, 1 spm., PG 24; Sant'Agata Fossili: 1 spm. (operculated shell), MGPT-PU 135104, 3 spms., PG 23; Soprasalmo: 2 spms., private collection.

Dimensions of Miocene specimens (mm)

DHW	PD	H	D	SH	AH	AW
0.068-0.076	1.250-1.430	2.510-16.914	2.852-16.628	0.280-3.660	1.973-13.509	2.585-9.313
0.072	1.340	9.712	9.740	1.970	7.741	5.949
UW	**WUC**	**WAD**	**WAB**	**IS**	**SA**	
0.972-6.524	0.696-2.956	0.053-2.633	0.007-1.151	9°-29°	107°-131°	
3.748	1.826	1.343	0.579	19°	119°	

Remarks. Pedriali & Robba (2008a) noted that the present taxon is closely similar to the Recent species *Tanea dillwyni* (Payraudeau, 1826) in shell shape, funicle, and opercular characters. They listed as differentiating elements the two-whorled protoconch (that of *T. dillwyni* has slightly more than three whorls) and the subsutural wrinkles (absent in *T. dillwyni*). Pedriali & Robba (2008a) concluded that Sacco's taxon is to be considered as a subspecies of *T. dillwyni*. The values of the characteristic elements of the protoconch reported by Pedriali & Robba (2008a) were based on a single, partially abraded larval shell. The recovering of new, better preserved material has shown that the protoconch is of 3.25-3.47 whorls (see Pl. 5, fig. 1), thus identical to that of *T. dillwyni*. It appears that the presence of the subsutural wrinkles constitute the sole character distinguishing Sacco's taxon from *T. dillwyni*. This evidence supports their separation, but only at the subspecies level. For the teleoconch characters and the relationships with *Natica plicatula* Bronn, 1831, see Pedriali & Robba (2008a).

Stratigraphic occurrence. *Tanea dillwyni koeneni* (Sacco, 1891) is definitely known from upper Burdigalian to Tortonian deposits of the North Sea Basin. Italian occurrences are from upper Langhian to Zanclean units. Pedriali & Robba (2008a) remarked that the subspecies seems to have not survived subsequent to the Zanclean.

Genus *Tectonatica* Sacco, 1890

Tectonatica Sacco, 1890a, p. 205 (*nomen nudum*).

Tectonatica Sacco, 1890b, p. 33. Type species by monotypy: *Natica tectula* Bonelli, 1826 (MS) = *Natica (Tectonatica) tectula* Sacco, 1890, Miocene to Pliocene, Italy (see also Kabat 1991).

Tectonatica was introduced as a subgenus of *Natica* Adanson, 1757 (= *Natica* Scopoli, 1777), but subsequent workers regarded it as a distinct genus. According to Kabat (1991), *Tectonica* Carcelles & Williamson, 1951 and *Tectonatic* Maeda, 1988 are errors for *Tectonatica*.

For the relationships between *Tectonatica* and *Cryptonatica* Dall, 1892, see the above remarks on *Cryptonatica* and also Pedriali & Robba (2008, pp. 98, 99). Besides the grooved calcareous operculum, the species of *Tectonatica* have mostly small-sized teleoconchs with the umbilicus completely or partly filled by the umbilical callus (in the last case, a broad funicle can be noted) and with the semicircular to subtriangular umbilical callus distinguished from the parietal callus. Except for *Tectonatica tectula* and *Tectonatica astensis* (Sacco, 1890), some of the species described below are assigned to *Tectonatica* only provisionally since the respective opercula are unknown. Future recovering of specimens with the operculum *in situ* may prove that they belong in *Cryptonatica*.

Tectonatica albertii sp. n.

Pl. 5, figs. 2, 3

Derivation of name: The species is named after Riccardo Alberti, who provided material relevant to this study.

Holotype: Monte Gloso: MPUM 11264 (Pl. 5, fig. 2).

Paratypes: Altavilla Vicentina: 5 spms., MGP-PD 1223R, 2 spms., MPUM 11265, 1 spm., MPUM 11266 (Pl. 5, fig. 3), 1 spm., MPUM 11267, 1 spm., MPUM 11268, 36 spms., MCZ 4322; Case Soghe: 2 spms., MPPLF 5123 pr (Accorsi Benini collection); Monte Gloso: 1 spm., MPUM 11269; Sangonini: 9 spms., MGP-PD 6418/a.

Other material examined: Altavilla Vicentina: 2 spms., NP 9908, 6 spms., NP 9909, 1 spm., NP 9910, 1 spm., NP 9912, 1 spm., NP 9913, 1 spm., NP 9914; Monte Gloso: 1 spm., NP 9916, 2 spms., private collection.

Preservation: Mostly fair.

Type locality: Monte Gloso (see appendix).

Horizon: Yellowish-gray, coarse-grained marly sandstone of Rupelian age.

Diagnosis. Protoconch paucispiral, depressed-turbiniform. Shell globose, with low to moderately elevated spire and globose last whorl. Umbilicus deep of moderate breadth, comma-like. Parietal callus subrectangular, with very slight, angular anterior lobe; funicle broad and low; umbilical callus thick, with reverse S-shaped adaxial outline, merging into anterior lobe of parietal callus. Color pattern of blackish-brown subsutural band, lower base and collabral stripes over brown background.

Description. Protoconch medium-sized, depressed-turbiniform, of 1.87-2 gently convex, smooth whorls, tip medium-sized. Teleoconch glo-

bose, thick. Spire broadly conical, low to moderately elevated, whorls gently convex, flatly convex in some specimens, suture adpressed to almost flush. Last whorl globose, scarcely extended toward aperture; subsutural shelf indistinct; periphery above midline. Aperture D-shaped, in prosocline plane, length about 1.60 times width; inner lip straight, outer lip semicircular, basal lip thickened. Parietal callus rather thick, subrectangular, with very slight, angular anterior lobe below border of umbilicus. Umbilicus deep, of variable but moderate breadth, comma-like, wider adapically and gradually narrowing downward. Funicle broad and low, separated from steep umbilical wall by narrow, shallow groove. Umbilical callus long, thick, located at mid-abapical part of inner lip, with reverse S-shaped adaxial outline, merging into anterior lobe of parietal callus. Basal fasciole indistinct. Outer surface with coarse growth markings changing into moderate subsutural wrinkles. Most specimens retain vestige of brown background, with blackish-brown subsutural band, lower base and collabral stripes.

Dimensions (mm)

DHW	PD	H	D	SH
0.330-0.414	1.219-1.399	5.549-13.125	5.587-12.707	1.151-3.323
0.372	1.309	9.337	9.147	2.237
AH	**AW**	**UW**	**IS**	**SA**
4.150-10.050	3.196-8.204	1.602-4.490	8°-24°	114°-138°
7.100	5.700	3.046	16°	126°

Remarks. The present new species is assigned to the genus *Tectonatica* Sacco, 1890 on the basis of its umbilical characters, which are closely similar to those of *Tectonatica astensis* (Sacco, 1890) and *Tectonatica prietoi* (Hidalgo, 1873).

Tectonatica albertii exhibits a striking resemblance to *Tectonatica burtoni altavillensis* subsp. n. (see below) in shell morphology and color pattern, but differs from it in that it has a larger protoconch with 0.75 fewer whorls and the diameter of the first half-whorl three times the size. *T. albertii* differs from *Natica burtoni* Wrigley, 1949, a species herein assigned to the genus *Tectonatica* Sacco, 1890 (see the remarks on *T. burtoni altavillensis*), because of its protoconch with fewer whorls (1.87-2 instead of 2.55-2.75) and significantly greater diameter of the initial half-whorl (four times the size). The less convex spire whorls and the adpressed, almost flush sutures (weakly channeled in *N. burtoni*) are other minor differences.

Stratigraphic occurrence. *Tectonatica albertii* sp. n. was recovered from lower Oligocene deposits of Veneto.

Tectonatica astensis (Sacco, 1890)

Pl. 5, figs. 4-6

1890b *Natica (Naticina) pulchella* var. *astensis* Sacco, p. 31.

1891 *Natica (Naticina) pulchella* var. *astensis* - Sacco, p. 77, pl. 2, fig. 50.

2008a *Tectonatica astensis* - Pedriali & Robba, p. 106, pl. 1, fig. 14; pl. 2, figs. 1, 2, 17; pl. 3, figs. 1, 2, 15-17 (*cum syn.*).

Type material: Pedriali & Robba (2008a, p. 107) reviewed the type material of *Tectonatica astensis*, and described the characters of this species.

Material examined: Albugnano: 2 spms., PG 79; Borelli: 14 spms., MGPT-PU 135105, 1 spm., MGPT-PU 135106 (Pl. 5, fig. 4), 1 spm., MGPT-PU 135107, 1 spm., MGPT-PU 135108, 1 spm., MGPT-PU 135109, 1 spm., MGPT-PU 135110, 1 spm., MGPT-PU 135111, 1 spm., MGPT-PU 135112, 1 spm., MGPT-PU 135113, 1 spm., MGPT-PU 135114, 2 spms. (opercula), MGPT-PU 135115, 1 spm. (operculum), MGPT-PU 135116 (Pl. 5, fig. 5), 2 spms., MPUM 11270, 2 spms., NP 9907; Rio di Bocca d'Asino: 1 spm., NP 9889; Sant'Agata Fossili: 1 spm., PG 18b, 1 spm., PG 18c, (Pl. 5, fig. 6), 1 spm., PG 18d, 1 spm., PG 73a (operculated shell), 1 spm., NP 9890; Sogliano al Rubicone: 1 spm., PP.SR 01/02.

Dimensions of Miocene specimens (mm)

DHW	PD	H	D	SH
0.101-0.121	1.149-1.401	2.692-6.664	2.846-6.430	0.795-1.747
0.111	1.275	4.678	4.638	1.271
AH	**AW**	**UW**	**IS**	**SA**
1.859-4.963	1.768-4.104	0.935-3.215	14°-22°	99°-131°
3.411	2.936	2.075	18°	115°

Remarks. The specimens listed above fully conform to the Pliocene material dealt with by Pedriali & Robba (2008a). The 95% confidence intervals calculated for the dimension (protoconch and teleoconch) of the Miocene specimens overlap those obtained for the Pliocene shells; in particular, there are no significant differences as regards the values of the characteristic elements of the protoconch. For description and comments, see Pedriali & Robba (2008a).

Stratigraphic occurrence. *Tectonatica astensis* (Sacco, 1890) was known to range from late Miocene (Tortonian) to late Pliocene. The uncommon occurrence in the Serravallian of

Albugnano reported herein pushes back the first known occurrence of the species.

Tectonatica burtoni altavillensis subsp. n.

Pl. 5, figs. 7, 8

Derivation of name: The name refers to Altavilla Vicentina, which is the type locality.

Holotype: Altavilla Vicentina, MPUM 11271 (Pl. 5, fig. 7).

Paratypes: Altavilla Vicentina: 1 spm., MPUM 11272 (Pl. 5, fig. 8), 1 spm., MPUM 11273, 9 spms., MGP-PD 1224R; Le Coe: 1 spm., MPUM 11274; Sangonini: 3 spms., MCZ 4323.

Other material examined: Altavilla Vicentina: 1 spm., NP 9900, 1 spm., NP 9901, 1 spm., NP 9902, 2 spms., NP 9942, 5 spms., NP 9903; Le Coe: 1 spm., NP 9905, 3 spms., NP 9906, 2 spms., NP 9907; Monte Gloso: 2 spms., private collection, 1 spm., NP 9904.

Preservation: Rather fair on the whole.

Type locality: Altavilla Vicentina (see appendix).

Horizon: Gray-brown marl of Rupelian age.

Diagnosis: Protoconch multispiral, depressed-turbiniform. Shell globose, with low to moderately elevated spire and globose last whorl. Umbilicus deep of moderate breadth, comma-like. Parietal callus subrectangular, with very slight, angular anterior lobe; funicle broad and low; umbilical callus thick, with reverse S-shaped adaxial outline, merging into anterior lobe of parietal callus. Color pattern of blackish-brown subsutural band, lower base and collabral stripes over brown background.

Description. Protoconch medium-sized, depressed-turbiniform, of 2.75-2.80 gently convex, smooth whorls, tip small. Teleoconch globose, thick. Spire broadly conical, low to slightly elevated, whorls gently convex, flatly convex in some specimens, suture adpressed to almost flush. Last whorl globose, scarcely extended toward aperture; subsutural shelf indistinct; periphery above midline. Aperture D-shaped, in prosocline plane, length about 1.60 times width; inner lip straight, outer lip semicircular, basal lip thickened. Parietal callus rather thin to thick, subrectangular, anterior lobe angular, very slight or indistinct. Umbilicus deep, of variable but moderate breadth, comma-like, wider adapically and gradually narrowing downward. Funicle broad, low to markedly depressed, separated from steep umbilical wall by narrow, shallow groove. Umbilical callus long, thick, located at mid-abapical part of inner lip, with attenuated reverse S-shaped adaxial outline, merging into anterior lobe of parietal callus. Basal fasciole indistinct. Outer surface with coarse growth markings changing into slight wrinkles subsuturally. Most specimens retain vestige of brown background, with blackish-brown subsutural band, lower base and undulating collabral stripes.

Dimensions (mm)

DHW	PD	H	D	SH
0.094-0.118	0.934-1.126	4.962-13.502	5.109-13.509	1.113-4.041
0.106	1.030	9.232	9.309	2.577
AH	**AW**	**UW**	**IS**	**SA**
3.664-9.648	3.233-8.453	1.606-4.294	14°-26°	112°-136°
6.656	5.843	2.950	20°	124°

Remarks. We obtained outstanding photographs of specimens in NHM originally grouped by Wrigley (1949) into his new species *Natica burtoni*. On the basis of the photographs and of the examination of topotypes from the Middle Barton Beds at Barton and from the Upper Bracklesham Beds in our collection, we can state that these specimens are a mixed assortment of species. Since Wrigley (1949, p. 13, fig. 8) designated the holotype (NHM G. 67389), this specimen is to be considered the valid reference for *N. burtoni*. The holotype of *N. burtoni* has umbilical characters that agree with those

PLATE 5

Fig. 1 - *Tanea dillwyni koeneni* (Sacco, 1891). Monte dei Cappuccini. MGPT-PU 135103; protoconch.

Fig. 2 - *Tectonatica albertii* sp. n. Monte Gloso. Holotype, MPUM 11264; a, apertural side (height of shell 9.94 mm); b, abapertural side.

Fig. 3 - *Tectonatica albertii* sp. n. Altavilla Vicentina. Paratype, MPUM 11266; protoconch.

Fig. 4 - *Tectonatica astensis* (Sacco, 1890). Borelli. MGPT-PU 135106; apertural side.

Fig. 5 - *Tectonatica astensis* (Sacco, 1890). Borelli. MGPT-PU 135116; operculum.

Fig. 6 - *Tectonatica astensis* (Sacco, 1890). Sant'Agata Fossili. PG 18c; protoconch.

Fig. 7 - *Tectonatica burtoni altavillensis* subsp. n. Altavilla Vicentina. Holotype, MPUM 11271; apertural side (height of shell 12.06 mm).

Fig. 8 - *Tectonatica burtoni altavillensis* subsp. n. Altavilla Vicentina. Paratype, MPUM 11272; protoconch.

Fig. 9 - *Tectonatica consimilis* sp. n. Borelli. Holotype, MGPT-PU 135117; a, apertural side (height of shell 6.62 mm); b, protoconch.

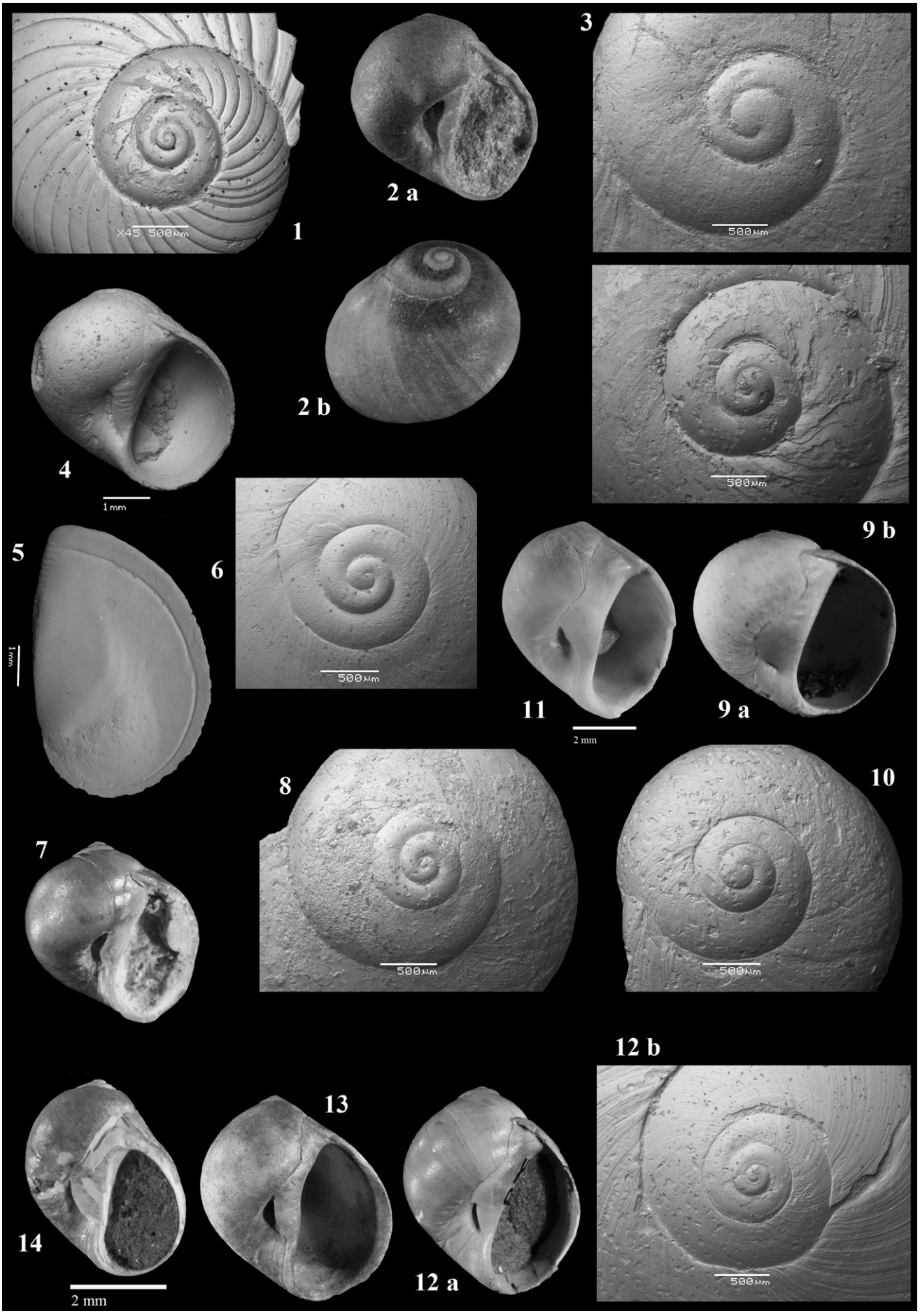
Fig. 10 - *Tectonatica consimilis* sp. n. Borelli. Paratype, MGPT-PU 135120; protoconch.

Fig. 11 - *Tectonatica dertomamilla* (Sacco, 1890). Stazzano. Holotype of *Natica (Polinices) dertomamilla* Sacco, 1890. MGPT BS.029.06.009; apertural side.

Fig. 12 - *Tectonatica dertomamilla* (Sacco, 1890). Montegibbio. MPUM 11276; a, apertural side (height of shell 18.69 mm); b, protoconch.

Fig. 13 - *Tectonatica dertomamilla* (Sacco, 1890). Rio di Bocca d'Asino. Private collection; apertural side (height of shell 19.12 mm).

Fig. 14 - *Tectonatica miocolligens* (Sacco, 1890). Colli Torinesi. Holotype of *Natica (Polinices) miocolligens* Sacco, 1890. MGPT BS.029.06.007; apertural side.


1
×45 500µm
2 a
2 b
3
500µm
4
1 mm
5
1 mm
6
500µm
7
8
500µm
9 a
9 b
500µm
10
500µm
11
2 mm
12 a
12 b
500µm
13
14
2 mm

of several species of *Tectonatica* Sacco, 1890; consequently, Wrigley's species is herein assigned to this genus.

Compared to the holotype of the Eocene species *Tectonatica burtoni*, the present specimens from the early Oligocene of Altavilla Vicentina appear to have the values of the characteristic elements of the protoconch identical to those measured for Wrigley's species. They differ from *T. burtoni* only in having gently to flatly convex spire whorls separated by adpressed to almost flush sutures (*T. burtoni* has well convex whorls and very slightly channeled sutures). These differences are not considered sufficient for consistent separation at the species level. Consequently, we regard the studied specimens as representatives of a new allochronous subspecies of *T. burtoni* and name it *altavillensis*.

Stratigraphic occurrence. *Tectonatica burtoni altavillensis* subsp. n. was recovered from upper Priabonian and Rupelian units of Veneto.

Tectonatica consimilis sp. n.

Pl. 5, figs. 9, 10

Derivation of name: From Latin *consimilis* = closely similar, with reference to the remarkable similarity to *Tectonatica tectula* (Sacco, 1890).

Holotype: Borelli: MGPT-PU 135117 (Pl. 5, fig. 9).

Paratypes: Borelli: 1 spm., MGPT-PU 135120 (Pl. 5, fig. 10), 1 spm., MGPT-PU 135121, 29 spms., MGPT-PU 135122, 1 spm., MPUM 11275.

Other material esamined: Borelli: 1 spm., NP 9881

Material erroneously referred to as *Natica (Polinices) redempta* Michelotti, 1847 in MGPT: Borelli: 1 spm., MGPT BS.029.06.014/02.

Preservation: Fair on the whole.

Type locality: Borelli (see appendix).

Horizon: Gray, medium sand of Tortonian age.

Diagnosis: Globose shell with depressed to moderately elevated spire and inflated last whorl. Umbilicus completely plugged or faint oblique chink in a few specimens. Parietal callus thick, subquadrangular, expanded adapically; umbilical callus thick, large, semicircular, merging into parietal callus. Basal fasciole broad, depressed. Color pattern of pale brown spots arranged into spiral rows.

Description. Protoconch small, low-turbiniform, of 1.75 convex, smooth whorls, tip small. Teleoconch globose, rather thin. Spire broadly conical, depressed to moderately elevated, whorls gently convex, suture very slightly channeled. Last whorl inflated, moderately extended toward aperture; subsutural shelf obscure to indistinct; periphery above midline. Aperture D-shaped, in prosocline plane, length averaging 1.67 times width; inner lip straight, outer lip semicircular. Parietal callus rather thick, subquadrangular, expanded adapically, with concave abapertural outline. Umbilicus completely plugged by umbilical callus; faint oblique chink present in a few specimens. Umbilical callus large, thick, semicircular in outline, overlapping mid-adapical part of basal fasciole, merging into parietal callus (abapertural outline changing from convex to concave). Basal fasciole broad, markedly depressed. Outer surface with dense growth markings prosocyrt adapically. Some specimens retain vestige of pale brown quadrangular spots, arranged into spiral rows.

Dimensions (mm)

DHW	PD	H	D	SH
0.180-0.216	0.693-0.809	2.692-7.016	2.565-7.053	0.352-1.728
0.198	0.751	4.854	4.809	1.040
AH	**AW**	**UW = WUC**	**IS**	**SA**
2.254-5.374	1.448-5.308	1.008-2.924	17°-33°	116°-140°
3.814	3.378	1.966	25°	128°

Remarks. *Tectonatica consimilis* is morphologically similar to *Tectonatica tectula* (Sacco, 1890), but differs from it in that it has: 1) a protoconch of one fewer whorl, with a significantly smaller diameter and with the diameter of the initial half-whorl two times the size, 2) a less elevated spire (Fig. 10), 3) a slightly channeled suture (adpressed in *T. tectula*), 4) a distinct basal fasciole (absent in *T. tectula*), and 5) a different color pattern. The values of the characteristic elements of the protoconch stand as the most relevant distinguishing characters. The present new species is provisionally assigned to *Tectonatica* Sacco, 1890 because of its very close similarity to *T. tectula*, type species of the genus. As already noted (see the remarks on *Tectonatica*), new findings may prove that it belongs in *Cryptonatica* Dall, 1892.

Stratigraphic occurrence. *Tectonatica consimilis* sp. n. was recovered from Tortonian deposits at the type locality.

Tectonatica dertomamilla (Sacco, 1890) comb. n.

Pl. 5, figs 11-13

1890b *Natica (Polinices) dertomamilla* Sacco, p. 36.

1891 *Natica (Polinices) dertomamilla* - Sacco, p. 93, pl. 2, fig. 70.

1969 *Polinices dertomamilla* - Janssen, p. 161, pl. 4, fig. 2.

1984 *Polinices dertomamilla* - Ferrero Mortara et al., p. 37, pl. 3, fig. 12.

Type material: *Natica (Polinices) dertomamilla* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 2, fig. 70) and refigured herein (Pl. 5, fig. 11), MGPT BS.029.06.009, Stazzano.

Material erroneously referred to as *Natica submamillaris* var. *mioclausa* Sacco, 1890 in IPUM: Montegibbio: 2 spms., IPUM 4395.

Material erroneously referred to as *Natica pardalis* Doderlein, 1864 in IPUM: Montegibbio: 3 spms., IPUM 4396.

Other material examined: Montegibbio: 1 spm., MPUM 11276 (Pl. 5, fig. 12), 1 spm., MZB 60112; Rio di Bocca d'Asino: 1 spm., private collection (Pl. 5, fig. 13), 1 spm., private collection; Stazzano: 1 spm., MZB 60110, 1 spm., NP 9880.

Description. Protoconch small, low-turbiniform, of two gently convex, apparently smooth whorls, tip small. Teleoconch globose, globose-oval in some specimens, moderately thick. Spire broadly conical, pointed, rather elevated, whorls nearly flat-sided. Suture thin, almost flush, adpressed in one specimen, which has gently convex whorls. Last whorl globose to globose-oval, scarcely extended toward aperture; subsutural shelf indistinct; periphery about at midline. Aperture D-shaped in prosocline plane, length averaging 1.84 times width; inner lip straight, outer lip arched, with maximum convexity at abapical one-third. Parietal callus long, thick, with concave abapertural outline, ending at transition between umbilical border and steep umbilical wall; anterior lobe small to indistinct. Umbilicus largely plugged by parietal and umbilical calluses, reduced to narrow, markedly oblique mid-abapical groove exposing thick, broad funicle. Umbilical callus thick, rather short, triangular, with reverse J-shaped adaxial outline, merging into anterior lobe (or corner) of parietal callus. Basal fasciole broad, markedly depressed. Outer surface with fine growth lines prosocyrt adapically. Some specimens retain vestige of uniform pale brown background, with dark brown subsutural band.

Dimensions (mm)

DHW	PD	H	D	SH
0.165-0.189	0.883-0.995	15.992-26.032	13.560-25.312	0.930-7.818
0.177	0.939	21.012	19.436	4.374
AH	**AW**	**UW**	**IS**	**SA**
12.558-20.718	7.230-17.358	2.308-7.804	7°-19°	103°-119°
16.638	12.294	5.056	13°	111°

Remarks. The present species was assigned by the authors to *Polinices* Montfort, 1810. We think that the narrow, adaxial, markedly oblique umbilical groove and the umbilical callus well distinct from the parietal callus, as commonly noted in species of *Tectonatica* Sacco, 1890, e.g. *Tectonatica astensis* (Sacco, 1890), account for an assignment to *Tectonatica* rather than to *Polinices* (in the latter genus the umbilical callus is fused with the parietal callus and is hardly distinguishable from it). As regards the relationships with *Tectonatica miocolligens* (Sacco, 1890), the most closely related species, see below (remarks on *T. miocolligens*).

Stratigraphic occurrence. *Tectonatica dertomamilla* (Sacco, 1890) occurs uncommonly only in Tortonian deposits of Piedmont and Emilia.

Tectonatica miocolligens (Sacco, 1890) comb. n.

Pl. 5, fig. 14; Pl. 6, figs. 1-6

1890b *Natica (Polinices) submamillaris* var. *praenuntia* Sacco, p. 35 (*new synonym*).

1890b *Natica (Polinices) miocolligens* Sacco, p. 36.

1890b *Natica (Polinices) miocolligens* var. *pseudomamilla* Sacco, p. 36.

1891 *Natica (Polinices) submamillaris* var. *praenuntia* - Sacco, p. 90, pl. 2, fig. 63.

1891 *Natica (Polinices) miocolligens* - Sacco, p. 93, pl. 2, fig. 68.

1891 *Natica (Polinices) miocolligens* var. *pseudomamilla* - Sacco, p. 93, pl. 2, fig. 69.

1919 *Natica (Polinices) dertomamilla* - Cossmann & Peyrot, p. 219, pl. 12, figs. 16-18 (not *Natica dertomamilla* Sacco, 1890).

1952a *Polynices (Polynices) submamillaris* f. *dertomamilla* - Glibert, p. 73, pl. 5, fig. 12 (not *Natica dertomamilla* Sacco, 1890).

1969 *Polinices (Polinices) miocolligens* - Janssen, p. 161 (pars), pl. 4, figs. 1, 3, 9 (not figs. 4-8).

1984 *Polinices submamillaris* var. *praenuntia* - Ferrero Mortara et al., p. 36.

1984 *Polinices miocolligens* - Ferrero Mortara et al., p. 36, pl. 4, fig. 4.

1984 *Polinices miocolligens* var. *pseudomamilla* - Ferrero Mortara et al., p. 36.

not 1984 *Polinices (Polinices) miocolligens* - Janssen, p. 199, pl. 56, figs. 1, 2 (not Sacco, 1890).

? 2001 *Polinices (Polinices) miocolligens* - Wienrich, p. 430, pl. 69, fig. 4; pl. 86, fig. 9.

2007 *Polinices miocolligens* - Zunino, p. 120, pl. 1, fig. 6.

Type material: *Natica (Polinices) miocolligens* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 2, fig. 68) and refigured herein (Pl. 5, fig. 14), MGPT BS.029.06.007, Colli Torinesi. *Natica (Polinices) miocolligens* var. *pseudomamilla* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 2, fig. 69) and refigured herein (Pl. 6, fig. 1), MGPT BS.029.06.008, Colli Torinesi. *Natica (Polinices) submamillaris* var. *praenuntia* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 63) and refigured herein (Pl. 6, fig. 2), MGPT BS.029.06.003, Cassinelle; 1 paralectotype, MGPT BS.029.06.003/01, Cassinelle.

Other material examined: Albugnano: 1 spm., PG 48; Case Soghe: 1 spm., MPUM 11277, 1 spm., NP 9878, 2 spms., private collection; Mioglia: 2 spms., MZB 60099; Monte dei Cappuccini: 3

spms., MGPT-PU 25662; Sangonini: 1 spm., MGP-PD 15948/a, 1 spm., MGP-PD 15924 (Pl. 6, fig. 3), 1 spm., MGP-PD 31536; Valle Ceppi: 1 spm., NP 9879, 1 spm., MGPT-PU 25269, 1 spm., MGPT-PU 23858, 2 spms., MGPT-PU 135123, 1 spm., MGPT-PU 25902, 1 spm., MGPT-PU 135124 (Pl. 6, fig. 4), 1 spm., PG 47, 1 spm., MPUM 11278, 2 spms., MZB 60029, 1 spm., MZB 60150, 1 spm., MGPT-PU 135125, 1 spm., MPUM 11279, 1 spm., NP 9828; Val Sanfrà: 1 spm., MGPT-PU 135126, 8 spms., MGPT-PU 107626, 1 spm., MGPT-PU 135127 (Pl. 6, fig. 5), 2 spms., MGPT-PU 23663, 1 spm., MGPT-PU 107629, 4 spms., MGPT-PU 135128; Valle Vergnana: 1 spm., MZB 60028 (Pl. 6, fig. 6), 2 spms., PG 46.

Description. Protoconch small, low-turbiniform, of 2.65-2.70 gently convex, apparently smooth whorls, tip small. Teleoconch globose, globose-pyriform in some specimens, rather thick. Spire broadly conical, pointed, moderately elevated, slightly more so in a few specimens, whorls flat-sided. Suture thin, almost flush, adpressed in a few specimens, which have gently convex whorls. Last whorl globose to globose-oval, only slightly extended toward aperture; subsutural shelf indistinct, very slightly concave but poorly defined in a few larger specimens; periphery above midline. Aperture D-shaped in prosocline plane, length averaging 1.60 times width; inner lip straight, outer lip semicircular. Parietal callus thick, subrectangular, ending in slight anterior lobe below border of umbilical area. Umbilicus largely plugged by umbilical callus; narrow, markedly oblique mid-abapical groove separates umbilical callus from umbilical wall and exposes thick funicle. Umbilical callus at abapical half of inner lip, thick, subtriangular, with arched adaxial outline, demarcated from anterior lobe of parietal callus by very slight sinus. Basal fasciole indistinct. Outer surface with dense growth lines prosocyrt adapically.

Dimensions (mm)

DHW	PD	H	D	SH
0.107-0.115	0.925-0.981	8.770-23.626	7.678-21.210	0.346-5.322
0.111	0.953	16.198	14.444	2.834
AH	**AW**	**UW**	**IS**	**SA**
6.471-19.591	4.591-12.535	2.886-5.882	9°-33°	85°-113°
13.031	8.563	4.384	21°	99°

Remarks. The present species was regarded as belonging in *Polinices* Montfort, 1810 by previous authors. Actually, it has the characters of *Tectonatica* Sacco, 1890 and is herein assigned to this genus (see also the remarks on *Tectonatica dertomamilla* Sacco, 1890).

Tectonatica miocolligens is morphologically similar to *Tectonatica dertomamilla*, but differs from it in that it has: 1) a protoconch with 0.5 more whorls and with significantly smaller diameter of the first half-whorl, 2) a wider aperture with different curvature of the outer lip, 3) a shorter parietal callus, 4) a longer umbilical callus with arched adaxial outline, demarcated from parietal callus by a slight sinus (the umbilical callus is triangular, with reverse J-shaped outline in *T. dertomamilla*), and 5) an indistinct basal fasciole (present, broad and low in *T. dertomamilla*).

Janssen (1969) included in the synonymy of *Polinices miocolligens* the specimens dealt with by Glibert (1952a) and referred to as *Polynices (Polynices) submamillaris* f. *dertomamilla* Sacco, 1891. We have not seen Glibert's material, however, considering: 1) that the shell figured by Glibert appears to agree with the characters of *Tectonatica miocolligens*, and 2) that the age cited by Glibert for his specimens is late Burdigalian to Langhian, we retain the Belgian material in the synonymy of the present species. Concerning Sacco's variety *pseudomamilla* of the present species (see the above synonymy), we examined the holotype in MGPT and can state that it cannot be distinguished from *T. miocolligens* consistently. The variety *praenuntia* of *Natica (Polinices) submamillaris* Sacco,1890 was proposed by Sacco (1890b) on the basis of scarce material from the early Oligocene of Piedmont. Wheras the typical form belongs in *Euspira* Agasiz in J. Sowerby, 1837 (see the species of *Euspira* described below), the variety *praenuntia* exhibits the characters of *T. miocolligens* and is herein included in the synonymy of it.

The lower Miocene specimens recorded by Wienrich (2001) and referred to as *Polinices (Polinices) miocolligens* Sacco, 1891 may be this species in that they have a 2.5-whorled protoconch, a close teleoconch shape and a rather similar umbilical callus (the umbilicus slightly more widely open than in the typical specimens of Piedmont being the sole difference). Since the values of the other characteristic elements of the protoconch (diameter and diameter of the first half-whorl) are not known, we include these shells in the synonymy of the present species only doubtfully. The specimens figured by Janssen (1984) and referred to as *Polinices (Polinices) miocolligens* Sacco, 1891 have umbilical characters that are unlike those of Sacco's species and are herein excluded from the synonymy

of *Tectonatica miocolligens*; likely, these Dutch shells belong to a species of the genus *Cochlis* Röding, 1798.

Stratigraphic occurrence. *Tectonatica miocolligens* (Sacco, 1890) is known from the early Oligocene of Piedmont, Liguria and Veneto (*Natica submamillaris* var. *praenuntia* Sacco) and from the Burdigalian and the Langhian of Piedmont; it occurs also in the late Aquitanian to Langhian of Belgium. The species was recovered at Winterswijk-Miste in The Netherlands (Janssen 1969) from deposits of late Burdigalian age (Kowalewski et al. 2002). Cossmann & Peyrot (1919) described it as *Natica dertomamilla* (see the above synonymy) from deposits in the Saubrigues area said to be of Tortonian age, but actually of Langhian age (Cahuzac & Poignant 1993; Cahuzac et al. 1995). We recovered only one specimen from Serravallian deposits of Albugnano. In summary, *T. miocolligens* ranges from early Oligocene to Serravallian, being extremely rare in the Serravallian.

Tectonatica pasinii (Bayan, 1870)

Pl. 6, figs. 7-9

1870a *Natica pasinii* Bayan, p. 481.
1870b *Natica pasinii* - Bayan, p. 23, pl. 3, fig. 6.
1896 *Natica pasinii* var. *zagaropsis* De Gregorio, p. 56, pl. 5, fig. 11.
1901 *Natica pasinii* - Oppenheim, p. 259.
1953 *Polynices (Naticina) pasinii* - Szőts, p. 178, pl. 5, figs. 12, 13.
1985 *Polinices pasinii* - Brigantini, p. 413, pl. 2, figs. 28, 29.
2008 *Polinices pasinii* - Quaggiotto & Mellini, p. 48, pl. 3, fig. 12.

Type material: *Natica pasinii* Bayan, type material not seen. Bayan's material is curated at the Université de Lyon 1, France, but the syntypes of *Natica pasinii* were not identified yet and are presently unavailable (Robert Emmanuel, personal communication 2013).

Material examined: Roncà: 2 spms., NP 9917, 5 spms., NP 9911, 8 spms., NP 9915, 2 spms., NP 9918, 5 spms., MPUM 11280, 1 spm., MPUM 11281 (Pl. 6, fig. 7), 1 spm., MPUM 11282 (Pl. 6, fig. 8), 1 spm., MPUM 11283 (Pl. 6, fig. 9), 15 spms., MCZ 4324.

Description. Protoconch small, depressed-turbiniform, of 2.25 gently convex, apparently smooth whorls, tip small. Teleoconch globose-oval to elongate-oval, moderately thick. Spire cyrtoconoid, rather elevated, less so in a few specimens, whorls flatly convex, suture almost flush. Last whorl globose to oval, scarcely extended toward aperture; subsutural shelf indistinct; periphery at midline. Aperture D-shaped, in prosocline plane, length averaging twice width; inner lip straight, outer lip arched, basal lip slightly thickened. Parietal callus thick, subrectangular, with obtuse adapical ridge, roundly expanded abapically, rather long to very long, hindering umbilicus at variable extent. Umbilicus rather narrow and deep to very narrow. Funicle broad and thick, separated from umbilical wall by narrow groove. Umbilical callus subtriangular, short to very short, thick, restricted to abapical part of inner lip in most specimens, with straight or attenuated reverse S-shaped adaxial outline, merging into anterior expansion of parietal callus, demarcated from parietal callus by shallow transverse depression in a few specimens. Basal fasciole indistinct. Outer surface with rather coarse growth markings. A few specimens retain vestige of uniform brown background.

Dimensions (mm)

DHW	PD	H	D	SH
0.141*	0.672*	9.380-16.992	6.399-16.935	1.655-5.503
* 1 protoconch measurable		13.186	11.667	3.579
AH	**AW**	**UW**	**IS**	**SA**
7.419-11.795	5.146-7.486	2.324-3.792	18°-30°	88°-116°
9.607	6.316	3.058	24°	102°

Remarks. The present species is rather variable as regards the teleoconch shape, the length of the parietal callus and the size of the umbilical opening. The elongate-oval shells (var. *zagaropsis* De Gregorio, 1896) do not warrant separation from the typical form with which they co-occur in the type locality (Roncà). *Natica pasinii* was currently included in the genus *Polinices* Montfort, 1810 by later authors. However, the umbilical characters of Bayan's species do not agree with those of *Polinices* species, whereas they appear to be more similar to the characters occurring in the species belonging in *Tectonatica* Sacco, 1890. Thus, we concur with Cossmann (1925, p. 121), who assigned *Natica pasinii* to *Tectonatica*.

Tectonatica pasinii is readily distinguished from the other Italian Paleogene taxa *Tectonatica albertii* sp. n. and *Tectonatica burtoni altavillensis* subsp. n. in that it has a more elongated teleoconch (Fig. 9) with higher spire, a longer parietal callus, and a smaller umbilicus. Moreover, it is differentiated from *T. albertii* by its protoconch with significantly smaller diameter and diameter of the initial half-whorl (less than half the size), and from *T. burtoni altavillensis* because of its protoconch with 0.5 fewer whorls, with significantly

smaller diameter.

Stratigraphic occurrence. *Tectonatica pasinii* (Bayan, 1870) is known definitely from middle Eocene (Bartonian) deposits of Veneto. It occurs also in the early and middle Eocene of Hungary.

Tectonatica rupeliana sp. n.

Pl. 6, figs. 10-12

Derivation of name: The name refers to the Rupelian age of the unit that yielded the bulk of the material.

Holotype: Case Soghe: MPUM 11284 (Pl. 6, fig. 10).

Paratypes: Case Soghe: 2 spms., MPUM 11285, 1 spm., MPUM 11286 (Pl. 6, fig. 11), 1 spm., MPUM 11287, 3 spms., MPUM 11288, 1 spm., MPPLF 5157 pr, 1 spm., MCZ 4325; Sangonini: 1 spm., MGP-PD 31537.

Other material examined: Cà Sella: 1 spm., NP 9891; Case Soghe: 3 spms., NP 9892, 3 spms., NP 9893, 2 spms., NP 9895, 2 spms., private collection, 1 spm., NP 9897, 1 spm., private collection (Pl. 6, fig. 12), 1 spm., private collection, 7 spms., private collection, 2 spms., NP 9898; Chiuppano: 1 spm., NP 9899; Lerma: 1 spm., PG 80; Monte Gloso: 2 spms., private collection, 1 spm., NP 9896.

Preservation: Most specimens are rather well preserved.

Type locality: Case Soghe (see appendix).

Horizon: Gray to yellowish-brown clayey silt with small pebbles of Rupelian age.

Diagnosis: Globose-oval shell with depressed, broadly conical spire and oval, very tall last whorl. Umbilicus a narrow, oblique crescentic chink, more widely open in a few specimens. Parietal callus thick, subquadrangular, wider abapically; umbilicus largely filled by thick funicle; umbilical callus large, rather thick, with convex adaxial outline, merging into anterior corner of parietal callus. Basal fasciole indistinct.

Description. Protoconch small, low-turbiniform, of 3.15 convex, smooth whorls, tip very small. Teleoconch globose-oval, slightly higher than wide, rather thick. Spire low, broadly conical, whorls flatly convex, suture almost flush. Last whorl oval, very tall (about nine-tenths of total height), inflated; subsutural shelf indistinct; periphery slightly above midline. Aperture D-shaped, in prosocline plane, length averaging two times width; outer lip asymmetrically arched; inner lip very slightly bent and thick abapically. Parietal callus thick to very thick, subquadrangular, expanded abapically, with concave abapertural outline; anterior lobe poorly defined. Umbilicus largely filled by thick funicle separated from umbilical wall by narrow, oblique crescentic groove, more widely open in a few specimens. Umbilical callus large, rather thick, with convex adaxial outline, merging into anterior corner of parietal callus, narrover, subtriangular in specimens with more widely open umbilicus. Basal fasciole indistinct. Outer surface with dense growth markings prosocyrt adapically.

Dimensions (mm)

DHW	PD	H	D	SH
0.079*	0.943*	6.571-18.815	2.992-18.588	1.069-5.629
*1 protoconch measurable		12.693	10.790	3.349
AH	**AW**	**UW**	**IS**	**SA**
5.390-13.298	2.934-10.838	1.899-5.803	14°-26°	87°-111°
9.344	6.886	3.851	20°	99°

Remarks. *Tectonatica rupeliana* is closely similar to *Tectonatica pasinii* (Bayan, 1870) in shell shape. However, it can be readily distinguished from *T. pasinii* because of its protoconch with about one more whorl and significantly greater diameter and smaller diameter of the initial half-whorl, its shorter parietal

PLATE 6

Fig. 1 - *Tectonatica miocolligens* (Sacco, 1890). Colli Torinesi. Holotype of *Natica (Polinices) miocolligens* var. *pseudomamilla* Sacco, 1890. MGPT BS.029.06.008; apertural side.

Fig. 2 - *Tectonatica miocolligens* (Sacco, 1890). Cassinelle. Lectotype (here designated) of *Natica (Polinices) submamillaris* var. *praenuntia* Sacco, 1890. MGPT BS.029.06.003; apertural side.

Fig. 3 - *Tectonatica miocolligens* (Sacco, 1890). Sangonini. MGP-PD 15924; apertural side (height of shell 20.16 mm).

Fig. 4 - *Tectonatica miocolligens* (Sacco, 1890). Valle Ceppi. MGPT-PU 135124; protoconch.

Fig. 5 - *Tectonatica miocolligens* (Sacco, 1890). Val Sanfrà. MGPT-PU 135127; apertural side (height of shell 15.04 mm).

Fig. 6 - *Tectonatica miocolligens* (Sacco, 1890). Valle Vergnana. MZB 60028; protoconch.

Fig. 7 - *Tectonatica pasinii* (Bayan, 1870). Roncà. MPUM 11281; protoconch.

Fig. 8 - *Tectonatica pasinii* (Bayan, 1870). Roncà. MPUM 11282; apertural side (height of shell 10.79 mm).

Fig. 9 - *Tectonatica pasinii* (Bayan, 1870). Roncà. MPUM 11283; apertural side (height of shell 11.35 mm).

Fig. 10 - *Tectonatica rupeliana* sp. n. Case Soghe. Holotype, MPUM 11284; apertural side (height of shell 11.77 mm).

Fig. 11 - *Tectonatica rupeliana* sp. n. Case Soghe. Paratype, MPUM 11286; protoconch.

Fig. 12 - *Tectonatica rupeliana* sp. n. Case Soghe. Private collection; apertural side (height of shell 17.41 mm).

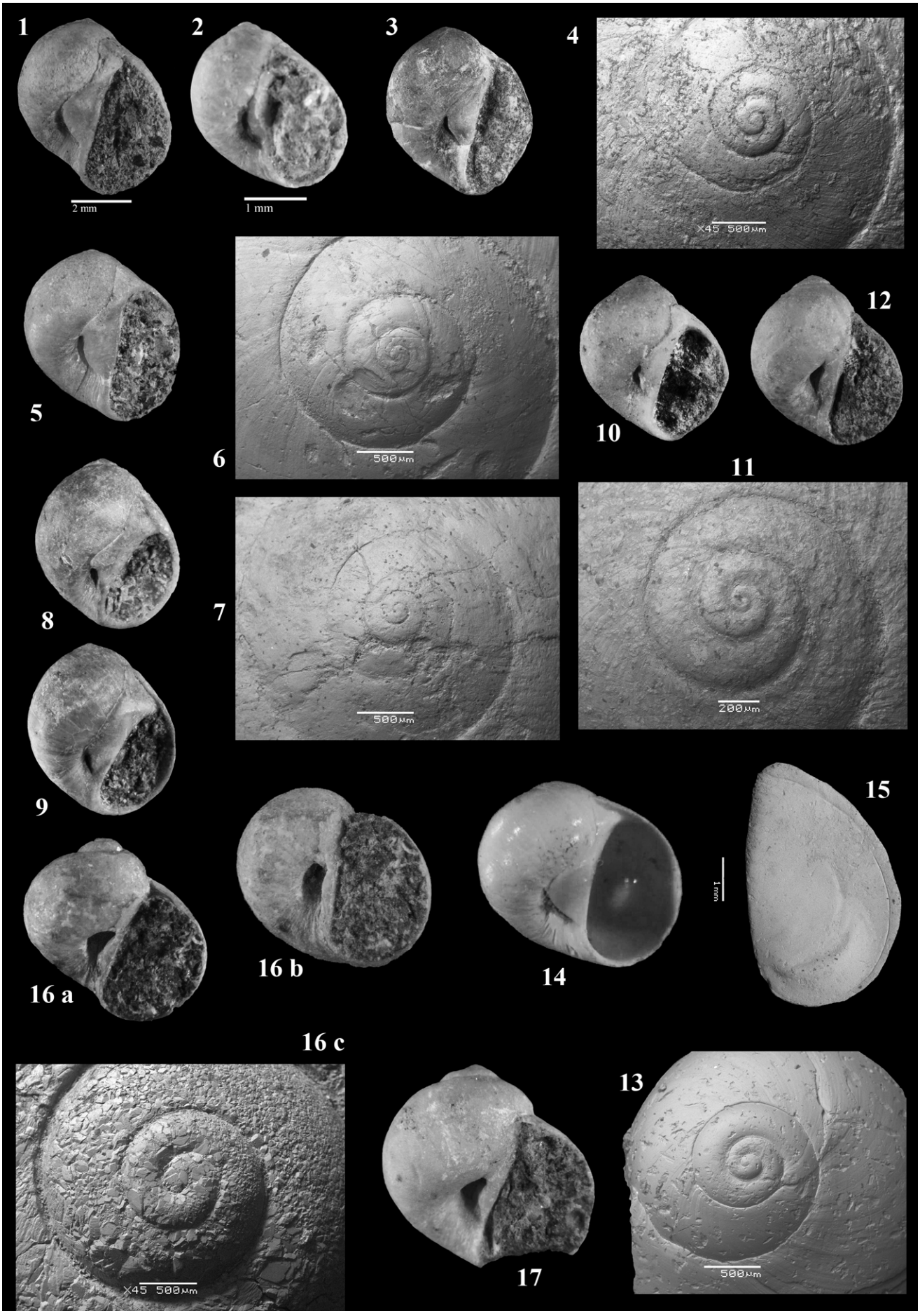
Fig. 13 - *Tectonatica tectula* (Sacco, 1890). Borelli. MGPT-PU 135129; protoconch.

Fig. 14 - *Tectonatica tectula* (Sacco, 1890). Borelli. MGPT-PU 135134; apertural side (height of shell 4.71 mm).

Fig. 15 - *Tectonatica tectula* (Sacco, 1890). Borelli. MGPT-PU 135137; operculum.

Fig. 16 - *Tectonatica* sp. 1. Cava Albanello. MGP-PD 1225R; a, apertural side (height of shell 8.49 mm); b, basal view; c, protoconch.

Fig. 17 - *Tectonatica* sp. 2. Cava Grola. MGP-PD 1227R; apertural side (height of shell 14.57 mm).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7
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16 a
16 b
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16 c
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17
13
500µm

callus devoid of adapical ridge (present in *T. pasinii*), and its larger, differently shaped umbilical callus (that of *T. pasinii* is subtriangular instead of semicircular). *T. rupeliana* differs from the coeval *Tectonatica albertii* sp. n. (see above) by its protoconch with one more whorl and significantly smaller diameter and diameter of the first half-whorl, its slenderer, ovate teleoconch, and its narrower umbilicus. Finally, the present species is differentiated from the also coeval *Tectonatica burtoni altavillensis* subsp. n. in that it has a protoconch with significantly smaller diameter of the first half-whorl, a less globose teleoconch, a narrower umbilicus, and a different outline of the umbilical callus.

