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A REVISION OF THE PLIOCENE NATICIDS OF NORTHERN AND CENTRAL ITALY. I. THE SUBFAMILY NATICINAE EXCEPT *TECTONATICA*

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Abstract. The present paper is the first in a series devoted to the revision of the Pliocene naticids of Northern and Central Italy. It recovers some previously disregarded but valid species and expands the number of naticine taxa (*Tectonatica* excluded) from four to twelve. Of these, one belongs to the genus *Natica* Scopoli, 1777, the others are assigned to the genus *Cochlis* Röding, 1798 which is reused herein for the first time after more than one century. The vast material examined (personal and museum collections) has allowed to analyze all shell and opercular characters, in terms of range of variation and significance in species recognition. The study demonstrates that the morphological characters of the teleoconch, such as the height of the spire, the suture, the umbilical features and the sculpture (subsutural axial wrinkles), are diagnostic only in some instances as it happens with the color. The operculum stands as the most significant diagnostic element in that is species-specific and, thence, sufficient to recognize each taxon. The protoconch is relevant as well to distinguish several, but not all species. The characters which are necessary and/or sufficient for the identification of the species considered in this study are summarized in the conclusive remarks. All the twelve taxa considered in this study are described and commented in the systematic account. One species, *Cochlis sulcogradata*, and one subspecies, *Cochlis raropunctata obliquicallosa*, are proposed as new.

Riassunto. Il presente lavoro è il primo di una serie dedicata alla revisione dei naticidi pliocenici dell'Italia settentrionale e centrale. Esso ripropone alcune specie che in passato erano state ignorate, ma che risultano valide, ed incrementa il numero dei taxa della sottofamiglia Naticinae (a parte quelle del genere Tectonatica trattate in un successivo lavoro) da quattro a dodici. Di queste, una appartiene al genere *Natica* Scopoli, 1777, le altre sono attribuite al genere *Cochlis* Röding, 1798 che viene riusato qui per la prima volta dopo oltre un secolo. L'abbondante materiale esaminato (raccolte personali e collezioni museali) ha consentito di analizzare tutti i caratteri scheletrici in termini di variabilità e validità come elementi diagnostici. Questo studio dimostra che i caratteri morfologici della teleoconca, quali altezza della spira, suture, tipologia ombelicale e ornamentazione (presenza di pieghe assiali subsuturali), consentono di riconoscere le specie solo in qualche caso e lo stesso vale per la colorazione. L'opercolo si qualifica come carattere diagnostico più valido in quanto peculiare di ciascuna specie e quindi sufficiente per riconoscerla. Anche la protoconca è spesso diagnostica, ma non in ogni caso. I caratteri che sono necessari e/o sufficienti per la identificazione di ciascuna delle specie considerate vengono sintetizzati nelle considerazioni conclusive. Nelle stesse si sottolinea che, non essendo questi ultimi osservabili/disponibili nel materiale che si esamina, è più saggio astenersi da qualsiasi attribuzione a specie. Tutti i dodici taxa oggetto di questo studio vengono descritti e commentati nella enumerazione sistematica. La specie *Cochlis sulcogradata* e la sottospecie *Cochlis raropunctata obliquicallosa* vengono proposte come nuove.

Introduction

The present paper is the first in a series aiming to revise the Pliocene naticids of Northern and Central Italy. It examines eleven species and a new subspecies included in the subfamily Naticinae since they possess a calcareous operculum. The species of the genus *Tectonatica* Sacco, 1890, also belonging to the Naticinae, will be dealt with in a subsequent paper.

This study is based on a huge collection of about 19,000 specimens, assembled during the last twenty years to include material from number of Pliocene exposures in Central and Northern Italy (Fig. 1); the locality data are shortly dealt with in the appendix. The preservation of the recovered shells is usually fair, sometimes spectacular; moreover, the amplitude of the collection has allowed to obtain several specimens that retain the color pattern and/or have the operculum still filling the aperture. Consequently, all the shell characters and the operculum of each species could be observed and analyzed in terms of range of variation and diagnostic value. The vast material in the Bellardi-Sacco collection (Museo di Geologia e Paleontologia dell'Uni-

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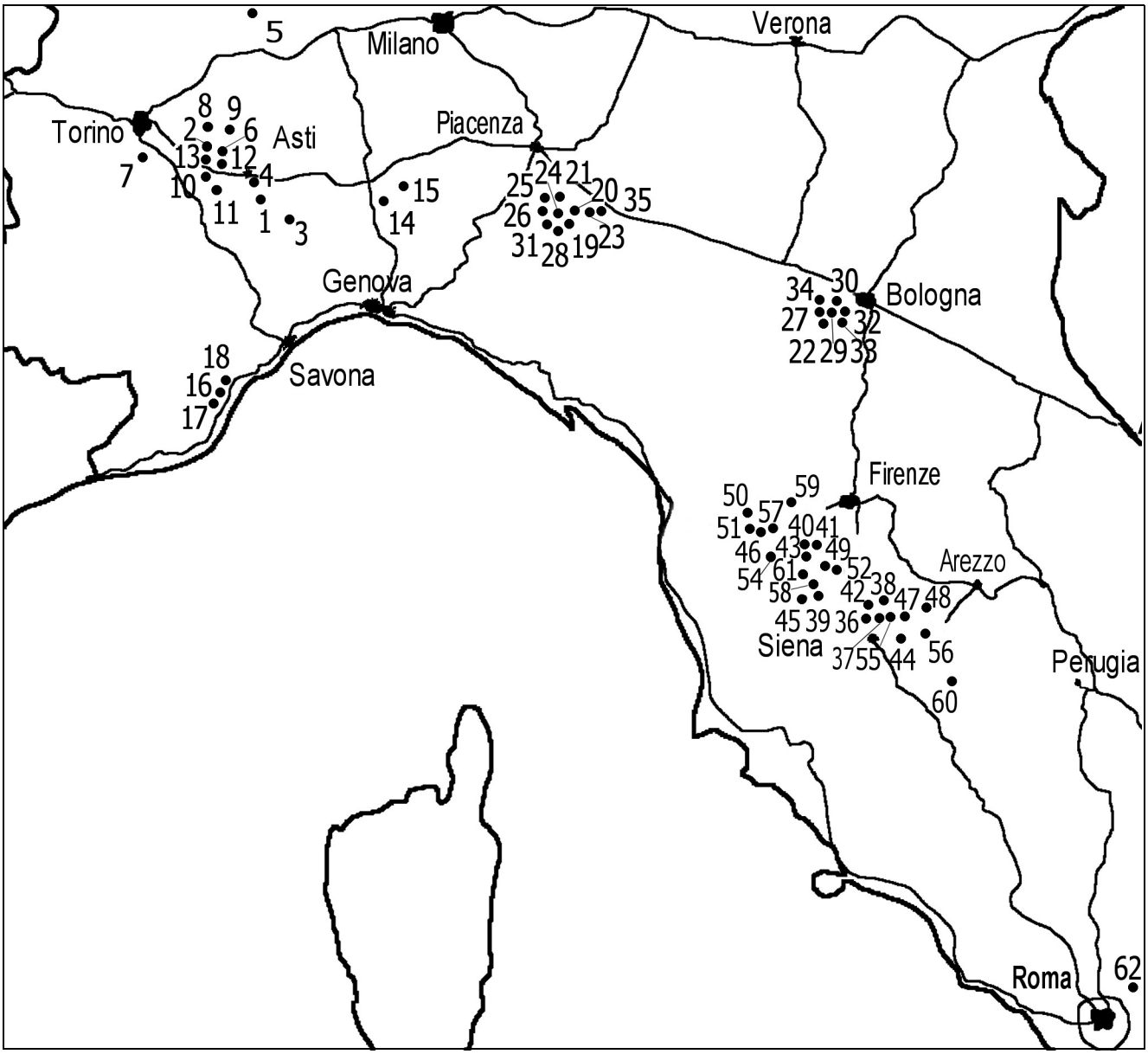


Fig. 1 - Sketch map of naticid localities; locality numbers are those in the appendix.

versità di Torino), Coppi's and Doderlein's collections (Museo Paleontologico dell'Università, Modena), Bertarelli's collection (Museo Civico, Vignola), Foresti's collection (Museo di Geologia e Paleontologia G. Capellini, Bologna), De Stefani's and Pecchioli's collections (Museo di Storia Naturale, Sezione di Geologia e Paleontologia dell'Università, Firenze) along with naticids in Laboratorio di Malacologia (Museo di Zoologia, Bologna) and in private collections have been examined as well.

Naticids are a significant component of Cenozoic molluscan assemblages of Italy and species occur commonly, often abundantly, in sedimentary rock bodies that reflect number of marine environments. Nevertheless, the naticids were rarely surveyed and no critical evaluation of this family was published during the last century by Italian workers; information is ordinarily sparse and must be sought after throughout the paleontological literature. Actually, the sole comprehensive account is that published by Sacco (1891) who monographed the naticids of the Tertiary Basin of Piedmont and Liguria in the context of the treatment of the molluscan fauna of that basin. Sacco dealt with 28 species, variously ranging through time, and proposed over 100 varieties some of which were later on recognized to be distinct species. It is noteworthy that Sacco on one hand lumped different species and on the other hand split most species into a number of varieties based on trifling differences. Currently, authors have relied upon shell characters, primarily shell shape and umbilical features, in identifying and describing species. Remarkable exceptions were Brugnone (1880), Ruggieri (1949), Mor-

oni (1956), Moroni & Paonita (1964), Moroni & Torre (1965), Di Geronimo (1969), Pavia (1980) and few others who also considered or focused on the opercular features. The review of the literature of the last decades concerning the Pliocene shows that the Naticinae ordinarily recorded, apart from the *Tectonatica* species, were *Natica plicatula* Bronn, 1831, *Natica pseudoepiglottina* Sacco, 1890 (see below for authorship), *Natica tigrina* Defrance, 1825 and, occasionally, *Natica virguloides* Sacco, 1890. The first three species were assigned either to the genus *Natica* Scopoli, 1777 or to the genus *Naticarius* Duméril, 1806. Bronn's taxon was currently regarded as a subspecies of the Recent *Natica dillwyni* Payraudeau, 1826; *Natica tigrina* was quoted by some authors under the names *millepunctata* Lamarck, 1822 or *raropunctata* Sasso, 1827.

The present paper recovers some previously disregarded but otherwise valid species, and expands the number of Pliocene naticine taxa (*Tectonatica* excluded) from four to twelve. This result largely depends on the fact that we were lucky enough to find for each of them the operculum, a feature that was often unavailable to previous authors. Of the twelve taxa, one belongs to the genus *Natica* (*virguloides* Sacco, 1890). The others (*depressofuniculata* Sacco, 1890, *fulgurata* Meneghini in Pecchioli, 1864, *plicatula* Bronn, 1831, *propinqua* Pecchioli, 1864, *pseudoepiglottina* Sacco, 1890, *raropunctata* Sasso, 1827, *raropunctata obliquicallosa* subsp. n., *stric-*

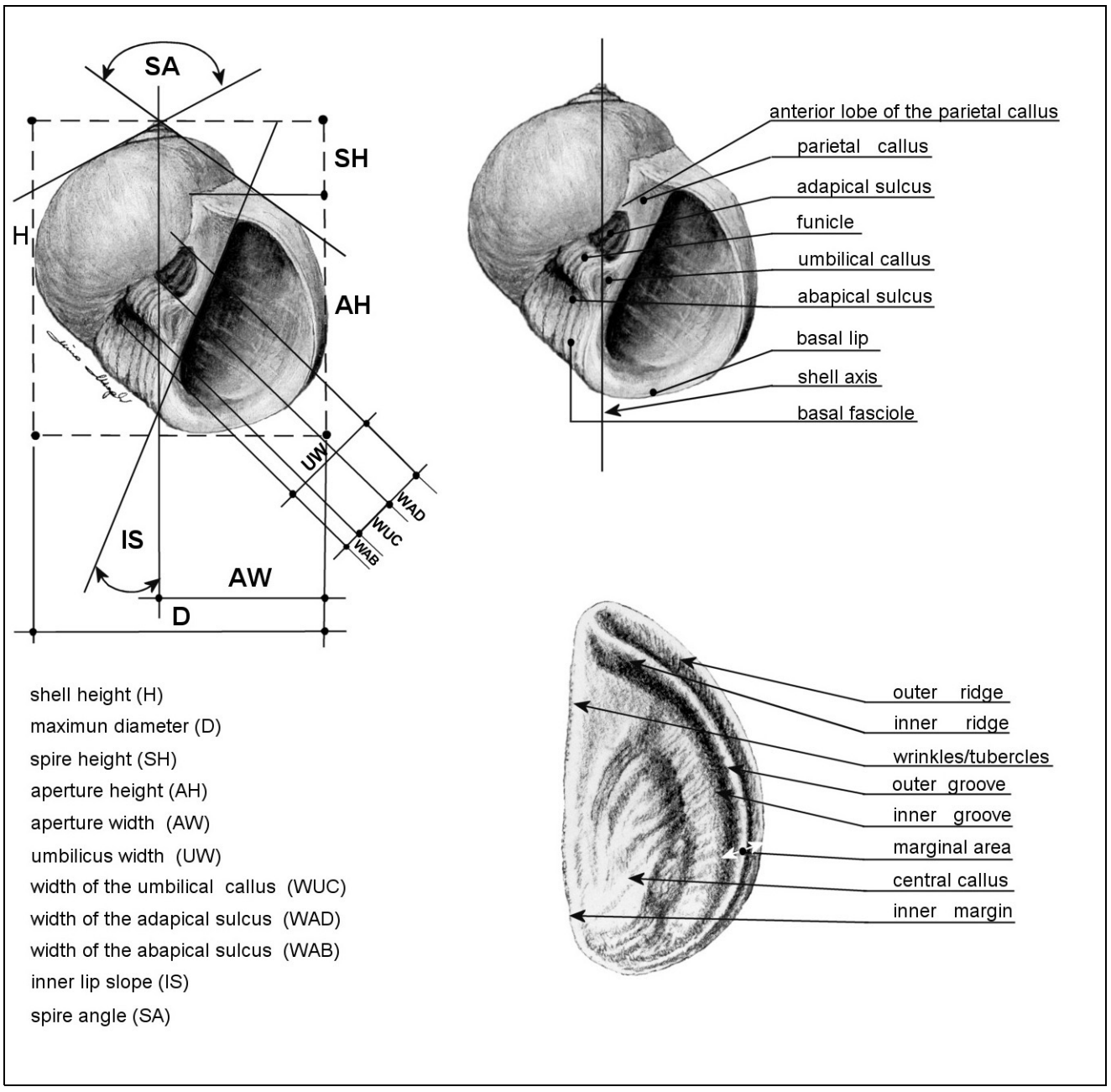


Fig. 2 - Standard measurements and illustrated glossary of the terms applied to parts of naticid shell and operculum.

tiumbilicata Sacco, 1890, *sulcogradata* sp. n., *undata* Sasso, 1827 and *vittata* Gmelin, 1791) have been assigned to the genus *Cochlis* Röding, 1798 which is reused herein for the first time after more than one century (see discussion in generic classification).

When analyzing the morphology and shell characters of the studied species, we have found convenient to divide *Cochlis* species (except for *plicatula*) into two groups, respectively the *raropunctata* group and the *pseudoepiglottina* group. The former includes species having small protoconch with large nucleus and 2 ribs to the operculum, the latter contains those species having larger protoconch with small nucleus and 3 ribs to the operculum. At the present state of the research, we cannot say whether these groups may have any taxonomic significance.

In the following, ample reference will be made to Bouchet & Waren (1993) who, in the frame of a revision of Recent northeast Atlantic bathyal and abyssal Mesogastropoda, thoroughly treated the naticids, to some major revisions concerning both modern and Cenozoic naticids (Kilburn 1976; Marinchovich 1977; Majima 1989), and to Kabat (1991) who reviewed the genus level names of the Naticidae.

Short history of the naticids covered in this study

The naticine species considered herein were mostly described during the 19th century and currently assigned to the broadly defined genus *Natica*. The first species to be introduced were *Natica raro-punctata* (sic) and *Natica undata*, both described by Sasso (1827) on the basis of specimens obtained from the Pliocene locality of Rio Torsero. Shortly after, Philippi (1844) used the name *undata* to designate Recent shells from Sicily; although he treated *undata* as a new species, he also set the doubt whether those specimens could simply represent a variety of *Natica millepunctata* Lamarck, 1822. Likely, *undata* Philippi differs from *undata* Sasso, but nothing certain can be stated in this respect, the original Philippi's material being unavailable and probably lost.

Sismonda (1847) proposed *Natica pseudo-epiglottina* (sic) to group the Italian Late Miocene and Pliocene specimens and distinguish them from the Eocene French material included in *Natica epiglottina* Lamarck, 1822 (as shown later, the name *pseudoepiglottina* Sismonda, 1847 is not available). Sismonda also quoted *Natica umbilicosa*, a species in Bonelli's unpublished catalogue of the Museo Zoologico di Torino, but neither described it nor gave any illustration. The meaning of *umbilicosa* will be discussed later, in the section devoted to problematic species. Later, Pecchioli (1864) described *Natica fulgurata* and *Natica propinqua* on the basis of material recovered from the Pliocene "Argille Subappennine" of Tuscany. De Stefani (1889) proposed *Natica pantanelli*, which is a junior synonym of *Nerita vittata* Gmelin, 1791. Both *pantanelli* and *vittata* were never quoted later on in the paleontological literature.

Sacco (1891) treated most of the naticid species dealt with in the present paper. He included *raropunctata* Sasso, 1827 in the synonymy of *tigrina* Defrance, 1825 and regarded the latter as a variety of *Natica millepunctata*; also *fulgurata* Meneghini in Pecchioli, 1864, *propinqua* Pecchioli, 1864, *undata* Sasso, 1827 and the new taxon *depressofuniculata* were lumped under *millepunctata* and considered to be varieties of it. Further, Sacco regarded *pseudoepiglottina* Sismonda, 1847 and his new taxon *strictiumbilicata* as varieties of *epiglottina* Lamarck, 1822, *plicatula* Bronn, 1831 as a variety of the Recent *Natica dillwyni* Payraudeau, 1826 and redescribed *Natica (Naticina) virguloides* that he had proposed one year earlier (1890). It is notable that while Sacco lumped distinct species, he recognized as many as 27 varieties of *Natica millepunctata* and 18 of *Natica epiglottina*, thus expanding the meaning and the stratigraphic range of these species. Sacco's treatment was confusing and led most of subsequent authors to retain only a few species, i.e. *tigrina*, *pseudoepiglottina*, *plicatula* and *virguloides*, this latter quoted later on only by Pavia (1980) and few others (see synonymy in the systematic account); *tigrina* and *pseudoepiglottina* were the species much frequently dealt with or simply quoted in papers issued during the second half of the last century.

The name *raropunctata* was rediscovered about fifty years later when Ruggieri (1949) assigned to it the new variety *sulcooperculata* based on Pliocene and Pleistocene shells having peculiar opercular characters that had been formerly noted by Brugnone (1880). The most recent work dedicated to naticids is that by Pavia (1980) which focuses more on opercular than on shell features of species. Apart from *Tectonatica* species, the paper reflects the current view and considers only *virguloides*, *plicatula*, *pseudoepiglottina* and *tigrina*; *sulcooperculata* is regarded not to be worthy of separation from *tigrina*.

Basically, the approach followed until recently by the majority of the authors, on the authority of Sacco (1891), was to include in *pseudoepiglottina* the specimens having rather elevated spire, small umbilicus with thick, central funicle, in *tigrina* those shells with more or less depressed spire, wider umbilicus and central funicle of variable strength but usually thinner than that of *pseudoepiglottina*. The other species, save *plicatula* and *virguloides*, were neglected and respective shells ordinarily referred to as *tigrina*. A remarkable exception is due to Solsona & Martinell (1999) who discussed *strictiumbilicata*, formerly included in *epiglottina*, and demonstrated it to be a fully distinct species.

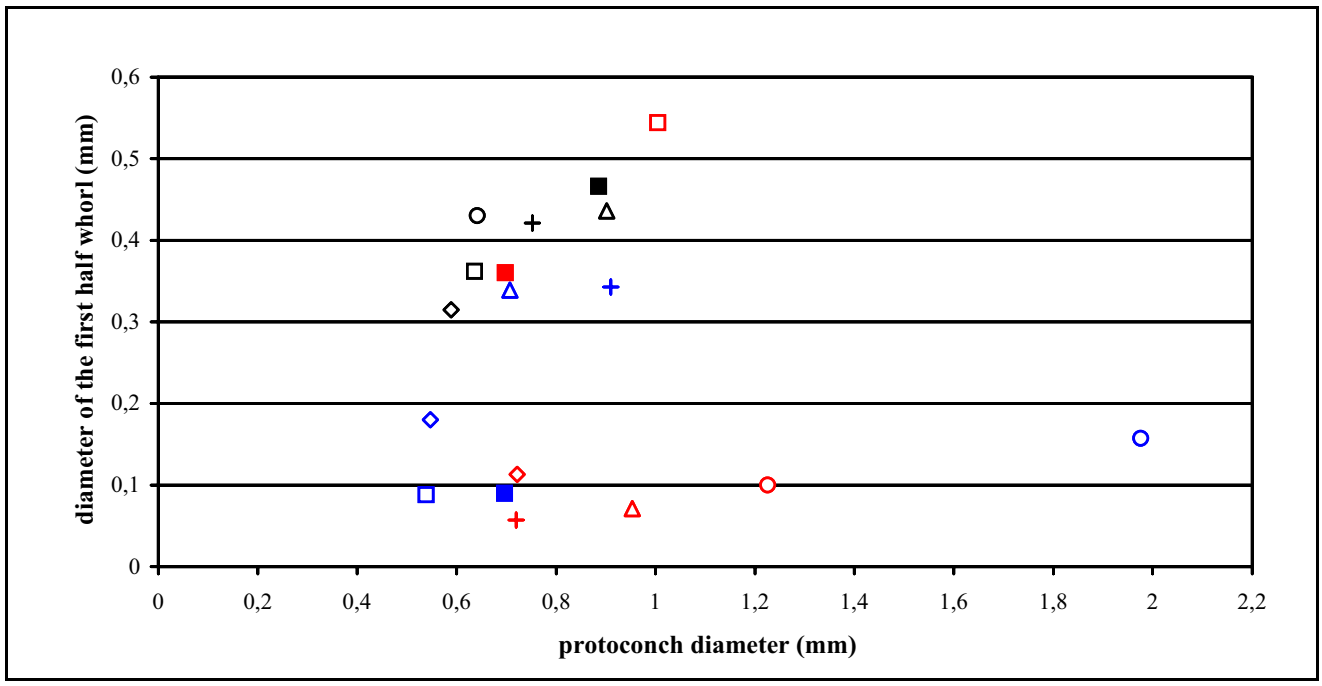


Fig. 3 - Relationship between diameter of the first half whorl of the protoconch and protoconch diameter; blue open circle: *canariensis*; black open diamond: *depressofuniculata*; red open triangle: *dillwyni*; blue open diamond: *fulgurata*; red cross: *gualtieriana*; black open triangle: *hebraea*; blue solid square: *marochiensis*; red solid square: *obliquicallosa*; red open circle: *plicatula*; black open circle: *propinqua*; red open diamond: *pseudoepiglottina*; black open square: *raropunctata*; red open square: *stercusmuscarum*; black cross: *strictiumbilicata*; black solid square: *sulcogradata*; blue cross: *undata*; blue open triangle: *virguloides*; blue open square: *vittata*.

Morphology and character analysis

The shell of the Naticidae is usually globose, but may be ovate or auriform like in the subfamily Sininae. The spire is low to moderately elevated in most subfamilies, often elevated in members of the subfamily Ampullospirinae. The aperture is D-shaped, rather large to enormous like that of the sinines. The shell is mostly umbilicate, the umbilicus being broad to slit-like, open to plugged by shelly matter. The funicle, a thick to thin or inconspicuous cord, may ascend spirally within the umbilicus in several naticids. The outer surface is usually smooth, at most with the growth markings changing into more or less coarse wrinkles close to the adapical suture; a distinct spiral sculpture occurs only in the Sininae. Living naticids exhibit distinctive color and/or color patterns that may be preserved in fossil specimens, but commonly are not. The naticids possess an operculum that is corneous, occasionally partly calcareous, in the Ampullospirinae, Policinae and Siniinae, while it is fully calcareous in the Naticinae. The radular dentition is a rather conservative character, currently considered to be of little taxonomic use in naticids (Marinchovich 1977; Majima 1989) and, anyway, it is unavailable in fossil specimens.

According to Majima (1989), the morphology of the protoconch, the degree of channeling of the suture and the range of morphological variation of a given character may be useful in defining species. Concerning the protoconch, it is to be noted that Kilburn (1976), Bouchet & Waren (1993) and Solsona & Martinell (1999) used it to distinguish species, but only the latter authors explicitly designated it as a reliable diagnostic character.

The shell shape can be rather variable within a species and, conversely, it may be exceedingly similar in different species even when they belong to distinct subfamilies, primarily Naticinae and Polinicinae, likely because of the many convergences due to similarity in ecology between species (Bouchet & Waren 1993). Nevertheless, authors, in particular Maricovich (1977) and Majima (1989), have accorded basic importance to this character.

The umbilical features, i.e. shape and amplitude of the umbilical opening, absence/presence and strength of the funicle, shape of the umbilical callus and the extent to which it hides the umbilicus, were currently regarded by the authors as most relevant diagnostic characters at both the genus and species level. Kilburn (1976) largely relied upon them in the keys to species of the various naticid subgenera he dealt with.

The shell sculpture is an unusual feature and was considered of scarce value in distinguishing species (Maricovich 1977), but exceptions do exist, e.g. the Neogene *Natica plicatula* Bronn, 1831 was traditionally separated from the Recent *Natica dillwyni* Payraudeau, 1826 in that has distinct subsutural axial wrinkles whereas the Recent form has not. Majima (1989) stated

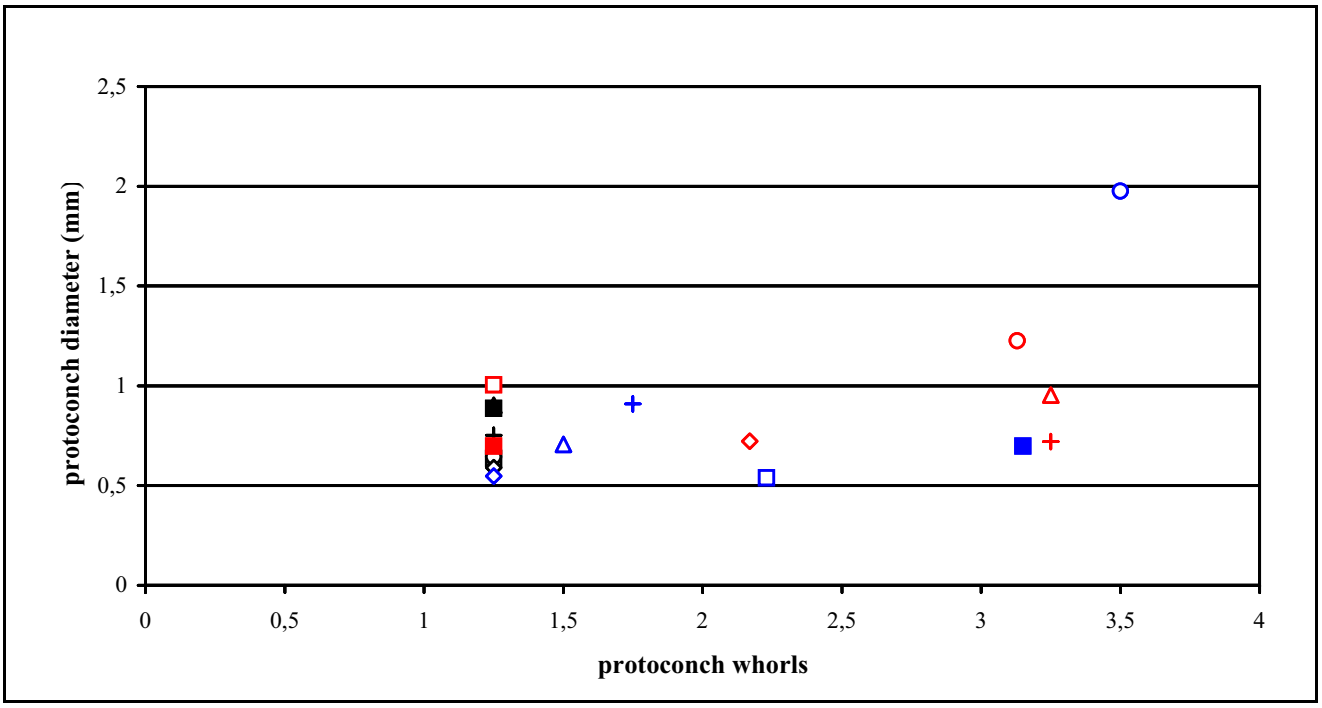


Fig. 4 - Relationship between protoconch diameter and protoconch whorls; symbols as in Fig. 3.

that the "shell-surface ornamentation is commonly useful for defining species" (p. 6), but later on (p. 24) wrote that this character "is considered to be of only suprageneric importance". Actually, the sculpture is relevant at the subfamily level and basically serves to distinguish the sinine species that are characterized by spirally lirate shells.

Apart from the most obvious use in separating the naticids with calcareous operculum from those having a corneous one, the opinion of the author about the value of this solid accessory to the shell is not univocal. Marincovich (1977) stated that numerous species occur in which the morphology of the calcareous operculum is not taxonomically useful. Bouchet & Waren (1993), even if agreeing on the utility of the opercular features to group naticine species, appear to be much cautious as regards the use of this character. Majima (1989) regarded the sculpture of calcareous opercula as "taxonomically useful in combination with shell morphology". Ruggieri (1949), Kilburn (1976) and Pavia (1980) regarded the operculum as a distinctive character. In particular, Pavia demonstrated significant opercular differences in a lot of Pliocene naticine species of Northern Italy.

In the following we examine the same characters considered above, occurring in the species covered by this study in order to evaluate their respective relevance. The terms that have been used to indicate the parts of the naticid shells along with the standard measurements are shown in Fig. 2.

Protoconch

The naticids possess a turbiniform larval shell consisting of 1 to over 3 whorls that are more or less convex and usually smooth. Relatively few species exhibit a spiral microsculpture on the first whorl, e.g. the Eastern Atlantic *Euspira grossularia* (Marche-Marchad, 1957), *Polinices montagui* (Forbes, 1838) and the Atlantic-Mediterranean *Polinices pulchella* (Risso, 1826), or throughout the protoconch, e.g. the South African *Polinices syrphetodes* Kilburn, 1976 and *Sinum quasimodoides* Kilburn, 1976. The larval shell is partly concealed by the teleoconch and appears as a broad, low cone forming the apical part of the adult shells. This implies that the visible (measurable) diameter is smaller, also as much as 50% less, than the real diameter of the protoconch. The demarcation from the teleoconch may be sharp, but more often it is ill-defined, obscurely marked by the change in the wall texture, by a faint scar, or by a slight swelling of the teleoconch (Fretter & Manly 1979).

The protoconch features were scarcely dealt with, also in some major accounts, likely because the apical whorls in naticid shells are often more or less eroded, particularly in fossil specimens. For example, only qualitative information was occasionally included in describing the Cenozoic species of Northeastern Pacific (Marincovich 1977) and of Japan (Majima 1989).

Fully informative papers as regards the larval shell are that by Fretter & Graham (1981) which includes several naticid species living in Britain and Denmark waters, and the revisions published by Kilburn (1976)

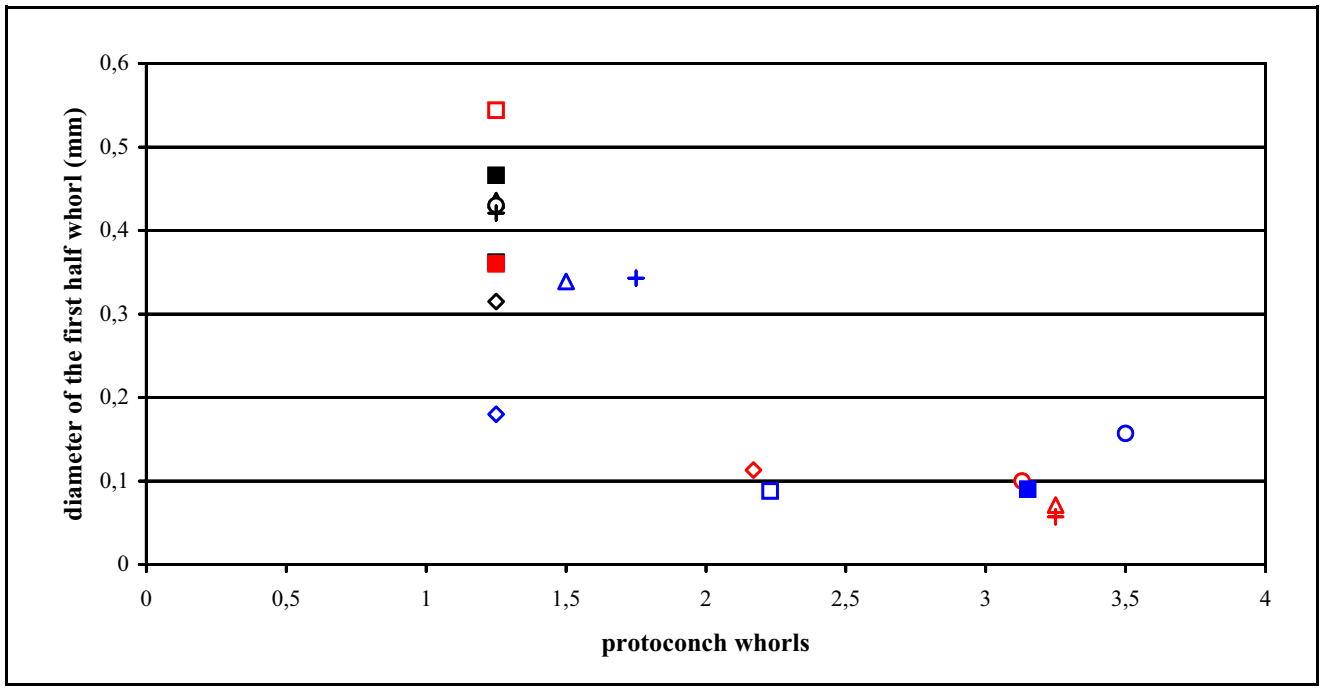


Fig. 5 - Relationship between diameter of the first half whorl of the protoconch and protoconch whorls; symbols as in Fig. 3.

and by Bouchet & Waren (1993), dealing with Recent naticids, respectively of South Africa and Northeast Atlantic.

Kilburn (1976) provided a thorough description of the protoconch for several species, inclusive of number of whorls and diameter measurements. Even if not esplicitly considering the protoconch to be diagnostic, he used this character in separating species. It is worthy to notice the following.

• He referred to *Natica lemniscata* Philippi, 1851 an Okinawan shell close to *Natica cernica* Jousseaume, 1847 also on the basis of its protoconch larger than that of *Natica cernica*, i.e. with a diameter of 1.4 mm instead of 1.1 mm.

• Discussing the new species *Natica roscoei*, he pointed out that, if the teleoconch characters alone are considered, the same specimens could be referred to *Natica simplex* Sowerby, 1897 or to *Natica telaaraneae* Melvill, 1901. However, he noted that, apart from opercular differences, *Natica roscoei* has the protoconch slightly smaller (1.5 whorls, diameter 0.5-0.8 mm) than that of *Natica simplex* (1.5 whorls, diameter 0.8-1 mm) and that *Natica telaaraneae* has the protoconch of 3 whorls instead of only 1.5 as in *Natica roscoei*. Further, he wrote that *Natica buriasiensis* Récluz, 1844 differs "significantly from *roscoei* in the protoconch... with two whorls, of which the initial one is relatively minute".

• Finally, considering the relationships between *Sinum planatum* (Récluz, 1843) and *Sinum diauges* Kilburn, 1974, he remarked that the latter species is distinguished, among the other characters, by fewer protoconch whorls.

Bouchet & Waren (1993) also gave a detailed description of the larval shell of most of the naticid species dealt with, and used it as a diagnostic character in some instances.

• In distinguishing *Cryptonatica affinis* (Gmelin, 1791) from *Cryptonatica operculata* (Jeffreys, 1885), they noted that the diameter of the initial half whorl is 0.4-0.5 mm in the former species and 0.6-0.7 in the latter; moreover, they indicated another difference in that "the whorls of the larval shell are unusually flat in *Cryptonatica operculata*, while they are more convex in *Cryptonatica affinis*".

• Discussing the relationships between *Polinices fusca* (Blainville, 1825) and *Polinices montagui* (Forbes, 1838), they remarked that the larval shells of these species "are very similar, but that of *fusca* is slightly larger, about 1.6 mm instead of 1.2 in diameter".

Further, Solsona & Martinell (1999) noted that the Pliocene *Natica pseudoepiglottina* Sismonda, 1847 (actually of Sacco, 1890) and *Natica strictiumbilicata* Sacco, 1891 have basically identical teleoconch, but separated them on the basis of their protoconch characters. They pointed out that the larval shell of the former species is "multispiral with a small nucleus", while that of the latter is "paucispiral with a large nucleus". According to the measurements given by the authors, the average values of 1) number of whorls, 2) protoconch diameter and 3) diameter of the first half whorl are respectively 2.5, 1.07 mm and 0.15 mm in *pseudoepiglottina*, 1.5, 0.82 mm and 0.30 mm in *strictiumbilicata*.

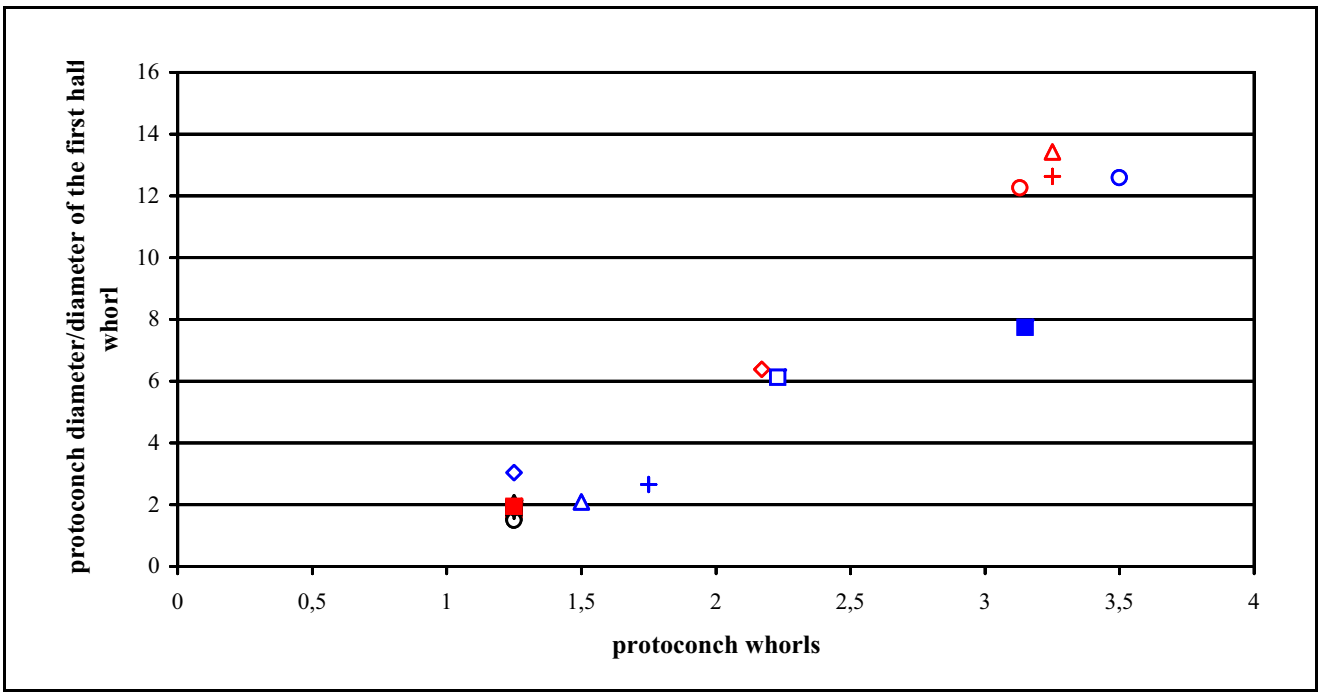


Fig. 6 - Relationship between protoconch diameter/diameter of the first half whorl ratio and protoconch whorls; symbols as in Fig. 3.

From the above, it becomes evident that the number of whorls, the diameter and the diameter of the first half whorl are the distinctive features of the larval shell of naticids. In terms of measurements, a least 20-25% difference in diameter (protoconch and/or first half whorl) as well as a half whorl difference in number of whorls appear to be adequate to separate species.

Considering the present material, the average values of the characteristic elements of the protoconch pertaining to the studied species, and to another six

	canariensis	*depressofuniculata*	*dillwyni*	*fulgurata*	*gualtieriana*	*hebraea*	*marochiensis*	*obliquicallosa*	*plicatula*	*propinqua*	*pseudoepiglottina*	*raropunctata*	*stercusmuscarum*	*strictiumbilicata*	*sulcogradata*	*undata*	*virguloides*	*vittata*
canariensis		**2,3**	0,3	**2,3**	0,3	**2,3**	0,4	0,1	0,4	**2,3**	**1,3**	**2,3**	**2,3**	**2,3**	**2,3**	**1,8**	**2,0**	**1,3**
depressofuniculata			**-2,0**	0,0	**-2,0**	0,0	**-1,9**	0,0	**-1,9**	0,0	**-0,9**	0,0	0,0	0,0	0,0	**-0,5**	-0,3	**-1,0**
dillwyni				**2,0**	0,0	**2,0**	0,1	**2,0**	0,1	**2,0**	**1,1**	**2,0**	**2,0**	**2,0**	**2,0**	**1,5**	**1,8**	**1,0**
fulgurata					**-2,0**	0,0	**-1,9**	0,0	**-1,9**	0,0	**-0,9**	0,0	0,0	0,0	0,0	**-0,5**	-0,3	**-1,0**
gualtieriana						**2,0**	0,1	**2,0**	0,1	**2,0**	**1,1**	**2,0**	**2,0**	**2,0**	**2,0**	**1,5**	**1,8**	**1,0**
hebraea							**-1,9**	0,0	**-1,9**	0,0	**-0,9**	0,0	0,0	0,0	0,0	**-0,5**	-0,3	**-1,0**
marochiensis								**1,9**	0,0	**1,9**	**1,0**	**1,9**	**1,9**	**1,9**	**1,9**	**1,4**	**1,7**	**0,9**
obliquicallosa									**-1,9**	0,0	**-0,9**	0,0	0,0	0,0	0,0	**-0,5**	-0,3	**-1,0**
plicatula										**1,9**	**1,0**	**1,9**	**1,9**	**1,9**	**1,9**	**1,4**	**1,6**	**1,0**
propinqua											**-0,9**	0,0	0,0	0,0	0,0	**-0,5**	-0,3	**-1,0**
pseudoepiglottina												**0,9**	**0,9**	**0,9**	**0,9**	0,4	**0,7**	0,0
raropunctata													0,0	0,0	0,0	**-0,5**	-0,3	**-1,0**
stercusmuscarum														0,0	0,0	**-0,5**	-0,3	**-1,0**
strictiumbilicata															0,0	**-0,5**	-0,3	**-1,0**
sulcogradata																**-0,5**	-0,3	**-1,0**
undata																	0,3	**-0,5**
virguloides																		**-0,7**
vittata																		

Tab. 1 - Matrix showing difference in number of protoconch whorls within species pairs; significant values are boldfaced.

considered for comparison and discussed later, are shown in the plots of Fig. 3 through 6.

As regards the size (Fig. 3), most species have small protoconch and respective average values of the diameter fall within a moderate extent of variation, i.e. between 0.5 and 1.0 mm. Only *plicatula* has a medium-sized protoconch averaging 1.226 mm in diameter. Conversely, the first half whorl ranges widely in diameter, from less than 0.1 mm to about 0.45 mm (Fig. 3). It may be classified as very small in *vittata* (0.088 mm), small (0.1-0.2 mm) in *fulgurata*, *plicatula* and *pseudoepiglottina*, medium-sized (0.3-0.4 mm) in *depressofuniculata*, *obliquicallosa*, *raropunctata*, *undata* and *virguloides* and large (greater than 0.4 mm) in *propinqua*, *strictiumbilicata* and *sulcogradata*.

The number of protoconch whorls is also variable, from 1.25 to over 3 (Fig. 4). While *depressofuniculata*, *fulgurata*, *obliquicallosa*, *propinqua*, *raropunctata*, *strictiumbilicata*, *sulcogradata*, *undata* and *virguloides* have a paucispiral, 1.25 to 1.75 whorled larval shell reflecting a non-planktotrophic larval development, *plicatula*, *pseudoepiglottina* and *vittata* have a multispiral protoconch averaging 2.17 to 3.13 whorls, and are inferred to have had a planktotrophic larval development.

Except for *fulgurata*, that has a 1.25 whorled protoconch with small tip, this latter is usually medium to large in those species having a paucispiral protoconch, while it is small to very small in multispiral larval shells (Fig. 5). The difference between diameter of the first half whorl (DHW) and protoconch diameter (PD) tends to increase with the increasing number of protoconch whorls, thus, the PD/DHW ratio increases according to the increasing number of protoconch whorls (Fig. 6).

On the basis of the vast material examined, we can state that the protoconch shows little variation within a species, the range being of no more than 0.25 as regards the number of whorls and of less than 20% concerning the diameters (protoconch and first half whorl).

The matrix in Tab. 1 shows the difference in number of protoconch whorls within species pairs. As can be seen, values of half a whorl or greater occur in several instances. As regards the species studied herein, *virguloides* and the *raropunctata* group are readily distinguished from the other taxa having a multispiral larval shell (*plicatula*, *pseudoepiglottina* group). Within the *raropunctata* group, *undata* exhibits a rather significant half whorl difference from the other species in the group. No difference does exist within the *pseudoepiglottina* group, but the two species in it (*pseudoepiglottina* and *vittata*) are readily distinguished from *plicatula*, which has one more protoconch whorl.

The percent difference in protoconch diameter (Tab. 2) appears to be meaningful in most cases. We notice that it can be used to distinguish:

- *depressofuniculata* from *plicatula*, *strictiumbilicata* and *undata*;
- *fulgurata* from *obliquicallosa*, *plicatula*, *pseudoepiglottina*, *strictiumbilicata*, *undata* and *virguloides*;

	canariensis	*depressofuniculata*	*dillwyni*	*fulgurata*	*gualtieriana*	*hebraea*	*marochiensis*	*obliquicallosa*	*plicatula*	*propinqua*	*pseudoepiglottina*	*raropunctata*	*stercusmuscarum*	*strictiumbilicata*	*sulcogradata*	*undata*	*virguloides*	*vittata*
canariensis		**70**	**52**	**72**	**64**	**54**	**65**	**65**	**38**	**68**	**63**	**68**	**49**	**70**	**55**	**54**	**64**	**73**
depressofuniculata			**-38**	7	-18	**-35**	-15	-16	**-52**	-8	-18	-7	**-41**	**-22**	**-34**	**-35**	-17	8
dillwyni				**43**	**24**	5	**27**	**27**	**-22**	**33**	**24**	**33**	-5	**21**	7	5	**26**	**43**
fulgurata					**-24**	**-39**	**-22**	**-22**	**-55**	-15	**-24**	-14	**-45**	**-27**	**-38**	**-40**	**-23**	1
gualtieriana						**-20**	3	3	**-41**	11	-0,3	11	**-28**	-4	-19	**-21**	2	**25**
hebraea							**23**	**23**	**-26**	**29**	**20**	**25**	-10	17	2	-1	**22**	**40**
marochiensis								-0,1	**-43**	8	-3	9	**-31**	-7	**-21**	**-23**	-1,4	**23**
obliquicallosa									**-43**	8	-3	9	**-31**	-7	**-21**	**-23**	-1,3	**23**
plicatula										**48**	**41**	**48**	18	**37**	**28**	**26**	**43**	**56**
propinqua											-11	1	**-36**	-15	**-28**	**-29**	-9	16
pseudoepiglottina												12	**-28**	-4	-19	**-21**	2	**25**
raropunctata													**-37**	-15	**-28**	**-30**	-10	15
stercusmuscarum														**25**	12	9	**30**	**46**
strictiumbilicata															-15	-17	6	**28**
sulcogradata																-3	**20**	**39**
undata																	**22**	**41**
virguloides																		**24**
vittata																		

Tab. 2 - Matrix showing percent difference in diameter of the larval shell within species pairs; significant values are boldfaced.

	canariensis	*depressofuniculata*	*dillwyni*	*fulgurata*	*gualtieriana*	*hebraea*	*marochiensis*	*obliquicallosa*	*plicatula*	*propinqua*	*pseudoepiglottina*	*raropunctata*	*stercusmuscarum*	*strictiumbilicata*	*sulcogradata*	*undata*	*virguloides*	*vittata*
canariensis		**-50**	**55**	**-13**	**64**	**-64**	**43**	**-56**	**36**	**-63**	**28**	**-57**	**-71**	**-63**	**-66**	**-54**	**-54**	**44**
depressofuniculata			**77**	**43**	**82**	**-28**	**71**	-13	**68**	**-27**	**64**	-13	**-42**	**-25**	**-32**	8	-7	**72**
dillwyni				**-61**	**20**	**-84**	**-21**	**-80**	**-29**	**-83**	**-37**	**-80**	**-87**	**-83**	**-85**	**-79**	**-79**	-19
fulgurata					**68**	**-59**	**50**	**-50**	**44**	**-58**	**37**	**-50**	**-33**	**-57**	**-61**	**-48**	**-47**	**51**
gualtieriana						**-87**	**-37**	**-84**	**-43**	**-87**	**-50**	**-84**	**-90**	**-86**	**-88**	**-83**	**-83**	**-35**
hebraea							**79**	17	**77**	1	**74**	17	**-20**	3	-6	**21**	**22**	**80**
marochiensis								**-75**	-10	**-79**	**-20**	**-75**	**-83**	**-79**	**-81**	**-74**	**-73**	2
obliquicallosa									**72**	-16	**69**	-1	**-34**	-14	**-23**	5	6	**76**
plicatula										**-77**	-12	**-72**	**-82**	**-76**	**-79**	**-71**	**-71**	12
propinqua											**74**	16	**-21**	2	-8	**20**	**21**	**80**
pseudoepiglottina												**-69**	**-79**	**-73**	**-76**	**-67**	**-66**	**22**
raropunctata													**-33**	-14	**-22**	5	6	**76**
stercusmuscarum														**23**	14	**37**	**38**	**84**
strictiumbilicata															-10	19	19	**79**
sulcogradata																**26**	**27**	**81**
undata																	1	**74**
virguloides																		**74**
vittata																		

Tab. 3 - Matrix showing percent difference in diameter of the first half whorl of the protoconch within species pairs; significant values are boldfaced.

• *plicatula* from *obliquicallosa*;
• *propinqua* from *plicatula* and *undata*;
• *pseudoepiglottina* from *plicatula* and *vittata*;
• *raropunctata* from *plicatula*, *sulcogradata* and *undata*;
• *strictiumbilicata* from *plicatula* and *vittata*;
• *sulcogradata* from *depressofuniculata*, *fulgurata*, *obliquicallosa*, *plicatula*, *propinqua*, *virguloides* and *vittata*;
• *undata* from *obliquicallosa*, *plicatula*, *pseudoepiglottina*, *virguloides*, and *vittata*;
• *virguloides* from *plicatula*;
• *vittata* from *obliquicallosa*, *plicatula* and *virguloides*;

The percent difference in the diameter of the initial half whorl of the protoconch (Tab. 3) resulted to be diagnostic for several species pairs. As regards the studied species, it serves to distinguish:

• *depressofuniculata* from *fulgurata*, *plicatula*, *pseudoepiglottina*, *strictiumbilicata* and *vittata*;
• *fulgurata* from *obliquicallosa*, *plicatula*, *pseudoepiglottina*, *strictiumbilicata*, *undata*, *virguloides*, and *vittata*;
• *plicatula* from *obliquicallosa*;
• *propinqua* from *depressofuniculata*, *fulgurata*, *undata*, *plicatula*, *pseudoepiglottina*, *virguloides* and *vittata*;
• *pseudoepiglottina* from *obliquicallosa*, *virguloides* and *vittata*;
• *raropunctata* from *fulgurata*, *plicatula*, *pseudoepiglottina*, *sulcogradata* and *vittata*;
• *strictiumbilicata* from *plicatula*, *pseudoepiglottina* and *vittata*;
• *sulcogradata* from *depressofuniculata*, *fulgurata*, *obliquicallosa*, *plicatula*, *pseudoepiglottina*, *undata*, *virguloides* and *vittata*;
• *undata* from *plicatula*, *pseudoepiglottina* and *vittata*;
• *virguloides* from *plicatula*;
• *vittata* from *obliquicallosa* and *virguloides*.

From Tab. 4, that summarizes the differences among species on the basis of the three protoconch characters combined, it will be seen that *fulgurata*, *plicatula*, *pseudoepiglottina*, *undata* and *vittata* are readily distinguished from one another and from the other studied species on the basis of at least one character; *sulcogradata* is differentiated from all except for *strictiumbilicata*. The respective larval shells of *depressofuniculata*, *obliquicallosa*, *raropunctata*, *strictiumbilicata* and *virguloides* appear not to differ significantly from one another; the protoconch of *propinqua* resulted to be closely similar only to that of *obliquicallosa*, *raropunctata* and *strictiumbilicata*.

	NUMBER OF WHORLS	PROTOCONCH DIAMETER	DIAMETER OF THE FIRST HALF WHORL
1. ***depressofuniculata***	4, 6, 10, 12	4, 9, 10	2, 4, 5, 6, 8, 9, 12
2. ***fulgurata***	4, 6, 10, 12	3, 4, 6, 8, 9, 10, 11	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
3. ***obliquicallosa***	4, 6, 10, 12	2, 4, 9, 10, 12	2, 4, 6, 9, 12
4. ***plicatula***	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 5, 7, 8, 9, 10, 11
5. ***propinqua***	4, 6, 10, 12	4, 9, 10	1, 2, 4, 6, 10, 11, 12
6. ***pseudoepiglottina***	1, 2, 3, 4, 5, 7, 8, 9, 11	2, 4, 10, 12	1, 2, 3, 5, 7, 8, 9, 10, 11, 12
7. ***raropunctata***	4, 6, 10, 12	4, 9, 10	2, 4, 6, 9, 12
8. ***strictiumbilicata***	4, 6, 10, 12	1, 2, 4, 12	1, 2, 4, 6, 12
9. ***sulcogradata***	4, 6, 10, 12	1, 2, 3, 4, 5, 7, 11, 12	1, 2, 3, 4, 6, 7, 10, 11, 12
10. ***undata***	1, 2, 3, 4, 5, 7, 8, 9, 12	1, 2, 3, 4, 5, 6, 7, 11, 12	2, 4, 5, 6, 9, 12
11. ***virguloides***	4, 6, 12	2, 4, 9, 10, 12	2, 4, 5, 6, 9, 12
12. ***vittata***	1, 2, 3, 4, 5, 7, 8, 9, 10, 11	3, 4, 6, 8, 9, 10, 11	1, 2, 3, 5, 6, 7, 8, 9, 10, 11

Tab. 4 - Summarized differences in protoconch features. Figures refer to species (left of first column) and denote those species which are distinguished from that on the left of each row, on the basis of the considered protoconch characters (columns 2 to 4).

We conclude that the simple larval shell is a valuable character, which can often contribute in distinguishing species, provided that the numerical approach followed herein is adopted. This study further demonstrates that the protoconch of the naticids cannot be regarded as ordinarily species-diagnostic, since species do occur having basically identical larval shell, even when they belong to different genera (e.g. *virguloides* and the other four species cited above).

Teleoconch

The teleoconch features are currently used to identify the naticid species although a number of them exhibit overlapping variations in shell form and umbilical morphology. In several species groups, an overall teleoconch similarity is noticed and the shell would appear to be a difficult structure to use diagnostically, in particular when juvenile specimens are considered. The fact, already perceived by earlier authors (cf. Sacco 1891, p. 64, 65), was pointed out later on by other workers who treated couples or groups of species that are distinguishable only on the basis of characters other than the shell morphology. Pertinent examples in this respect were offered by Kilburn (1976, p. 840), Marincovich (1977, p. 258, 331, 383), Majima (1989, p. 48, 86, 93), Bouchet & Waren (1993, p. 760, 780) and Solsona & Martinell (1999, p. 415).

Shell shape. The shell shape can be defined quantitatively by means of the relations between 1) maximum diameter and shell height, 2) spire height and shell height and 3) by the values of the spire angle. For this purpose, *plicatula*, eight species of the *raropunctata* group, namely *depressofuniculata*, *fulgurata*, *propinqua*,

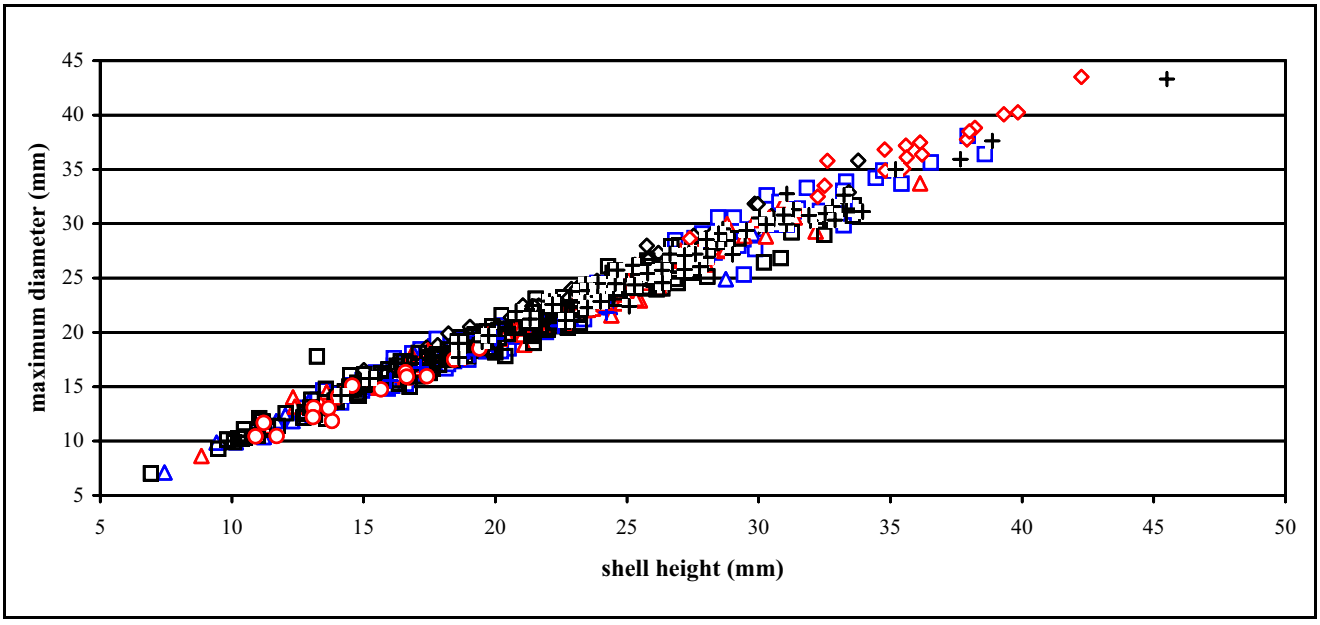


Fig. 7 A - Relationship between maximum diameter and shell height of the species of the *raropunctata* group; blue open squares: *depressofuniculata*; black open diamonds: *fulgurata*; red open triangles: *propinqua*; black open squares: *raropunctata*; red open diamonds: *obliquicallosa*; blue crosses: *strictiumbilicata*; red open circles: *sulcogradata*; black crosses: *undata*; *plicatula* (blue open triangles) included for comparison.

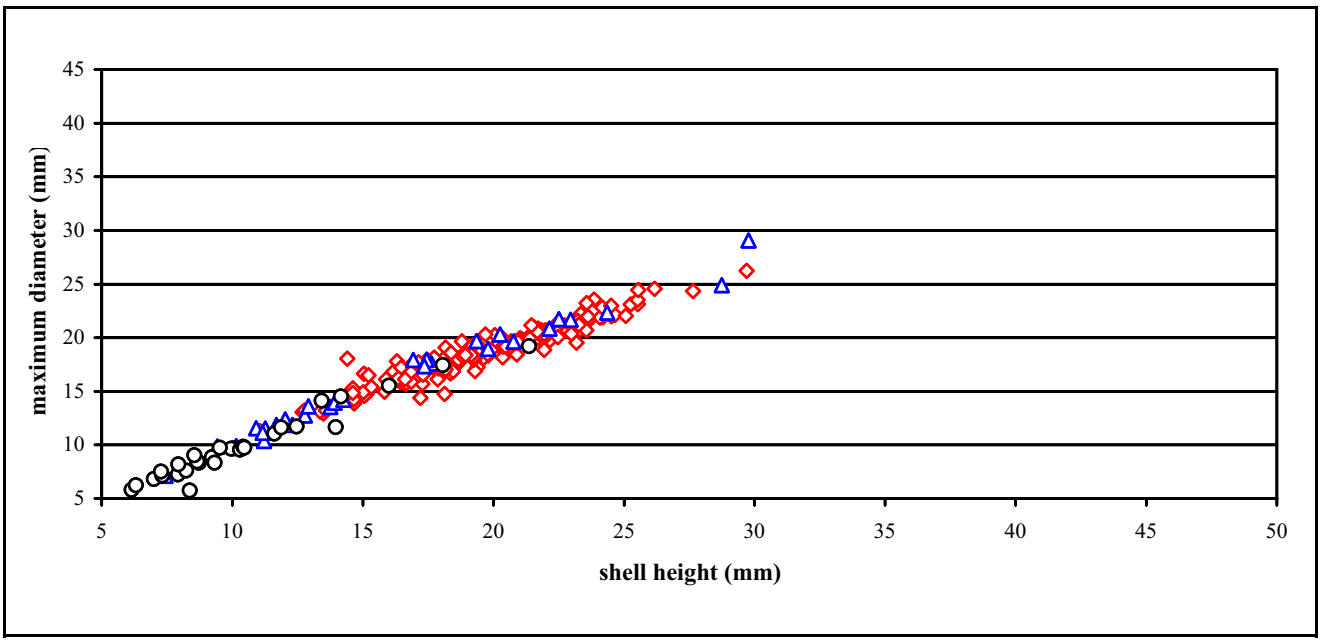


Fig. 7 B - Relationship between maximum diameter and shell height of the species of the *pseudoepiglottina* group; red open diamonds: *pseudoepiglottina*; black open circles: *vittata*; *plicatula* (blue open triangles) included for comparison.

raropunctata, *obliquicallosa*, *strictiumbilicata*, *sulcogradata* and *undata* along with other two that we consider to form the *pseudoepiglottina* group, i.e. *pseudoepiglottina* and *vittata*, have been treated statistically; the shells of *plicatula* were plotted in the graphs of both groups in order to make easier to compare this species with the others. Only *virguloides* was not included in the statistical analysis. It is the sole Pliocene member of the genus *Natica* and is readily distinguished from the other species on the basis of the apertural and umbilical features.

The plot of maximum diameter against the height of the shell for the *raropunctata* group (Fig. 7A) shows that the points representing the shells belonging to the eight species in this group form a series of fully overlapping, elongate scatters indicating no significant dif-

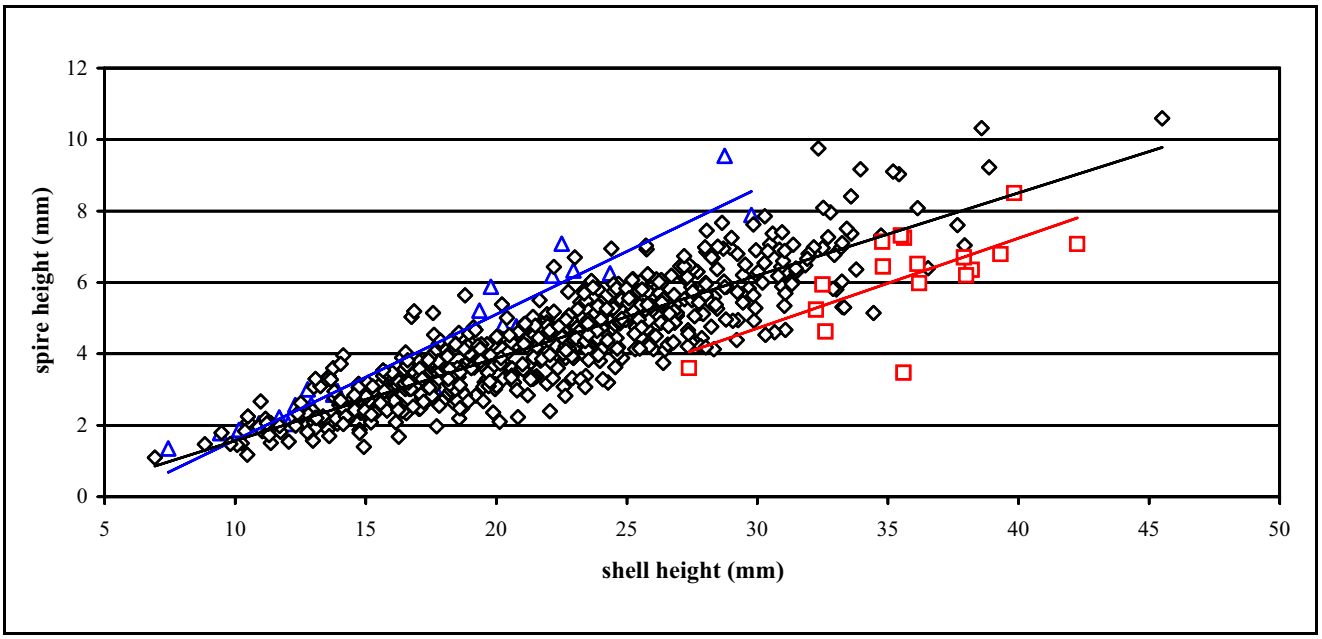


Fig. 8 A - Relationship between spire height and shell height of the species of the *raropunctata* group; black open diamonds: *raropunctata* group *obliquicallosa* excluded; red open squares: *obliquicallosa*; *plicatula* (blue open triangles) included for comparison.

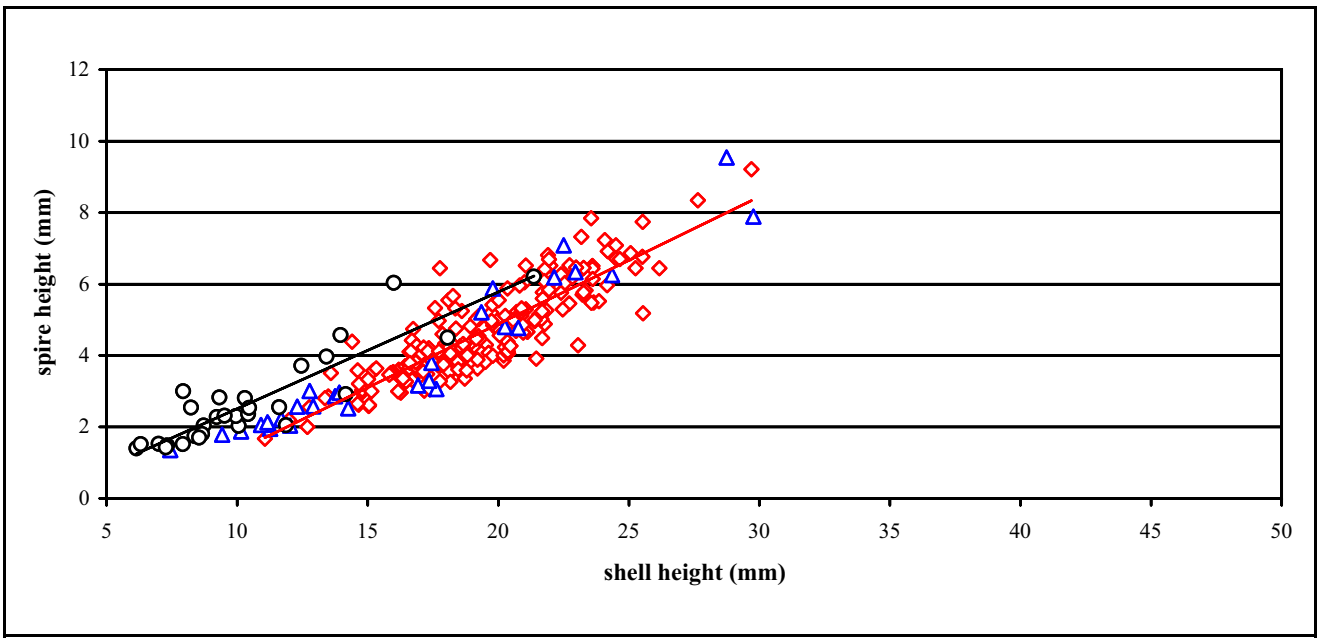


Fig. 8 B - Relationship between spire height and shell height of the species of the *pseudoepiglottina* group; *plicatula* included for comparison; symbols as in Fig. 7 B.

ference. The regression lines resulted to be basically coincident and were omitted from the graph to preserve clarity. As regards the *psudoepiglottina* group (Fig. 7B), the line for *pseudoepiglottina* is insignificantly inclined to that of *vittata* (lines also omitted). The graph shows that the former species usually attains a larger size compared to that of *vittata*. It is to be noted that the scatters of the *raropunctata* and *pseudoepiglottina* groups as well as that of *plicatula* fully overlap each other. The coefficients of correlation proved good in all species (r = 0.95-0.99).

The height of the spire gave a good correlation with the height of the shell (r = 0.84-0.96) for *plicatula* and the species in the *raropunctata* and *pseudoepiglottina* groups; the correlation for *obliquicallosa* was lower (r = 0.66) but still significant. Measurements of the

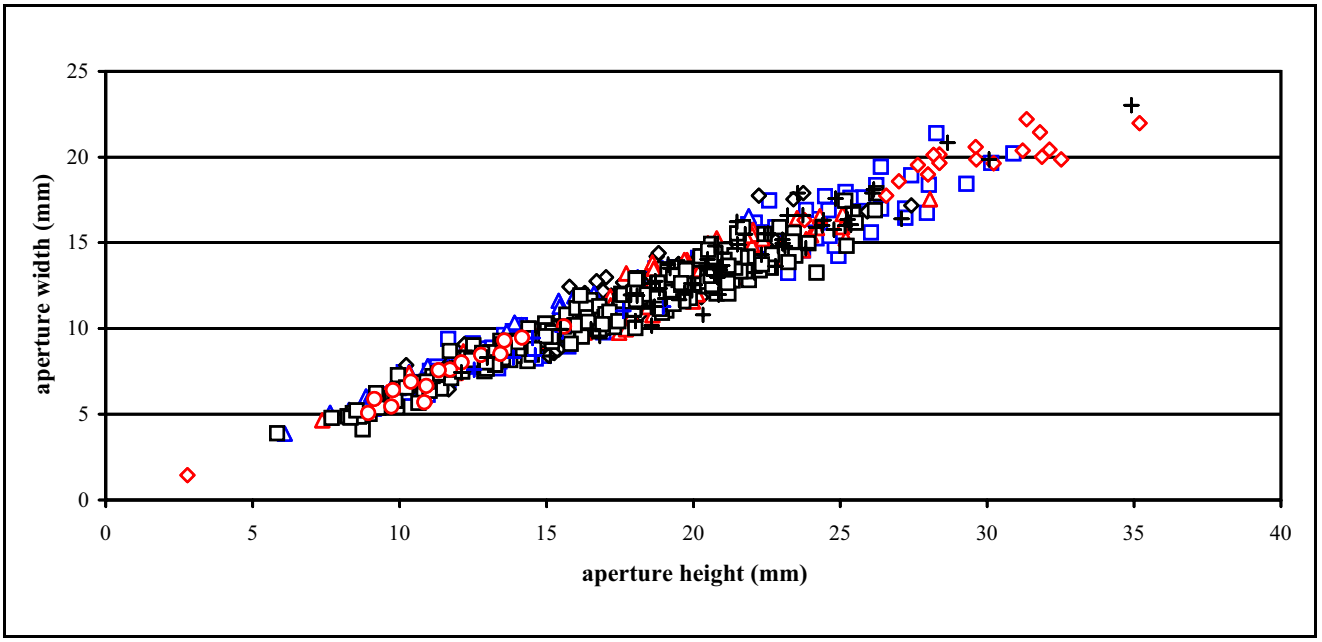


Fig. 9 A - Relationships between aperture width and aperture height of the species of the *raropunctata* group; *plicatula* included for comparison; symbols as in Fig. 7 A.

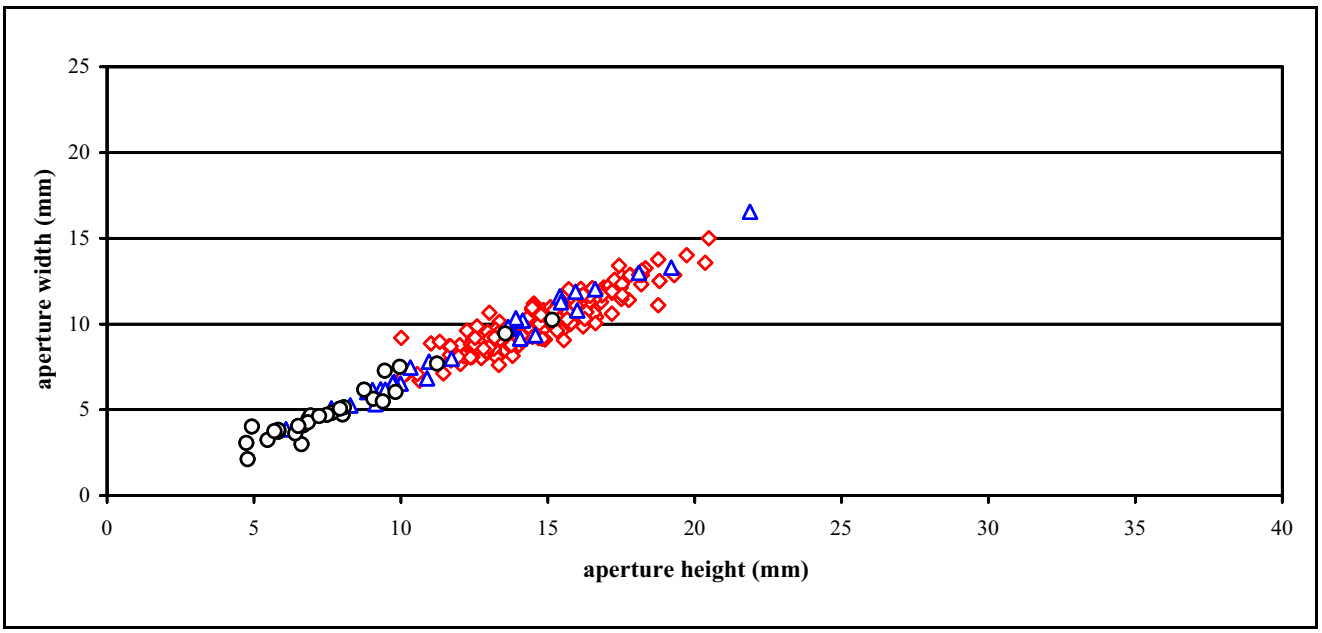


Fig. 9 B - Relationships between aperture width and aperture height of the species of the *pseudoepiglottina* group; *plicatula* included for comparison; symbols as in Fig. 7 B.

shells in the *raropunctata* group form a wide scatter (Fig. 8A) showing that *obliquicallosa* can be distinguished from the other species in the group. The slope and elevation of *depressofuniculata*, *fulgurata*, *propinqua*, *raropunctata*, *strictiumbilicata*, *sulcogradata* and *undata* are not significantly different from one another, but their combined regression, having a similar slope to *obliquicallosa*, has a significantly different elevation; for a given height of the shell, *obliquicallosa* tends to have the spire significantly lower. A similar conclusion applies to the *pseudoepiglottina* group (Fig. 8B); for a given height of the shell, *pseudoepiglottina* normally has the spire somewhat lower than that of *vittata*. The line for *plicatula* basically conforms to that for *pseudoepiglottina* and is omitted from Fig. 8B to preserve clarity. The slope of *plicatula* (Fig. 8A) appears to be signifi-

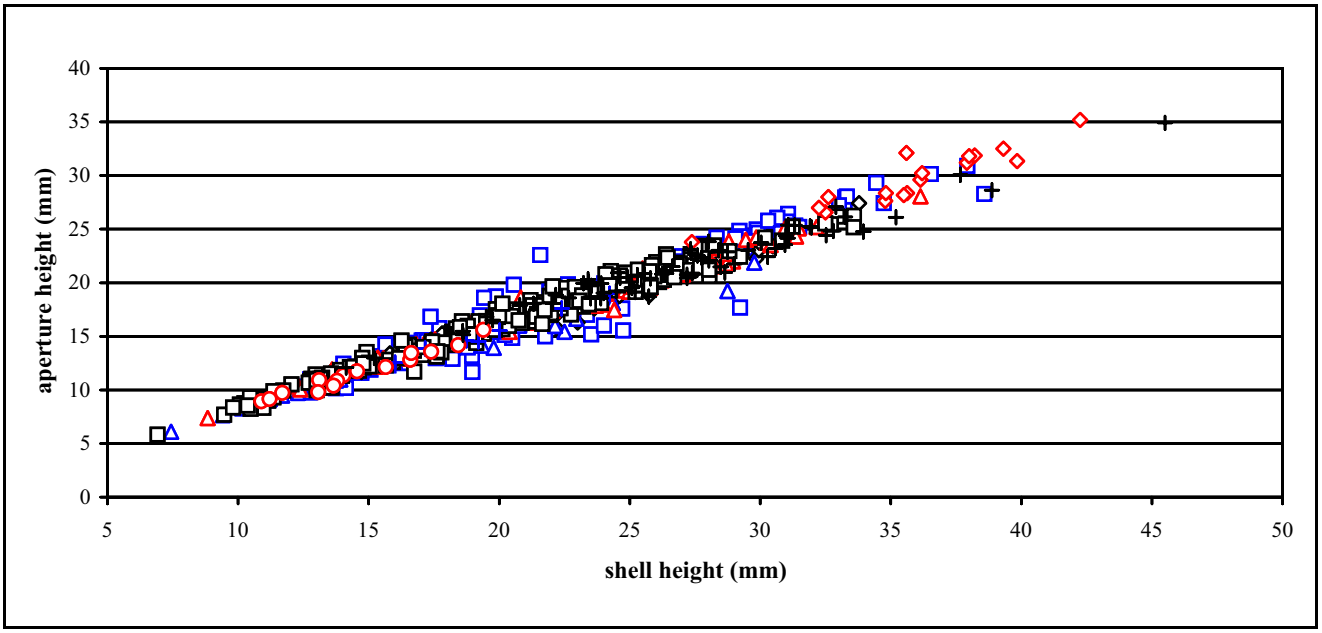


Fig. 10 A - Relationship between aperture height and shell height of the species of the *raropunctata* group; *plicatula* included for comparison; symbols as in Fig. 7 A.