Stratigraphic occurrence. *Tectonatica rupeliana* sp. n. was recovered only from Rupelian deposits of Veneto and Piedmont.

Tectonatica tectula (Sacco, 1890)

Pl. 6, figs. 13-15

1890b *Natica (Tectonatica) tectula* Sacco, p.33.

1891 *Natica (Tectonatica) tectula* - Sacco, p. 81, pl. 2, fig. 53.

2008a *Tectonatica tectula* - Pedriali & Robba, p. 110, pl. 2, figs. 7-9, 19, 20; pl. 3, figs. 9, 22, 23 (*cum syn.*).

2013 *Tectonatica tectula* - Landau et al., p. 102, pl. 11, fig. 6.

Type material: Pedriali & Robba (2008a, p. 111) listed the type material of *Tectonatica tectula*.

Material examined: Borelli: 1 spm., MGPT-PU 135129 (Pl. 6, fig. 13), 1 spm., MGPT-PU 135130, 1 spm., MGPT-PU 135131, 1 spm., MGPT-PU 135132, 9 spms., MGPT-PU 135133, 1 spm., MGPT-PU 135134 (Pl. 6, fig. 14), 9 spms., MGPT-PU 135135, 6 spms., MPUM 11289, 3 spms. (opercula), MGPT-PU 135136, 1 spm. (operculum), MGPT-PU 135137 (Pl. 6, fig. 15), 5 spms., PG 22d, 1 spm., NP 9843, 3 spms., NP 9906; Orthez, Le Paren (France): 1 spm., NP 10011; Passo dei Meloni: 1 spm., PP.PM 01/01; Rio di Bocca d'Asino: 2 spms., NP 9887; Sogliano al Rubicone: 4 spms., PP.SR 01/01; Valle Ceppi: 5 spms., NP 9888, 3 spms., MPUM 11290, 4 spms., MGPT-PU 135138, 1 spm., MGPT-PU 135139.

Dimensions of Miocene specimens (mm)

DHW	PD	H	D	SH
0.080-0.100	1.019-1.195	3.304-5.956	3.289-5.453	0.435-2.059
0.090	1.107	4.630	4.371	1.247
AH	**AW**	**UW**	**IS**	**SA**
2.713-4.053	2.220-3.336	1.348-2.304	10°-22°	106°-126°
3.383	2.778	1.826	16°	116°

Remarks. The Miocene shells listed above are identical to the Pliocene ones described by Pedriali & Robba (2008a). The 95% confidence intervals calculated for the dimensions (protoconch and teleoconch) of the Miocene specimens overlap those pertaining to the Pliocene shells; in particular, there is no significant difference as regards the values of the characteristic elements of the protoconch. For description and comments, see Pedriali & Robba (2008a).

Stratigraphic occurrence. Combined reliable records from European countries and Italy (Pedriali & Robba 2008a) show that *Tectonatica tectula* (Sacco, 1890) ranges from the Burdigalian to the late Pliocene; the species is also present in the Serravallian of Turkey. According to Pedriali & Robba (2008a), the rare citations from the Pleistocene probably refer to *Cryptonatica filosa* (Philippi,1845).

Tectonatica sp. 1

Pl. 6, fig. 16

Material examined: Cava Albanello: 1 spm., MGP-PD 1225R (Pl. 6, fig. 16), 1 spm., MGP-PD 1226R, 1 spm., MCZ 4326.

Description. Protoconch medium-sized, low-turbiniform, of two whorls, tip medium-sized, slightly sunken. Teleoconch globose, rather thin. Spire moderately elevated, broadly conical, whorls convex, suture very slightly channeled. Last whorl globular; subsutural shelf indistinct; periphery above midline. Aperture D-shaped, in slightly prosocline plane, length about 1.6 times width; outer lip semicircular; inner lip straight. Parietal callus thin, rectangular, wider adapically, with straight abapertural outline; anterior lobe indistinct. Umbilicus rather wide, deep. Funicle broad, markedly depressed, obsolescent toward interior of umbilicus. Umbilical callus thick, narrowly elongate, with gently convex adaxial outline, merging into anterior end of parietal callus. Basal fasciole indistinct. Outer surface with remnants of fine growth lines.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.230	1.143	8,490	8.211	2.200	6.290	4.849
UW	**IS**	**SA**				
2.702	18°	116°				

Remarks. See below for the relationships with *Tectonatica* sp. 2.

Tectonatica sp. 1 superficially resembles the

Eocene to lower Oligocene species *Tectonatica pasinii* (Bayan, 1870), but differs from it in that it has: 1) a protoconch with significantly greater diameter and diameter of the initial half-whorl, 2) a more globose teleoconch, 3) a spire with more convex whorls (flatly convex in *T. pasinii*), 4) a shorter aperture, 5) a parietal callus lacking the obtuse adapical ridge (present in *T. pasinii*), 6) a narrower umbilicus, and 7) a narrowly elongate umbilical callus (subtriangular, short in *T. pasinii*). The present specimens probably represent a new species, but a decision in this respect must await that more, better preserved material be recovered.

Stratigraphic occurrence. *Tectonatica* sp. 1 was found to occur in lower Lutetian deposits of Veneto.

Tectonatica sp. 2

Pl. 6, fig. 17; Pl. 7, fig. 1

Material examined: Cava Albanello: 1 spm., MCZ 4327; Cava Grola: 1 spm., MGP-PD 1227R (Pl. 6, fig. 17), 1 spm., MCV 15/04 (Pl. 7, fig. 1).

Description. Protoconch small, low-turbiniform, of 2.80 whorls, tip small. Teleoconch globose, rather thick. Spire moderately elevated, broadly conical, whorls convex, suture adpressed. Last whorl globose, very slightly higher than wide; subsutural shelf very slightly concave, poorly defined; periphery above midline. Aperture D-shaped, in moderately prosocline plane, length 1.8 times width; outer lip regularly arched; inner lip straight, thickened abapically. Parietal callus thick, more so at both ends, with concave abapertural outline; anterior lobe rounded, scarcely produced. Umbilicus deep, crescent-shaped; umbilical wall moderately steep. Funicle broad, rather thick to thick, separated from umbilical wall by rather narrow, shallow spiral depression. Umbilical callus large and thick, at mid-abapical part of inner lip, with convex adaxial outline, separated from anterior lobe of parietal callus by shallow notch. Basal fasciole indistinct. Outer surface with dense growth markings prosocyrt adapically.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.110	0.912	12.238	12.080	3.621	8.619	7.230
UW	**IS**	**SA**				
4,370	23°	125°				

Remarks. *Tectonatica* sp. 2 is closely similar to *Tectonatica* sp. 1 (see above) in teleoconch morphology, but can be differentiated from it because of its protoconch of 0.8 more whorls, with significantly smaller diameter of the first half-whorl, its adpressed suture (slightly channeled in *Tectonatica* sp. 1), its parietal callus markedly thickened at both ends, with concave abapertural outline (thin, rectangular in *Tectonatica* sp. 1), its narrower, crescent-shaped umbilicus, its more prominent funicle, and its large, semicircular umbilical callus (narrowly elongate in *Tectonatica* sp. 1). The protoconch of 0.5 more whorls, with significantly greater diameter, the shorter spire with more convex whorls, and the different characters of the inner lip calluses readily distinguish *Tectonatica* sp. 2 from *Tectonatica pasinii* (Bayan, 1870). The three examined shells likely represent a new species, but naming it requires more material.

Stratigraphic occurrence. *Tectonatica* sp. 2 was recovered from middle Lutetian deposits of Veneto.

Subfamily Poliniceinae Finlay & Marwick, 1937

The species of the Poliniceinae have teleoconch types similar to those occurring in the Naticinae. The umbilicus is either widely open or completely covered by the umbilical callus; the funicle is absent to weak, or thick. The outer surface is mostly smooth, but some genera are spirally sculptured (e.g. *Eunaticina* Fischer, 1885 and *Sigatica* Meyer & Aldrich, 1886). The Poliniceinae were said to be characterized by their corneous operculum (Cernohorsky 1971; Kilburn 1976; Marincovich 1977; Majima 1989; Wilson 1993; Kabat 1998; Pastorino 2005; Huelsken et al. 2008). However, Marincovich (1977, p. 212) remarked that *Eunaticina insculpta* (Carpenter, 1865) has a partially calcified operculum. A similar mixed composition of the operculum was cited by Pastorino (2005, p. 226) concerning the poliniceine species *Euspira falklandica* (Preston, 1913) and *Euspira patagonica* (Philippi, 1845). Obviously, the capacity for preservation in the fossil record of these only partly calcified opercula is strongly reduced.

Genus *Ampullonatica* Sacco, 1890

Ampullonatica Sacco, 1890a, p. 208 (*nomen nudum*).

Ampullonatica Sacco, 1890b, p. 40. Type species by subsequent designation (Cossmann 1893, p. 740): *Ampullaria ambulacrum* Sowerby, 1822, Eocene, Great Britain and France (see also Kabat 1991 and Caze et al. 2011).

Ampullonatica was introduced as a subgenus of *Sigaretus* Lamarck, 1799 (= *Sinum* Röding, 1798). Kabat (1991) treated *Ampullonatica* as a junior subjective synonym of *Euspira* Agassiz in J. Sowerby, 1837, implicitly allocating it in the Naticidae. Cossmann (1925) regarded *Ampullonatica* as a subgenus of *Ampullina* Lamarck in Defrance, 1821 (= *Ampullina* Bowdich, 1822; see Kabat 1991, pp. 426, 427). Several subsequent authors considered *Ampullonatica* as a member of the family Ampullinidae Cossmann, 1918 (Wrigley 1946; Pacaud & Le Renard 1995 among others). Caze et al. (2011) included *Ampullonatica* in a group of "ampullinid-like gastropods of uncertain affinity". Recently, the Ampullinidae were regarded as a family unrelated to the Naticidae, removed from the Naticoidea and included in the superfamily Ampullinoidea Cossmann, 1918 (Bandel 2006; Harzhauser et al. 2009) or in the superfamily Campaniloidea Douvillé, 1904 (Bouchet et al. 2005; Beu & Marshall 2011; Caze et al. 2011). According to Kase & Ishikawa (2003) and Beu & Marshall (2011), the distinctive morphological characters of the Ampullinidae are: 1) a rather elevated, pointed, conical protoconch with inflated and smooth whorls, different from that of the Naticidae, which is low-turbiniform, with obtuse, often sculptured tip, 2) a layer of callus (termed sheath by Wrigley 1946) around the umbilical area, overlain by the inner lip calluses, and 3) an umbilicus (when present) devoid of funicle.

Both *Ampullonatica ambulacrum*, type species of *Ampullonatica*, and *Ampullonatica repressa* Sacco, 1890 (described below) have the protoconch shaped like that of the naticids and lack the sheath; further, a vestigial funicle was noted in some species. On this basis, we are inclined to consider *Ampullonatica* better allocated in the Naticidae than in the Ampullinidae, at least provisionally. The deep sutural channel with subangular to sharply angular abaxial border is markedly different from the less deep sutural channel with rounded abaxial border, occurring in a few *Euspira* species (e.g. *Euspira magenesi* Pedriali & Robba, 2001; *Euspira giuntellii* sp. n., herein), and easily separates *Ampullonatica* from *Euspira*.

Ampullonatica pseudorepressa sp. n.

Pl. 7, figs. 2, 3

Derivation of name: From Greek *pseudes* = false and *repressa* = the name of the similar species *Ampullonatica repressa* (Sacco, 1890).

Holotype: Monte Gloso: MPUM 11291 (Pl. 7, fig. 2).

Paratypes: Cà Sella: 1 spm., MPUM 11292; Cassinelle: 1 spm., MPUM 11293 (Pl. 7, fig. 3); Mioglia: 1 spm., MZB 60100; Sangonini; 1 spm., MGP-PD 15948/b.

Other material examined: Cà Sella: 1 spm., NP 9922; Cassinelle: 3 spms., PG 83; Mioglia: 1 spm., NP 9923.

Preservation: Most specimens are rather well preserved.

Type locality: Monte Gloso (see appendix).

Horizon: Yellowish-gray, coarse-grained marly sandstone of Rupelian age.

Diagnosis: Medium-sized, globose shell with moderately elevated to low spire; earlier whorls largely covered by succeeding whorl; suture widely channeled, with subangular abaxial border. Last whorl globose. Umbilicus deep, rather wide; funicle short, markedly depressed, rapidly vanishing toward interior of umbilicus. Parietal callus thick; umbilical callus slender to very slender, merging into anterior end of parietal callus.

Description. Protoconch medium-sized, turbiniform, of 2.8 convex whorls, tip small. Teleoconch medium-sized, globose, rather thick. Spire moderately elevated to low; whorls gently convex, quickly increasing in diameter, earlier ones largely covered by succeeding whorl. Suture widely channeled, with subangular abaxial border. Last whorl globose to depressed-globose, scarcely expanded toward aperture; subsutural shelf indistinct; flatly rounded periphery slightly above or at midline. Aperture D-shaped in moderately prosocline plane, length about 1.7 times width; outer lip semicircular,

PLATE 7

Fig. 1 - *Tectonatica* sp. 2. Cava Grola. MCV 15/04; a, apertural side (height of shell 12.24 mm); b, protoconch.

Fig. 2 - *Ampullonatica pseudorepressa* sp. n. Monte Gloso. Holotype, MPUM 11291; a, apertural side (height of shell 18.11 mm); b, apical view; c, basal view.

Fig. 3 - *Ampullonatica pseudorepressa* sp. n. Cassinelle. Paratype, MPUM 11293; protoconch.

Fig. 4 - *Ampullonatica repressa* (Sacco, 1890). Albugnano. Lectotype (here designated) of *Sigaretus (Ampullonatica) repressa* Sacco, 1890. MGPT BS.029.10.001; a, apertural side (height of shell 32.01 mm); b, apical view.

Fig. 5 - *Ampullonatica repressa* (Sacco, 1890). Cascina Pianfiorito. PG 81; a, apertural side (height of shell 18.96 mm); b, apical view; c, basal view.

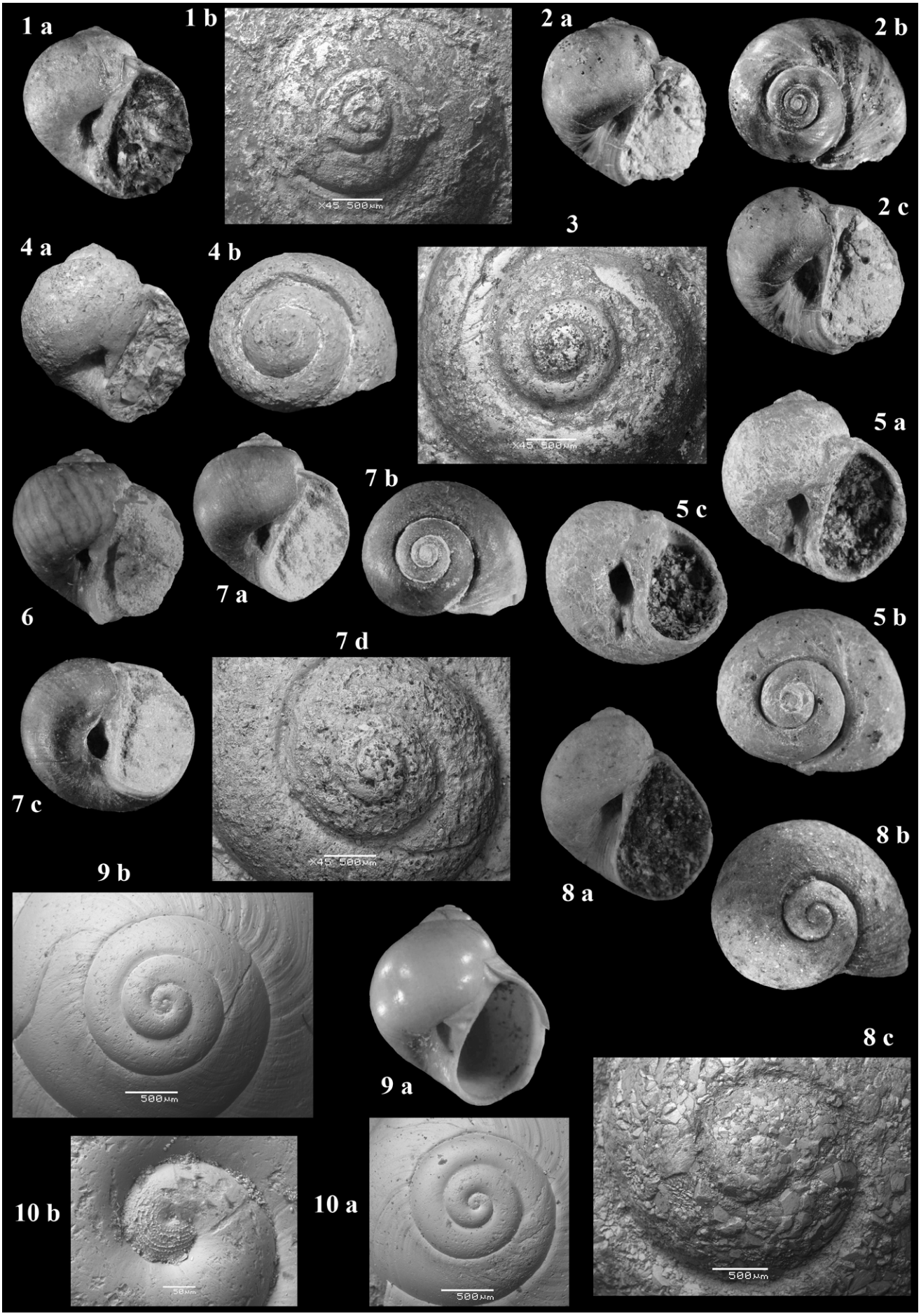
Fig. 6 - *Ampullonatica* sp. Monte Gloso. Private collection; apertural side showing color pattern (height of shell 10.65 mm).

Fig. 7 - *Ampullonatica* sp. Monte Gloso. MPUM 11294; a, apertural side (height of shell 13.38 mm); b, apical view; c, basal view; d, protoconch.

Fig. 8 - *Eunaticina* sp. Cava Albanello. MPUM 11295; a, apertural side (height of shell 13.17 mm); b, apical view; c, protoconch.

Fig. 9 - *Euspira gianoi* sp. n. Rio di Bocca d'Asino. Holotype, MPUM 11296; a, apertural side (height of shell 7.49 mm); b, protoconch.

Fig. 10 - *Euspira gianoi* sp. n. Rio di Bocca d'Asino. Paratype, MPUM 11298; a, protoconch; b, detail of protoconch.


1 a
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2 b
2 c
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4 a
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5 c
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7 b
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7 d
8 a
8 b
8 c
9 a
9 b
10 a
10 b
500µm

inner lip straight, slightly thickened abapically. Parietal callus rather thick; anterior lobe small to indistinct, ending below umbilical border. Umbilicus deep, rather wide, asymmetrically teardrop-shaped; umbilical wall steeply sloping, with coarse growth ridges. Funicle a short, depressed adaxial thickening of inner lip, soon vanishing toward interior of umbilicus. Umbilical callus slender to very slender, triangular, merging into anterior end of parietal callus. Basal fasciole broad, scarcely prominent, with coarse growth ridges. Outer surface with uneven and unevenly spaced, straight growth lines.

Dimensions (mm)

DHW	PD	H	D	SH
0.118*	1.116*	14.057-19.053	14.344-21.592	2.033-7.017
* 1 protoconch measurable		16.555	17.968	4.525
AH	**AW**	**UW**	**IS**	**SA**
10.498-13.562	7.183-13.315	5.161-7.489	11°-31°	115°-147°
12.030	10.249	6.325	21°	131°

Remarks. The present species differs from *Ampullonatica repressa* (Sacco, 1890) in that it has: 1) a globose instead of globose-oval shell, 2) a differently coiled spire (earlier whorls largely covered by subsequent whorl), with greater spiral angle, 3) a wider, less deep sutural channel, with roundly angular abaxial border (sharply angular in *A. repressa*), and 4) a more distinct funicle (vestigial to indistinct in *A. repressa*). No comparison of respective larval shells can be made since all the examined specimens of *A. repressa* have the apical whorls abraded at various extent. The Eocene species *Natica brongniarti* Deshayes, 1864 also belongs in *Ampullonatica* (Pacaud & Le Renard 1995; Caze et al. 2011). Deshayes' species is strikingly similar to *Ampullonatica pseudorepressa* in overall shell shape, but can be differentiated from it by its very narrow and very deep sutural channel, and by its umbilicus without any trace of funicle.

Stratigraphic occurrence. *Ampullonatica pseudorepressa* sp. n. was recovered from lower Oligocene deposits of Piedmont, Liguria and Veneto.

Ampullonatica repressa (Sacco, 1890)
Pl. 7, figs. 4, 5

1890b *Sigaretus (Ampullonatica) repressa* Sacco, p. 40.
1891 *Ampullonatica repressa* - Sacco, p. 105, pl. 1, fig. 75.
1984 *Ampullonatica repressa* - Ferrero Mortara et al., p. 39, pl. 4, fig. 2.

Type material: *Sigaretus (Ampullonatica) repressa* Sacco, lectotype (here desinated): the unique syntype presently existing in MGPT, figured by Ferrero Mortara et al. (1984, pl. 4, fig. 2) and refigured herein (Pl. 7, fig. 4), MGPT BS.029.10.001, Albugnano (see remarks below).

Other material examined: Cascina Pianfiorito: 1 spm., PG 81 (Pl. 7, fig. 5), 2 spms., PG 82.

Description. Protoconch abraded. Teleoconch medium-sized, globose-oval, rather thick. Spire moderately elevated, somewhat stepped; whorls convex, roundly subangular at adapical one-third, with obscure subsutural shelf. Suture deeply and rather widely channeled, with sharply angular abaxial border. Last whorl widely oval to globose, scarcely expanded toward aperture; subsutural shelf indistinct; periphery slightly below or at midline. Aperture D-shaped in prosocline plane, length about 1.9 times width; outer lip semicircular, inner lip straight, slightly thickened abapically. Parietal callus rather thick, with concave abapertural outline; anterior lobe short, subangular, ending at level of umbilical border. Umbilicus deep, moderately wide, subrectangular, angular adapically, rounded abapically; umbilical wall very steep, with coarse growth ridges. Funicle vestigial to indistinct. Umbilical callus slenderly triangular, slightly overhanging adapical part of umbilicus and merging into anterior lobe of parietal callus. Basal fasciole indistinct. Outer surface with unevenly spaced, straight growth lines. One specimen retains vestige of uniform, pale brown background.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
-	-	18.961	17.649	6.570	12.392	10.270
UW	**IS**	**SA**				
5.598	20°	121°				

Remarks. The present species was created by Rovasenda and named *Natica repressa* on a manuscript label. Subsequently, the name *repressa* was merely listed only by Sacco (1890a). Sacco (1890b) first published a concise diagnosis of *N. repressa* (see the above synonymy), thus making the name available, and is to be considered the author of this species. The Bellardi-Sacco collection in MGPT encloses a single syntype of *Ampullonatica repressa* (cf. Ferrero Mortara et al. 1984). Since Sacco (1891) affirmed that some specimens (more than one) have been collected, it is supposed that other syntypes existed in the collection, but were probably lost. In

these circumstances, the unique syntype remaining (MGPT BS.029.10.001) is not eligible as the holotype of the species, instead, it can be designated as the lectotype.

Ampullonatica ambulacrum (Sowerby, 1822), type species of *Ampullonatica*, is rather similar to *Ampullonatica repressa* in shell shape. We examined some topotypes of *A. ambulacrum* in our collection and can state that Sowerby's species is readily differentiated from *A. repressa* in that it has: 1) a higher, pointed, more stepped spire, 2) a wider, flat-bottomed sutural channel with abaxial border subrounded and slightly overhanging the channel, 3) a last whorl more expanded toward the aperture, with the periphery above midline (at midline in *A. repressa*), 4) a remarkably thin parietal callus, and 5) a smaller umbilicus.

Stratigraphic occurrence. *Ampullonatica repressa* (Sacco, 1890) appears to be a rare species, hitherto recovered only from the Langhian Baldissero Formation near Albugnano (Piedmont).

Ampullonatica sp.

Pl. 7, figs. 6, 7

Material examined: Monte Gloso: 1 spm., private collection, 1 spm., private collection (Pl. 7, fig. 6), 1 spm., MPUM 11294 (Pl. 7, fig. 7), 1 spm., NP 9950.

Description. Protoconch medium-sized, low-turbiniform, of 2.5-2.75 gently convex whorls, tip small. Teleoconch small, globose and thick. Spire broadly conical, moderately elevated; whorls gently convex, roundly subangular at adapical one-third, with obscure subsutural shelf. Suture rather shallowly channeled; sutural channel V-shaped in cross section, with subangular abaxial border. Last whorl globose, slightly expanded toward aperture; subsutural shelf poorly defined; periphery well above midline. Aperture D-shaped in prosocline plane, length about 1.7 times width; outer lip regularly arched, inner lip straight, thickened abapically. Parietal callus thickened at both ends, with concave abapertural outline; anterior lobe indistinct. Umbilicus deep, moderately wide, angular adapically, rounded abapically; umbilical wall very steep, interior of umbilicus with rather even spiral cordlets. Funicle a short, depressed adaxial thickening of inner lip, soon vanishing toward interior of umbilicus. Umbilical callus triangular, merging into anterior corner of parietal callus at level of abaxial border of basal fasciole. Basal fasciole rather broad, markedly depressed, enclosed within obscure spiral angulations. Outer surface with unevenly spaced, straight growth lines, slightly prosocyrt subsuturally. One specimen with dark brown, well spaced axial lines.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.172	1.053	13.380	12.571	3.779	9.601	7.432
UW	**IS**	**SA**				
3.860	25°	112°				

Remarks. The protoconch of these specimens is poorly preserved, thence the above values of its characteristic elements are reported with reservation. We have been uncertain about the generic assignment of the present taxon. The inner spiral cordlets of the umbilicus point toward the genus *Euspira* Agassiz in J. Sowerby, 1837, whereas the other shell characters (especially the V-shaped sutural channel) are much alike those of *Ampullonatica*. The final decision has been in favor of the allocation in *Ampullonatica*, at least provisionally.

Ampullonatica sp. has teleoconch characters intermediate between *Ampullonatica repressa* (Sacco, 1890) and *Ampullonatica pseudorepressa* sp. n. The inner spiral cordlets of the umbilicus distinguish it from both *A. repressa* and *A. pseudorepressa*. Probably, *Ampullonatica* sp. can be differentiated from *A. pseudorepressa* also in that it has the protoconch with a significantly greater diameter of the initial half-whorl. *Ampullonatica* sp. attains a size smaller than that of both *A. pseudorepressa* and *A. repressa*. *Euspira bartonensis* Wrigley, 1949 (topotypes examined) is closely similar in shell shape and likewise has the umbilicus with inner spiral cordlets, but its adpressed, slightly incised suture is a primary differentiating element and denotes that Wrigey's species definitely belongs in *Euspira*.

Most likely, the present specimens represent a new species, which, however, requires more material to be named.

Stratigraphic occurrence. *Ampullonatica* sp. was recovered only from lower Oligocene deposits of Monte Gloso (Veneto).

Genus *Eunaticina* Fischer, 1885

Naticina Gray, 1840, p. 147 (*nomen nudum*).
Naticina Gray, 1847, p. 150. Type species by original designa-

tion: *Nerita papilla* Gmelin, 1791, Pliocene to Recent, Indo-West Pacific (junior homonym of *Naticina* Guilding, 1834).

Eunaticina Fischer, 1885, p. 768. Replacement name for *Naticina* Gray, 1847, preoccupied.

Heliconatica Dall, 1924, p. 90. Type species by original designation: *Eunaticina (Heliconatica) margaritaeformis* Dall, 1924 (see the remarks on *Sigatica* Meyer & Aldrich 1886).

Pervisinum Iredale, 1931, p. 216. Type species by original designation: *Pervisinum dingeldii* Iredale, 1931 (=*Nerita papilla* Gmelin, 1791).

The status of *Nerita papilla* was thoroughly discussed by Beu (2004, p. 206), who provided a detailed synonymy. Kabat (1991) considered *Pervisinum* Iredale, 1931, *Propesinum* Iredale, 1924 and *Sigaretotrema* Sacco, 1890 as junior subjective synonyms of *Eunaticina*. We concur with Kabat as concerns *Pervisinum* (see also Kilburn 1976 and Beu 2004), but regard *Sigaretotrema* as a distinct genus and place *Propesinum* in the synonymy of it (see comments on *Sigaretotrema*).

Eunaticina was originally introduced as a subgenus of *Sigaretus* Lamarck, 1799 (= *Sinum* Röding, 1798). Fischer (1885, p. 768) published the following concise diagnosis for *Eunaticina*: "Coquille ombiliquée, ovale oblongue, naticiforme, mince, venture; spire acuminée; tours striés ou sillonnés; ouverture oblongue; opercula de *Sigaretus*". Examination of the type species (material in our collection; figures of Beu 2004) and of *Narica insculpta* Carpenter, 1865 has shown that *Eunaticina* is distinguished by the following combination of characters: 1) protoconch of 2.5-3 smooth whorls; 2) teleoconch elongate-oval, with moderately elevated spire; 3) spire whorls rather convex, meeting at channeled sutures; 4) last whorl extended abapically; 5) aperture prosocline, with length almost twice the width; 6) umbilicus open and deep, devoid of funicle; 7) umbilical callus indistinct to very narrow; 8) sculpture of spiral cords. *Eunaticina* has been currently included in the subfamily Sininae (Kilburn, 1976; Marincovich, 1977; Majima, 1989). Recent research supports its allocation in Polinicinae (Aronowsky 2000).

Eunaticina is a poorly speciose genus at present occurring widely throughout the Indo-West Pacific (*Eunaticina papilla*) and in the Eastern Pacific, from Southern Gulf of California to Ecuador (*Eunaticina insculpta*). *E. papilla* has recently entered the Mediterranean (one specimen found in the Iskenderum Bay, Turkey), probably by means of larval stages in ballast water (Öztürk & Bitlis 2013). Fossil records were so far from the early and late Miocene of Europe, from middle Miocene to Pleistocene deposits of West Pacific countries, and from the Pleistocene of Baja California, Mexico. The Eocene species described below constitutes the first record of the genus in Italy and predates the appearance of *Eunaticina*.

Eunaticina sp.

Pl. 7, fig. 8

Material examined: Cava Albanello: 1 spm., MPUM 11295.

Description. Protoconch very large, low-turbiniform, of 2.25 convex whorls, tip medium-sized. Teleoconch oval, rather thick. Spire cyrtoconoid, moderately elevated, whorls convex. Suture channeled. Last whorl inflate-oval, higher than wide; subsutural shelf indistinct; periphery above midline. Aperture D-shaped in prosocline plane, length 1.8 times width. Outer lip arched; inner lip almost straight, slightly reflected over adapical part of umbilicus. Parietal callus rectangular, rather thin, angular at level of umbilical border. Umbilicus deep, rather widely open; umbilical border rounded; umbilical wall steep, with prominent growth ridges. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of rather even, flat-topped spiral cords, approximately 50 on last whorl, wider than interspaces, finer and more widely spaced over base; spirals crossed by dense growth markings.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.258	2.114	13.171	11.890	2.513	10.662	6.670
UW	**IS**	**SA**				
3.13	14°	102°				

Remarks. This small Eocene shell is unlike any known *Eunaticina* species and likely belongs to a previously undescribed species. However, we refrain from proposing a new species on the basis of a single, probably not fully grown specimen, whose preservation is not perfect.

The upper Miocene to Recent Indo-West Pacific species *Eunaticina papilla* (Gmelin, 1791) differs from *Eunaticina* sp. in that has: 1) a protoconch with significantly smaller diameter and diameter of the first half-whorl, 2) a higher last whorl and a higher aperture, and 3) wider, ribbon-like spirals separated

by narrow grooves, less attenuated over the base and continuing on the umbilical wall (*Eunaticina* sp. has the umbilical wall only with growth markings). *Eunaticina (Eunaticina) visenda*, introduced by Beets (1984, p. 13) on the basis of Preangerian (middle Miocene) material from Kalimantan (Indonesia), differs by its more globose shell with more deeply channeled sutures and wider umbilicus, and by its sculpture of uneven spiral bands. The upper Miocene to Recent West American species *Eunaticina insculpta* (Carpenter, 1865) is readily distinguished in having a globose shell, also with wider spirals and "sharply incised", narrower interspaces (cf. Marincovich 1977).

Lozouet et al. (2001) regarded *Natica sulcata* and *Natica striatella*, both introduced by Grateloup (1828), as synonyms; they used the name *striatella* as the valid one and assigned the species to *Eunaticina*. We examined the specimens illustrated by Cossmann & Peyrot (1919), referred to as *Sigaretus (Sigaretotrema) striatellus* (MNHN-F-J03843) and *Sigaretus (Sigaretotrema) sulcatus* (MNHN-F-J05702), another shell of *Eunaticina striatella* from Mérignac in our collection and concur with the opinion of the cited authors. *Eunaticina striatella* appears to differ from *Eunaticina* sp. in having a protoconch with significantly smaller diameter and diameter of the first half-whorl, a more globose teleoconch with wider umbilicus, and a sculpture of spiral ribbons.

Sigaretus gouldianus Recluz, 1851, described from Eocene deposits of Paris area, was later assigned to *Eunaticina* Fischer, 1885 (cf. Cossmann 1888; Cossmann & Pissarro 1907 and Pacaud & Le Renard 1995). From the original description (Recluz 1851, p. 188), it is evident that this species is devoid of umbilicus, which is said to be "réduit à un tout petit trou, équivalant à une piqûre d'épingle". On the basis of this character, it results that: 1) Recluz's species differs markedly from *Eunaticina* sp., and 2) it is unlikely to belong in *Eunaticina*.

The Tortonian Bulgarian shell referred to as *Sinum (Sigaretotrema) michaudi* (Michelotti, 1847) by Kojumdgieva & Strachimirov (1960) seems better allocated in *Eunaticina* (see comments to *Sigaretotrema michaudi* below). According to the figure published by Kojumdgieva & Strachimirov, the Bulgarian specimen appears to have the teleoconch similar in shape to that of *Eunaticina* sp., but differs from it in having less convex whorls, thicker inner lip and parietal callus, and the umbilical wall with spiral cords.

Stratigraphic occurrence. *Eunaticina* sp. was recovered from lower Lutetian deposits of Cava Albanello (Veneto).

Genus *Euspira* Agassiz in J. Sowerby, 1837

Euspira Agassiz in J. Sowerby, 1837, p. 14. Type species by subsequent designation (Bucquoy, Dautzenberg & Dollfus 1883, p. 143): *Natica glaucinoides* J. Sowerby, 1812, Eocene, Great Britain.

Lunatia Gray, 1847, p. 149. Type species by original designation: *Natica ampullaria* Lamarck, 1822 (= *Natica heros* Say, 1822).

Labellinacca Cossmann in Cossmann & Peyrot, 1919, p. 188. Type species by subsequent designation (Cossmann 1925, p. 137): *Natica labellata* Lamarck, 1804.

The genus was briefly discussed in terms of type species designation and authorship by Kabat (1991). Cox (1930) considered *Natica glaucinoides* as a junior synonym of *Natica labellata* Lamarck, 1804 and this conclusion was implicitly or explicitly agreed upon by several workers (e.g. Glibert 1933; MacNeil 1960; Murphy & Rodda 1960; Kilburn 1976; Torigoe & Inaba 2011), who indicated *N. labellata* as the type species of *Euspira*. Wrigley (1949) redescribed *N. glaucinoides* and *N. labellata* (both included in *Euspira*) and affirmed them to be distinct species. Wrigley's opinion was accepted by other authors (e.g. Glibert 1963; Kanno 1971; Majima 1989; Pastorino 2005; Pedriali & Robba 2009; Huelsken et al. 2012; Garvie 2013; Landau et al. 2013). We examined some topotypes of *N. glaucinoides* and of *N. labellata* and could note that these species share many teleoconch characters. However, *N. labellata* differs from *N. glaucinoides* in that it has: 1) a greater protoconch of about one more whorl, with significantly smaller diameter of the initial half-whorl, 2) a narrow, gently sloping subsutural shelf (indistinct in *N. glaucinoides*), 3) a vestigial to absent funicle (broad, markedly depressed in *N. glaucinoides*), and 4) an abapical sulcus with subangular abaxial border (rounded in *N. glaucinoides*). On this basis, it is concluded that *N. glaucinoides* is the type species of *Euspira*.

Natica labellata is the type species of *Labellinacca* Cossmann, 1919. Since it is evidently congeneric with *Natica glaucinoides*, we agree with the opinion of Kabat (1991) and Torigoe & Inaba (2011), who considered *Labellinacca* a junior synonym of *Euspira*. Cossmann (in Cossmann & Peyrot 1919, p. 188) introduced *Labellinacca* as a section of *Lunatia* and wrote "Section s'appliquant aux forms qui, telles que *N. labellata* par exemple". This statement nei-

ther is designation (ICZN 1999, Article 67.5 of the Code), nor is fixation by monotypy (ICZN 1999, Article 68.3 of the Code). The first valid designation was subsequently made by Cossmann (1925, p. 137), who explicitly indicated *N. labellata* as the type species of *Labellinacca*.

Torigoe & Inaba (2011, p. 13) reinstated *Lunatia* (type species *Natica ampullaria* Lamarck, 1822 = *Natica heros* Say, 1822) as a valid genus, distinct from *Euspira*. However, the characters of *Natica heros* and of *Natica glaucinoides* demonstrate that these species are congeneric. Accordingly, we concur with Kabat (1991) in considering *Lunatia* as a junior synonym of *Euspira*.

Besides *Labellinacca* and *Lunatia*, Kabat (1991) regarded *Laguncula* Benson, 1842, *Bensonia* Gray, 1847, *Ampullonatica* Sacco, 1890, *Dallitesta* Mansfield, 1930, *Scarlatia* Schileyko, 1977, and *Pseudopolinices* Golikov & Sirenko, 1983 as synonyms of *Euspira*. Concerning *Ampullonatica*, we note that the remarkably deep sutural channel characterizing the species of this genus constitutes a reliable element distinguishing *Ampullonatica* from *Euspira* (see also the above comments on *Ampullonatica*). In a previous paper (Pedriali & Robba 2009, p. 387), *Pseudopolinices* was included in the synonymy of *Polinices* Montfort, 1810 (instead of *Euspira*) on the basis of the umbilical and parietal callus characters of *Natica nana* Möller, 1842 (type species of *Pseudopolinices*). This conclusion is retained herein. *Laguncula*, *Bensonia*, *Dallitesta* and *Scarlatia* appear to be unrelated to *Euspira*.

Euspira was regarded as a subgenus of *Polinices* Montfort, 1810 by some authors (e.g. Marwick 1924; Kilburn 1976; Marincovich 1977; Garvie 2013), but recently Huelsken et al. (2012), on the basis of molecular and shell morphology analyses, concluded that "*Euspira* is not a subgenus of *Polinices* but represents a valid genus".

Pedriali & Robba (2009) listed the diagnostic characters of *Euspira* as follows: 1) protoconch low-turbiniform, of 1.25-3 convex whorls, initial half-whorl with spiral microsculpture in some species; 2) teleoconch thin to moderately thick, globose or globose-elongate; 3) spire depressed to moderately elevated, somewhat stepped in some species; 4) suture almost flush to adpressed, channeled in a few species; 5) parietal callus moderately thick, slender, with more-or-less distinct anterior lobe overhanging the adapical part of the umbilicus, slightly in some species; 6) umbilicus open and deep, narrow to wide, with an inner spiral furrow in most species, spirally sculptured in some species; 7) funicle markedly depressed to absent; 8) umbilical callus slender to indistinct, better developed in a few species, merging into the anterior lobe of the parietal callus or demarcated from it by a weak groove. Pedriali & Robba (2009) remarked that *Euspira* is a distinctive cosmoplolitan genus useful to accommodate poli-niceine species with an open (not slit-like) umbilicus virtually devoid of a funicle and with a reduced to absent umbilical callus.

Euspira gianoi sp. n.

Pl. 7, figs. 9, 10

Derivation of name: The species is named after Giano Della Bella, who provided lot of material relevant to the present study.

Holotype: Rio di Bocca d'Asino: MPUM 11296 (Pl. 7, fig. 9).

Paratypes: Borelli: 1 spm., MGPT-PU 135140, 1 spm., MGPT-PU 135141, 1 spm., MGPT-PU 135142, 1 spm., MGPT-PU 135143, 1 spm., MGPT-PU 135144, 11 spms., MGPT-PU 135145, 3 spms., MPUM 11297, 2 spms., NP 9872; Monte dei Cappuccini: 3 spms., MGPT-PU 135146; Rio di Bocca d'Asino: 1 spm., MPUM 11298 (Pl. 7, fig. 10), 4 spms., MPUM 11299; Valle Ceppi: 2 spms., MGPT-PU 135147, 1 spm., MGPT-PU 135148.

Other material examined: Albugnano: 5 spms., PG 64, 1 spm., PG 74; Pietracuta: 4 spms., PP.PC02/04; Rio di Bocca d'Asino: 5 spms., NP 9860, 1 spm., PG 62, 1 spm., PG 63; Sant'Agata Fossili: 1 spm., PG 73b.

Preservation: Rather fair on the whole.

Type locality. Rio di Bocca d'Asino (see appendix).

Horizon: Resedimented sandstones and conglomerates forming lenticular bodies into the lower member of the S. Agata Fossili Formation; the age is Tortonian.

Diagnosis: Small, globose-oval shell with rather elevated spire and broadly oval last whorl. Umbilicus deep, narrowly bean-shaped, narrower and comma-shaped in a few specimens; funicle markedly depressed. Parietal callus thick, with anterior lobe covering adapical part of umbilicus; umbilical callus subtriangular, slightly overhanging umbilical opening and merging into anterior lobe of parietal callus. Vestige of pale brown background with darker subsutural band and lower base.

Description. Protoconch medium-sized, low-turbiniform, of 3-3.12 convex whorls, tip very small; protoconch I with evenly spaced spiral rows of interconnected, axially elongated and variously shaped microprotuberances forming a markedly irregular, somewhat reticulated pattern. Teleoconch small, globose-oval, moderately thick. Spire conical, rather elevated, whorls gently convex; suture adpressed. Last whorl broadly oval, scarcely produced abapically toward aperture; subsutural shelf moderately wide, somewhat concave, bounded by obtuse

but distinct angulation, with slight subsutural margining in a few specimens; periphery above midline. Aperture D-shaped in slightly prosocline plane, length about 1.7 times width; outer lip semicircular, inner lip nearly straight. Parietal callus thick, less so medially, with concave abapertural outline and slight adapical tubercle; anterior lobe subangular covering adapical part of umbilicus. Umbilicus deep, narrowly bean-shaped, narrower and comma-shaped in a few specimens; umbilical wall steep, bounded downward by very slight groove. Funicle markedly depressed. Umbilical callus subtriangular, with straight or attenuated reverse S-shaped abapertural outline, slightly overhanging umbilical opening and merging into anterior lobe of parietal callus. Basal fasciole weak to indistinct. Outer surface with fine growth lines obliquely prosocyrt over subsutural shelf. Specimens from Rio di Bocca d'Asino retain vestige of pale brown background with darker subsutural band and lower base.

Dimensions (mm)

DHW	PD	H	D	SH
0.074-0.086	1.217-1.473	1.653-8.201	1.600-7.352	0.351-2.799
0.080	1.345	4.927	4.476	1.575
AH	**AW**	**UW**	**IS**	**SA**
1.079-5.623	0.816-4.576	0.313-1.849	17°-29°	81°-109°
3.351	2.696	1.081	23°	95°

Remarks. The present new species can be compared only with *Euspira grossularia* (Marche-Marchad, 1957), *Euspira helicina helicina* (Brocchi, 1814), *Euspira notabilis* (Jeffreys, 1885), *Euspira pulchella* (Risso, 1826) and *Euspira umbilicocarinata* sp. n. (see below), taxa that also occur in the Miocene and are closely or superficially similar to *Euspira gianoi*. The values of the characteristic elements of the protoconch measured for *E. gianoi* do not differ significantly from those pertaining to *E. grossularia* and the sculpture of protoconch I is similar in both species. However, *E. gianoi* is readily distinguished from *E. grossularia* in that it has: 1) a higher, more narrowly coiled spire (Fig. 11), 2) an oval, less inflated last whorl with distinct subsutural shelf (indistinct in *E. grossularia*), and 3) a slight groove bounding downward the umbilical wall (absent in *E. grossularia*). *E. gianoi* resembles *E. helicina helicina* in teleoconch shape, umbilical characters and color pattern, but can be differentiated from it because of its protoconch of about 0.5 more whorls, with significantly greater diameter and smaller diameter of the initial half-whorl; further, the rather elaborated sculpture of protoconch I is different from the simpler one observed in *E. helicina helicina* (spiral cordlets). *E. notabilis* is another similar species, differing from *E. gianoi* in having: 1) a protoconch of 0.8 fewer whorls, with significantly smaller diameter and with the first whorl bearing nodulose spiral cordlets, 2) a more globose teleoconch with lower spire, and 3) a crescent-shaped umbilicus. *E. pulchella* is similar to *E. gianoi* in teleoconch shape and size, but has a more widely open umbilicus, an obsolete funicle, and a larval shell significantly smaller in diameter. *E. umbilicocarinata* is easily distinguished from *E. gianoi* because of its protoconch with significantly greater diameter of the first half-whorl, its globose shell with lower spire, and its wider umbilicus, whose interior is bounded by a keel-like angulation. *E. grossularia*, *E. helicina helicina* and *E. notabilis* attain a size larger than that of *E. gianoi*.

Stratigraphic occurrence. *Euspira gianoi* sp. n. was recovered from Burdigalian to Tortonian deposits of Piemont.

Euspira giuntellii sp. n.

Pl. 8, figs. 1-4

Derivation of name: The species is named after Piero Giuntelli, who provided a wealth of material relevant to the present study.

Holotype: Borelli: MGPT-PU 135149 (Pl. 8, fig. 1).

Paratypes: Borelli: 1 spm., MGPT-PU 135150 (Pl. 8, fig. 2), 1 spm., MGPT-PU 135151 (Pl. 8, fig. 3), 1 spm., MGPT-PU 135152 (Pl. 8, fig. 4), 1 spm., MGPT-PU 135153, 1 spm., MGPT-PU 135154, 29 spms., MGPT-PU 135155.

Preservation: Most specimens have minor damages.

Type locality: Borelli (see appendix).

Horizon: Gray, medium sand of Tortonian age.

Diagnosis: Small, depressed-globose shell with scarcely elevated spire and somewhat depressed last whorl. Suture slightly channeled. Umbilicus deep, narrowly oval to comma-shaped, funicle markedly depressed to indistinct. Parietal callus thickened at both ends, thin medially; umbilical callus slender, with attenuated reverse S-shaped or straight outline, merging into anterior lobe of parietal callus.

Description. Protoconch small, low-turbiniform, of 1.75-1.85 convex whorls, last half-whorl with even spiral cordlets, tip small. Teleoconch small, depressed-globose, slightly thick. Spire broadly conical, scarcely elevated, moderately taller in a few specimens, whorls convex. Suture slightly channeled. Last whorl large, globose, somewhat de-

pressed, expanding and produced abapically toward aperture; subsutural shelf poorly defined; periphery well above midline. Aperture ovately D-shaped in slightly prosocline plane, length about 1.6 times width; outer lip semicircular, inner lip very slightly arched adapically. Parietal callus thin medially, thickened at both ends, with concave abapertural outline; anterior lobe tongue-shaped covering adapical part of umbilicus, poorly differentiated in a few specimens. Umbilicus deep, narrowly oval, narrower and comma-shaped in a few specimens; umbilical wall steep, bounded downward by slight groove. Funicle markedly depressed to indistinct. Umbilical callus slender, with straight or attenuated reverse S-shaped outline, merging into anterior lobe (or corner) of parietal callus. Basal fasciole weak to indistinct. Outer surface with fine growth lines slightly bent subsuturally. Vestige of yellowish-brown color present in a few specimens.

Dimensions (mm)

DHW	PD	H	D	SH
0.178-0.210	0.682-0.802	2.882-5.786	2.963-6.091	0.515-1.259
0.194	0.742	4.334	4.527	0.887
AH	**AW**	**UW**	**IS**	**SA**
2.155-4.739	1.973-3.873	0.628-1.776	14°-30°	124°-144°
3.447	2.923	1.202	22°	134°

Remarks. *Euspira giuntellii* is closely similar to the Pliocene species *Euspira magenesi* Pedriali & Robba, 2001 in teleoconch shape and there is no significant difference as regards the values of the characteristic elements of the protoconch. However, *E. giuntellii* is readily distinguished from *E. magenesi* in that it has: 1) a protoconch with spirally sculptured last half-whorl (the protoconch of *E. magenesi* has smooth whorls), 2) a less deeply channelled suture, 3) a narrowly oval, distinctly smaller umbilicus (that of *E. magenesi* is round and wide), and 4) an interior of the umbilicus lacking the spiral cords, which are present in *E. magenesi*.

Stratigraphic occurrence. *Euspira giuntellii* sp. n. was recovered only from Tortonian deposits at the type locality.

Euspira grossularia (Marche-Marchad, 1957)

Pl. 8, figs. 5-7

1957 *Polynices grossularia* Marche-Marchad, p. 201, pl. 1, fig. 3.

2009 *Euspira grossularia* - Pedriali & Robba, p. 391, pl. 1, figs. 8, 9; pl. 3, fig. 6; pl. 4, figs. 4-6 (*cum syn.*).

Type material: Pedriali & Robba (2009, p. 391) reviewed the type material of *Euspira grossularia* and described the characters of this species.