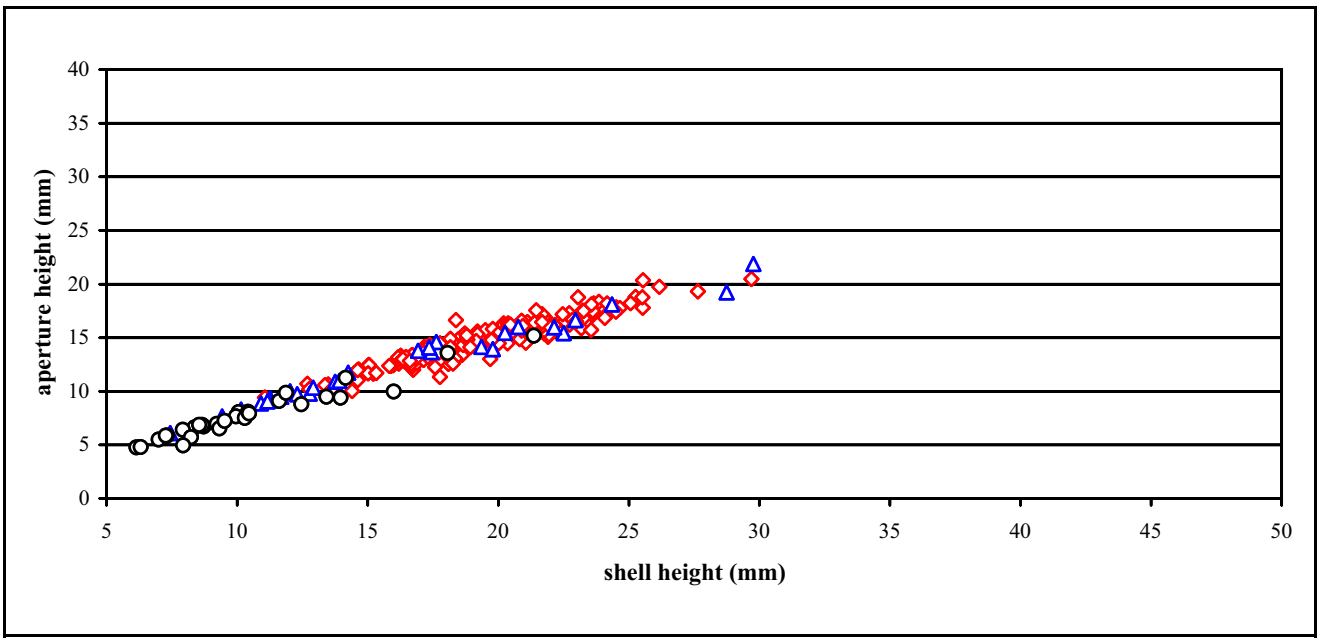


Fig. 10 B - Relationship between aperture height and shell height of the species of the *pseudoepiglottina* group; *plicatula* included for comparison; symbols as in Fig. 7 B.

cantly steeper than that of the *raropunctata* group (*obliquicallosa* excluded); the spire of *plicatula* tends to be taller than that of the species in the *raropunctata* group and the fact becomes increasingly manifest during growth.

The spire angle varies greatly in all species and this accounts for the large standard deviation values obtained (Tab. 5). The 95% confidence intervals pertaining to species are largely overlapping and the considered character appears to be devoid of any significance, at least as concerns the species involved in this statistical treatment.

The suture, a feature of the spire, is incorporated in this section. It is adpressed in all species but for *fulgurata* in which the more or less deeply channeled suture stands as a distinctive character. It is apparent

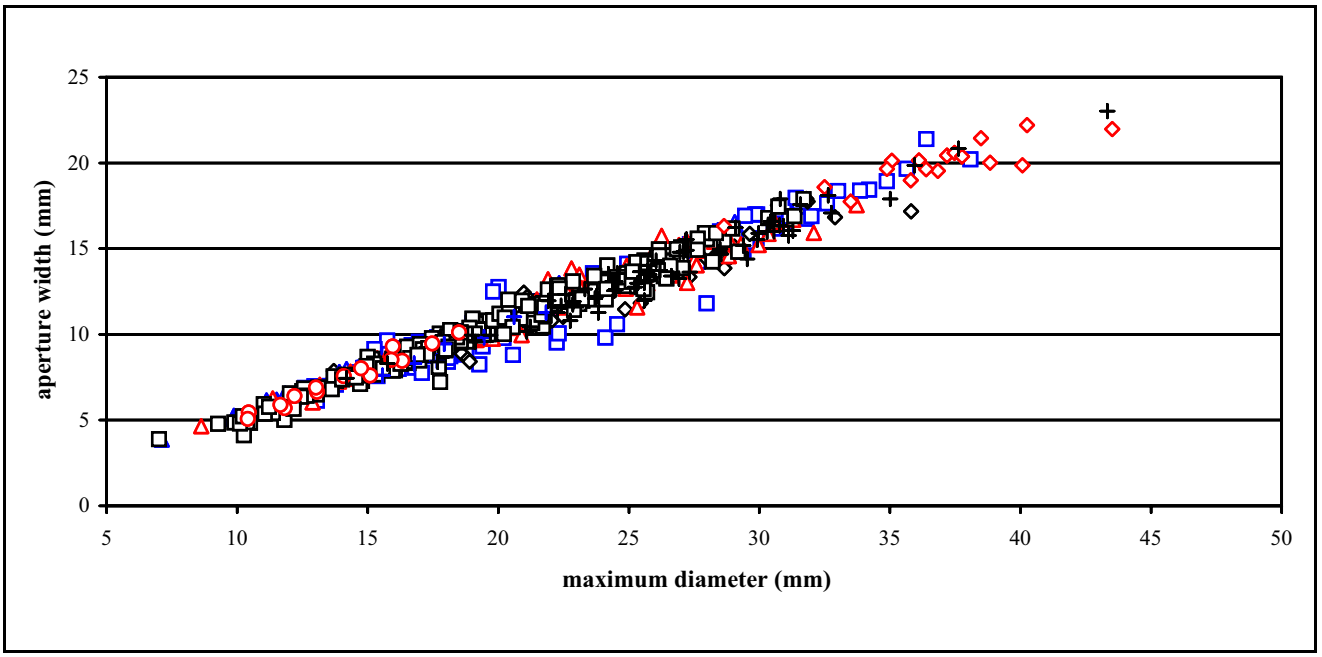


Fig. 11 A - Relationship between aperture width and maximum diameter of the species of the *raropunctata* group; *plicatula* included for comparison; symbols as in Fig. 7 A.

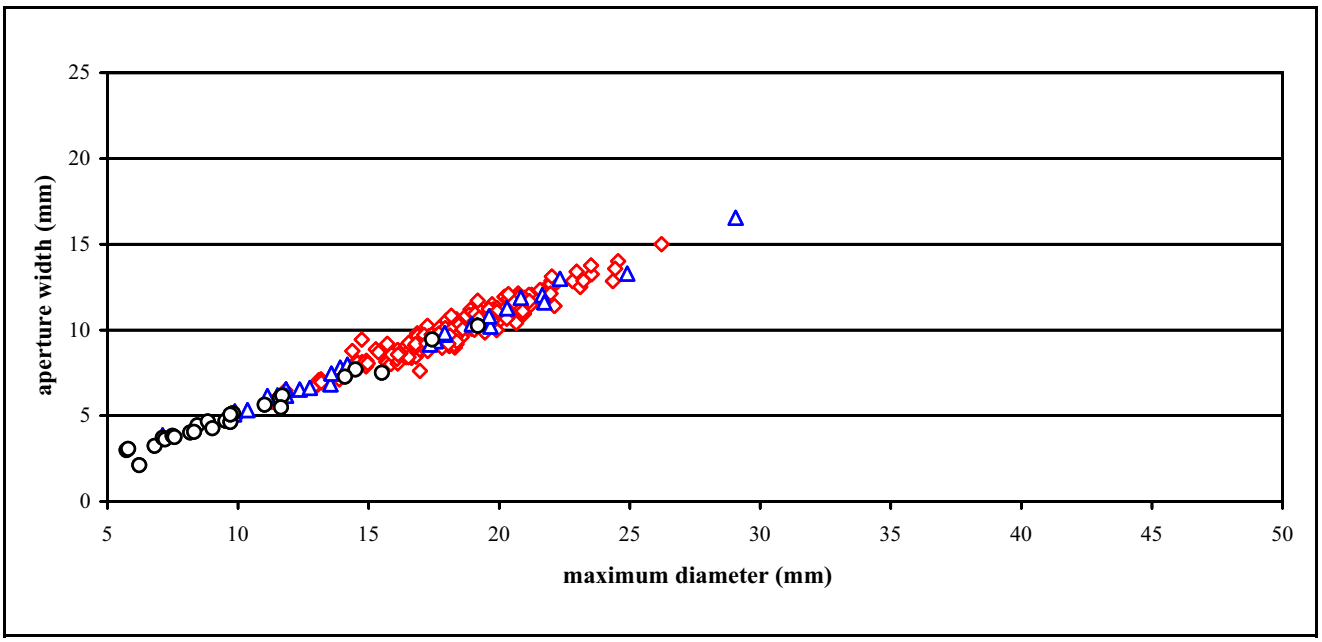


Fig. 11 B - Relationship between aperture width and maximum diameter of the species of the *pseudoepiglottina* group; *plicatula* included for comparison; symbols as in Fig. 7 B.

that the suture can be used for species recognition only occasionally.

Aperture. The D-shaped aperture can be defined quantitatively by means of the relations between 1) aperture width and aperture height, 2) aperture height and height of the shell, 3) aperture width and maximum diameter and 4) by the values of the inner lip slope. The coefficients of correlation relative to the three pairs of characters just cited proved good in all species (r = 0.85-0.98). From Fig. 9A through 11B (regression lines omitted to preserve clarity) it will be seen that there is no significant difference among species within each group. Likewise, the combined regressions of the *raropunctata* and *pseudoepiglottina* groups (not illustrated here) are not significantly different from one another and from that of *plicatula*. The inner lip slope, i.e. the inclination of the inner lip to the shell axis, is rather variable in all species. Again, the 95% confidence intervals pertaining to species show no significant difference (Tab. 6).

	mean	standard deviation	95% confidence interval
depressofuniculata	128°	7	114°-142°
fulgurata	128°	9	110°-146°
propinqua	125°	7	111°-139°
raropunctata	125°	9	107°-143°
obliquicallosa	134°	10	114°-154°
strictiumbilicata	115°	5	105°-125°
sulcogradata	130°	7	116°-144°
undata	129°	6	117°-141°
plicatula	122°	8	106°-138°
pseudoepiglottina	116°	8	100°-132°
vittata	117°	8	101°-133°

Tab. 5 - Spire angle of species involved in the statistical analysis.

	mean	standard deviation	95% confidence interval
depressofuniculata	30°	6	18°-42°
fulgurata	25°	5	15°-35°
propinqua	30°	6	18°-42°
raropunctata	27°	6	15°-39°
obliquicallosa	25°	6	13°-37°
strictiumbilicata	26°	4	18°-34°
sulcogradata	26°	5	16°-36°
undata	25°	7	11°-39°
plicatula	28°	7	14°-42°
pseudoepiglottina	33°	6	21°-45°
vittata	30°	7	16°-44°

Tab. 6 - Slope of inner lip of species involved in the statistical analysis.

The parietal callus is another apertural character consisting of a thin to thick coating of smooth shelly matter extending from the parietal lip. Features of the parietal callus are 1) thickness, 2) width, 3) shape and 4) absence/presence and development of an anterior lobe. The authors have accorded scarce importance to the parietal callus and have used it occasionally as an additional distinguishing character in comparing species. As

depressofuniculata	moderately thick to thick, subquadrangular, ending some distance from the basal fasciole; anterior lobe indistinct.
fulgurata	thick, short and broad, ending some distance from the basal fasciole; anterior lobe indistinct.
obliquicallosa	thick, slightly narrowing abapically, ending some distance from the basal fasciole; anterior lobe indistinct.
plicatula	quadrangular, rather wide and thin, nearly reaching the basal fasciole; anterior lobe indistinct.
propinqua	rather thick, subquadrangular, never reaching the basal fasciole; anterior lobe indistinct.
pseudoepiglottina	moderately thick, narrowing abapically, ending close to but not in touch with the basal fasciole; anterior lobe indistinct.
raropunctata	moderately thick, slightly narrowing abapically, ending near the basal fasciole but not touching it; anterior lobe very small to indistinct.
strictiumbilicata	thick, narrowing abapically, ending close to but not reaching the basal fasciole; anterior lobe indistinct.
sulcogradata	rather thin and short, ending some distance from the basal fasciole; anterior lobe indistinct.
undata	rather thick, subquadrangular, ending some distance from the basal fasciole; anterior lobe indistinct.
virguloides	very thick, overlapping the basal fasciole; anterior lobe well developed, tongue-shaped, obscuring the adapical part of the umbilicus.
vittata	thin to moderately thick, ending some distance from the basal fasciole; anterior lobe small, pointed.

Tab. 7 - Features of parietal callus of the studied species.

regards the species covered in this study (Tab. 7), we note that *vittata* and, more so, *virguloides* posses a distinctive parietal callus featured by the presence of the anterior lobe which is small and pointed in the former species, more developed, tongue-shaped, stretching to cover the adapical part of the umbilical opening in the latter. The parietal callus ends close to the basal fasciole but does not touch it in *plicatula*, *pseudoepiglottina*, *raropunctata* and *strictiumbilicata* whereas it terminates more distantly from the basal fasciole in *depressofuniculata*, *fulgurata*, *obliquicallosa*, *propinqua*, *sulcogradata*, *undata* and *vittata*. The overall shape is ordinarily subquadrangular to quadrangular in most species and exhibits only minor differences in terms of respective length and breadth; it clearly narrows downward in *pseudoepiglottina* and *strictiumbilicata*, less so in *obliquicallosa* and *raropunctata*.

We conclude that the proportions of the aperture by themselves and related to those of the shell are hardly significant for the lot of species considered herein. The parietal callus can be used diagnostically only in two cases, being otherwise suitable to indicate, at most, to which species a shell does not belong more than to which it belongs to.

Umbilical characters. As already said, the umbilical features were ordinarily used to distinguish taxa. In order to verify the diagnostic value of the umbilical characters in the species of the *raropunctata* and *pseudoepiglottina* groups and of *plicatula*, we measured the width of 1) umbilicus, 2) umbilical callus, 3) adapical sulcus and 4) abapical sulcus.

The umbilicus width gave a good correlation with maximum diameter of the shell in all species (r = 0.71-0.97). The plot of the umbilicus width against the maximum diameter for each species of the *raropunctata* group (not illustrated herein) shows that the points representing the shells belonging to *fulgurata*, *obliquicallosa*, *propinqua*, *raropunctata* and *undata* form a series of overlapping, elongate scatters indicating no significant difference and the same proved true as regards *depressofuniculata* and *strictiumbilicata*; in both cases the respective regression lines resulted to be basically coincident. The combined regression of the latter two species appears to be significantly shallower than that of the former five (Fig.12A) which tend to have a somewhat wider umbilicus, particularly in later growth stages. The line for *sulcogradata* is the most elevated (Fig. 12A) and shows that this species has the umbilicus ordinarily wider than any other in the *raropunctata* group. As can be seen from Fig. 12B, no significant difference does exist for this same relationship between *pseudoepiglottina* and *vittata*. It is of note that, should the two graphs be superimposed, the combined regression of *pseudoepiglottina* and *vittata* fits in with that of the pair *depressofuniculata* and *strictiumbilicata* as does

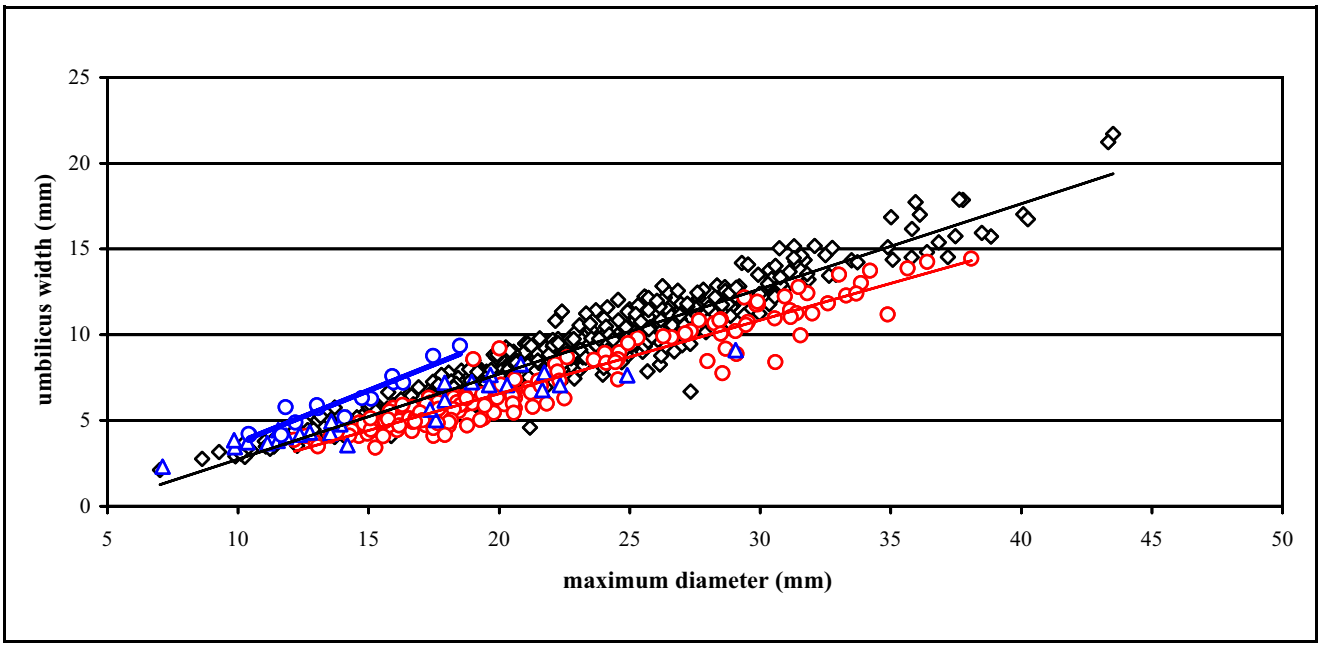


Fig. 12 A - Relationships between umbilicus width and maximum diameter of the species of the *raropunctata* group; back open diamonds: *fulgurata*, *propinqua*, *raropunctata*, *obliquicallosa* and *undata*; red open circles: *depressofuniculata* and *strictiumbilicata*; blue open circles: *sulcogradata*; *plicatula* (blue open triangles) included for comparison.

that of *plicatula* (line omitted from the graphs to preserve clarity). In summary, the umbilicus, compared to the size of the body whorl, tends to be smaller in *depressofuniculata*, *plicatula*, *pseudoepiglottina*, *strictiumbilicata*, and *vittata* than in *fulgurata*, *obliquicallosa*, *propinqua*, *raropunctata* and *undata*; it attains the greatest width in *sulcogradata*. The analysis shows that the amplitude of the umbilical opening has a moderate diagnostic value and can be used efficiently only in some cases to characterize species or, more often, lots of species, provided that fully grown shells are available. Juvenile specimens of the species considered in this analysis are practically indistinguishable on the basis of this character and, in fact, the points representing them are tightly clustered close to the origin of coordinate axes.

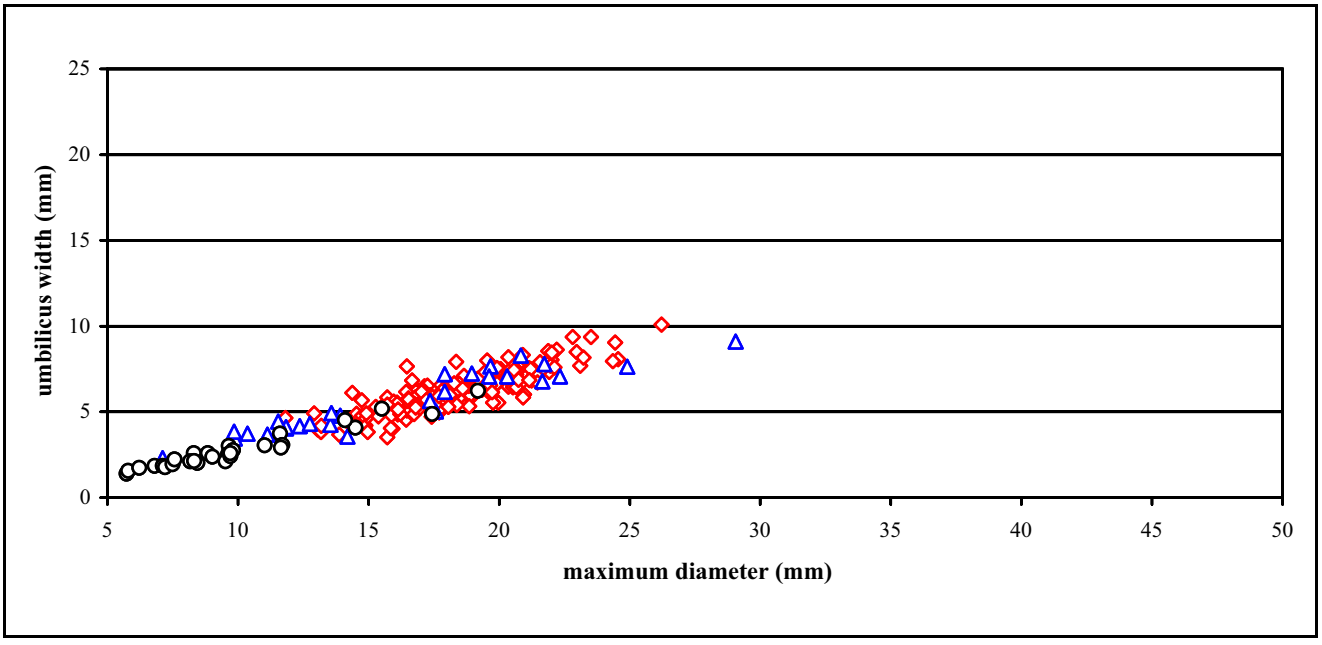


Fig. 12 B - Relationships between umbilicus width and maximum diameter of the species of the *pseudoepiglotiina* group; *plicatula* included for comparison; symbols as in Fig. 7 B.

The correlation between width of the umbilical callus (related to the strength of the funicle) and width of the umbilical opening resulted to be significant in all species (r = 0.52-0.88). The lowermost values were obtained for *obliquicallosa* (r = 0.52) and *pseudoepiglottina* (r = 0.57) in which the funicle ranges more widely in strength. The plot of width of the umbilical callus against umbilicus width for the species of the *raropunctata* group (not illustrated herein) indicates that *depressofuniculata*, *obliquicallosa*, *raropunctata* and *undata* do not differ significantly from one another for this relationship, as do *fulgurata*, *propinqua* and *sulcogradata* whereas *strictiumbilicata* is clearly differentiated. From Fig. 13A it will be seen that the combined regressions of the two lots of species and that of *strictiumbilicata* have rather similar slope, but differ significantly in elevation. For a given amplitude of the umbilical opening, the width of the umbilical callus tends to be the greatest in *strictiumbilicata*, medium in *depressofuniculata*, *obliquicallosa*, *raropunctata* and *undata*, the smallest in *fulgurata*, *propinqua* and *sulcogradata*. For this same relationship, *pseudoepiglottina* differs from *vittata* in having the umbilical callus significantly wider (Fig. 13B). It is worthy to note that the regression lines of *pseudoepiglottina* and *vittata* are basically superimposed respectively to that of the four species including *raropunctata* and to that of the lot including *fulgurata*, *propinqua* and *sulcogradata*. The regression line of *plicatula* (Fig. 13A, B) is significantly steeper than the others; its large umbilical callus increases in strength much faster during growth than in the rest of the considered taxa. Once again, the present relationship is not straightforward to distinguish species.

The correlation between width of the abapical sulcus and width of the adapical sulcus proved moderate to good (r = 0.49-0.72) except for *obliquicallosa* and *strictiumbilicata*. This relationship depends on 1) strength and 2) position of the umbilical callus. When the width of the abapical sulcus is regressed against the width of the adapical sulcus (Fig. 14A), the combined slope for *depressofuniculata*, *fulgurata* and *sulcogradata* appears to be significantly steeper than that (also combined) for *propinqua*, *raropunctata* and *undata*; the abapical sulcus usually widens during growth more quickly in the former species than in the latter ones. The points representing the measured shells of *obliquicallosa*, *plicatula* and *strictiumbilicata* are reported in the graph for comparison. From Fig. 14B it will be seen that the regression of *pseudoepiglottina* has similar slope to *vittata*, but has significantly greater elevation; for a given width of the adapical sulcus, the abapical sulcus is significantly wider. Also this relationship fails to distinguish species.

Basal fasciole. The basal fasciole, a distinct spiral band marking successive positions of the thickened basal lip, encircles the umbilicus and smoothly merges into the umbilical wall. Form Tab. 8, which summarizes the features of this part of the shell, it will be seen that the basal fasciole is hardly useful to characterize the studied species in that quite similar aspects are shared by several taxa and, conversely, more than one aspect

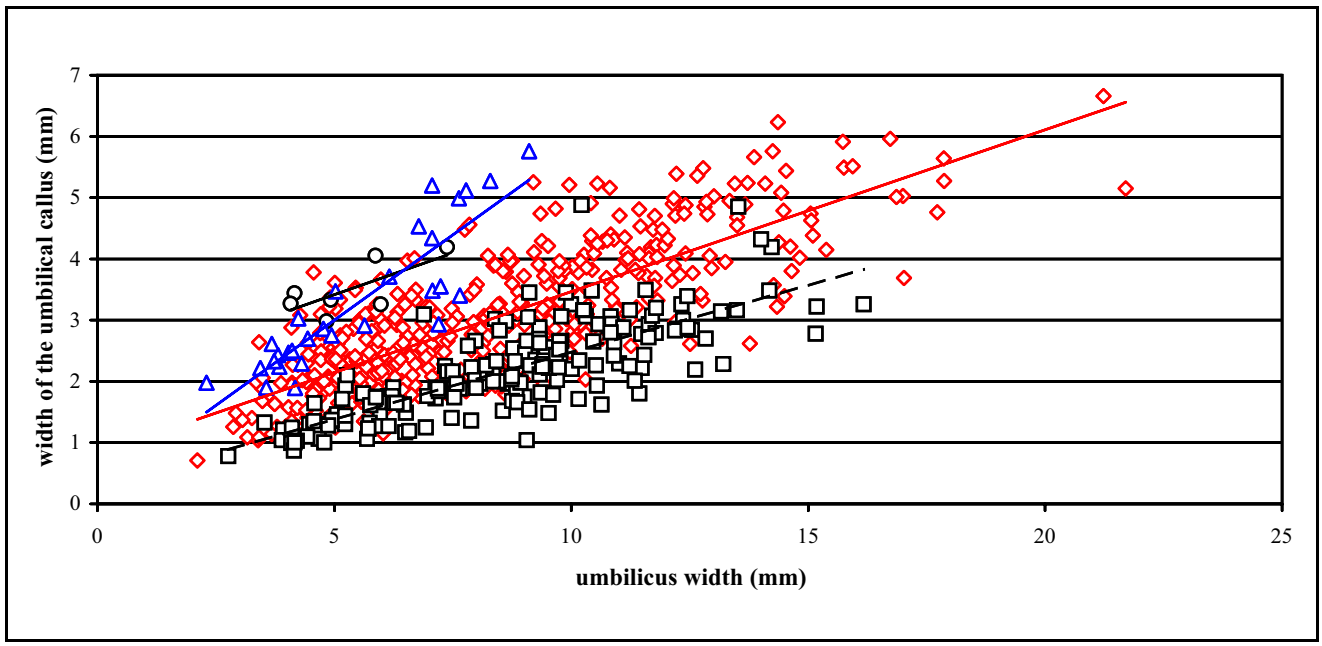


Fig. 13 A - Relationship between the width of the umbilical callus and the umbilicus width of the species of the *raropunctata* group; red open diamonds: *depressofuniculata*, *raropunctata*, *obliquicallosa* and *undata*; black open squares: *fulgurata*, *propinqua* and *sulcogradata*; black open circles: *strictiumbilicata*; *plicatula* (blue open triangles) included for comparison.

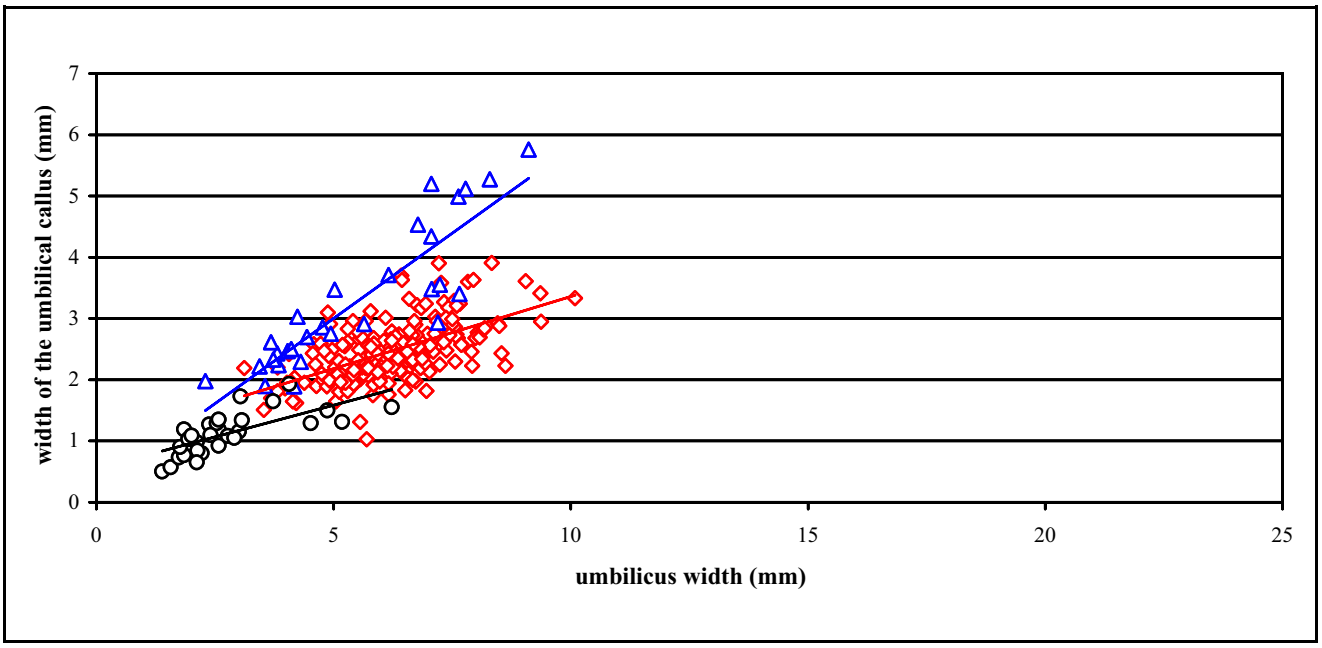


Fig. 13 B - Relationship between the width of the umbilical callus and the umbilicus width of the species of the *pseudoepiglottina* group; *plicatula* included for comparison; symbols as in Fig. 7 B.

may occur in the same species. The basal fasciole can be bounded abaxially by 1) a sharp to rounded step as in *fulgurata*, *obliquicallosa*, *propinqua*, *pseudoepiglottina* and *raropunctata*, or 2) a sudden deviation of the growth lines as in *depressofuniculata*, *strictiumbilicata*, *sulcogradata*, *undata*, and, occasionally, in *pseudoepiglottina*, or 3) an incised spiral line as in *sulcogradata* and *undata*. It is poorly differentiated to indistinct in *plicatula*, *virguloides* and *vittata*.

Outer surface. All the considered species are unsculptured. They have the outer surface of the shell bearing fine, prosocline growth lines that may be slightly stronger toward the adapical suture and over

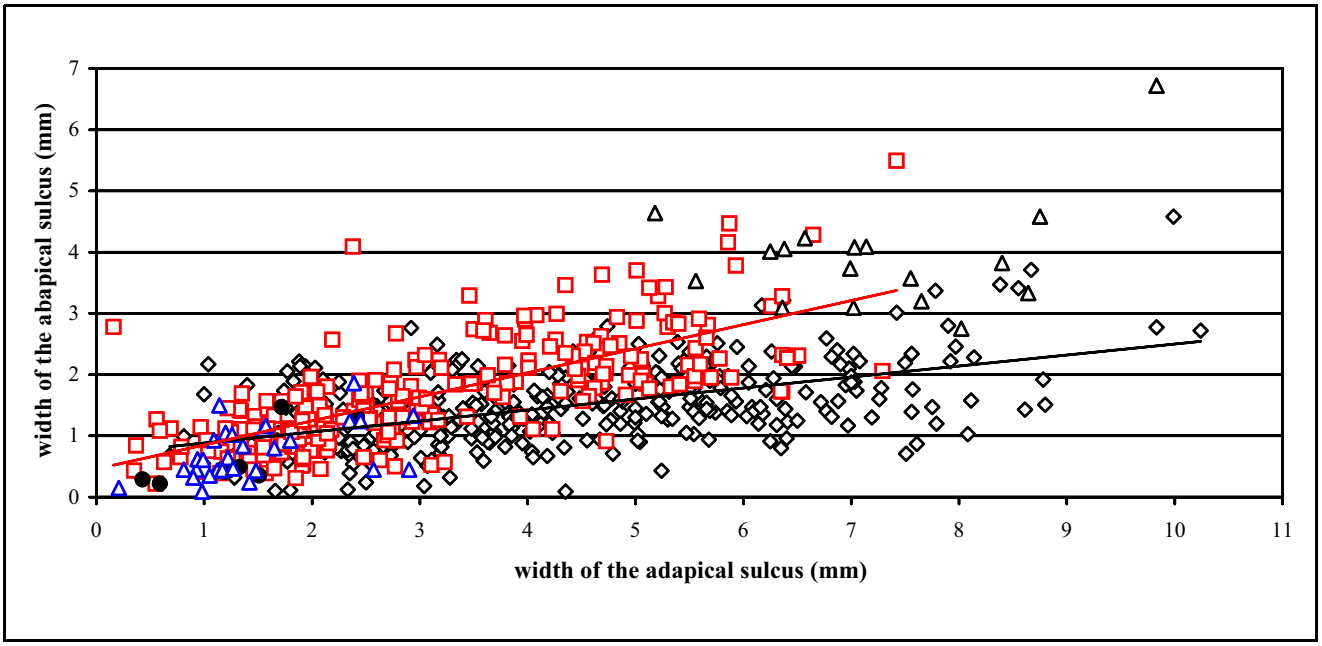


Fig. 14 A - Relationship between the width of the abapical sulcus and the width of the adapical sulcus of the species of the *raropunctata* group; black open diamonds: *propinqua*, *raropunctata* and *undata*; red open squares: *depressofuniculata*, *fulgurata* and *sulcogradata*; black open triangles: *obliquicallosa*; black solid circles: *strictiumbilicata*; *plicatula* (blue open triangles) included for comparison.

	basal fasciole
depressofuniculata	wide, markedly depressed, defined abaxially by the sudden deviation of growth lines
fulgurata	moderately wide, bluntly rounded, defined abaxially by a low, obtuse angulation
obliquicallosa	wide, sharply edged abaxially by a low step
plicatula	nearly indistinct
propinqua	moderately wide, bounded abaxially by a rounded step
pseudoepiglottina	blunt and rather broad, defined abaxially by a very low step, occasionally only by the sudden deviation of the growth lines
raropunctata	wide, sharply edged abaxially by a low step
strictiumbilicata	moderately wide, not prominent at all, defined abaxially by the sudden bending of the growth lines
sulcogradata	wide and blunt, defined abaxially by the deviation of the growth lines or by a spiral, incised line
undata	wide, triflingly prominent or not prominent at all, defined abaxially by the sudden deviation of the growth lines or by an incised spiral line
virguloides	poorly differentiated, marked by the bending of the growth lines
vittata	poorly differentiated, defined abaxially by the bending of the growth lines

Tab. 8 - Features of basal fasciole of the studied species.