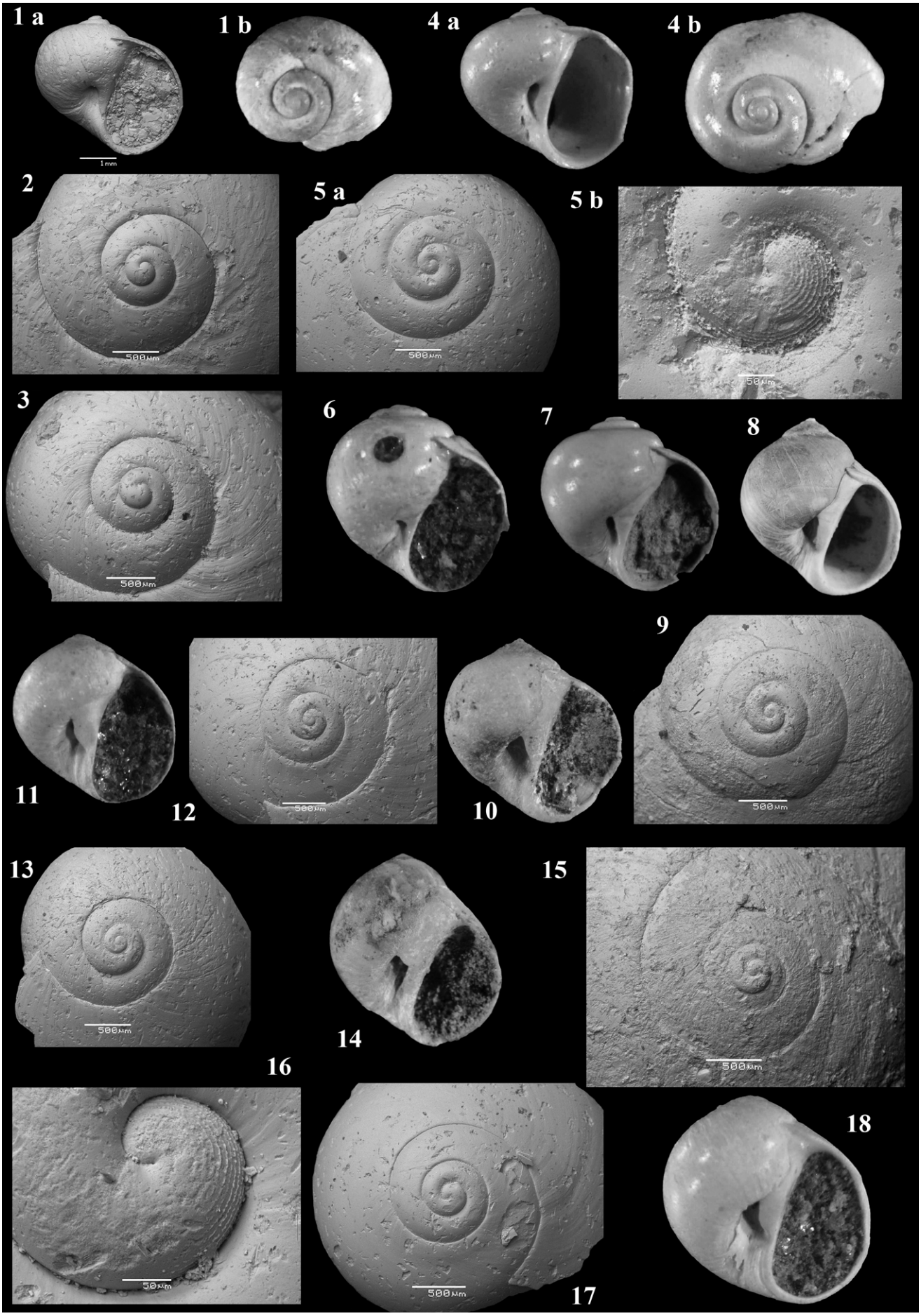
Material examined: Borelli: 1 spm., MGPT-PU 135156 (Pl. 8, fig. 5), 1 spm., MGPT-PU 135157, 1 spm., MGPT-PU 135158, 5 spms., MGPT-PU 135159, 1 spm., MGPT-PU 135160 (Pl. 8, fig. 6); 2 spms., MPUM 11300, 4 spms., NP 9869; Monte dei Cappuccini: 2 spms., MGPT-PU 135161, 8 spms., MGPT-PU 135162, 26 spms., MGPT-PU 135163, 1 spm., MGPT-PU 135164 (Pl. 8, fig. 7); Rio di Bocca d'Asino: 1 spm., NP 9855, 1 spm., MPUM 11301; Sant'Agata Fossili: 1 spm., NP 9856; Valle Ceppi: 2 spms., NP 9857, 1 spm., MGPT-PU 135165.

Dimensions (mm)

DHW	PD	H	D	SH
0.071-0.091	1.290-1.606	2.424-6.564	2.722-6.138	0.403-1.563
0.081	1.448	4.494	4.430	0.983
AH	**AW**	**UW**	**IS**	**SA**
1.945-5.077	1.519-3.667	0.275-1.563	18°-34°	109°-133°
3.511	2.593	0.919	26°	121°

PLATE 8

Fig. 1 - *Euspira giuntellii* sp. n. Borelli. Holotype, MGPT-PU 135149; a, apertural side; b, apical view.
Fig. 2 - *Euspira giuntellii* sp. n. Borelli. Paratype, MGPT-PU 135150; protoconch.
Fig. 3 - *Euspira giuntellii* sp. n. Borelli. Paratype, MGPT-PU 135151; protoconch.
Fig. 4 - *Euspira giuntellii* sp. n. Borelli. Paratype, MGPT-PU 135152; a, apertural side (height of shell 4.35 mm); b, apical view.
Fig. 5 - *Euspira grossularia* (Marche-Marchad, 1957). Borelli. MGPT-PU 135156; a, protoconch; b, detail of protoconch.
Fig. 6 - *Euspira grossularia* (Marche-Marchad, 1957). Borelli. MGPT-PU 135160; apertural side (height of shell 3.98 mm).
Fig. 7 - *Euspira grossularia* (Marche-Marchad, 1957). Monte dei Cappuccini. MGPT-PU 135164; apertural side (height of shell 5.03 mm).
Fig. 8 - *Euspira helicina helicina* (Brocchi, 1814). Montegibbio. MPUM 11302; apertural side (height of shell 14.76 mm).
Fig. 9 - *Euspira helicina helicina* (Brocchi, 1814). Valle Ceppi. MPUM 11305; protoconch.
Fig. 10 - *Euspira helicina helicina* (Brocchi, 1814). Valle Ceppi. MGPT-PU 135171; apertural side (height of shell 14.44 mm).
Fig. 11 - *Euspira latecallosa* sp. n. Borelli. Holotype, MGPT-PU 135180; apertural side (height of shell 4.93 mm).
Fig. 12 - *Euspira latecallosa* sp. n. Borelli. Paratype, MGPT-PU 135182; protoconch.
Fig. 13 - *Euspira latecallosa* sp. n. Borelli. Paratype, MGPT-PU 135183; protoconch.
Fig. 14 - *Euspira molarensis* sp. n. Molare. Holotype, MPUM 11307; apertural side (height of shell 12.77 mm).
Fig. 15 - *Euspira molarensis* sp. n. Mioglia. Paratype, MPUM 11308; protoconch.
Fig. 16 - *Euspira notabilis* (Jeffreys, 1885). Borelli. MGPT-PU 135185; detail of protoconch.
Fig. 17 - *Euspira notabilis* (Jeffreys, 1885). Borelli. MGPT-PU 135186; protoconch.
Fig. 18 - *Euspira notabilis* (Jeffreys, 1885). Borelli. MGPT-PU 135188; apertural side (height of shell 6.48 mm).


1 a
1 b
4 a
4 b
1 mm
2
5 a
5 b
500µm
50µm
3
6
7
8
9
11
12
10
13
14
15
16
17
18

Remarks. Except for a smaller size, the examined specimens are identical to the Pliocene ones dealt with by Pedriali & Robba (2009). Their larval shells have a slightly greater diameter, but the difference (+ 7%) is far from being significant. The 95% confidence intervals calculated for each dimension of the teleoconch overlap the lower part of those obtained for the Pliocene material. For description and comments, see Pedriali & Robba (2009).

Stratigraphic occurrence. *Euspira grossularia* (Marche-Marchad, 1957) was hitherto known to range from late Miocene to Recent (see Pedriali & Robba 2009). The new records from Piedmont (Monte dei Cappuccini, Valle Ceppi) show that the species was already present during the Burdigalian (rare) and the Langhian (rather abundant).

Euspira helicina helicina (Brocchi, 1814)

Pl. 8, figs. 8-10

1814 *Nerita helicina* Brocchi, p. 297, pl. 1, fig. 10.

2008b *Nerita helicina* - Pedriali & Robba, pp. 173-175, text-fig. 1.

2009 *Euspira helicina helicina* - Pedriali & Robba, p. 393, pl. 1, figs. 12, 13, 16-18; pl. 3, fig. 8; pl. 4, fig. 10 (*cum syn.*).

2013 *Euspira helicina helicina* - Landau et al., p. 103, pl. 11, fig. 9; pl. 12, figs. 1-3; pl. 62, figs. 6, 7.

Type material: Pedriali & Robba (2009, p. 396, 397) reviewed the type material of *Euspira helicina helicina*, and described the characters of this subspecies.

Material erroneously referred to as *Natica submamillaris* var. *mioclausa* Sacco, 1890 in IPUM: Montegibbio: 1 spm., IPUM 4395.

Material erroneously referred to as *Natica pardalis* Doderlein, 1864 in IPUM: Montegibbio: 4 spms., IPUM 4420, 4 spms., IPUM 4470.

Other material examined: Albugnano: 20 spms., PG 52, 4 spms., PG 70, 2 spms., PG 74a; Grazzano Badoglio: 2 spms., PG 54, 2 spms., PG 76a; Moncucco Torinese: 1 spm., PG 1; Monte dei Cappuccini: 1 spm., MGPT-PU 135196, 10 spms., MGPT-PU 25661, 1 spm., MGPT-PU 135166, 27 spms., MGPT-PU 25663, 3 spms., MGPT-PU 25664; Montegibbio: 1 spm., MPUM 11302 (Pl. 8, fig. 8), 2 spms., MGC 1417, 34 spms., private collection, 12 spms., private collection, 42 spms., private collection, 144 spms., private collection, 1 spm., private collection; Pietracuta: 23 spms., PP.PC 02/03, 4 spms., PP.PC 03/03; Rio di Bocca d'Asino: 19 spms., MZB 60034, 14 spms., MZB 60035, 27 spms., MZB 60036, 1 spm., MZB 60037, 17 spms., MZB 60038, 3 spms., MZB 60039, 4 spms., MZB 60053, 10 spms., NP 9847, 5 spms., PG 2, 2 spms., PG 5, 2 spms., PG 53, 3 spms., PG 7a, 2 spms., PG 8, 2 spms., PG 11, 12 spms., PG 12, 4 spms., PG 13, 22 spms., PG 25a, 2 spms., PG 26, 3 spms., PG 27a, 13 spms., PG 58a, 19 spms., NP 9846, 3 spms., NP 9848, 38 spms., private collection; Sant'Agata Fossili: 4 spms., MGPT-PU 23321, 1 spm., NP 9849, 10 spms., PG 18, 3 spms., PG 23a, 7 spms., PG 59b, 2 spms., PG 73; Stazzano: 6 spms., MGPT-PU 23408, 5 spms., NP 9850, 1 spm., MPUM 11303, 1 spm., MZB 60033, 26 spms., private collection; Termofourà: 2 spms., MGPT-PU 23518; Tetti Civera: 1 spm., MZB 60045; Valle Ceppi: 1spm., MGPT-PU 135167, 3 spms., MGPT 26046, 12 spms., MGPT-PU 135168, 3 spms., MGPT-PU 135169, 1 spm., MGPT-PU 25904, 1 spm., MGPT-PU 26144, 37 spms., MZB 60118, 1 spm., MZB 60042, 5 spms., MZB 60050, 47 spms., MZB 60051, 1 spm., MZB 60052, 25 spms., MZB 60055, 2 spms., MGPT-PU 107766, 11 spms., MGPT-PU 107767, 33 spms., MGPT-PU 108196, 1 spm., MGPT-PU 135170, 3 spms., MGPT-PU 107940, 1 spm., MPUM 11304, 1 spm., MPUM 11305 (Pl. 8, fig. 9), 1 spm., MPUM 11306, 24 spms., PG 71, 45 spms., PG 21b, 25 spms., MGPT-PU 23667, 1 spm., MGPT-PU 135171 (Pl. 8, fig. 10), 34 spms., MGPT-PU 25265, 3 spms., PG 55, 16 spms., MGPT-PU 23861, 1 spm., MGPT-PU 25907, 1 spm., MGPT-PU 26146, 1 spm., MGPT-PU 135172, 3 spms., MGPT-PU 135173, 1 spm., MGPT-PU 135174, 1 spm., MGPT-PU 135175, 1 spm., MGPT-PU 135176, 3 spms. NP 9852; Val Sanfrà: 27 spms., MGPT-PU 107942, 1 spm., MGPT-PU 135177, 1 spm., MGPT-PU 135178; Valle Vergnana: 4 spms., MZB 19144, 3 spms., MZB 43806, 6 spms., MZB 60040, 1 spm., MZB 60041, 16 spms., MZB 60047, 6 spms., MZB 60048, 5 spms., MZB 60049, 1 spm., NP 9851; Villa Allason: 1 spm., MGPT-PU 107072, 12 spms., MGPT-PU 108783; Villa Bertini: 1 spm., MGPT-PU 135179, 37 spms., MGPT-PU 108782.

Dimensions (mm)

DHW	PD	H	D	SH
0.108-0.136	0.873-1.001	9.311-25.467	8.389-22.077	1.668-8.272
0.122	0.937	17.389	15.233	4.970
AH	**AW**	**UW**	**IS**	**SA**
6.932-17.996	4.230-11.450	1.619-5.159	15°-35°	94°-122°
12.464	7.840	3.389	25°	108°

Remarks. The specimens listed above agree in all characters with those described by Pedriali & Robba (2009); for extensive description and remarks, reference to the cited authors. The specimen 4680 in Museo Civico di Storia Naturale di Milano is the neotype of *Nerita helicina* Brocchi, 1814 (International Commission on Zoological Nomenclature 2010, Opinion 2247).

Stratigraphic occurrence. *Euspira helicina helicina* (Brocchi, 1814) ranges continuously from the Burdigalian to the Pliocene of Italy. Other reliable occurrences are from the Burdigalian of France and North Sea Basin, from the Serravallian of Turkey, and from the Pliocene of France. Pedriali & Robba (2009) pointed out that it was replaced by *Euspira helicina fusca* (Blainville, 1825) subsequent to the Pliocene.

Euspira latecallosa sp. n.

Pl. 8, figs. 11-13

Derivation of name. From Latin *late* = widely and *callosus*, *a*, *um* = provided with a callus, with reference to the umbilical callus unusually wide for the genus.

Holotype: Borelli: MGPT-PU 135180 (Pl. 8, fig. 11).

Paratypes: Borelli: 1 spm., MGPT-PU 135181, 1 spm., MGPT-PU 135182 (Pl. 8, fig. 12), 1 spm., MGPT-PU 135183 (Pl. 8, fig. 13), 8 spms., MGPT-PU 135184.

Preservation: All specimens are rather well preserved.

Type locality: Borelli (see appendix).

Horizon: Gray, medium sand of Tortonian age.

Diagnosis: Small, globose shell with scarcely elevated spire and globose last whorl. Umbilicus deep, narrowly crescent-shaped, funicle a broad, depressed adaxial thickening of inner lip. Parietal callus thin medially; umbilical callus wide and thick, with convex abapertural outline, overhanging mid-adapical part of umbilicus and merging into anterior lobe of parietal callus.

Description. Protoconch medium-sized, low-turbiniform, of 2.87-3.06 convex, smooth whorls, tip small. Teleoconch globose, thin, hardly exceeding six mm in height. Spire broadly conical, scarcely elevated, whorls gently convex; suture adpressed, nearly flush. Last whorl globose to globose-oval, approximately nine-tenth of total height, slightly produced abapically toward aperture; subsutural shelf indistinct; periphery well above midline. Aperture ovately D-shaped in prosocline plane, length about 1.6 times width; outer lip nearly semicircular, inner lip subangular in the middle. Parietal callus thin medially, slightly thickened at both ends, with concave abapertural outline, anterior lobe small, at level of umbilical border, poorly differentiated in a few specimens. Umbilicus deep, crescent-shaped, very narrow, slightly less so in a few specimens; umbilical wall steep. Funicle a broad, depressed adaxial thickening of inner lip, soon obsolete toward interior of umbilicus. Umbilical callus wide and thick, with convex abapertural outline, expanded to overhang mid-adapical part of umbilicus, merging into anterior lobe of parietal callus; weak oblique depression at adapical end of umbilical callus present in most specimens. Basal fasciole indistinct. Outer surface with fine, incised growth lines.

Dimensions (mm)

DHW	PD	H	D	SH
0.096-0.112	1.130-1.190	2.504-6.408	2.390-6.054	0.449-1.357
0.104	1.160	4.456	4.222	0.903
AH	**AW**	**UW**	**IS**	**SA**
1.979-5.127	1.466-3.886	0.809-1.981	15°-27°	104°-136°
3.553	2.676	1.395	21°	120°

Remarks. *Euspira latecallosa* exhibits teleoconch characters strikingly similar to those of the Burdigalian to Serravallian species *Euspira submamillaris* (Sacco, 1890). The two taxa can be differentiated from one another on the basis of their larval shells: that of *E. submamillaris* has a significantly smaller diameter of the initial half-whorl. Further, Sacco's species attains a larger size and has a moderately wide umbilical opening.

Euspira latecallosa somewhat resembles *Euspira grossularia* (Marche-Marchad, 1957) in shell shape and the respective values of the characteristic elements of the protoconchs do not differ significantly. However, *E. grossularia* is readily distinguished from *E. latecallosa* in that it has: 1) the protoconch I spirally sculptured, 2) a more inflated last whorl slightly expanded abapically toward the aperture, 3) a small, oval umbilicus, 4) a triangular umbilical callus; it is also worth noting that *E. grossularia* attains a larger size.

The Tortonian to Recent species *Euspira notabilis* (Jeffreys, 1885) and *Euspira pulchella* (Risso, 1826) are also similar in teleoconch shape. *E. notabilis* differs from *Euspira latecallosa* because of its protoconch with fewer whorls (2.12-2.25 instead of 2.87-3.06), spirally sculptured tip and significantly smaller diameter and diameter of the first half-whorl, its more widely open umbilicus, and its narrower umbilical callus. *E. pulchella* (Risso, 1826) is distinguished from *E. latecallosa* in having a protoconch with significantly smaller diameter and sculptured tip, a more elevated spire, a wider umbilicus, an obsolete funicle, and a narrowly subtriangular umbilical callus.

The values of the characteristic elements of the protoconch of *Euspira latecallosa* do not differ significantly from those measured for the Burdigalian to Pliocene subspecies *Euspira helicina helicina* (Brocchi, 1814), but *E. latecallosa* can be distinguished easily from *E. helicina helicina* because of its smooth protoconch (that of *E. helicina helicina* has a spirally sculptured tip), its lower spire, its smaller to poorly differentiated anterior lobe of the parietal callus, its wider, abaperturally convex umbilical callus, and its smaller size.

Stratigraphic occurrence. *Euspira latecallosa* sp. n. was recovered only from Tortonian deposits at the type locality.

Euspira molarensis sp. n.

Pl. 8, figs. 14, 15

Derivation of name: The name refers to the village of Molare, which is the type locality.

Holotype: Molare: MPUM 11307 (Pl. 8, fig. 14).

Paratypes. Mioglia: 1 spm., MPUM 11308 (Pl. 8, fig. 15); Molare: 1 spm., MPUM 11309; Monte Gloso: 1 spm., MPUM 11310.

Other material examined: Madonna delle Rocche: 1 spm., PG 49; Molare: 3 spms., PG 50; Monte Gloso: 1 spm., NP 9839, 1 spm., private collection.

Preservation: Most specimens have minor damages, some are rather well preserved.

Type locality: Molare (see appendix).

Horizon: Gray, coarse sandstone belonging to the upper part of the Molare Formation; the age is late Rupelian.

Diagnosis: Globose-oval shell with moderately elevated spire and oval last whorl. Umbilicus deep, rather wide to wide, subcircular to subquadrangular, funicle absent. Parietal callus thick, truncated abapically, with blunt, transverse adapical bulge separated from outer lip by narrow groove; umbilical callus obsolete, short and narrowly triangular in some specimens.

Description. Protoconch small, low-turbiniform, of 2.5 convex, apparently smooth whorls, tip very small. Teleoconch globose-oval, slightly higher than wide, rather thick. Spire broadly conical, moderately elevated, whorls gently convex; suture adpressed, almost flush on earlier whorls. Last whorl oval, approximately nine-tenth of total height; subsutural shelf indistinct; periphery nearly at midline. Aperture D-shaped in slightly prosocline plane, length about two times width; outer lip regularly arched, adapical half of inner lip very slightly concave. Parietal callus thick, subrectangular, obliquely truncated abapically at level of umbilical border, expanded adapically toward interior of aperture and forming a blunt transverse bulge separated from outer lip by long, narrow furrow; anterior lobe indistinct. Umbilicus deep, subcircular to subquadrangular, moderately wide to wide; umbilical wall steep, with coarse growth markings. Funicle absent. Umbilical callus obsolete, short, very narrowly triangular in a few specimens. Basal fasciole indistinct. Outer surface with fine, dense growth lines.

Dimensions (mm)

DHW	PD	H	D	SH
0.078*	0.674*	7.016-24.892	7.853-21.285	0.697-8.629
* 1 protoconch measurable		15.954	14.569	4.663
AH	**AW**	**UW**	**IS**	**SA**
5.585-16.997	4.691-12.187	1.892-9.196	11°-27°	81°-129°
11.291	8.439	5.544	19°	105°

Remarks. The small protoconch, the characters of the parietal callus, the widely open umbilicus devoid of funicle, and the obsolete umbilical callus combined distinguish *Euspira molarensis* from the other *Euspira* species covered in the present study.

Stratigraphic occurrence. *Euspira molarensis* sp. n. was recovered from lower Oligocene deposits of Piedmont, Liguria and Veneto.

Euspira notabilis (Jeffreys, 1885)

Pl. 8, figs. 16-18

1885 *Natica notabilis* Jeffreys, p. 31, pl. 4, figs. 1, 1a.

2009 *Euspira notabilis* - Pedriali & Robba, p. 400, pl. 2, figs. 1, 2; pl. 3, figs. 11, 12; pl. 4, figs. 12-14 (*cum syn*).

Type material: See Pedriali & Robba (2009, p. 400).

Material examined: Borelli: 1 spm., MGPT-PU 135185 (Pl. 8, fig. 16), 1 spm., MGPT-PU 135186 (Pl. 8, fig. 17) 1 spm., MPUM 11311, 3 spms., MPUM 11312, 3 spms., NP 9870, 11 spms., MGPT-PU 135187, 1 spm., MGPT-PU 135188 (Pl. 8, fig. 18); Rio di Bocca d'Asino: 2 spms., NP 9854, 1 spm., MZB 60103, 1 spm., MZB 60126.

Dimensions (mm)

DHW	PD	H	D	SH
0.070-0.086	0.725-0.817	1.725-18.413	1.598-17.130	0.262-4.310
0.078	0.771	10.069	9.364	2.286
AH	**AW**	**UW**	**IS**	**SA**
1.152-14.412	1.266-8.954	0.507-4.095	11°-27°	95°-119°
7.782	5.110	2.301	19°	107°

Remarks. The small upper Miocene specimens listed above perfectly conform to the Pliocene ones dealt with by Pedriali & Robba (2009); the values of the characteristic elements of the protoconch are identical and the 95% confidence intervals obtained for Pliocene and upper Miocene protoconchs fully overlap one another. Pedriali & Robba (2009) described the protoconch as smooth throughout. The new findings from Borelli show that the protoconch I is sculptured with unevenly noded, thin and well spaced spiral threads (Pl. 8, fig. 16). Also *Euspira grossularia* (Marche-Marchad, 1957) has the protoconch I similarly sculptured, but the spirals are coarser and more closely set. For full description and other comments, see Pedriali & Robba (2009).

Stratigraphic occurrence. *Euspira notabilis* (Jeffreys, 1885) was recorded from Torto-

nian to Pleistocene deposits of Italy. Presently, it occurs in the western Mediterranean and in the eastern Atlantic, from Portugal to Mauritania.

Euspira perforata (Deshayes, 1864)

Pl. 9, figs. 1-3

1864 *Natica perforata* Deshayes, p. 46, pl. 72, figs. 9-11.
1888 *Natica perforata* - Cossmann, p. 161.
1902 *Natica perforata* - Cossmann, p. 63, pl. 7, figs. 5, 6.
1907 *Natica perforata* - Cossmann & Pissarro, pl. 9, fig. 61-11.
2011 *Payraudeautia perforata* - Caze et al., fig. 11B.
2012 *Payraudeautia perforata* - Caze et al., p. 36, pl. 13, figs. G, H.
2012 *Natica perforata* - Courville et al., pl. 5, fig. 17.

Type material: *Natica perforata* Deshayes, lectotype (here designated): the shell figured by Deshayes (1864, pl. 72, figs. 9-11) and refigured herein (Pl. 9, fig. 1), EM 32699, Grignon (France). From Deshayes' text, it appears that *Natica perforata* was introduced on the basis of specimens from many localities (possible paralectotypes), but these specimens were not identified so far (Robert Emmanuel, personal communication 2014).

Other material examined Cava Grola: 1 spm., private collection, 1 spm., NP 9886, 1 spm., MPUM 11313 (Pl. 9, fig. 2); Cava Rossi: 1 spm., MCZ 4328; Damery: 13 spms., NP 9882, 1 spm., NP 9883, 1 spm., MPUM 11314, 3 spms., NP 9884, 1 spm., MPUM 11315; Villiers-Saint-Frédéric (France): 3 spms., NP 9885, 1 spm., MPUM 11316 (Pl. 9, fig. 3), 3 spms., MPUM 11317.

Description. Protoconch small, depressed turbiniform, of 2.12-2.25 gently convex, smooth whorls, tip small. Teleoconch globose, moderately thick. Spire rather elevated, low in smaller specimens, almost flat-topped, whorls well convex; suture adpressed, slightly incised. Last whorl globular, slightly produced abapically; subsutural shelf indistinct; periphery above midline. Aperture D-shaped in prosocline plane, length about 1.5 times width; outer lip semicircular, inner lip almost straight. Parietal callus rather thin, with straight or gently concave abapertural outline; anterior lobe indistinct. Umbilicus medium-sized, deep; umbilical wall vertical. Interior of umbilicus with 4-9 uneven, rather coarse spiral cordlets crossed by growth markings, abapical one markedly broader, depressed to moderately prominent, obsolescent in a few specimens. Funicle absent. Umbilical callus moderately thick, triangular, reflected over adapical part of umbilicus and merging into anterior corner of parietal callus. Basal fasciole indistinct. Outer surface with uneven growth markings.

Dimensions (mm)

DHW	PD	H	D	SH
0.108-0.128	0.891-1.011	7.944-10.056	8.030-9.886	1.761-3.313
0.118	0.951	9.000	8.958	2.537
AH	**AW**	**UW**	**IS**	**SA**
5.887-7.039	4.528-6.136	2.292-2.932	16°-32°	110°-130°
6.463	5.332	2.612	24°	120°

Remarks. The four shells from Veneto have the protoconch abraded, but the teleoconch, identical to that of the French specimens listed above, makes their identification certain.

Natica perforata was recently included in *Payaraudeautia* Bucquoy, Dautzenberg & Dollfus, 1883 by some authors (Pacaud & Le Renard 1995; Caze et al. 2011; Caze et al. 2012). This generic allocation of *N. perforata* was probably based on its lowermost, broad spiral cordlet in the interior of the umbilicus, reminiscent of the inner spiral ridge or cord occurring abapical to the funicle in the species of *Payraudeautia*. However, the lack of a true (adapical or mid-adapical) funicle and the presence of additional spiral cordlets within the umbilicus (never present in *Payraudeautia*) make *N. perforata* unlike *Payraudeautia* species and, instead, support its assignment to the genus *Euspira* Agassiz in J. Sowerby, 1837.

Stratigraphic occurrence. *Euspira perforata* (Deshayes, 1864) is definitely known from the Early and Middle Eocene of France; it occurs rarely also in the middle Lutetian of Veneto (present paper).

Euspira piccolii sp. n.

Pl. 9, figs. 4, 5

Derivation of name: The species is named after the late Prof. Giuliano Piccoli (University of Padova), who extensively dealt with the Paleogene fossils of Veneto.

Holotype: Cava Rossi, MPUM 11318 (Pl. 9, fig. 4).

Paratypes: Cava Boschetto: 1 spm., MPUM 11319 (Pl. 9, fig. 5); Cava Rossi: 2 spms., MPUM 11320, 3 spms., MCZ 4329, 2 spms., MGP-PD 31524.

Other material examined: Cava Grola: 1 spm., NP 9836; Cava Rossi: 3 spms., NP 9838, 6 spms., private collection; Le Coe: 1 spm., NP 9837.

Preservation: Most specimens are rather well preserved.

Type locality: Cava Rossi (see appendix).

Horizon: Volcanoclastic layer of late Ypresian to earliest Lutetian age.

Diagnosis: Depressed-globose shell with moderately elevated to low spire and globose last whorl. Umbilicus deep, medium-

sized, teardrop-shaped, with over 20 inner spiral cordlets; funicle absent. Parietal callus rather thin; anterior lobe slight to indistinct. Umbilical callus moderately thick, triangular, slender in most specimens, reflected over adapical part of umbilicus, merging into anterior corner of parietal callus.

Description. Protoconch large, low-turbiniform, of three convex, apparently smooth whorls, tip small, slightly sunken. Teleoconch depressed-globose, moderately thick. Spire broadly conical, moderately elevated, low in a few specimens, whorls well convex; suture narrowly and shallowly channeled. Last whorl globose, slightly wider than tall, markedly depressed in abapertural view, somewhat expanded toward aperture; subsutural shelf narrow, poorly defined; periphery above midline. Aperture D-shaped in slightly prosocline plane, length about 1.66 times width; outer lip regularly arched, inner lip almost straight. Parietal callus rather thin, with straight or gently concave abapertural outline; anterior lobe slight to indistinct. Umbilicus medium-sized, deep, asymmetrically teardrop-shaped; umbilical wall vertical. Interior of umbilicus with numerous (more than 20), rather even spiral cordlets crossed by growth markings. Funicle absent. Umbilical callus moderately thick, triangular, slender in most specimens, reflected over adapical part of umbilicus and merging into anterior corner of parietal callus. Basal fasciole indistinct. Outer surface with remnants of fine growth lines, more evident over lowermost base.

Dimensions (mm)

DHW	PD	H	D	SH
0.123-0.131	1.574-2.022	11.064-22.512	12.470-22.262	2.071-9.379
0.127	1.798	16.788	17.366	5.725
AH	**AW**	**UW**	**IS**	**SA**
8.213-13.913	5.411-12.855	3.580-7.472	8°-28°	99°-135°
11.063	9.133	5.526	18°	117°

Remarks. *Euspira piccolii* is morphologically similar to the British, Bartonian species *Euspira bartonensis* Wrigley, 1949. We examined some topotypes of *E. bartonensis* from Middle Barton Beds at Barton and can state that Wrigley's species differs from *E. piccolii* in that it has: 1) the protoconch half the size of that of *E. piccolii*, 2) the interior of the umbilicus bounded by a sharp ridge (absent in *E. piccolii*), and 3) the umbilical callus nearly semicircular, demarcated from the parietal callus by a distinct transverse depression. *Euspira perforata* (Deshayes, 1864) is another similar species in shell shape, but differs from *E. piccolii* by its protoconch of 0.75 fewer whorls, with significantly smaller diameter, and its umbilicus with less numerous, coarser inner spiral cordlets.

Stratigraphic occurrence. *Euspira piccolii* sp. n. was recovered from upper Ypresian to Priabonian units of Veneto, being more common in the earliest Lutetian.

Euspira pulchella (Risso, 1826)

Pl. 9, figs. 13, 14

1826 *Natica pulchella* Risso, p. 148, pl. 4, fig. 42.

2009 *Euspira pulchella* - Pedriali & Robba, p. 401, pl. 2, figs. 3, 4; pl. 3, fig. 13; pl. 4, figs. 15, 16 (*cum syn.*).

Type material: Pedriali & Robba (2009, p. 401) reviewed the type material of *Euspira pulchella*, and described the characters of this species.

Material examined: Borelli: 1 spm., MGPT-PU

PLATE 9

Fig. 1 - *Euspira perforata* (Deshayes, 1864). Grignon (France). Lectotype (here designated) of *Natica perforata* Deshayes, 1864. EM 32699; apertural side.

Fig. 2 - *Euspira perforata* (Deshayes, 1864). Cava Grola. MPUM 11313; apertural side (height of shell 9.30 mm).

Fig. 3 - *Euspira perforata* (Deshayes, 1864). Villiers Saint Frédéric (France). MPUM 11316; protoconch.

Fig. 4 - *Euspira piccolii* sp. n. Cava Rossi. Holotype, MPUM 11318; a, apertural side (height of shell 13.34 mm); b, apical view; c, basal view.

Fig. 5 - *Euspira piccolii* sp. n. Cava Boschetto. Paratype, MPUM 11319; protoconch.

Fig. 6 - *Euspira submamillaris* (Sacco, 1890). Colli Torinesi. Holotype of *Natica (Naticina) catena* var. *proboniensis* Sacco, 1890. MGPT BS.029.02.008; apertural side (scale bar 4 mm).

Fig. 7 - *Euspira submamillaris* (Sacco, 1890). Colli Torinesi. Lectotype (here designated) of *Natica (Polinices) submamillaris* Sacco, 1890. MGPT BS.029.06.001; apertural side (scale bar 4 mm).

Fig. 8 - *Euspira submamillaris* (Sacco, 1890). Albugnano. MPUM 11321; a, protoconch; b, detail of protoconch.

Fig. 9 - *Euspira submamillaris* (Sacco, 1890). Albugnano. PG 44; protoconch.

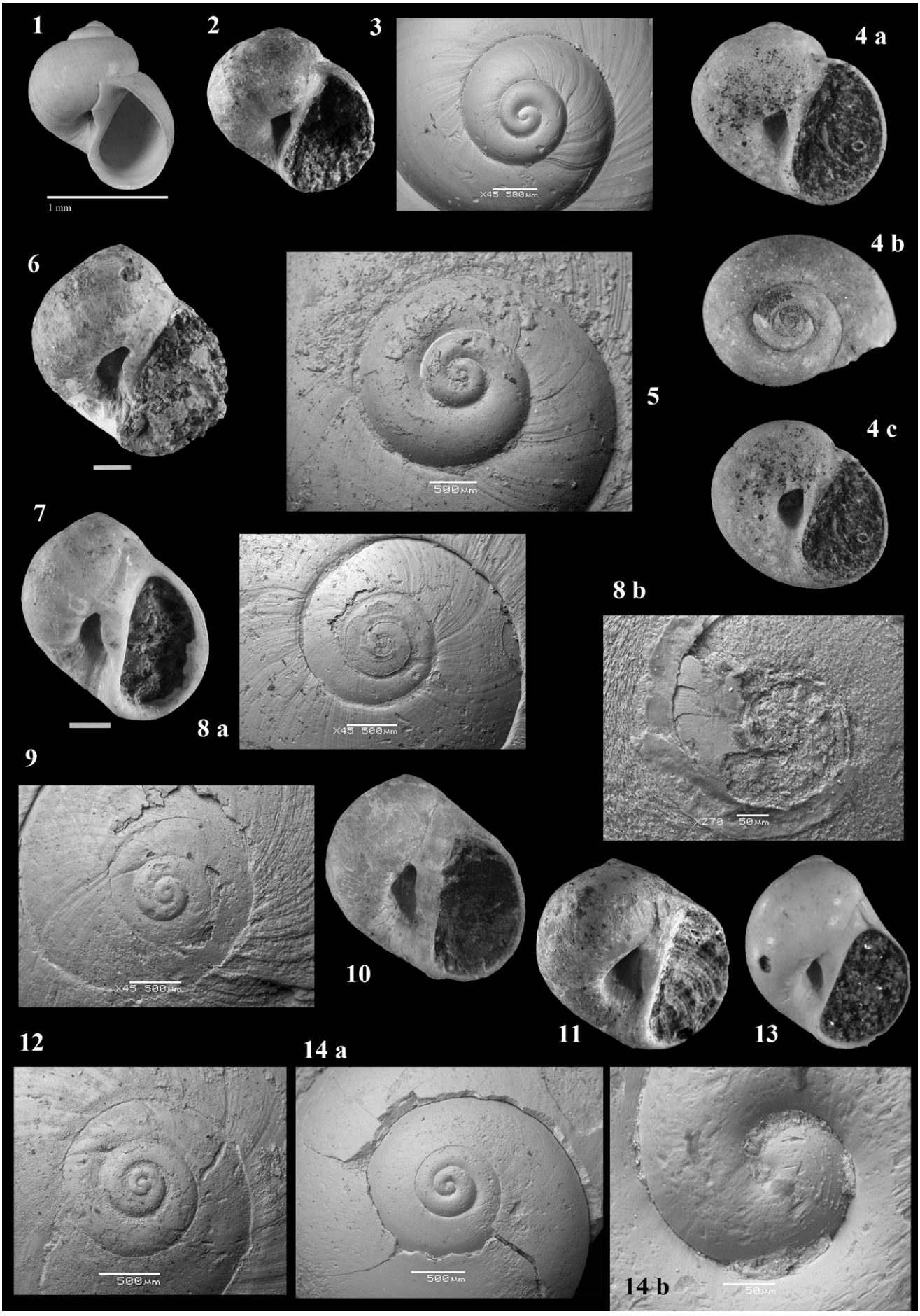
Fig. 10 - *Euspira submamillaris* (Sacco, 1890). Valle Ceppi. MPUM 11323; apertural side (height of shell 16.40 mm).

Fig. 11 - *Euspira submamillaris* (Sacco, 1890). Valle Ceppi. MPUM 11324; apertural side (height of shell 14.95 mm).

Fig. 12 - *Euspira submamillaris* (Sacco, 1890). Valle Vergnana. MZB 60022; protoconch.

Fig. 13 - *Euspira pulchella* (Risso, 1826). Borelli. MGPT-PU 135197; apertural side (height of shell 7.20 mm).

Fig. 14 - *Euspira pulchella* (Risso, 1826). Rio di Bocca d'Asino. MPUM 11326; a, protoconch; b, detail of protoconch.


1
1 mm
2
3
×45 500µm
4 a
4 b
4 c
5
500µm
6
7
8 a
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8 b
×270 50µm
9
×45 500µm
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11
12
500µm
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14 a
500µm
14 b
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135197 (Pl. 9, fig. 13), 19 spms., MGPT-PU 135198, 1 spm., MGPT-PU 135199, 1 spm., MGPT-PU 135200, 1 spm., MGPT-PU 135201, 1 spm., MGPT-PU 135202, 1 spm., MGPT-PU 135203, 2 spms., MPUM 11325, 4 spms., NP 9871, 6 spms., PG 22a; Rio di Bocca d'Asino: 1 spm., MPUM 11326 (Pl. 9, fig. 14), 6 spms., PG 22, 2 spms., NP 9840; Sogliano al Rubicone: 1 spm., PP.PM 01/02.

Dimensions (mm)

DHW	PD	H	D	SH
0.072-0.092	0.714-0.804	1.372-12.204	0.950-11.042	0.657-3.191
0.082	0.738	6.788	5.996	1.899
AH	**AW**	**UW**	**IS**	**SA**
0.456-9.344	0.616-5.940	0.296-3.048	12°-24°	77°-121°
4.900	3.278	1.672	18°	99°

Remarks. The examined upper Miocene specimens conform to the Pliocene and Recent ones dealt with by Pedriali & Robba (2009) in terms of values of the characteristic elements of the protoconch, sculpture of protoconch I, teleoconch shape, umbilical characters and color pattern. For full description and comments see Pedriali & Robba (2009).

Stratigraphic occurrence. *Euspira pulchella* (Risso, 1826) was known to range from Pliocene to Recent. The new recoverings listed above show that the species was already present in the Tortonian of Piedmont and Emilia. *Euspira pulchella* presently is distributed from Iceland and northern Norway and southward into the Mediterranean.

Euspira submamillaris (Sacco, 1890) comb. n.

Pl. 9, figs. 6-12

1847 *Natica mamillaris* - Sismonda, p. 51 (not *Natica mamillaris* Lamarck, 1822 = *Albula hepatica* Röding, 1798).

1852 *Natica submamillaris* d'Orbigny, p. 38 (*nomen nudum*).

1890b *Natica (Naticina) catena* var. *proboniensis* Sacco, p. 30 (*new synonym*).

1890b *Natica (Polinices) submamillaris* Sacco, p. 35.

1890b *Natica (Polinices) submamillaris* var. *mioinflata* Sacco, p. 35.

1890b *Natica (Polinices) submamillaris* var. *mioaperta* Sacco, p. 36.

1890b *Natica (Polinices) submamillaris* var. *mioclausa* Sacco, p. 36.

1891 *Natica (Naticina) catena* var. *proboniensis* - Sacco, p. 70, pl. 2, fig. 42.

1891 *Natica (Polinices) submamillaris* - Sacco, p. 90, pl. 2, fig. 62.

1891 *Natica (Polinices) submamillaris* var. *mioinflata* - Sacco, p. 91, pl. 2, fig. 64.

1891 *Natica (Polinices) submamillaris* var. *mioaperta* - Sacco, p. 91, pl. 2, fig. 65.

1891 *Natica (Polinices) submamillaris* var. *mioclausa* - Sacco, p. 91, pl. 2, fig. 66.

not 1956 *Polynices (Polynices) submamillaris* - Banke Rasmussen, p. 60, pl. 5, fig. 1 (not Sacco, 1890).

not 1958 *Natica (Naticina) submamillaris* - Sorgenfrei, p. 192, pl. 36, fig. 124 (not Sacco, 1890).

1984 *Naticina catena* var. *probononiensis* (sic) - Ferrero Mortara et al., p. 32.

1984 *Polinices submamillaris* - Ferrero Mortara et al., p. 36 (not BS.029.06.002 = *Natica (Polinices) submamilla* Sacco, 1891).

1984 *Polinices submamillaris* var. *mioinflata* - Ferrero Mortara et al., p. 36.

1984 *Polinices submamillaris* var. *mioaperta* - Ferrero Mortara et al., p. 36.

1984 *Polinices submamillaris* var. *mioclausa* - Ferrero Mortara et al., p. 36.

2007 *Polinices submamillaris* - Zunino, p. 121, pl. 1, fig. 7.

Type material: *Natica (Polinices) submamillaris* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 62) and refigured herein (Pl. 9, fig. 7), MGPT BS.029.06.001, Colli Torinesi. *Natica (Polinices) submamillaris* var. *mioinflata* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 64), MGPT BS.029.06.004, Colli Torinesi; 11 paralectotypes, MGPT BS.029.06.004/01, Colli Torinesi (other 2 syntypes are unidentifiable, 1 could be a species of *Cochlis*, 5 are *Natica (Polinices) proredempta* Sacco, 1890, all also numbered MGPT BS.029.06.004/01). *Natica (Polinices) submamillaris* var. *mioaperta* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 65), MGPT BS.029.06.005, Colli Torinesi; 17 paralectotypes, MGPT BS.029.06.005/01, Colli Torinesi. *Natica (Polinices) submamillaris* var. *mioclausa* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 66), MGPT BS.029.06.006, Colli Torinesi; 11 paralectotypes, MGPT BS.029.06.006/01, Colli Torinesi. *Natica (Naticina) catena* var. *proboniensis* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 2, fig. 42) and refigured herein (Pl. 9, fig. 6), MGPT BS.029.02.008, Colli Torinesi.

Other material examined: Albugnano: 1 spm., MPUM 11321 (Pl. 9, fig. 8), 1 spm., PG 44 (Pl. 9, fig. 9), 3 spms., MPUM 11322, 11 spms., PG 42; Mioglia: 1 spm., PG 43; Miste (The Netherlands): 42 spms., NP 9826; Monte dei Cappuccini: 1 spm., MGPT-PU; Termofourà: 1 spm., MGPT-PU 135190; Tetti Civera: 1 spm., MZB 15799; Valle Ceppi: 26 spms., MZB 60119, 5 spms., MGPT-PU 25264, 6 spms., MGPT-PU 23860, 1 spm., MGPT-PU 26143, 15 spms., PG 45, 15 spms., MGPT-PU 107939, 15 spms., MGPT-PU 23664, 1 spm., MZB 28566, 1 spm., MZB 60026, 7 spms., MZB 60027, 3 spms., MZB 60021, 1 spm., MPUM 11323 (Pl. 9, fig. 10), 1 spm., MPUM 11324 (Pl. 9, fig. 11), 2 spms., NP 9827, 8 spms., MZB 60056, 1 spm., MZB 60057, 1 spm., MZB 60058, 10 spms., MZB 60059, 1 spm., MZB 60061, 1 spm., MGPT-PU 135191, 1 spm., MGPT-PU 135192, 1 spm., MGPT-PU 135193, 1 spm., MGPT-PU 135194, 1 spm., PG 75; Val Sanfrà: 2 spms., MGPT-PU 107621, 3 spms., MGPT-PU 135195; Valle Vergnana: 2 spms., MZB 23757, 6 spms., MZB 43239, 2 spms., MZB 60054, 1 spm., MZB 60023, 1 spm., MZB 60022 (Pl. 9, fig. 12), 6 spms., MZB 60024, 1 spm., MZB 60025, 2 spms., PG 77; Villa Allason: 1 spm., MGPT-PU 107620, 2 spms., MGPT-PU 107623, 5 spms., MGPT-PU 107954; Villa Bertini: 2 spms., MGPT-PU 107622.

Description. Protoconch almost medium-sized, low-turbiniform, of 3-3.25 gently convex whorls, tip very small; one specimen from Albugnano with remnants of straight collabral riblets (Pl. 9, fig. 8b). Teleoconch globose-oval to oval, thick. Spire conical to broadly conical, pointed, moder-

ately elevated, less so in a few specimens; whorls gently convex to flat-sided; suture thin, almost flush. Last whorl globose-oval, globose in a few specimens, moderately extended toward aperture; subsutural shelf indistinct, very slightly concave but poorly defined in specimens with more elevated spire; periphery above midline. Aperture somewhat bean-shaped in prosocline plane, length about twice width; outer lip arched, inner lip markedly thick, slightly bent abapically. Parietal callus thick, subrectangular, rather short, ending in slight anterior lobe below border of umbilical area. Umbilicus deep, narrow to semicircular and largely open, umbilical wall subvertical, with coarse growth ridges. Funicle a broad, depressed adaxial thickening of inner lip, soon obsolete toward interior of umbilicus. Umbilical callus at submedian part of inner lip, thick, subtriangular, with straight or reverse S-shaped adaxial outline, overhanging adapical part of umbilicus and merging into anterior lobe of parietal callus. Basal fasciole indistinct. Outer surface with dense growth lines prosocyrt adapically. Some specimens retain vestige of brown subsutural band.

Dimensions (mm)

DHW	PD	H	D	SH
0.068-0.076	0.929-1.057	10.083-19.251	9.412-17.224	0.627-3.311
0.072	0.993	14.667	13.318	1.969
AH	**AW**	**UW**	**IS**	**SA**
8.784-16.604	4.589-9.157	2.108-4.776	9°-29°	97°-121°
12.694	6.873	3.442	19°	109°

Remarks. Sismonda (1847, p. 51) used the binomen *Natica mamillaris* Lamarck, 1822 for Miocene naticids from the Torino Hills; he did not provide any description or illustration of his material. Since *N. mamillaris* is a Recent Caribbean species, d'Orbigny (1852, p. 38) introduced the replacement name *submamillaris* for the fossil shells dealt with by Sismonda. D'Orbigny just listed (n° 566) a *Natica submamillaris* d'Orbigny, 1847, but we failed to locate this reference. The name *N. submamillaris* was reported as of d'Orbigny, 1852 by all subsequent authors. However, from the 1852 compilation, it appears that the name *submamillaris* is a nomen nudum and, thence, unavailable. Sacco (1890b, p. 35), also dealing with Miocene naticids from the Torino Hills, first published a concise diagnosis of *N. submamillaris*, thus making the name available, and is to be considered the author of the species. *N. mamillaris* is currently regarded as a synonym of *Albula hepatica* Röding, 1798 (cf. Warmke & Tucker Abbott 1975; Kabat et al. 1997). *N. submamillaris* was currently included in *Polinices* Montfort, 1810 by the authors. Instead, we think that it fully agrees with the characters of the genus *Euspira* Agassiz in J. Sowerby, 1837.

Natica submamillaris appears to be a variable species in teleoconch shape, spire height and amplitude of the umbilical opening. This fact induced Sacco (1890b, 1891) to propose the varieties *praenuntia*, *submioclausa*, *mioinflata*, *mioaperta* and *mioclausa*. The vast material examined has shown that the varieties *mioinflata*, *mioaperta* and *mioclausa* (of Sacco, 1890b) cannot be separated consistently from one another and from the typical form because of gradual transitions among them. Thus, they are included in the synonymy of *N. submamillaris*. The variety *praenuntia* Sacco, 1890 has a narrow, oblique umbilical opening and an arched adaxial outline of the umbilical callus, characters that are more similar to those of *Tectonatica miocolligens* (Sacco, 1890). On this basis, we consider the variety *praenuntia* as a synonym of *T. miocolligens*. Nothing can be reliably said about the variety *submioclausa* Sacco, 1891, reported to occur rarely in lower Oligocene units of Piedmont, since no specimens originally assigned to it were found in MGPT.

Sacco (1890b) briefly described the new variety *proboniensis* of *Natica catena* (da Costa, 1778) from lower Miocene deposits of Colli Torinesi (Torino Hills). Examination of the unique specimen (holotype) of the variety *proboniensis* in MGPT demonstrated that it is unrelated to *N. catena* because of its smaller umbilicus devoid of inner spiral cordlets (present and numerous in *N. catena*). Consequently, the variety *proboniensis* is herein ranked at species level and considered distinct from *N. catena*. The comparison of the original material of *Natica submamillaris* with the holotype of *Natica proboniensis* has shown that these two taxa are congeneric and that no reliable difference exists between them. We conclude that *N. submamillaris* and *N. proboniensis* are synonyms. Both *N. submamillaris* and *N. proboniensis* were published simultaneously in 1890 (see the above synonymy). The valid name is *submamillaris*, which was proposed at higher rank (ICZN 1999, Article 24 of the Code). It is also worth noting that the name *submamillaris* is that in current usage.

Euspira submamillaris superficially resembles *Euspira helicina helicina* (Brocchi, 1814) in shell shape,

but can be differentiated from it because of its protoconch with significantly smaller diameter of the initial half-whorl, and its almost flat-sided spire whorls (convex in Brocchi's taxon). The Miocene specimens from Denmark referred to as *Polynices (Polynices) submamillaris* or as *Natica (Naticina) submamillaris* (see the above synonymy) are similar to *E. submamillaris*, but are distinguished from it in that they have a protoconch of 0.5 fewer whorls (cf. Sorgenfrei 1958), a more inflated teleoconch with depressed, obtuse spire and a different course of the inner lip.

Stratigraphic occurrence. *Euspira submamillaris* Sacco, 1890 occurs abundantly in the Burdigalian of Piedmont, less so in the Serravallian of Piedmont; we have only one specimen from the early Oligocene of Liguria. The species is also present in the Burdigalian of Miste, The Netherlands (specimens in our collection).

Euspira subobturata (Sacco, 1891)
stat. n., comb. n.

Pl. 10, figs. 1-4

1890b *Natica (Naticina) catena* var. *helicina* subvar. *subopturata* Sacco, p. 30 (*nomen nudum*).