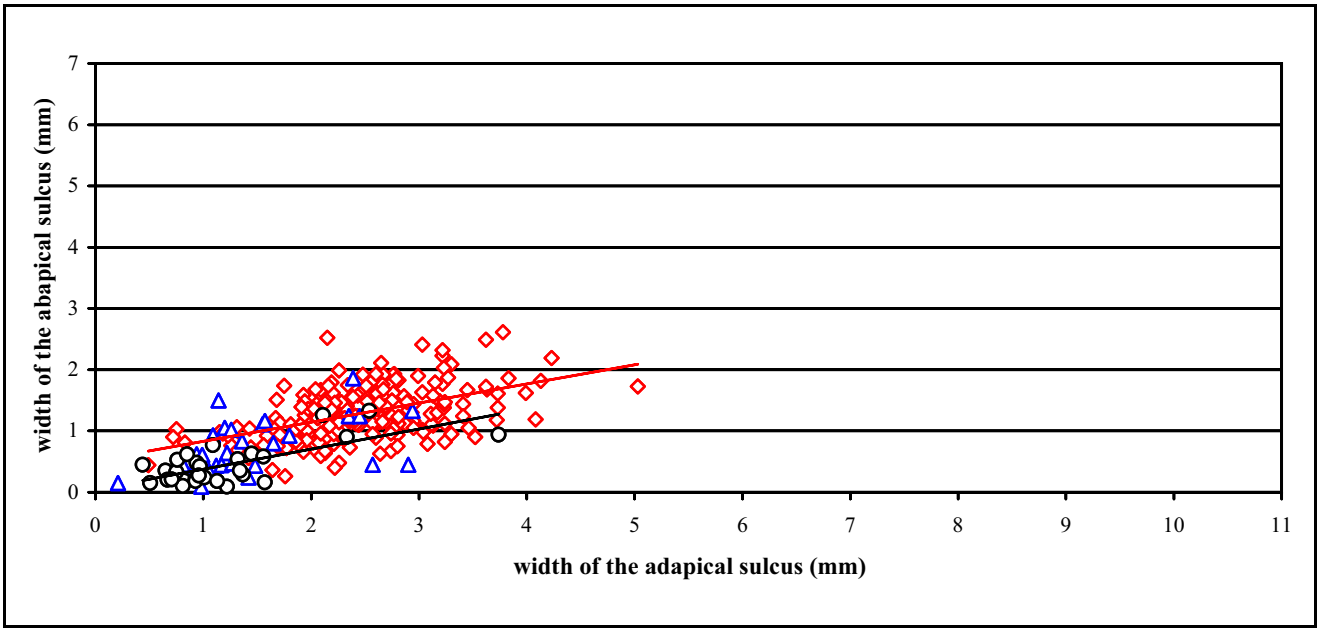


Fig. 14 B - Relationship between the width of the abapical sulcus and the width of the adapical sulcus of the species of the *pseudoepiglottina* group; *plicatula* included for comparison; symbols as in Fig. 7 B.

the basal fasciole. Only *plicatula* is distinguished in that the growth lines change subsuturally into distinct axial wrinkles. Except for *fulgurata*, *plicatula* and *pseudoepiglottina*, a more or less faint spiral microstriation is ordinarily noted on the body whorl.

The color is another feature of the shell surface. Many living naticids exhibit distinctive background color and color patterns used in specific recognition (cf. Kilburn 1976, keys to species). However, this character is uncommonly preserved in fossil shells and was considered only in few instances by paleontologists (e.g., Sacco 1891). The fact that a number of shells in the vast material recovered still retain the color enabled us to define the color pattern of each species (summarized in Tab. 9) and to evaluate the diagnostic value of it. Three species, namely *plicatula*, *virguloides* and *vittata*, are readily distinguished from one another and from the rest of the studied species on the basis of their peculiar

	background	color pattern
depressofuniculata	light-brown	reddish pattern which may consist of: **1.** uneven, irregularly arranged spots **2.** ***spirally elongated oval spots*** **3.** triangular spots and/or chevron marks which may fuse to form collabral stripes
fulgurata	pale yellowish brown	reddish pattern which may consist of: **4.** usually crowded, small and even dots often arranged in collabral rows **5.** ***axial zigzag lines or stripes*** **6.** ***uneven, variously sized dots and spots arranged in irregular collabral rows*** **7.** ***spots replaced by chevron markings during growth***
plicatula	***light gray***	***reddish brown pattern of 4 spiral rows of squarish or chevron spots***
propinqua	light-brown	reddish pattern which may consist of: **8.** dense, undulating, collabral lines or stripes; spots may replace lines in later growth stages (rare occurrence)
pseudoepiglottina	• *uniform pale brown to pinkish brown* ***without any color pattern*** • pale reddish brown	red pattern which may consist of: **4.** small and even dots roughly arranged in collabral rows **9.** ***crowded, uneven and irregularly arranged small dots which may fuse adapically to form subsutural chevron markings*** **1.** uneven, variously sized and irregularly arranged spots
raropunctata	brown to light-brown	reddish-brown pattern which may consist of: **4.** usually crowded, small and even dots often arranged in collabral rows **10.** large, even spots irregularly arranged in collabral rows **1.** uneven, irregularly arranged, large spots **11.** spirally elongated spots **3.** spots and chevron marks occasionally fused to form collabral stripes **12.** irregular spiral broken lines
obliquicallosa	pale brown	**4.** usually crowded, small and even dots often arranged in collabral rows **1.** uneven, irregularly arranged spots **11.** spirally elongated spots **12.** irregular spiral broken lines
strictiumbilicata	pale brown	reddish pattern of: **1.** uneven, irregularly arranged spots
sulcogradata	light-brown	reddish-brown pattern which may consist of: **4.** usually crowded, small and even dots often arranged in collabral rows **10.** large, even spots irregularly arranged in collabral rows **11.** spirally elongated spots
undata	pale brown	reddish pattern which may consist of: **8.** gently undulating collabral lines occasionally interrupted or partially replaced by variously shaped spots **13.** ***axially elongated, oval spots arranged in collabral rows***
virguloides	not observable	***reddish brown dots and 2 spiral rows of large, approximated, irregular spots***
vittata	*pinkish white*	***reddish brown irregular reticulated pattern of interconnected polygons and 2-3 spiral rows of brown spots; a subsutural dark band is also present***

Tab. 9 - Background color and color patterns of the studied species.

color patterns. None of the other six species can be univocally characterized in that shares one or more color patterns at least with another species. In fact, pattern 1 occurs in *depressofuniculata*, *obliquicallosa*, *pseudoepiglottina*, *raropunctata* and *strictiumbilicata*, pattern 3 in *depressofuniculata* and *raropunctata*, pattern 4 in *fulgurata*, *obliquicallosa*, *pseudoepiglottina*, *raropunctata* and *sulcogradata*, pattern 8 in *propinqua* and *undata*, pattern 10 in *raropunctata* and *sulcogradata*, pattern 11 in *obliquicallosa*, *raropunctata* and *sulcogradata* and pattern 12 in *obliquicallosa* and *raropunctata*. It is noteworthy that patterns 2, 5 through 7, 9 and 13 are restricted respectively to *depressofuniculata*, *fulgurata*, *pseudoepiglottina* and *undata*, but are not the unique one occurring in those species. Ultimately, *pseudoepiglottina* is readily identified when unpatterned, uniform pale brown or pinkish brown shells are found.

Operculum. Since several shells were obtained with the operculum still filling the aperture, we could examine the morphology of these calcified plates for all the studied species. From Tab. 10, that summarizes the most significant opercular features, it will be seen that 3 main groups are distinguishable on the basis of the sculpture of the outer surface. Group 1, including the opercula of *virguloides*, *depressofuniculata*, *fulgurata*, *obliquicallosa*, *propinqua*, *raropunctata*, *strictiumbilicata*, *sulcogradata* and *undata* is characterized by 2 marginal grooves alternating with 2 ridges. Group 2, including the opercula of *pseudoepiglottina* and *vittata*, bears 3 marginal grooves alternating with 3 ridges, the ridges along with median and outer grooves lying upon a distinctly elevated, sloping inward shelf. Group 3 contains the operculum of *plicatula* which is sculptured with 2 marginal ridges separated by a groove.

The operculum of *plicatula* (group 3) is readily distinguished from those of the other species by the number of marginal elements; the central callus bent toward the inner (columellar) margin constitutes an additional character. Within group 2, the short, nearly oval central callus and the wide, flat-topped middle ridge differentiate the operculum of *vittata* from that of *pseudoepiglottina* which has longer central callus bent toward the inner margin and sharp, thin middle ridge. As regards group 1, the most readily distinguished opercula are those of *depressofuniculata*, *propinqua* and *virguloides*. In the former species, the marginal area bearing the outer groove and ridge is distinctly sloping outward while the same sculptural elements lie upon a well elevated shelf in *depressofuniculata*; the marginal area of *virguloides* bears coarse transverse wrinkles that cross both grooves and ridges. The opercula of the other

	central callus	marginal outer sculpture	outer groove	middle groove	inner groove	outer ridge	middle ridge	inner ridge
depressofuniculata	elongate	2 grooves, 2 ridges; ***outer groove and ridges on distinctly elevated shelf***	wide and shallow, sloping adaxially, bearing longitudinal rows of granules		of variable breadth, exceedingly shallow to obsolescent	thin and moderately prominent		identical to the outer one, bent toward the inner furrow
fulgurata	elongate	2 grooves, 2 ridges	***broad and shallow, regularly arched in cross section***		***attenuated, markedly narrower***	sharp		***rather strong, flat-topped***
obliquicallosa	operculum indistinguishable from that of *raropunctata*							
plicatula	bent toward the inner margin	***2 ridges separated by a groove***		rather deep, asymmetric in cross section		robust and rather sharp, sloping inward		strong, flat-topped, vertical or sloping inward
propinqua	broad	2 grooves, 2 ridges; ***marginal area bearing outer groove and ridge sloping outward***	moderately excavated, angular in cross section		narrower and shallower, attenuated to obsolete in larger specimens	sharp		sharply or roundly edged, reclinate toward the inner groove
pseudoepiglottina	***bent toward inner margin***	***3 grooves, 3 ridges; ridges, median and outer grooves on elevated, sloping inward shelf***	rather narrow and shallow	similar to the outer one	wider and deeper, with subvertical outer side	blunt and low	***sharp, thinner, occasionally thread-like***	similar to the outer one
raropunctata	elongate, prominent	2 grooves, 2 ridges	***rather wide, moderately deep, sometimes obsolescent, may bear longitudianl rows of granules***		***usually narrower and less excavated, sometimes attenuated or obsolete***	sharp to round-topped		usually well developed, thin to thick, with sharp to flat top, seldom obsolete
strictiumbilicata	elongate, prominent	2 grooves, 2 ridges	***deep, with flat bottom and vertical, concave sides***		***of equal breadth, deeper, with vertical outer side and inward sloping inner side***	rather thin, moderately sharp		***massive, with bluntly rounded top and slightly concave sides***
sulcogradata	elongate	2 grooves, 2 ridges	wide, arched in cross section, with dense granules sometimes forming 1-2 secondary thin ridges		equally wide, ***bounded adaxially by an abrupt angulation***	sharp to round-topped		***laminar with toothed edge***
undata	***broad***	2 grooves, 2 ridges	***wide and shallow, arched in cross section***		***similar to the outer one***	***sharp, subvertical***		***similar to the outer one***
virguloides	***short, nearly perpendicular to inner margin***	2 grooves, 2 ridges; ***marginal area with coarse transverse wrinkles***	***excavated, with concave bottom and subvertical sides***		***similar to the outer one, but deeper***	rather sharp		***robust, with flatly convex top and vertical sides***
vittata	***short, nearly oval***	***3 grooves, 3 ridges; ridges, median and outer grooves on elevated, sloping inward shelf***	narrow, well incised, attenuated during growth	similar to the outer one	wider, moderately excavated, with outer side subvertical or sloping outward	thin, flat-topped	***wider, flat topped***	similar to the outer one

Tab. 10 - Opercular features of the studied species.

species (*fulgurata*, *raropunctata*, *strictiumbilicata*, *sulcogradata* and *undata*) require accurate examination of the sculpture; in fact, configuration and strength of grooves and ridges combine in different ways in each species (see Tab. 10), resulting in quite distinctive and constant aspects. The operculum of *undata* is featured by both grooves and ridges that are remarkably twin, that of *sulcogradata* by the abrupt angulation bounding adaxi-

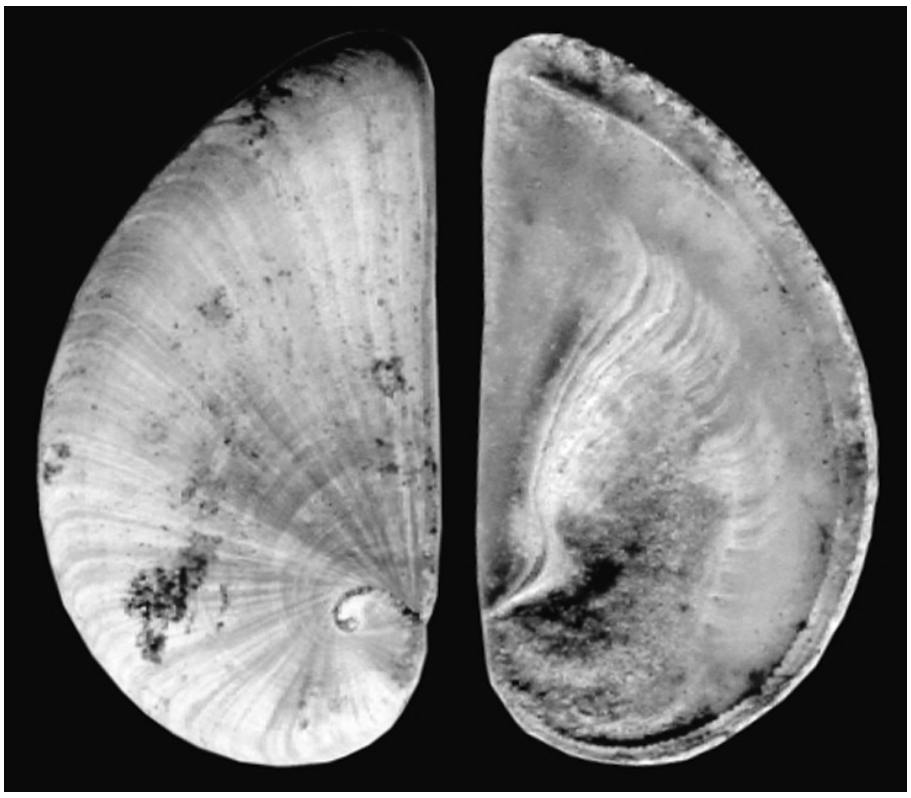


Fig. 15 - The holotype of *Natica raropunctata* var. *sulcooperculata* Ruggeri (original designation): the operculum figured by Ruggeri (1949, pl. 1, fig. 1), recovered from "Calabrian" deposits near Cosenza, provisionally in Tabanelli Collection.

ally the inner groove and by the laminar, tooth-edged inner ridge, that of *fulgurata* by the attenuated inner groove which is as wide as one-third to one-fourth of the outer one, thus considerably narrower (much more than in any other species). The opercular difference between *strictiumbilicata* and *virguloides*, apart from the marginal area devoid of transverse wrinkles in the former species, relies upon respective cross sections of grooves and inner ridge; moreover, in the latter species, the central callus is short, nearly perpendicular to the inner margin whereas it is elongate and roughly parallel to the inner margin in the former. The opercula of both *strictiumbilicata* and *virguloides* are easily distinguished from those of the other species in group 1 because of the robust to massive inner ridge. The operculum of *raropunctata* is characterized by the subequal, rib-like ridges and by the very shallow inner groove which is only slightly narrower than the outer one; the incipient to fully developed obsolescence of the grooves was noted only in this species and in *obliquicallosa* whose operculum resulted to be indistinguishable from that of *raropunctata*.

On the basis of our evidence, the opercular features of eleven taxa (out of twelve) considered in this study proved to be species-diagnostic and constitute the only character, among those we have analyzed, that univocally identifies species. The case of *obliquicallosa* seems exceptionable in that does not conform to this rule; as will be shown later (see discussion in the systematic account), *obliquicallosa* is to be regarded as a subspecies of *raropunctata* and, thence, it is not surprising that these two taxa have identical opercula. To conclude, we concur with Pavia (1980) in considering the operculum of relevant value in specific recognition. We are aware that it is possibly the most difficult element to be dealt with because it requires careful examination also of rather subtle morphological details; a statistical treatment (not used herein), like that utilized by Pavia, is likely to offer further elements to differentiate the opercula of the various species.

Generic classification

Aim of this section is to discuss the generic assignment of the species included in the present revision. For this purpose, the genera used by the authors to allocate the studied species have been considered along with their interpretation offered in some major accounts. The respective type-species have been also examined (specimens in our collection) in order to docu-

	Kilburn, 1976	Marincovich, 1977	Pavia, 1980	Majima, 1989
shell	globose	globose	globose	globose
spire	depressed to moderately high	low to moderately elevated	depressed	low to moderately elevated
parietal callus	with more or less developed anterior lobe	with weak anterior lobe sometimes overhanging the umbilicus	with well developed anterior lobe obscuring the adapical part of the umbilicus	with distinct anterior lobe
umbilicus	narrow to widely open	narrow but not slit-like	narrow to medium, never slit-like	rather narrow
funicle	present, more or less thick	low	absent	weak
umbilical callus	large	slender	reduced	weakly developed
sculpture	smooth or with subsutural axial pliculae	smooth	smooth	smooth or with subsutural axial wrinkles
operculum	with 1-3 marginal ridges, sometimes with additional faint striations	with one to many spiral ribs	with one or several marginal ridges	smooth except for a few marginal grooves
diagnostic features pointed out by the authors	***operculum with 1-3 marginal ridges***	***1. smooth shell 2. open umbilicus 3. slender umbilical callus***	***1. funicle wanting 2. anterior lobe of the parietal callus expanded***	***1. globose shell 2. deeply open umbilicus 3. weakly developed umbilical callus 4. operculum with a few marginal grooves***

Tab. 11 - Diagnostic characters of the genus *Natica* according to selected authors. Some features not explicitly stated were inferred on the basis of descriptions of the species assigned to *Natica* or *Natica* s.s.

shell	globose, body whorl not expanded
protoconch	of 2 whorls (diameter = 1.124 mm; diameter of the first half whorl = 0.368 mm)
spire	low to moderately elevated
parietal callus	thick and narrow, ***with distinct anterior lobe partially covering the posterior part of the umbilicus***
umbilicus	rather wide and deep
funicle	***lacking or poorly defined***
umbilical callus	usually small but distinct, with reverse ***S-shaped outline, smoothly merging into parietal callus***
sculpture	smooth, growth markings more prominent subsuturally
operculum	with ***2 marginal ribs and a reduced third one sometimes extending from the central callus***; inner margin distinctly crenulated

Tab. 12 - Characters of *Nerita vitellus*; the most significant are boldfaced.

ment the diagnostic characters of each genus. The species studied herein can be divided into two lots; lot 1 contains only *virguloides* which has a well developed anterior lobe of the parietal callus and the umbilical cavity devoid of funicle; lot 2 includes the rest of the species that have a poorly developed or indistinct anterior lobe of the parietal callus and the umbilicus more or less widely filled by the funicle.

The quotations of *virguloides* are scanty in the paleontological literature. Sacco (1891, p. 76), establishing the new species *virguloides*, assigned it to *Naticina* Guilding, 1834 (regarded as a subgenus of *Natica* Adanson, 1757) which is a junior subjective synonym of *Polinices* Montfort, 1810 (cf. Kabat 1991). The possible allocation of *virguloides* in the genus *Polinices* is untenable since the species has a calcareous operculum whereas polinicine species have a corneous one. Later authors referred *virguloides* to the genus *Natica* Scopoli, 1777 (cf. Pavia 1980).

The type-species of *Natica* is *Nerita vitellus* Linnaeus, 1758 by subsequent designation (Anton, 1838, p. 31). The problem of the type-species was discussed by several authors and conclusively elucidated by Oyama (1985), Majima (1989) and particularly by Kabat (1990) who redescribed the type-species. According to Kabat (1991), *Ampullina* Férussac, 1822 *non* Bowdich, 1822, *Mamilla* Fabricius, 1823, *Nacca* Risso, 1826 and *Payraudeautia* Bucquoy, Dautzenberg & Dollfus, 1883 are synonyms of *Natica*; *Natica* Lamarck, 1799 is equivalent to *Naticarius* Duméril, 1806; *Natica* Risso, 1826 is a junior homonym but not a synonym of *Natica*.

The characters ascribed to the genus *Natica* by the authors appear not to be univocal. From Tab. 11, which refers to some major accounts, it will be seen that the most significant discrepancies concern 1) absence/presence and strength of the funicle, 2) size of the umbilical callus and 3) number of outer marginal ridges in the operculum. It is clear that the considered authors have relied upon different diagnostic elements to characterize the genus *Natica*, sometimes adopting a rather broad genus concept in order to incorporate several, manifestly unrelated and quite different species. Reconsideration of the type-species would serve as guide in establishing the identity of *Natica*. We have examined several specimens of *Nerita vitellus* (Pl. 6, fig. 16; Pl. 7, fig. 23; Pl. 8, fig. 42) from different locations in the Indo-Pacific and its features are summarized in Tab. 12. On this basis, the main diagnostic characters of *Natica* result to be 1) anterior lobe of the parietal callus clearly developed, expanded to hide more or less extensively the adapical part of the umbilicus, 2) funicle lacking or weakly prominent, 3) umbilical callus absent to weak, with reverse S-shaped outline when present, 4) operculum with 2-3 marginal ridges. Thus, the applications of *Natica* to species with a thick funicle and/or with several ribs to the operculum are not acceptable. Instead, those species that fulfill characters 1 to 3 and have the operculum with 1 to 4 marginal ridges may advisably belong to *Natica*. Sacco's *virguloides* perfectly fits in with the characters of *Natica* and its assignment to this genus is herein confirmed.

The rest of the studied species (*depressofuniculata*, *fulgurata*, *obliquicallosa*, *plicatula*, *propinqua*, *pseudoepiglottina*, *raropunctata*, *strictiumbilicata*, *sulcogradata*, *undata* and *vittata*), formerly regarded as belonging to *Natica*, were currently assigned later on to the genus *Naticarius* Duméril, 1806. The type-species of *Naticarius* is *Nerita canrena* Linnaeus, 1758 by subsequent designation (Froriep 1806, p. 165). Kabat (1990) discussed the problems connected with this generic name and redescribed the type-species. According to Kabat (1991), *Naticus* Montfort, 1810, *Quantonatica* Iredale, 1936 and *Tella* Palmer, 1942 are synonyms. As shown in Tab. 13, the genus *Naticarius* was differently applied by the

	Kilburn, 1976	Marincovich, 1977	Pavia, 1980	Majima, 1989
shell	globose	globose to somewhat elongated, small to medium in size, body whorl distinctly inflated	globose, sometimes elongated with swollen whorls	globose to somewhat elongated, with tabulated shoulder
spire	not mentioned	moderately elevated to elevated	moderately elevated to elevated	moderately elevated
parietal callus	not mentioned	thin to slightly thickened	thin to moderately thick, with poorly developed anterior lobe	with distinct anterior lobe
umbilicus	wide	usually narrow, rarely broad, with moderately to deeply excavated sulcus	narrow, with distinct adapical sulcus	not greatly open
funicle	robust to low	robust to low and indistinct	robust to low or indistinct	strong
umbilical callus	not mentioned	slender	slender	well developed, semicircular to half heart-shaped
sculpture	subsutural axial grooves	sharply incised axial grooves that extend from suture part way to periphery	incised subsutural axial grooves	distinctly developed subsutural axial wrinkles
operculum	with 6-12 strong spiral ridges	with one or two ribs at outer margin or several ribs over outer portion	with one, two or many ribs over outer portion	with numerous spiral grooves or costae
diagnostic features pointed out by the authors	***operculum with 6-12 strong spiral ridges***	***1. distinct radial grooves above the periphery*** ***2. slender umbilical callus*** ***3. operculum usually with several spiral ribs***	***umbilical characters***	***1. subsutural axial wrinkles*** ***2. umbilical callus large, semicircular to half heart-shaped*** ***3. tabulated shoulder*** ***4. multisulcate operculum***

Tab. 13 - Diagnostic characters of the genus *Naticarius* according to selected authors. Some features not explicitly stated were inferred on the basis of descriptions of the species assigned to this genus.

authors, primarily as regards the sculpture of the operculum. In fact, Kilburn (1976) and Majima (1989) stated that the operculum of *Naticarius* is characterized by several spiral ridges, while Maricovich (1977) and Pavia (1980) expanded the meaning of the genus to include also species having one or two opercular ridges. Once again the type species is to be referred to; its characters, based on personal material from Brasil (Pl. 4, fig. 9; Pl. 7, fig. 24; Pl. 8, fig. 28; Pl. 10, fig. 22) and on the description published by Kabat (1990), are summarized in Tab. 14. From this latter, it will be seen that the definitions of *Naticarius* adopted by Kilburn (1976) and Majima (1989) are basically correct. It is manifest that the assignment of species having the operculum with 1-3 marginal ribs to *Naticarius* would be forcible and, thence, is not acceptable.

In the Mediterranean area, only the Pleistocene to Recent *Nerita stercusmuscarum* Gmelin, 1791 (Pl. 4, fig. 8; Pl. 7, fig. 10; Pl. 8, fig. 27) and the Recent *Nerita hebraea* Martyn, 1784 (Pl. 4, fig. 7; Pl. 7, fig. 11; Pl. 8, fig. 26) likely belong to *Naticarius* in that meet the shell characters of this genus and have many ribs to the operculum. The second lot of Pliocene species (all but for *virguloides*) studied herein cannot belong to *Naticarius* and require a different, more adequate generic allocation.

shell	globose, body whorl expanded
protoconch	of 2 whorls (diameter = 1.340 mm; diameter of the first half whorl = 0.510 mm)
spire	low to moderately elevated
parietal callus	short, ***with poorly developed anterior lobe***
umbilicus	rather narrow and deep with distinct adapical sulcus and largely filled by the umbilical callus
funicle	***broad, prominent***
umbilical callus	broad, ***semicircular, separated from the parietal callus by a squarish notch***
sculpture	slightly curved subsutural wrinkles but otherwise smooth
operculum	with ***8 low and broad marginal ribs***

Tab. 14 - Characters of *Nerita canrena*; the most significant are boldfaced.

Among the supraspecific taxa of the Naticidae recently reviewed by Kabat (1991), *Cochlis* Röding, 1798 appears to be the most suitable for the species in lot 2. The type-species is *Cochlis flammea* Röding, 1798 (= *Nerita vittata* Gmelin, 1791) by subsequent designation (Hedley 1916, p. 51). Both Oyama (1985) and Kabat (1991) discussed the status of *Cochlis* and concluded it to be a distinct, valid genus; moreover, Oyama noted that it is quite dissimilar to *Naticarius* Duméril, 1806 by the operculum with only three marginal ribs instead of many ribs on the surface of the latter.

On account of the features of the type-species (Tab. 15, material in our collection) and of others which are closely related to it, the characters of *Cochlis* can be outlined as follows: 1) shell thin to solid, globose to depressed-globose, body whorl moderately expanded, 2) protoconch low-turbiniform of 1.25-3.5 smooth whorls, 3) spire rather depressed to moderately elevated, 4) suture adpressed to channeled, 5) parietal callus thin to thick, usually short, with indistinct or poorly developed anterior lobe, 6) umbilicus rather small to wide, 7) funicle thread-like to thick and more or less prominent, 8) umbilical callus small to broad, ordinarily separated from the parietal callus by a reverse J-shaped notch, 9) calcareous operculum with 2-3 marginal ribs. The operculum stands as the most relevant diagnostic element to be used in combination with the parietal callus and umbilical features. The Pliocene species in lot 2 fully conform to the characters of *Cochlis* and are herein assigned to it.

It seems that several European Cenozoic species may belong to *Cochlis*, but listing them is beyond the scope of the present paper. Subsequent to the Pliocene, the genus *Cochlis* appears to be represented in the Mediterranean area only by *Cochlis vittata* (Gmelin, 1791); many species that likely match the characters of this genus occur in West African waters.

According to Oyama (1985), the Indo-Pacific genus *Tanea* Marwick, 1931, which exhibits shell and opercular characters similar to those of *Cochlis*, is distinguished on the basis of its radular features.

Concluding remarks

The Naticidae is a taxonomic group difficult to handle because it is morphologically conservative (Mar-

shell	globose, body whorl moderately expanded
protoconch	of 2-2.25 whorls (diameter = 0.557 mm; diameter of the first half whorl = 0.090 mm)
spire	moderately elevated
parietal callus	moderately thick, narrow and relatively short, ***with poorly developed anterior lobe***
umbilicus	narrow and deep, with distinct adapical sulcus
funicle	***rather thin, placed abapically***
umbilical callus	small, ***semicircular, separated from the parietal callus by a reverse J-shaped notch***
sculpture	smooth, growth markings slightly more prominent subsuturally
operculum	slightly concave externally, ***with 3 low marginal ribs***

Tab. 15 - Characters of *Nerita vittata*; the most significant are boldfaced.

CHARACTERS	*depressofuniculata*	*fulgurata*	*obliquicallosa*	*plicatula*	*propinqua*	*pseudoepiglottina*	*raropunctata*	*strictiumbilicata*	*sulcogradata*	*undata*	*virguloides*	*vittata*
protoconch	○	●		●		●				●		●
spire (height)			●									●
suture		●										
parietal callus (all features)		○									●	○
umbilicus (width)												●
funicle (absence/presence, all features)		○									○	
umbilical callus (absence/presence, all features)			●	●				●		●	○	
sculpture				●								
color	○	○		●		○				○	●	●
operculum	●	●		●	●	●	●	●	●	●	●	●

Tab. 16 - Summary of distinguishing characters. Diagnostic characters are indicated by solid circles; additional useful characters are indicated by open circles.

incovich 1977) and the usable shell characters are limited. In these circumstances, the study of the naticids appears to be discouraging and many problems, at both species and higher categories level, are pending or have been only tentatively solved. As regards genera, the critical compilation offered by Kabat (1991) has made considerable clarity and provides profitable assistance with the generic assignment of species.

Our approach was to consider all skeletal characters and verify their significance in species recognition. This was made possible by the huge number of specimens obtained and by the fair preservation of most of them. We are aware that some relevant diagnostic features are often unavailable (protoconch eroded, color decayed, operculum separated from the shell prior to the burial of this latter in the sediment) because of life-time and/or taphonomic processes. Actually, the morphological characters of the teleoconch, that have been traditionally used, are not necessarily (or not always) effective to distinguish species and this may account for the constant disregard of some valid taxa whose specimens were referred to other species having quite similar shell morphologies (*tigrina*, *pseudoepiglottina*).

The characters which are necessary and/or sufficient for the identification of the species considered in this study are summarized in Tab. 16. As can be seen from it, the operculum stands as the most significant diagnostic element in that is species-specific and, thence, sufficient to recognize each taxon. The protoconch is also relevant to distinguish several, but not all species. Other teleoconch characters, such as the height of the spire, the suture, the umbilical features and the sculpture (subsutural axial wrinkles), proved to be diagnostic only in some instances as it happens with the color, but this latter is uncommonly preserved. Many taxa, namely *virguloides*, *fulgurata*, *plicatulus*, *pseudoepiglottina*, *obliquicallosa*, *strictiumbilicata*, *undata* and *vittata* can be distinguished on the basis of a combination of two or more characters, whereas *depressofuniculata*, *propinqua*, *raropunctata* and *sulcogradata* positively require operculate specimens to be confidently identified. We conclude that, being the characters cited in Tab. 16 unavailable, it should be wise to abstain from any assignment to species in order to avoid confusion.

Systematic account

We follow a traditional (non-cladistic) classification. The suprageneric arrangement is that adopted in recent major revisions of the Family Naticidae (Kilburn 1976; Marincovich 1977; Majima 1989; Kabat 1991).

The bulk of the studied material is housed in the Museo di Paleontologia dell'Università, Milano, Italy (MPUM in the following) and in the Museo G. Cortesi, Castell'Arquato, Italy (MGC in the following); the rest is kept in the authors' collection as reference material. Abbreviations for other collections/ institutions are: MGPT, Bellardi-Sacco collection in Museo di Geologia e Paleontologia dell'Università di Torino, Italy; PPMM, Magenes collection, Milano, Italy; CO/MPM, Coppi collection in Museo Paleontologico dell'Università, Modena, Italy; DO/MPM, Doderlein collection in Museo Paleontologico dell'Università, Modena, Italy; FO/MC, Foresti collection in Museo di Geologia e Paleontologia G. Capellini, Bologna, Italy; DS/MSNF, De Stefani collection in Museo di Storia Naturale, Sezione di Geologia e Paleontologia dell'Università, Firenze, Italy; PE/ MSNF, Pecchioli collection in Museo di Storia Naturale, Sezione di Geologia e Paleontologia dell'Università, Firenze, Italy; NP, authors' collection, Dipartimento di Scienze Geologiche e Geotecnologie, Milano-Bicocca, Italy.

The synonymies ordinarily refer to the Pliocene. The citations, which are verifiable in that enclose adequate description and/or illustration of species, and other quotations referring to material that has been directly examined by the present authors, were included in the synonymies. Other citations, poorly documented or not documented at all, are listed too

as uncertain references in order to provide a most complete framework of species.

Symbols for shell dimensions (see also Fig. 2) are: DHW, diameter of the first half whorl of the protoconch; PD, diameter of the protoconch; PW, number of protoconch whorls; 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.

Family Naticidae Forbes, 1838

Subfamily Naticinae Forbes, 1838

Genus *Natica* Scopoli, 1777

Natica virguloides Sacco, 1890

Pl. 6, fig. 11-15; Pl. 7, fig. 20; Pl. 8, fig. 41; Pl. 9, fig. 29, 30; Pl. 10, fig. 32, P

1890 *Natica (Naticina) virguloides* Sacco, p. 30.

1891 *Natica (Naticina) virguloides* – Sacco, p. 76, pl. 2, fig. 48.

1891 *Natica (Naticina) virguloides* var. *zonulata* Sacco, p. 77.

1980 *Natica virguloides* - Pavia, p. 245, pl. 1, fig. 6; pl. 3, fig. 4; pl. 5, fig. 1-4; text- fig. 2E, 5.

1984 *Naticina virguloides* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 34, pl. 3, fig. 11.

1995 *Natica virguloides* – Forli & Dell'Angelo, p. 15, fig. 7.

1996 *Natica virguloides* – Pedriali, p. 6 (pars), pl. 2, fig. 5, not fig. 6 (= *Natica epiglottina* var. *strictiumbilicata* Sacco, 1891).

1997 *Natica (Natica) virguloides* - Lacroce, p. 24, pl. 2, fig. 2.

2000 *Natica (Natica) virguloides* – Lacroce, p. 32.

2001 *Natica virguloides* – Della Bella & Scarponi, p. 68.

Type material. The lectotype of *Natica (Naticina) virguloides* Sacco (designated by Ferrero Mortara et al., 1984), MGPT BS.029.02.030 and 3 paralectotypes, MGPT BS.029.02.031-031/01-031/02 (Colli Astesi); 1 paralectotype, MGPT BS.029.02.031/03 (Savona).

Other material examined. Le Grottine: 2 spms. (NP 9529-9530), 1 spm. (MPUM 8752); Valle Botto: 1 spm. (NP 9563); Montezago: 1 spm. (MPUM 8751); Balze di Caspreno: 4 spms. (NP 9514-9517); Bibbiano: 6 spms. (NP 9518-9523), 1 spm. (PPMM 48327), 1 spm. (MPUM 8743); Corazzano: 1 spm. (NP 9524); Guistrigona: 1 spm. (NP 9525); Il Campino: 1 spm. (NP 9526), 1 spm. (MPUM 8744); Il Treppié: 2 spms. (NP 9528), 1 spm. (MPUM 8745); Linari: 5 spms. (NP 9531-9535), 1 spm. (PPMM 48328); Montaione: 25 spms. (NP 9536-9560), 12 spms. (PPMM 48315-48326); 4 spms. (MPUM 8746), 4 spms. (MPUM 8747-8750), 3 spms. (MGC 724-726); Podere Cavallara: 1 spm. (NP 9561); Ulignano: 1 spm. (NP 9562).

Characters

Protoconch: small, depressed turbiniform of 1.5 convex, smooth whorls, tip medium-sized.

Shell: globose, moderately depressed, robust.

Spire: low-conical, more or less depressed; whorls convex to flatly convex.

Suture: linear, finely incised, adpressed.

Body whorl: inflated, somewhat depressed, produced and more or less expanded toward the aperture, with poorly defined, gently sloping subsutural shelf.

Aperture: D-shaped, height nearly twice the width.

Parietal callus: very thick, overlapping the basal fasciole; anterior lobe well developed, tongue-shaped, obscuring the adapical part of the umbilicus.

Umbilicus: rather small to moderately wide.

Funicle: absent.

Umbilical callus: absent.

PLATE 1

Fig. 1 - *Cochlis depressofuniculata* (Sacco, 1891). Lectotype (here designated). Zinola. MGPT BS.029.01.027; a) apertural side, b) abapertural side, c) top view.

Fig. 2 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8757; a) apertural side, b) abapertural side, c) top view.

Fig. 3 - *Cochlis depressofuniculata* (Sacco, 1891). La Valle. MPUM 8754; apertural side.

Fig. 4 - *Cochlis depressofuniculata* (Sacco, 1891). Guistrigona. MPUM 8766; apertural side.

Fig. 5 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8758; a) apertural side, b) abapertural side.

Fig. 6 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8759; a) apertural side, b) abapertural side.

Fig. 7 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8760; a) apertural side, b) abapertural side.

Fig. 8 - *Cochlis depressofuniculata* (Sacco, 1891). Guistrigona. MPUM 8767; apertural side.

Fig. 9 - *Cochlis fulgurata* (Pecchioli, 1864). Calanchi di San Martino. MPUM 8783; a) apertural side, b) abapertural side.

Fig. 10 - *Cochlis fulgurata* (Pecchioli, 1864). Bibbiano. MPUM 8784; apertural side.

Fig. 11 - *Cochlis fulgurata* (Pecchioli, 1864). Il Campino. MPUM 8785; apertural side.

Fig. 12 - *Cochlis fulgurata* (Pecchioli, 1864). Rio Rosello. MPUM 8786; a) apertural side, b) abapertural side.

Fig. 13 - *Cochlis fulgurata* (Pecchioli, 1864). Rio del Mulino di Serralunga. MPUM 8787; apertural side.

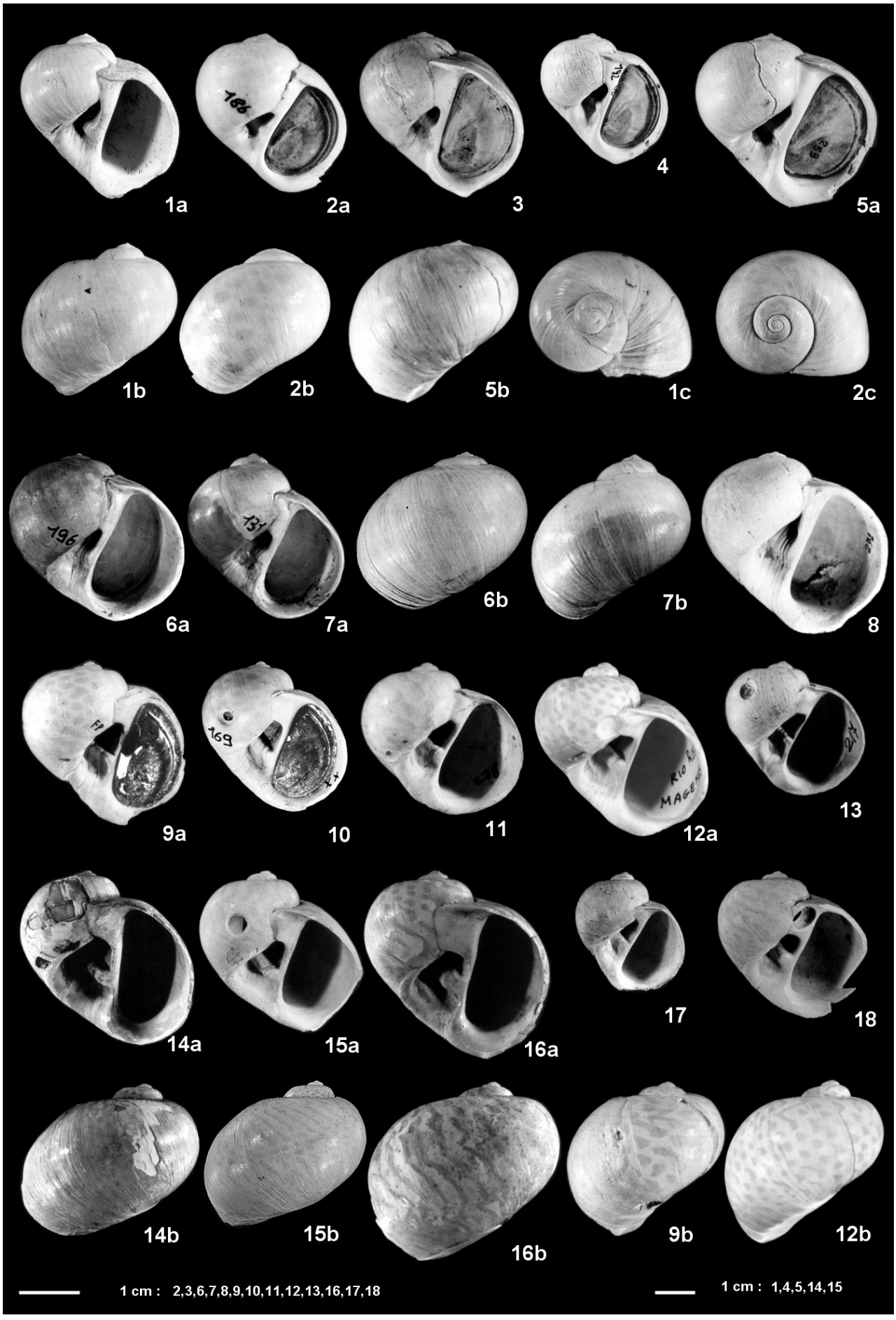
Fig. 14 - *Cochlis fulgurata* (Pecchioli, 1864). Lectotype (here designated) of *Natica (Natica) millepunctata* var. *umbilicosa* Sacco, 1891. Colli Astesi. MGPT BS.029.01.018; a) apertural side, b) abapertural side.

Fig. 15 - *Cochlis fulgurata* (Pecchioli, 1864). Lectotype (here designated) of *Natica (Natica) millepunctata* var. *fulguropunctata* Sacco, 1890. Colli Astesi. MGPT BS.029.01.024; a) apertural side, b) abapertural side.

Fig. 16 - *Cochlis fulgurata* (Pecchioli, 1864). The shell (previously unfigured) assigned to *Natica millepunctata* var. *undata* Sassi (sic) in Bellardi-Sacco collection. Rocca d'Arazzo. MGPT BS.029.01.024 bis; a) apertural side, b) abapertural side.

Fig. 17 - *Cochlis fulgurata* (Pecchioli, 1864). Lectotype (here designated) of *Natica (Natica) millepunctata* var. *pseudocollaria* Sacco, 1891. Colli Astesi. MGPT BS.029.01.025; apertural side.

Fig. 18 - *Cochlis fulgurata* (Pecchioli, 1864). Paralectotype of *Natica (Natica) millepunctata* var. *pseudocollaria* Sacco, 1891. Rocca d'Arazzo. MGPT BS.029.01.025/01; apertural side.


1a
2a
3
4
5a
1b
2b
5b
1c
2c
6a
7a
6b
7b
8
9a
10
11
12a
13
14a
15a
16a
17
18
14b
15b
16b
9b
12b
1 cm : 2,3,6,7,8,9,10,11,12,13,16,17,18
1 cm : 1,4,5,14,15

Basal fasciole: poorly differentiated, marked by the bending of the growth lines.

Surface: with dense, fine, prosocline growth lines; a spiral microstriation occurs on the body whorl.

Color: background not observable; color pattern of reddish brown dots and 2 spiral rows of large, approximated, irregular spots.

Operculum:

- relatively thin but solid;
- central callus short, tongue-shaped, nearly perpendicular to the inner margin and bounded abapically by a distinct step;
- inner margin straight, with weak, blunt transverse ridges;
- inner surface nearly flat, nucleus very slightly prominent;
- outer surface concave toward the inner margin, with 2 marginal grooves and 2 ridges that are well developed and bear coarse transverse wrinkles;
- outer and inner grooves approximately of the same breadth, deeply excavated, the inner more than the outer one; both have gently concave bottom and subvertical sides;
- outer ridge rather sharp;
- inner ridge robust, with flatly convex top and vertical sides.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.301-0.376	0,677-0.737	13.74-37.46	12.70-37.42	2.41-7.37	9.75-31.67	6.00-17.52
0.339	0.707	25.60	25.06	4.89	20.71	11.76
UW	WUC	WAD	WAB	IS	SA	
—	—	—	—	18°-26°	125°-157°	
—	—	—	—	22°	141°	

Remarks. This is up to now the sole Italian Pliocene member of the genus *Natica* Scopoli, 1777, readily recognized on the basis of 1) features of the parietal callus, 2) absence of funicle and umbilical callus, 3) peculiar color pattern, and 4) distinctive sculpture of the operculum. The East Atlantic *Natica fulminea* (Gmelin, 1791) and, particularly, the West Pacific *Natica stellata* Hedley, 1913 are closely related in that have similar shell morphology and the tongue-shaped anterior lobe of the parietal callus extending to obscure the adapical part of the umbilicus, but exhibit rather different opercular characters. *Natica vitellus* (Linnaeus, 1758), the type species of the genus *Natica*, differs in having 1) significantly larger, 2-whorled protoconch, 2) more deeply incised to weakly canaliculate suture, 3) smaller anterior lobe of the parietal callus, 4) small but distinct umbilical callus with reverse S-shaped outline and 5) marginal area of the operculum devoid of transverse wrinkles and with subequal ridges and narrower grooves.

Stratigraphic occurrence. *N. virguloides* Sacco is an uncommon taxon occurring in Pliocene deposits of Piedmont, Liguria, Emilia, Tuscany and Sicily (2 specimens of Seguenza collection in MSNF). On the basis of literature and personal data, it appears to be restricted to the Early-Mid Pliocene.

Genus *Cochlis* Röding, 1798

Cochlis depressofuniculata (Sacco, 1891) comb. nov.

Pl. 1, figs 1-8; Pl. 7, figs 1; Pl. 8, figs 1-3; Pl. 9, figs 1-3; Pl. 10, figs 1-3, A, B

1873 *Natica maculata* - Cocconi, p.524, 525 (not Deshayes in Lamarck, 1838).

1890 *Natica (Natica) millepunctata* var. *epiglottinoformis* subv. *depresso-funiculata* Sacco, p. 29 (nomen nudum).

PLATE 2

Fig. 1 - *Cochlis fulgurata* (Pecchioli, 1864). Il Campino; top view of the same specimen in Pl. 1, fig. 11.

Fig. 2 - *Cochlis fulgurata* (Pecchioli, 1864). Rio Rosello; top view of the same specimen in Pl. 1, fig. 12.

Fig. 3 - *Cochlis fulgurata* (Pecchioli, 1864). Colli Astesi; top view of the same specimen in Pl. 1, fig. 15.

Fig. 4 - *Cochlis fulgurata* (Pecchioli, 1864). Colli Astesi; top view of the same specimen in Pl. 1, fig. 17.

Fig. 5 - *Cochlis fulgurata* (Pecchioli, 1864). Rocca d'Arazzo; top view of the same specimen in Pl. 1, fig. 18.

Fig. 6 - *Cochlis plicatula* (Bronn, 1831). Ciuciano. MPUM 8802; a) apertural side, b) Abapertural side, c) top view.

Fig. 7 - *Cochlis plicatula* (Bronn, 1831). Barca. MPUM 8804; apertural side.

Fig. 8 - *Cochlis plicatula* (Bronn, 1831). Barca. MPUM 8805; apertural side.

Fig. 9 - *Cochlis plicatula* (Bronn, 1831). Montezago. MPUM 8806; apertural side.

Fig. 10 - *Cochlis plicatula* (Bronn, 1831). La Valle. MPUM 8808; a) apertural side, b) abapertural side.

Fig. 11 - *Cochlis plicatula* (Bronn, 1831). San Lorenzo in Collina. MPUM 8809; apertural side.

Fig. 12 - *Cochlis canariensis* (Odhner, 1931). Off West Africa. MPUM 8686; a) apertural side, b) abapertural side, c) top view.

Fig. 13 - *Natica dillwyni* Payraudeau, 1826. Punta Ala. Private collection; a) apertural side, b) abapertural side, c) top view.

Fig. 14 - *Cochlis propinqua* (Pecchioli, 1864). Lectotype (here designated). Argille Senesi (Siena). PE/MSNF IGF8305E; a) apertural side, b) abapertural side.

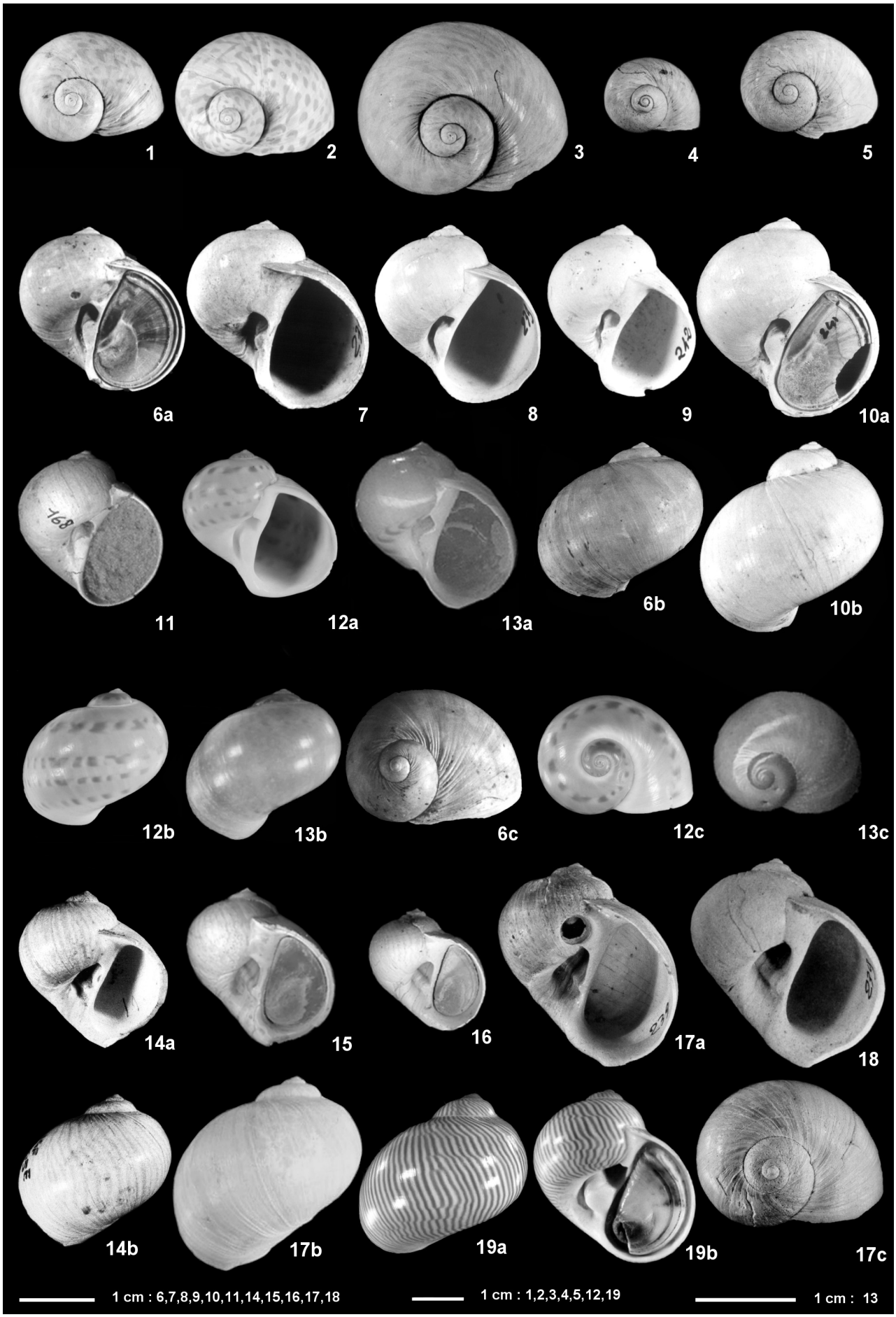
Fig. 15 - *Cochlis propinqua* (Pecchioli, 1864). Linari. MPUM 8829; apertural side.

Fig. 16 - *Cochlis propinqua* (Pecchioli, 1864). Montezago. MPUM 8831; apertural side.

Fig. 17 - *Cochlis propinqua* (Pecchioli, 1864). Barca. MPUM 8833; a) apertural side, b) Abapertural side, c) top view.

Fig. 18 - *Cochlis propinqua* (Pecchioli, 1864). Barca. MPUM 8834; apertural side.

Fig. 19 - *Tanea lineata* (Röding, 1798). Taiwan. MPUM 8846; a) apertural side, b) abapertural side.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1 cm : 6,7,8,9,10,11,14,15,16,17,18
1 cm : 1,2,3,4,5,12,19
1 cm : 13

1891 *Natica (Natica) millepunctata* var. *depressofuniculata* Sacco, p. 56, pl. 2, fig. 22.

1980 *Naticarius tigrinus* – Pavia, p. 251 (pars), pl. 6, fig. 9 (not Defrance, 1825).

1984 *Natica millepunctata* var. *depressofuniculata* – Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

1996 *Natica* (*Naticarius*) *tigrina* - Pedriali, p. 4 (pars), pl. 1, fig. 2 (not Defrance, 1825).

1996 *Natica* (*Naticarius*) *tigrina* f. *magnopunctata* - Pedriali, p. 1 (not Sacco, 1890).

1996 *Natica* (*Naticarius*) *tigrina* cf. *pliomaculata* - Pedriali, p. 1 (not Sacco, 1890).

Uncertain references

Natica millepunctata var. *epiglottinoformis* subvar. *depressofuniculata* - Mastrorilli, 1969: p. 156.

Natica (Natica) tigrina – Malatesta, 1974: p. 236 (pars), pl. 18, fig. 8b.

Type material. The lectotype of *Natica (Natica) millepunctata* var. *depressofuniculata* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 22) and refigured herein (Pl. 1, fig. 1), MGPT BS.029.01.027 (Zinola); 1 paralectotype, MGPT BS.029.01.027/02 (Zinola); 3 paralectotypes, MGPT BS.029.01.027/01 (Savona Fornaci); 5 paralectotypes, MGPT BS.029.01.027/03 (Colli Astesi); 2 paralectotypes, MGPT BS.029.01.027/04/05 (locality unknown).

Other material examined. Rio Torsero: 4 spms. (NP 1801-1804); Badagnano: 3 spms. (NP 01-03), 4 spms. (PPMM 48209-48212), 1 spm. (MPUM 8753); La Valle: 1 spm. (NP 88), 1 spm. (MPUM 8754); Pradalbino I: 109 spms. (NP 108-216), 7 spms. (MPUM 8755), 58 spms. (MPUM 8756); Pradalbino II: 1584 spms. (NP 217-1800), 1 spm. (MPUM 8757), 1 spm. (MPUM 8758), 1 spm. (MPUM 8759), 1 spm. (MPUM 8760), 1 spm. (MPUM 8774), 1 spm. (MPUM 8775), 3 spm. (MPUM 8776-8778), 4 spms. (MPUM 8779-8782), 98 spms. (MPUM 8761), 552 spms. (MPUM 8762), 1 spm. (MPUM 8773), 7 spms. (MGC 660-666); Rio Rosello: 1 spm. (PPMM 48208); San Lorenzo in Collina: 5 spms. (MPUM 8763); Balze di Caspreno: 1 spm. (NP 04); Barca: 4 spms. (NP 1817-1820); Bibbiano: 1 spm. (MPUM 8764); Cava di Certaldo: 12 spms. (NP 05-16), 4 spms. (MPUM 8765); Cava I Sodi: 4 spms. (NP 17-20); Guistrigona: 67 spms. (NP 21-87), 1 spm. (MPUM 8766), 1 spm. (MPUM 8767), 21 spms. (MPUM 8768), 24 spms. (MPUM 8769); Poggio Armaiolo: 19 spms. (NP 89-107); San Benedetto: 12 spms. (NP 1805-1816), 8 spms. (MPUM 8770); Ulignano: 59 spms. (NP 1821-1879), 16 spms. (MPUM 8771), 35 spms. (MPUM 8772).

Characters

Protoconch: small, depressed turbiniform, of 1.25 slightly convex, smooth whorls, tip medium-sized.

Shell: globose, moderately depressed, solid.

Spire: low-conical, rather depressed, whorls moderately convex.

Suture: fine, incised, adpressed.

Body whorl: inflated, somewhat depressed, moderately produced and expanded toward the aperture, with distinct subsutural shelf.

Aperture: D-shaped, height averaging 1.5 times the width.

Parietal callus: moderately thick to thick, subquadrangular, ending some distance from the basal fasciole; anterior lobe indistinct.

Umbilicus: moderately wide.

Funicle: a broad, low cord separated from the basal fasciole by a wide depression.

Umbilical callus: depressed and moderately thick, with bluntly arched, more or less asymmetrical outline, located at the mid-abapical part of the columellar lip and separated from the parietal callus by a very shallow, wide, reverse J-shaped notch.

Basal fasciole: wide, markedly depressed, defined abaxially by the sudden deviation of growth lines.

Surface: with dense and fine, gently prosocline growth lines, slightly stronger on subsutural shelf and basal fasciole; a faint spiral striation is noted on the body whorl.

Color: background light-brown with reddish pattern, which may consist of

- uneven, irregularly arranged spots;

PLATE 3

Fig. 1 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino I. MPUM8847; apertural side.

Fig. 2 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino I. MPUM 8848; apertural side.

Fig. 3 - *Cochlis pseudoepiglottina* (Sacco, 1890). Rio Torsero. MPUM 8853; apertural side.

Fig. 4 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino I. MPUM 8849; apertural side.

Fig. 5 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino I. MPUM 8850; a) apertural side, b) abapertural side.

Fig. 6 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino I. MPUM 8851; a) apertural side, b) abapertural side.

Fig. 7 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino I. MPUM 8852; apertural side.

Fig. 8 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino II. MPUM 8854; apertural side.

Fig. 9 - *Cochlis pseudoepiglottina* (Sacco, 1890). Guistrigona. MPUM 8855; a) apertural side, b) abapertural side, c) top view.

Fig. 10 - *Cochlis raropunctata* (Sasso, 1827). Rio Torsero. Topotype, MPUM 8883; a) apertural side, b) abapertural side, c) top view.

Fig. 11 - *Cochlis raropunctata* (Sasso, 1827). Rio Torsero. Topotype, MPUM 8884; a) apertural side, b) abapertural side.

Fig. 12 - *Cochlis raropunctata* (Sasso, 1827). Rio Torsero. Topotype, MPUM 8885; apertural side.

Fig. 13 - *Cochlis raropunctata* (Sasso, 1827). The shell figured by Sacco (1891, pl. 2, fig. 11) and referred to as *Natica millepunctata* var. *tigrina*. Colli Astesi. MGPT BS.029.01.015; a) apertural side, b) abapertural side.

Fig. 14 - *Cochlis raropunctata* (Sasso, 1827). Villalvernia. MPUM 8886; apertural side.

Fig. 15 - *Cochlis raropunctata* (Sasso, 1827). Rio del Mulino di Seralunga. MPUM 8887; apertural side.

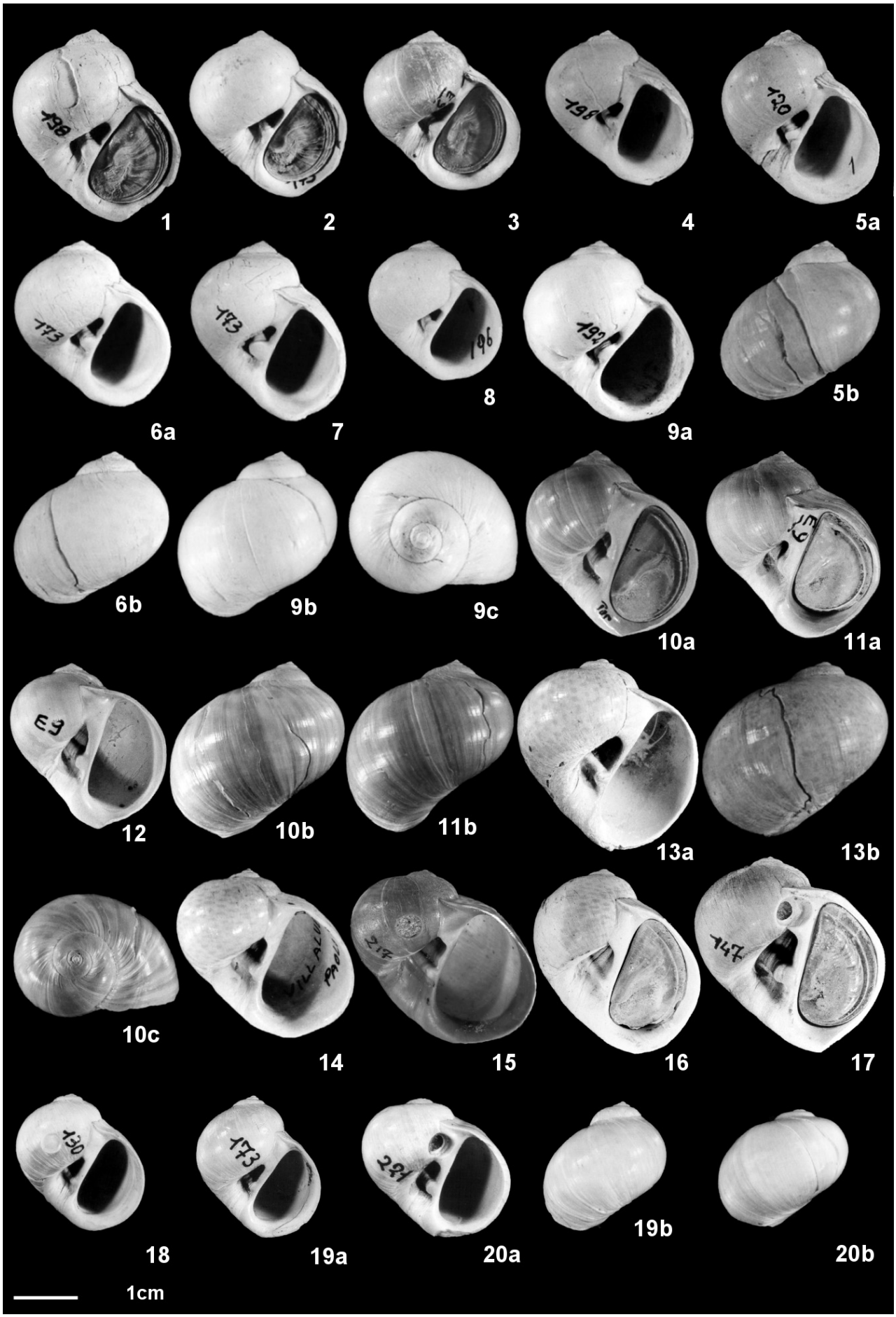
Fig. 16 - *Cochlis raropunctata* (Sasso, 1827). Passerano. MPUM 8888; apertural side.

Fig. 17 - *Cochlis raropunctata* (Sasso, 1827). Badagnano. MPUM 8889; apertural side.

Fig. 18 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8890; apertural side.

Fig. 19 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8891; a) apertural side, b) abapertural side.

Fig. 20 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8892; a) apertural side, b) abapertural side.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10c
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19a
20a
19b
20b
1cm

• spirally elongated oval spots;

• triangular spots and/or chevron marks which may fuse to form collabral stripes.

Operculum:

• rather thin;

• central callus distinct, moderately elongate, tongue-shaped;

• inner margin nearly straight, with blunt granules;

• inner surface flat, nucleus not protruding at all;

• outer surface slightly concave, with 2 marginal furrows and 2 ribs; outer furrow and ribs on a distinctly elevated shelf;

• outer groove wide and shallow, sloping adaxially, bearing granules that tend to form longitudinal rows;

• inner groove of variable breadth, exceedingly shallow, obsolescent in larger specimens; may bear granules;

• outer ridge thin and moderately prominent;

• inner ridge identical to the outer one, clearly bent toward the inner furrow and with toothed edge in young specimens.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.290-0.336	0.559-0.621	8.85-35.20	16.68-36.52	1.39-7.03	6.97-27.53	4.23-18.35
0.315	0.589	21.41	21.21	4.21	17.25	11.29
UW	WUC	WAD	WAB	IS	SA	
1.6-12.6	1.10-4.82	0.0-5.64	0.0-3.09	18°-42°	114°-142°	
7.1	2.96	2.66	1.49	30°	128°	

Remarks. The present species was originally proposed by Sacco (1891) and treated as a variety of *Natica millepunctata* Lamarck, 1822. Actually, it differs markedly from Lamarck's taxon (belonging to the genus *Naticarius* Duméril, 1806; see discussion above) in having quite different opercular features that are consistent with those of the genus *Cochlis* Röding, 1798. We regard *depressofuniculata* as a distinct species, readily distinguished from the others herein included in *Cochlis* primarily on the basis of the operculum with ridges and outer groove lying on a distinctly elevated shelf (Tab. 10).

Stratigraphic occurrence. *C. depressofuniculata* (Sacco) is restricted to Pliocene deposits of Piedmont, Liguria, Emilia and Tuscany. It seems to occur more abundantly in the Middle Pliocene.

Cochlis fulgurata (Meneghini in Pecchioli, 1864) comb. nov.

Pl. 1, figs 9-18; Pl. 2, figs 1-5; Pl. 7, fig. 2; Pl. 8, figs 4-9; Pl. 9, figs 4-7; Pl. 10, figs 4-6, C

1864 *Natica fulgurata* - Pecchioli, p. 517, pl. 5, figs 21-24.

1890 *Natica (Natica) millepunctata* var. *tigrina* subv. *umbilicosa* Sacco, p. 28 (nomen nudum).

1890 *Natica (Natica) millepunctata* var. *tigrina* subv. *depressispira* Sacco, p. 28 (nomen nudum).

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

1890 *Natica (Natica) millepunctata* var. *undata* - Sacco, p. 28 (not Sasso, 1827).

1890 *Natica (Natica) millepunctata* var. *undata* subv. *pseudocollaria* Sacco, p. 28 (nomen nudum).

1891 *Natica millepunctata* var. *umbilicosa* Sacco, p. 52, pl. 2, fig. 19.

1891 *Natica millepunctata* var. *depressispira* Sacco, p. 52, pl. 2, fig. 14.

1891 *Natica millepunctata* var. *fulguropunctata* - Sacco, p. 54, pl. 2, fig. 19.

1891 *Natica millepunctata* var. *undata* - Sacco, p. 54 (not Sasso, 1827).

1891 *Natica millepunctata* var. *pseudocollaria* Sacco, p. 55, pl. 2, fig. 20.

1974 *Natica* (*Natica*) *fulgurata* - Malatesta, p. 235, pl. 19, fig. 1.

1975 *Naticarius (Naticarius) tigrinus* - Pavia, p. 138 (pars), pl. 5, fig. 11 (not Defrance, 1825).

1984 *Natica millepunctata* var. *umbilicosa* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica millepunctata* var. *depressispira* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica millepunctata* var. *fulgaropunctata* – Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica millepunctata* var. *pseudocollaria* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

1996 *Natica* (*Naticarius*) *fulgurata* - Pedriali, p. 6.

1997 *Natica (Natica) fulgurata* - Lacroce, p. 25, pl. 2, fig. 4.

2000 *Natica (Natica) fulgurata* - Lacroce, p. 32.

Uncertain references

Natica fulgurata - Foresti, 1868: p. 72, n. 168; - Foresti, 1874: p. 81, n. 183; - Seguenza, 1876: p. 10, n. 478; - De Stefani & Pantanelli, 1878/80: p. 22, 209; - De Stefani, 1888: p. 221.

Natica (Natica) millepunctata var. *fulgurata* - Sacco, 1890: tab. B.

Natica millepunctata var. *fulguropunctata* - Hornung, 1920: p. 86.

Type material. Meneghini's original material (presumably stored in Museo di Storia Naturale, Centro Interdipartimentale, Università di Pisa, Certosa di Calci) is presently unavailable.

Other type material. The lectotype of *Natica (Natica) millepunctata* var. *depressispira* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 14), MGPT BS.029.01.019 (Colli Astesi). The lectotype of *Natica (Natica) millepunctata* var. *fulguropunctata* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 19) and refigured herein (Pl. 1, fig. 15; Pl. 2, fig. 3), MGPT BS.029.01.024 (Colli Astesi). The lectotype of *Natica millepunctata* var. *pseudocollaria* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 20) and refigured herein (Pl. 1, fig. 17; Pl. 2, fig. 4), MGPT BS.029.01.025 (Colli Astesi); 3 paralectotypes, MGPT BS.029.01.025/01 (Rocca d'Arazzo). The lectotype of *Natica millepunctata* var. *umbilicosa* Sacco (designated herein and figured in Pl. 1, fig. 14) and 1 paralectotype, both labeled MGPT BS.029.01.018 (Colli Astesi).

Other material examined. Siena: 1 spm. (MSNF IGF8304E); Rocca d'Arazzo: the shell (previously unfigured) referred to as *Natica millepunctata* var. *undata* Sassi (sic) by Sacco (1890), MGPT BS.029.01.024 bis; Rio del Mulino di Serralunga: 6 spms. (NP 1981-1986), 1 spm. (MPUM 8787), 5 spms. (MPUM 8798); Villalvernia: 2 spms. (NP 1998-1999); Badagnano: 2 spms. (MPUM 8795); Balzo del Musico: 1 spm. (NP 1889); Diolo: 1 spm. (NP 1929); Montezago: 8 spms. (NP 1971-1978), 2 spms. (MPUM 8793); Rio Rosello: 4 spms. (NP 1987-1990), 14 spms. (PPMM 48216-48229), 1 spm. (MPUM 8786); San Lorenzo in Collina: 5 spms. (NP 1991-1995), 1 spm. (MPUM 8799); Balze di Caspreno: 3 spms. (NP 1880-1882); Barca: 6 spms. (NP 1890-1895); Bibbiano: 15 spms. (NP 1896-1910), 1 spm. (PPMM 48237), 1 spm. (MPUM 8790), 1 spm. (MPUM 8784), 1 spm. (MPUM 8791), 2 spms. (MPUM 8796), 1 spm. (MGC 667); Calanchi di San Martino: 1 spm. (NP 1911), 1 spm. (PPMM 48230), 1 spm. (MPUM 8783), 2 spm. (MPUM 8801);

Calanco di Casale: 1 spm. (NP 1912); Ciuciano: 2 spms. (NP 1915-1916), 1 spm. (private collection); Corazzano: 12 spms. (NP 1917-1928), 2 spms. (MPUM 8788-8789); Guistrigona: 1 spm. (NP 1930); Il Campino: 13 spms. (NP 1931-1943), 1 spm. (MPUM 8785), 1 spm. (MPUM 8792), 2 spms. (MPUM 8794); Il Treppié: 5 spms. (NP 1884-1888); La Serra: 4 spms. (NP 1944-1947); Linari: 13 spms. (NP 1948-1960); Marcialla: 9 spms. (NP 1961-1969), 6 spms. (PPMM 48231-46236), 1 spm. (private collection), 11 spms. (MPUM 8800); Montaione: 1 spm. (NP 1970); Podere Cavallara: 2 spms. (NP 1979-1980); Ulignano: 2 spms. (NP 1996-1997), 1 spm. (MPUM 8797).

Characters

Protoconch: small, depressed turbiniform of 1.25 slightly convex, smooth whorls, tip small.

Shell: depressed globose, rather solid.

Spire: low-conical, rather depressed, somewhat stepped, whorls convex.

Suture: more or less deeply channeled.

Body whorl: inflated, depressed, produced and expanded toward the aperture, flatly convex adapical to the periphery and with an obtuse angulation bounding the nearly horizontal subsutural shelf; a sharper angulation encircles the sutural channel.

Aperture: D-shaped, height averaging 1.5 times the width.

Parietal callus: thick, short and broad, ending some distance from the basal fasciole; anterior lobe indistinct.

Umbilicus: wide.

Funicle: thin with angular top, sometimes a thin to medium cord, separated from the basal fasciole by a wide furrow.

Umbilical callus: small to medium-sized, rather thin, triangular or sharply rounded in outline, located at the abapical one-third of the inner lip and separated from the parietal callus by a wide, shallow, reverse J-shaped notch.

Basal fasciole: moderately wide, bluntly rounded, defined abaxially by a low, obtuse angulation.

Surface: with dense, very fine, gently prosocline growth lines, triflingly stronger toward the suture and on the basal fasciole.

Color: background pale yellowish brown with a reddish pattern, which may consist of

- usually crowded, small and even dots often arranged in collabral rows;
- zigzag axial lines or stripes;
- uneven, variously sized dots and spots arranged in irregular collabral rows;
- spots replaced by chevron markings during growth.

Operculum:

- usually thick, solid;
- central callus distinct, elongate, tongue-shaped;
- inner margin slightly arched, smooth;
- inner surface nearly flat, nucleus not protruding;
- outer surface slightly convex, with 2 well defined marginal grooves and 2 ridges;
- outer groove broad and shallow, regularly arched in cross section;
- inner groove attenuated, as wide as one-third to one-fourth of the outer one;
- outer ridge sharp;
- inner ridge rather strong, flat-topped.