1891 *Natica (Naticina) catena* var. *subobturata* Sacco, p. 72.

1904 *Naticina catena* var. *subobturata* - Sacco, p. 103, pl. 22, figs. 31, 32.

1984 *Naticina catena* var. *subopturata* (sic) - Ferrero Mortara et al., p. 32.

Type material: *Natica (Naticina) catena* var. *subobturata* Sacco, lectotype (designated by Pedriali & Robba 2009, p. 396): the shell figured by Sacco (1904, pl. 22, fig. 32) and refigured herein (Pl. 10, fig. 1), MGPT BS.029.02.011, Savona; 1 paralectotype, MGPT BS.029.02.010, Colli Torinesi; 28 paralectotypes, MGPT BS.029.02.011/04, Savona.

Other material examined: Albugnano: 1 spm., MPUM 11327 (Pl. 10, fig. 2), 1 spm., MPUM 11328, 3 spms., PG 56; Valle Ceppi: 1 spm., NP 9853, 1 spm., MZB 60123, 1 spm., MZB 60151 (Pl. 10, fig. 3), 1 spm., MZB 60124, 1 spm., MZB 60125 (Pl. 10, fig. 4), 1 spm., MGPT-PU 135205; Val Sanfrà: 5 spms., MGPT-PU 135206.

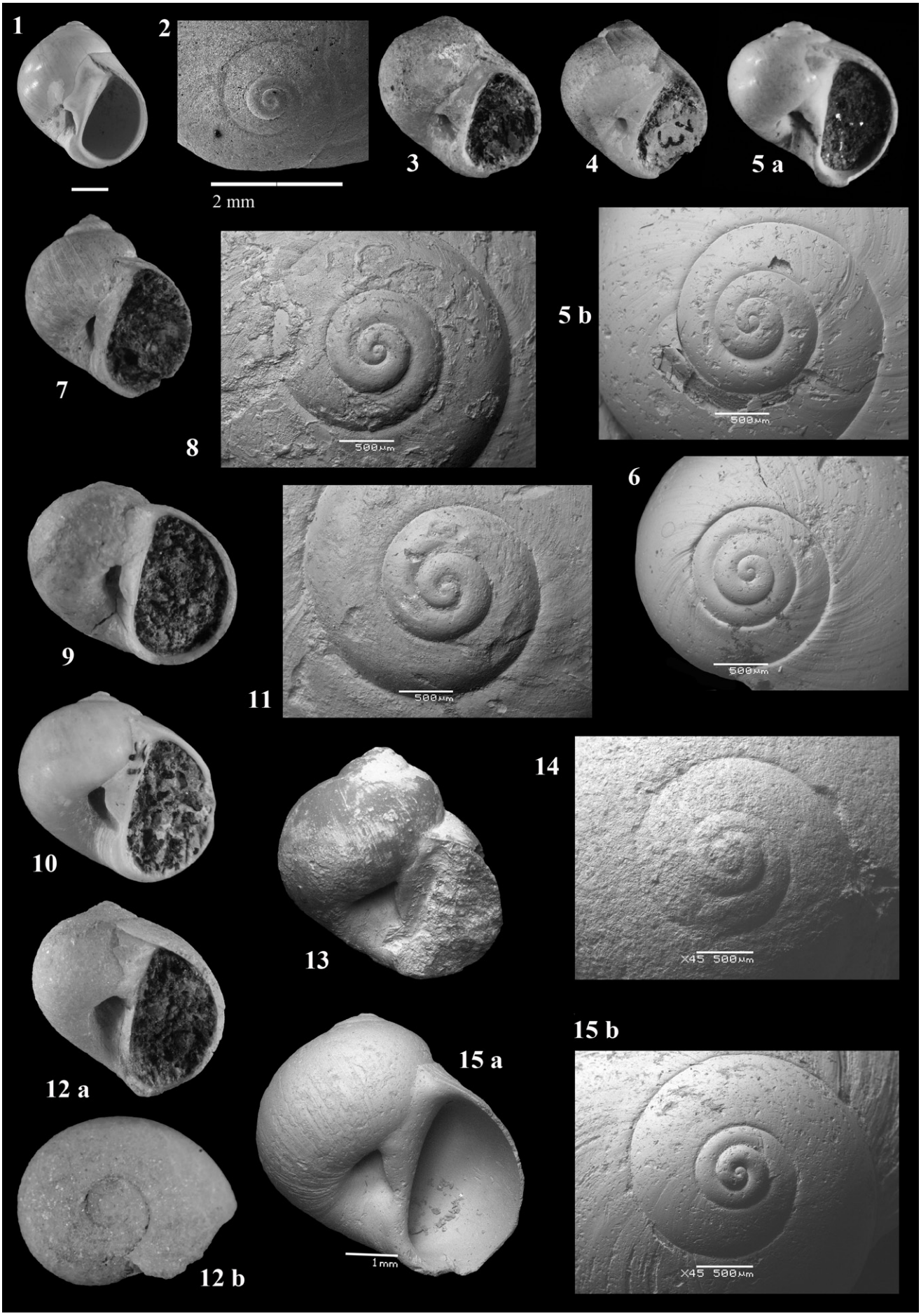
Description. Protoconch medium-sized, low-turbiniform, of 2.08-2.25 convex, apparently smooth whorls, tip small. Teleoconch globose to globose-oval, rather thick. Spire broadly conical, pointed, moderately elevated; whorls gently convex to nearly flat-sided; suture thin, adpressed, almost flush in some specimens. Last whorl globose, subsutural shelf indistinct, periphery well above midline. Aperture D-shaped in prosocline plane, length about 1.8 times width; outer lip regularly arched, inner lip straight, thickened abapically. Parietal callus thick, subrectangular, extended abapically and largely covering the umbilicus; anterior lobe expanded adaxially, broad, obtusely rounded, ending at level of upper umbilical wall. Umbilicus deep, small to very small, narrowly oval; umbilical wall subvertical, bounded downward by shallow groove. Funicle only partially exposed, broad, depressed, obsolescent toward interior of umbilicus. Umbilical callus at mid-abapical part of inner lip, very short, thick, subtriangular, with straight or reverse J-shaped adaxial outline, merging into anterior lobe of parietal callus. Basal fasciole broad and markedly depressed to poorly differentiated, producing abapical tickening of inner lip. Outer surface with dense growth lines prosocyrt adapically. Some specimens retain vestige of brown subsutural band.

Dimensions (mm)

DHW	PD	H	D	SH
0.174-0.214	1.117-1.193	7.928-15.724	6.708-15.660	1.353-3.973
0.194	1.155	11.826	11.184	2.663
AH	**AW**	**UW**	**IS**	**SA**
6.361-11.981	4.306-8.854	1.271-3.675	15°-31°	98°-134°
9.171	6.580	2.473	23°	116°

PLATE 10

Fig. 1 - *Euspira subobturata* (Sacco, 1891). Savona. Lectotype (here designated) of *Natica (Naticina) catena* var. *subobturata* Sacco, 1891. MGPT BS.029.02.011; apertural side (scale bar 4 mm).
Fig. 2 - *Euspira subobturata* (Sacco, 1891). Albugnano. MPUM 11327; protoconch.
Fig. 3 - *Euspira subobturata* (Sacco, 1891). Valle Ceppi. MZB 60151; apertural side (height of shell 13.07 mm).
Fig. 4 - *Euspira subobturata* (Sacco, 1891). Valle Ceppi. MZB 60125; apertural side (height of shell 14.04 mm).
Fig. 5 - *Euspira umbilicocarinata* sp. n. Borelli. Holotype, MGPT-PU 135207; a, apertural side (height of shell 5.61 mm); b, protoconch.
Fig. 6 - *Euspira umbilicocarinata* sp. n. Rio di Bocca d'Asino. Paratype, MPUM 11329; protoconch.
Fig. 7 - *Euspira umbilicolunata* sp. n. Valle Ceppi. Holotype, MPUM 11331; apertural side (height of shell 15.98 mm).
Fig. 8 - *Euspira umbilicolunata* sp. n. Valle Ceppi. Paratype, MPUM 11333; protoconch.
Fig. 9 - *Euspira* sp. 1. Cava Albanello. NP 9851; apertural side (height of shell 22.30 mm).
Fig. 10 - *Euspira* sp. 2. Valle Vergnana. MZB 43250; apertural side (height of shell 11.18 mm).
Fig. 11 - *Euspira* sp. 2. Valle Vergnana. MZB 60132; protoconch.
Fig. 12 - *Euspira* sp. 3. Case Soghe. MPUM 11335; a, apertural side (height of shell 12.34 mm); b, apical view.
Fig. 13 - *Euspira* sp. 4. Cassinelle. MPUM 11336; apertural side (height of shell 6.59 mm).
Fig. 14 - *Euspira* sp. 4. Monte Gloso. MPUM 11337; protoconch.
Fig. 15 - *Euspira* sp. 5. Albugnano. MPUM 11338; a, apertural side; b, protoconch.


1
2
2 mm
3
4
5 a
5 b
500µm
7
8
500µm
6
500µm
9
11
500µm
10
13
14
X45 500µm
12 a
15 a
15 b
12 b
1 mm
X45 500µm

Remarks. Sacco (1890b) listed the subvar. *subopturata* of *Natica (Naticina) catena* var. *helicina* (Brocchi, 1814) without description or illustration; the name *subopturata* results to be *nomen nudum*. One year later (1891), Sacco published a brief description of this form using the name *subobturata*, hence making this name available, with the authorship of Sacco, 1891. Sacco (1891) regarded *subobturata* as a variety of *Natica (Naticina) catena* (da Costa, 1778), distinct from the variety *helicina*. Da Costa's and Brocchi's taxa are currently assigned to the genus *Euspira* Agassiz in J. Sowerby, 1837.

In a recent paper (Pedriali & Robba 2009), *Natica (Naticina) catena* var. *subobturata* was included in the synonymy of *Euspira helicina helicina* (Brocchi, 1814). Re-examination of the original material in MGPT and of additional Miocene specimens retaining the protoconch induced us to consider Sacco's taxon as a distinct species. *Euspira subobturata* differs from *E. helicina helicina* in that it has: 1) a protoconch with significantly greater diameter, 2) a lower spire with less convex whorls, 3) a longer parietal callus covering the mid-adapical part of the umbilicus, and 4) a significantly shorter umbilical callus located more abapically than that of *E. helicina helicina*.

The lower Miocene, French species *Euspira benoisti* (Cossmann & Peyrot, 1919) is similar to *Euspira subobturata* in shell shape, inner lip calluses and umbilical characters. We examined some specimens from Lariey and noted that *E. benoisti* is readily distinguished from *E. subobturata* by its protoconch with significantly smaller diameter of the sculptured first half-whorl.

Stratigraphic occurrence. *Euspira subobturata* (Sacco, 1891) is known from Burdigalian, Langhian and Piacenzian units of northwestern Italy.

Euspira umbilicocarinata sp. n.

Pl. 10, figs. 5, 6

Derivation of name: From Latin *umbilicus* = umbilicus and *carinatus* = shaped like a keel, with reference to the keel-like angulation bounding the interior of the umbilicus.

Holotype: Borelli: MGPT-PU 135207 (Pl. 10, fig. 5).

Paratypes: Borelli: 1 spm., MGPT-PU 135208, 1 spm., MGPT-PU 135209, 1 spm., MGPT-PU 135210, 1 spm., MGPT-PU 135211, 48 spms., MGPT-PU 135212, 1 spm., NP 9873; Monte dei Cappuccini: 2 spms., MGPT-PU 135213, 16 spms., MGPT-PU 135214; Rio di Bocca d'Asino: 1 spm., MPUM 11329 (Pl. 10, fig. 6), 1 spm., MPUM 11330; Sant'Agata Fossili: 5 spms., MGPT-PU 135215.

Other material examined: Albugnano: 6 spms., PG 61; Rio di Bocca d'Asino: 1 spm., PG 60, 1 spm., NP 9858, 2 spms., NP 9859.

Preservation: Most specimens are rather well preserved; some have minor damages to the outer lip.

Type locality: Borelli (see appendix).

Horizon: Gray, medium sand of Tortonian age.

Diagnosis: Protoconch I with nodulose spiral cordlets. Small, globose shell with scarcely elevated spire and globose last whorl. Umbilicus deep, rather wide in most specimens, subrectangular; umbilical wall bounded downward by keel-like angulation; funicle markedly depressed. Parietal callus thick, with small, subangular anterior lobe. Umbilical callus short, thick, subtriangular; faint transverse depression between umbilical and parietal calluses present in some specimens.

Description. Protoconch small, low-turbiniform, of 2.75-3 convex whorls, tip small; protoconch I with remnants of irregularly nodulose spiral cordlets. Teleoconch small-sized, globose, moderately thick. Spire broadly conical, scarcely elevated, slightly higher in a few specimens; whorls gently convex; suture thin, adpressed. Last whorl globose, subsutural shelf indistinct, periphery well above midline. Aperture D-shaped in slightly prosocline plane, length exceeding twice width; outer lip semicircular, inner lip straight, thickened abapically. Parietal callus rather thick, less so medially, with concave, subangular abapertural outline; anterior lobe small, subangular, ending at level of upper umbilical wall. Umbilicus deep, rather wide, less so in a few specimens, obliquely subrectangular; umbilical wall subvertical, bounded downward by distinct, keel-like angulation. Funicle markedly depressed, obsolescent toward interior of umbilicus, separated from keel-like angulation by broad, shallow depression forming flat sinus on abapical part of inner lip. Umbilical callus short, thick, subtriangular, with straight or reverse S-shaped adaxial outline, slightly overhanging umbilicus and merging into anterior lobe of parietal callus; faint transverse depression may occur between umbilical and parietal calluses. Basal fasciole indistinct. Outer surface with fine growth lines prosocyrt adapically. Specimens from Rio di Bocca d'Asino retain vestige of pale brown background.

Dimensions (mm)

DHW	PD	H	D	SH
0.102-0.126	1.119-1.203	0.920-12.492	0.944-11.800	0.040-3.156
0.114	1.161	6.706	6.372	1.598
AH	**AW**	**UW**	**IS**	**SA**
0.861-9.233	0.333-7.885	0.030-3.710	12°-32°	98°-130°
5.047	4.109	1.870	22°	114°

Remarks. The present new species is characterized by the keel-like angulation forming a distinct step that demarcates the umbilical wall from the innermost part of the umbilicus.

Euspira latecallosa sp. n. (see above) is the most closely similar species in shell shape and the values of the characteristic elements of the protoconch are identical to those measured for *Euspira umbilicocarinata*. However, *E. umbilicocarinata* is readily differentiated from *E. latecallosa* because of its rather wide, subrectangular umbilicus (that of *E. latecallosa* is narrower, crescent-shaped), its narrower umbilical callus with straight or reverse S-shaped adaxial outline (that of *E. latecallosa* has a well convex adaxial outline), and, principally, its umbilical wall bounded downward by a distinct keel-like angulation.

The relationships with *Euspira gianoi* sp. n. have been already dealt with (see above). Other similar species are *Euspira grossularia* (Marche-Marchad, 1957), *Euspira helicina helicina* (Brocchi, 1814), *Euspira notabilis* (Jeffreys, 1885) and *Euspira pulchella* (Risso, 1826). *Euspira umbilicocarinata* differs from *E. grossularia* in having a protoconch with significantly greater diameter of the first half-whorl, a spire with less convex whorls, a less globular last whorl, and the umbilicus with an inner step (absent in *E. grossularia*). Concerning *E. helicina helicina*, the values of the characteristic elements of the protoconch do not differ significantly from those measured for *E. umbilicocarinata*, but the teleoconch characters of *E. umbilicocarinata* distinguish it easily from *E. helicina helicina*. *E. umbilicocarinata* differs from *E. helicina helicina* by its smaller size, its lower-spired shell, its smaller anterior lobe of the parietal callus, its rather wide, subrectangular umbilicus with the innermost part bounded by a distinct step, and its noticeably wider depression separating the funicle from the base of the umbilical wall. *E. umbilicocarinata* is distinguished from *E. notabilis* because of its protoconch with over 0.5 more whorls and significantly greater diameter and diameter of the initial hal-whorl, its lower spire, and its different umbilical characters (*E. notabilis* has a crescent-shaped instead of subrectangular umbilicus, devoid of any inner step). The protoconch with significantly greater diameter and diameter of the first half-whorl is the primary element differentiating *E. umbilicocarinata* from *E. pulchella*.

Stratigraphic occurrence. *Euspira umbilicocarinata* sp. n. was recovered from Langhian to Tortonian deposits of Piedmont.

Euspira umbilicolunata sp. n.

Pl. 10, figs. 7, 8

Derivation of name: From Latin *umbilicus* = umbilicus and *lunatus* = crescentic, with reference to the narrow, crescent-shaped umbilicus.

Holotype: Valle Ceppi: MPUM 11331 (Pl. 10, fig. 7).

Paratypes: Grazzano Badoglio: 2 spms., MPUM 11332, 4 spms., MZB 60031, 13 spms., MZB 29800; Valle Ceppi: 1 spm., MGPT-PU 135216, 1 spm., MPUM 11333 (Pl. 10, fig. 8), 1 spm., MZB 60030, 8 spms., MGPT-PU 135217, 2 spms., MGPT-PU 135218, 1 spm., MGPT-PU 135219, 1 spm., MGPT-PU 135220, 6 spms., MGPT-PU 135221, 1 spm., MGPT-PU 135222, 4 spms., MZB 60120; Tetti Civera: 2 spms., MZB 60032; Val Sanfrà: 1 spm., MGPT-PU 135223; Villa Allason: 23 spms., MGPT-PU 135224; Villa Bertini: 21 spms., MGPT-PU 108782.

Other material examined: Grazzano Badoglio: 6 spms., PG 51, 1 spm., NP 9842, 4 spms., PG 76b; Valle Ceppi: 2 spms., NP 9841.

Preservation: Most specimens are rather well preserved; some have minor damages.

Type locality: Valle Ceppi (see appendix).

Horizon: Coarse, gray sand (Termofourà Formation) of Burdigalian age.

Diagnosis: Globose to globose-oval shell with rather elevated spire and globose last whorl. Umbilicus narrow to very narrow, crescent-shaped; umbilical wall with coarse growth markings; funicle broad, markedly depressed. Parietal callus rather thick; anterior lobe slight to indistinct. Umbilical callus slender, merging into anterior corner of parietal callus; slight transverse depression between umbilical and parietal calluses present in some specimens. Uniform pale brown color throughout.

Description. Protoconch medium-sized, low-turbiniform, of 2.85-3 convex, apparently smooth whorls, tip very small, slightly sunken. Teleoconch globose to globose-oval, moderately thick. Spire conical, rather elevated, less so in a few specimens, whorls convex. Suture adpressed; slight subsutural margining present in some specimens. Last whorl globose, depressed in abapertural view, scarcely produced toward aperture; subsutural shelf poorly defined to absent; periphery about at midline. Aperture D-shaped in slightly prosocline plane, length about 1.76 times width; outer lip regularly arched, basal lip slightly thickened, inner lip almost straight. Parietal callus rather thick, with concave abapertural outline; anterior lobe slight to indistinct. Umbilicus narrow to very narrow, crescent-shaped, somewhat wider in a few larger specimens; umbilical wall with coarse growth markings. Funicle broad,

markedly depressed. Umbilical callus rather slender, with gently convex to convex adaxial outline, merging into anterior corner of parietal callus; slight transverse depression in between umbilical callus and parietal callus present in some specimens. Basal fasciole indistinct. Outer surface with fine growth lines slightly bent subsuturally. Best preserved specimens retain uniform pale brown color throughout.

Dimensions (mm)

DHW	PD	H	D	SH
0.073-0.089	1.229-1.265	8.259-16.103	7.297-14.485	2.243-6.023
0.081	1.247	12.181	10.891	4.133
AH	**AW**	**UW**	**IS**	**SA**
5.616-10.396	3.800-8.788	1.929-3.977	13°-29°	88°-112°
8.006	6.294	2.953	21°	100°

Remarks. The teleoconch of *Euspira umbilicolunata* bears a close resemblance to that of *Euspira pulchella* (Risso, 1826). However, *E. umbilicolunata* can be distinguished easily from *E. pulchella* because of its significantly greater protoconch diameter, its narrower umbilicus, and its better developed funicle (obsolete in *E. pulchella*) not separated from the umbilical wall by a furrow. The values of the characteristic elements of the protoconch of *E. umbilicolunata* do not differ significantly from those measured for *Euspira grossularia* (Marche-Marchad, 1957), but the teleoconch characters of *E. umbilicolunata* readily distinguish it from *E. grossularia*. *E. umbilicolunata* differs from *E. grossularia* by its more elevated spire (Fig. 12), its less inflated last whorl, its more widely open umbilicus, its obsolescent funicle, and its more slender, subtriangular umbilical callus. *Euspira notabilis* (Jeffreys, 1885) is another similar species. *E. umbilicolunata* differs from it in having the protoconch of 2.85-3 whorls (2.12-2.25 in *E. notabilis*), with significantly greater diameter and no groove separating the funicle from the umbilical wall. *E. umbilicolunata* might be confused with specimens of *E. helicina helicina* (Brocchi, 1814), in particular with those having a very narrow, crescentic umbilicus. The most relevant characters distinguishing *E. umbilicolunata* from Brocchi's taxon are: 1) the larger protoconch with significantly smaller diameter of the initial half-whorl, and 2) the absence of any spiral furrow separating the funicle from the umbilical wall (present and deep in *E. helicina helicina*).

Stratigraphic occurrence. *Euspira umbilicolunata* appears to be restricted to the Burdigalian-Langhian time span.

Euspira sp. 1

Pl. 10, fig. 9

Material examined: Cava Albanello: 1 spm., NP 9851 (Pl. 10, fig. 9); Cava Grola: 1 spm., private collection, 1 spm., NP 9852, 1 spm., MPUM 11334, 1 spm., private collection, 2 spms., private collection.

Description. Protoconch poorly preserved, medium-sized, of 2.25 convex whorls, tip missing. Teleoconch medium to large, depressed-globose, rather thin. Spire obtusely conical, moderately elevated, whorls convex; suture shallowly channeled. Last whorl large, globose, somewhat depressed, very slightly expanded toward aperture; subsutural shelf rather narrow, poorly defined; periphery above midline. Aperture ovately D-shaped in prosocline plane, length about 1.6 times width; outer lip semicircular, inner lip straight. Parietal callus moderately thick, rectangular; anterior corner (right angle) at level of umbilical border. Umbilicus deep, moderately wide, crescent-shaped; umbilical wall steep, bounded downward by slight groove ending at most abapical part of inner lip; interior of umbilicus with spiral cordlets crossed by growth markings. Funicle obsolete. Umbilical callus very slender, with reverse J-shaped outline, ending in middle of abapical margin of parietal callus. Basal fasciole weak to indistinct. Outer surface with vestige of growth lines more evident on lower base.

Dimensions (mm)

DHW	PD	H	D	SH
-	-	7.000-26.288	8.066-27.958	1.804-6.732
-	-	16.644	18.012	4.268
AH	**AW**	**UW**	**IS**	**SA**
4.820-19.932	5.158-16.138	2.670-8.966	10°-22°	122°-138°
12.376	10.648	5.818	16°	130°

Remarks. The Eocene *Euspira piccolii* sp. n. (see above) appears to be the most closely similar species in shell morphology, but differs from *Euspira* sp. 1 in that it has a protoconch of 0.75 more whorls, a comparatively wider, teardrop-shaped umbilicus, and a better developed, triangular umbilical callus ending into the anterior corner of the parietal

callus, not in the middle of the anterior margin of the parietal callus as in *Euspira* sp. 1. The British, Bartonian species *Euspira bartonensis* Wrigley, 1949 is also closely similar (topotypes examined). However, *E. bartonensis* differs from *Euspira* sp. 1 because of its interior of the umbilicus bounded by a sharp ridge instead of a groove as in *Euspira* sp. 1 and its umbilical callus nearly semicircular, demarcated from the parietal callus by a distinct transverse depression. The Tortonian species *Euspira giuntellii* sp. n. (see above) is also similar, but is readily distinguished from *Euspira* sp. 1 in having the umbilicus devoid of spirals; moreover, it attains a larger size.

The present specimens almost certainly represent an undescribed species, but more material retaining the protoconch is required in order to name it.

Stratigraphic occurrence. *Euspira* sp. 1 was recovered only from Lutetian deposits of Veneto.

Euspira sp. 2

Pl. 10, figs. 10, 11

Material examined: Valle Ceppi: 1 spm., MZB 60130;Valle Vergnana: 1 spm., MZB 43250 (Pl. 10, fig. 10), 1 spm., MZB 60132 (Pl. 10, fig. 11), 1 spm., MZB 60131.

Description. Protoconch medium-sized, of 2.16-2.25 convex, apparently smooth whorls, tip small. Teleoconch medium-sized, depressed-globose, rather thick. Spire broadly conical, scarcely to moderately elevated, whorls gently convex to convex; suture, fine, adpressed. Last whorl inflated, somewhat depressed, very slightly expanded toward aperture; subsutural shelf indistinct; periphery about at midline. Aperture D-shaped in prosocline plane, length about 1.9 times width; outer lip semicircular, inner lip straight, thickened abapically. Parietal callus thick, with markedly concave abapertural outline; anterior lobe poorly differentiated, subangular to rounded, at level of adapical umbilical border. Umbilicus deep, crescent-shaped, rather narrow to moderately wide; umbilical wall slightly overhanging interior of umbilicus, bounded downward by shallow, rather narrow spiral depression forming slight sinus on abapical part of inner lip. Funicle broad, depressed, obsolescent toward interior of umbilicus. Umbilical callus thick, with well curved, reverse S-shaped adaxial outline and merging into anterior lobe of parietal callus. Basal fasciole indistinct. Outer surface with fine growth lines prosocyrt subsuturally. All specimens retain vestige of pale brown background, with darker subsutural band and lowermost base.

Dimensions (mm)

DHW	PD	H	D	SH
0.178-0.194	1.100-1.132	9.974-16.002	9.389-15.701	1.565-4.621
0.186	1.116	12.988	12.545	3.093
AH	**AW**	**UW**	**IS**	**SA**
8.113-11.677	6.415-10.191	1.948-5.972	12°-20°	112°-128°
9.895	8.303	3.960	16°	120°

Remarks. *Euspira* sp. 2 appears to be closely similar to the Tortonian to Recent species *Euspira notabilis* (Jeffreys, 1885) if the teleoconch characters and the size are considered. However, it can be differentiated from *E. notabilis* on the basis of its protoconch, which has significantly greater diameter and diameter of the initial half-whorl. *Euspira* sp. 2 is also similar to the coeval species *Euspira submamillaris* (Sacco, 1890) and *Euspira umbilicolunata* sp. n (see above). It differs from *E. submamillaris* in having the protoconch of about one fewer whorl, with a significantly greater diameter of the first half-whorl, and the teleoconch depressed-globose instead of globose-oval to oval as in *E. submamillaris*. *Euspira* sp. 2 is readily distinguished from *E. umbilicolunata* in that it has: 1) a protoconch of about one fewer whorl, with significantly greater diameter of the first half-whorl, 2) a depressed-globose teleoconch (that of *E. umbilicolunata* is more elongate, globose-oval), 3) a lower spire with less convex whorls, and 4) a distinctly wider umbilicus.

Most probably the examined specimens represent a new species, but additional material is required to assess them.

Stratigraphic occurrence. *Euspira* sp. 2 seems to be an uncommon element, occurring in Burdigalian deposits of the Torino Hills.

Euspira sp. 3

Pl. 10, fig. 12

Material examined: Case Soghe: 1 spm., MPUM 11335.

Description. Protoconch abraded. Teleoconch medium-sized, globose, rather thick. Spire broadly conical, scarcely elevated, whorls flatly

convex; suture, fine, adpressed. Last whorl inflated, slightly produced abapically toward aperture; subsutural shelf indistinct; periphery above midline. Aperture D-shaped in prosocline plane, length about twice width; outer lip semicircular, inner lip almost straight. Parietal callus expanded adapically, thick at both ends, rather thin medially, with concave abapertural outline; anterior lobe poorly differentiated, subangular, hindering most adapical part of umbilicus. Umbilicus deep, broadly semicircular; umbilical wall and interior of umbilicus with uneven spiral cordlets crossed by growth markings. Funicle absent. Umbilical callus obsolete. Basal fasciole indistinct. Outer surface with remnants of growth lines.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
-	-	12.340	11.681	1.762	10.580	8.339
UW	**IS**	**SA**				
5.320	14°	126°				

Remarks. The present form seems unlike any other *Euspira* species dealt with in the literature and likely represents a new species, which, however, requires more material retaining the protoconch to be named.

Euspira sp. 3 can be compared with the Eocene species *Euspira piccolii* sp. n. and *Euspira* sp. 1 (see above) that also have the interior of the umbilicus spirally sculptured. *E. piccolii* differs from *Euspira* sp. 3 in that it has: 1) a more depressed teleoconch, 2) a more elevated spire with well convex whorls and narrowly channeled sutures, 3) a rather wide, teardrop-shaped umbilicus (semicircular in *Euspira* sp. 3), and 4) a distinct, triangular umbilical callus. *Euspira* sp. 1 is readily distinguished from *Euspira* sp. 3 on the basis of its depressed-globose teleoconch, its convex spire whorls and channeled suture, its narrower, crescent-shaped umbilicus, and its narrow but distinct umbilical callus (obsolete in *Euspira* sp. 3).

Stratigraphic occurrence. *Euspira* sp. 3 seems to be a very rare taxon, recovered from Rupelian deposits at Case Soghe (Veneto).

Euspira sp. 4

Pl. 10, figs. 13, 14

Material examined: Cassinelle: 1 spm., MPUM 11336 (Pl. 10, fig. 13); Monte Gloso: 1 spm., MPUM 11337 (Pl. 10, fig. 14); Sangonini: 1 spm., MCZ 4330.

Description. Protoconch small, depressed-turbiniform, of 2.25 whorls, tip small. Teleoconch small, globose-oval, thick. Spire moderately elevated, whorls convex; suture, fine, adpressed. Last whorl broadly oval; subsutural shelf indistinct; periphery nearly at midline. Aperture D-shaped in prosocline plane, length about twice width; outer lip semicircular, inner lip almost straight, thickened abapically. Parietal callus rather thin, less so at both ends, with concave abapertural outline; anterior lobe short, subrounded, hindering most adapical part of umbilicus. Umbilicus deep, broadly semicircular, umbilical wall steep. Funicle broad, markedly depressed, separated from umbilical wall by shallow spiral depression bounded abaxially by distinct step. Umbilical callus rather thick, slenderly subtriangular, merging into anterior lobe of parietal callus. Basal fasciole broad, poorly defined. Outer surface with fine, dense growth lines.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.173	0.802	6.590	6.038	2.221	4.370	3.061
UW	**IS**	**SA**				
2.640	13°	117°				

Remarks. *Euspira* sp. 4 differs from the coeval species *Euspira* sp. 3 by its more elevated spire with well convex whorls (flatly convex in *Euspira* sp. 3), its better developed anterior lobe of the parietal callus, its umbilicus devoid of inner spiral cordlets (present in *Euspira* sp. 3), and 4) its broad funicle (absent in *Euspira* sp. 3). The latter two characters constitute the most relevant distinguishing elements. *Euspira* sp. 4 can be readily differentiated from the other coeval species *Euspira molarensis* sp. n. in that it has a protoconch with significantly greater diameter of the first half-whorl, a markedly different parietal callus, and a distinct funicle (absent in *E. molarensis*). The Langhian to Tortonian new species *Euspira umbilicocarinata* (see above) shares many characters with *Euspira* sp. 4, but is distinguished from it by having a protoconch with significantly greater diameter and smaller diameter of the initial half-whorl, a more globose shell, and an indistinct basal fasciole.

Stratigraphic occurrence. *Euspira* sp. 4 was found in Rupelian deposits of Piedmont and Veneto.

Euspira sp. 5

Pl. 10, fig. 15

Material examined: Albugnano: 1 spm., MPUM 11338 (Pl. 10, fig. 15), 1 spm., PG 105.

Description. Protoconch small, depressed-turbiniform, of 2.56 whorls, tip very small. Teleoconch small, globose, rather thin. Spire broadly conical, somewhat elevated, whorls gently convex; suture, fine, adpressed. Last whorl globose-oval, tall; subsutural shelf indistinct; periphery slightly above midline. Aperture ovately D-shaped in prosocline plane, length about 1.5 times width; outer lip nearly semicircular, inner lip very slightly arched. Parietal callus rather thick medially, slightly more so at both ends, with concave abapertural outline; anterior lobe small, subrounded, at level of umbilical border. Umbilicus deep, rather wide, nearly semicircular, umbilical wall moderately sloping, more steep downward. Funicle a broad, depressed adaxial thickening of inner lip, soon obsolete toward interior of umbilicus. Umbilical callus rather wide, thick, with convex abapertural outline, expanded to overhang mid-adapical part of umbilicus, merging into anterior lobe of parietal callus. Basal fasciole indistinct. Outer surface with fine, incised, uneven and unevenly spaced growth lines.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.068	0.755	5.290	5.110	1.601	3.689	2.840
UW	**IS**	**SA**				
1.920	17°	117°				

Remarks. *Euspira* sp. 5 is closely similar to the Tortonian new species *Euspira latecallosa* (see above) in teleoconch morphology, but can be distinguished from it because of its protoconch with significantly smaller diameter and diameter of the initial half-whorl. Moreover, *Euspira* sp. 5 has a wider, semicircular umbilicus, whereas that of *E. latecallosa* is crescent-shaped and very narrow.

Stratigraphic occurrence. *Euspira* sp. 5 was recovered from deposits near Albugnano (Piedmont) said to be of Serravallian age.

Euspira sp. 6

Pl. 11, figs. 1, 2

Material examined: Valle Ceppi: 1 spm., MPUM 11339 (Pl. 11, fig. 1), 1 spm., MPUM 11340 (Pl. 11, fig. 2), 2 spms., NP 9993, 1 spm., MZB 60149.

Description. Protoconch small, depressed-turbiniform, of 2.05-2.40 whorls, tip small. Teleoconch small, globose-oval, moderately thick. Spire broadly conical, rather elevated, nearly straight-sided; whorls flatly convex, suture, fine, almost flush. Last whorl broadly oval; subsutural shelf indistinct; periphery slightly above midline. Aperture ovately D-shaped in moderately prosocline plane, length about 1.5 times width; outer lip semicircular, inner lip very slightly arched. Parietal callus moderately thick, long, subrectangular; anterior lobe very small to indistinct. Umbilicus deep, small; umbilical wall regularly sloping. Funicle a broad, depressed adaxial thickening of inner lip, obsolescent toward interior of umbilicus, separated from umbilical wall by narrow, shallow depression bounded abaxially by slight step more distinct in small specimens. Umbilical callus thick, triangular, hindering mid-adapical part of umbilicus, merging into anterior corner of parietal callus; umbilical channel obliquely elliptical, narrow to very narrow. Basal fasciole poorly differentiated. Outer surface with uneven and unevenly spaced growth lines; faint spiral striation occurs on last whorl. Two specimens retain vestige of uniform, light brown background.

Dimensions (mm)

DHW	PD	H	D	SH
0.104-0.120	0.768-0.828	4.391-11.495	3.769-10.317	0.391-3.855
0.112	0.798	7.943	7.043	2.123
AH	**AW**	**UW**	**IS**	**SA**
3.640-8.000	1.722-6.698	0.933-2.835	9°-21°	97°-137°
5.820	4.210	1.893	15°	117°

Remarks. *Euspira* sp. 6 appears to be closely similar to the Burdigalian to Piacenzian species *Euspira subobturata* (Sacco, 1891) in teleoconch characters and probably has been mistaken for it. However, *Euspira* sp. 6 has a protoconch with significantly smaller diameter and diameter of the first half-whorl. The protoconch stands as the main differentiating element. The examined specimens likely represent a new species, but more material is required in order to name it.

Stratigraphic occurrence. *Euspira* sp. 6 was collected from coarse sandy deposits belonging to the mid-Burdigalian Termofourà Formation.

Genus *Neverita* Risso, 1826

Neverita Risso, 1826, p. 149. Type species by monotypy: *Neverita josephinia* Risso, 1826, Recent, Mediterranean.

Mamillaria Swainson, 1840, p. 345. Type species by subsequent designation (Hedley 1924, p. 154): *Mamillaria lactea* Swainson, 1840 (= *Nerita peselephanti* Link, 1807).

Kabat (1991, p. 434) regarded *Poliniciella* Petuch, 1988 as synonym of *Neverita*. We note that *Poliniciella marylandica* Petuch, 1988 (type species of *Poliniciella* by monotypy) does not agree with the characters of *Neverita* because of its markedly different umbilical features. Accordingly, we consider Kabat's opinion untenable.

Neverita was either considered as a subgenus of *Polinices* Montfort, 1810 (Cernohorsky 1972; Kilburn 1976) or as a distinct genus (Marincovich 1977; Majima 1989; Kabat 1990, 1991). Huelsken et al. (2012, p. 372), on the basis of molecular data, rejected the concept of *Neverita* as a subgenus of *Polinices*, and concluded that "the taxa *Neverita* and *Polinices* each form statistically well-supported monophyletic clades".

The diagnostic characters of *Neverita* were listed by Pedriali & Robba (2009). These characters are herein redefined as follows: 1) shell rather thick to thick, depressed-globose, globose-pyriform in a few species, wider than high in most species; 2) spire very low to moderately elevated, whorls slightly convex to convex, with obscure subsutural shelf in a few species, suture almost flush to adpressed; 3) last whorl greatly enlarged, depressed in most species; 4) aperture strongly prosocline, D-shaped to ovately D-shaped; 5) parietal callus rather thick to thick, rather short, with slender anterior lobe encircling adapical part of umbilical callus in most species; 6) umbilicus broad, largely or completely filled by umbilical callus, with excavated, rather wide, abapical or mid-abapical umbilical channel present in a few species; 7) funicle thick and prominent, covered by umbilical callus in most species; 8) umbilical callus massive, semicircular, subtriangular in a few species, separated from parietal callus by a slight notch, overlapped from and fused to parietal callus in a few species. The depressed shell somewhat *Sinum*-like and the large, button-like umbilical callus are the most obvious distinctive characters of *Neverita*.

Neverita antiqua (Sacco, 1890) stat. n.

Pl. 11, figs. 3, 4

1890b *Natica (Neverita) josephinia* var. *antiqua* Sacco, p. 34.

1891 *Natica (Neverita) josephinia* var. *antiqua* - Sacco, p. 85, pl. 2, fig. 55.

1984 *Natica (Neverita) josephinia* var. *antiqua* - Ferrero Mortara et al., p. 35.

Type material: *Natica (Neverita) josephinia* var. *antiqua* Sacco, lectotype (designated by Pedriali & Robba 2009, p. 407): the shell figured by Sacco (1891, pl. 2, fig. 55) and refigured herein (Pl. 11, fig. 3), MGPT BS.029.05.003, Cassinelle; 2 paralectotypes, MGPT BS.029.05.003/01 and MGPT BS.029.05.003/02, Dego.

Other material examined: Cassinelle: 2 spms., PG 17; Colle del Giovo Ligure: 1 spm., NP 9861; Madonna delle Rocche: 1 spm., PG 65; Mioglia: 10 spms., MZB 60127, 1 spm., MZB 60128; Molare, Torrente Orba: 2 spms., PG 66; Pareto: 1 spm., PG 67; Monte Gloso: 1 spm., MPUM 11341 (Pl. 11, fig. 4), 1 spm., NP 9862.

Description. Protoconch abraded in all specimens. Teleoconch globose-conical, depressed, wider than high, moderately thick. Spire broadly cyrtoconoid, moderately elevated, low in some

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PLATE 11

Fig. 1 - *Euspira* sp. 6. Valle Ceppi. MPUM 11339; apertural side (height of shell 9.46 mm).

Fig. 2 - *Euspira* sp. 6. Valle Ceppi. MPUM 11340; protoconch.

Fig. 3 - *Neverita antiqua* (Sacco, 1890). Cassinelle. Lectotype of *Natica (Neverita) josephinia* var. *antiqua* Sacco, 1890. MGPT BS.029.05.003; a,

Fig. 4 - *Neverita antiqua* (Sacco, 1890). Monte Gloso. MPUM 11341; a, apertural side showing color pattern (height of shell 17.27 mm); b, abapertural side; c, basal view.

Fig. 5 - *Neverita maga* (De Gregorio, 1880). Cava Boschetto. MPUM 11342; protoconch.

Fig. 6 - *Neverita maga* (De Gregorio, 1880). Cava Grola. MCZ 4331; a, apertural side (height of shell 22.84 mm); b, abapertural side; c, basal view.

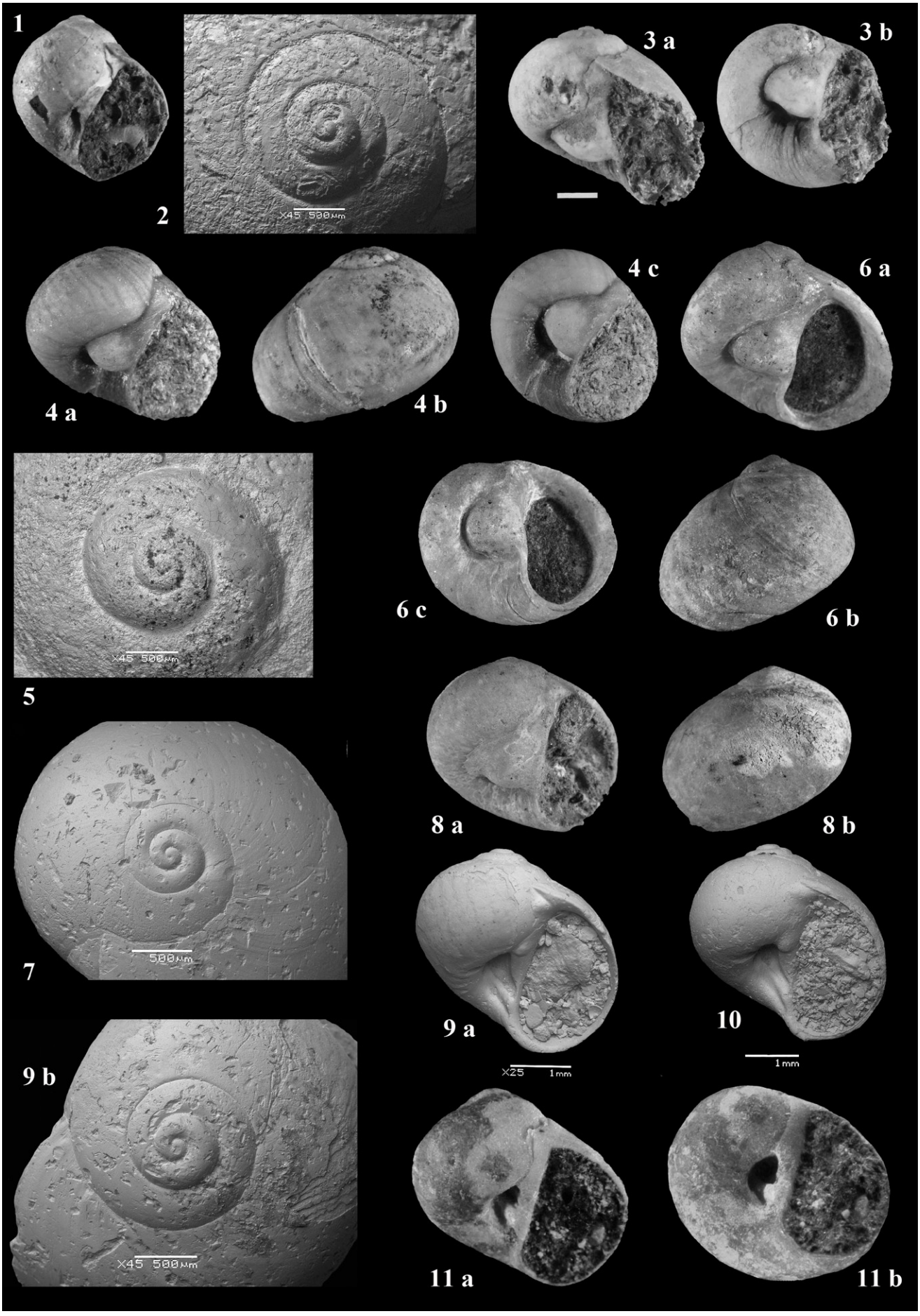
Fig. 7 - *Neverita olla* (de Serres, 1829). Borelli. MGPT-PU 135225; protoconch.

Fig. 8 - *Neverita olla* (de Serres, 1829). Valle Ceppi. MGPT-PU 135238; a, apertural side (height of shell 20.24 mm); b, abapertural side.

Fig. 9 - *Payraudeautia bituberculata* sp. n. Borelli. Holotype, MGPT-PU 135240; a, apertural side; b, protoconch.

Fig. 10 - *Payraudeautia bituberculata* sp. n. Borelli. Paratype, MGPT-PU 135241; apertural side.

Fig. 11 - *Payraudeautia crassicorda* sp. n. Cava Albanello. Holotype, MPUM 11350; a, apertural side (height of shell 8.52 mm); b, basal view.


1
2
×45 500µm
3 a
3 b
4 a
4 b
4 c
6 a
6 c
6 b
5
×45 500µm
8 a
8 b
7
500µm
9 a
×25 1mm
10
1 mm
9 b
×45 500µm
11 a
11 b

specimens; whorls very slightly convex; suture almost flush. Last whorl expanded, rather depressed; subsutural shelf indistinct; periphery nearly at midline; base almost flat. Aperture D-shaped in markedly prosocline plane, length about 1.70 width; inner lip very slightly concave. Parietal callus rather thick to thick; anterior lobe slender, sealing adapical part of umbilical groove. Umbilicus broad, largely filled by thick, prominent funicle; umbilical wall very steep, with coarse growth ridges; umbilical channel well developed, deeply excavated, of variable breadth, restricted to abapical part of umbilicus in most specimens, extended to middle part in some. Umbilical callus massive, roundly triangular, adapically overlapped by and fused to parietal callus. Outer surface with dense growth lines, prosocyrt adapically. One specimen retains vestige of brown color over umbilical wall and of reddish-brown collabral lines throughout last whorl.

Dimensions (mm)

DHW	PD	H	D	SH
-	-	8.193-17.289	9.515-21.327	0.972-5.648
-	-	12.741	15.421	3.310
AH	**AW**	**WUC**	**IS**	**SA**
6.233-12.629	3.366-11.030	4.381-10.297	12°-32°	115°-139°
9.431	7.198	7.339	22°	127°

Remarks. In a previous paper (Pedriali & Robba 2009), *Natica (Neverita) josephinia* var. *antiqua* Sacco, 1890 was included with doubt in the synonymy of *Neverita olla* (de Serres, 1829). Examination of additional material has convinced us to treat Sacco's variety as a species, distinct from *N. olla*. The deeply excavated, rather wide umbilical channel and the subtriangular umbilical callus distinguish *Neverita antiqua* from *N. olla*, which, instead, has a semicircular umbilical callus and a narrower to indistinct umbilical channel. These morphological characters, supported by molecular data, were used by Huelsken et al. (2006) in separating *Neverita delessertiana* (Récluz in Chenu, 1843) from *Neverita duplicata* (Say, 1822). Further, *N. olla* exhibits a uniform pale brown background with suprasutural darker stripe (Pedriali & Robba 2009), a color pattern different from that occurring in *N. antiqua* (see above).

Stratigraphic occurrence. *Neverita antiqua* (Sacco, 1890) appears to be restricted to the early Oligocene of Piedmont, Liguria and Veneto.

Neverita maga (De Gregorio, 1880)

Pl. 11, figs. 5, 6

1880 *Natica maga* De Gregorio, p. xiii, pl. 3, figs. 24, 25; pl. 6, fig. 69.

2008 *Neverita maga* - Quaggiotto & Mellini, p. 48, pl. 3, figs. 24, 25; pl. 6, fig. 69 (plates reproduced from De Gregorio 1880).

Type material: *Natica maga* De Gregorio, type material not seen. De Gregorio collection, stored in the Istituto di Geologia dell'Università di Palermo (presently Dipartimento di Geologia e Geodesia), was heaped up by American troops landed in Sicily during the second World War and the material is still awaiting to be identified (Dolin & Pacaud 2009).

Material examined: Cava Albanello: 1 spm., NP 9919, 1 spm., NP 9920; Cava Boschetto: 1 spm., MPUM 11342 (Pl. 11, fig. 5), 1 spm., NP 9921; Cava Grola: 1 spm., MCZ 4331 (Pl. 11, fig. 6); Cava Main: 1 spm., private collection; Cava Rossi: 1 spm., MPUM 11343, 1 spm., private collection, 1 spm., private collection.

Description. Protoconch small, depressed turbiniform, of 1.9 gently convex whorls, tip small. Teleoconch large, globose-conical, depressed, wider than high, moderately thick. Spire broadly conical, rather low, somewhat stepped; whorls slightly convex, roundly subangular at adapical one-third, with poorly defined subsutural shelf; suture adpressed. Last whorl expanded, rather depressed; subsutural shelf indistinct; narrowly rounded periphery nearly at midline; base slightly concave. Aperture D-shaped in markedly prosocline plane, length about twice width. Parietal callus moderately thick, short; anterior lobe slender, encircling adapical part of umbilical callus. Umbilicus broad, completely filled by umbilical callus; umbilical wall slightly concave, gently sloping, with growth markings; umbilical channel wanting. Umbilical callus large, semicircular, thick and prominent medially, somewhat excavated abapically (more so in smaller specimens), adapically overlapped by and fused to parietal callus. Outer surface with dense, prosocyrt growth lines.

Dimensions (mm)

DHW	PD	H	D	SH
0.189*	0.975*	12.338-26.578	15.687-33.039	2.315-8.151
* 1 protoconch measurable		19.458	24.363	5.233
AH	**AW**	**WUC**	**IS**	**SA**
8.545-19.905	8.819-20.851	8.761-17.985	9°-21°	107°-147°
14.225	14.835	13.373	15°	127°

Remarks. The Eocene, Nigerian species *Neverita amekiensis*, introduced by Eames (1957, p. 39), is closely similar to *Neverita maga* in teleoconch shape,

but differs from it because of its less concave base and its umbilical callus not completely filling the umbilicus. The species *Natica calvimontana* Deshayes, 1864, *Natica lineolata* Deshayes, 1832 and *Natica semiclausa* Deshayes, 1864, described from Eocene deposits of the Paris Basin, were subsequently assigned to *Neverita* Risso, 1826 (Cossmann 1888; Cossmann & Pissarro 1907; Le Renard & Pacaud 1995; Pacaud & Le Renard 1995). These three French species exhibit a superficial resemblance to *N. maga* in that they have a globose shell, a higher and pointed spire, and an umbilical callus distinctly smaller than that of *N. maga*. We have not seen the original material of the cited Deshayes' species, but, according to the excellent illustration of them provided by Deshayes (1864) and Cossmann & Pissarro (1907), we are doubtful concerning their assignment to *Neverita*. The name *calvimontensis*, used by Cossmann (1888) and Cossmann & Pissarro (1907) instead of the original name *calvimontana*, is an unjustified emendation.