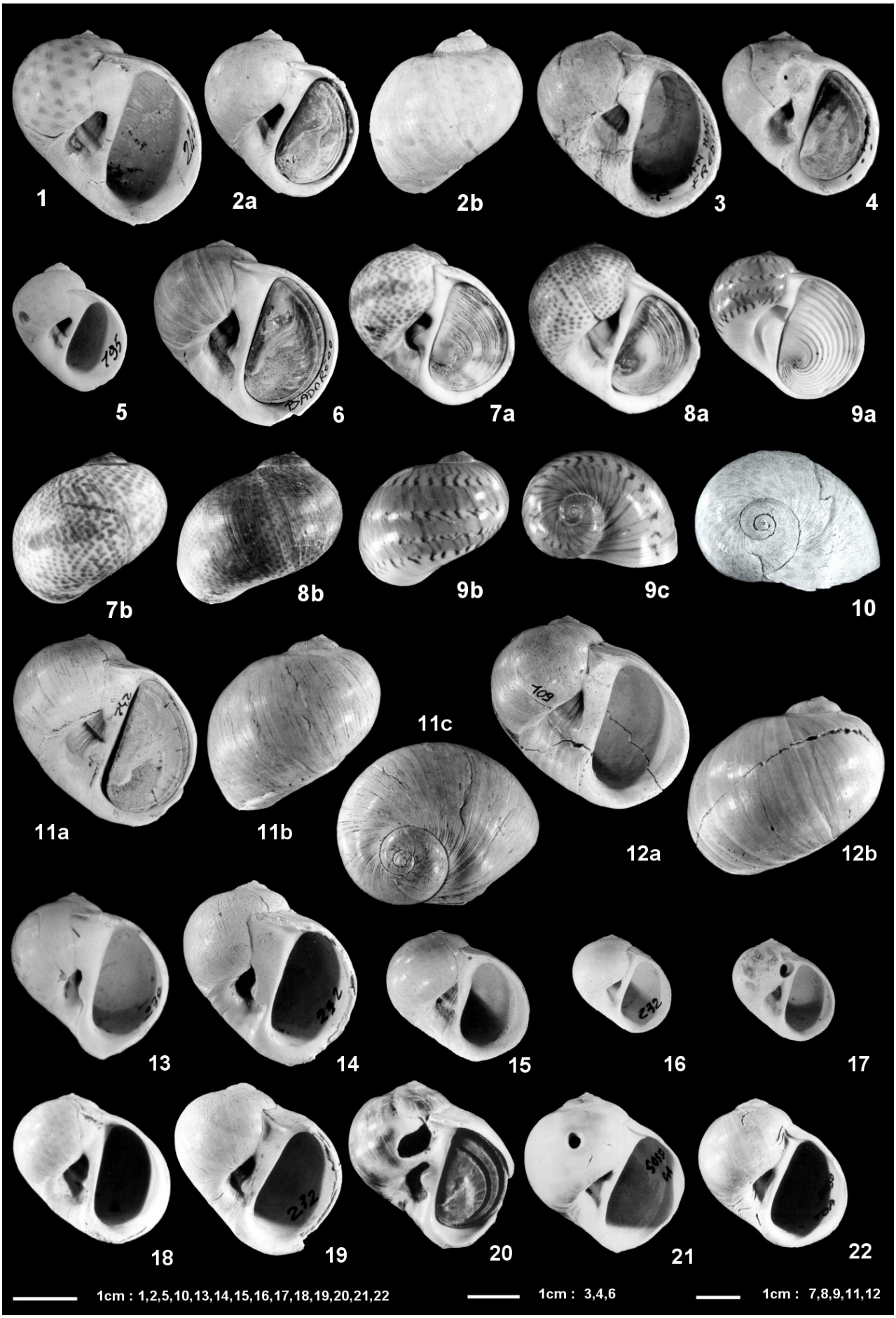
Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.177-0.182	0.533-0.560	12.69-32.17	12.59-33.03	1.78-7.62	10.47-24.99	6.41-17.53
0.180	0.547	22.43	22.81	4.70	17.73	11.97
UW	WUC	WAD	WAB	IS	SA	
3.71-14.03	0.79-3.95	1.50-7.14	0.32-4.04	15°-35°	110°-146°	
8.87	2.37	4.32	2.18	25°	128°	

Remarks. The present species was first published by Pecchioli (1864) who used for it Meneghini's manu-

PLATE 4

Fig. 1 - *Cochlis raropunctata* (Sasso, 1827). Rio Rosello. MPUM 8898; apertural side.
Fig. 2 - *Cochlis raropunctata* (Sasso, 1827). Bibbiano. MPUM 8899; a) apertural side, b) abapertural side.
Fig. 3 - *Cochlis raropunctata* (Sasso, 1827). Calanchi di San Martino. MPUM 8900; apertural side.
Fig. 4 - *Cochlis raropunctata* (Sasso, 1827). Calanchi di San Martino. MPUM 8901; apertural side.
Fig. 5 - *Cochlis raropunctata* (Sasso, 1827). Linari. MPUM 8902; apertural side.
Fig. 6 - *Cochlis raropunctata* (Sasso, 1827). Guistrigona. MPUM 8903; apertural side.
Fig. 7 - *Nerita hebraea* Martyn, 1784. Adriatic Sea. MPUM 8949; a) apertural side, b) abapertural side.
Fig. 8 - *Nerita stercusmuscarum* Gmelin, 1791. Adriatic Sea. MPUM 8950; a) apertural side, b) abapertural side.
Fig. 9 - *Nerita canrena* Linneo, 1758. Gurarapari Channel, Espirito Santo, Brasil. MPUM 8951; a) apertural side, b) abapertural side, c) top view.
Fig. 10 - *Cochlis raropunctata* (Sasso, 1827). Colli Astesi; top view of specimen in Pl. 3, fig. 13.
Fig. 11 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Holotype, MPUM 8953; a) apertural side, b) abapertural side, c) top view.
Fig. 12 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8954; a) apertural side, b) abapertural side.
Fig. 13 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8955; apertural side.
Fig. 14 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8956; apertural side.
Fig. 15 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8957; apertural side.
Fig. 16 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8958; apertural side.
Fig. 17 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8959; apertural side.
Fig. 18 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8960; apertural side.
Fig. 19 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8961; apertural side.
Fig. 20 - *Cochlis strictiumbilicata* (Sacco, 1891). Caranchi. MPUM 8968; apertural side.
Fig. 21 - *Cochlis strictiumbilicata* (Sacco, 1891). Caranchi. MPUM 8969; apertural side.
Fig. 22 - *Cochlis strictiumbilicata* (Sacco, 1891). Rio Torsero. MPUM 8970; apertural side.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7a
8a
9a
7b
8b
9b
9c
10
11a
11b
11c
12a
12b
13
14
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16
17
18
19
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21
22
1cm : 1,2,5,10,13,14,15,16,17,18,19,20,21,22
1cm : 3,4,6
1cm : 7,8,9,11,12

script name *fulgurata*. Pecchioli explicitly stated (see footnote on p. 517) that the taxon had been named *Natica fulgurata* by Meneghini and published verbatim the original description provided to him by this latter. This demonstrates the availability of the name *fulgurata* and Meneghini's authorship of it (I.C.Z.N., fourth Ed. 1999, Art. 50). From Pecchioli's text, it appears that the name *pecchiolii* Hörnes, 1858 is a junior synonym.

Cochlis fulgurata was originally regarded to be characterized by the color pattern of reddish zigzag axial stripes. Actually, it is featured by 1) protoconch measurements (Tab. 1-3), 2) channeled suture, 3) wide umbilicus, 4) funicle usually thin, angular in cross section and 5) fully distinctive operculum (Tab. 10). The channeled suture is the principal and easiest criterion for recognition of *Cochlis fulgurata* and distinguishes it from the other *Cochlis* species treated in this study that have adpressed sutures.

Sacco (1891) shortly described his varieties *umbilicosa*, *depressispira*, *fulguropunctata* and *pseudocollaria* of *Natica millepunctata* Lamarck, 1822; he also regarded as a variety of that species a single shell referred to as *undata* Sasso, 1827. We have examined the respective specimens in MGPT and can state that they exhibit channeled suture, wide umbilicus with thin angular funicle and color patterns which are distinguishing characters of *Cochlis fulgurata*. Accordingly, we include the cited varieties in the synonymy of the present species. It is notable that Sacco (1891), dealing with the var. *umbilicosa*, did not provide the figure of it, but actually made reference to the figure of var. *fulguropunctata* (Pl. 2, fig. 19) and wrote: Pl. 2, fig. 19, "excepta superficiei coloratione", i.e. except for color pattern.

Subsequent to its creation, *Cochlis fulgurata* was figured only by Malatesta (1974) and Lacroce (1997) and rarely cited, likely because specimens with color pattern other than the most typical one (zig zag collabral stripes) have been mistaken for the more commonly recorded *Naticarius tigrinus* auctorum (not *Natica tigrina* Defrance, 1825; see discussion of *Cochlis raropunctata* Sasso, 1827). The operculum is illustrated herein for the first time.

Stratigraphic occurrence. *C. fulgurata* (Meneghini in Pecchioli) occurs in Pliocene deposits of Piedmont, Emilia, Tuscany and Umbria regions, being more common in the Middle Pliocene.

Cochlis plicatula (Bronn, 1831) comb. nov.

Pl. 2, figs 6-11; Pl. 7, fig. 3; Pl. 8, figs 10, 11; Pl. 9, fig. 8; Pl. 10, fig. 7, D.

1831 *Natica plicatula* Bronn, p. 72.

1848 *Natica plicatula* - Bronn, p. 786.

1890 *Natica (Natica) (Cochlis) dillwyni* var. *plicatula* - Sacco, p. 29.

1891 *Natica* (*Natica*) *epiglottina* var. *umbilicina* Sacco, p. 60.

1891 *Natica (Natica) (Cochlis) dillwyni* var. *plicatula* - Sacco, p. 62, pl. 2, fig. 36.

1904 *Natica* (*Natica*) *epiglottina* var. *umbilicina* - Sacco, p. 102, pl. 22, fig. 24.

1949 *Natica pseudoepiglottina* - Ruggieri, p. 80 (pars), pl. 1, fig. 5 (not Sacco, 1890).

1976 *Naticarius (Naticarius) dillwyni plicatulus* – Pavia, p. 138, pl. 5, figs 6, 7, 9, 13, 15-17.

1980 *Naticarius dillwyni plicatulus* - Pavia, p. 247, pl. 1, fig. 3; pl. 2, fig. 3; pl. 3, figs 2, 3; pl. 5, figs 10-14; text-figs 4, 5.

1984 *Natica epiglottina* var. *umbilicina* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

1984 *Natica dillwyni* var. *plicatula* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 31.

1992 *Natica* (*Naticarius*) *dillwyni* - Cavallo & Repetto, text-fig. 122 (not Payraudeau, 1826).

1996 *Natica* (*Naticarius*) *dillwyni* plicatula - Pedriali, p. 6, pl. 2, figs 7-8 (not Payraudeau, 1826).

1997 *Natica* (*Natica*) *dillwynii* - Lacroce, p. 23, pl. 2, fig. 1 (not Payraudeau, 1826).

Uncertain references

Natica dillwynii - Philippi, 1844: p. 141, 266, 269, 270; - Seguenza, 1876: p. 12; - Almera & Bofill, 1898: p. 51, 181; - Cerulli-Irelli, 1914: p. 215, pl. 19, figs 18-19; - Ruggieri, 1949: p. 80; - Fekih, 1975: p. 61, 152, pl. 22, fig. 6; - Repetto, 1997: p. 60; - Bogi & Cauli, 1998: p. 131, 134; - Lacroce & Repetto, 1998: p. 148.

Natica (Natica) dillwynii - Tabanelli & Segurini, 1994: p. 9.

Natica (Naticarius) dillwyni - Mancini, 1997: p. 41.

Naticarius (Naticarius) dillwyni - Montefameglio, 1984: p. 276; - Caretto, 1985: p. 109; - Caretto, 1986: p. 42, 50, 53.

Natica (Natica) dillwyni plicatula - Ferrero & Merlino, 1992: p. 129, 132; - Ferrero, Merlino & Provera, 1998: p. 48.

Naticarius (Naticarius) dillwyni plicatulus – Montefameglio, Pavia & Rosa, 1980: p. 177, 178, 189, 195; - Aimone & Ferrero Mortara, 1983: p. 284, 295, 309; - Tropeano, Arduino, Bosso & Fornaio, 1984: p. 58.

Natica plicatula - Sismonda, 1847: p. 51; - D'Orbigny, 1852: p. 168; - Cocconi, 1873: p. 527; - Coppi, 1881: p. 62.

Naticarius (Naticarius) plicatulus - Bernasconi, 1989: p. 58, 63, 72.

Type material. Not seen (location unknown).

Material examined. Colli Astesi: the shell figured by Sacco (1891, pl. 2, fig. 36, MGPT BS.029.01.043), 8 spms. (MGPT BS.029.01.043/09); Masserano: 13 spms. (MGPT BS.029.01.043/06); Rocca d'Arazzo: 2 spms. (MGPT BS.029.01.043/07); Vezza d'Alba: 1 spm. (MGPT BS.029.01.043/08); Albenga: 3 spms. (MGPT BS.029.01.043/05); Zinola: 7 spms. (MGPT BS.029.01.043/03); Savona: 12 spms. (MGPT BS.029.01.043/02); Casa Bosco: 1 spm. (NP 2016); Cossato: 7 spms. (NP 2022-2028); Passerano: 2 spms. (NP 2052-2053); Rio del Mulino di Serralunga: 3 spms. (NP 2058-2060), 3 spms. (MPUM 8817); Volpedo: 2 spms. (NP 2090-2091); Rio Torsero: 2 spms. (MPUM 8810); Bacedasco: 1 spm. (MPUM 8812); Badagnano: 2 spms. (PPMM 46756-46757), 1 spm. (MPUM 8820); Balzo del Musico: 7 spms. (NP 2001-2007), 2 spms. (MPUM 8813); Castell'Arquato: 2 spms. (NP 2017-2018), 1 spm. (MPUM 8822); Diolo: 2 spms. (NP 2029-2030); La Valle: 4 spms. (NP 2032-2035), 1 spm. (MPUM 8808); Montemaggiore: 1 spm. (MPUM 8815); Montezago: 16 spms. (NP 2036-2051), 1 spm. (MPUM 8806), 5 spms. (MPUM 8807), 1 spm. (MGC 668); Pradalbino I: 2 spms. (NP 2055-2056), 2 spms. (MPUM 8816); Pradalbino II: 1 spm. (NP 2057); Rio Rosello: 6 spms. (NP 2061-2066), 32 spms. (PPMM 46722-46753), 1 spm. (MPUM 8821); San Lorenzo in Collina: 21 spms. (NP 2069-2089), 1 spm. (MPUM 8809), 20 spms. (MPUM 8811), 14 spms. (MPUM 8818), 2 spms. (MGC 669-670); Torrente Samoggia: 1 spm. (MPUM 8819); Balze di Caspreno: 1 spm. (NP 2000); Barca: 7 spms. (NP 2008-2014), 2 spms. (PPMM 46754-46755), 2 spms. (MPUM 8804-8805); Bibbiano: 1 spm. (NP 2015); Calanchi di San Martino: 1 spm. (PPMM 46758); Ciuciano: 2 spms. (NP 2019-2020), 1 spm. (MPUM

8802), 1 spm. (MPUM 8803); Corazzano: 1 spm. (NP 2021); Il Campino: 1 spm. (NP 2031); Linari: 1 spm. (MPUM 8814), 1 spm. (MPUM 8823); Podere Cavallara: 1 spm. (NP 2054).

Characters

Protoconch: medium-sized, depressed turbiniform of 3-3.5 convex, smooth whorls, tip very small to small.

Shell: depressed globose, rather thin.

Spire: conical, moderately elevated, whorls convex.

Suture: linear, adpressed.

Body whorl: inflated, somewhat depressed, moderately extended and slightly expanded toward the aperture, with poorly defined subsutural shelf.

Aperture: D-shaped, height averaging 1.5 times the width.

Parietal callus: quadrangular, rather wide and thin, nearly reaching the basal fasciole; anterior lobe indistinct.

Umbilicus: moderately wide, more or less widely filled by the funicle.

Funicle: broad, more or less prominent, separated from the basal fasciole by a narrow to very narrow furrow.

Umbilical callus: medium to large, rather thick, usually prominent, roundly triangular and markedly asymmetric in outline, with adapical side decidedly shorter than the abapical one, located at the mid-abapical part of the columellar lip and separated from the parietal callus by a rather short and shallow, reverse J-shaped notch; the open space between the umbilical callus and the umbilical periphery is narrow on the whole, comma-shaped, wider adapically and gradually narrowing abapically.

Basal fasciole: nearly indistinct.

Surface: with prosocline growth lines that are slightly bent and change into wrinkles subsuturally.

Color: background light gray with a reddish brown pattern of 4 spiral rows of squarish or chevron spots.

Operculum:

- rather thin, broad;
- central callus tongue-shaped, moderately wide, bending toward the inner margin;
- inner margin thin, bluntly rounded, smooth or with obsolescent transverse wrinkles, following a subangular course;
- inner surface nearly flat, with weak depression parallel to the outer margin, nucleus triflingly protruding;
- outer surface slightly concave, with 2 marginal ridges separated by a groove;
- groove rather deep, asymmetric in cross-section, with sloping outer side and vertical inner one or viceversa;
- outer ridge robust and rather sharp, as strong as the inner ridge or slightly thinner, more or less sloping inward;
- inner ridge strong, flat-topped, vertical or sloping inward.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.093-0.118	1.159-1.414	4.77-28.01	5.54-26.54	0.00-8.09	4.93-20.17	2.68-14.76
0.100	1.226	16.39	16.04	3.83	12.55	8.72
UW	WUC	WAD	WAB	IS	SA	
1.86-9.10	0.99-5.55	0.13-2.81	0.00-1.62	14°-42°	106°-138°	
5.48	3.27	1.47	0.74	28°	122°	

Remarks. *Cochlis plicatula* is readily distinguished (Tab. 16) on the basis of 1) protoconch dimensions, 2) characters of the umbilical callus, 3) presence of collabral sculpture, 4) color pattern and 5) opercular features.

The present species was either referred to as *Natica dillwyni* Payraudeau, 1826, or regarded as a subspecies of this latter taxon. Actually, the Recent Mediterranean *Natica dillwyini* (Pl. 2, fig. 13; Pl. 7, fig. 5; Pl. 8, fig. 13) differs markedly in that has smaller protoconch (Tab. 2) with smaller diameter of the first half whorl (Tab. 3) and the operculum with single, broad marginal rib bearing a faint median groove (Pl. 10, fig. 9). Among Recent species, the Atlantic *Natica canariensis* Odhner, 1931 appears to be more closely related in terms of teleoconch characters, color pattern and opercular features (Pl. 2, fig. 12; Pl. 8, fig. 12; Pl. 10, fig. 8), but has

PLATE 5

Fig. 1 - *Cochlis strictiumbilicata* (Sacco, 1891). Badagnano. MPUM 8971; a) apertural side, b) abapertural side.

Fig. 2 - *Cochlis strictiumbilicata* (Sacco, 1891). Caranchi; abapertural side of specimen in Pl. 4, fig. 20.

Fig. 3 - *Cochlis strictiumbilicata* (Sacco, 1891). Rio Torsero; abapertural side of specimen in Pl. 4, fig. 22.

Fig. 4 - *Cochlis strictiumbilicata* (Sacco, 1891). Caranchi; top view of specimen in Pl. 4, fig. 21.

Fig. 5 - *Cochlis sulcogradata* sp. n. Montaione. Holotype, MPUM 8975; a) apertural side, b) abapertural side.

Fig. 6 - *Cochlis sulcogradata* sp. n. Montaione. Paratype, MPUM 8976; a) apertural side, b) abapertural side.

Fig. 7 - *Cochlis sulcogradata* sp. n. Bibbiano. Paratype, MPUM 8977; apertural side.

Fig. 8 - *Cochlis sulcogradata* sp. n. Torrente Stirone. Paratype, private collection; a) apertural side, b) abapertural side.

Fig. 9 - *Cochlis undata* (Sasso, 1827). Rio Torsero. Topotype, MPUM 8983; a) apertural side, b) abapertural side, c) top view.

Fig. 10 - *Cochlis undata* (Sasso, 1827). La Valle. MPUM 8984; apertural side.

Fig. 11 - *Cochlis undata* (Sasso, 1827). Barca. MPUM 8985; apertural side.

Fig. 12 - *Cochlis undata* (Sasso, 1827). Lectotype of *Natica (Natica) millepunctata* var. *epiglottinoformis* Sacco, 1890. Savona. MGPT BS.029.01.026; a) apertural side, b) abapertural side, c) top view.

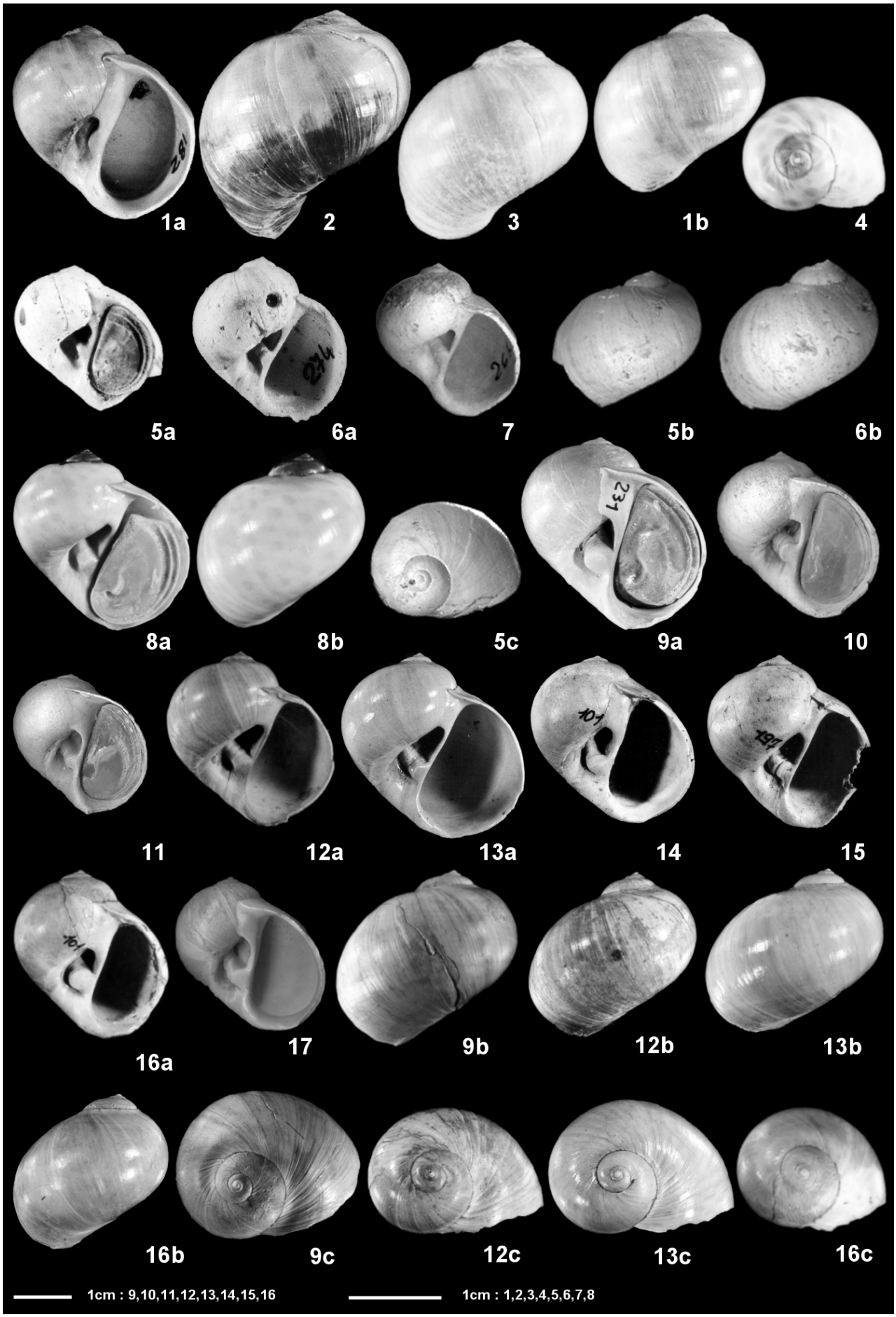
Fig. 13 - *Cochlis undata* (Sasso, 1827). Rio Torsero. Topotype, MPUM 8986; a) apertural side, b) abapertural side, c) top view.

Fig. 14 - *Cochlis undata* (Sasso, 1827). San Lorenzo in Collina. MPUM 8987; apertural side.

Fig. 15 - *Cochlis undata* (Sasso, 1827). San Lorenzo in Collina. MPUM 8988; apertural side.

Fig. 16 - *Cochlis undata* (Sasso, 1827). San Lorenzo in Collina. MPUM 8989; a) apertural side, b) abapertural side, c) top view.

Fig. 17 - *Cochlis undata* (Sasso, 1827). Rio del Mulino di Serralunga. MPUM 8990; apertural side.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13c
16c
1cm : 9,10,11,12,13,14,15,16
1cm : 1,2,3,4,5,6,7,8

significantly larger protoconch with larger nucleous (Pl. 7, fig. 4; text-fig. 3, 4). The Indo-Pacific *Natica gualteriana* Récluz, 1844 and the Atlantic-Mediterranean *Nerita marochiensis* Gmelin, 1791 are superficially similar, but have the protoconch significantly smaller (Tab. 2; Pl. 7, fig. 21, 22). On the basis of the opercular features, they are referable to the genus *Notocochlis* Powell, 1933 (cf. Majima, 1989).

Stratigraphic occurrence. *C. plicatula* (Bronn, 1831) occurs in Tortonian units of Italy, Morocco and Paratethys. It is widespread in the Pliocene deposits of the Mediterranean area, being less common in the Late Pliocene.

Cochlis propinqua (Pecchioli, 1864) comb. nov.

Pl. 2, figs 14-18; Pl. 7, fig. 6; Pl. 8, figs 14, 15; Pl. 9, fig. 9; Pl. 10, figs 10-12, E, F.

1864 *Natica propinqua* Pecchioli, p. 521, pl. 5, figs 25, 26.
1988 *Natica propinqua* - Chirli, p. 18, pl. 5, fig. 4.
1996 *Natica* (*Naticarius*) *propinqua* - Pedriali, p. 6, pl. 2, figs 3, 4.
1997 *Natica (Natica) propinqua* - Lacroce, p. 33.
2000 *Natica (Natica) propinqua* - Lacroce, p. 32.

Uncertain references

Natica propinqua - Foresti, 1868: p. 72; - Foresti, 1874: p. 81; - Seguenza, 1876: p. 10; - Pantanelli, 1876: p. 5.

Natica lineata - Pantanelli, 1877: p. 226, 232, 233; - De Stefani & Pantanelli, 1878: p. 140; - Pantanelli, 1884: p. 24; - De Stefani, 1888: p. 221.

Natica (*Natica*) *millepunctata* var. *propinqua* - Sacco, 1890: tab. B; - Sacco, 1891: p. 51, 54, 55.

Type material. The lectotype of *Natica propinqua* Pecchioli (here designated): the shell figured by Pecchioli (1864, pl. 5, fig. 25, 26) and refigured herein (Pl. 2, fig. 14), PE/MSNF IGF8305E (Siena); 3 paralectotypes also labeled IGF8305E (Siena).

Other material examined. Pino d'Asti: 1 spm. (NP 2397); Rio del Mulino di Serralunga: 60 spms. (NP 2399-2458), 14 spms. (PPMM 48254-48267), 1 spm. (MPUM 8837), 1 spm. (MPUM 8840), 38 spms. (MPUM 8843); Villalvernia: 9 spms. (PPMM 48243-48251); Diolo: 3 spms. (NP 2099-2101); Montemaggiore: 1 spm. (NP 2123); Montezago: 273 spms. (NP 2124-2396), 1 spm. (MPUM 8831), 1 spm. (MPUM 8838), 104 spms. (MPUM 8832), 1 spm. (MGC 671); Rio Rosello: 4 spms. (NP 2459-2462); San Lorenzo in Collina: 1 spm. (FO/MC 900, sub *Natica fulgurata* Meneghini); 17 spms. (NP 2463-2479), 28 spms. (MPUM 8845); Balze di Caspreno: 7 spms. (NP 2092-2098), 1 spm. (MPUM 8841), 27 spms. (MPUM 8842); Barca: 33 spms. (NP 2480-2512), 2 spms. (PPMM 48241-48242), 1 spm. (MPUM 8833), 1 spm. (MPUM 8834), 9 spms. (MPUM 8835), 1 spm. (MPUM 8836), 1 spm. (MPUM 8839); Casa Cuccule: 1 spm. (NP 2104); Guistrigona: 2 spms. (NP 2102-2103), 2 spms. (MPUM 8844); Linari: 18 spms. (NP 2105-2122), 2 spms. (PPMM 48252-48253), 1 spm. (MPUM 8829), 4 spms. (MPUM 8830); Podere Cavallara: 1 spm. (NP 2398).

Characters

Protoconch: small, depressed turbiniform of 1.25 moderately convex, smooth whorls, tip large.

Shell: globose, moderately depressed, rather thin to thick.

Spire: low-conical, moderately depressed, whorls gently convex.

Suture: linear, adpressed.

Body whorl: inflated, somewhat depressed, produced and moderately expanded toward the aperture, with poorly defined subsutural shelf.

Aperture: D-shaped, height averaging 1.5 times the width.

Parietal callus: rather thick, subquadrangular, never reaching the basal fasciole; anterior lobe indistinct.

Umbilicus: wide.

Funicle: a more or less thin cord, separated from the basal fasciole by a wide, shallow furrow.

Umbilical callus: small and rather thin, forming a slight swelling at the abapical one-third of the inner lip, separated from the parietal callus by a wide, shallow reverse J-shaped notch.

Basal fasciole: moderately wide, bounded abaxially by a rounded step.

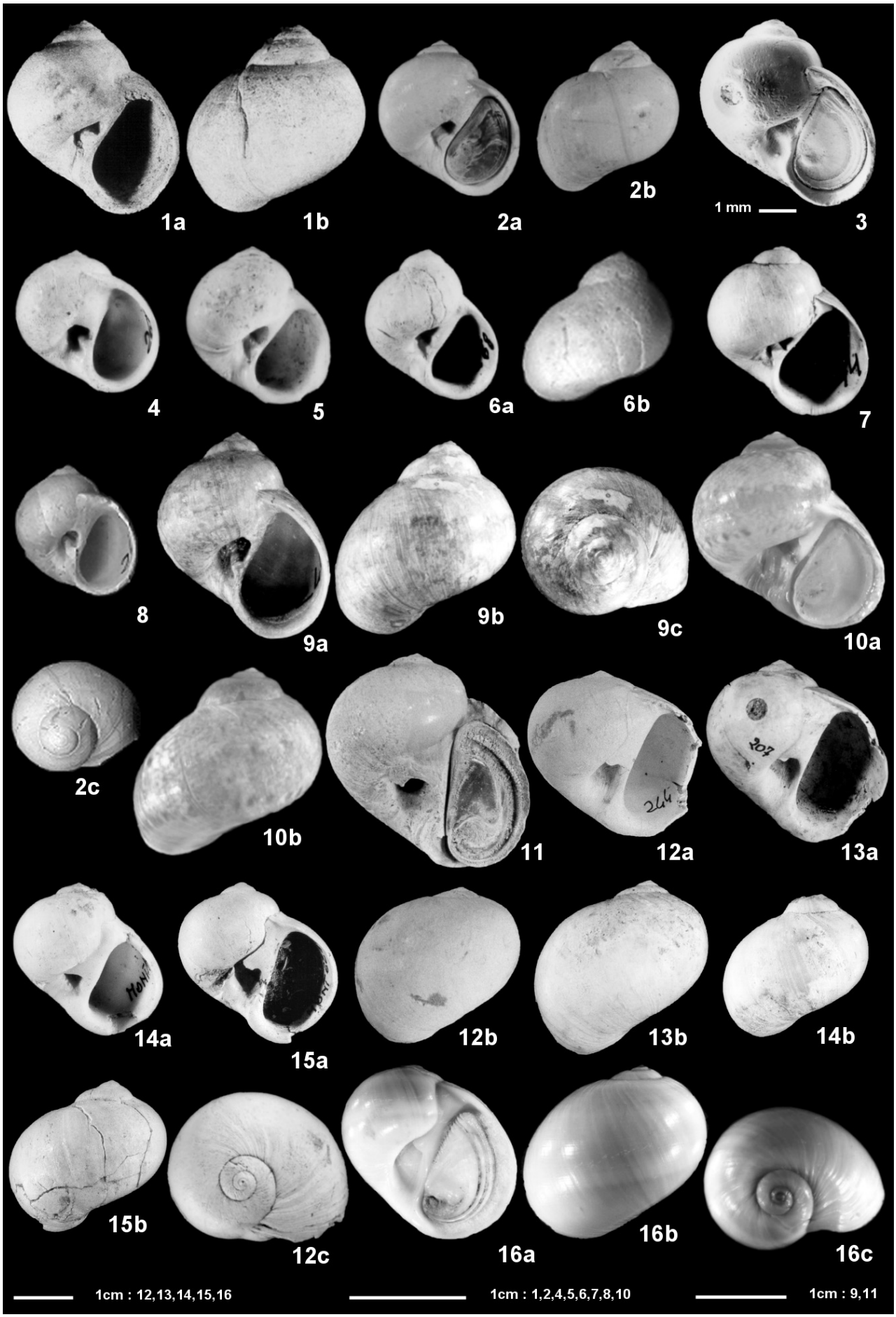
Surface: with dense and fine, gently prosocline growth lines, slightly stronger on subsutural shelf and basal fasciole; a faint spiral striation is noted on the body whorl.

Color: background light-brown with reddish pattern, which may consist of

- dense, undulating, collabral lines or stripes occasionally interrupted;

PLATE 6

Fig. 1 - *Cochlis vittata* (Gmelin, 1791). Lectotype of *Natica pantanelli* De Stefani, 1889. Castagno (Siena). DS/MSNF IGF8590E; a) apertural side, b) abapertural side.
Fig. 2 - *Cochlis vittata* (Gmelin, 1791). La Catena. MPUM 9007; a) apertural side, b) abapertural side.
Fig. 3 - *Cochlis vittata* (Gmelin, 1791). Il Campino. MPUM 9008; apertural side.
Fig. 4 - *Cochlis vittata* (Gmelin, 1791). Montaione. MPUM 9009; apertural side.
Fig. 5 - *Cochlis vittata* (Gmelin, 1791). Montaione. MPUM 9010; apertural side.
Fig. 6 - *Cochlis vittata* (Gmelin, 1791). Montaione. MPUM 9011; a) apertural side, b) abapertural side.
Fig. 7 - *Cochlis vittata* (Gmelin, 1791). Il Treppié. MPUM 9012; apertural side.
Fig. 8 - *Cochlis vittata* (Gmelin, 1791). Il Treppié. MPUM 9013; apertural side.
Fig. 9 - *Cochlis vittata* (Gmelin, 1791). Il Treppié. MPUM 9014; a) apertural side, b) abapertural side, c) top view.
Fig. 10 - *Cochlis vittata* (Gmelin, 1791). Fuengirola, Spain (Recent). MPUM 9015; a) apertural side, b) abapertural side.
Fig. 11 - *Natica virguloides* Sacco, 1890. Montaione. MPUM 8748; apertural side.
Fig. 12 - *Natica virguloides* Sacco,1890. Il Treppié. MPUM 8745; a) apertural side, b) abapertural side, c) top view.
Fig. 13 - *Natica virguloides* Sacco,1890. Il Campino. MPUM 8744; a) apertural side, b) abapertural side.
Fig. 14 - *Natica virguloides* Sacco,1890. Montaione. MPUM 8747; a) apertural side, b) abapertural side.
Fig. 15 - *Natica virguloides* Sacco,1890. Montezago. MPUM 8751; a) apertural side, b) abapertural side.
Fig. 16 - *Nerita vitellus* Linnaeus, 1758. India. MPUM 8825; a) apertural side, b) abapertural side, c) top view.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14b
15b
12c
16a
16b
16c
1cm : 12,13,14,15,16
1cm : 1,2,4,5,6,7,8,10
1cm : 9,11

• spots may replace lines in later growth stages (rare occurrence).

Operculum:

• very thick and solid;

• central callus moderately long, wide, tongue-shaped;

• inner margin straight, with blunt granules, sometimes missing;

• inner surface nearly flat, nucleus scarcely prominent;

• outer surface planar, with 2 marginal furrows and 2 ridges; marginal area bearing outer groove and ridge sloping outward;

• outer groove moderately excavated, asymmetrically angular in cross section;

• inner groove similar to the outer one but narrower and shallower, markedly attenuated or obsolete in larger specimens;

• outer ridge sharp;

• inner ridge more or less raised, sharply or roundly edged, distinctly reclinate toward the inner groove.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.420-0.439	0.640-0.643	11.98-33.30	11.88-32.20	1.48-7.48	10.18-26.14	6.07-17.51
0.430	0.642	22.64	22.04	4.48	18.16	11.79
UW	WUC	WAD	WAB	IS	SA	
3.32-14.36	0.68-3.60	0.06-9.02	0.22-2.90	18°-42°	111°-139°	
8.84	2.14	4.54	1.56	30°	125°	

Remarks. Pecchioli (1864) based the new species *propinqua* on material recovered from the "Argille plioceniche senesi" (Pliocene clay of Siena area). He regarded the color pattern as the main distinguishing character. Actually, *Cochlis propinqua* is morphologically similar to the other *Cochlis* species treated herein and shares the color design (Tab. 9, pattern 8) with *Cochlis undata* (Sasso, 1827). The unique operculum, with outer groove and ridge lying onto a sloping outward marginal area, stands as the sole diagnostic element (Tabs. 10, 16).

Natica lineata Lamarck, 1822 (= *Natica lineata* Röding, 1798), with which the present species has been compared or confused in the past, is a Recent Indo-West Pacific element presently assigned to the genus *Tanea* Marwick, 1931. This species (Pl. 2, fig. 19) superficially resembles *Cochlis propinqua* in that exhibits a rather similar color pattern, but has markedly broader umbilical callus and different opercular features.

Stratigraphic occurrence. *C. propinqua* (Pecchioli) was hitherto known from Pliocene deposits of Piedmont, Emilia and Tuscany. The species seems to be restricted to Early-Mid Pliocene.

Cochlis pseudoepiglottina (Sacco, 1890) comb. nov.

Pl. 3, figs 1-9; Pl. 7, fig. 7; Pl. 8, figs 16-18; Pl. 9, figs 10-13; Pl. 10, figs 13-16, G, H

1847 *Natica pseudo-epiglottina* Sismonda, p. 51.

1890 *Natica* (*Natica*) *epiglottina* var. *pseudoepiglottina* Sacco, p. 29.

1890 *Natica* (*Natica*) *epiglottina* var. *pseudoepiglottina* subv. *spiralata* Sacco, p. 29 (nomen nudum).

1890 *Natica* (*Natica*) *epiglottina* var. *pseudoepiglottina* subv. *funicillata* Sacco, p. 29 (nomen nudum).

1890 *Natica* (*Natica*) *epiglottina* var. *millepunctatoides* Sacco, p. 29.