Stratigraphic occurrence. *Neverita maga* (De Gregorio, 1880) is known from upper Ypresian to middle Lutetian deposits of Veneto.

Neverita olla (de Serres, 1829)

Pl. 11, figs. 7, 8

1829 *Natica olla* de Serres, p. 102, pl. 1, figs. 1, 2.

1866 *Natica (Neverita) josephinia* - Speyer, p. 27, pl. 3, fig. 2 (not Risso, 1826).

1896 *Neverita josephinia* var. *bellunensis* Vinassa de Regny, p. 206, pl. 5, fig. 4 (*new synonym*).

1917 *Natica josephinia* - Stefanini, p. 98, pl. 2, fig. 20 (not Risso, 1826).

1937 *Natica (Neverita) bellunensis* - Venzo, p. 46, pl. 2, fig. 37.

1985 *Neverita bellunensis* - Brigantini, p. 413, pl. 2, fig. 30.

2007 *Neverita olla* - Pfister & Wegmüller, p. 102, pl. 18, figs. 17-24; pl. 19, figs. 1-7.

2007 *Neverita josephinia* - Zunino, p. 123, pl. 1, fig. 9 (not Risso, 1826).

2009 *Neverita olla* - Pedriali & Robba, p. 404, pl. 2, figs. 5-9; pl. 3, figs. 14, 15; pl. 4, fig. 17 (*cum. syn.*).

2013 *Neverita olla* - Landau et al., p. 107, pl. 11, fig. 8; pl. 62, fig. 8 (*cum syn.*).

Type material: Pedriali & Robba (2009, p. 407) reviewed the type material of *Neverita olla*, and described the characters of this species.

Material referred to as *Natica subglaucinoides* d'Orbigny, 1852 in MGPT: Termofourà: 10 spms., MGPT-PU 23520.

Material examined.: Albugnano: 1 spm., PG 68; Borelli: 1 spm., MGPT-PU 135225 (Pl. 11, fig. 7), 1 spm., MGPT-PU 135226, 1 spm., MGPT-PU 135227, 1 spm., MGPT-PU 135228, 1 spm., MGPT-PU 135229, 1 spm., MGPT-PU 135230, 1 spm., MGPT-PU 135231, 27 spms., MGPT-PU 135232, 2 spms., MPUM 11344, 4 spms., NP 9868, 7 spms., PG 22b; Léognan, Le Coquillat (France): 10 spms., private collection, 6 spms., PPMM 40821, 140 spms., private collection, 40 spms., private collection, 258 spms., MPUM 11345, 802 spms., NP 9966; Martignas-sur-Jalle (France): 1 spm., NP 10004; Mérignac (France): 10 spms., NP 9957; Monte dei Cappuccini: 2 spms., MGPT-PU 25665; Montegibbio: 2 spms., MGC 1418, 1 spm., private collection, 11 spms., private collection, 25 spms., private collection, 1 spm., private collection; Orthez, Le Paren (France): 10 spms., NP 10007; Passo dei Meloni: 1 spm., NP 9953; Pauvrelay: 1 spm., NP 10001; Rio di Bocca d'Asino: 25 spms., MZB 60063, 1 spm., MZB 60111, 1 spm., MZB 60104, 11 spms., PG 25, 1 spm., NP 9864; Salles, Argilas (France): 26 spms., NP 10015; Saucats, Le Péloua (France): 6 spms., MPUM 11346, 1 spm., MPUM 11347, 1 spm., NP 9863, 1 spm., NP 9865, 3 spms., NP 10002; Stazzano: 2 spms., MGPT-PU 23407; Termofourà: 10 spms., MGPT-PU 23520; Valle Ceppi: 3 spms., MGPT-PU 135204, 3 spms., MGPT-PU 107768, 5 spms., MGPT-PU 135233, 3 spms., MGPT-PU 135234, 4 spms., MGPT-PU 135235, 1spm., MGPT-PU 135236, 6 spms., MGPT-PU 135237, 1 spm., MPUM 11348, 11 spms., PG 21, 35 spms., PG 69, 7 spms., MGPT-PU 107862, 1 spm., MGPT-PU 107023, 1 spm., MGPT-PU 107024, 3 spms., MGPT-PU 23864, 7 spms., MGPT-PU 25905, 1 spm., MGPT-PU 135238 (Pl. 11, fig. 8), 39 spms., MGPT-PU 25267, 1 spm., MGPT-PU 26048, 2 spms., MGPT-PU 26049, 1 spm., MGPT-PU 26145, 44 spms., MGPT-PU 108041, 5 spms., MGPT-PU 135239, 33 spms., MZB 60062, 1 spm., MZB 60129, 1 spm., NP 9866, 4 spms., NP 9867; Val Sanfrà: 6 spms., MGPT-PU 23666, 3 spms., MGPT-PU 107619, 1 spm., MGPT-PU 107627; Valle Vergnana: 1 spm., MZB 60133, 1 spm., MZB 44000; Vigoleno: 9 spms., private collection; Villa Allason: 9 spms., MGPT-PU 107617; Villa Bertini: 5 spms., MGPT-PU 107618; locality unknown: 2 spms., MGP-PD 2764z (specimens dealt with by Briganini 1985; see remarks below).

Dimensions of Miocene specimens (mm)

DHW	PD	H	D	SH
0.092-0.112	0.754-0.938	3.195-29.727	5.648-35.408	0.762-7.186
0.102	0.846	16.461	20.528	3.974
AH	**AW**	**WUC**	**IS**	**SA**
1.491-23.503	2.478-17.262	4.109-10.097	10°-26°	118°-142°
12.497	9.870	7.103	18°	130°

Remarks. The examined Miocene specimens have the protoconch slightly larger than that of the Pliocene ones dealt with by Pedriali & Robba (2009), but the difference (+ 8% in protoconch diameter) is not significant. The protoconch of *Neverita olla* was described as smooth by Pedriali & Robba (2009); we noted that the protoconch of one specimen from the Tortonian of Borelli shows vestige of spiral rows of granules on the first half-whorl. For complete description, relationships with *Neverita josephinia* Risso, 1826, and other comments, see Pedriali & Robba (2009).

Vinassa de Regny (1896) introduced the variety *bellunensis* of *Neverita josephinia* on the basis of a single Oligocene shell (holotype by monotypy) characterized by a broad and prom-

inent umbilical callus. The variety *bellunensis* was regarded later on as a distinct species (Venzo 1937; Brigantini 1985). The holotype of *Neverita bellunensis* was not located. However, we examined the two specimens in MGPPD dealt with by Brigantini (1985), referred to as *N. bellunensis*, and conforming to the short diagnosis published by Vinassa de Regny (1896). We could note that they are hardly distinguishable from *Neverita olla*, a species with a much variable extent and thickness of the umbilical callus. Moreover, the specimen illustrated by Brigantini (1985, pl. 2, fig. 30) has the protoconch of 2.60 whorls, with values of the diameter and diameter of the initial half-whorl that fall within the ranges calculated for *N. olla* (see above). Accordingly, we consider *N. bellunensis* as a synonym of *N. olla*. It is worth noting that the two specimens of *N. bellunensis* in MGPPD were said to had been collected from upper Eocene deposits of Valle Organa. This age assignment is inconsistent with the calcareous nannoplankton present in the matrix filling the shells, which demonstrates an age not older than the Miocene (Maria Triantaphyllou, personal communication 2014). It is likely that the specimens were accidentally coupled with the wrong label during movings of the material.

Stratigraphic occurrence. *Neverita olla* (de Serres, 1829) ranges from early Oligocene to Pliocene. According to Pedriali & Robba (2009), it was replaced by *Neverita josephinia* Risso, 1826 by the Pleistocene.

Genus *Payraudeautia* Bucquoy, Dautzenberg & Dollfus, 1883

Payraudeautia Bucquoy, Dautzenberg & Dollfus, 1883, p. 149. Type species by original designation: *Natica intricata* Donovan, 1803, Recent, Mediterranean.

Payraudeautia was introduced as a subgenus of *Natica* Adanson, 1757 (= *Natica* Scopoli, 1777). Kabat (1991) considered *Payraudeautia* to be a junior subjective synonym of *Natica* Scopoli, 1777. Kabat's conclusion is untenable since the type species of *Payraudeautia* has a corneous operculum denoting a poliniceine instead of a naticine allocation of the genus. Huelsken et al. (2008, 2012), on the basis of molecular data, have shown that *Payraudeautia intricata* exhibits a high genetic similarity with species of *Euspira* Agassiz in J. Sowerby, 1837. Thus, Huelsken et al. (2012) concluded that "synonymisation of *Payraudeautia* with *Euspira* is therefore appropriate". We provisionally retain *Payraudeautia* as valid on account of its distinctive open umbilicus with an inner spiral ridge or cord abapical to the funicle. *Payraudeautia* appears to be a poorly speciose genus in that it includes, besides the type species, only *Payraudeautia fasciolata* (Sacco, 1890) and *Payraudeautia nubila* (Dall, 1889). The Eocene species *Natica perforata* Deshayes, 1864 and the Recent, eastern Atlantic species *Natica gruveli* Dautzenberg, 1910 (*Payraudeautia esterias* Bernard, 1983 is a synonym) were assigned to *Payraudeautia*, but have a single funicle (*N. perforata* has a funicle-like abapical cord) and deserve a different generic allocation. Presently, *Payraudeautia* ranges in the Mediterranean (*P. intricata*) and in the Caribbean Sea (*P. nubila*). Fossil occurrences of *Payraudeautia* were so far from late Miocene to Pleistocene of Italy. The two Eocene species described below are the earliest records of the genus and push back the first occurrence of *Payraudeautia*.

Payraudeautia bituberculata sp. n.

Pl. 11, figs. 9, 10

Derivation of name: From Latin *bis* = two times and *tuberculata* = provided with a tubercle, with reference to the knob present at both ends of the parietal callus.

Holotype: Borelli: MGPT-PU 135240 (Pl. 11, fig. 9).

Paratypes: Borelli: 1 spm., MGPT-PU 135241 (Pl. 11, fig. 10), 4 spms., MGPT-PU 135242, 2 spms., MPUM 11349.

Other material examined: Borelli: 2 spms., NP 9831.

Preservation. Rather fair.

Type locality: Borelli (see appendix).

Horizon. Gray, medium sand of Tortonian age.

Diagnosis: Globose, moderately depressed shell with scarcely elevated spire, somewhat depressed last whorl. Umbilicus very large with broad, depressed funicle and abapical inner spiral ridge. Parietal callus with rounded knob at both ends; umbilical callus thick, subtriangular, demarcated from anterior knob of parietal callus by slight transverse groove.

Description. Protoconch medium-sized, turbinate with nearly flat-topped spire, of 2.90-3.05 convex and smooth whorls, tip very small. Teleoconch globose, moderately depressed, rather solid. Spire broadly conical, scarcely elevated, whorls gently convex; suture thin, adpressed. Last whorl inflated, somewhat depressed, slightly expanded toward aperture; subsutural shelf indistinct; pe-

riphery above midline. Aperture D-shaped in slightly prosocline plane, length approximately 1.5 times width. Parietal callus rather narrow, thin medially, with markedly concave abapertural outline and with rounded knob at both ends, abapical one slightly more prominent nearly at level of basal fasciole. Umbilicus deep, very large; umbilical border narrowly rounded; umbilical wall concave, bearing prominent spiral ridge that overhangs interior of umbilicus and terminates in subtriangular, asymmetric plug on lowermost part of inner lip. Funicle broad and rather depressed, separated from inner spiral ridge by wide groove whose abaxial side ascends to form sharp angle with top of ridge. Umbilical callus rather thick, subtriangular, demarcated from anterior knob of parietal callus by slight transverse groove. Basal fasciole poorly differentiated, rather broad and blunt. Surface with very fine growth lines subangular adapically.

Dimensions (mm)

DHW	PD	H	D	SH
0.054-0.062	1.080-1.084	1.503-5.855	1.706-5.686	0.409-1.253
0.058	1.082	3.679	3.696	0.831
AH	**AW**	**UW**	**IS**	**SA**
1.083-4.611	0.767-3.831	0.467-2.227	12°-24°	115°-127°
2.847	2.299	1.347	18°	121°

Remarks. *Payraudeautia bituberculata* is very close to *Payraudeautia fasciolata* (Sacco, 1890) in teleoconch shape and umbilical characters, but differs from Sacco's species in that has: 1) a protoconch with significantly smaller diameter of the first half-whorl, and 2) a knob at both ends of the parietal callus. The features of the parietal callus constitute the most obvious distinguishing character of *Payraudeautia bituberculata*. *Payraudeautia intricata* (Donovan, 1803) is another morphologically similar species, differing from *P. bituberculata* because of its protoconch with fewer whorls (1.50-1.70 instead of 2.90-3.05) and significantly greater diameter of the first half-whorl, its parietal callus devoid of knobs and with distinct anterior lobe, and its narrower funicle. It is also worth noting that *P. bituberculata* hardly exceeds five mm in height, whereas *P. fasciolata* and *P. intricata* attain a larger size.

Stratigraphic occurrence. *Payraudeautia bituberculata* sp. n. was recovered only from Tortonian deposits at the type locality.

Payraudeautia crassicorda sp. n.

Pl. 11, fig. 11; Pl. 12, fig. 1

Derivation of name: From Latin *crassus* = thick and *corda* = cord, with reference to the thick, cord-like inner ridge of the umbilicus.

Holotype: Cava Albanello: MPUM 11350 (Pl. 11, fig. 11).

Paratypes: Cava Albanello: 1 spm., MPUM 11351 (Pl. 12, fig. 1), 2 spms., MPUM 11352, 48 spms., MGP-PD 1228R, 10 spms., MCZ 4332; Ciupio: 1 spm., MGP-PD 11624/b-11664/b.

Other material examined: Cava Albanello: 20 spms., NP 9832; Cava Boschetto: 1 spm., NP 9833, 1 spm., NP 9834, 1 spm., private collection; Cava Grola: 2 spms., private collection.

Preservation: All specimens have the surface somewhat abraded; a few are broken.

Type locality: Cava Albanello (see appendix).

Horizon: Rather coarse, gray tuff forming the lower part of a thick, fining upward volcanoclastic bed of early Lutetian age.

Diagnosis: Globose, rather thin shell with scarcely elevated spire and inflated, somewhat depressed last whorl. Umbilicus deep, large, with thick, cord-like spiral ridge ending in semicircular plug on lowermost inner lip; funicle broad, markedly depressed, adjacent to adapical part of umbilical wall. Parietal callus thick; umbilical callus thick, narrowly subtriangular, merging into anterior angle of parietal callus.

Description. Protoconch medium-sized, low-turbiniform, of 1.95-2.05 convex and apparently smooth whorls, tip medium-sized. Teleoconch globose, slightly wider than high, rather thin. Spire low-conical, scarcely elevated, whorls very gently convex; suture almost flush. Last whorl inflated, somewhat depressed, slightly produced toward aperture; subsutural shelf indistinct; periphery above midline. Aperture D-shaped in slightly prosocline plane, length approximately 1.7 times width. Parietal callus thick, subrectangular, with gently concave abapertural outline, ending at level of umbilical border. Umbilicus deep, large; umbilical border broadly rounded; umbilical wall steeply sloping; interior of umbilicus bearing thick, cord-like spiral ridge that terminates in semicircular plug on lowermost part of inner lip. Funicle markedly depressed, broad, adjacent to adapical part of umbilical wall, separated from inner spiral ridge by narrow, deeply incised groove. Umbilical callus thick, narrowly subtriangular, with oblique, straight or reverse S-shaped outline, merging into anterior angle of parietal callus. Basal fasciole in-

distinct. Surface with vestige of fine growth lines faintly arched subsuturally.

Dimensions (mm)

DHW	PD	H	D	SH
0.276-0.292	1.135-1.207	3.498-9.602	3.615-9.959	0.644-2.496
0.284	1.171	6.550	6.787	1.570
AH	**AW**	**UW**	**IS**	**SA**
2.646-7.314	2.220-6.056	0.987-3.319	14°-26°	106°-126°
4.980	4.138	2.153	20°	116°

Remarks. *Payraudeautia crassicorda* sp. n. is characterized by its large umbilicus with unusually thick, cord-like inner spiral ridge and markedly depressed funicle; these two structures occupy almost entirely the straight adapertural margin of the umbilicus. *P. crassicorda* is morphologically similar to the lower and middle Lutetian species *Payraudeautia zarantonelloi* sp. n. (see below) and the values of the characteristic elements of the protoconch of both taxa do not display any significant difference. However, *P. crassicorda* can be distinguished from *P. zarantonelloi* by its wider umbilicus (Fig. 15), with a thick inner spiral ridge and a markedly depressed funicle. The reverse occurs in *P. zarantonelloi* that has a smaller umbilicus with a narrower, subangular spiral ridge and a rather prominent funicle. This difference is deemed to warrant specific separation.

Stratigraphic occurrence. *Payraudeautia crassicorda* sp. n. was recovered from lower Lutetian deposits of Veneto.

Payraudeautia fasciolata (Sacco, 1890)

Pl. 12, figs. 2, 3

1890b *Natica (Payraudeautia) intricata* var. *fasciolata* Sacco, p. 33.

1891 *Natica (Payraudeautia) intricata* var. *fasciolata* - Sacco, p. 80, pl. 2, fig. 52.

1984 *Payraudeautia intricata* var. *fasciolata* - Ferrero Mortara et al., p. 35.

1996 *Payraudeautia intricata* - Pedriali, p. 14 (pars), pl. 4, figs. 5, 6 (not Donovan, 1803).

2009 *Payraudeautia fasciolata* - Pedriali & Robba, p. 410, pl. 2, figs. 11, 12; pl. 3, fig. 17; pl. 4, figs. 19, 20.

Type material: Pedriali & Robba (2009, p. 411) listed the type material of *Payraudeautia fasciolata*, and described the characters of this species.

Material examined: Borelli: 1 spm., MGPT-PU 135243 (Pl. 12, fig. 2); Montegibbio: 1 spm., MZB 31669 (Pl. 12, fig. 3).

Dimensions (mm)

DHW	PD	H	D	SH
0.093-0.101	0.957-1.117	1.555-11.827	1.356-11.784	0.471-1.891
0.097	1.037	6.691	6.570	1.181
AH	**AW**	**UW**	**IS**	**SA**
1.127-9.855	1.166-5.462	0.430-4.782	11°-23°	111°-135°
5.491	3.314	2.606	17°	123°

Remarks. For description, dimensions and comparison with *Payraudeautia intricata* (Donovan, 1803), see Pedriali & Robba (2009). An unidentified *Payraudeautia* species from the Pliocene Lillo Formation of Belgium (specimens in our collection) appears to be similar to *Payraudeautia fasciolata* in teleoconch morphology, but differs from it in that it has the protoconch of less than two whorls (2.60-2.65 in *P. fasciolata*), with significantly greater diameter of the initial half-whorl and the umbilicus with a broad, markedly depressed abapical spiral ridge (prominent in *P. fasciolata*).

PLATE 12

Fig. 1 - *Payraudeautia crassicorda* sp. n. Cava Albanello. Paratype, MPUM 11351; protoconch.

Fig. 2 - *Payraudeautia fasciolata* (Sacco, 1890). Borelli. MGPT-PU 135243; a, apertural side (height of shell 3.67 mm); b, basal view.

Fig. 3 - *Payraudeautia fasciolata* (Sacco, 1890). Montegibbio. MZB 31669; protoconch.

Fig. 4 - *Payraudeautia intricata* (Donovan, 1803). Rio di Bocca d'Asino. NP 9835; a, apertural side; b, basal view.

Fig. 5 - *Payraudeautia zarantonelloi* sp. n. Cava Grola. Holotype, MPUM 11353; a, apertural side (height of shell 15.26 mm); b, basal view; c, protoconch.

Fig. 6 - *Payraudeautia zarantonelloi* sp. n. Cava Grola. Paratype, MPUM 11355; a, apertural side (height of shell 12.95 mm); b, basal view.

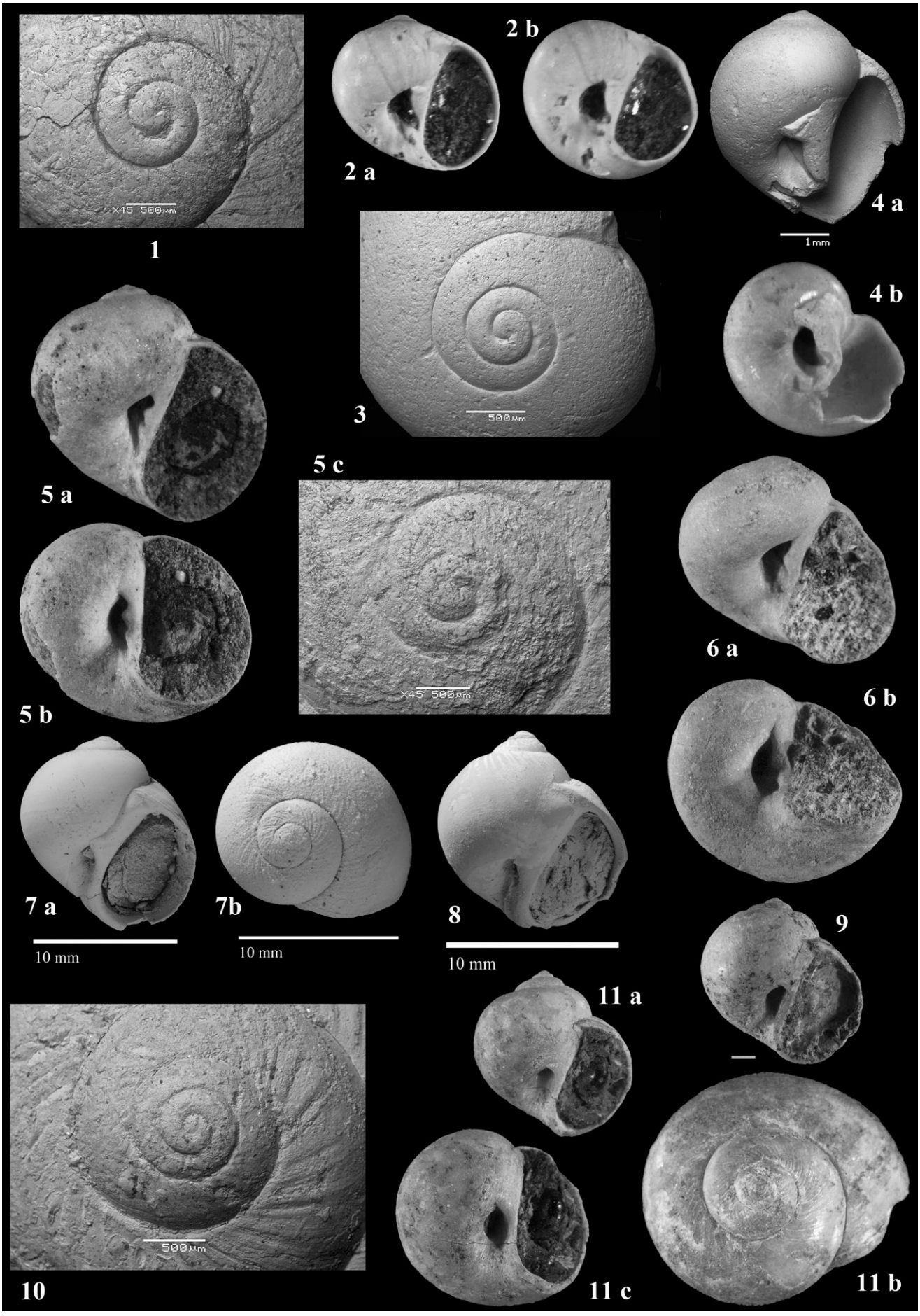
Fig. 7 - *Pliconacca plicatulaeformis* (Kittl, 1887). Orlau (Czech Republic). Lectotype (here designated) of *Natica plicatulaeformis* Kittl, 1887. NHMW I.26; a, apertural side; b, apical view.

Fig. 8 - *Pliconacca plicatulaeformis* (Kittl, 1887). Orlau (Czech Republic). Paralectotype. NHMW I.25; apertural side.

Fig. 9 - *Pliconacca plicatulaeformis* (Kittl, 1887). Colli Torinesi. Lectotype (here designated) of *Natica* (*Naticina*) *catena* var. *probelicina* Sacco, 1890. MGPT BS.029.02.001; apertural side (scale bar 4 mm).

Fig. 10 - *Pliconacca plicatulaeformis* (Kittl, 1887). Valle Ceppi. MZB 60013; protoconch.

Fig. 11 - *Pliconacca plicatulaeformis* (Kittl, 1887). Valle Ceppi. MGPT-PU 135259; a, apertural side (height of shell 17.58 mm); b, apical view; c, basal view.


1
2 a
2 b
3
4 a
4 b
5 a
5 b
5 c
6 a
6 b
7 a
7b
8
9
10
11 a
11 b
11 c
10 mm
10 mm
10 mm
1 mm
500 µm
X45 500µm

Stratigraphic occurrence. *Payraudeautia fasciolata* (Sacco, 1890) appears to be very rare in the Tortonian of Piedmont and Emilia. It is an uncommon element in the Pliocene of Piedmont, Liguria, Emilia and Tuscany. There are no records subsequent to the early Piacenzian.

Payraudeautia intricata (Donovan, 1803)

Pl. 12, fig. 4

1803 *Nerita intricata* Donovan, pl. 167 (short description in the explanation to the plate).

2009 *Payraudeautia intricata* - Pedriali & Robba, p. 411, pl. 2, figs. 13, 14; pl. 3, fig. 18; pl. 4, fig. 21 (*cum syn.*).

Type material: Pedriali & Robba (2009, p. 412) reviewed the type material of *Payraudeautia intricata*, and described the characters of this species.

Material examined: Rio di Bocca d'Asino: 1 spm., NP 9835.

Remarks. For description, dimensions and comments, see Pedriali & Robba (2009).

Stratigraphic occurrence. *Payraudeautia intricata* (Donovan, 1803) is extremely rare in the Tortonian of Piedmont. The species was recorded from Pliocene deposits in Piedmont, Emilia, Tuscany and Latium. Pleistocene occurrences are from Tuscany and Calabria. *Payraudeautia intricata* ranges nowadays throughout the Mediterranean, being more common in the western part of it.

Payraudeautia zarantonelloi sp. n.

Pl. 12, figs. 5, 6

Derivation of name: The species is named after Giannino Zarantonello, who donated material relevant to the present study.

Holotype: Cava Grola: MPUM 11353 (Pl. 12, fig. 5).

Paratypes: Cava Albanello: 1 spm., MGP-PD 1229R, 2 spms., MGP-PD 1230R, 1 spm., MCZ 4333; Cava Boschetto: 1 spm., MPUM 11354; Cava Grola: 1 spm., MPUM 11355 (Pl. 12, fig. 6), 1 spm., MCV 15/02; Cava Rossi: 1 spm., MCZ 4334.

Other material examined: Cava Boschetto: 1 spm., NP 9829; Cava Grola: 2 spms., NP 9830, 3 spms., private collection, 3 spms., private collection.

Preservation: All specimens have the surface somewhat abraded.

Type locality: Cava Grola (see appendix).

Horizon: Greenish-gray volcanoclastic sandstone of middle Lutetian age.

Diagnosis: Globose, rather thin shell with moderately elevated spire and globose last whorl very slightly expanded toward aperture. Umbilicus deep, moderate, with low, subangular spiral ridge that terminates in subtriangular, asymmetric plug on lowermost part of inner lip. Funicle moderately prominent. Parietal callus narrow, with straight abapertural outline; umbilical callus thick, triangular, demarcated from anterior angle of parietal callus by sinuation of various width.

Description. Protoconch medium-sized, low-turbiniform, of 1.80 convex and apparently smooth whorls, tip medium-sized. Teleoconch globose, nearly as high as wide, rather thin. Spire obtusely conical, moderately elevated, whorls convex; suture adpressed. Last whorl globose, somewhat depressed in abapertural view, very slightly expanded toward aperture; subsutural shelf indistinct; periphery about at midline. Aperture D-shaped in slightly prosocline plane, length approximately 1.6 times width. Parietal callus narrow, rather thick, with straight abapertural outline, ending at level of umbilical border. Umbilicus deep, moderate; umbilical border broadly rounded; umbilical wall steeply sloping; interior of umbilicus bearing low, subangular spiral ridge that terminates in subtriangular, asymmetric plug on lowermost part of inner lip. Funicle moderately prominent, separated from inner spiral ridge by rather narrow groove. Umbilical callus thick, triangular, demarcated from anterior angle of parietal callus by sinuation of various breadth. Basal fasciole indistinct. Surface with vestige of fine growth lines.

Dimensions (mm)

DHW	PD	H	D	SH
0.242*	1.129*	4.147-16.323	4.738-16.174	0.886-5.078
* 1 protoconch measurable		10.235	10.456	2.982
AH	**AW**	**UW**	**IS**	**SA**
3.031-11.475	3.040-10.052	1.165-4.717	14°-34°	97°-133°
7.253	6.546	2.941	24°	115°

Remarks. For discussion and comparison with *Payraudeautia crassicorda* sp. n., see the remarks on this species.

Stratigraphic occurrence. *Payraudeautia zarantonelloi* sp. n. was recovered from upper Ypresian, lower and middle Lutetian deposits of Veneto.

Genus *Pliconacca* Cossmann & Martin in Martin, 1914

Pliconacca Cossmann & Martin in Martin, 1914, p. 171. Type species by monotypy: *Natica (Pliconacca) trisulcata* Martin, 1914, middle Eocene, Java. The type species was excellently illustrated by Leloux & Wesselingh (2009, pls. 204, 205).

Pliconacca was originally proposed as a subgenus of *Natica* Lamarck, 1799 (according to Kabat 1991, *Natica* Lamarck is a junior homonym of *Natica* Scopoli, 1777, equivalent to *Naticarius* Dumeril, 1806). Subsequent to its introduction, *Pliconacca* was regarded either as a subgenus/section of *Polinices* Montfort, 1810 (cf. Van Winkle Palmer 1937), or as a distinct genus (cf. Ladd 1977; Majima 1989). We concur with the latter workers in considering *Pliconacca* a full genus.

Pliconacca is distinguished by the following characters: 1) teleoconch globose to oval, 2) inner lip callus with one-three variously prominent obtuse transverse folds separated by shallow depressions, 3) umbilicus largely covered by the umbilical callus in most species, less so in some, and 4) outer surface with subsutural collabral wrinkles in most species. The genus has been sometimes compared with *Glossaulax* Pilsbry, 1929, which differs markedly in having a rather depressed teleoconch with the umbilical callus (broad in most species) divided medially by a deep and narrow transverse groove (there are no folds). Some New Zealand species formerly assigned to the genus *Uberella* Finlay, 1928 (*Uberella cicatricella* Marwick, 1965; *Uberella cicatrix* Marwick, 1931; *Natica denticulifera* Marwick, 1924) have been correctly transferred to *Pliconacca* in most recent years (cf. Beu & Raine 2009) because of their umbilical callus provided with transverse folds. *Uberella* somewhat resembles *Pliconacca* in terms of shell shape and umbilical characters, but the transverse callus folds are absent from *Uberella* species.

The New Zealand species *Pliconacca denticulifera* (Marwick, 1924) seems to be the sole Recent species of the genus. Fossil occurrences of *Pliconacca* were from the middle Eocene of southern United States and Java (Indonesia), from the late Eocene of Japan, from lower to upper Miocene units of Indonesia, New Zealand and Fiji Islands, from the Pliocene of Japan and New Zealand, and from the Pleistocene of Japan and New Zealand. The Burdigalian *Polinices cerovaensis* Harzhauser, 2011, the Burdigalian and Langhian *Natica (Naticina) catena* var. *prohelicina* Sacco, 1890, and the middle Miocene *Natica plicatulaeformis* Kittl, 1887 agree with the characters of *Pliconacca* and are the representatives of the genus so far described from Europe.

Pliconacca plicatulaeformis (Kittl, 1887) comb. n.

Pl. 12, figs. 7-11

1887 *Natica plicatulaeformis* Kittl, p. 257, pl. 8, figs. 23, 24.

1890b *Natica (Naticina) catena* var. *prohelicina* Sacco, p. 30 *(new synonym).*

1890b *Natica (Naticina) catena* var. *prohelicina* subvar. *tauroumbilicata* Sacco, p. 30 (*nomen nudum*).

1890b *Natica (Naticina) catena* var. *ampullinoides* Sacco, p. 30 (*new synonym*).

1890b *Natica (Naticina) catena* var. *cyclostomoides* Sacco, p. 30 (*new synonym*).

1890b *Natica (Naticina) catena* var. *cyclostomoides* subvar. *scalarioides* Sacco, p. 30 (*nomen nudum*).

1890b *Natica (Naticina) catena* var. *cyclostomoides* subvar. *subhemiclausa* Sacco, p. 30 (*nomen nudum*).

1891 *Natica (Naticina) catena* var. *prohelicina* - Sacco, p. 67, pl. 2, fig. 38.

1891 *Natica (Naticina) catena* var. *tauroumbilicata* Sacco, p. 67 (*new synonym*).

1891 *Natica (Naticina) catena* var. *ampullinoides* - Sacco, p. 67, pl. 2, fig. 39.

1891 *Natica (Naticina) catena* var. *cyclostomoides* - Sacco, p. 68, pl. 2, fig. 40.

1891 *Natica (Naticina) catena* var. *scalarioides* Sacco, p. 69 (*new synonym*).

1891 *Natica (Naticina) catena* var. *subhemiclausa* Sacco, p. 69 (*new synonym*).

1891 *Natica (Naticina) catena* var. *varians* - Sacco, p. 69, pl. 2, fig. 41 (not Dujardin, 1837).

1904 *Natica (Naticina) catena* var. *tauroumbilicata* - Sacco, p. 102, pl. 22, fig. 27.

1904 *Natica (Naticina) catena* var. *scalarioides* - Sacco, p. 102, pl. 22, fig. 28.

1904 *Natica (Naticina) catena* var. *subhemiclausa* - Sacco, p. 103, pl. 22, fig. 30.

not 1952b *Polynices (Euspira) cyclostomoides* - Glibert, p. 247, pl. 2, fig. 1 (not Sacco, 1890).

1984 *Naticina catena* var. *prohelicina* - Ferrero Mortara et al., p. 32.

1984 *Naticina catena* var. *tauroumbilicata* - Ferrero Mortara et al., p. 32.

1984 *Naticina catena* var. *cyclostomoides* - Ferrero Mortara et al., p. 32.

1984 *Naticina catena* var. *scalarioides* - Ferrero Mortara et al., p. 32.

1984 *Naticina catena* var. *subhemiclausa* - Ferrero Mortara et al., p. 32.

1984 *Naticina catena* var. *varians* - Ferrero Mortara et al., p. 32 (not Dujardin, 1837).

2007 *Euspira catena* - Zunino, p. 119, pl. 1, fig. 5 (not da Costa, 1778).

2009 *Euspira catena* - Zunino & Pavia, pl. 1, fig. 6 (not da Costa, 1778).

Type material: *Natica plicatulaeformis* Kittl, lectotype (here designated): the shell figured by Kittl (1887, pl. 8, fig. 24) and refigured herein (Pl. 12, fig. 7), NHMW I.26, Orlau (Czech Republic); 1 paralectotype: the shell figured by Kittl (1887, pl. 8, fig. 23) and refigured herein (Pl. 12, fig. 8), NHMW I.25, Orlau (Czech Republic); other 118 syntypes cited by Kittl (1887) were not examined. *Natica (Naticina) catena* var. *prohelicina* Sacco, lectotype (here designated): the

shell figured by Sacco (1891, pl. 2, fig. 38) and refigured herein (Pl. 12, fig. 9), MGPT BS.029.02.001, Colli Torinesi; 26 paralectotypes, MGPT BS.029.02.001/01, Villa Forzano (other 3 syntypes are *Nerita helicina* Brocchi, 1814, 1 is *Natica submamillaris* d'Orbigny, 1852 and 6 were not identified, all also numbered BS.029.02.001/01); 3 paralectotypes, MGPT BS.029.02.001/03, Colli Torinesi; another 64 syntypes, MGPT BS.029.02.001/02, Colli Torinesi were not examined. *Natica (Naticina) catena* var. *tauroumbilicata* Sacco, holotype (by monotypy): the shell figured by Sacco (1904, pl. 22, fig. 27), MGPT BS.029.02.002, Colli Torinesi. *Natica (Naticina*) *catena* var. *ampullinoides* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 39), MGPT BS.029.02.003, Colli Torinesi; 8 paralectotypes, MGPT BS.029.02.003/01, Colli Torinesi (another syntype, also numbered BS.029.02.003/01, was not identified). *Natica (Naticina) catena* var. *cyclostomoides* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 40), MGPT BS.029.02.004, Colli Torinesi; 23 paralectotypes, MGPT BS.029.02.004/01, Colli Torinesi (other 10 syntypes are *Nerita helicina* Brocchi, 1814, 8 are *Euspira umbilicolunata* sp. n., all also numbered BS.029.02.004/01). *Natica (Naticina) catena* var. *scalarioides* Sacco, lectotype (here designated): the shell figured by Sacco (1904, pl. 22, fig. 28), MGPT BS.029.02.005, Colli Torinesi; in MGPT there is only another syntype numbered BS.029.02.005/01, which is *Nerita helicina* Brocchi, 1814. *Natica (Naticina) catena* var. *subhemiclausa* Sacco, lectotype (here designated): the shell figured by Sacco (1904, pl. 22, fig. 30), MGPT BS.02.029.006, Colli Torinesi; 5 paralectotypes, MGPT BS.029.02.006/01, Colli Torinesi (other 8 syntypes, also numbered BS.029.02.006/01, are *Nerita helicina* Brocchi, 1814).

Material erroneously referred to as *Natica (Natica) millepunctata* var. *sismondiana* d'Orbigny, 1852 in MGPT: Colli Torinesi: 1 spm., MGPT BS.029.01.003/03.

Other material examined: Albugnano: 3 spms., PG 29; Termofourà: 3 spms., MGPT-PU 135244; Tetti Civera: 4 spms., MZB 15773, 24 spms., MZB 60044, 2 spms., MGPT-PU 135245; Valle Ceppi: 1 spm., MGPT-PU 135246, 1 spm., MGPT-PU 135247, 4 spms., MGPT-PU 135248, 1 spm., MGPT-PU 135249, 4 spms., MGPT-PU 135250, 1 spm., MGPT-PU 135251, 3 spms., MGPT-PU 135252, 2 spms., MGPT-PU 135253, 4 spms., MGPT-PU 135254, 1 spm., MGPT-PU 135255, 1 spm., MGPT-PU 135256,14 spms., MPUM 11356, 1 spm., MZB 60122, 6 spms., MZB 60043, 216 spms., MZB 60117, 61 spms., MZB 60005, 159 spms., MZB 60006, 3 spms., MZB 60007, 12 spms., MZB 60008, 1 spm., MZB 60009, 5 spms., MZB 60010, 57 spms., MZB 60011, 1 spm., MZB 60012, 1 spm., MZB 60013 (Pl. 12, fig. 10), 1 spm., MZB 60014, 14 spms., MZB 60020, 5 spms., MGPT-PU 135257, 16 spms., MGPT-PU 135258, 1 spm., MGPT-PU 135259 (Pl. 12, fig. 11), 29 spms., MGPT-PU 135260, 1 spm., MGPT-PU 25903, 5 spms., MGPT-PU 135261, 3 spms., MGPT-PU 135262, 3 spms., MGPT-PU 135263, 2 spms., MGPT-PU 135264, 1 spm., MGPT-PU 135265, 1 spm., MGPT-PU 135266, 2 spms., MGPT-PU 135267, 3 spms., MGPT-PU 135269, 1 spm., MGPT-PU 135270, 3 spms., MGPT-PU 135271, 2 spms., MGPT-PU 135272, 1 spm., MGPT-PU 135273, 1 spm., MGPT-PU 135274, 2 spms., MGPT-PU 135275, 2 spms., MGPT-PU 135276, 38 spms., PG 28, 1 spm., NP 9809, 6 spms., NP 9825; Val Sanfrà: 1 spm., MGPT-PU 107636, 19 spms., MGPT-PU 135277; Valle Vergnana: 4 spms., MZB 23754, 1 spm., MZB 23773, 4 spms., MZB 60046, 4 spms., MZB 43255, 2 spms., MZB 43795, 2 spms., MZB 43940, 1 spm., MZB 43972, 1 spm., MZB 44020, 1 spm., MZB 60019; Villa Allason: 3 spms., MGPT-PU 135278; Villa Bertini: 13 spms., MGPT-PU 135279.

Description. Protoconch small, low-turbiniform, of 2.70-2.90 convex, apparently smooth whorls, tip also small. Teleoconch globose to globose-pyriform, moderately thick. Spire conical, rather elevated in some specimens, whorls convex. Suture thin, adpressed. Last whorl globose to globose-oval, only slightly extended toward aperture; subsutural shelf poorly defined; periphery at midline. Aperture D-shaped in gently prosocline plane, length about 1.65 times width. Parietal callus thick, subrectangular, with concave abapertural outline; anterior lobe well developed, rather broad, with rounded to squarish edge; two transverse abapical folds occur at level of anterior lobe, lower rather prominent, other slightly above, narrower and shorter in most specimens, of same strength or obsolescent in some. Umbilicus deep, narrow to very narrow, more widely open in some specimens, margin broadly rounded, hence demarcation from base poorly defined; umbilical wall subvertical; inner surface with coarse growth markings. Funicle obsolete. Umbilical callus rather thick, narrowly subtriangular, with oblique reverse J-shaped outline, merging into anterior lobe of parietal callus and largely covering adapical part of umbilicus in most specimens, less so in some. Basal fasciole indistinct. Surface with subsutural prosocline collabral wrinkles.

Dimensions (mm)

DHW	PD	H	D	SH
0.103-0.111	0.937-1.013	9.895-20.231	8.953-17.537	1.716-7.008
0.107	0.975	15.063	13.245	4.362
AH	**AW**	**UW**	**IS**	**SA**
7.421-13.993	4.998-9.870	1.071-2.823	20°-40°	70°-118°
10.707	7.434	1.947	30°	94°

Remarks. The present species is herein assigned to the genus *Pliconacca* Cossmann & Martin in Martin, 1914 on account of its subsutural collabral wrinkles and its transverse folds on the abapical part of the parietal callus. It appears to be rather variable as regards the teleoconch shape, the elevation of the spire, the width of the umbilical opening, and the development of the folds on the parietal callus.

Sacco (1890b) introduced the variety *prohelicina* of *Natica (Naticina) catena* (da Costa, 1778), a species currently included in the genus *Euspira* Agassiz in J. Sowerby, 1837. The variety *prohelicina* is morphologically similar to *Euspira catena*, but dif-

fers from da Costa's taxon because of its transverse folds on the abapical part of the parietal callus (absent in *Euspira catena*). We conclude that this difference is adequate to warrant specific separation from *E. catena* and that the cited character firmly points toward an assignment of Sacco's taxon to the genus *Pliconacca*. Examination of the figured syntypes of *Pliconacca plicatulaeformis* in NHMW revealed that *Pliconacca prohelicina* does not differ significantly from *P. plicatulaeformis* and, therefore, we consider it as a synonym of Kittl's species, which has priority. The same conclusion proved true as regards other Sacco's varieties of *Natica (Naticina) catena* (see the above synonymy). *Polinices cerovaensis* Harzhauser, 2011, described from Burdigalian deposits of Slovak Republic, also belongs in *Pliconacca*. According to Harzhauser (personal communication 2013), it differs from *P. plicatulaeformis* in that it lacks the subsutural collabral wrinkles.

Stratigraphic occurrence. *Pliconacca plicatulaeformis* (Kittl, 1887) occurs in Burdigalian and Langhian units of Piedmont, being particularly abundant in the early Burdigalian of Valle Ceppi, and in the Badenian (middle Miocene) of Central Paratethys.

Pliconacca tortonensis sp. n.

Pl. 13, figs. 1-3

Derivation of name: The name refers to the Tortonian age of the type horizon.

Holotype: Borelli: MGPT-PU 135280 (Pl. 13, fig. 1).

Paratypes: Borelli: 1 spm., MGPT-PU 135281 (Pl. 13, fig. 2), 1 spm., MGPT-PU 135282 (Pl. 13, fig. 3), 1 spm., MGPT-PU 135283, 1 spm., MGPT-PU 135284, 1 spm., MGPT-PU 135285, 22 spms., MGPT-PU 135286, 1 spm., MPUM 11357.

Other material examined: Borelli: 2 spms., NP 9823; Stazzano: 1 spm., NP 9824, 1 spm., MZB 60015, 1 spm., MZB 60016.

Preservation: All specimens are rather well preserved.

Type locality: Borelli (see appendix).

Horizon: Gray, medium sand of Tortonian age.

Diagnosis: Globose shell with slightly elevated spire, rather depressed last whorl, small to very small umbilicus; inner lip callus with three transverse folds, one on uppermost umbilical callus, two at level of anterior lobe of parietal callus. Surface with subsutural prosocline collabral wrinkles.

Description. Protoconch medium-sized, low-turbiniform, of 2.70-2.84 convex, apparently smooth whorls, tip small. Teleoconch globose, of moderate thickness. Spire broadly conical, slightly elevated, whorls convex. Suture thin, adpressed. Last whorl globose, rather depressed, scarcely extended toward aperture; subsutural shelf poorly defined to indistinct; periphery at midline. Aperture D-shaped in gently prosocline plane, length about 1.8 times width. Parietal callus thick, subrectangular, with concave abapertural outline; anterior lobe well developed, rather broad, with rounded to squarish edge; two transverse abapical folds occur at level of anterior lobe, lower rather prominent, other some distance above, shorter in most specimens, narrower and extending into aperture in some. Umbilicus deep, small to very small, margin broadly rounded, hence demarcation from base poorly defined; umbilical wall subvertical, bounded downward by slight groove. Funicle obsolete. Umbilical callus rather thick, narrowly subtriangular, with oblique reverse J-shaped outline and with 1 transverse fold where it merges into anterior lobe of parietal callus. Basal fasciole indistinct. Surface with subsutural prosocline collabral wrinkles; last whorl with faint spiral microstriation throughout. Some specimens retain traces of pale reddish-brown color.

Dimensions (mm)

DHW	PD	H	D	SH
0.115-0.131	0.970-1.142	2.804-12.728	2.296-11.368	0.886-3.018
0.123	1.056	7.766	6.832	1.952
AH	**AW**	**UW**	**IS**	**SA**
1.818-9.850	1.270-7.934	0.397-2.765	12°-28°	105°-125°
5.834	4.602	1.581	20°	115°

Remarks. The present new species has a quite constant teleoconch shape, whereas it exhibits a moderate variability concerning the development of the transverse folds on the parietal callus. The values of the characteristic elements of the protoconch of *Pliconacca tortonensis* do not differ significantly from those measured for *Pliconacca plicatulaeformis* (Kittl, 1887), but the two species can be readily distinguished on the basis of respective teleoconch characters. *P. tortonensis* differs from *P. plicatulaeformis* in that it has: 1) a lower spire (Fig. 13) with greater mean spiral angle, 2) a more depressed last whorl, 3) a wider aperture (Fig. 14), 4) a wider umbilicus (Fig. 16), 5) an umbilical wall bounded downward by a slight but distinct groove (absent in *P. plicatulaeformis*), and 6) a transverse fold on the adapical end of the umbilical callus that is never present in *P. plicatulaeformis*. The three-folded inner lip callus stands as the main differentiating character.

Stratigraphic occurrence. *Pliconacca tortonensis* sp. n. was recovered from Tortonian deposits of Piedmont.

Genus *Polinices* Montfort, 1810

Polinices Montfort, 1810, p. 222. Type species by original designation: *Polinices albus* Montfort, 1810 (= *Nerita mammilla* Linnaeus, 1758), Recent, Indo-Pacific. Kabat (1990) selected the lectotype of *Nerita mammilla*, designated it as the neotype of *Polinices albus*, and redescribed Linnaeus' species (see also Bouchet & Waren 1993).

Albula Röding, 1798, p. 20. Type species by subsequent des-ignation (Winckworth 1945, p. 137): *Nerita mammilla* Linnaeus, 1758.

Eucaryorum Ehrenberg, 1831, p. 46. Type species by mono-typy: *Nerita mammilla* Linnaeus, 1758 (*fide* Kabat 1991).

Naticina Guilding, 1834, p. 30. Type species by original des-ignation: *Naticina lactea* Guilding, 1834.

Naticella Swainson, 1840, p. 345. Type species by monotypy: "*N. aurantia* Martini" Swainson, 1840 (= *Albula aurantium* Röding, 1798).

Uber Gray, 1847, p. 149 (*Uber* Humphrey, 1797 unavailable). Type species by subsequent designation (Philippi 1853, p. 497): *Nerita mammilla* Linnaeus, 1758.

Mamma H. & A. Adams, 1853, p. 210 (*Mamma* Klein MS.; *Mamma* Klein in Mörch, 1852 merely listed in the synonymy of *Polinices*). Type species by original designation: *Nerita mammilla* Linnaeus, 1758.

Pseudopolinices Golikov & Sirenko, 1983, p. 1339. Type species by original designation: *Natica nana* Möller, 1842.

Kabat (1991) regarded *Pseudopolinices* as a synonym of *Euspira* Agassiz in J. Sowerby, 1837. However, *Natica nana* (type species of *Pseudopolinices*) has the umbilicus completely filled by a rather broad umbilical callus fused with the parietal callus (cf. Golikov & Sirenko 1983, fig. 1: 20), a character that is distinctive of *Nerita mammilla*. Consequently, we regard *Pseudopolinices* as another synonym of *Polinices*.

Polinices was discussed by Pedriali & Robba (2009, p. 388), who listed the following distinctive characters of the genus: 1) shell usually thick, pyriform to slightly globular, 2) spire moderately el-evated to low, sutures almost flush, 3) parietal callus thick and broad, 4) umbilicus completely plugged or a narrow and deep abapical groove, and 5) umbilical callus thick, broad in most species, fused with the parietal callus. The cited authors considered the umbilical callus completely filling the umbilicus or nearly so, and its smooth merging with the parietal callus as the main distinguishing characters of *Polinices*.

Polinices proredemptus (Sacco, 1890)

Pl. 13, figs. 4-6

? 1856 *Natica redempta* - Hoernes, p. 522, pl. 47, fig. 3.

1890b *Natica (Polinices) proredempta* Sacco, p. 36.

1890b *Natica (Polinices) proredempta* subvar. *scalariformis* Sacco, p. 36 (*nomen nudum*).

1890b *Natica (Polinices) proredempta* var. *subnaticoides* Sacco, p. 36.

1890b *Natica (Polinices) proredempta* var. *tauromamilla* Sacco, p. 36.

1891 *Natica (Polinices) proredempta* - Sacco, p. 93, pl. 2, fig. 71.

1891 *Natica (Polinices) proredempta* var. *scalariformis* Sacco, p. 94.

1891 *Natica (Polinices) proredempta* var. *subnaticoides* - Sacco, p. 94, pl. 2, fig. 72.

1891 *Natica (Polinices) proredempta* var. *tauromamilla* - Sacco, p. 94, pl. 2, fig. 73.