1890 *Natica* (*Natica*) *epiglottina* var. *basipicta* Sacco, p. 29.

1891 *Natica* (*Natica*) *epiglottina* var. *pseudoepiglottina* - Sacco, p. 57, pl. 2, fig. 25.

1891 *Natica* (*Natica*) *epiglottina* var. *spiralata* Sacco, p. 59, pl. 2, fig. 26.

1891 *Natica* (*Natica*) *epiglottina* var. *funicillata* Sacco, p. 60, pl. 2, fig. 27.

1891 *Natica* (*Natica*) *epiglottina* var. *millepunctatoides* - Sacco, p. 61, pl. 2, fig. 31.

1891 *Natica* (*Natica*) *epiglottina* var. *basipicta* - Sacco, p. 62, pl. 2, fig. 34.

1949 *Natica pseudoepiglottina* - Ruggieri, p. 80 (pars); not pl. 1, fig. 5 (= *Natica plicatula* Bronn, 1831).

1960 *Natica (Natica) epiglottina* - Baldi, p. 64, pl. 2, figs. 1, 2b.

1966 *Natica (Natica) pseudoepiglottina* - Moroni & Torre, p. 30, pl. 1, figs 3, 4.

1967 *Natica epiglottina pseudoepiglottina* - Pelosio, p. 126, pl. 37, fig. 5.

1967 *Natica epiglottina pseudoepiglottina* f. *millepunctatoides* - Pelosio, p. 127, pl. 37, figs 8, 9.

1969 *Natica epiglottina pseudoepiglottina* - Mastrorilli, p. 118, pl. 6, fig. 14.

1974 *Natica (Natica) epiglottina pseudoepiglottina* - Malatesta, p. 233, pl. 18, fig. 7.

1974 *Natica (Natica) pseudoepiglottina* - Caprotti, pag. 24, n. 46 (pars), pl. 1, fig. 5.

1976 *Naticarius (Naticarius) pseudoepiglottinus* - Pavia, p. 112, 117, 138, pl. 5, fig. 8.

1980 *Naticarius pseudoepiglottinus* - Pavia, p. 249, 250, pl. 5, fig. 5-9; text-figs 2G, 4, 5.

1984 *Natica epiglottina* var. *pseudoepiglottina* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

1984 *Natica millepunctata* var. *spiralata* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

1984 *Natica epiglottina* var. *funicillata* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

1984 *Natica epiglottina* var. *millepunctatoides* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 31.

1984 *Natica epiglottina* var. *basipicta* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 31.

1989 *Natica pseudoepiglottina* - Lauriat-Rage, Brébion, Buge, Chaix, Chevalier, Margerel, Pajaud, Pouit, Roman & Viaud, p. 129, 130, 131, pl. 8, fig. 17.

1992 *Natica* (*Naticarius*) *pseudoepiglottina* - Cavallo & Repetto, text-fig 123.

1996 *Natica* (*Naticarius*) *pseudoepiglottina* - Pedriali, p. 7, pl. 3, figs 2-4.

1996 *Natica* (*Naticarius*) *pseudoepiglottina* f. *millepunctatoides* - Pedriali, p. 7, pl. 3, fig. 5.

1997 *Natica pseudoepiglottina* - Lacroce, p. 26, pl. 2, fig. 5.

1999 *Natica pseudoepiglottina* - Solsona & Martinell, p. 414, text-fig. 3 (6-11), text-fig. 4 (5-8).

Uncertain references

Natica epiglottina - Sasso, 1827: p. 478; - Sismonda, 1842: p. 27; - Calcara, 1845: p. 30; - Cerulli-Irelli, 1896: p. 11; - De Angelis D'Ossat, 1897: p. 116; - Hornung, 1920: p. 86; - Zuffardi Comerci, 1929: p. 307; - Cowper Reed, 1930: p. 257.

Natica epiglottina var. *basipicta* - Arduini, 1895: p. 185.

Natica epiglottina var. *funicillata* - Arduini, 1895: p. 184.

Natica epiglottina var. *pliocarinata* - Hornung, 1920: p. 87.

Natica epiglottina var. *spiralata* - Arduini, 1895: p. 184.

Natica epiglottina pseudoepiglottina - Cauli & Ragaini, 1991: p. 283, 284; - Ragaini & Mariani, 1992: p. 8, 12, 19.

Natica (*Natica*) *epiglottina pseudoepiglottina* - Menesini, 1977: p. 255.

Naticarius (Naticarius) epiglottinus pseudoepiglottinus - Brambilla, Cantaluppi & Lualdi, 1983: p. 18; - Brambilla & Lualdi, 1986: p. 243.

Natica pseudo-epiglottina - d'Orbigny, 1852: p. 38; - Foresti, 1868: p. 73; - Cocconi, 1873: p. 527; - Foresti, 1874: p. 81; - Foresti, 1876: p. 550; - Seguenza, 1876: p. 12; - Arduini, 1895: p. 184.

Natica pseudoepiglottina - Seguenza, 1880: p. 264; - Neviani, 1887: p. 175, 188, 204; - Ruggieri, 1950: p. 80, 81, 82; - Ruggieri, 1957: p. 23; - Bogi & Cauli, 1998: p. 134; - Lacroce & Repetto, 1998: p. 148.

Natica cf. *pseudoepiglottina* - Annoscia, 1970. p. 213, pl. 2, fig. 8.

Natica (Natica) pseudoepiglottina - Caprotti, 1974: p. 24 (pars), pl. 1, fig. 8.

Natica (*Naticarius*) *pseudoepiglottina* - Ortoleva, 1992: p. 140; - Tabanelli & Segurini, 1994: p. 9.

Naticarius pseudoepiglottinus - Brambilla & Lualdi, 1988: p. 19; - Pavia, Chiambretto & Oreggia, 1989: p. 543, 547, 554, 563, 566, 568.

Naticarius (Naticarius) pseudoepiglottinus - Montefameglio, Pavia & Rosa, 1980: p. 176, 183, 187, 189; - Aimone & Ferrero Mortara, 1983: p. 295; - Tropeano, Arduino, Bosso & Fornaio, 1984: p. 58; - Caretto, 1986: p. 50.

Type material. The syntypes of *Natica pseudoepiglottina* were included in the collection of fossil mollusks of the Museo Geologico di Torino (then Bellardi-Sacco collection) during the second half of the nineteen century and are not identifiable yet in MGPT.

Other type material. The lectotype of *Natica (Natica) epiglottina* var. *spiralata* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 26), MGPT BS.029.01.030 (Stazzano); 7 paralectotypes, MGPT BS.029.01.030/02 (Savonese); 1 paralectotype, MGPT BS.029.01.030/03 (Carrù); 3 paralectotypes, MGPT BS.029.01.030/04 (Volpedo). The lectotype of *Natica (Natica) epiglottina* var. *funicillata* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 27), MGPT BS.029.01.032 (Savona); 4 paralectotypes, MGPT BS.029.01.032/01 (Savona); 1 paralectotype, MGPT BS.029.01.032/03 (Colli Astesi). The lectotype of *Natica (Natica) epiglottina* var. *millepunctatoides* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 31), MGPT BS.029.01.038 (Rocca d'Arazzo); 2 paralectotypes, MGPT BS.029.01.038/03 (Rio Torsero); 1 paralectotype, MGPT BS.029.01.038/05 (Volpedo); 5 paralectotypes, MGPT BS.029.01.038/06 (Colli Astesi). The lectotype of *Natica (Natica) epiglottina* var. *basipicta* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 34), MGPT BS.029.01.042 (Savona); 3 paralectotypes, MGPT BS.029.01.042/01 (Savona); 1 paralectotype, MGPT BS.029.01.042/02 (Rio Torsero).

Other material examined. Savonese: the shell figured by Sacco (1891, pl. 2, fig. 25, MGPT BS.029.01.029); Savona Fornaci: 74 spms. (MGPT BS.029.01.29/03); Albenga: 11 spms. (MGPT BS.029.01.029/04); Zinola: 10 spms. (MGPT BS.029.01.029/05); Borsoli: 1 spm. (MGPT BS.029.01.029/07); Monte Capriolo: 9 spms. (MGPT BS.029.01.029/08); Vezza d'Alba: 6 spms. (MGPT BS.029.01.029/09); Clavesana: 10 spms. (MGPT BS.029.01.029/11); Viale: 5 spms. (MGPT BS.029.01.029/12); Cortazzone: 6 spms. (MGPT BS.029.01.029/14); Castelnuovo d'Asti: 23 spms. (MGPT BS.029.01.029/15); Rocca d'Arazzo: 2 spms. (MGPT BS.029.01.029/16); Colli Astesi: 4 spms. (MGPT BS.029.01.029/17/18); Belveglio: 1 spm. (NP 2544); Cassine: 5 spms. (NP 2545-2549); Castello di Annone: 64 spms. (NP 2563-2626); Passerano: 29 spms. (NP 2920-2948); Pino d'Asti: 24 spms. (NP 2949-2972); Rio del Mulino di Serralunga: 1 spm. (NP 4331); Valle Botto: 2 spms. (NP 4638-4639); Villalvernia: 7 spms. (PPMM 48139-48145); Volpedo: 1 spm. (MGPT BS.029.01.029/13); Garlenda: 11 spms. (NP 2742-2752); Rio Torsero: 29 spms. (NP 4336-4364), 1 spm. (MPUM 8853), 1 spm. (MPUM 8856), 1 spm. (MPUM 8867); Bacedasco: 8 spms. (NP 2513-2520), 1 spm. (MPUM 8860); Badagnano: 20 spms. (NP 2521-2540), 70 spms. (PPMM 48068-48137); Balzo del Musico: 29 spms. (NP 2891-2919), 8 spms. (MPUM 8876), 5 spms. (MPUM 8881); Castell'Arquato: 13 spms. (NP 2550-2562); Diolo: 2 spms. (NP 2740-2741); La Valle: 6 spms. (NP 2875-2880); Pradalbino I: 256 spms. (NP 3039-3294), 6 spms. (MPUM 8847-8852), 127 spms. (MPUM 8868), 30 spms. (MPUM 8869); Pradalbino II: 1036 spms. (NP 3295-4330), 104 spms. (MPUM 8870), 443 spms. (MPUM 8871), 1 spm. (MPUM 8854), 1 spm. (MPUM 8857), 2 spms. (MPUM 8861-8862), 1 spm. (MPUM 8866), 10 spms. (MGC 676-685); Rio Rosello: 4 spms. (NP 4332-4335), 67 spms. (PPMM 48001-48067); San Lorenzo in Collina: 266 spms. (NP 4366-4631), 282 spms. (MPUM 8872), 57 spms. (MPUM 8873), 2 spms. (MPUM 8858-8859), 3 spms. (MPUM 8863-8865); Balze di Caspreno: 3 spms. (NP 2541-2543); Barca: 2 spms. (NP 4632-4633); Calanchi di San Martino: 1 spm. (PPMM 48138); Casa Cuccule: 1 spm. (NP 2874); Cava di Certaldo: 1 spm. (MPUM 8882); Cava I Sodi: 7 spms. (NP 2639-2645); Ciuciano: 94 spms. (NP 2646-2739), 14 spms. (MPUM 8878), 5 spms. (MPUM 8879), 4 spms. (MGC 672-675); Guistrigona: 92 spms. (NP 2782-2873), 1 spm. (MPUM 8855), 37 spms. (MPUM 8877), 2 spms. (MPUM 8880); Linari: 9 spms. (NP 2881-2889); Marcialla: 1 spm. (NP 2890); Podere Cavallara: 3 spsms. (NP 2973-2975), 2 spms. (MPUM 8875); Poggio Armaiolo: 17 spsms. (NP 2976-2992); Ponte a Elsa: 46 spms. (NP 2993-3038), 32 spms. (MPUM 8874); San Benedetto: 1 spm. (NP 4365); Spicchio: 12 spsms. (NP 2627-2638), 1 spm. (PPMM 48146); Ulignano: 4 spms. (NP 4634-4637); Guidonia: 29 spms. (NP 2753-2781):

Characters

Protoconch: small, depressed turbiniform of 2-2.25 gently convex, smooth whorls, tip small.

Shell: globose, thin to moderately thick.

Spire: conical, moderately elevated, whorls convex.

Suture: linear, adpressed.

Body whorl: inflated, moderately produced but not expanded toward the aperture, with poorly defined, rather steep subsutural shelf.

Aperture: D-shaped, height averaging 1.5 times the width.

Parietal callus: moderately thick, narrowing abapically, ending close to but not in touch with the basal fasciole; anterior lobe indistinct.

Umbilicus: moderately wide, largely filled by the funicle in some specimens.

Funicle: a well developed, prominent cord, medium to thick, separated from the basal fasciole by a groove of variable breadth.

Umbilical callus: rather large to small, moderately thick, semicircular in outline, located about at the middle of the columellar lip and separated from the parietal callus by a short to medium, moderately deep, reverse J-shaped notch.

Basal fasciole: blunt and rather broad, defined abaxially by a very low step, occasionally only by the sudden deviation of the growth lines.

Surface: with fine, dense, prosocline growth lines slightly more evident on the subsutural shelf, stronger on the basal fasciole.

Color:

1. uniform pale brown to pinkish brown without any color pattern;

2. background pale reddish brown with red pattern, which may consist of

• small and even dots roughly arranged in collabral rows;

• crowded, uneven and irregularly arranged small dots which may fuse adapically to form subsutural chevron markings;

• uneven, variously sized and irregularly arranged spots.

Operculum:

• of various thickness;

• central callus well developed, bent toward the inner margin;

• inner margin straight, with moderate, blunt transverse ridges;

• inner surface nearly flat, with slightly prominent nucleus;

• outer surface somewhat concave, with 3 distinct marginal grooves and 3 also distinct ridges; the ridges as well as the median and outer grooves lie upon an elevated, sloping inward shelf;

• outer and middle groove similar, rather narrow and shallow, occasionally with granules;

• inner groove of various breadth, constantly wider and deeper than the other two, with subvertical outer side;

• outer and inner ridges similar, blunt and low;

• middle ridge sharp, thinner, occasionally thread-like.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.094-0.160	0.661-0.775	13.10-25.54	13.42-23.42	2.10-7.18	10.50-18.90	6.97-13.21
0.113	0.722	19.32	18.42	4.64	14.70	10.09
UW	WUC	WAD	WAB	IS	SA	
3.88-8.56	1.51-3.43	1.09-3.85	0.43-2.15	21°-45°	100°-132°	
6.22	2.47	2.47	1.29	33°	116°	

Remarks. The name *pseudoepiglottina* was proposed by Sismonda (1847) to accommodate Miocene and Pliocene shells formerly referred to as *Natica epiglottina* Lamarck, 1804, which is a Paleogene north-European species. Sismonda neither described nor figured *Natica pseudoepiglottina*, but simply wrote "olim *N. epiglottina* Lam. sec. Auct. Pedem. Terr. mioc. Taur. Pedem." that, freely translated, reads: once *N. epiglottina* according to Piedmontese authors, Miocene deposits of Turin, Piedmont. Since no previous description or illustration does exist, Sismonda's statement does not constitute indication (I.C.Z.N., fourth Ed. 1999, Art. 12.3) and, consequently the name *pseudoepiglottina* Sismonda, 1847 is unavailable. *Natica pseudoepiglottina* was just cited later on by d'Orbigny (1852), Cocconi (1873), Seguenza (1876) and Della Campana (1890). Sacco is to be considered the first relevant reference author. He (1890) regarded *pseudoepiglottina* as a variety of *Natica epiglottina* and published a short diagnosis of it (p. 29). Thus, the name *pseudoepiglottina* was made available by Sacco who is to be considered as the author of this species. One year later, Sacco dealt with *pseudoepiglottina* more extensively and noted that it was originally based on Pliocene specimens. From Sacco's text, it can be determined that he had examined Sismonda's material, at that time already incorporated in the Bellardi-Sacco collection. As noted by Pavia (1980, p. 249), *Cochlis pseudoepiglottina* is manifestly unrelated to *Natica epiglottina* in that has a quite different oper-

PLATE 7

Fig. 1 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8773; protoconch.

Fig. 2 - *Cochlis fulgurata* (Pecchioli, 1964). Corazzano. MPUM 8788; protoconch.

Fig. 3 - *Cochlis plicatula* (Bronn, 1831). Badagnano. MPUM 8820; protoconch.

Fig. 4 - *Cochlis canariensis* (Odhner, 1931). Cape Naj, Canary Islands. MPUM 8826; protoconch.

Fig. 5 - *Natica dillwyni* Payraudeau, 1826. Arenella, Pantelleria. Private collection; protoconch.

Fig. 6 - *Cochlis propinqua* (Pecchioli, 1864). Rio del Mulino di Serralunga. MPUM 8837; protoconch.

Fig. 7 - *Cochlis pseudoepiglottina* (Sacco, 1890). Rio Torsero. MPUM 8856; protoconch.

Fig. 8 - *Cochlis raropunctata* (Sasso, 1827). Rio Torsero. Topotype, MPUM 8893; protoconch.

Fig. 9 - *Cochlis raropunctata* (Sasso, 1827). Bibbiano. MPUM 8894; protoconch.

Fig. 10 - *Nerita stercusmuscarum* Gmelin, 1791. San Vincenzo (Livorno), Tyrrhenian Sea. Private collection; protoconch.

Fig. 11 - *Nerita hebraea* Martyn, 1784. Adriatic Sea. Private collection; protoconch.

Fig. 12 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8962; protoconch.

Fig. 13 - *Cochlis strictiumbilicata* (Sacco, 1891). Rio Torsero. MPUM 8972; protoconch.

Fig. 14 - *Cochlis sulcogradata* sp. n. Montaione. Paratype, MPUM 8978; protoconch.

Fig. 15 - *Cochlis sulcogradata* sp. n. Torrente Stirone; protoconch of paratype in Pl. 5, fig. 8.

Fig. 16 - *Cochlis undata* (Sasso, 1827). Rio Torsero. Topotype, MPUM 8991; protoconch.

Fig. 17 - *Cochlis undata* (Sasso, 1827). Rio Torsero. Topotype, MPUM 8992; protoconch.

Fig. 18 - *Cochlis vittata* (Gmelin, 1791). Il Campino. MPUM 9016; protoconch.

Fig. 19 - *Cochlis vittata* (Gmelin, 1791). Lagos, Portugal (Recent). Private collection; protoconch.

Fig. 20 - *Natica virguloides* Sacco, 1890. Montaione. MPUM 8749; protoconch.

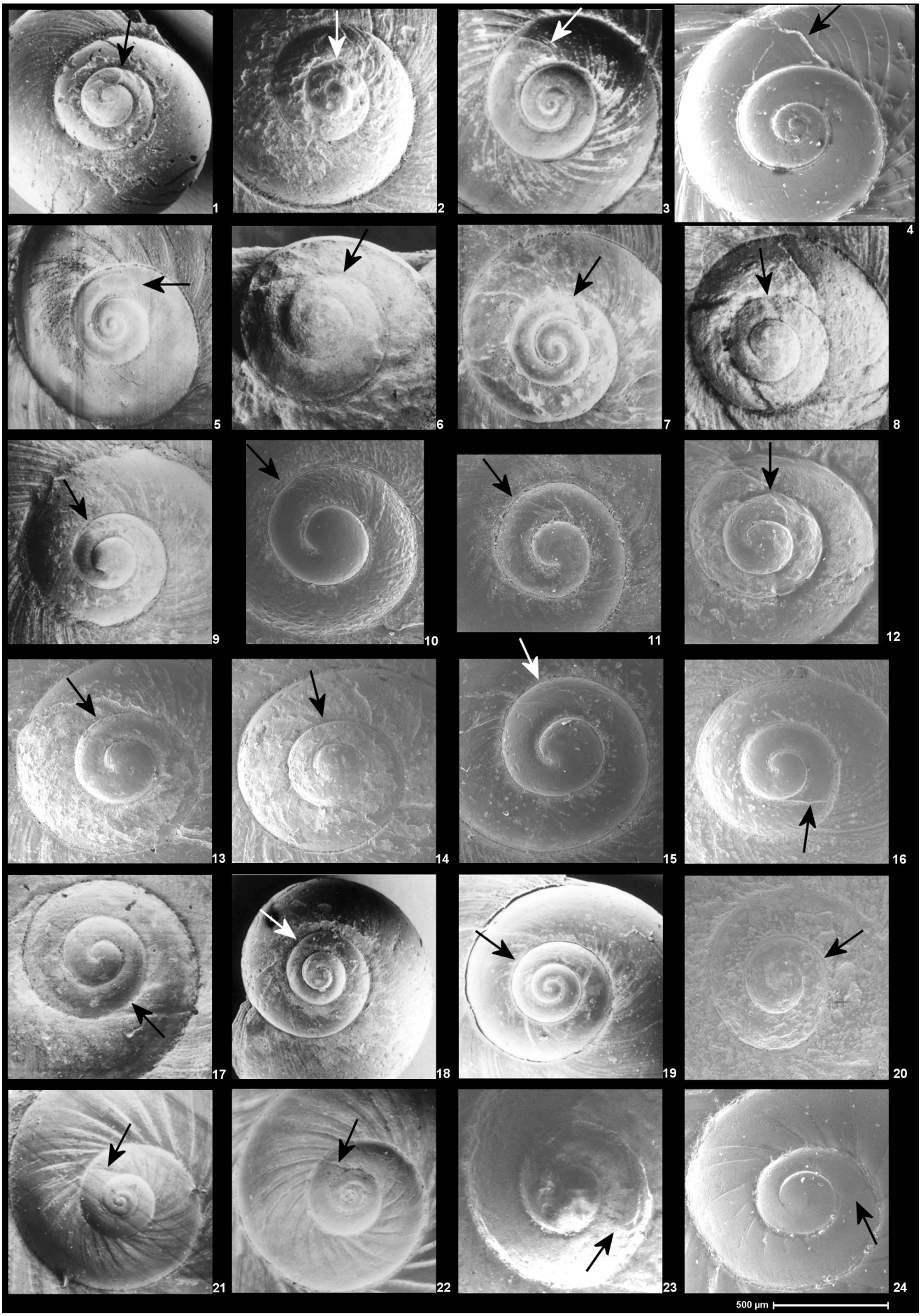
Fig. 21 - *Natica gualteriana* Récluz, 1844. Madagascar (Recent). MPUM 9023; protoconch.

Fig. 22 - *Nerita marochiensis* Gmelin, 1791. Casablanca, Morocco (Recent). MPUM 9024; protoconch.

Fig. 23 - *Nerita vitellus* Linnaeus, 1758. Cebu, Philippines. MPUM 8827; protoconch.

Fig. 24 - *Nerita canrena* Linneo, 1758. Gurarapari Channel, Espirito Santo, Brasil. MPUM 8952; protoconch.

Arrow indicates the protoconch-teleoconch transition.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culum, i.e. with 3 marginal ribs instead of 2 as in Lamarck's species.

The larger protoconch with small nucleus and the 3-ribbed operculum easily distinguish *Cochlis pseudoepiglottina* from the other *Cochlis* species except for *Cochlis vittata* (Gmelin, 1791). *Cochlis pseudoepiglottina* can be differentiated from *Cochlis vittata* on the basis of protoconch significantly greater (Tab. 2) and with larger nucleous (Tab. 3), spire usually less elevated (Fig. 8B), umbilical callus and abapical sulcus ordinarily wider (Figs 13B, 14B), different color pattern (Tab. 9), and opercular middle ridge thin and sharp instead of broad and flat-topped (Tab. 10).

Sacco (1891) shortly described his varieties *basipicta*, *funicillata*, *millepunctatoides* and *spiralata* of *Natica epiglottina*. We have examined the respective specimens in MGPT and can state that they fully match the distinguishing characters of *Cochlis pseudoepiglottina*. Accordingly, we include the cited varieties in the synonymy of the present species.

Stratigraphic occurrence. *C. pseudoepiglottina* (Sacco, 1890) is surely known from several Late Miocene and Pliocene localities throughout the Mediterranean area. It also occurs in Late Miocene deposits of Hungary.

Cochlis raropunctata raropunctata (Sasso, 1827) comb. nov.

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

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

1880 *Natica millepunctata* - Brugnone, p. 117 (not Lamarck, 1822).

1880 *Natica tigrina* - Brugnone, p. 117, pl. 1, fig. 10 (not Defrance, 1825).

1881 *Natica millepunctata* var. *raropunctata* - Fontannes, p. 111 (pars), pl. 7, fig. 7.

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

1890 *Natica* (*Natica*) *millepunctata* var. *subfuniculosa* - Sacco, p. 28.

1890 *Natica* (*Natica*) *millepunctata* var. *tigrina* - Sacco, p. 28.

1890 *Natica* (*Natica*) *millepunctata* var. *tigrina* subv. *lineopunctata* Sacco, p. 28 (nomen nudum).

1890 *Natica millepunctata* var. *tigrina* subv. *elatospira* Sacco, p. 28 (nomen nudum).

1890 *Natica millepunctata* var. *tigrina* subv. *ventricodepressa* Sacco, p. 28 (nomen nudum).

1890 *Natica* (*Natica*) *millepunctata* var. *magnopunctata* Sacco, pag. 28.

1890 *Natica* (*Natica*) *millepunctata* var. *pliomaculata* Sacco, pag. 28.

1890 *Natica* (*Natica*) *epiglottina* var. *pseudoepiglottina* subv. *aspirata* Sacco, p. 29 (nomen nudum).

1891 *Natica* (*Natica*) *millepunctata* var. *tigrina* - Sacco, p. 49, pl. 2, figs 11-12.

1891 *Natica* (*Natica*) *millepunctata* var. *pliodertonensis* - Sacco, p. 47, pl. 2, fig. 7.

1891 *Natica* (*Natica*) *millepunctata* var. *subfuniculosa* - Sacco, p. 48, pl. 2, fig. 10.

1891 *Natica* (*Natica*) *millepunctata* var. *lineopunctata* Sacco, p. 51.

1891 *Natica (Natica) millepunctata* var. *elatospira* Sacco, p. 52, pl. 2, fig. 15.

1891 *Natica (Natica) millepunctata* var. *ventricodepressa* Sacco, p. 52, pl. 2, fig. 16.

1891 *Natica (Natica) millepunctata* var. *magnopunctata* - Sacco, p. 53, pl. 2, fig. 17.

1891 *Natica (Natica) millepunctata* var. *pliomaculata* - Sacco, p. 53, pl. 2, fig. 18.

1891 *Natica (Natica) epiglottina* var. *aspirata* Sacco, p. 60.

1904 *Natica (Natica) millepunctata* var. *lineopunctata* - Sacco, p. 102, pl. 22, fig. 21.

1904 *Natica (Natica) epiglottina* var. *aspirata* - Sacco, p. 102, pl. 22, fig. 22.

1914 *Natica millepunctata* - Cerulli-Irelli, p. 214 (pars), pl. 19, fig. 11 (not Lamarck, 1822).

1949 *Natica raropunctata* - Ruggieri, p. 78, pl. 1, fig. 3.

1960 *Natica (Natica) millepunctata* - Pelosio, p. 130, 149, 150, pl. 2, fig. 5 (not Lamarck, 1822).

1964 *Natica raropunctata* - Moroni & Paonita, p. 38, text-fig. 6.

1967 *Natica millepunctata* - Palla, p. 963, pl. 72, fig. 5 (not Lamarck, 1822).

1969 *Natica (Natica) tigrina* - Di Geronimo, p. 108, 109, 114, 124, 136, pl. 4, fig. 3 (not Defrance, 1825).

1970 *Natica (Natica) tigrina* - Caprotti, p. 164, pl. 5, fig. 3 (not Defrance, 1825).

not 1971 *Natica tigrina* – D'Alessandro, p. 380, 382, 385, pl. 1, figs 2-2b (= *Cochlis sulcogradata* n. sp., present paper).

1974 *Natica tigrina* - Abatino & Barbera Lamagna, p. 577, 579, 584, 585, text-fig. 2, text-figs 3 A-D, text-fig. 9, text-fig. 10 B, D, F (not Defrance, 1825).

1974 *Naticarius tigrinus* - Barsotti et alii, p. 432, 441, pl. 2, fig. 7 (not Defrance, 1825).

1974 *Natica (Natica) tigrina* - Malatesta, p. 236 (pars), pl. 18, fig. 8a, 8c (not Defrance, 1825).

1976 *Naticarius (Naticarius) tigrinus* - Pavia, p. 103, 110, 112, pl. 5, fig. 5 (not Defrance, 1825), not fig. 11 (= *Natica fulgurata* Pecchioli, 1864).

1976 *Natica tigrina* - Caprotti, p. 9, 38, 39, pl. 12, fig. 3 (not Defrance, 1825).

1980 *Naticarius tigrinus* - Pavia, p. 251(pars), pl. 1, fig. 5; pl. 2, figs 4-6; pl. 4, figs 2-4; pl. 6, figs 2, 3, 7, 8, 10, 11; text-figs 1, 4, 5, 6 (not Defrance, 1825); not pl. 6, fig. 1 (= *Natica undata* Sasso, 1827); not pl. 6, fig. 5 (= *Natica epiglottina* var. *strictiumbilicata* Sacco, 1891); not pl. 6, fig. 9 (= *Natica millepunctata* var. *depressofuniculata* Sacco, 1891); not text-fig. 2D, 6 (= *Natica epiglottina* var. *strictiumbilicata* Sacco, 1891).

1984 *Natica millepunctata* var. *lineopunctata* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica millepunctata* var. *tigrina* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica millepunctata* var. *pliodertonensis* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 28.

1984 *Natica millepunctata* var. *subfuniculosa* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica millepunctata* var. *elatospira* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica millepunctata* var. *ventricodepressa* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica millepunctata* var. *magnopunctodentata* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica millepunctata* var. *pliomaculata* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 29.

1984 *Natica epiglottina* var. *aspirata* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

1988 *Naticarius (Naticarius) tigrinus* - Brambilla & Lualdi, p. 19, 22, 24, pl. 12, fig. 4 (not Defrance, 1825).

1988 *Natica tigrina* - Chirli, p. 18, pl. 5, fig. 3 (not Defrance, 1825).

1992 *Natica (Naticarius) tigrina* - Cavallo & Repetto, text-figs 121 operculum excluded (not Defrance, 1825).

1996 *Natica (Naticarius) tigrina* - Pedriali, p. 4 (pars), pl. 1, fig. 1, 3-7 (not Defrance, 1825); not pl. 1, fig. 2 (= *Natica millepunctata* var. *depressofuniculata* Sacco, 1891).

1996 *Natica (Naticarius) tigrina* f. *subfuniculosa* - Pedriali, p. 4, 8, 9, pl. 1, fig. 8.

1996 *Natica (Naticarius) tigrina* f. *magnopunctata* – Pedriali, p. 5, pl. 1, figs 9, 10; not p. 1 (= *Natica millepunctata* var. *depressofuniculata* Sacco, 1891).

1996 *Natica (Naticarius) tigrina* f. *pliomaculata* – Pedriali, p. 5, pl. 1, fig. 11; pl. 2, fig. 1; not p. 1 (= *Natica millepunctata* var. *depressofuniculata* Sacco, 1891).

1997 *Natica tigrina* - Lacroce, p. 24, pl. 2, fig. 3 (not Defrance, 1825).

Uncertain references

Natica hebraea - Appelius, 1871: p. 23, 46, 59, 75, 88, 123; - Fekih, 1975: p. 152.

Natica maculosa - Coppi, 1869: p. 35; - Mazzetti, 1874: p. 164.

Natica millepunctata - Philippi, 1836: p. 163; - Sismonda, 1842: p. 27; - Philippi, 1844: p. 141; - Sismonda, 1847: p. 51; - D'Orbigny, 1852p. 168; - Pecchioli, 1864: p. 519; - Foresti, 1868: p. 71; - Manzoni, 1868: p. 53; - Coppi, 1869: p. 19, 35; - Appelius, 1871: p. 23, 46, 59, 83, 117; - Cocconi, 1873: p. 524; - Foresti, 1874: p. 81; - Mazzetti, 1874: p. 164; - Crespellani, 1875: p. 19; - De Stefani, 1876: p. 7; - Foresti, 1876: pag. 550; - Pantanelli, 1876: p. 5; - Seguenza, 1876: p. 10; - Depontaillier, 1877: p. 781; - Pantanelli, 1877a: p. 231, 232; - Pantanelli, 1877b: p. 3; - Pantanelli, 1878: p. 13, 15; De Stefani & Pantanelli, 1879: p. 140; - Coppi, 1880: p. 11; - Pantanelli, 1880: p. 274; - Seguenza, 1880: p. 264; - Coppi, 1881: p. 61; - Pantanelli, 1881: p. 67; - Parona, 1883: p. 8; - Pantanelli, 1884: p. 24; - Cavara, 1886a: p. 713; - Cavara, 1886b: p. 274; - Parona, 1886: p. 106, 112, 118; - Terrenzi, 1886: p. 333; - Verri, 1886: p. 446; - Neviani, 1887: p. 173, 186, 187, 188, 189, 191, 197, 199, 204; - Clerici, 1888: p. 109; - De Stefani, 1888: p. 221; - Trabucco, 1888: p. 25; - Antonelli, 1890: p. 106; - Arduini, 1895: p. 183;

- Busacchi, 1896: p. 322; - Cerulli-Irelli, 1896: p. 11; - Almera & Bofill, 1898: p. 49; - Cerulli-Irelli, 1898: p. 89; - Ugolini, 1898: p. 4; - Cerulli-Irelli, 1914: p. 214 (pars), 215, pl. 19, fig. 2, 5-8, 10, 12, 13; - Harmer, 1921: p. 678, pl. 55, fig. 16; - Bevilacqua, 1928: p. 153, 155, 159, 160, 161, 162; - Cowper Reed, 1930: p. 264; - Dubertret, Vautrin & Keller, 1937: p. 104; - Moretti, 1938: p. 79; - Dieni & Omenetto, 1960: p. 608, 610; - Mazzanti, 1961: p. 76, 77, 80, 83, 86; - Caretto, 1963: p. 21, 22, 25, pl. 1 fig. 25; - Fekih, 1975: p. 59, pl. 22, fig. 1.

Natica (*Nacca*) *millepunctata* - Bondi & Sandrucci, 1949: p. 5.

Naticarius millepunctatus - Caretto, 1981: p. 182; - Menesini, 1989: p. 217.

Naticarius (Naticarius) millepunctatus - Montefameglio, 1984: p. 276.

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Natica millepunctata var. *maculosa* - Coppi, 1881a: p. 17; - Coppi, 1881b: p. 61.

Natica millepunctata var. *pseudocollaria* - Hornung, 1920: p. 86.

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Natica raropunctata - Ruggieri, 1949: p. 37; - Ruggieri, 1950: p. 82; - Ruggieri, 1957: p. 23; - Pelosio, 1964: p. 61; - Cuscani Politi, 1978: p. 36, 39, 41.

Natica (*Natica*) *raropunctata* - Papani & Pelosio, 1962: p. 15, 25, 26, pl. 2 fig. 9.

Natica (*Natica*) cfr. *raropunctata* - Compagnoni, 1964: p. 256, 260, 274, 275.

Natica tigrina - Philippi, 1844: p. 141, pl. 24, fig. 17; - Mazzetti, 1874: p. 164; - Seguenza, 1880: p. 264; - Harmer, 1921: p. 679, pl. 55, fig. 15; - Pelosio, 1967: p. 127; - Caprotti, 1972: p. 28, 29, 30, 31, 32, 33, 34; - Robba & Ostinelli, 1975: p. 309, 317, 319, 320, 349; - Robba & Ostinelli, 1976: p. 524; - Marasti & Raffi, 1977: p. 232; - Cuscani Politi, 1982: p. 7, 10, 11, pl. 2, fig. 10; - Monegatti e Raineri, 1987: p. 293, 296, 297, 302; - Repetto, 1997: p. 60; - Bogi & Cauli, 1998: p. 134; - Lacroce & Repetto, 1998: p. 148.

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Naticarius tigrinus var. *magnopunctata* - Pavia, 1980: p. 251 (pars).

Naticarius (Naticarius) tigrinus - Montefameglio, Pavia & Rosa, 1980: p. 187, 189; - Aimassi & Ferrero Mortara, 1983: p. 182, 186; - Aimone & Ferrero Mortara, 1983: p. 295, 309; - Brambilla, Cantaluppi & Lualdi, 1983: p. 8, 18; - Tropeano, Arduino, Bosso. & Fornaio, 1984: p. 58; - Brambilla & Lualdi, 1987: p. 243, 245, 246, 254, 255, 262; - Buccheri, Di Stefano & Greco, 1987: p. 225, 227, 230, 236, 258, 259; - Gonzáles Delgado, 1987: p. 92, 96, 99, 100, 101, 102, 103, 104, 105, 110, 111, 112, 115, 118; - Bernasconi, 1989: p. 58, 75.

Naticarius (Naticarius) stercusmuscarum - Caretto, 1986: p. 42, 50.

Type material. Not seen (syntypes of *Natica raropunctata*, originally in Museo Civico di Storia Naturale "G. Doria", Genova, not found and possibly lost).

Other type material. The lectotype of *Natica millepunctata* var. *pliodertonensis* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 7), MGPT BS.029.01.009 (Stazzano); 5 paralectotypes, MGPT BS.029.01.009/04 (Volpedo); 3 paralectotypes, MGPT BS.029.01.009/05 (locality unknown). The lectotype of *Natica millepunctata* var. *lineopunctata* Sacco (here designated): the shell figured by Sacco (1904, pl. 22, fig. 21), MGPT BS.029.01.016 (Colli Astesi); 1 paralectotype, MGPT BS.029.01.016/01 (Colli Astesi). The holotype (monotypy) of *Natica millepunctata* var. *elatospira* Sacco: the shell figured by Sacco (1891, pl. 2, fig. 15), MGPT BS.029.01.020 (Colli Astesi). The lectotype of *Natica millepunctata* var. *ventricodepressa* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 16), MGPT BS.029.01.021 (Colli Astesi); 5 paralectotypes, MGPT BS.029.01.021/01 (Rocca d'Arazzo). The lectotype of *Natica millepunctata* var. *magnopunctata* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 17), MGPT BS.029.01.022 (Colli Astesi); 1 paralectotype, MGPT BS.029.01.022/01 (Savonese); 1 paralectotype, MGPT BS.029.01.022/02 (Viale); 5 paralectotypes, MGPT BS.029.01.022/04 (Colli Astesi). The lectotype of *Natica millepunctata* var. *pliomaculata* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 18), MGPT BS.029.01.023 (Savonese). The lectotype of *Natica epiglottina* var. *aspirata* Sacco (here designated): the shell figured by Sacco (1904, pl. 22, fig. 22), MGPT BS.029.01.031 (Savona); 1 paralectotype, MGPT BS.029.01.031/01 (Savona).