1904 *Natica (Polinices) proredempta* var. *scalariformis* - Sacco, p. 104, pl. 23, fig. 6.

? 1919 *Natica (Polinices) proredempta* - Cossmann & Peyrot, p. 221, pl. 12, figs. 23-26.

? 1923 *Natica redempta* var. Friedberg, p. 433, pl. 26, figs. 6, 7.

PLATE 13

Fig. 1 - *Pliconacca tortonensis* sp. n. Borelli. Holotype, MGPT-PU 135280; a, apertural side (height of shell 12.65 mm); b, abapertural side; c, apical view; d, basal view.

Fig. 2 - *Pliconacca tortonensis* sp. n. Borelli. Paratype, MGPT-PU 135281; protoconch.

Fig. 3 - *Pliconacca tortonensis* sp. n. Borelli. Paratype, MGPT-PU 135282; a, apertural side (height of shell 6.07 mm); b, basal view.

Fig. 4 - *Polinices proredemptus* (Sacco, 1890). Colli Torinesi. Lectotype (here designated) of *Natica (Polinices) proredempta* Sacco, 1890. MGPT BS.029.06.010; a, apertural side (scale bar 4 mm); b, basal view.

Fig. 5 - *Polinices proredemptus* (Sacco, 1890). Valle Ceppi. MZB 60134; protoconch.

Fig. 6 - *Polinices proredemptus* (Sacco, 1890). Val Sanfrà. MGPT-PU 135287; apertural side (height of shell 24.08 mm).

Fig. 7 - *Polinices redemptus* (Michelotti, 1847). Stazzano. Neotype (here designated) of *Natica redempta* Michelotti, 1847. MGPT BS.029.06.014; a, apertural side (scale bar 4 mm); b, abapertural side.

Fig. 8 - *Polinices redemptus* (Michelotti, 1847). Montegibbio. NP 10000; protoconch.

Fig. 9 - *Polinices redemptus* (Michelotti, 1847). Rio di Bocca d'Asino. PG 102; a, apertural side (height of shell 38.19 mm); b, abapertural side; c, apical view.

Fig. 10 - *Polinices redemptus* (Michelotti, 1847). Rio di Bocca d'Asino. PG 103; abapertural side showing color pattern (height of shell 31.81 mm).

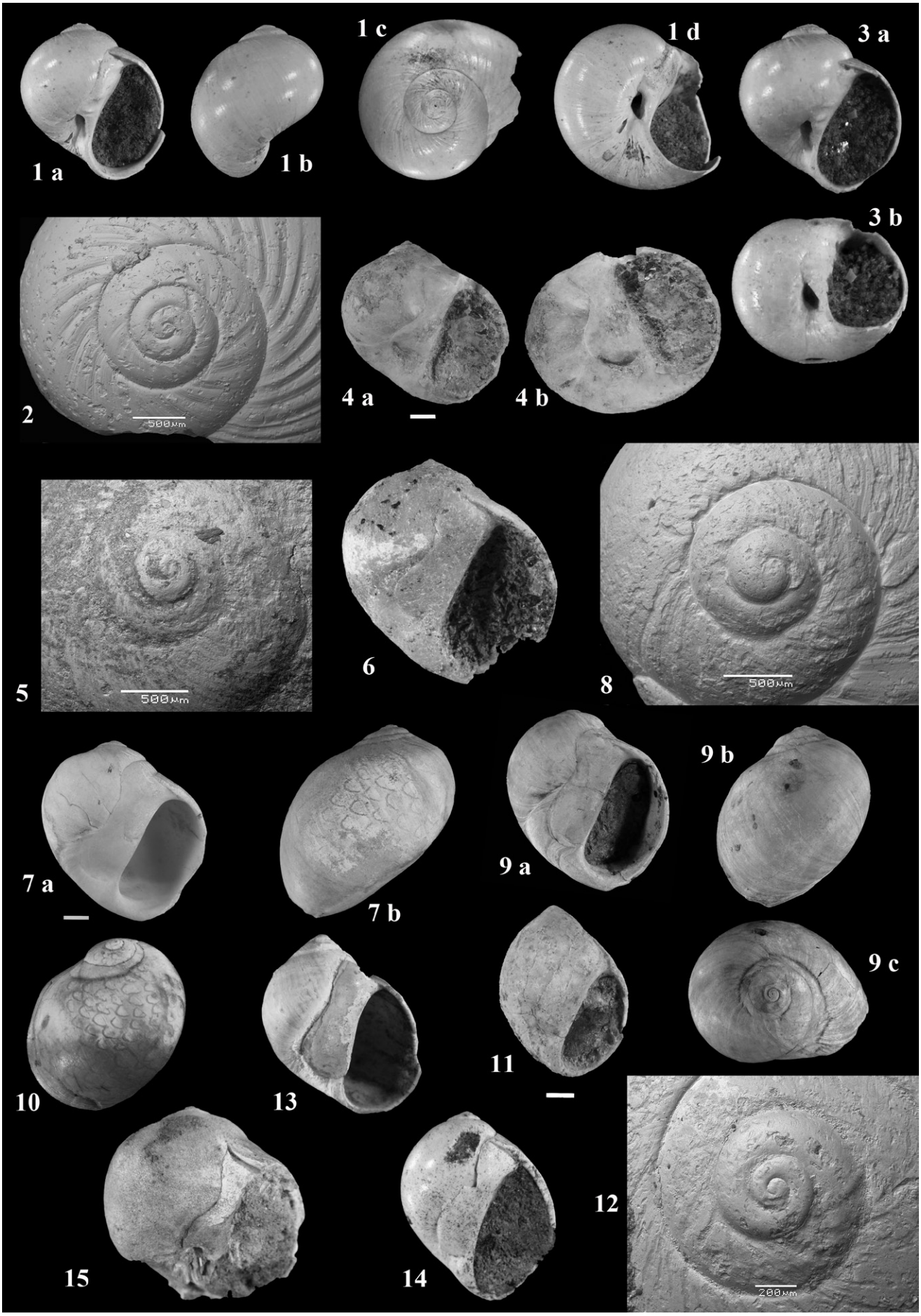
Fig. 11 - *Polinices submamilla* (Sacco, 1891). Colli Torinesi. Lectotype (here designated) of *Natica (Polinices) submamilla* Sacco, 1891. MGPT BS.029.06.002; apertural side (scale bar 4 mm).

Fig. 12 - *Polinices submamilla* (Sacco, 1891). Colli Torinesi. Paralectotype. MGPT BS.029.06.002/02a; protoconch.

Fig. 13 - *Polinices submamilla* (Sacco, 1891). Valle Ceppi. MGPT-PU 135288; apertural side (height of shell 16.62 mm).

Fig. 14 - *Polinices submamilla* (Sacco, 1891). Valle Ceppi. PG 104; apertural side (height of shell 12.00 mm).

Fig. 15 - *Polinices* sp. Valle Organa. MGP-PD 31519; apertural side (height of shell 16.53 mm).


1 a
1 b
1 c
1 d
3 a
3 b
2
500µm
4 a
4 b
5
500µm
6
8
500µm
7 a
7 b
9 a
9 b
9 c
10
13
11
12
200µm
15
14

? 1923 *Natica staszici* Friedberg, p. 435, pl. 26, figs. 8, 9.

? 1925 *Natica (Polynices) proredempta* - Cossmann, p. 126, pl. 2, figs. 17, 18.

? 1966 *Natica (Polynices) redempta* - Strausz, p. 231 (pars), pl. 47, figs. 29, 30 (not figs. 19-28, 31, 32 = *Natica pseudoredempta* Friedberg, 1923).

1966 *Polynices (Lunatia)* ex gr. *proredempta* - Kókai, p. 55, pl. 7, fig. 7.

1984 *Polinices proredempta* - Ferrero Mortara et al., p. 37, pl. 4, fig. 1.

1984 *Polinices proredempta* var. *scalariformis* - Ferrero Mortara et al., p. 37.

1984 *Polinices proredempta* var. *subnaticoides* - Ferrero Mortara et al., p. 37.

1984 *Polinices proredempta* var. *tauromamilla* - Ferrero Mortara et al., p. 37.

? 1995 *Polinices redemptus* - Baluk, p.198, pl. 15, figs. 7, 8.

2007 *Polinices proredemptus* - Zunino, p. 122, pl. 1, fig. 8.

2009 *Polinices proredemptus* - Zunino & Pavia, pl. 1, fig. 7.

Type material: *Natica (Polinices) proredempta* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 71) and refigured herein (Pl. 13, fig. 4), MGPT BS.029.06.010, Colli Torinesi; 7 paralectotypes, MGPT BS.029.06.010/01, Colli Torinesi (other 2 syntypes, also numbered MGPT BS.029.06.010/01, are unidentifiable). *Natica (Polinices) proredempta* var. *scalariformis* Sacco, lectotype (here designated): the shell figured by Sacco (1904, pl. 23, fig. 6), MGPT BS.029.06.011, Colli Torinesi; 1 paralectotype, MGPT BS.029.06.011/01, Colli Torinesi (other 2 syntypes, also numbered MGPT BS.029.06.011/01, are *Natica tigrina* Defrance, 1825). *Natica (Polinices) proredempta* var. *subnaticoides* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 2, fig. 72), MGPT BS.029.06.012, Colli Torinesi; 17 paralectotypes, MGPT BS.029.06.012/01, Colli Torinesi (other 4 syntypes, also numbered MGPT BS.029.06.012/01, are unidentifiable or belong to another species). *Natica (Polinices) proredempta* var. *tauromamilla* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 2, fig. 73), MGPT BS.029.06.013, Colli Torinesi.

Material erroneously referred to as *Natica (Polinices) submamillaris* var. *mioinflata* Sacco, 1890 in MGPT: Colli Torinesi: 5 syntypes, MGPT BS.029.06.004/01.

Other material examined: Salles, Argilas (France): 22 spms., NP 10016; Salles, Largileyre (France): 3 spms., NP 10003; Valle Ceppi: 1 spm., MGPT-PU 23859, 1 spm., MZB 60135, 1 spm., MZB 60134 (Pl. 13, fig. 5); Val Sanfrà: 1 spm., MGPT-PU 135287 (Pl. 13, fig. 6), 15 spms., MGPT-PU 23665, 1 spm., MGPT-PU 107628; Valle Vergnana: 1 spm., MZB 60136, 1 spm., MZB 60137, 1 spm., MZB 60152.

Description. Protoconch medium-sized, low-turbiniform, of 2.45 convex, apparently smooth whorls, tip small. Teleoconch globose, wider than high in most specimens, sometimes globose-pyriform, moderately thick. Spire broadly conical, pointed and low, more elevated in a few specimens (globose-pyriform), whorls flatly convex. Suture thin, almost flush, adpressed in a few specimens that have more convex whorls. Last whorl inflated, somewhat depressed, only slightly extended toward aperture; subsutural shelf poorly defined to indistinct; periphery slightly above midline. Aperture D-shaped in moderately prosocline plane, length averaging 1.85 times width. Parietal callus thick. Umbilicus completely plugged or a narrow abapical groove in a few specimens. Umbilical callus rather thick, subcircular, expanded to overlap basal fasciole, slightly excavated in most specimens, fused with parietal callus. Abapertural outline of inner lip callus (parietal + umbilical) concave, straight in a few specimens. Basal fasciole broad, scarcely prominent. Many specimens retain vestige of uniform pale brown background with darker subsutural and lowermost basal bands.

Dimensions (mm)

DHW	PD	H	D	SH
0.137*	1.029*	8.550-31.990	9.020-30.680	1.620-7.020
* 1 protoconch measurable		20.276	19.858	4.326
AH	**AW**	**WUC**	**IS**	**SA**
6.520-25.380	5.400-17.800	2.660-11.280	18°-34°	99°-131°
15.955	11.600	6.975	26°	115°

Remarks. Sacco (1890b) introduced *Natica (Polinices) proredempta* on the basis of material from the Torino Hills (Colli Torinesi) said to be of "Helvetian" age, and pointed out the characters that distinguish this "Helvetian" species from the Tortonian *Natica (Polinices) redempta* Michelotti, 1847. Glibert (1952b) regarded the distinguishing characters cited by Sacco (1890b) as "peu apparents" and, in order to clarify the relationships between the "Helvetian" species and the Tortonian one, compared some middle Miocene shells from France and Austria to specimens from the Tortonian of Montegibbio "représentant *P. redempta* typique". Glibert concluded that the middle Miocene French and Austrian specimens were not distinguishable from those of Montegibbio. Consequently, he rejected the separation of *Polinices proredemptus* from *Polinices redemptus* made by Sacco. Glibert's opinion was agreed upon subsequently by some workers (Strausz 1954; Ruggieri & Davoli 1984; Baluk 1995; Landau et al. 2013). However, considering 1) that Glibert (1952b) did not examine specimens from the "Helvetian" of Piedmont, and 2) that recent research has shown that the "Helvetian" fossils dealt with by Sacco were collected from coarse sandstone levels of the Termofourà Formation, demonstrated to be of early Miocene (Burdigalian) age (see Zunino & Pavia 2009),

we think that Glibert's conclusion is not acceptable since it is based on specimens of different age, but all belonging to *P. redemptus*, which appears to occur also in the middle Miocene (Serravallian).

In our opinion, *Polinices proredemptus* is a distinct species differing from *Polinices redemptus* in that it has: 1) a protoconch with 0.5 more whorls and with the diameter of the first half-whorl half of the size, 2) a teleoconch attaining a smaller size, 3) a nearly flat-sided spire (that of *P. redemptus* is somewhat stepped, with more convex whorls), and 4) a quite different color pattern. Furthermore, *P. proredemptus* lacks the subsutural groove that is always present in *P. redemptus*.

Specimens either assigned to *Polinices proredemptus* or to *Polinices redemptus* were illustrated from middle Miocene deposits of France (Cossmann & Peyrot 1919; Cossmann 1925) and eastern Europe (Hoernes 1856; Friedberg 1923; Strausz 1954, 1966; Kojumdgieva & Strachimirov 1960; Kókai 1966; Baluk 1995). We have not seen the material dealt with by the cited authors, and it is difficult to decide any species assignment on the basis of the figures published by them. However, it seems that the French specimens (Cossmann & Peyrot 1919; Cossmann 1925) could be *P. proredemptus*. Of the eastern European shells, those illustrated by Hoernes (1856), Friedberg (1923), Strausz (1966, in part) and Baluk (1995) probably are *P. proredemptus* (see the above synonymy); that figured by Kókai (1966) is *P. proredemptus*. Finally, we note that several Badenian (Langhian to early Serravallian) shells from Austria, Poland, Hungary and Ukraine in our collection fully agree with the characters of *P. proredemptus*, whereas others conform to *P. redemptus*. In summary, *P. proredemptus* is well documented in the early Miocene (Burdigalian) of Italy as is *P. redemptus* in the late Miocene (Tortonian) also of Italy; so far, there are no records of these species from the Italian middle Miocene. Both taxa result to have co-occurred in the middle Miocene of other European countries.

Natica staszici Friedberg, 1923 appears to be closely similar to *Polinices proredempta* and could be a synonym of it. The var. *revoluta* Friedberg, 1923 of *Natica staszici* seems to be a different species belonging in the genus *Euspira* Agassiz in J. Sowerby, 1837.

Stratigraphic occurrence. *Polinices proredemptus* (Sacco, 1890) is known definitely from the Burdigalian Termofourà Formation in the Torino Hills (Piedmont). Sacco (1891) quoted his variety *subnaticoides* of *Natica (Polinices) proredempta* as very rare in the Tortonian deposits of Sant'Agata Fossili (Piedmont). However, since no specimens of this variety in MGPT are from the cited locality, the presence of *Polinices proredemptus* in the Tortonian of Piedmont is to be confirmed. The species occurs also in the middle Miocene of eastern Europe and, probably, of France.

Polinices redemptus (Michelotti, 1847)

Pl. 13, figs. 7-10

1847 *Natica redempta* Michelotti, p. 157, pl. 6, figs. 6, 6[1].

1890b *Natica (Polinices) redempta* - Sacco, p. 36.

1890b *Natica (Polinices) redempta* subvar. *subalbula* Sacco, p. 36 (*nomen nudum*).

1890b *Natica (Polinices) redempta* subvar. *elliptica* Sacco, p. 36 (*nomen nudum*).

1890b *Natica (Polinices) redempta* var. *dertoconvexa* Sacco, p. 36.

1891 *Natica (Polinices) redempta* - Sacco, p. 95, pl. 2, fig. 74.

1891 *Natica (Polinices) redempta* var. *subalbula* Sacco, p. 95.

1891 *Natica (Polinices) redempta* var. *elliptica* Sacco, p. 96.

1891 *Natica (Polinices) redempta* var. *dertoconvexa* - Sacco, p. 96, pl. 2, fig. 75.

1903 *Natica (Polinices) redempta* - Dollfus et al., p. 18, pl. 35, fig. 1.

1904 *Natica (Polinices) redempta* var. *elliptica* - Sacco, p. 104, pl. 23, fig. 7.

? 1917 *Natica redempta* - Stefanini, p. 99.

1952b *Polynices (Polynices) redempta* - Glibert, p. 252, pl. 2, figs. 5a-i.

1963 *Polinices (Polinices) redemptus* - Venzo & Pelosio, p. 83, pl. 34, figs. 39-42.

1968 *Polinices (Polinices) redemptus* - Robba, p. 527.

1973 *Polinices (Polinices) redemptus* - Marasti, p. 87, pl. 20, figs. 6, 7.

1984 *Polinices redempta* - Ferrero Mortara et al., p. 37.

1984 *Polinices redempta* var. *subalbula* - Ferrero Mortara et al., p. 37.

1984 *Polinices redempta* var. *elliptica* - Ferrero Mortara et al., p. 37.

1984 *Polinices redempta* var. *dertoconvexa* - Ferrero Mortara et al., p. 37.

1984 *Polinices (Polinices) redemptus* - Ruggieri & Davoli, p. 55, pl. 10 [1], fig. 19.

2011 *Euspira redempta* - Caprotti, p. 53, figs. 2M-P.

2013 *Polinices redemptus* - Landau et al., p. 105, pl. 11, fig. 7; pl. 79, fig. 7.

Type material: *Natica redempta* Michelotti, neotype (here designated): the specimen figured by Sacco (1891, pl. 2, fig. 74) and refigured herein (Pl. 13, fig. 7), MGPT BS.029.06.014, Stazzano (see remarks below). *Natica (Polinices) redempta* var. *subalbula* Sacco, lectotype (here designated): the specimen MGPT BS.029.06.015, Stazzano; 4 paralectotypes, MGPT BS.029.06.015/01, Sant'Agata Fossili. *Natica (Polinices) redempta* var. *elliptica* Sacco, lectotype (here designated): the shell figured by Sacco (1904, pl. 23, fig. 7), MGPT BS.029.06.016, Stazzano; 7 paralectotypes, MGPT BS.029.06.016/01, Stazzano. *Natica (Polinices) redempta* var. *dertoconvexa* Sacco, lectotype (here des-

ignated): the shell figured by Sacco (1891, pl. 2, fig. 75), MGPT BS.029.06.017, Stazzano; 5 paralectotypes, MGPT BS.029.06.017/01, Sant'Agata Fossili, 1 paralectotype, MGPT BS.029.06.017/02, Stazzano, 5 paralectotypes, MGPT BS.029.06.017/03, Stazzano.

Material erroneously referred to as *Natica submamillaris* var. *mioclausa* Sacco, 1890 in IPUM: Montegibbio: 1 spm., IPUM 4395.

Other material examined: Colli Torinesi: 1 spm., MGPT BS.029.06.014/01; Colli Tortonesi: 5 spms., MGPT BS.029.06.014/07; Moncucco Torinese: 1 spm., PG 1c; Montegibbio: 1 spm., MZB 005036, 2 spms., MZB 005724, 1 spm., MZB 60113, 1 spm., MZB 60014, 1 spm., MZB 60115, 3 spms., MGC 1419, 6 spms., private collection, 2 spms., private collection, 12 spms., NP 9811, 1 spm., NP 10000 (Pl. 13, fig. 8), 7 spms., private collection, 6 spms., private collection, 14 spms., private collection, 3 spms., private collection; Passo dei Meloni: 1 spm., PP.PM 01/04, 3 spms., NP 9954; Pietracuta: 1 spm., MS 8940,0; Rio di Bocca d'Asino: 1 spm., MGPT BS.029.06.014/06, 1 spm., MZB 60001, 3 spms., MZB 60002, 2 spms., MZB 29718, 11 spms., MZB 29726, 9 spms., MZB 29759, 12 spms., MZB 29801, 3 spms., MZB 25955, 6 spms., MZB 60003, 8 spms., MZB 60004, 19 spms., MZB 45451, 10 spms., PG 25b, 1 spm., PG 102 (Pl. 13, fig. 9), 1 spm., PG 103 (Pl. 13, fig. 10), 11 spms., NP 9812, 2 spms., MPUM 11358, 6 spms., private collection; Sant'Agata Fossili: 1 spm., MGPT BS.029.06.014/03, 1 spm., MGPT-PU 23320, 2 spms., NP 9822, 2 spms., MPUM 11359; Scipione Ponte: 1 spm., private collection; Sogliano al Rubicone: 3 spms., MS 8917,0; Stazzano: 6 spms., MGPT BS.029.06.014/04, 4 spms., MGPT BS.029.06.014/05, 3 spms., MGPT-PU 23405, 1 spm., MGPT-PU 23406, 2 spms., MPUM 11360, 5 spms., MPUM 11361, 2 spms., MS 12824, 1 spm., NP 9810, 8 spms., NP 9813, 2 spms., NP 9821, 11 spms., private collection; Vigoleno: 12 spms., private collection.

Description. Protoconch medium-sized, low turbiniform, of 1.75-1.90 moderately convex whorls, tip medium-sized, rather inflated. Teleoconch globose-ovate, slightly higher than wide, robust. Spire moderately elevated, somewhat stepped, whorls convex, with distinct, gently sloping subsutural shelf in most specimens. Suture thin, adpressed. Last whorl inflated, somewhat depressed, slightly expanded toward aperture; subsutural shelf less defined than on spire whorls, but distinct in all specimens; periphery about at midline. Aperture D-shaped in moderately prosocline plane, length averaging 1.83 times width. Parietal callus thick, subrectangular, slightly expanded adapically to meet suture. Umbilicus completely plugged or a narrow abapical groove in a few specimens. Umbilical callus also thick, subrectangular with arched abapical outline, touching basal fasciole, fused with parietal callus. Abapertural outline of inner lip callus (parietal + umbilical) straight, very slightly concave in a few specimens. Basal fasciole broad, scarcely prominent, bounded by very slightly incised groove in most specimens. Outer surface with subsutural spiral groove separating from suture by second or third (more frequently) spire whorl, often appearing as breakage line of shell. Many specimens retain vestige of uniform pale brown background with darker crescent-shaped marks roughly arranged into collabral alignments, observable on the last 1.5 whorls.

Dimensions (mm)

DHW	PD	H	D	SH
0.271-0.295	0.938-1.110	11.175-41.939	9.981-40.681	1.972-9.896
0.283	1.024	26.557	25.331	5.934
AH	**AW**	**WUC**	**IS**	**SA**
8.633-32.623	5.843-22.063	2.050-16.606	13°-33°	95°-115°
20.623	13.953	9.328	23°	105°

Remarks. Inquiries about the location of Michelotti collection had negative results and that collection is to be considered lost (Giulio Pavia, personal communication 2013). Since Sacco (1891, p. 95), in the remarks to *Natica (Polinices) redempta*, explicitly affirmed to have examined Michelotti's type specimens, his specimens in MGPT, collected from the same area ("environs de Tortone"), stand as the most relevant reference material for *Polinices redemptus*. Thus, it is advisable to designate the shell figured by Sacco (1891, pl. 2, fig. 74) as the neotype of *P. redemptus*, in order to clarify and fix the characters of Michelotti's species (ICZN 1999, Article 75 of the Code).

Polinices redemptus exhibits a considerable variability in shell shape, reflected by the varieties proposed by Sacco (1890b, 1891). However, the diagnostic characters (protoconch, inner lip callus, subsutural groove and color pattern) are rather stable. The lower Messinian specimens from Vigoleno differ from the rest of the examined material only in that they have a wider abapical groove (umbilical channel); this difference is not considered sufficient to warrant separation from the typical form.

The relationships with *Polinices proredemptus* (Sacco, 1890) have been already dealt with in the remarks on that species (see above). Sacco (1890b) introduced *Natica (Polinices) redemptoaurantia* on the basis of extremely rare material from the Tortonian of Mioglia di Montaldo in the Torino Hills, said to be in the Museo Geologico of Roma. Inquiries there had no answer and no specimens of this species are present in MGPT. According to the figures and the brief descriptive remarks published by Sacco (1891,

p. 96, pl. 2, fig. 76), *N. (Polinices) redemptoaurantia* seems to be strikingly close to *Polinices redemptus*, in particular to its variety *elliptica* herein included in the synonymy of the typical form. Likely Sacco's species is a synonym of the variable *P. redemptus*, but a decision in this respect would require that the original material (probably a single specimen) be examined. Pfister & Wegmüller (2007) described and figured specimens referred to as *Polinices* cf. *redemptus*. Because of the preservation (mostly internal casts), an attempt to assign them to species can be hardly made. However, considering the Burdigalian age of these specimens, they could be referred to as *Polinices* cf. *proredemptus*.

Stratigraphic occurrence. *Polinices redemptus* (Michelotti, 1847) was recorded from middle Miocene deposits of France, Paratethys and Turkey. It occurs in the Tortonian and in the early Messinian of Italy and Portugal (according to Studencka & Zieliński 2013, the age of the Portuguese Cacela Formation is late Tortonian to early Messinian). There are no reliable records of this species prior to middle Miocene and subsequent to the early Messinian.

Polinices submamilla (Sacco, 1891)

Pl. 13, figs. 11-14

1847 *Natica mamilla* - Sismonda, p. 51 (not *Natica mamilla* Lamarck, 1822 = *Nerita mammilla* Linnaeus, 1758).

1852 *Natica submamilla* d'Orbigny, p. 38 (*nomen nudum*).

1861 *Natica submamilla* - Michelotti, p. 87.

1890b *Natica (Polinices) submamilla* - Sacco, p. 36 (*nomen nudum*).

1891 *Natica (Polinices) submamilla* Sacco, p. 92, pl. 2, fig. 67.

not 1903 *Natica (Polinices) submamilla* - Dollfus et al., p. 19, pl. 35, fig. 8 (not Sacco, 1891).

1984 *Polinices submamillaris* - Ferrero Mortara et al., p.36 (only BS.029.06.002, see remarks below).

Type material: *Natica (Polinices) submamilla* Sacco, lectotype (here designated); the shell figured by Sacco (1891, pl. 2, fig. 67) and refigured herein (Pl. 13, fig. 11), MGPT BS.029.06.002, Colli Torinesi; 1 paralectotype (Pl. 13, fig. 12), MGPT BS.029.06.002/02a, Colli Torinesi; 15 paralectotypes, MGPT BS.029.06.002/02b, Colli Torinesi; 6 paralectotypes, MGPT BS.029.06.002/01, Villa Forzano (another syntype, also numbered MGPT BS.029.06.002/01, is *Natica olla* de Serres, 1829).

Other material examined: Valle Ceppi: 1 spm., MGPT-PU 135288 (Pl. 13, fig. 13); 1 spm., PG 104 (Pl. 13, fig. 14).

Description. Protoconch small, low turbiniform, of 2.75 moderately convex, apparently smooth whorls, tip very small. Teleoconch oval, higher than wide, rather thin. Spire elevated, broadly cyrtoconoid, whorls very slightly convex, flat-sided in a few specimens. Suture thin, adpressed to almost flush. Last whorl oval, subsutural shelf indistinct, periphery about at midline. Aperture D-shaped in moderately prosocline plane, length twice width. Parietal callus thick, subrectangular. Umbilicus completely plugged. Umbilical callus very thick, subrectangular with arched abapical outline, overlapping basal fasciole, fused with parietal callus. Abapertural outline of inner lip callus (parietal + umbilical) straight, very slightly concave in a few specimens. Basal fasciole broad, scarcely prominent, bounded by slight step in most specimens. Outer surface with rather distant growth markings. A few better preserved specimens have yellowish-white, shining surface.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.069	0.742	16.620	13.971	3.022	13.601	10.062
UW	**IS**	**SA**				
8.220	24°	106°				

Remarks. Sismonda (1847) applied the name *Natica mamilla* Lamarck, 1822 (= *Nerita mammilla* Linnaeus, 1758) to Miocene fossils from the Torino Hills, which were neither described, nor illustrated. Since *Nerita mammilla* is a Recent Indo-Pacific species, d'Orbigny (1852, p. 38) introduced the replacement name *submamilla* for the fossil shells dealt with by Sismonda. D'Orbigny just listed (n° 563) a *Natica submamilla* d'Orbigny, 1847, but this reference was not located. *N. submamilla* was later on attributed to d'Orbigny, 1852 by the authors. However, from the 1852 work, it appears that the name *submamilla* is a nomen nudum and, thence, unavailable. Subsequent to its introduction, *N. submamilla* d'Orbigny, 1852 was only cited by Michelotti (1861, p. 87) and Sacco (1890b, p. 36). Sacco (1891) is to be considered the first reference author. He published a concise description, some remarks, and figured the species. Thus, the name *submamilla* was made available by Sacco (1891), who is to be considered the author of this species.

It is to be noted that in the Catalogue of the Bellardi e Sacco collection (Ferrero Mortara et al. 1984, p. 36), probably because of an oversight, the whole material of *Polinices submamilla* (registration numbers BS.029.06.002, BS.029.06.002/01 and BS.029.06.002/02) was listed as *Polinices submamillaris* (d'Orbigny, 1852).

Polinices albus Montfort, 1810 (= *Nerita mammilla* Linnaeus, 1758) differs from *Polinices submamilla* because of its protoconch with 0.5 fewer whorls and significantly smaller diameter, and its more inflated, ovate-pyriform to pyriform teleoconch (see Huelsken et al. 2012 for the protoconch of *Nerita mammilla*).

The shell figured by Dollfus et al. (1903) and referred to as *Natica (Polinices) submamilla* does not agree with the characters of *Polinices submamilla* in that it has a globose teleoconch and a somewhat different abapical outline of the umbilical callus.

Stratigraphic occurrence. *Polinices submamilla* (Sacco, 1891) was hitherto recorded from Burdigalian deposits exposed in the Torino Hills.

Polinices sp.

Pl. 13, fig. 15

Material examined: Valle Organa: 1 spm., MGP-PD 31519.

Descripion. Protoconch poorly preserved, apparently of two whorls. Teleoconch globose, nearly as wide as high, thick, damaged abapically. Spire broadly conical, pointed, scarcely elevated, whorls very slightly convex; suture adpressed, almost flush. Last whorl globular, subsutural shelf indistinct, periphery at midline. Aperture D-shaped in slightly prosocline plane. Parietal callus thick, more so adapically. Umbilicus largely plugged, appearing as narrow, crescent-shaped abapical groove. Umbilical callus rather thick, subcircular, expanded against umbilical border, fused with parietal callus. Abapertural outline of inner lip callus (parietal + umbilical) concave. Basal fasciole not observable, likely present. Outer surface with uneven growth markings, more prominent and prosocyrt subsuturally.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
-	-	16.531	16.130	4.742	11.790	9.759
UW	**IS**	**SA**				
-	21°	134°				

Remarks. The preservation of the present specimen, erroneously labeled *Natica canovae* Oppenheim, 1900 in MGP-PD, prevents any reliable comparison with named species.

Stratigraphic occurrence. *Polinices* sp. was recovered from Priabonian marly deposits of Veneto.

Genus *Sigatica* Meyer & Aldrich, 1886

Sigatica Meyer & Aldrich, 1886, p. 42. Type species by monoypy: *Sigaretus (Sigatica) boettgeri* Meyer & Aldrich, 1886, Eocene, United States.

Gennaeosinum Iredale, 1929, p. 279. Type species by original designation: *Gennaeosinum peleum* Iredale, 1929.

Glyptanatica Gardner, 1947, p. 554. Type species by original designation: *Sigatica (Glyptanatica) euglypta* Gardner, 1947.

Nerinatica Olsson, 1930, p. 68. Type species by original designation: *Natica (Nerinatica) paytensis* Olsson, 1930.

Kabat (1991, p. 430) regarded *Heliconatica* Dall, 1924 as a subjective synonym of *Sigatica*. However, *Eunaticina (Heliconatica) margaritaeformis* Dall, 1924 (type species of *Heliconatica*) is devoid of funicle (present in *Sigatica*) and appears to agree closely with the characters of *Eunaticina* Fischer, 1885. On this basis, we concur with Torigoe & Inaba (2011) in considering *Heliconatica* a synonym of *Eunaticina*. According to Kabat (1991), *Sigaticus* Aldrich, 1887 is an unjustified emendation.

Sigatica was originally proposed as a subgenus of *Sigaretus* Lamarck, 1799 (= *Sinum* Röding, 1798). Meyer & Aldrich (1886, p. 42) considered the globose shell, the wide umbilicus, the inner lip without callus, the spiral striation of basal and upper part of the whorls, and of the interior of the umbilicus as distinguishing characters of *Sigatica*. Examination of the type species and of those confidently assigned to *Sigatica* allowed us to define the diagnostic characters of this genus as follows: 1) shell globose in most species; 2) umbilicus wide and spirally sculptured in most species; 3) funicle present, variously developed; 4) umbilical callus triangular, demarcated from the parietal callus by a groove, or prominent, rounded, separated from the parietal callus by a distinct sinus in some species (see also Kabat 2000, figs. 41, 42); 5) spiral sculpture restricted to subsutural and/or basal part of the whorls, extending across the entire last whorl in some species. The spiral sculpture within the umbilicus, present in most species of *Sigatica*, occurs also in species of *Euspira* Agassiz in J. Sowerby, 1837, e.g. *Euspira magenesi* Pedriali & Robba, 2001 and *Euspira nysti* (d'Orbigny, 1852). However, this character, combined with the spiral sculpture of the teleoconch, is another useful distinguishing element of *Sigatica*.

Steven Tracey (NHM) collected from the London Clay (Div. C1, Kingsclere) a shell of *Sigatica hantoniensis* (Pilkington, 1804) with the operculum still filling the aperture. We obtained from Alan

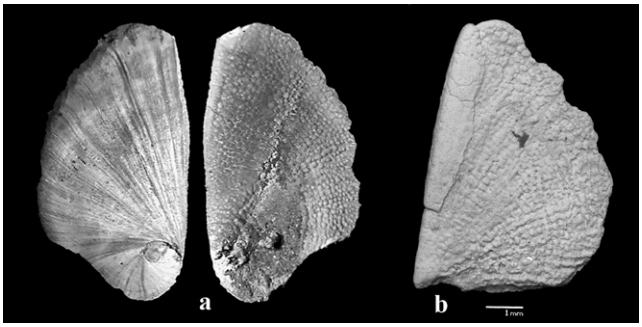


Fig. 18 - Outer surface of the operculum of fossil *Sigatica* species: a, *Sigatica hantoniensis* (Pilkington, 1804), Early Eocene, London Clay, Division C1, Kingsclere, United Kingdom; b, *Sigatica clarkeana* (Aldrich, 1887), Early Eocene, Hatchetigbee Formation (Upper member), Hatchetigbee Bluff, Tombigbee River, Washington County, Alabama, USA.

Morton an excellent photograph of this operculum (Fig. 18a) and could note that it has the whole outer surface sculptured with coalescent beads roughly arranged into radial rows, and that it seems to be solid and calcified throughout. Other opercula of *S. hantoniensis*, with identical external sculpture, were figured by Deshayes (1864, pl. 68, figs. 29, 30), von Koenen (1891, pl. 40, figs. 4a, b) and Gürs (1983, pl. 4, figs. 10a, b). Also the operculum of the lower Eocene, US species *Sigatica clarkeana* (Aldrich, 1887) exhibits a closely similar outer sculpture and seems to be calcified throughout (Fig. 18b). The presence of a solid, calcified operculum would imply a subfamilial affiliation of *Sigatica* with the Naticinae. However, Marincovich (1977, p. 212) affirmed that *Eunaticina insculpta* (Carpenter, 1865), a poliniceine species (see remarks herein on the genus *Eunaticina* Fischer, 1885), has a partially calcified operculum, and wrote "whereas the inner surface of the operculum is entirely corneous, most of the outer surface has a thin calcareous coating formed of radial rows of minute, coalescent beads". It appears that the external sculpture of the operculum of both *S. hantoniensis* and *E. insculpta* is remarkably similar. On this basis, *Sigatica* is herein provisionally included in the subfamily Poliniceinae. Only future recovering of *in situ*, fully calcified opercula of other *Sigatica* species (especially Recent species) will demonstrate that *Sigatica* is to be moved to the Naticinae.

Eunaticina Fischer, 1885 is another spirally sculptured poliniceine genus, which differs from *Sigatica* in that its species have an oval, more elongate teleoconch with the open umbilicus devoid of funicle. *Sigaretopsis* Cossmann, 1888 (type species *Natica infundibulum* Watelet, 1853 by original designation), originally introduced as a "section" of *Natica* Adanson, 1757, was later on regarded either as a synonym of *Natica* Scopoli, 1777 (Newton 1891), or as a synonym of *Polinices* Montfort, 1810 (Dall 1909), or as a subgenus of *Gyrodes* Conrad, 1860 (Cossmann 1925; Murphy & Rodda 1960), or as a subgenus of *Sigatica* (Forney & Nitecki 1976; Pacaud & Le Renard 1995). Actually, *Sigaretopsis* appears to be related to *Sigatica* because of its shell shape, its open umbilicus with inner spirals, and its subsutural spiral cords. We examined the specimen referred to as *Natica (Sigaretopsis) infundibulum* by Cossmann & Pissarro (1907) in MNHN (F-J02184) and can note that the absence of funicle stands as the main difference between *Sigatica* and *Sigaretopsis*. On the basis of the cited difference, we are inclined to consider *Sigaretopsis* as a poliniceinae genus distinct from *Sigatica*. Kabat (1991, p. 436) regarded *Sigaretopsis* as a synonym of *Mammilla* Schumacher, 1817. Kabat's conclusion is untenable because of the many important differences between *Natica infundibulum* and *Albula mammata* Röding, 1798, type species of *Mammilla*.

Sigatica was hitherto known from Eocene to Holocene deposits of United States, from the Eocene of Northern Europe, and from the Miocene and the Holocene of Japan; the Eocene *Sigatica* species described below stand for the first sure record of the genus from Italy. Recent species of *Sigatica* occur in the tropical Atlantic and Indo-Pacific oceans.

Sigatica claudiae sp. n.

Pl. 14, figs. 1, 2

Derivation of name: The species is named for Claudia Savegnago, wife of the late collector Isidoro Rossi, who donated her husband's collection to MGP-PD.

Holotype: Cava Boschetto: MGP-PD 31525 (Pl. 14, fig. 1).

Paratypes: Cava Albanello: 3 spms., MGP-PD 1231R; Cava Boschetto: 1 spm., MPUM 11362 (Pl. 14, fig. 2), 1 spm., NP 9815; Cava Rossi: 1 spm., MCZ 4335.

Preservation: All specimens have the surface abraded at various extent.

Type locality: Cava Boschetto (see appendix).

Horizon: Greenish-gray tuff of early Lutetian age.

Diagnosis: Globose, low-spired shell with deep, very large umbilicus, robust, moderately prominent funicle and semicircular umbilical callus, separated from parietal callus by slight sinus. Umbilical wall with two-four spiral cords. Surface of last whorl with traces of spiral cords over base.

Description. Protoconch small, low-turbiniform, of two slightly convex whorls, tip medium-

sized. Teleoconch small, globose, rather thick. Spire low-conical, moderately depressed, whorls very slightly convex. Suture adpressed (almost flush). Last whorl inflated, slightly depressed; subsutural shelf indistinct; periphery at midline. Aperture D-shaped, prosocline, length about twice width. Parietal callus thick, rectangular, ending at level of umbilical border. Umbilicus deep, very large; umbilical border rounded, overhanging umbilical wall; umbilical wall slightly concave, bounded upward by groove and bearing two to four spiral cords crossed by growth lines. Funicle robust, moderately prom-inent, in mid-adapical part of umbilicus. Umbilical callus rather thick, semicircular, separated from parietal callus by slight sinus. Basal fasciole indistinct. Surface of last whorl with traces of spiral cords over basal part.

Dimensions (mm)

DHW	PD	H	D	SH
0.227*	0.773*	5.597-7.473	4.891-6.519	0.943-2.063
* 1 protoconch measured		6.535	5.705	1.503
AH	**AW**	**UW**	**IS**	**SA**
4.289-5.777	2.594-3.122	1.442-3.274	17°-25°	103°-119°
5.033	2.858	2.358	21°	111°

Remarks. The present form is herein assigned to the genus *Sigatica* Meyer & Aldrich, 1886 on account of its teleoconch shape, its widely open umbilicus with inner spiral cords and thick funicle, and its basal spiral cords. *Sigatica claudiae* sp. n. is closely similar to *Sigatica eleonorae* sp. n. (see below) in shell shape and adapical location of the funicle, but differs from it in that it has: 1) a protoconch with significantly smaller diameter and diameter of the first half-whorl, 2) an umbilical wall bounded by a distinct groove and overhung by the umbilical border, and 3) a more prominent funicle; it is also worth noting that *S. claudiae* attains a smaller size.

Stratigraphic occurrence. *Sigatica claudiae* sp. n. was recovered from upper Ypresian-lower Lutetian deposits of Veneto.

Sigatica eleonorae sp. n.

Pl. 14, figs. 3, 4

? 1870a *Natica hantoniensis* - Bayan, p. 461.
? 1870 *Natica hantoniensis* - Fuchs, p. 195.
? 1894 *Natica hantoniensis* - Oppenheim, pp. 442, 445.
1985 *Sigatica hantoniensis* - Brigantini, p. 414, pl. 2, fig. 34 (not Pilkington, 1804).
2008 *Sigatica hantoniensis* - Quaggiotto & Mellini, p. 48, pl. 6, fig. 56 (not Pilkington, 1804).

Derivation of name: The species is named for Eleonora, daughter of one of the present authors (L.P.).

Holotype: Cava Grola: MCZ 4336 (Pl. 14, fig. 3).

Paratypes: Cava Albanello: 1 spm., MGP-PD 31526, 1 spm., MCZ 4337; Cava Grola: 1 spm., MCZ 4338 (Pl. 14, fig. 4); Ciupio: 1 spm., MGP-PD 11624/c-11664/c; Monte Merlo: 1 spm., MGP-PD 31527.

Other material examined: Cava Albanello: 3 spms., private collection, 1 spm., private collection; Cava Grola: 2 spms., private collection, 1 spm., private collection; Cava Rossi: 1 spm., private collection; Monte Merlo: 1 spm., NP 9814.

Preservation: All specimens have the surface abraded at various extent.

Type locality: Cava Grola (see appendix).

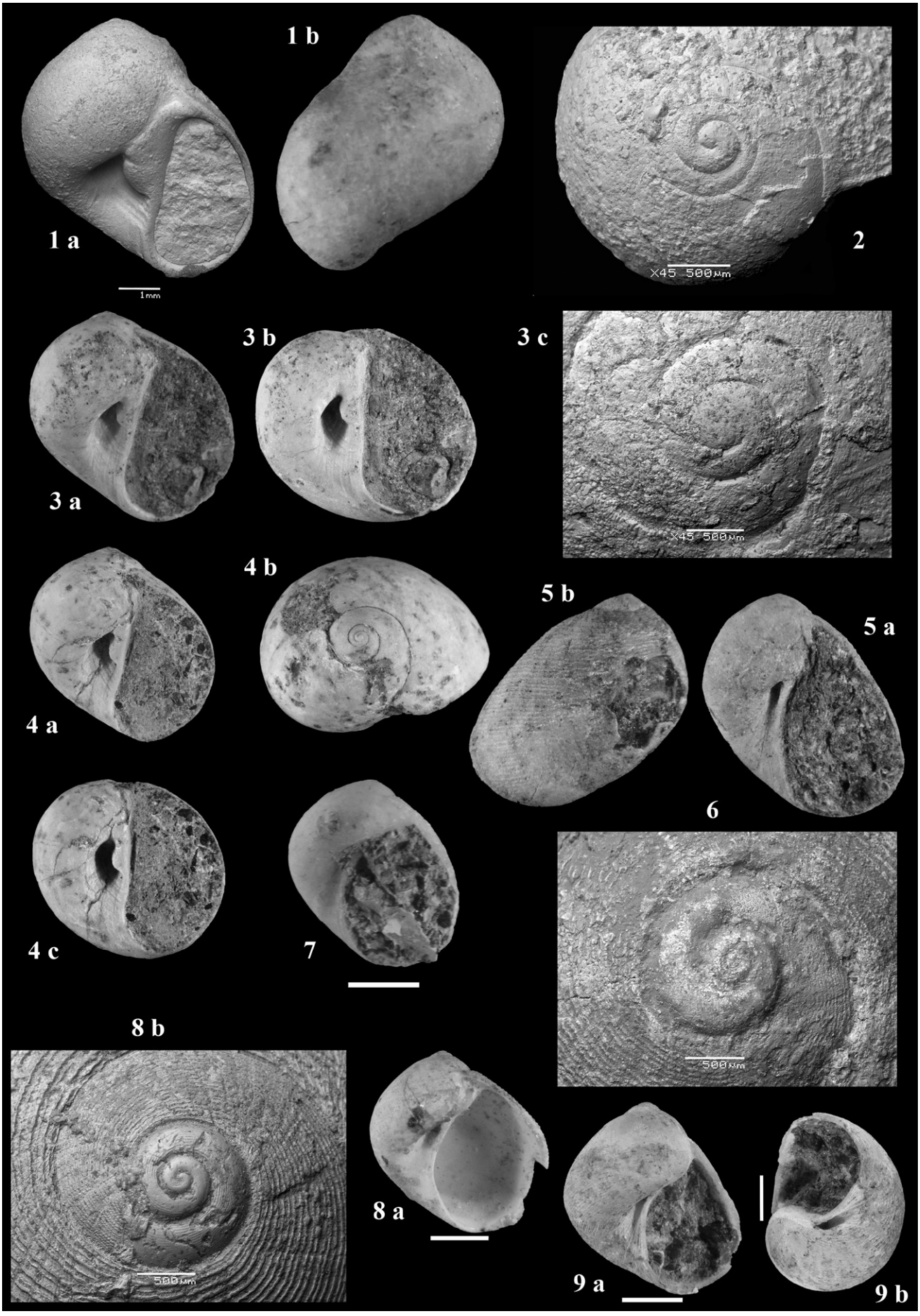
Horizon: Greenish-gray volcanoclastic sandstone of middle Lutetian age.

Diagnosis: Globose, low-spired shell with deep, large to very large umbilicus, robust, moderately depressed funicle and semicircular umbilical callus, separated from parietal callus by deep sinus. Umbilical wall with coarse spiral cords. Surface of last whorl with traces of uneven, low spiral cords throughout.

Description. Protoconch large, low-turbiniform, of 2-2.10 slightly convex whorls, tip large. Teleoconch globose, rather thin. Spire low-conical, moderately depressed, whorls very slightly convex; suture adpressed (almost flush). Last whorl inflated, moderately depressed, somewhat expanded toward aperture in larger specimens; subsutural shelf in-

PLATE 14

Fig. 1 - *Sigatica claudiae* sp. n. Cava Boschetto. Holotype, MGP-PD 31525; a, apertural side; b, abapertural side.
Fig. 2 - *Sigatica claudiae* sp. n. Cava Boschetto. Paratype, MPUM 11362; protoconch.
Fig. 3 - *Sigatica eleonorae* sp. n. Cava Grola. Holotype, MCZ 4336; a, apertural side (height of shell 23.67 mm); b, basal view; c, protoconch.
Fig. 4 - *Sigatica eleonorae* sp. n. Cava Grola. Paratype, MCZ 4338; a, apertural side (height of shell 20.29 mm); b, apical view; c, basal view.
Fig. 5 - *Sigaretotrema checchii* sp. n. Cava Grola. Holotype, MPUM 11363; a, apertural side (height of shell 18.13 mm); b, abapertural side.
Fig. 6 - *Sigaretotrema checchii* sp. n. Cava Albanello. Paratype, MGP-PD 31528; protoconch.
Fig. 7 - *Sigaretotrema clathratum deshayesi* (Michelotti, 1847). Colli Torinesi. MGPT BS.029.08.003; apertural side (scale bar 4 mm).
Fig. 8 - *Sigaretotrema clathratum deshayesi* (Michelotti, 1847). Colli Torinesi. MGPT BS.029.08.003/01; a, apertural side (scale bar 4 mm); b, protoconch.
Fig. 9 - *Sigaretotrema michaudi* (Michelotti, 1847). Colli Torinesi. Neotype (here designated) of *Sigaretus michaudi* Michelotti, 1847. MGPT BS.029.07.001; a, apertural side; b, basal view (scale bars 4 mm).


1 b
1 a
1 mm
2
X45 500µm
3 b
3 c
3 a
X45 500µm
4 b
5 b
5 a
4 a
6
4 c
7
500µm
8 b
8 a
500µm
9 a
9 b

distinct; periphery above midline. Aperture D-shaped in slightly prosocline plane, length about twice width. Parietal callus thick, rectangular, ending at level of umbilical border. Umbilicus deep, large to very large; umbilical border rounded; umbilical wall concave, bearing coarse, rough spiral cords crossed by growth lines. Funicle robust, moderately depressed, in mid-adapical part of umbilicus. Umbilical callus rather thick, semicircular, separated from parietal callus by deep sinus, shallower to obsolescent in larger specimens. Basal fasciole indistinct. Surface of last whorl with traces of uneven, low spiral cords throughout, better discernible over basal part.

Dimensions (mm)

DHW	PD	H	D	SH
0.440-0.552	1.566-1.714	12.351-26.771	10.465-27.193	0.973-4.969
0.496	1.640	19.561	18.829	2.971
AH	**AW**	**UW**	**IS**	**SA**
10.302-22.878	6.623-16.775	4.845-13.673	16-24°	112°-140°
16.590	11.699	9.259	20°	126°

Remarks. Four European species have been hitherto included in *Sigatica*, i.e. *Natica abducta* Deshayes, 1864, *Nerita hantoniensis* Pilkington, 1804, *Natica obovata* Sowerby, 1850 (Wrigley 1949; Pacaud & Le Renard 1995), and *Natica repanda* Deshayes, 1864 (Glibert 1963; Pacaud & Le Renard 1995).

Natica abducta and *Natica repanda* were thoroughly described by Deshayes (1864), who unambiguously stated that both species have the umbilicus devoid of funicle and a smooth outer surface (except for growth markings). We examined the specimen of *N. abducta* figured by Cossmann & Pissarro (1907; MNHN-F-J02173) and noted that it lacks the funicle and has spiral sculpture neither on the outer surface nor within the umbilicus. On this basis, it is apparent that neither *N. abducta* nor *N. repanda* can be assigned to *Sigatica* and a comparison with *Sigatica eleonorae* sp. n. is therefore unnecessary.

Nerita hantoniensis fully matches the characters of *Sigatica*. The original material of Pilkington's species is not in NHM (Consuelo Sendino, personal communication 2012) and we were unable to locate it elsewhere. Consequently, for comparison with *Sigatica eleonorae*, we make reference to two relevant specimens, i.e. that illustrated by Wrigley (1949, fig. 38; NHM PI G 67417) and that illustrated by Cossmann & Pissarro (1907, pl. 9, fig. 61-21; MNHN-F-J02171). Examination of these specimens and of another from the Barton Beds shows that *S. eleonorae* is morphologically similar to *N. hantoniensis*, but differs from it in that it has: 1) a protoconch with one fewer whorl and with the diameter of the first half-whorl over three times greater, 2) a parietal callus devoid of anterior lobe, 3) a better developed funicle, and 4) a semicircular umbilical callus demarcated from the parietal callus by a sinus, whereas it is subtriangular, separated from the parietal callus by a transverse groove in *N. hantoniensis*. It is difficult to compare the respective sculptural characters since the considered specimens have an abraded surface; however, there seems to be no significant difference, the spirals being manifest subsuturally and basally, less so in the middle of last whorl in both species. No reliable evaluation of the number of spirals can be done because of abrasion. *Sigatica hantoniensis* seems to be restricted to Paris and North Sea Basins. The records of *Natica hantoniensis* from Eocene units of Vicenza area made by Bayan (1870a), Fuchs (1870) and Oppenheim (1894) likely refer to *Sigatica eleonorae*, but without examination of the material dealt with by these authorities nothing can be stated definitely in this respect.

Natica obovata also belongs in *Sigatica* since it has the umbilicus with a low but distinct funicle and fine spiral grooves on the subsutural area and around the umbilicus. Its assignment to the genus *Pliconacca* Martin, 1914, assumed by Majima (1989, p. 67), is untenable because *Natica (Pliconacca) trisulcata* Martin, 1914, type species of *Pliconacca*, has an unsculptured shell and the inner lip callus with prominent transverse folds. *N. obovata* differs markedly from *Sigatica eleonorae* in that it has: 1) a oval shell with more elevated spire, 2) a narrower umbilicus devoid of inner spirals, and 3) a subtriangular umbilical callus separated from the parietal callus by a transverse groove. The specimen figured by Wrigley (1949; NHM PI G 67418) has fine spiral grooves observable only subsuturally and basally. Its protoconch is abraded, but the diameter of the first half-whorl seems definitely smaller than that of the protoconch of *S. eleonorae*.

Stratigraphic occurrence. *Sigatica eleonorae* sp. n. was recovered from upper Ypresian, lower and middle Lutetian deposits of Veneto.

Subfamily Sininae Woodring, 1928

The subfamily Sininae includes genera characterized by spirally sculptured teleoconchs (mostly the last two whorls). The teleoconch is: 1) auriculate, variably flattened, with very depressed spire and with the umbilicus closed or reduced to a faint chink (*Sinum* Röding, 1798), or 2) globose, low-spired, with open umbilicus (*Sigaretotrema* Sacco, 1890). The operculum of the sinine species was said to be corneous, reduced to vestigial (Kilburn 1976; Kabat 1998). Huelsken et al. (2012, p. 373), on the basis of molecular data, stated that the Sininae should be "a true subfamilial taxon independent of Polinicinae".

Genus *Sigaretotrema* Sacco, 1890

Sigaretotrema Sacco, 1890b, p. 38 . Type species by monotypy: *Sigaretus michaudi* Michelotti, 1847, Oligocene to early Miocene, Piedmont.

Propesinum Iredale, 1924, p. 256. Type species by original designation: *Natica umbilicata* Quoy & Gaimard, 1832.

Sigaretotrema was originally proposed as a subgenus of *Sigaretus* Lamarck, 1799 (= *Sinum* Röding, 1798). Kabat (1991, p. 436) regarded *Sigaretotrema* as a junior subjective synonym of *Eunaticina* Fischer, 1885. *Sigaretotrema* is herein considered as distinct from *Eunaticina* since the species of *Eunaticina* have more elongate, oval shells with taller spire, more convex whorls separated by shallowly channeled sutures (those of *Sigaretotrema* species are adpressed), and the apertures that are more prosocline, more produced abapically, with length almost twice the width. According to Kabat (1991, p. 435), *Propesinum* is another junior subjective synonym of *Eunaticina*. However, the type species of *Propesinum*, is more similar to *Sigaretus michaudi* than to the type species of *Eunaticina* (*Nerita papilla* Gmelin, 1791). Consequently, we concur with Finlay & Marwick (1937) in considering *Propesinum* as a synonym of *Sigaretotrema*. We are uncertain about the suprageneric allocation of *Sigaretotrema* and provisionally follow Pacaud & Le Renard (1995), which included it in the subfamily Sininae.

Sacco (1890b, p. 38) cited the conical-subglobose shell, the slightly convex whorls and the visible, variously deep umbilicus as the main distinguishing characters of *Sigaretotrema*. Examination of the type species (described herein) and of several European species certainly belonging in *Sigaretotrema* enabled us to define the diagnostic characters of the genus as follows: 1) protoconch depressed-turbiniform, smooth or spirally sculptured; 2) teleoconch globose in most species; 3) spire low, conical to dome-shaped; 4) whorls very slightly convex, sutures adpressed; 5) umbilicus open, deep, narrow in most species; 6) aperture broad, nearly as wide as high in most species; 7) sculpture of spiral cords, with intervening cordlets and/or threads in most species.

Sigaretotrema should be present in Eocene to Oligocene deposits of United States; the species *Sigaretus bilix* Conrad, 1833, *Sigaretus declivis* Conrad, 1833, *Sigaretus arctatus* Conrad, 1833 and *Naticina obliqua* Gabb, 1864 seem to belong in *Sigaretotrema* (see the figures published by Van Winkle Palmer 1937, pl. 15 and by Marincovich 1977, pl. 33). The genus occurs in the Eocene of France, Italy and New Zealand, as well as in the early and middle Miocene of some European localities and, possibly, of Australia (*Natica subinfundibulum* Tate, 1893). Modern occurrences are from South Australia and China (*Sigaretus inflatus* Tesch, 1920).

Sigaretotrema checchii sp. n.

Pl. 14, figs. 5, 6

Derivation of name: The species is named after Andrea Checchi, who provided lot of material relevant to the present study.

Holotype: Cava Grola: MPUM 11363 (Pl. 14, fig. 5).

Paratypes: Cava Albanello: 1 spm., MGP-PD 31528 (Pl. 14, fig. 6), 1 spm., MGP-PD 1232R, 1 spm., MGP-PD 1233R, 2 spms., MCZ 4339; Cava Grola: 1 spm., MGP-PD 31529, 1 spm., MCV 15/03; Cava Main: 1 spm., MCZ 4340.

Other material examined: Cava Albanello: 1 spm., private collection; Cava Boschetto: 1 spm., NP 9816; Cava Grola: 1 spm., NP 9817, 4 spms., private collection, 1 spm., private collection, 2 spms., private collection.

Preservation: Most specimens have the surface somewhat abraded.

Type locality: Cava Grola (see appendix).

Horizon: Greenish-gray volcanoclastic sandstone of middle Lutetian age.

Diagnosis: Globose to oval, low-spired shell with deep, rather narrow umbilicus. Funicle and umbilical callus absent. Aperture oval, slightly prosocline. Sculpture starting with 16-17 rounded, closely set spiral cords becoming uneven and unevenly spaced, slightly undulating, finer over base.

Description. Protoconch small, low-turbiniform, of two moderately convex, apparently smooth whorls, tip small. Teleoconch globose, oval in larger specimens, thin to moderately thick. Spire broadly conical, rather depressed, whorls

very slightly convex. Suture adpressed (almost flush). Last whorl globose-ovate, moderately depressed, slightly extended toward aperture, much so in fully grown specimens; subsutural shelf indistinct; periphery above midline. Aperture oval in slightly prosocline plane, length about 1.7 times width. Mid-abapical part of inner lip rather thick, gently arched. Parietal callus rather thick, with concave abapertural outline, ending with very slight lobe at level of umbilical border or slightly below it. Umbilicus deep, rather narrow; umbilical border broadly rounded; umbilical wall steep. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of 16-17 rounded, closely set spiral cords on first quarter of first teleoconch whorl, then slightly undulating, nearly flat-topped, uneven and unevenly spaced, increasingly finer over base; spirals crossed by dense growth markings. Last whorl of one specimen retains traces of rectangular spots arranged into two spiral rows, respectively halfway between suture and periphery and peripheral.

Dimensions (mm)

DHW	PD	H	D	SH
0.161*	0,707*	10.040-19.076	10.594-18.474	1.115-4.011
* 1 protoconch measurable		14.558	14.534	2.563
AH	**AW**	**UW**	**IS**	**SA**
8.375-15.615	6.224-13.552	1.633-3.429	25°-53°	108°-128°
11.995	9.888	2.531	39°	118°

Remarks. The present new species is characterized by its globose-ovate, moderately depressed last whorl noticeably extended toward the aperture. *Sigaretotrema checchii* somewhat resembles the Eocene species *Sigaretotrema clathratum* (Gmelin, 1791), but is readily distinguished from it because of its probably smooth protoconch of 0.7 fewer whorls and with significantly greater diameter of the first half-whorl, its less globose teleoconch, its umbilical wall devoid of spirals, and its sculpture of spiral cords with intervening threads or cordlets. The lower Miocene species *Sigaretotrema michaudi* (Michelotti, 1847) is superficially similar, but differs in that it has: 1) a protoconch of 0.5 more whorls and with the diameter of the first half-whorl nearly two thirds of the size, 2) a more globose teleoconch, 3) a wider aperture less produced abapically, 4) an umbilical wall with fine spiral threads, and 5) a sculpture of narrower, more distant spiral cords with one-two threads or one cordlet in their interspaces.

Stratigraphic occurrence. *Sigaretotrema checchii* sp. n. was recovered from lower and middle Lutetian deposits of Vicenza area.

Sigaretotrema clathratum deshayesi

(Michelotti, 1847) comb. n.

Pl. 14, figs. 7, 8

1847 *Sigaretus deshayesi* Michelotti, p. 158.

1891 *Sigaretus (Sigaretus) aquensis* var. *deshayesi* - Sacco, p. 99, pl. 1, fig. 61.

? 1952a *Sigaretus (Sigaretus) aquensis* f. *deshayesi* - Glibert, p. 78, pl. 6, fig. 7.

1971 *Sigaretus (Sigaretus) aquensis* subsp. *deshayesi* - Accorsi Benini, p. 245, pl. 4, figs. 4, 4a.

1984 *Sigaretus aquensis* var. *deshayesi* - Ferrero Mortara et al., p. 38.

Type material: *Sigaretus deshayesi* Michelotti, type material not seen. Michelotti's collection was not located and is possibly lost.

Material examined: Colli Torinesi: 1 spm., MGPT BS.029.08.003 (Pl. 14, fig. 7) [other 3 spms. are *Sigaretus cryptostomoides* Sacco, 1890 and 5 spms. are *Sigaretus haliotideus* var. *patula* Grateloup, 1847, all also numbered BS.029.08.003], 1 spm., MGPT BS.029.08.003/01 (Pl. 14, fig. 8); Case Soghe: 2 spms., MPPLF 5110 pr. (Accorsi Benini collection).

Description. Protoconch medium-sized, low-turbiniform, of 2.75 convex whorls, last 1.3 whorls with even, flatly rounded spiral cordlets, tip small. Teleoconch globose, rather thin. Spire broadly conical, depressed, whorls slightly convex. Suture adpressed. Last whorl globose, slightly depressed, somewhat expanded toward aperture; subsutural shelf indistinct; periphery above midline. Aperture oval in moderately prosocline plane, length about 1.3 times width. Abapical part of inner lip gently arched, thickening upward, slightly bent to merge into parietal callus. Parietal callus rather thin, with concave abapertural outline, ending with very slight lobe below level of umbilical border. Umbilicus deep, narrow; umbilical border broadly rounded; umbilical wall rather steep, with very fine spiral threads. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of 16-18 rounded, closely set spiral cords on first quarter of first teleoconch whorl, then slightly undulating, flat-topped, wider or as wide as interspaces, without threads in interspaces or with one fine thread in some, finer over base; spirals crossed and made somewhat rough by dense growth markings.

Dimensions (mm)

DHW	PD	H	D	SH
0.097-0.121	1.254-1.618	8.140-12.440	7.795-12.915	0.684-3.456
0.109	1.436	10.290	10.355	2.070
AH	**AW**	**UW**	**IS**	**SA**
7.476-8.984	4.867-8.743	1.152-1.888	45°-61°	108°-128°
8.220	6.805	1.520	53°	118°

Remarks. Michelotti (1847), introducing *Sigaretus deshayesi*, published a quite concise diagnosis that reads "*S. testa ovato-depressa, transversim undulato-striata; aperture valde concava; umbilico subtecto*". Michelotti also affirmed that his material was from "la colline de Turin". From this diagnosis, it appears that the umbilicus of *Sigaretus deshayesi* is only partially covered, thence narrow but visible. Since Michelotti's collection is lost, we are forced to make reference to the material in MGPT studied by Sacco (1891) and collected from the same area (Colli Torinesi = la colline de Turin). We have selected from Sacco's specimens labeled *Sigaretus (Sigaretus) aquensis* var. *deshayesi* (Michelotti) those having a narrow, open umbilicus and consider them to be representative of Michelotti's taxon. It is to be noted that *Sigaretus deshayesi* agrees with the characters of *Sigaretotrema* Sacco, 1890 and is unrelated to *Sigaretus aquensis* Récluz, 1851 (= *Sigaretus patulus* Grateloup, 1847, see below), which has a more depressed, imperforated teleoconch and belongs in *Sinum* Röding, 1798.

Sigaretus deshayesi is strikingly similar to *Nerita clathrata* Gmelin, 1791 (also belonging in *Sigaretotrema*). In order to clarify the relationships between these two taxa, the shells of Gmelin's species figured by Cossmann & Pissarro (1907, pl. 10, fig. 62-1; MNHN-F-J02185), by Wrigley (1949, fig. 45; NHM PI G 67423), and others from Middle Barton Beds (Great Britain) and from Oise (France) in our collection were examined. We note that the characteristic elements of the protoconch of both taxa are identical, as are the shell shape, the aperture and the bulk of sculptural characters. However, *S. deshayesi* has the protoconch with nearly flat, wider and less numerous spirals, attains a smaller size and has few or no threads at all in between the spiral cords. These differences are not considered to be sufficient for consistent separation at the species level. Consequently, we regard the Miocene *S. deshayesi* as an allochronous subspecies of the Eocene *Sigaretotrema clathratum*.

Sigaretotrema clathratum deshayesi is closely similar to *Sigaretotrema michaudi* (Michelotti, 1847), but differs from it in having the sculptured protoconch with significantly greater diameter and diameter of the first half-whorl, and the teleoconch with finer spiral cords with scarce or no threads in the interspaces. Glibert (1952a) figured a shell referred to as *Sigaretus (Sigaretus) aquensis* f. *deshayesi* Michelotti, 1847. From Glibert's figure, that shell seems to have a narrow umbilicus and could be Michelotti's taxon. However, having not seen the specimen, we include it in the synonymy of *Sigaretus deshayesi* with reservation.

Stratigraphic occurrence. *Sigaretotrema clathratum deshayesi* (Michelotti, 1847) is surely known from the early Oligocene of Veneto and from the early Miocene (Burdigalian) of Piedmont.

Sigaretotrema michaudi (Michelotti, 1847)

Pl. 14, fig. 9; Pl. 15, fig. 1

1847 *Sigaretus michaudi* Michelotti, p. 158, pl. 6, figs. 16, 18.

? 1862 *Sigaretus michaudi* - Doderlein, p. 18.

1890b *Sigaretus (Sigaretotrema) michaudi* var. *clausula* Sacco, p. 38.

1890b *Sigaretus (Sigaretotrema) michaudi* var. *eunaticinoides* Sacco, p. 38.

1890b *Sigaretus (Sigaretotrema) michaudi* var. *pseudoaquensis* Sacco, p. 38.

1891 *Sigaretus (Sigaretotrema) michaudi* - Sacco, p. 97, pl. 1, fig. 55.

1891 *Sigaretus (Sigaretotrema) michaudi* var. *clausula* - Sacco, p. 97, pl. 1, fig. 56.

1891 *Sigaretus (Sigaretotrema) michaudi* var. *eunaticinoides* Sacco, p. 98, pl. 1, fig. 57.

1891 *Sigaretus (Sigaretotrema) michaudi* var. *pseudoaquensis* Sacco, p. 98, pl. 1, fig. 58.

not 1960 *Sinum (Sigaretotrema) michaudi* - Kojumdgieva & Strachimirov, p. 122, pl. 34, fig. 1 (not Michelotti, 1847).

1984 *Sigaretus michaudi* - Ferrero Mortara et al., p. 37.

1984 *Sigaretus michaudi* var. *clausula* - Ferrero Mortara et al., p. 37.

1984 *Sigaretus michaudi* var. *eunaticinoides* - Ferrero Mortara et al., p. 38.

1984 *Sigaretus michaudi* var. *pseudoaquensis* - Ferrero Mortara et al., p. 38.

2007 *Eunaticina michaudi* - Zunino, p.126, pl. 1, fig. 13.

Type material: *Sigaretus michaudi* Michelotti, neotype (here designated): the specimn figured by Sacco (1891, pl. 1, fig. 55) and refigured herein (Pl. 14, fig. 9), MGPT BS.029.07.001, Colli Torinesi (see remarks below). *Sigaretus (Sigaretotrema) michaudi* var. *clausula* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 1, fig. 56), MGPT BS.029.07.002, Colli Torinesi. *Sigaretus (Sigaretotrema) michaudi* var. *eunaticinoides* Sacco, holotype (by monotypy): the shell

figured by Sacco (1891, pl. 1, fig. 57), MGPT BS.029.07.003, Colli Torinesi. *Sigaretus (Sigaretotrema) michaudi* var. *pseudoaquensis* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 1, fig. 58), MGPT BS.029.07.004, Colli Torinesi.

Material erroneously referred to as *Sigaretus (Sigaretus) aquensis* var. *praecedens* Sacco, 1890 in MGPT: Dego: 1 syntype, MGPT BS.029.08.001/01.

Other material examined: Colli Torinesi: 7 spms., MGPT BS.029.07.001/01; Termofourà: 1 spm., MGPT-PU 23519 (Pl. 15, fig. 1); Valle Ceppi: 1 spm., MGPT-PU 25268 (specimen of Zunino 2007), 2 spms., PG 32.

Description. Protoconch small, low-turbiniform, of 2.55 slightly convex whorls, tip very small. Teleoconch globose, rather thick. Spire low-conical, moderately depressed, whorls slightly convex. Suture adpressed. Last whorl globose, moderately depressed, slightly expanded toward aperture; subsutural shelf indistinct; periphery about at midline. Aperture ovate- to roundly-quadrangular in slightly prosocline plane, length about 1.5 times width. Abapical part of inner lip thick, almost straight. Parietal callus rather thin, with concave abapertural outline, ending with very slight lobe at level of umbilical border. Umbilicus deep, narrow; umbilical border broadly rounded; umbilical wall steep, with fine spiral threads. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of rather coarse spiral cords, nine-ten on first quarter of first teleoconch whorl, soon increasing in number and with one-two threads or one cordlet in interspaces; spirals crossed and made rough by dense growth markings.

Dimensions (mm)

DHW	PD	H	D	SH
0.063*	0.597*	14.532-19.420	14.652-21.848	1.994-4.850
* 1 protoconch measurable		16.976	18.250	3.422
AH	**AW**	**UW**	**IS**	**SA**
12.018-15.090	8.652-14.032	2.504-5.020	38°-58°	112°-128°
13.554	11.342	3.762	48°	120°

Remarks. Repeated inquiries about the location of Michelotti collection had negative results and that collection is to be considered lost (Giulio Pavia, personal communication 2013). Since Sacco (1891, p. 97), in the remarks to *Sigaretus* (*Sigaretotrema) michaudi*, explicitly affirmed to have examined Michelotti's type specimens, his specimens in MGPT, collected from the same area (colline de Turin = Colli Torinesi), stand as the most relevant reference material for *Sigaretotrema michaudi*. Thus, it is advisable to designate the shell figured by Sacco (1891, pl. 1, fig. 55) as the neotype of *S. michaudi*, in order to clarify and fix the characters of Michelotti's species (ICZN 1999, Article 75 of the Code).

The Eocene species *Nerita clathrata* Gmelin, 1791 (for the examined material, see the remarks on *Sigaretotrema clathratum deshayesi*) is the closest relative of *Sigaretotrema michaudi*. Both species have similarly shaped teleoconchs and identical umbilical characters. However, *S. michaudi* is distinguished from *Sigaretotrema clathratum* in that it has: 1) a protoconch with significantly smaller diameter and diameter of the initial half-whorl, 2) a more inflated last whorl, 3) a more distinctly angular inner lip, 4) the teleoconch sculpture starting with nine-ten spiral cords (with 16-18 in *S. clathratum*), and 5) more numerous threads/cordlets in between the spiral cords. Gmelin's species has a spirally sculptured larval shell; nothing can be said as regards *S. michaudi*, since all the examined specimens have the protoconch decorticated to a variable extent. *Sigaretotrema levesquei* (Deshayes, 1864) is another closely related species. We have examined the specimen figured by Cossmann & Pissarro (1907, pl. 10, fig. 62-2; MNHN-F-J02186) and can note that *S. levesquei* is distinguished from *S. michaudi* in having the protoconch with significantly greater diameter and smaller diameter of the first half-whorl, and the sculpture of rough, uneven and unevenly spaced spiral cordlets without threads in the interspaces.

In the course of consultation of the syntypes of the Burdigalian *Sigaretus subcanaliculatus* d'Orbigny, 1852 in MNHN (5 specimens collectively numbered F-B27769), we noticed that one syntype (the smallest) belongs in *Sigaretotrema* because of its more globose teleoconch with well distinct umbilicus (the other four syntypes belong in *Sinum* Röding, 1798). This specimen likely represents an unnamed species of *Sigaretorema* that resembles *Sigaretotrema michaudi*, but differs from it at least by its sculptured protoconch with significantly greater diameter and diameter of the first half-whorl. *S. subcanaliculatus* is currently regarded as a synonym of *Sinum patulum* (Grateloup, 1847).

Sacco (1891, p. 97) proposed the variety *exclathrata* of *Sigaretus (Sigaretotrema) michaudi* on the basis of the shell figured by Hoernes (1856, pl. 46, fig. 28) and referred to as *Sigaretus clathratus* Recluz, 1843. We obtained outstanding photographs

of the specimen of *Sigaretus clathratus* (NHMW 2013/0053/0001) illustrated by Schaffer (1912), supposedly identical to that of Hoernes (Mathias Harzhauser, personal communication 2013). From the photographs, it appears that the Austrian shells differ from *Sigaretotrema michaudi* in having a two-whorled protoconch (that of Michelotti's species exceeds three whorls), a less globose teleoconch with the last whorl more extended toward the aperture, and a narrower umbilicus. Accordingly, Hoernes' and Schaffer's specimens represent a separate species from *S. michaudi* and cannot be regarded as a variety of it. The Austrian shells also seem not to fully agree with the characters of *Sigaretotrema clathratum*. Should they prove to represent an unnamed *Sigaretotrema* species (a decision is beyond the purpose of this study), the name *exclathrata* remains available for it. Concerning the other Sacco's varieties of *Sigaretus (Sigaretotrema) michaudi* (see the above synonymy), we have examined the respective original material in MGPT and can state that they cannot be distinguished from *S. michaudi* consistently. We assign to *S. michaudi* also one Oligocene shell in MGPT erroneously referred to as *Sigaretus (Sigaretus) aquensis* var. *praecedens* Sacco, 1890 by Sacco (1891).

The Tortonian Bulgarian shell figured by Kojumdgieva & Strachimirov (1960) and referred to as *Sinum (Sigaretotrema) michaudi* (Michelotti, 1847) appears to differ markedly from Michelotti's species in that it has an oval, more elongated teleoconch with taller spire, wider umbilical opening and nearly D-shaped aperture with length twice the width. According to the figure published by Kojumdgieva & Strachimirov, that shell likely represents an unnamed species of the genus *Eunaticina* Fischer, 1885.

Stratigraphic occurrence. *Sigaretotrema michaudi* (Michelotti, 1847) was hitherto known from lower Oligocene and lower Miocene (Burdigalian) units of Piedmont. Records from the Tortonian of Montegibbio (Doderlein 1864) and those from Germany are doubtful and need to be confirmed.

Sigaretotrema sp.

Pl. 15, fig. 2

Material examined: Cava Rossi: 1 spm., MPUM 11364 (Pl. 15, fig. 2), 1 spm., private collection.

Description. Protoconch small, low-turbiniform, of 2.5 moderately convex, apparently smooth whorls, tip small. Teleoconch globose, nearly as wide as high, rather thick. Spire broadly conical, depressed, whorls almost flat-sided. Suture adpressed (almost flush). Last whorl globular, slightly expanded toward aperture; subsutural shelf indistinct, only scarcely defined behind outer lip; periphery above midline. Aperture teardrop-shaped in slightly prosocline plane, length 1.5 times width. Outer lip subangular adapically; middle part of inner lip nearly straight, increasingly thick upward. Parietal callus rather thin, with concave abapertural outline, ending with faint lobe slightly below umbilical border. Umbilicus deep, moderately wide; umbilical border rounded; umbilical wall steep, bounded by groove. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of seven-eight rounded, closely set spiral cords on first quarter of first teleoconch whorl, then slightly undulating, flat-topped, uneven, wider than interspaces that bear one-two threads, finer over base; spirals crossed by dense growth markings.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.125	0.707	18.470	18.611	2.370	16.101	11.900
IS	**SA**					
39°	126°					

Remarks. The globular teleoconch nearly as wide as high is the primary character that differentiates the present specimens from the other European species of *Sigaretotrema* Sacco, 1890. They are distinguished from *Sigaretotrema checchii* sp. n. (see above) also in having the protoconch of 0.5 more whorls, with significantly smaller diameter of the first half-whorl. Compared to *Sigaretotrema michaudi* (Michelotti, 1847), besides the different shell shape, they have a protoconch with significantly greater diameter of the first half-whorl. The two examined specimens certainly represent a previously undescribed species, but more, better preserved material is required in order to name it.

Stratigraphic occurrence. *Sigaretotrema* sp. was recovered from upper Ypresian-lowermost Lutetian deposits of Cava Rossi (Veneto).

Genus *Sinum* Röding, 1798

Sinum Röding, 1798, p. 14. Type species by subsequent designation (Dall 1915, p. 109): *Helix haliotoidea* Linnaeus, 1758, Recent, Indo-Pacific.

Sigaretus Lamarck, 1799, p. 77. Type species by monotypy: *Helix haliotoidea* Linnaeus, 1758.

Sigaretarius Duméril, 1806, p. 164. Type species by subsequent designation (Kabat 1991, p. 436): *Helix haliotoidea* Linnaeus, 1758.

Cryptostomus Blainville, 1818a, p. 120. The genus was based on two species: *Cryptostomus leachii* Blainville, 1818 and *Cryptostomus breviculus* Blainville, 1818. The type species was designated neither originally, nor subsequently. *Cryptostomus* is currently regarded as a synonym of *Sinum* (cf. Kabat 1991 and Torigoe & Inaba 2011).

Cryptostoma Blainville, 1818b, p. 126. Incorrect subsequent spelling of *Cryptostomus*.

Catinus Blainville, 1827 (reference to Lamarck, Klein and Martini), p. 105. *Nomen nudum*.

Catinus H. & A. Adams, 1853, p. 212. Type species not designated. All the species listed (25) belong in *Sinum* (see also Kabat 1991 and Torigoe & Inaba 2011).

Ectosinum Iredale, 1931, p. 216-217, 232. Type species by original designation: *Ectosinum pauloconvexum* Iredale, 1931.

Pedriali & Robba (2009) listed the distinctive characters of *Sinum* that are slightly modified here as follows: 1) depressed-turbiniform to planorbid protoconch of from less than 2 up to 3 whorls, with faint spiral striation, 2) variably flattened, auriculate shell, oval in some species, 3) moderately high to very depressed spire, 4) strongly prosocline aperture, broad in most species, with markedly arched inner lip, 5) umbilicus closed or a small chink, 6) outer surface spirally sculptured, or smooth in some species.

Sinum borellense sp. n.

Pl. 15, figs. 3-5

Derivation of name: The name refers to the hamlet of Borelli, which is the type locality.

Holotype: Borelli: MGPT-PU 135289 (Pl. 15, fig. 3).

Paratypes: Borelli: 1 spm., MGPT-PU 135290 (Pl. 15, fig. 4), 1 spm., MGPT-PU 135291 (Pl. 15, fig. 5), 1 spm., MGPT-PU 135292, 20 spms., MGPT-PU 135293, 1 spm., MPUM 11365.

Other material examined: Borelli: 7 spms., PG 31, 1 spm., NP 9819.

Preservation: Most specimens are fairly well preserved, a few are variously damaged.

Type locality: Borelli (see appendix).

Horizon: Gray, medium sand of Tortonian age.

Diagnosis: Protoconch I apparently smooth; protoconch II with spiral cordlets. Shell auriculate, depressed, markedly low-spired, with very narrow umbilical chink. Funicle and umbilical callus absent. Aperture oval, markedly prosocline. Sculpture starting with 10-11 even, rather widely spaced spiral cords becoming uneven and flat-topped by second whorl; interspaces narrower than cords; lowermost base with increasingly finer cords.

Description. Protoconch medium-sized, depressed-turbiniform, of 2.75-2.8 rather convex whorls, tip very small; protoconch I apparently smooth, protoconch II with even spiral cordlets missing from last quarter of whorl. Teleoconch auriculate, depressed, wider than high, rather thin. Spire broadly conical, very low (scarcely protruding from outline of last whorl), whorls faintly convex. Suture adpressed. Last whorl lenticular, depressed, quickly expanding toward aperture; subsutural shelf indistinct; narrowly rounded periphery nearly at midline. Aperture large, oval, oblique, in markedly prosocline plane, distinctly wider than high. Outer lip arched; basal lip semicircular; inner lip with thin, narrow callus, bent adapically, reflected toward umbilical area, then merging into thin parietal callus well below border of umbilical area. Umbilicus a very narrow chink. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture starting with 10-11 even spiral cords becoming uneven and flat-topped by second whorl; interspaces narrower than cords, a few in adapical part with one thread; moderately wide subsutural band with five-six narrower cords; base with increasingly finer cordlets; spirals crossed by dense growth markings.

PLATE 15

Fig. 1 - *Sigaretotrema michaudi* (Michelotti, 1847). Termofourà. MGPT-PU 23519; protoconch.

Fig. 2 - *Sigaretotrema* sp. Cava Rossi. MPUM 11364; a, apertural side (height of shell 18.47 mm); b, abapertural side.

Fig. 3 - *Sinum borellense* sp. n. Borelli. Holotype, MGPT-PU 135289; a, apertural side (height of shell 6.02 mm); b, abapertural side.

Fig. 4 - *Sinum borellense* sp. n. Borelli. Paratype, MGPT-PU 135290; a, protoconch; b, detail of protoconch.

Fig. 5 - *Sinum borellense* sp. n. Borelli. Paratype, MGPT-PU 135291; a, apertural side (height of shell 5.89 mm); b, abapertural side.

Fig. 6 - *Sinum cryptostomoides* (Sacco, 1890). Colli Torinesi. Holotype of *Sigaretus (Sigaretus) cryptostomoides* var. *colligens* Sacco, 1890. MGPT BS.029.08.007; a, apertural side (scale bar 4 mm); b, protoconch.

Fig. 7 - *Sinum oligopolitum* (Sacco, 1890). Sassello. Holotype of *Sigaretus (Sigaretus) oligopolitus* Sacco, 1890. MGPT BS.029.08.006; apertural side, × 2. From Ferrero Mortara et al. (1984).

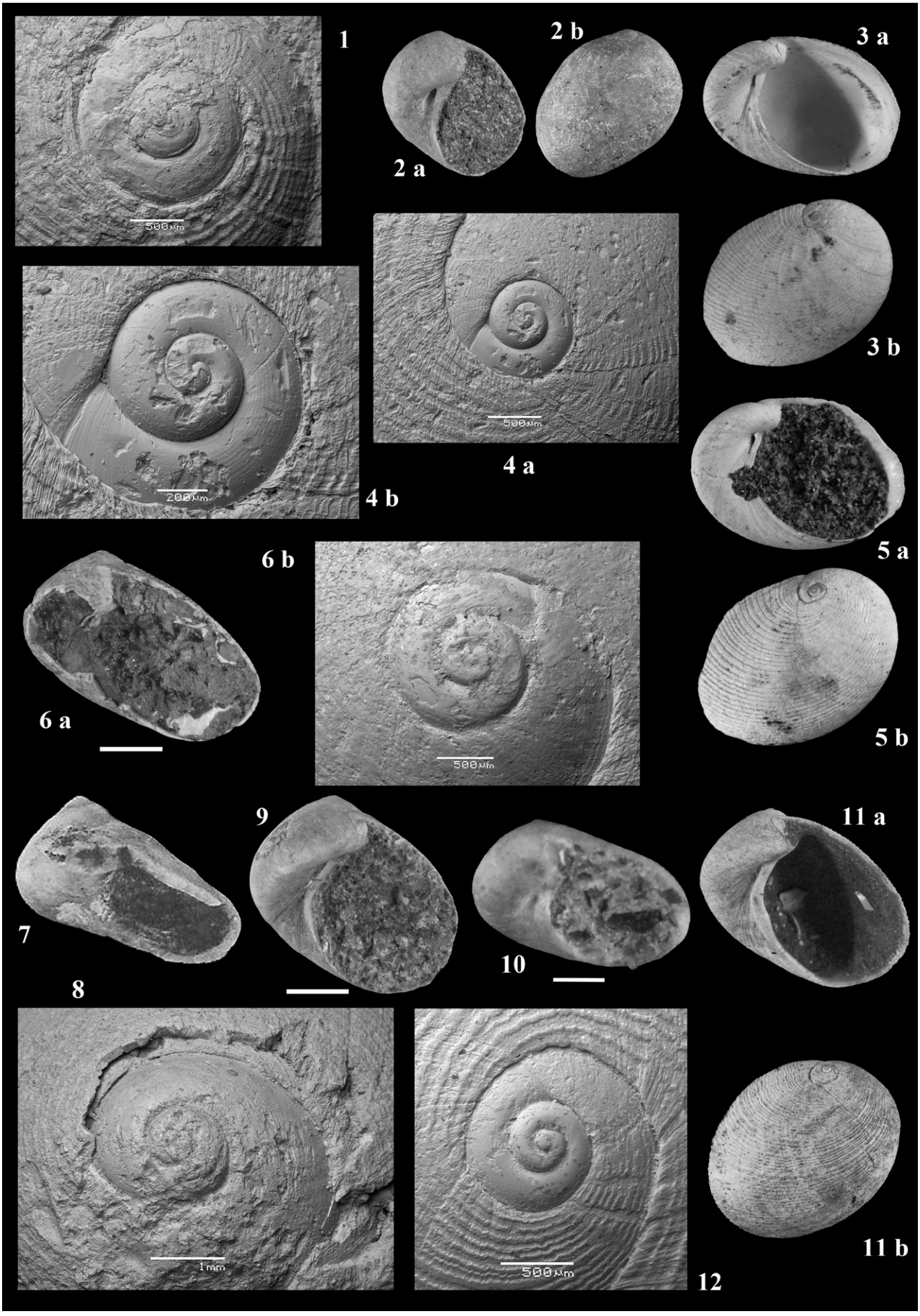
Fig. 8 - *Sinum oligopolitum* (Sacco, 1890). Mioglia. MZB 60000; protoconch.

Fig. 9 - *Sinum patulum* (Grateloup, 1847). Colli Torinesi. Lectotype (here designated) of *Sigaretus (Sigaretus) aquensis* var. *longotriangula* Sacco, 1890. MGPT BS.029.08.004; apertural side (scale bar 4 mm).

Fig. 10 - *Sinum patulum* (Grateloup, 1847). Colli Torinesi. Holotype of *Sigaretus (Cryptostoma) sigaretoides* Sacco, 1890. MGPT BS.029.09.001; apertural side (scale bar 4 mm).

Fig. 11 - *Sinum patulum* (Grateloup, 1847). Léognan, Le Coquillat (France). MPUM 11367; a, apertural side (height of shell 13.58 mm); b, abapertural side.

Fig. 12 - *Sinum patulum* (Grateloup, 1847). Saucats (France). MPUM 11370; protoconch.


1
500µm
2 b
2 a
3 a
3 b
500µm
4 a
200µm
4 b
5 a
5 b
6 b
6 a
500µm
7
8
9
10
11 a
11 b
1mm
500µm
12

Dimensions (mm)

DHW	PD	H	D	SH
0.076-0.092	0.945-1.237	2.909-7.637	6.437-12.857	0.675-1.139
0.084	1.091	5.273	9.647	0.907
AH	**AW**	**IS**	**SA**	
2.173-6.561	5.010-9.030	13°-41°	130°-142°	
4.367	7.020	27°	136°	

Remarks. An unidentified *Sinum* species (one specimen, MZB 60017) collected from middle Miocene deposits near Orthez (France) appears to be the most closely similar to *Sinum borellense* sp. n. in shell shape, umbilical and apertural characters. It differs from *S. borellense* in having the protoconch (also spirally sculptured) with slightly, but significantly greater diameter of the first half-whorl, the teleoconch somewhat more depressed with the spiral cords that are more even and more widely spaced. The cited differences could be not enough for a separation at species level, but additional material of the French taxon is required to settle a decision in this respect.

Sinum paviai sp. n. (see below), co-occurring with *Sinum borellense* in the type locality of Borelli, displays similar values of the characteristic elements of the protoconch, but its protoconch I has irregular spiral rows of minute granular microprotuberances, whereas that of *S. borellense* has not. *S. paviai* differs also in having a rather globose teleoconch with more inflated last whorl and the spaces in between the spiral cords with one cordlet or one-three threads; moreover, it lacks the subsutural band with finer cords present in *S. borellense*. The Pliocene species *Sinum perregulare* (Sacco, 1891) is another similar species in terms of shell shape. It differs from *S. borellense* in that it has the differently sculptured protoconch with a significantly greater diameter of the first half-whorl and the teleoconch with alternating spiral ribbons and threads. The Pliocene species *Sinum subhaliotideum* (d'Orbigny, 1852) is also similar in shell shape and sculpture. However, the two syn-types in MNHN (F-B35752 and F-B36276) have a significantly smaller, smooth protoconch. D'Orbigny's species was regarded as a synonym of *Sinum striatum* (de Serres, 1829) by some workers (Sacco 1891; Cossmann & Peyrot 1919). However, *Sinum subhaliotideum* differs from *Sinum striatum* at least by its smooth protoconch with significantly greater diameter.

Stratigraphic occurrence. *Sinum borellense* sp. n. was recovered only from the type locality.

Sinum cryptostomoides (Sacco, 1890)

Pl. 15, fig. 6

1890b *Sigaretus (Sigaretus) cryptostomoides* Sacco, p. 39.
1890b *Sigaretus (Sigaretus) cryptostomoides* var. *colligens* Sacco, p. 39.
1891 *Sigaretus (Sigaretus) cryptostomoides* - Sacco, p. 101, pl. 1, fig. 68.
1891 *Sigaretus (Sigaretus) cryptostomoides* var. *colligens* - Sacco, p. 101, pl. 1, fig. 69.
1984 *Sigaretus criptostomoides* (sic) - Ferrero Mortara et al., p. 38.
1984 *Sigaretus criptostomoides* var. *colligens* - Ferrero Mortara et al., p. 38, pl. 4, fig. 5.

Type Material: *Sigaretus (Sigaretus) cryptostomoides* Sacco, original material not found in MGPT and likely lost. *Sigaretus (Sigaretus) cryptostomoides* var. *colligens* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 1, fig. 69) and refigured herein (Pl. 15, fig. 6), MGPT BS.029.08.007, Colli Torinesi.

Material erroneously referred to as *Sigaretus (Sigaretus) aquensis* var. *deshayesi* Michelotti, 1847 in MGPT: Colli Torinesi: 3 spms., MGPT BS.029.08.003.

Description. Protoconch large, low-turbiniform, of three convex, apparently smooth whorls, tip very small. Teleoconch auriculate, moderately depressed, wider than high, rather thin. Spire low-conical, pointed, whorls faintly convex. Suture adpressed. Last whorl dome-shaped in abapertural (dorsal) view, depressed, remarkably extended toward aperture; subsutural shelf indistinct; narrowly rounded periphery above midline. Aperture elliptical, oblique, in markedly prosocline plane, width nearly two times length. Outer lip gently arched in mid-adapical part, more so abapically; inner lip reflected adapically toward umbilical area, then merging into thin parietal callus well below border of umbilical area. Umbilicus a very narrow chink. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of 19 even, closely set spiral ribbons on first quarter of first whorl; subsequently, ribbons slowly increase in number and may be slightly undulating behind outer lip; interspaces narrower than ribbons, a few in adapical part with one thread; base with spiral cords increasingly finer downward; spirals crossed by dense growth markings.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.081	1.548	13.87	17.11	1.39	12.48	12.09
IS	**SA**					
52°	125°					

Remarks. *Sigaretus (Sigaretus) cryptostomoides* can be easily recognized on the basis of the descrip-

tion and the figure published by Sacco (1891). The auriculate teleoconch, the dome-shaped last whorl remarkably extended toward the aperture, and the sculpture of broad spiral ribbons with scarce intervening threads are the most relevant distinguishing elements. The co-occurring variety *colligens* of *S. (Sigaretus) cryptostomoides* was proposed by Sacco (1890b) and said to differ from the nominal species in having "testa minus depressa; spira subelato-conica; superficies undulato-striolata". These differences do not warrant separation even at the subspecies level. Consequently, we include the variety *colligens* in the synonymy of the present species.

Sinum cryptostomoides is similar to *Sinum patulum* (Grateloup, 1847), but differs from it in that it has: 1) a protoconch with significantly greater diameter and smaller diameter of the first half-whorl, 2) a more distinctly auriculate teleoconch, 3) a sculpture starting with 19 spiral ribbons (seven-ten cords in *S. patulum*), and 4) an occasional occurrence of one thread in the interspaces, whereas *S. patulum* has one-three threads or one cordlet throughout.

Stratigraphic occurrence. Considering the matrix infilling, *Sinum cryptostomoides* (Sacco, 1890) appears to have been collected from the Termofourà Formation of Burdigalian age (cf. Zunino & Pavia 2009).

Sinum oligopolitum (Sacco, 1890)

Pl. 15, figs. 7, 8

1890b *Sigaretus (Sigaretus) oligopolitus* Sacco, p. 38.

1891 *Sigaretus (Sigaretus) oligopolitus* - Sacco, p. 100, pl. 1, fig. 66.

1937 *Sigaretus oligopolitus* - Venzo, p. 48, pl. 2, figs. 40-40b.

1984 *Sigaretus oligopolitus* - Ferrero Mortara et al., p. 38, pl. 4, fig. 3.

? 1990 *Sinum oligopolitum* - Baglioni Mavros, p. 241, pl. 1, figs. 10, 11.

Type material: *Sigaretus (Sigaretus) oligopolitus* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 1, fig. 66) and refigured herein (Pl. 15, fig. 7; reproduced from Ferrero Mortara et al. 1984), MGPT BS.029.08.006, Sassello.

Other material examined: Mioglia: 1 spm., MPUM 11366, 1 spm., MZB 60000 (Pl. 15, fig. 8), 1 spm., PG 33, 1 spm., PG 34, 1 spm., PG 35.

Description. Protoconch medium-sized, low-turbiniform, of two convex whorls, tip apparently small. Teleoconch conical-ovate, slightly higher than wide, thick. Spire conical, pointed, rather elevated, whorls gently convex. Suture adpressed. Last whorl broadly oval, slightly expanded toward aperture; subsutural shelf indistinct; periphery shortly above midline. Aperture ovate-quadrangular in markedly prosocline plane, length 1.3 times width. Outer lip slightly arched in mid-adapical part, more so abapically; inner lip thick, subangular medially, merging into also thick parietal callus well below border of umbilical area. Umbilicus absent, or a chink largely covered by everted inner lip. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of uneven, rather widely spaced spiral cords, slightly finer over base; interspaces with two-three threads; spirals crossed by dense growth markings.

Dimensions (mm)

DHW	PD	H	D	SH
-	1.486*	8.281-25.305	8.831-22.855	1.807-2.967
* 1 protoconch measurable		16.793	15.843	2.387
AH	**AW**	**IS**	**SA**	
8.459-18.591	4.651-18.255	30°-42°	106°-118°	
13.525	11.453	36°	112°	

Remarks. Sacco (1890b) named the species on the basis of the smooth surface of the single shell he examined. This specimen (the holotype) is poorly preserved, with the surface badly abraded. Our material demonstrates that Sacco's species is spirally sculptured as are most species of the genus. *Sinum oligopolitum* is characterized by its two-whorled protoconch (nothing can be said about eventual sculpture and diameter of the first half-whorl because of abrasion), its conical-ovate teleoconch with pointed, rather elevated spire (unusually elevated for the genus), and its spiral cords with two-three threads in the interspaces.

Sigaretus philippii, introduced by Speyer (1870, p. 81) on the basis of upper Oligocene material from Cassel area, appears to be the most closely related species. It has a two-whorled protoconch, a similarly shaped teleoconch with rather elevated, pointed spire, and an identical apertural outline. The unique difference seems to be the sculpture (detail in Speyer's pl. 12, fig. 12 d), consisting in even spiral cords without threads in the interspaces. This difference is deemed not sufficient for consistent separation at species level. A decision in this respect would require the direct examination of the original material of *S. philippii* in BGR. However, that material was not found there and is possibly lost (Angela Ehling,

personal communication 2013) and the problem remains pending. Should the two taxa prove to be synonyms, *S. philippii* has priority by seniority.

The Recent East Pacific species *Sinum cymba* (Menke, 1828) is superficially similar in that has a somewhat elevated spire. However, it is readily distinguished from *Sinum oligopolitum* by its protoconch of 0.5 more whorls, its markedly cyrtoconoid teleoconch with nearly flat base, and its sculpture of wide spiral ribbons with no threads in the narrow interspaces.

Baglioni Mavros (1990) listed *Sinum oligopolitum* from upper Oligocene deposits of Belluno area. The author did not provide any description and the poor illustrations published rise some doubt about the assignment of that material. Consequently, we consider this citation as an uncertain reference and include it in the synonymy of the present species with much reservation.

Stratigraphic occurrence. *Sinum oligopolitum* (Sacco, 1890) is known definitely from the early Oligocene of Liguria, and from the late Oligocene of Veneto.

Sinum patulum (Grateloup, 1847)

Pl. 15, figs. 9-12; Pl. 16, figs. 1, 2

1847 *Sigaretus haliotideus* - Grateloup, pl. 48, fig. 19.

1847 *Sigaretus haliotideus* var. B *patula* Grateloup, pl. 48, fig. 20.

1852 *Sigaretus subcanaliculatus* d'Orbigny, p. 39, n° 589.

1890b *Sigaretus (Sigaretus) aquensis* var. *praecedens* Sacco, p. 38.

1890b *Sigaretus (Sigaretus) aquensis* var. *longotriangula* Sacco, p. 38.

1890b *Sigaretus (Cryptostoma) sigaretoides* Sacco, p. 39 *(new synonym)*.

1891 *Sigaretus (Sigaretus) aquensis* var. *praecedens* - Sacco, p. 98, pl. 1, fig. 59.

1891 *Sigaretus aquensis* var. *longotriangula* - Sacco, p. 99, pl. 1, fig. 63.

1891 *Sigaretus aquensis* var. *taurinensis* Sacco, p. 100, pl. 1, fig. 62.

1891 *Sigaretus (Cryptostoma) sigaretoides* - Sacco, p. 102, pl. 1, fig. 70.

1919 *Sigaretus aquensis* - Cossmann & Peyrot, p. 234, pl. 12, figs. 47, 48.

1925 *Sigaretus (Sigaretus) aquensis* - Cossmann, p. 143, pl. 4, figs. 23, 24.

1952b *Sigaretus aquensis* - Glibert, p. 262, pl. 3, fig. 2.

1984 *Sigaretus aquensis* var. *praecedens* - Ferrero Mortara et al., p. 38.

1984 *Sigaretus aquensis* var. *longotriangula* - Ferrero Mortara et al., p. 38.

1984 *Sigaretus aquensis* var. *taurinensis* - Ferrero Mortara et al., p. 38.

1984 *Cryptostoma sigaretoides* - Ferrero Mortara et al., p. 39, pl. 3, fig. 10.

2001 *Sinum patulum* - Lozouet et al., p. 45, pl. 18, fig. 6.

2007 *Sinum aquense* - Zunino, p. 127 (pars); not specimen PU23669 in pl. 1, fig. 14 = *Sinum* sp. 3 (see below); not specimen BS.029.08.007 = *Sigaretus cryptostomoides* Sacco, 1890.

2007 *Sinum sigaretoides* - Zunino, p. 127, pl. 1, fig. 15.

? 2007 *Sinum patulum* - Pfister & Wegmüller, p. 103, pl. 19, figs. 8-21.

Type material: *Sigaretus haliotideus* var. B *patula* Grateloup, type material not seen. Grateloup's original material is housed in the University of Bordeaux 1 in Talence, France (Didier Merle, personal communication 2013), but we failed to have any answer from the curator there. *Sigaretus subcanaliculatus* d'Orbigny, syntypes MNHN-F-B27769, localities around Bordeaux (5 specimens). One specimen (out of 5) belongs in *Sigaretotrema* Sacco, 1890 (see remarks below). *Sigaretus (Sigaretus) aquensis* var. *longotriangula* Sacco, lectotype (here designated): the shell figured by Sacco (1891, pl. 1, fig. 63) and refigured herein (Pl. 15, fig. 9), MGPT BS.029.08.004, Colli Torinesi; 1 paralectotype, MGPT BS.029.08.004/01, Colli Torinesi. *Sigaretus aquensis* var. *taurinensis* Sacco, syntype: the shell figured by Sacco (1891, pl. 1, fig. 62), MGPT BS.029.08.005, Colli Torinesi (see the remarks on *Sinum perinflatum* below). *Sigaretus (Cryptostoma) sigaretoides* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 1, fig. 70) and refigured herein (Pl. 15, fig. 10), MGPT BS.029.09.001, Colli Torinesi.

Material erroneously referred to as *Sigaretus (Sigaretus) aquensis* var. *deshayesi* Michelotti, 1847 in MGPT: Colli Torinesi: 5 spms., MGPT BS.029.08.003.

Other material examined: Léognan, Le Coquillat (France): 2 spms., MZB 60116, 125 spms., NP 9877, 1 spm., MPUM 11367 (Pl. 15, fig. 11), 16 spms., private collection; Saucats (France): 1 spm., MNHN-F-J03842 (specimen figured by Cossmann 1925, pl. 4, figs. 23, 24), 1 spm., MPUM 11370 (Pl. 15, fig. 12); Valle Ceppi: 1 spm., MGPT-PU 108134, 1 spm., MGPT-PU 25270 (specimen referred to as *Sinum sigaretoides* by Zunino 2007), 1 spm., MZB 30796, 1 spm., PG 40 (Pl. 16, fig. 1), 1 spm., PG 41 (Pl. 16, fig. 2); Val Sanfrà: 1 spm., MGPT-PU 107640.

Description. Protoconch small, low-turbiniform, of 2.5-2.6 convex whorls, with remnants of spiral sculpture in some specimens, tip small. Teleoconch conical-auriculate, moderately depressed, nearly as high as wide, rather thin. Spire cyrtoconoid, low, rather pointed, whorls faintly convex. Suture adpressed. Last whorl dome-shaped in abapertural (dorsal) view, depressed, noticeably extended toward aperture; subsutural shelf indistinct; narrowly rounded periphery about at midline. Aperture ovate-rectangular, oblique, in markedly prosocline plane, length nearly 1.3 times width. Outer lip arched; basal lip gently to very gently arched; inner lip reflected toward umbilical area, subangular adapically, then curving to form an angle with thin parietal callus below border of umbilical area. Umbilicus absent or a very narrow chink. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture starting with seven-ten even, closely set spiral cords; subsequently, cords slowly increase in number and change into ribbons, undulating on last whorl; in-

terspaces of last whorl narrower than ribbons, with one-three threads or one cordlet; base with spiral cords increasingly finer downward; spirals crossed by dense growth markings.

Dimensions (mm)

DHW	PD	H	D	SH
0.098-0.118	0.848-1.060	4.198-26.722	4.451-29.407	0.702-3.270
0.108	0.954	15.460	16.929	1.986
AH	**AW**	**IS**	**SA**	
3.178-23.770	3.305-21.273	44°-60°	116°-140°	
13.474	12.289	52°	128°	

Remarks. The present species was currently cited with the name *aquensis/aquense* either attributed to Recluz in Deshayes, 1843 (Cossmann & Peyrot 1919), or to Recluz in Chenu, 1843 (Sacco 1891; Glibert 1963), or to Recluz, 1851 (Anderson 1960; Nordsieck 1972; Janssen 1984; Wienrich 2001). Cossmann & Peyrot (1919, p. 234) made reference to Deshayes' "Traité élémentaire de conchyliologie"; in this account (1839-1853) neither the genus *Sigaretus* nor the name *aquensis* are cited. The genus *Sigaretus* is covered in Deshayes & Milne Edwards (1843, pp. 7-14), but also in this case the name *aquensis* is never mentioned. The genus *Sigaretus* was illustrated by Chenu (1843, pls. 1-4) in his monumental atlas (1842-1853); again, the name *aquensis* is not present. The name *aquensis* was used for the first time by Recluz (1851) to rename the shell figured by Grateloup (1847) and referred to as "*Sigaretus haliotideus* Lam". This being stated, we note that: 1) Grateloup (1847) validly introduced the var. *patula* of *Sigaretus haliotideus*, 2) the var. *patula* was based on trifling differences that do not warrant the separation from *Sigaretus haliotideus* (see the above synonymy), and 3) the name *patula* Grateloup has priority over the name *aquensis* Recluz. Consequently, we concur with Lozouet et al. (2001) in considering *patula* Grateloup as the oldest available name for the present species, this also in agreement with ICZN (1999, Article 23 of the Code).

After its introduction, *Sigaretus subcanaliculatus* d'Orbigny, 1852 was considered as a synonym of the present species. We have examined the syntypes of *S. subcanaliculatus* in MNHN (5 specimens collectively numbered F-B27769) and note that one specimen belongs in *Sigaretotrema* Sacco, 1890 (see the remarks on *Sigaretus michaudi* Michelotti, 1847); the other four specimens fully conform to the concept of d'Orbigny's species. These four syntypes are indistinguishable from *S. patulum*; thence, we confirm the placement of *S. subcanaliculatus* in the synonymy of *S. patulum*. *Sigaretus (Cryptostoma) sigaretoides* Sacco, 1890 (holotype in MGPT examined) has protoconch and teleoconch characters that fully agree with those of *Sinum patulum* and is herein regarded as a synonym of Grateloup's species.

Sinum aquense was recorded from lower and middle Miocene units of the North Sea Basin (Sorgenfrei 1958; Anderson 1960; Nordsieck 1972; Janssen 1984; Wienrich 2001). Examination of the illustrations published by the cited workers and of abundant Dutch material in RGM (225.947, 793.934, 793.935, 793.936) rises doubt on whether these specimens fully agree with the characters of *S. aquense* (= *patulum*). They differ somewhat from the French and Italian shells in that have a protoconch with greater diameter and with the spiral striation restricted to the last half-whorl, a teleoconch with wider umbilical chink, and a sculpture starting with more numerous (13-15) spiral cords. The Dutch, German and Danish specimens likely represent a northern subspecies of *Sinum patulum*. A note is to be made on the material of Nordsiek (1972): according to the quite poor illustration published by the author, his specimens seem to have a wide, open umbilicus and hardly belong in *Sinus*.

Concerning Sacco's varieties *praecedens*, *longotriangula* and *taurinensis* of *Sigaretus (Sigaretus) aquensis* (see the above synonymy), we have examined the respective original material in MGPT and can state that they cannot be distinguished from *Sinum patulum* consistently. The varieties *conicolonga* Sacco, 1890 and *tauroinflata* Sacco, 1890 were not found in MGPT (cf. Ferrero Mortara et al. 1984). According to the figures published by Sacco (1891), these varieties seem to differ somewhat from *S. patulum*. However, in the absence of respective original material, nothing can be stated definitely about their relationships with *S. patulum*. The variety *patula* Grateloup was just cited by Sacco (1890b, p. 38) without description; also in this case the related material was not found in MGPT.

The Burdigalian specimens from Switzerland referred to as *Sinum patulum* (Grateloup, 1847) by Pfister & Wegmüller (2007) are quite poorly preserved and their assignment to the present species is doubtful.

Stratigraphic occurrence. *Sinum patulum* (Grateloup, 1847) is known definitely from the early Oligocene of Italy (var. *praecedens* Sacco, 1890) and from lower Miocene units of France and Italy. Its quotation from the Burdigalian of Switzerland needs to be confirmed as does that of *Sinum (Sinum) aquense* from the Eggenburgian of Paratethys (Steininger et al. 1971).

Sinum paviai sp. n.

Pl. 16, figs. 3-5

Derivation of name: The species is named after Prof. Giulio Pavia, University of Torino, who provided lot of material relevant to the present study.

Holotype: Borelli: MGPT-PU 135294 (Pl. 16, fig. 3).

Paratypes. Borelli: 1 spm., MGPT-PU 135295 (Pl. 16, fig. 4), 1 spm., MGPT-PU:135353 (Pl. 16, fig. 5), 1 spm., MGPT-PU 135354, 10 spms., MGPT-PU 135355, 1 spm., MPUM 11368.

Other material examined: Borelli: 6 spms., PG 30, 1 spm., NP 9818; Rio di Bocca d'Asino: 1 spm., PG 36, 1 spm., PG 37.

Prservation: Except for slight abrasion of the surface in some shells, the preservation is fair.

Type locality: Borelli (see appendix).

Horizon: Gray, medium sand of Tortonian age.

Diagnosis: Protoconch I with minute granular microprotuberances; protoconch II with spiral cordlets. Shell rather globose, low-spired, with very narrow umbilical chink. Funicle and umbilical callus absent. Aperture oval, markedly prosocline. Sculpture starting with 10-11 even, rather widely spaced spiral cords tending to become flat-topped, with one cordlet or one-three threads in interspaces; lowermost base with increasingly finer cords.

Description. Protoconch medium-sized, low-turbiniform, of 2.75 convex whorls, tip very small; protoconch I with minute granular microprotuberances irregularly arranged into spiral rows and final coarse growth markings; protoconch II with last whorl sculptured with even spiral cordlets. Teleoconch rather globose, nearly as high as wide, moderately thick. Spire low, broadly cyrtoconoid, whorls very slightly convex. Suture adpressed. Last whorl broadly oval, slightly expanded toward aperture; subsutural shelf indistinct; periphery well above midline. Aperture oval in markedly prosocline plane, length about 1.35 times width. Outer lip arched, basal lip less so; inner lip with thin callus reflected over umbilical area, subangular adapically, merging into thin parietal callus well below border of umbilical area. Umbilicus a very narrow chink, absent in some specimens. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture starting with 10-11 even, rather widely spaced spiral cords; approximately by second whorl cords tend to became flat-topped and one cordlet or one-three threads occur in interspaces; lowermost base with increasingly finer cords; spirals crossed and made somewhat beaded by dense growth lines.

Dimensions (mm)

DHW	PD	H	D	SH
0.087-0.103	1.299-1.559	3.800-10.004	7.506-10.678	1.054-2.186
0.095	1.429	6.902	9.092	1.620
AH	**AW**	**IS**	**SA**	
2.558-8.006	4.862-6.722	33°-53°	99°-143°	
5.282	5.792	43°	121°	

Remarks. The Oligocene to lower Miocene species *Sinum patulum* (Grateloup, 1847) is somewhat similar, differing from *Sinum paviai* sp. n. in that it has a significantly smaller protoconch diameter, a conical-auriculate, more depressed teleoconch with the depressed last whorl distinctly extended toward the aperture, and the sculpture of undulating spiral ribbons. The Burdigalian species *Sinum cryptostomoides* (Sacco, 1890) is also similar, but is easily distinguished from *S. paviai* by its smooth protoconch, its auriculate teleoconch, its dome-shaped last whorl

PLATE 16

Fig. 1 - *Sinum patulum* (Grateloup, 1847). Valle Ceppi. PG 40; a, apertural side (height of shell 11.81 mm); b, abapertural side; c, basal view.

Fig. 2 - *Sinum patulum* (Grateloup, 1847). Valle Ceppi. PG 41; a, protoconch; b, detail of protoconch.

Fig. 3 - *Sinum paviai* sp. n. Borelli. Holotype, MGPT-PU 135294; a, apertural side (height of shell 9.37 mm); b, abapertural side; c, basal view.

Fig. 4 - *Sinum paviai* sp. n. Borelli. Paratype, MGPT-PU 135295; a, protoconch; b, detail of protoconch.

Fig. 5 - *Sinum paviai* sp. n. Borelli. Paratype, MGPT-PU 135353; a, apertural side (height of shell 6.37 mm); b, basal view.

Fig. 6 - *Sinum perinflatum* (Sacco, 1890). Sassello. Holotype of *Sigaretus (Sigaretus) aquensis* var. *perinflata* Sacco, 1890. MGPT BS.029.08.002; apertural side (scale bar 4 mm).

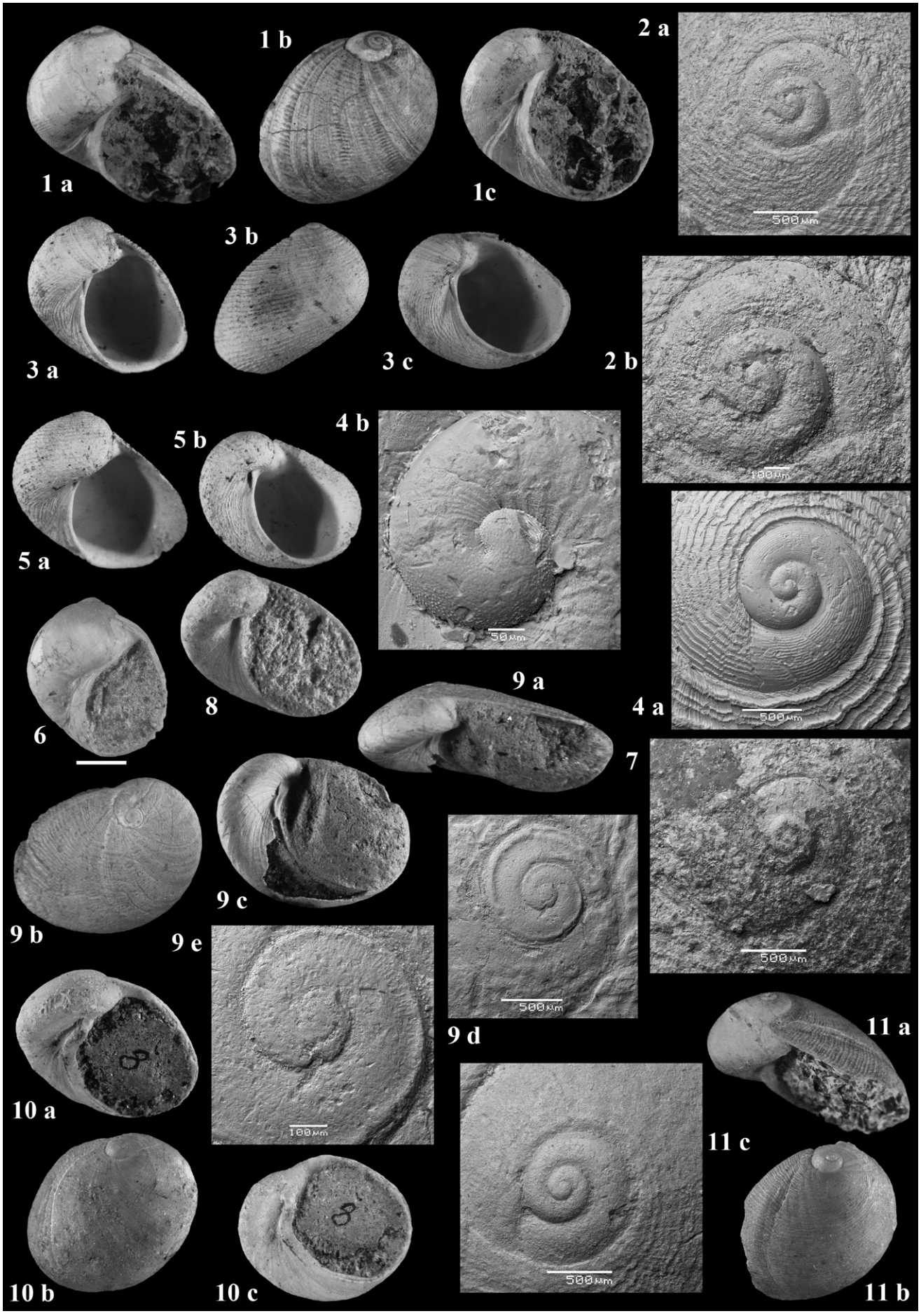
Fig. 7 - *Sinum* sp. 1. Case Soghe. MPUM 11369; protoconch.

Fig. 8 - *Sinum* sp. 1. Case Soghe. NP 9820; a, apertural side (height of shell 10.58 mm).

Fig. 9 - *Sinum* sp. 2. Villa Maiolo. PG 38; a, apertural side (height of shell 3.60 mm); b, abapertural side; c, basal view; d, protoconch; e, detail of protoconch.

Fig. 10 - *Sinum* sp. 3. Albugnano. PG 39; a, apertural side (height of shell 11.37 mm); b, abapertural side; c, basal view.

Fig. 11 - *Sinum* sp. 3. Valle Vergnana. MZB 19184; a, apertural side (height of shell 10.85 mm); b, abapertural side; c, protoconch.


1 a
1 b
1c
2 a
500µm
3 a
3 b
3 c
2 b
100µm
4 b
5 b
5 a
50µm
4 a
500µm
6
8
9 a
7
500µm
9 b
9 c
9 e
9 d
500µm
10 a
100µm
11 a
11 c
10 b
10 c
500µm
11 b

remarkably extended toward the aperture, and its sculpture of broad spiral ribbons with scarce intervening threads.

Stratigraphic occurrence. *Sinum paviai* sp. n. was recovered from upper Miocene (Tortonian) deposits of Piedmont.

Sinum perinflatum (Sacco, 1890) stat. n.

Pl. 16, fig. 6

1890b *Sigaretus (Sigaretus) aquensis* var. *perinflata* Sacco, p. 38.

1891 *Sigaretus (Sigaretus) aquensis* var. *perinflata* - Sacco, p. 99, pl. 1, fig. 60.

1984 *Sigaretus aquensis* var. *perinflata* - Ferrero Mortara et al., p. 38.

Type material: *Sigaretus (Sigaretus) aquensis* var. *perinflata* Sacco, holotype (by monotypy): the shell figured by Sacco (1891, pl. 1, fig. 60) and refigured herein (Pl. 16, fig. 6), MGPT BS.029.08.002, Sassello.

Material erroneously referred to as *Sigaretus (Sigaretus) aquensis* var. *taurinensis* Sacco, 1891 in MGPT: Colli Torinesi: 1 syntype (of 2), MGPT BS.029.08.005.

Description. Protoconch abraded. Teleoconch ovate-cylindrical, higher than wide, thick. Spire broadly cyrtoconoid, rather depressed, whorls very gently convex. Suture adpressed. Last whorl 90% of total height, globose, subcylindrical in abapertural (dorsal) view; subsutural shelf poorly defined, more distinct behind aperture; periphery about at midline. Aperture teardrop-shaped in markedly prosocline plane, length about twice width. Outer lip roundly angular adapically, slightly arched in mid-abapical part, more so basally; inner lip very thick, bent at level of umbilical area, merging into moderately thick parietal callus below border of umbilical area. Umbilicus, funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of rather even, closely set spiral ribbons, narrower and round-topped over base; interspaces very narrow, sharply incised, made pitted by crossing of coarse and dense growth markings.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
-	-	18.640	17.291	3.500	15.140	12.802
IS	**SA**					
40°	122°					

Remarks. Sacco (1890b) validly introduced the variety *perinflata* of *Sigaretus (Sigaretus) aquensis* Recluz, 1843. Examination of the holotype in MGPT showed that the variety *perinflata* is quite unlike *Sigaretus aquensis* because of its ovate-cylindrical, higher than wide teleoconch and its sculpture of spiral ribbons with very narrow interspaces devoid of threads.

The teleoconch shape is the most relevant distinguishing character of *Sinum perinflatum* and readily separates it from the other Italian species of *Sinum* that invariably have more depressed shells. *Sinum oligopolitum* (Sacco, 1890) is somewhat similar, but differs in that it has: 1) a conical-ovate teleoconch, 2) a more elevated, conical and pointed spire, 3) a broadly oval last whorl, expanded toward the aperture, 4) an ovate-quadrangular aperture, and 5) a sculpture of uneven, rather widely spaced spiral cords, with two-three threads in the interspaces.

Sacco (1891) proposed the var. *taurinensis* of *Sigaretus (Sigaretus) aquensis* on the basis of material from an unspecified locality in the Turin Hills (Colli Torinesi); the age was said to be "Helvetian". Sacco's material in MGPT consists of two syntypes collectively numbered BS.029.08.005. The larger syntype displays the characters of *Sinum perinflatum* and is herein assigned to this species. The other syntype (the smaller) fully agrees with the characters of *S. (Sigaretus) aquensis*.

Stratigraphic occurrence. The holotype of *Sinum perinflatum* (Sacco, 1890) was collected from lower Oligocene deposits of Liguria. The Miocene specimen originally referred to as *Sigaretus (Sigaretus) aquensis* var. *taurinensis* Sacco (see remarks above), on the basis of the matrix infilling, results to have been collected from the Termofourà Formation of Burdigalian age (cf. Zunino & Pavia 2009).

Sinum sp. 1

Pl. 16, figs. 7, 8

Material examined: Case Soghe: 1 spm., MPUM 11369 (Pl. 16, fig. 7), 1 spm., NP 9820 (Pl. 16, fig. 8), 1 spm., MGP-PD 31530.

Description. Protoconch small, depressed-turbiniform, of 2.5 rather convex whorls with remnants of spiral cordlets, tip small. Teleoconch auriculate, depressed, wider than high, rather thin. Spire broadly conical, pointed, low but distinctly protruding from last whorl, whorls faintly convex. Suture thin, adpressed. Last whorl lenticular, rather depressed, quickly expanding toward aperture; sub-

sutural shelf indistinct; narrowly rounded periphery slightly above midline. Aperture large, elliptical, oblique, in markedly prosocline plane, distinctly wider than high. Outer lip arched; basal lip semicircular; inner lip also arched, with thin, narrow callus curved adapically to merge into thin parietal callus well below border of umbilical area. Umbilicus a rather narrow chink. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of uneven, round-topped, rather closely set spiral cords, more widely spaced subsuturally, narrower toward periphery of last whorl, tending to fade away on base; spirals crossed by coarse growth markings.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.129	0.936	7.810	12.630	1.760	6.050	8.020
IS	**SA**					
45°	124°					

Remarks. *Sinum* sp. 1 appears to be closely similar to *Sinum borellense* sp. n. (see above) from which it differs in that it has: 1) a protoconch with a significantly greater diameter of the first half-whorl, 2) a teleoconch with a low but distinctly prominent spire and with a wider umbilical chink, and 3) a sculpture of round-topped spiral cords (in *S. borellense* the cords become flat-topped by the second whorl) that tend to fade away over the base. The present specimens almost certainly belong to a previously unrecorded species, but naming it must await that more, better preserved material be recovered.

Stratigraphic occurrence. *Sinum* sp. 1 was recovered from lower Oligocene deposits of Veneto.

Sinum sp. 2

Pl. 16, fig. 9

Material examined: Villa Maiolo: 1 spm., PG 38.

Description. Protoconch medium-sized, planorbid, of 2.5 flat whorls with increasingly robust peripheral cord overridden by short, irregular collabral riblets; tip small. Teleoconch auriculate, depressed, wider than high, rather thin. Spire broadly conical, very low, quite scarcely protruding from last whorl, whorls faintly convex. Suture thin, adpressed. Last whorl lenticular, markedly depressed, quickly expanding toward aperture; subsutural shelf indistinct; narrowly rounded periphery slightly above midline. Aperture large, oval, oblique, in markedly prosocline plane, distinctly wider than high. Outer lip arched; basal lip semicircular; inner lip gently arched, subangular adapically, then merging into thin parietal callus well below border of umbilical area. Umbilicus a narrow chink largely covered by everted labial callus. Funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of uneven and unevenly spaced spiral cords, narrower toward periphery of last whorl, changing into threads on upper base, obsolescent on lowermost base; spirals crossed by incised growth markings.

Dimensions (mm)

DHW	PD	H	D	SH	AH	AW
0.139	1.048	3.600	10.550	0.930	2.671	7.953
IS	**SA**					
36°	138°					

Remarks. *Sinum* sp. 2 is readily distinguished from the other *Sinum* species by its planorbid protoconch with peculiar sculpture. It somewhat resembles *Sinum borellense* sp. n. (see above) in terms of teleoconch shape, but the sculpture of uneven and unevenly spaced spiral cords is different from that of *S. borellense* (flat-topped cords).

Stratigraphic occurrence. *Sinum* sp. 2 seems to be a rare species occurring in Tortonian deposits of Piedmont.

Sinum sp. 3

Pl. 16, figs. 10, 11

Material erroneously referred to as *Sinum aquense* (Recluz, 1851) in MGPT: Val Sanfrà: 1 spm., MGPT-PU23669 (specimen of Zunino 2007, pl. 1, fig. 14).

Other material examined: Albugnano: 1 spm., PG 39 (Pl. 16, fig. 10); Valle Vergnana: 1 spm., MZB 19184 (Pl. 16, fig. 11).

Description. Protoconch medium-sized, low-turbiniform, of slightly more than three convex, apparently smooth whorls, tip very small. Teleoconch auriculate, depressed, markedly wider than high, rather thick. Spire broadly cyrtoconoid, very low, whorls faintly convex. Suture adpressed. Last whorl lenticular, depressed, only slightly expanding toward aperture; subsutural shelf absent on first whorl, poorly defined on subsequent whorls; narrowly rounded periphery above midline. Aper-

ture ovate-rectangular, oblique, in markedly prosocline plane, length about 1.3 times width. Outer lip subangular adapically in larger specimens, then gently arched; basal lip semicircular; inner lip with wide, flat and thick callus, subangular at adapical one-third, curving to form a sharp angle with thick parietal callus below border of umbilical area. Umbilicus, funicle and umbilical callus absent. Basal fasciole indistinct. Sculpture of rather even, closely set, slightly undulating spiral cords, finer adapically and much so over base; unsculptured subsutural band tends to develop in larger specimens; spirals crossed by dense growth markings.

Dimensions (mm)

DHW	PD	H	D	SH
0.068*	1.145*	6.208-13.832	7.757-17.637	0.799-2.235
* 1 protoconch measurable		10.020	12.697	1.517
AH	**AW**	**IS**	**SA**	
4.085-12.921	4.151-14.515	44°-68°	110°-146°	
8.503	9.333	56°	128°	

Remarks. *Sinum* sp. 3 somewhat resembles *Sinum aquense* = *Sinum patulum* (Grateloup, 1847) and has been mistaken for it. The present form is readily distinguished from Grateloup's species in that has: 1) a protoconch of 0.5 more whorls, with a significantly smaller diameter of the first half-whorl, 2) an auriculate, more depressed teleoconch with the last whorl scarcely extended toward the aperture (the shell has a subcircular outline in dorsal view, whereas the outline is oval in *S. patulum*), 3) an outer lip subangular adapically instead of regularly arched, and 4) a sculpture of closely set spiral cords with no threads in the interspaces (*S. patulum* has spiral ribbons with intervening threads or cordlets). *Sinum perinflatum* (Sacco, 1890) also exhibits some resemblance to *Sinum* sp. 3 in that has a similar outline in dorsal view, but its teleoconch is more inflated and differently shaped, its aperture length is nearly twice the width, and its sculpture consists of spiral ribbons separated by very narrow, sharply incised grooves. The three examined specimens certainly belong to a previously undescribed species, but more material is required in order to name it.

Stratigraphic occurrence. *Sinum* sp. 3 was collected from the Termofourà Formation of Burdigalian age (Torino Hills) and from Serravallian deposits near Albugnano.

Acknowledgements. This paper has benefited from reviewing by Dr. A. Beu (Institute of Geological and Nuclear Sciences, Lower Hutt) and by Dr. B. Landau (Naturalis Biodiversity Center, Leiden). The following curators provided access to the collections on their care and/or kindly loaned specimens: Dr. A. Bonfitto (Museo di Zoologia, Bologna); Dr. M. Fornasiero (Museo di Geologia e Paleontologia dell'Università, Padova); Dr. C. Francou (Museo Geologico G. Cortesi, Castell'Arquato); Dr. V. Frisone (Museo di Archeologia e Scienze Naturali "G. Zannato", Montecchio Maggiore); Mr. Y. Gilly (Réserve Naturelle Géologique de Saucats, Muséum de Saucats-La Brède); Dr. L. Mazzini (Museo G. Scarabelli, Imola); Dr. D. Merle (Muséum National d'Histoire Naturelle, Paris); Dr. D. Ormezzano (Museo Regionale di Scienze Naturali, Torino); Dr. B. Pallozzi (Museo Civico D. Dal Lago, Valdagno); Dr. R. Pancaldi (Museo Paleontologico e Preistorico "P. Leonardi" dell'Università, Ferrara); Dr. C. Sendino (Natural History Museum, London); Dr. P. Serventi (Dipartimento di Scienze Chimiche e Geologiche, Università di Modena e Reggio Emilia); Dr. M. Taviani (ISMAR-CNR, Bologna); Drs. F. Wesselingh and R. Pouwer (Nationaal Naturhistorisch Museum, Naturalis, Leiden). Mr. H. Boerman (Rotterdam) and Dr. R. G. Moolenbeek (Instituut voor Taxonomische Zoölogie, Amsterdam) donated naticids from Winterswijk Miste (Hemmorian), Dr. A. Morton (Penrhyncoch, Aberystwyth) donated much reference material from the London Clay; Dr. S. Tracey (Natural History Museum, London) donated two shells and two opercula of *Sigatica clarkeana* (Aldrich, 1887). Drs. M. Aberhan and H. Götz (Museum für Naturkunde, Berlin), Drs. L. Cavin and A. Piuz (Museum d'Histoire Naturelle, Geneva), Dr. M. Harzhauser (Naturhistorisches Museum, Wien), Drs. A. Prieur and E. Robert (Université de Lyon 1), and Dr. C. Sendino (Natural History Museum, London) provided excellent digital photographs of syntypes or relevant specimens. Mr. J.-F. Lesport (Sainte-Hélène, France) showed his vast collection of naticids from the Miocene of Bordeaux area and provided outstanding digital photographs of shells and opercula. Mr. J.-P. Dupuy (Cadillac, France) helped during field-work in Aquitaine. Dr. M. Aberhan (Museum für Naturkunde, Berlin), Drs. D. Merle and J.-M. Pacaud (Muséum National d'Histoire Naturelle, Paris) helped in trying to locate relevant collections including the original material of species (Speyer collection, Bayan and Grateloup collections). Dr. A. Ehling (Bundesanstalt für Geowissenschaften und Rohstoffe, Berlin), Dr. E. Robert (Université de Lyon 1) and Dr. L. Cavin (Museum d'Histoire Naturelle, Geneva) provided information about species presently available respectively in Speyer collection, Bayan collection and Defrance collection. Mr. J.-C. Hourcade (Villenave-d'Ornon) helped in going through the collections of the Muséum de Saucats-La Brède; Mr. C. Tabanelli (Cotignola) helped in locating Miocene naticids in the Museo G. Scarabelli, Imola. We are indebted to Prof. G. Pavia and Dr. M. Zunino (University of Torino) who informed on the most up-to-date cronostratigraphic framing of several naticid-bearing units of Piedmont and loaned a wealth of material relevant to the present study, to Mr. A. De Angeli (Vicenza) for information on the outcrops of Chiuppano and Sangonini, to Mr. M. Boscardin (Vicenza) for information on the locality Monte Gloso, to Mr. M. Gambillara (Treviso) for information on the hystorical localities near Possagno, and to Mr. Marco Vicariotto (Vicenza) for information on the section of Chiuppano. Prof. Maria Triantaphyllou (University of Atherns) provided calcareous nannoplankton evidence of the age of some shells. Prof. K. Bandel (Buchholz, Germany), Mr. J.-P. Dupuy (Cadillac, France), Dr. T. Huel-

sken (University of Queensland, Brisbane), Dr. P. Rocher (Muséum d'Histoire Naturelle, Bordeaux), Dr. D. Scarponi (University of Bologna) and Dr. S. Tracey (Natural History Museum, London) assisted with some essential references. Mr. H. Boerman (Rotterdam), Mr. A. Bottazzi (Valdagno), Mr. E. Stadelmann (Hersbruck) and Mr. Z. Zordan (Valdagno) helped with translations from Dutch and German. The following private collectors generously donated or loaned much valuable material: Mr. R. Alberti (Bassano del Grappa); Mr. E. Bartoli (Lugo di Romagna); Mr. D. Battilani (Modena); Mr. R. Bertamini (Cesena); Mr. L. Bertolaso (Reggio Emilia); Mr. B. Bizzotto (Treviso); Mr. S. Boschele (Borgo Valsugana); Mr. R. Bourgeais (Paris); Mr. M. Brunetti (Rioveggio); Mr. A. Checchi (Montecchio Maggiore); Mr. G. Cracco (Arzignano); Mr. M. Cresti (San Casciano in Val di Pesa); G. Della Bella (Monterenzio); Mr. B. Dell'Angelo (Genova); Mr. J.-P. Dupuy (Cadillac); Mr. M. Forli (Prato); Mr. P. Frediani (Castelfiorentino); Mr. P. Fremont (Bordeaux); Mr. G. Gariani (Milano); Mr. P. Giuntelli (Nole, Torino); Mr. S. Granelli (Noceto); Mr. L. Landini (San Donato, Parma); Mr. A. Maccaferri (Poggio Renatico, Ferrara); Mr. P. Magenes (Milano); Mr. S. Marsigli (Bazzano); Mr. S. Mezzalira (Bassano del Grappa); Mrs. P. Orru (Basiglio); Mr. P. Petracci (Cesena); Mr. M. Salmoiraghi (Castellanza); Mr. M. Sosso (Genova); Mr. G. Vecchi (Reggio Emilia); Mr. R. Villa (Anguillara Sabatia); Mr. F. Zamberlan (Trissino, Vicenza); Mr. G. Zarantonello (Piana di Valdagno). We thank Mr. L. Brunelli (San Martino, Ferrara) for help in field work and preparation of specimens; Mr. Alberto Cecalupo (Buccinasco) for great help in preparing the electronic version of the plates; Mr. F. Facchini (Funo, Bologna) for drawing text-fig. 1; Mr. P. Magenes (Milano), Miss P. Orru (Basiglio) and Miss E. Pedriali (Ferrara) for photography; Dr. Paolo Gentile (University of Milano Bicocca) for some scanning electron micrographs; Dr. Michele Zilioli (Museo Civico di Storia Naturale, Milano) for uncoated scanning electron micrographs. Facilities provided by the Dipartimento di Scienze dell'Ambiente e del Territorio e di Scienze della Terra (Sezione di Scienze Geologiche e Geotecnologie), University of Milano-Bicocca are also acknowledged.

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APPENDIX (Locality data)

PIEDMONT

1. **Albugnano** (Asti Province). There are no more precise locality data concerning the material so labeled. Ferrero Mortara et al. (1981, p. 14) considered the fossils from Albugnano as of Serravallian age. According to the Geological Map of Italy (scale 1:50,000, Sheet 156, Torino Est), the Serravallian deposits in Albugnano area are represented by the formation named Marne di Mincengo that crops out extensively south and southwest of the village.

2. **Borelli**, Moncucco Torinese (Torino Province). A small outcrop, approximately 0.15 km northeast of the hamlet named Borelli (formerly Tetti Borelli), exposes medium to coarse sand that was currently assigned a Messinian age. Recent research demonstrated a Tortonian age on the basis of nannoplankton and holoplanktonic mollusks. For additional information, reference to Pavia (1991) and Janssen (1999, 2010).

3. **Cascina Pianfiorito**, Albugnano (Asti Province). Excavations near Cascina Pianfiorito, approximately one km southeast of Albugnano, have unearthed sandstone and gray pebbly clay presently concealed by the cultivation of a vineyard. According to the Geological Map of Italy (scale 1:50,000, Sheet 156, Torino Est), the Langhian Baldissero Formation crops out in the area of Cascina Pianfiorito.

4. **Cassinelle** (Alessandria Province). Graywacke and gray silt exposed near Cascina Fogli, approximately 1.7 km south-southwest of the village of Cassinelle. According to the Geological Map of Italy (scale 1:50,000, Sheet 194, Acqui Terme) these lithotypes form the lowermost part of the formation named Marne di Rigoroso; the age is late Rupelian. For additional infor-

mation, reference to Lorenz (1969).

5. **Colli Torinesi** (Torino Province). There are no more precise locality data concerning the material so labeled. According to Zunino & Pavia (2009), the bulk of the fossils was collected from the mid to upper Burdigalian Termofourà Formation and, less abundantly, from the Langhian Baldissero Formation.

6. **Colli Tortonesi or Tortona** (Alessandria Province). Again, no detail on the localities is given on the labels. Most likely the fossils are from Tortonian marly deposits of the Sant'Agata Fossili Formation that crops out in the hill area south of the town of Tortona.

7. **Grazzano Badoglio** (Asti Province). Outcrop north of the village of Grazzano Badoglio, close to the former shooting gallery (Tiro a volo). Gray marl belonging to the formation named Arenìti di Tonengo of Langhian age. For additional information, reference to Arpa (2004).

8. **Lerma** (Alessandria Province). Exposures in the bed of Torrente Piota, upstream of the bridge located southwest of the village of Lerma. Coarse, gray sandstone with marly intercalations of the uppermost part of the Molare Formation; the location close to the upper boundary of the formation indicates a late Rupelian age. For additional information, reference to Lorenz (1969) and Gnaccolini (1978).

9. **Madonna delle Rocche**, Molare (Alessandria Province). Outcrops on both banks of Torrente Orba, approximately 2.8 km south of the village of Molare and 1.4 km southeast of the locality named Madonna delle Rocche. Coarse, gray sandstone with marly intercalations of the upper part of the Molare Formation; the age is late Rupelian. For additional information, reference to Lorenz (1969).

10. **Molare** (Alessandria Province). Cliffy bank on the right of Torrente Orba southeast of the village of Molare, upstream of the road connecting Molare to Ovada. Coarse, gray sandstone of the upper part of the Molare Formation; the age is late Rupelian. For additional information, reference to Lorenz (1969).

11. **Moncucco Torinese** (Asti Province). Outcrops on the southwestern slope of the hill on top of which the village of Moncucco Torinese is located. Medium to coarse sand belonging to the formation named Marne di S. Agata Fossili; the age is Tortonian. For additional information, reference to Arpa (2009).

12. **Monte dei Cappuccini**, Torino (Torino Province). Located on the northwestern slope of the Torino Hills facing the Po River. The fossils of this locality were collected from siltstones, sands and conglomerates forming the upper part of the Baldissero Formation of late Langhian age. For additional information, reference to Zunino & Pavia (2009).

13. **Pareto** (Alessandria Province). Outcrops in the locality named Sbarnera, three km east of the village of Pareto. Gray sandstone and sand belonging to the upper part of the Molare Formation; the age is late Rupelian. For additional information, reference to Lorenz (1969).

14. **Rio di Bocca d'Asino**, Stazzano (Alessandria Province). Exposures on both banks of the brook named Rio di Bocca d'Asino, upstream of the road connecting Stazzano to Sardigliano, about 1.9 km northeast of the former village. Resedimented sandstones and conglomerates forming lenticular bodies into the lower member of the S. Agata Fossili Formation; the age is Tortonian. For additional information, reference to Bongo (1914) and Ghibaudo et al. (1985).

15. **Sant'Agata Fossili** (Alessandria Province). Gully about 0.5 km east-southeast of the village of Sant'Agata Fossili, coinciding with the collecting site 10 of Robba (1968). Gray-bluish clayey marl belonging to the upper member of the S. Agata Fossili Formation; the age is late Tortonian. For additional information, reference to Robba (1968).

16. **Squaneto**, Spigno Monferrato (Alessandria Province). Outcrop along the road connecting Spigno Monferrato to Squaneto, approximately one km northwest of Squaneto. Gray sandstone and marl forming the uppermost part of the Molare Formation. The age is late Rupelian. For additional information, reference to Lorenz (1969).

17. **Stazzano** (Alessandria Province). There are no more precise locality data concerning the material so labeled. Some specimens might have been recovered at locations around Stazzano where the lower member of the S. Agata Fossili Formation (Tortonian) crops out extensively. Most of the material likely comes from Rio di Bocca d'Asino (see above).

18. **Termofourà** (Torino Province). Outcrop near Fontana dei Francesi, along the road leading to the locality named l'Eremo. Conglomerate made of small pebbles into a sandy-pelitic matrix pertaining to the topmost part of the Termofourà Formation; the age is late Burdigalian.

19. **Tetti Civera**, Pino Torinese (Torino Province). Outcrops close to the hamlet named Tetti Civera, approximately 1.1 km north-northwest of the village of Valle Ceppi. Coarse sand of the Termofourà Formation; the age is mid-Burdigalian. Likely the outcrops are those referred to as Valle Ceppi (see fig. 3 of Zunino & Pavia 2009).

20. **Val Sanfrà**, Baldissero Torinese (Torino Province). Outcrops on right bank of Rio Baldissero, about 0,8 km north-northwest of the village of Baldissero, expose alternating pelites and conglomeratic sandstones (known as "Val Sanfrà Strata") belonging to the Termofourà Formation; the age is mid-Burdigalian. For additional information, reference to Zunino & Pavia (2009).

21. **Valle Ceppi**, Pino Torinese (Torino Province). Outcrops along the small stream named Rio Civera, 1.5 km north-northwest of the village of Valle Ceppi and about three km east of Pino Torinese. Coarse sand belonging to the Termofourà Formation; the age is mid-Burdigalian. For additional information, reference to Zunino & Pavia (2009).

22. **Valle Vergnana**, Baldissero Torinese (Torino Province). Outcrop on right bank of the stream named Rio di Vergnana, about 0.84 km west-southwest of Baldissero Torinese, coinciding with the site UCLA 4927 of Hall (1964). Cemented sandy conglomerates belonging to the Termofourà Formation; the age is mid-Burdigalian, nearly coeval to Val Sanfrà. For additional information, reference to Hall (1964) and Arpa (2010).

23. **Villa Allason**, Torino (Torino Province). Outcrop along Val Salice, about 0.7 km west of Eremo (a district of Torino). The deposit, made of sandy pelites and poorly cemented sandstones, belongs to the lower part of the Baldissero Formation; the age is early Langhian. For additional information, reference to Zunino & Pavia (2009).

24. **Villa Bertini**, Torino (Torino Province). Outcrop about 0.8 km northeast of Villa Allason, close to the road connecting Eremo to the city of Torino. Conglomeratic layer made of small pebbles into a sandy-pelitic matrix pertaining to the topmost part of the Termofourà Formation; the age is late Burdigalian. For additional information, reference to Zunino & Pavia (2009).

25. **Villa Maiolo**, Marentino (Torino Province). Diggings nearby Villa Maiolo (also Castello Maiolo), approximately one km north of the village of Marentino, have unearthed coarse clayey sand belonging to the formation named Marne di S. Agata Fossili; the age is Tortonian. For additional information, reference to Arpa (2009).

LIGURIA

26. **Carpenaro**, Mioglia (Savona Province). Outcrop approximately two km southeast of the village of Mioglia and 0.3 km east-southeast of the hamlet named Carpenaro. Gray sandstone belonging to the uppermost part of the Molare Formation; the age is late Rupelian. For additional information, reference to Lorenz (1969).

27. **Colle del Giovo Ligure**, Pontinvrea (Savona Province). Outcrop about 0.65 km northwest of the Colle del Giovo Pass (road 334). Marly sandstone belonging to the Molare Formation; the age is Rupelian. For additional information, reference to Lorenz (1969; fig. 123 and p. 618).

28. **Dego** (Savona Province). Outcrop at Case Ciappeiroli, about one km southeast of the village of Dego. Gray sandstone belonging to the Molare Formation; the age is Rupelian. For additional information, reference to Lorenz (1969) and Arpa (2010).

29. **Mioglia** (Savona Province). Outcrop 0.25 km east of Case Sciriti, approximately 1.5 km east of the village of Mioglia. Coarse, gray sandstone belonging to the upper part of the Molare Formation; the age is late Rupelian. For additional information, reference to Lorenz (1969) and Arpa (2010).

30. **Sassello** (Savona Province). Outcrop about 1.7 km northeast of Sassello, 0.2 km left of the road connecting Sassello to Palo. Gray marl (Case Capè Marl) belonging to the Molare Formation; the age is latest Rupelian. For additional information, reference to Lorenz (1969).

EMILIA-ROMAGNA

31. **Montegibbio**, Sassuolo (Modena Province). Gully on the right side of the stream named Rio delle Bagole and small exposure about 0.4 km south of Cà del Chierico. Gray clayey marl belonging to the Formazione del Termina (Termina Formation); the age is Tortonian. For additional information, reference to Davoli (1972).

32. **Passo dei Meloni**, Sogliano al Rubicone (Forlì-Cesena Province). Small outcrop in the uppermost part of a gully close to the source of Rubicone River. Gray clay with abundant *Amalda glandiformis* (Lamarck, 1810) and *Amalda obsoleta* (Brocchi, 1814). The inferred age is Tortonian.

33. **Pietracuta**, San Leo (Rimini Province). Outcrop on the left bank of Marecchia River, approximately 1.5 km west of the village of Pietracuta. Blue-gray clay belonging to the formation named Argille di Montebello. According to the Geological Map of Italy (scale 1:50,000, Sheet 267, San Marino), the age is early Tortonian.

34. **Scipione Ponte**, Salsomaggiore Terme (Parma Province). Outcrops on the left of Torrente Stirone, approximately 0.9 km north-northeast of the hamlet named Scipione Ponte. Gray clay of Tortonian age. For additional information, reference to Marasti (1973).

35. **Sogliano al Rubicone** (Forlì-Cesena Province). Outcrop on the left of road 11 connecting Sogliano al Rubicone to Savignano, approximately 0.2 km before the junction with the road to San Giovanni in Galilea. Gray silty-clay belonging to the unit named Argille di Casa i Gessi; the age is early Messinian. For additional information, reference to Ruggieri & Davoli (1984).

36. **Vigoleno** (Piacenza Province). Val San Martino Section, slope on the right of Torrente Ongina near the village of Vigoleno. Gray clayey sand belonging to the Vigoleno Member of the Termina Formation. According to the Geological Map of Italy (scale 1:50,000, Sheet 180, Salsomaggiore Terme), the age of the Vigoleno Member is early Messinian. For additional information on the Val San Martino Section, reference to Venzo & Pelosio (1963).

VENETO

37. **Altavilla Vicentina** (Vicenza Province). Decommissioned basalt quarry north of Colle della Chiesa. Excavations for basalt have exposed a sedimentary sequence of various age, from mid-late Eocene to early Miocene. The naticids were collected from a gray-brown marly level rich in turritellids; the mollusk assemblage was said to belong to the "Sangonini Horizon" of Rupelian age. For further information, reference to Fabiani (1915), Mietto (1988), Mellini & Quaggiotto (1990) and Beschin & De Angeli (2012).

38. **Cà Sella**, Salcedo (Vicenza Province). Outcrop along the road connecting Cà Sella to Cà Gnata, southwest of the locality named Laverda. Resedimented, reddish-brown volcanoclastic bed that yielded an assemblage belonging to the "Sangonini Horizon". The age is Rupelian. For additional information, reference to Molon (1867) and Fuchs (1870).

39. **Case Soghe**, Barbarano Vicentino (Vicenza Province). A section near the locality named Case Soghe, approximately 2.4 km north-northeast of the locality named San Giovanni in Monte, exposes a 3.7 m thick bed of gray to yellowish-brown clayey silt with small pebbles that yielded the naticids. The age is Rupelian. For additional information, reference to Accorsi Benini (1971).

40. **Cava Albanello**, Nogarole Vicentino (Vicenza Province). Decommissioned quarry on the left side of Torrente Chiampo, about 1.5 km south of the village of Nogarole Vicentino. The naticids were collected from rather coarse, gray tuff forming the lower part of a thick, fining upward volcanoclastic bed underlying a limestone level ("San Giovanni Ilarione Horizon"). The age is early Lutetian. For additional information, reference to Beschin et al. (1991), Beschin et al. (1996) and De Angeli et al. (2010).

41. **Cava Boschetto**, Nogarole Vicentino (Vicenza Province). Quarry on the left side of Torrente Chiampo, 1.2 km south-southeast of the village of Nogarole Vicentino. The naticids were collected from the lower part of a 16.5 m thick level of bedded, greenish-gray tuff (unit c of Beschin et al. 1991). The age is early Lutetian. For further information, reference to Fornasiero & Vicariotto (1997) and Beschin et al. (1991).

42. **Cava Grola**, Cornedo Vicentino (Vicenza Province). Active quarry on the right side of Torrente Agno, 1.6 km west of the village of Cornedo Vicentino and about 0.6 km southwest of road 246. The naticids were collected from greenish-gray volcanoclastic sandstone layers alternating with limestone beds; the fossil assemblage is said to have a close similarity to that of the "San Giovanni Ilarione Horizon". The age is middle Lutetian. For additional information, reference to Mietto (1975), Beccaro & De Angeli (2001), Beschin et al. (2005) and De Angeli & Lovato (2011).

43. **Cava Main**, Arzignano (Vicenza Province). Decommis-

sioned quarry on the left side of Torrente Chiampo, 0.4 km northwest of the village of Arzignano. The naticids were collected from the uppermost level of gray volcanic sandstone reported to be of middle Lutetian age (cf. Beschin et al. 1996; Beschin et al. 2002).

44. **Cava Rossi**, Priabona (Vicenza Province). Active quarry about two km northeast of Priabona and approximately 1.9 km southeast of the hamlet of Monte di Malo, on the eastern margin of the Agno-Chiampo graben. Volcanoclastic layer in the lower part of the section. Research in progress demonstrates that the age is late Ypresian-earliest Lutetian. For further information, reference to Beschin et al. (1996), De Angeli et al. (2009), Checchi et al. (2012) and Zamberlan & Checchi (2014).

45. **Chiuppano** (Vicenza Province). Section exposed along Torrente Astico, approximately 1.4 km east of Chiuppano. The naticids were collected from grayish-brown marly sandstone layers of Rupelian age. For additional information, reference to Patrini (1902) and Fabiani (1912).

46. **Ciupio**, San Giovanni Ilarione (Verona Province). Outcrop on the left side of the brook adjacent to Case Ciupio, approximately two km east of San Giovanni Ilarione, exposes four to six m of a volcanoclastic deposit, greenish-gray basally, yellowish in the upper part; the age is early Lutetian. For additional information, reference to De Gregorio (1880) and Fabiani (1915).

47. **Le Coe**, Cavaso del Tomba (Treviso Province). Decommisioned quarry (cava Dalla Favera; site a of Bizzotto 2005) in the locality named Le Coe, approximately 1.2 km south-southeast of the village of Possagno. Blue-gray marl forming the uppermost part of the formation known as Marna di Possagno; the age is Priabonian. For additional information, reference to Fabiani (1915), Braga (1970), Reato (1983) and Bizzotto (2005).

48. **Monte Gloso**, Marostica (Vicenza Province). Decommissioned basalt quarry on Monte Gloso, near the locality of Marsan. Excavations for basalt have exposed intercalations of yellowish-gray, coarse-grained marly sandstone of Rupelian age. The mollusk assemblage is said to be a mixed assortment of species of the "Sangonini Horizon" and of the "Castelgomberto Horizon".

49. **Monte Merlo**, San Giovanni Ilarione (Verona Province). Outcrop in the locality named Croce Grande, approximately 1.5 km northeast of San Giovanni Ilarione. Yellowish volcanoclastic deposit forming a single bed about ten m thick; the age is Lutetian. For further information, reference to De Gregorio (1880).

50. **Roncà** (Verona Province). Outcrop on the left side of Valle della Chiesa (formerly Val Nera), approximately one km upstream of Roncà and 0.15 km south of Casa Tessari. Volcanoclastic layer slightly more than one m thick (black tuff with cerithiids of Fabiani 1915); the age is middle Eocene (Bartonian). For further information, reference to Fabiani (1915) and Zorzin et al. (2012).

51. **Sangonini** (presently Santa Maria di Lugo), Lugo (Vicenza Province). Section approximately 0.3 km northwest of the hamlet named Santa Maria. The naticids were collected from a blackish volcanoclastic level and from a yellowish-gray marly sandstone level, both of Rupelian age. For additional information, reference to Fabiani (1915).

52. **Soprasalmo**, Borgo Valsugana (Trento Province). Outcrops on the left side of the valley of Torrente Fumola (Pissavacca), near the locality named Soprasalmo. Sandstone level of mid-Tortonian age. For further information, reference to Venzo (1934).

53. **Valle Organa**, Castelcucco (Treviso Province). Outcrops close to the road connecting Castelcucco to Possagno, approximately 0.4 km north of the village of Castelcucco. Blue-gray marl belonging to the formation named Marna di Possagno; the age is Priabonian. For additional information, reference to Braga (1970).