Material referred to as *Natica millepunctata* var. *tigrina* (not Defrance, 1825) in MGPT. Colli Astesi: the operculum figured by

Sacco (1891, pl. 2, fig. 12, MGPT BS.029.01.014), the shell figured by Sacco (1891, pl. 2, fig. 11, MGPT BS.029.01.015) and refigured herein (Pl. 3, fig. 13; Pl. 4, fig. 10); Borzoli: 4 spms. (MGPT BS.029.01.015/01); Savona: 2 spms. (MGPT BS.029.01.015/02); Viale: 7 spms. (MGPT BS.029.01.015/03); Villalvernia: 1 spm. (MGPT BS.029.01.015/04); Volpedo: 31 spms. (MGPT BS.029.01.015/05); Vezza d'Alba: 4 spms. (MGPT BS.029.01.015/06).

Material referred to as *Natica millepunctata* var. *subfuniculosa* Fontannes, 1881 in MGPT. Colli Astesi: the shell figured by Sacco (1891, pl. 2, fig. 10, MGPT BS.029.01.013), 3 spms. (MGPT BS.029.01.013/04); Viale: 1 spm. (MGPT BS.029.01.013/01); Rocca d'Arazzo: 3 spms. (MGPT BS.029.01.013/02); Vezza d'Alba: 2 spms. (MGPT BS.029.01.013/03).

Other material examined. Belveglio: 3 spms. (NP 4856-4858); Casa Bosco: 1 spm. (MPUM 8936); Castello di Annone: 37 spms. (NP 5192-5228); Passerano: 8 spms. (NP 6575-6582), 1 spm. (MPUM 8888); Pino d'Asti: 7 spms. (NP 6583-6589); Rio del Mulino di Serralunga: 19 spms. (NP 7214-7232), 1 spm. (MPUM 8887), 28 spms. (MPUM 8943); San Pietro: 1 spm. (MPUM 8906); Valleandona: 7 spms. (NP 8230-8236); Valle Botto: 67 spms. (NP 8237-8303); Villalvernia: 20 spms. (NP 8304-8323), 514 spms. (PPMM 46895-47408), 1 spm. (MPUM 8886), 1 spm. (MPUM 8904), 6 spms. (MPUM 8948); Volpedo: 53 spms. (NP 8324-8376); Rio Torsero (topotypes): 59 spms. (NP 7284-7342), 3 spms. (MPUM 8883-8885), 1 spm. (MPUM 8893), 1 spm. (MPUM 8905); Bacedasco: 8 spms. (NP 4640-4647), 1 spm. (MPUM 8908), 3 spms. (MPUM 8930); Badagnano: 97 spms. (NP 4732-4828), 457 spms. (PPMM 45998-46454), 1 spm. (MPUM 8889), 1 spm. (MPUM 8915), 1 spm. (MPUM 8918), 7 spms. (MPUM 8931), 19 spms. (MPUM 8918); Balzo del Musico: 250 spms. (NP 6282-6531), 1 spm. (MPUM 8917), 43 spms. (MPUM 8933); Castell'Arquato: 14 spms. (DO/MPM 9802, sub *Natica millepunctata* var. *maculata*); 19 spms. (NP 5173-5191); Chiavenna Rocchetta: 16 spms. (NP 5230-5245); Diolo: 12 spms. (NP 5306-5317); La Valle: 30 spms. (NP 5653-5682), 4 spms. (PPMM 46718-46721); Montemaggiore: 2 spms. (NP 6532-6533); Montezago: 41 spms. (NP 6534-6574), 10 spms. (MPUM 8923); Pradalbino I: 258 spms. (NP 6864-7121), 3 spms. (MPUM 8890-8892), 3 spms. (MPUM 8895-8897), 2 spms. (MPUM 8909-8910), 2 spms. (MPUM 8913-8914), 1 spm. (MPUM 8916), 61 spms. (MPUM 8941), 125 spms. (MPUM 8926), 2 spms. (MGC 692-693); Pradalbino II: 92 spms. (NP 7122-7213), 17 spms. (MPUM 8942), 66 spms. (MPUM 8927); Rio Rosello: 50 spms. (NP 7233-7283), 967 spms. (PPMM 45001-45967), 1 spm. (MPUM 8898), 1 spm. (MGC 694); San Lorenzo in Collina: 792 spms. (NP 7343-8134), 65 spms. (MPUM 8944), 876 spms. (MPUM 8928), 1 spm. (MGC 695); Torrente Olivetta: 5 spms. (NP 8197-8201); Torrente Samoggia: 6 spms. (NP 8202-8207), 4 spms. (MPUM 8946); Torrente Stirone: 8 spms. (NP 8208-8215), 1 spm. (MPUM 8947); localities in Modena and Piacenza areas: 4 spms. (CO/MPM 13735, sub *Natica millepunctata* var. *maculosa*); Balze di Caspreno: 27 spms. (NP 4829-4855), 5 spms. (MPUM 8932); Barca: 62 spms. (NP 8135-8196), 7 spms. (PPMM 45968-45974), 39 spms. (MPUM 8929); Bibbiano: 268 spms. (NP 4859-5126), 161 spms. (PPMM 47439-47599), 1 spm. (MPUM 8894), 1 spm. (MPUM 8899), 1 spm. (MPUM 8907), 121 spms. (MPUM 8919), 24 spms. (MPUM 8934); Calanchi di San Martino: 16 spms. (NP 5127-5142), 252 spms. (PPMM 46455-46706), 2 spms. (MPUM 8900-8901), 1 spm. (MPUM 8935); Calanco di Casale: 30 spms. (NP 5143-5172), 68 spms. (PPMM 47813-47880); Casa Cuccule: 1 spm. (NP 5624); Cava I Sodi: 1 spm. (NP 5229); Corazzano: 60 spms. (NP 5246-5305), 34 spms. (MPUM 8920), 1 spm. (MGC 686); Guistrigona: 284 spms. (NP 5318-5601), 1 spm. (MPUM 8903), 28 spms. (MPUM 8937), 175 spms. (MPUM 8921), 2 spms. (MGC 687-688); Il Campino: 22 spms. (NP 5602-5623), 30 spms. (PPMM 47409-47438), 2 spms. (MPUM 8938); Il Treppié: 84 spms. (NP 4648-4731); La Catena: 3 spms. (NP 5625-5627); La Serra: 23 spms. (NP 5630-5652), 19 spms. (PPMM 45975-45993); Linari: 555 spms. (NP 5683-6237), 213 spms. (PPMM 47600-47812), 1 spm. (MPUM 8902), 2 spms. (MPUM 8911-8912), 3 spms. (MPUM 8939), 382 spms. (MPUM 8922), 2 spms. (MGC 689-690); Marcialla: 44 spms. (NP 6238-6281), 10 spms. (PPMM 46707-46716), 3 spms. (MPUM 8940), 1 spm. (MGC 691); Montaione: 1 spm. (PPMM 46717); Podere Cavallara: 35 spms. (NP 6590-6624), 15 spms. (MPUM 8924); Ponte a Elsa: 239 spms. (NP 6625-6863), 4 spms. (PPMM 45994-45997), 104 spms. (MPUM 8925); Spicchio: 16 spms. (PPMM 47881-47896), 2 spms. (MPUM 8945).

Characters

Protoconch: small, depressed-turbiniform of 1.25 gently convex, smooth whorls, tip medium-sized.

Shell: globose, moderately depressed, more or less solid.

Spire: low-conical, moderately depressed, whorls rather convex.

Suture: linear, occasionally slightly incised, adpressed.

Body whorl: inflated, somewhat depressed, produced and moderately expanded toward the aperture, with distinct, gently sloping subsutural shelf.

Aperture: D-shaped, height averaging 1.6 times the width.

Parietal callus: moderately thick, slightly narrowing abapically, ending near the basal fasciole but not touching it; anterior lobe very small to indistinct.

Umbilicus: wide, largely filled by the funicle in some specimens.

Funicle: thread-like to thick, separated from the basal fasciole by a furrow of variable breadth.

Umbilical callus: very small to large, rather thick, with more or less prominently arched outline, located at the abapical one-third of the columellar lip and separated from the parietal callus by a shallow, moderate to wide, reverse J-shaped notch.

Basal fasciole: wide, sharply edged abaxially by a low step.

Surface: with dense and fine, gently prosocline growth lines, slightly stronger on subsutural shelf and basal fasciole; an exceedingly faint spiral striation is noted on the body whorl.

Color: background brown to light-brown with reddish-brown pattern, which may consist of

- usually crowded, small and even dots often arranged in collabral rows;
- large, even spots irregularly arranged in collabral rows;
- uneven, irregularly arranged, large spots;
- spirally elongated spots;
- spots and chevron marks occasionally fused to form collabral stripes;
- irregular spiral broken lines.

Operculum:

- moderately thick to very thick, solid;
- central callus well developed, elongate, tongue-shaped, usually prominent;
- inner margin straight, with more or less distinct, blunt transverse ridges;
- inner surface nearly flat, nucleus not protruding;
- outer surface planar, usually with 2 well defined marginal grooves and 2 ridges;
- outer groove rather wide, moderately deep, obsolescent in some specimens, occasionally with granules arranged into longitudinal rows;

• inner groove of various breadth, usually narrower and somewhat less excavated than the outer one, sometimes attenuated or obsolete;

• outer ridge sharp to round-topped;

• inner ridge usually well developed, thin to thick, with sharp to flat top, seldom obsolete.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.329-0.389	0.572-0.671	9.47-31.51	9.81-30.17	0.99-6.75	8.01-25.21	4.77-16.45
0.361	0.636	20.49	19.99	3.87	16.61	10.61
UW	WUC	WAD	WAB	IS	SA	
2.49-12.85	0.63-4.55	0.66-6.78	0.21-2.49	15°-39°	107°-143°	
7.67	2.59	3.72	1.35	27°	125°	

Remarks. The present species, originally based on the color pattern of reddish-brown sparse spots, was cited under the names *tigrina* Defrance, 1825 and, less frequently, *raropunctata* Sasso, 1827. Throughout the nineteenth and early twentieth centuries, it was regarded either as a color variety of the Recent *Natica millepunctata* Lamarck, 1822 (cf. Sacco 1891) or considered to be indistinguishable from this latter (cf. Cerulli Irelli 1914). The current opinion was that the color pattern is extremely variable and grades from the sparse spots of Defrance's and Sasso's taxa into the dense, small dots of *Natica millepunctata*, allowing no species separation. Only a few workers (Philippi 1844; Mazzetti 1874; Seguenza 1880) regarded *tigrina* and *millepunctata* as distinct. Whatever the decision reached by the various authors, the character focused on was the color pattern. The only innovative contribution of that time is due to Brugnone (1880) who, regardless of the color, distinguished *tigrina* from *millepunctata* on the basis of

PLATE 8

Fig. 1 - *Cochlis depressofuniculata* (Sacco, 1891). Zinola; umbilicus of specimen in Pl. 1, fig. 1.

Fig. 2 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8774; umbilicus.

Fig. 3 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8775; umbilicus.

Fig. 4 - *Cochlis fulgurata* (Pecchioli, 1864). Calanchi di San Martino; umbilicus of specimen in Pl. 1, fig. 9.

Fig. 5 - *Cochlis fulgurata* (Pecchioli, 1864). Il Campino; umbilicus of specimen in Pl. 1, fig. 11.

Fig. 6 - *Cochlis fulgurata* (Pecchioli, 1864). Colli Astesi; umbilicus of specimen in Pl. 1, fig. 14.

Fig. 7 - *Cochlis fulgurata* (Pecchioli, 1864). Colli Astesi; umbilicus of specimen in Pl. 1, fig. 15.

Fig. 8 - *Cochlis fulgurata* (Pecchioli, 1864). Rocca d'Arazzo; umbilicus of specimen in Pl. 1, fig. 16.

Fig. 9 - *Cochlis fulgurata* (Pecchioli, 1864). Colli Astesi; umbilicus of specimen in Pl. 1, fig. 17.

Fig. 10 - *Cochlis plicatula* (Bronn, 1831). Ciuciano; umbilicus of specimen in Pl. 2, fig. 6.

Fig. 11 - *Cochlis plicatula* (Bronn, 1831). La Valle; umbilicus of specimen in Pl. 2, fig. 10.

Fig. 12 - *Cochlis canariensis* (Odhner, 1931). Off West Africa; umbilicus of specimen in Pl. 2, fig. 12.

Fig. 13 - *Natica dillwyni* (Payraudeau, 1826). Punta Ala; umbilicus of specimen in Pl. 2, fig. 13.

Fig. 14 - *Cochlis propinqua* (Pecchioli, 1864). Barca; umbilicus of specimen in Pl. 2, fig. 17.

Fig. 15 - *Cochlis propinqua* (Pecchioli, 1864). Barca; umbilicus of specimen in Pl. 2, fig. 18.

Fig. 16 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino I; umbilicus of specimen in Pl. 3, fig. 5.

Fig. 17 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino I; umbilicus of specimen in Pl. 3, fig. 7.

Fig. 18 - *Cochlis pseudoepiglottina* (Sacco, 1890). Guistrigona; umbilicus of specimen in Pl. 3, fig. 9.

Fig. 19 - *Cochlis raropunctata* (Sasso, 1827). Rio Torsero; umbilicus of specimen in Pl. 3, fig. 10.

Fig. 20 - *Cochlis raropunctata* (Sasso, 1827). Rio Torsero; umbilicus of specimen in Pl. 3, fig. 11.

Fig. 21 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8895; umbilicus.

Fig. 22 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8896; umbilicus.

Fig. 23 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8897; umbilicus.

Fig. 24 - *Cochlis raropunctata* (Sasso, 1827). Passerano; umbilicus of specimen in Pl. 3, fig. 16.

Fig. 25 - *Cochlis raropunctata* (Sasso, 1827). Bibbiano; umbilicus of specimen in Pl. 4, fig. 2.

Fig. 26 - *Nerita hebraea* Martyn, 1784. Adriatic Sea; umbilicus of specimen in Pl. 4, fig. 7.

Fig. 27 - *Nerita stercusmuscarum* Gmelin, 1791. Adriatic Sea; umbilicus of specimen in Pl. 4, fig. 8.

Fig. 28 - *Nerita canrena* Linneo, 1758. Gurarapari Channel, Espirito Santo, Brasil; umbilicus of specimen in Pl. 4, fig. 9.

Fig. 29 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano; umbilicus of paratype in Pl. 4, fig. 12.

Fig. 30 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano; umbilicus of paratype in Pl. 4, fig. 13.

Fig. 31 - *Cochlis strictiumbilicata* (Sacco, 1891). Caranchi; umbilicus of specimen in Pl. 4, fig. 20.

Fig. 32 - *Cochlis strictiumbilicata* (Sacco, 1891). Rio Torsero; umbilicus of specimen in Pl. 4, fig. 22.

Fig. 33 - *Cochlis sulcogradata* sp. n. Montaione; umbilicus of paratype in Pl. 5, fig. 6.

Fig. 34 - *Cochlis undata* (Sasso, 1827). Rio Torsero; umbilicus of specimen in Pl. 5, fig. 9.

Fig. 35 - *Cochlis undata* (Sasso, 1827). San Lorenzo in Collina. MPUM 8993; umbilicus.

Fig. 36 - *Cochlis undata* (Sasso, 1827). Savona; umbilicus of specimen in Pl. 5, fig. 12.

Fig. 37 - *Cochlis undata* (Sasso, 1827). Rio Torsero; umbilicus of specimen in Pl. 5, fig. 13.

Fig. 38 - *Cochlis vittata* (Gmelin, 1791). Il Treppié; umbilicus of specimen in Pl. 6, fig. 9.

Fig. 39 - *Cochlis vittata* (Gmelin, 1791). La Catena; umbilicus of specimen in Pl. 6, fig. 2.

Fig. 40 - *Cochlis vittata* (Gmelin, 1791). Fuengirola, Spain; umbilicus of specimen in Pl. 6, fig. 10.

Fig. 41 - *Natica virguloides* Sacco,1890. Il Campino; umbilicus of specimen in Pl. 6, fig. 13.

Fig. 42 - *Nerita vitellus* Linnaeus, 1758. India; umbilicus of specimen in Pl. 6, fig. 16.


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All scale bars : 4 mm

shell and opercular differences. Subsequent authors disregarded Brugnone's remarks and this led to considerable confusion later on. It is during the second half of the past century that the separation of the present species from *millepunctata* has been widely accepted, ordinarily using the name *tigrina*. The problem with the taxon considered herein is twofold and concerns 1) the relations with the Recent form and 2) the name to be used.

Concerning the first point, *Natica millepunctata* Lamarck, 1822 resembles the present species in terms of shell features and color patterns but, as already remarked by Brugnone (1880) and Ruggieri (1949), has a quite different operculum with many ribs instead of two; its protoconch (Pl. 7, fig. 10) is also different in that has significantly greater diameter (Fig. 4, Tab. 2) and remarkably larger tip (Fig. 5, Tab. 3). Consequently, *Cochlis raropunctata* has no relation with *Natica millepunctata* which, on account of the opercular features, likely belongs to the genus *Naticarius* Duméril, 1806. It is worthy to note that *Natica millepunctata* is a junior synonym of *Nerita stercusmuscarum* Gmelin, 1791 (cf. Kabat 1990; Poppe & Goto 1991).

Defrance (1825) proposed *Natica tigrina* on the basis of specimens recovered "dans le Plaisantin, dans le Piémont, aux environs de Sienne et de Bordeaux" and considered it to be so strongly related to *Natica millepunctata* that "on pourroit la regarder comme identique avec elle, si les taches dont cette dernière étoit couverte n'étoient pas beaucoup plus petites que celles qu'on voit encore sur les coquilles fossiles de cette espèce". Shortly after Grateloup (1827) redescribed more accurately *Natica tigrina* on the basis of Lower Miocene shells from St-Paul-lès-Dax and, later (1847), published several illustrations of it, which are the first that can be referred to. It is apparent that the name *tigrina*, as originally intended, applies to both Miocene and Pliocene fossils. Cossmann & Peyrot (1919), discussing Defrances' taxon, noted that the Pliocene specimens are different from those of the Miocene and concluded that two species are to be distinguished. They suggested to use the name *tigrina* to designate the French Miocene species, the name *raropunctata* Sasso, 1827 for the Mediterranean Pliocene species. Ruggieri (1949) followed this same line on the authority of Cossmann & Peyrot. Recently, Lozouet et al. (2001) adopted another decision in that retained the name *tigrina* for the Pliocene fossils on the ground of its wide use with reference to the Mediterranean material of that age, and proposed *crassiuscula*, a variety of *tigrina* introduced by Grateloup (1847), for the French Miocene shells.

We have examined a lot of Lower Miocene specimens from Aquitaine, which fully conform to the figures of *Natica tigrina* offered by Grateloup (1847) and Cossmann & Peyrot (1919), and can state that they actually differ from the Pliocene shells herein considered in several respects. In fact, the French shells are in comparison higher, more globular, have more elevated and distinctly stepped spire, better defined shoulder slope, less expanded body whorl, more or less depressed funicle, and broad, low umbilical callus merging into the parietal callus; unfortunately, nothing can be said as regards the protoconch and the operculum. Concerning the names to be used, we concur with Cossmann & Peyrot (1919) and Ruggieri (1949) in recommending *tigrina* Defrance, 1825 as much advisable for the Miocene material, also on the ground of the use made of it by Grateloup who stands as the most significant reference author after Defrance. The name *raropunctata* Sasso, 1827 is the next available one and, being based on Pliocene shells from Western Liguria (Rio Torsero), perfectly applies to the Pliocene specimens of the Mediterranean area. Consequently, the Pliocene species currently referred to as *tigrina* Defrance, 1825 by the authors is to be named *Cochlis raropunctata* Sasso, 1827. It is worthy to note that *Natica tigrina* Defrance is not a synonym of *Cochlis tigrina* Röding, 1798. This latter is a widespread Indo-West Pacific species that resembles *tigrina* Defrance only superficially (color pattern), but exhibits quite different umbilical features and is currently assigned to the genus *Paratectonatica* Azuma, 1961.

The Burdigalian Dutch shells figured by Janssen (1984) and referred to as *Natica tigrina* Defrance, 1825 appear to differ markedly from the present species, primarily in terms of opercular characters. In fact, those opercula exhibit a massive inner ridge which is quite unlike that of *tigrina* of the authors, i.e. of *Cochlis raropunctata*. According to the figures published by Janssen, a close similarity is to be noted with the operculum of *Natica hoernesi* Fischer & Tournouer, 1873.

Stratigraphic occurrence. On the basis of reliable literature data, *C. raropunctata* (Sasso, 1827) seems the have appeared in the Tortonian and occurs at several Late Miocene locations of Italy. The Miocene records outside Italy refer to taxa other than *raropunctata* (*tigrina* auctorum, not Defrance) or need to be confirmed. The species is widespread in the Pliocene deposits of Southern Europe. Uncommon occurrences show that *raropunctata* has survived during the Early Pleistocene and might have reached extinction toward the end of it.

Cochlis raropunctata obliquicallosa subsp. n.

Pl. 4, figs 11-19; Pl. 7, fig. 12; Pl. 8, fig. 29, 30; Pl. 9, figs 20-22; Pl. 10, figs 25, 26

Derivation of name. From Latin *obliquus* = oblique and *callosus* = callused, with reference to the umbilical callus obliquely connected to the parietal callus.

Holotype. Ciuciano: MPUM 8953 (Pl. 4, fig. 11; Pl. 10, fig. 25).

Paratypes. Ciuciano: 1 spm., MPUM 8954 (Pl. 4, fig. 12; Pl. 8, fig. 29); 1 spm., MPUM 8955 (Pl. 4, fig. 13; Pl. 8, fig. 30); 1 spm., MPUM 8956 (Pl. 4, fig. 14); 1 spm., MPUM 8957 (Pl. 4, fig. 15); 1 spm., MPUM 8958 (Pl. 4, fig. 16); 1 spm., MPUM 8959 (Pl. 4, fig. 17); 1 spm., MPUM 8960 (Pl. 4, fig. 18); 1 spm., MPUM 8961 (Pl. 4, fig. 19); 1 spm., MPUM 8962 (Pl. 7, fig. 12); 1 spm., MPUM 8963 (Pl. 9, fig. 20); 1 spm., MPUM 8964 (Pl. 9, fig. 21); 1 spm., MPUM 8965 (Pl. 9, fig. 22); 1 spm., MPUM 8966 (Pl. 10, fig. 26); 28 spms., MPUM 8967; 362 spms., NP 8377-8738; 104 spms., PPMM 47897-48000; 16 spms., MGC 696-711.

Preservation. The bulk of the material is perfectly preserved.

Type-locality. Ciuciano (see Appendix).

Horizon. Yellowish, fine sand of Zanclean age.

Diagnosis. Globose, low-spired and moderately depressed shell with wide umbilicus, thick funicle and rather large umbilical callus obliquely extended to merge into the parietal callus; marginal area of the operculum with 2 ridges and 2 furrows.

Characters

Protoconch: small, depressed turbiniform of 1.25 gently convex, smooth whorls, tip medium-sized.

Shell: globose, moderately depressed, solid.

Spire: low-conical, depressed, whorls moderately convex.

Suture: linear, occasionally slightly incised, adpressed.

Body whorl: inflated, somewhat depressed, produced and moderately expanded toward the aperture, with distinct, gently sloping subsutural shelf.

Aperture: D-shaped, height averaging 1.5 times the width.

Parietal callus: thick, quadrangular or slightly narrowing abapically, ending some distance from the basal fasciole; anterior lobe indistinct.

Umbilicus: wide.

Funicle: usually thick, separated from the basal fasciole by a rather narrow furrow.

Umbilical callus: medium to large, thin to thick, with depressedly arched outline, inclined toward the interior of the umbilicus, located at the abapical one-third of the columellar lip, obliquely extended to merge into the parietal callus.

Basal fasciole: wide, sharply edged abaxially by a low step.

Surface: with dense and fine, gently prosocline growth lines, slightly stronger on subsutural shelf and basal fasciole; an exceedingly faint spiral striation is noted on the body whorl.

Color: background brown to light-brown with reddish-brown pattern which may consist of

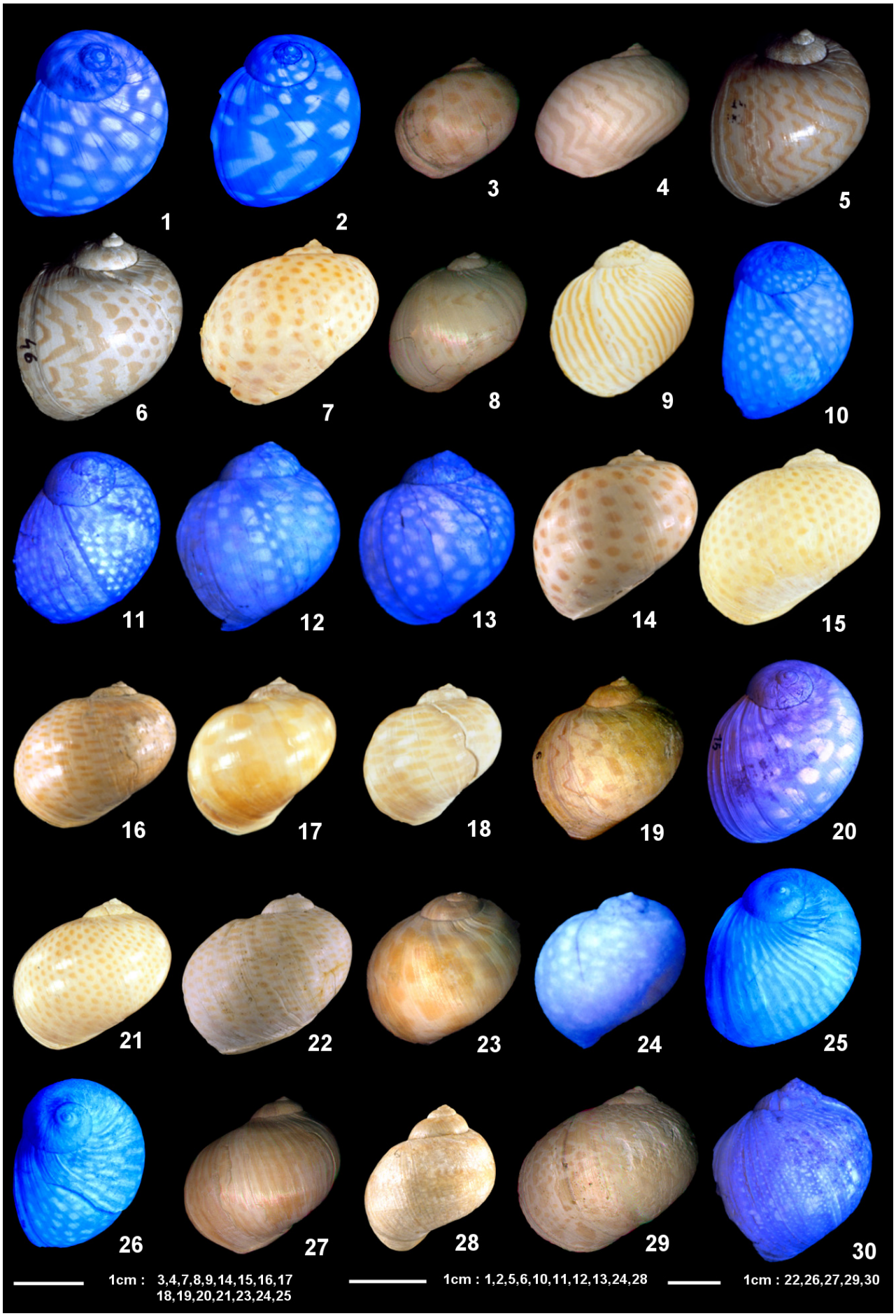
- usually crowded, small and even dots often arranged in collabral rows;
- uneven, irregularly arranged spots;
- spirally elongated spots;
- irregular spiral broken lines.

Operculum:

- moderately thick to very thick, solid;
- central callus well developed, elongate, tongue-shaped, usually prominent;
- inner margin straight, with more or less distinct, blunt transverse ridges;
- inner surface nearly flat, nucleus not protruding;
- outer surface planar, usually with 2 well defined marginal grooves and 2 ridges;

PLATE 9

Fig. 1 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8776; color pattern.
Fig. 2 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8777; color pattern.
Fig. 3 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8778; color pattern.
Fig. 4 - *Cochlis fulgurata* (Pecchioli, 1864). Corazzano. MPUM 8789; color pattern.
Fig. 5 - *Cochlis fulgurata* (Pecchioli, 1864). Marcialla. Private collection; color pattern.
Fig. 6 - *Cochlis fulgurata* (Pecchioli, 1864). Ciuciano. Private collection; color pattern.
Fig. 7 - *Cochlis fulgurata* (Pecchioli, 1864). Bibbiano. MPUM 8790; color pattern.
Fig. 8 - *Cochlis plicatula* (Bronn, 1831). Rio Rosello. MPUM 8821; color pattern.
Fig. 9 - *Cochlis propinqua* (Pecchioli, 1864). Montezago. MPUM 8838; color pattern.
Fig. 10 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino II. MPUM 8857; color pattern.
Fig. 11 - *Cochlis pseudoepiglottina* (Sacco, 1890). San Lorenzo in Collina. MPUM 8858; color pattern.
Fig. 12 - *Cochlis pseudoepiglottina* (Sacco, 1890). Bacedasco. MPUM 8860; color pattern.
Fig. 13 - *Cochlis pseudoepiglottina* (Sacco, 1890). San Lorenzo in Collina. MPUM 8859; color pattern.
Fig. 14 - *Cochlis raropunctata* (Sasso, 1827). Rio Rosello; color pattern of specimen in Pl. 4, fig. 1.
Fig. 15 - *Cochlis raropunctata* (Sasso, 1827). Villalvernia. MPUM 8904; color pattern..
Fig. 16 - *Cochlis raropunctata* (Sasso, 1827). Villalvernia; color pattern of specimen in Pl. 3, fig. 14.
Fig. 17 - *Cochlis raropunctata* (Sasso, 1827). Rio Torsero. Topotype, MPUM 8905; color pattern.
Fig. 18 - *Cochlis raropunctata* (Sasso, 1827). San Pietro. MPUM 8906; color pattern.
Fig. 19 - *Cochlis raropunctata* (Sasso, 1827). Bibbiano. MPUM 8907; color pattern.
Fig. 20 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8963; color pattern.
Fig. 21 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8964; color pattern.
Fig. 22 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8965; color pattern.
Fig. 23 - *Cochlis strictiumbilicata* (Sacco, 1891). Caranchi; color pattern of specimen in Pl. 4, fig. 21.
Fig. 24 - *Cochlis sulcogradata* sp. n. Montaione. Paratype, MPUM 8979; color pattern.
Fig. 25 - *Cochlis undata* (Sasso, 1827). San Lorenzo in Collina. MPUM 8994; color pattern.
Fig. 26 - *Cochlis undata* (Sasso, 1827). San Lorenzo in Collina. MPUM 8995; color pattern.
Fig. 27 - *Cochlis undata* (Sasso, 1827). Villalvernia. MPUM 8996; color pattern.
Fig. 28 - *Cochlis vittata* (Gmelin, 1791). Il Campino. Private collection; color pattern.
Fig. 29 - *Natica virguloides* Sacco,1890. Bibbiano. MPUM 8743; color pattern.
Fig. 30 - *Natica virguloides* Sacco,1890. Montaione. MPUM 8750; color pattern.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1cm : 22,26,27,29,30

• outer groove rather wide, moderately deep, obsolescent in some specimens, occasionally with granules arranged into longitudinal rows;

• inner groove of various breadth, usually narrower and somewhat less excavated than the outer one, sometimes attenuated or obsolete;

• outer ridge sharp to round-topped;

• inner ridge usually well developed, thin to thick, with sharp to flat top, seldom obsolete.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.360*	0.698*	28.88-42.76	29.94-43.38	3.54-8.82	24.07-35.19	16.98-22.74
* 1 protoconch measurable		35.82	36.66	6.18	29.63	19.86
UW	WUC	WAD	WAB	IS	SA	
11.82-19.74	2.69-6.53	4.83-9.67	2.11-5.71	13°-37°	114°-154°	
15.78	4.61	7.25	3.91	25°	134°	

Remarks. *Cochlis raropunctata obliquicallosa* shares the bulk of the characters with the nominal subspecies. It is distinguished from this latter in that has the spire significantly lower and, primarily, the outline of the umbilical callus obliquely extended to merge into the parietal callus. Being this feature quite constant, it seems advisable to keep the present form as a separate, local subspecies.

Stratigraphic occurrence. *C. raropunctata obliquicallosa* subsp. n. was recovered only from Zanclean deposits at Ciuciano (Siena Province). There, it was never found to co-occur with the nominal subspecies.

Cochlis strictiumbilicata (Sacco, 1891) comb. nov.

Pl. 4, figs 20-22; Pl. 5, figs 1-4; Pl. 7, fig. 13; Pl. 8, figs 31, 32; Pl. 9, fig. 23; Pl. 10, fig. 27, L

1890 *Natica (Natica) epiglottina* var. *millepunctatoides* subv. *strictoumbilicata* Sacco, p. 29 (nomen nudum).

1890 *Natica* (*Natica*) *epiglottina* var. *millepunctatoides* subv. *elatoligustica* Sacco, p. 29 (nomen nudum).

1891 *Natica* (*Natica*) *epiglottina* var. *strictiumbilicata* Sacco, p. 61.

1891 *Natica* (*Natica*) *epiglottina* var. *elatoligustica* Sacco, p. 61.

1904 *Natica* (*Natica*) *epiglottina* var. *strictiumbilicata* - Sacco, p. 102, pl. 22, fig. 25.

1904 *Natica* (*Natica*) *epiglottina* var. *elatoligustica* - Sacco, p. 102, pl. 22, fig. 26.

1980 *Naticarius tigrinus* - Pavia, p. 251 (pars), 255, pl. 6, fig. 5, text-fig. 2D, 6 (not Defrance, 1825).

1984 *Natica epiglottina* var. *strictiumbilicata* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 31.

1984 *Natica epiglottina* var. *elatoligustica* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 31.

1996 *Natica virguloides* - Pedriali, p. 6 (pars), pl. 2, fig. 6 (not Sacco, 1891).

1999 *Natica strictiumbilicata* - Solsona & Martinell, p. 412, text-fig. 3, n. 1-5, 12, 13; text-fig. 4, n. 1-4; text-fig. 6.

Type material. The lectotype of *Natica (Natica) epiglottina* var. *strictiumbilicata* Sacco (designated by Solsona & Martinell, 1999): the shell figured by Sacco (1904, pl. 22 fig. 25), MGPT BS.029.01.039 and 2 paralectotypes, MGPT BS.029.01.039/01 (Savona); 1 paralectotype, MGPT BS.029.01.039/02 (Albenga); 1 paralectotype, MGPT BS.029.01.039/03 (Carrù).

Other type material. The holotype (monotypy) of *Natica (Natica) epiglottina* var. *elatoligustica* Sacco: the shell figured by Sacco (1904, pl. 22, fig. 26), MGPT BS.029.01.041 (Albenga).

Other material examined. Caranchi: 14 spms. (NP 8741-8754), 2 spms. (MPUM 8968-8969); Rio Torsero: 18 spms. (NP 8769-8786), 1 spm. (MPUM 8970), 1 spm. (MPUM 8972), 1 spm. (MPUM 8973), 6 spms. (MPUM 8974), 1 spm. (MGC 712); Badagnano: 2 spms. (NP 8739-8740), 1 spm. (MPUM 8971); Castell'Arquato: 14 spms. (NP 8755-8768).

Characters

Protoconch: small, depressed turbiniform of 1.25 gently convex, smooth whorls, tip large.

Shell: globose, rather solid.

Spire: low-conical, moderately depressed, whorls gently convex.

Suture: very thin, adpressed.

Body whorl: inflated, moderately produced and slightly expanded toward the aperture, with more or less distinct, gently sloping subsutural shelf.

Aperture: D-shaped, height averaging 1.6 times the width.

Parietal callus: thick, narrowing abapically, ending close to but not reaching the basal fasciole; anterior lobe indistinct.

Umbilicus: moderately wide.

Funicle: depressed, broad, separated from the basal fasciole by a rather narrow groove.

Umbilical callus: rather large and thick, depressedly semicircular in outline, asymmetrical, located just abapical to the middle of the columnellar lip and separated from the parietal callus by a shallow, narrow sinuation.

Basal fasciole: moderately wide, not prominent at all, defined abaxially by the sudden bending of the growth lines.

Surface: with dense, fine, gently prosocline growth lines, somewhat stronger on the subsutural shelf; a spiral microstriation is noted on the body whorl.

Color: background pale brown with a reddish pattern of uneven, irregularly arranged spots.

Operculum:

• very thick, solid;

• central callus prominent, elongate, tongue-shaped;

• inner margin triflingly arched, with strong, blunt, transverse ridges;

• inner surface planar, nucleus slightly sunken;

• outer surface irregular but planar as a whole, with 2 marginal grooves and 2 ridges;

• outer and inner groove approximately of the same breadth, deep, the inner one more so; outer groove with flat bottom and vertical, concave sides; inner groove bounded adaxially by a distinct angulation, with vertical outer side and inward sloping inner side;

• outer ridge rather thin, moderately sharp;

• inner ridge massive, with bluntly rounded top and slightly concave sides.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.421*	0.725*	13.96-25.40	14.14-22.94	2.88-5.72	10.94-19.82	6.63-12.19
* 1 protoconch measurable		19.68	18.54	4.30	15.38	9.41
UW	WUC	WAD	WAB	IS	SA	
2.98-7.66	2.60-4.40	0.00-2.67	0.00-1.67	18°-34°	105°-125°	
5.32	3.50	1.31	0.65	26°	115°	

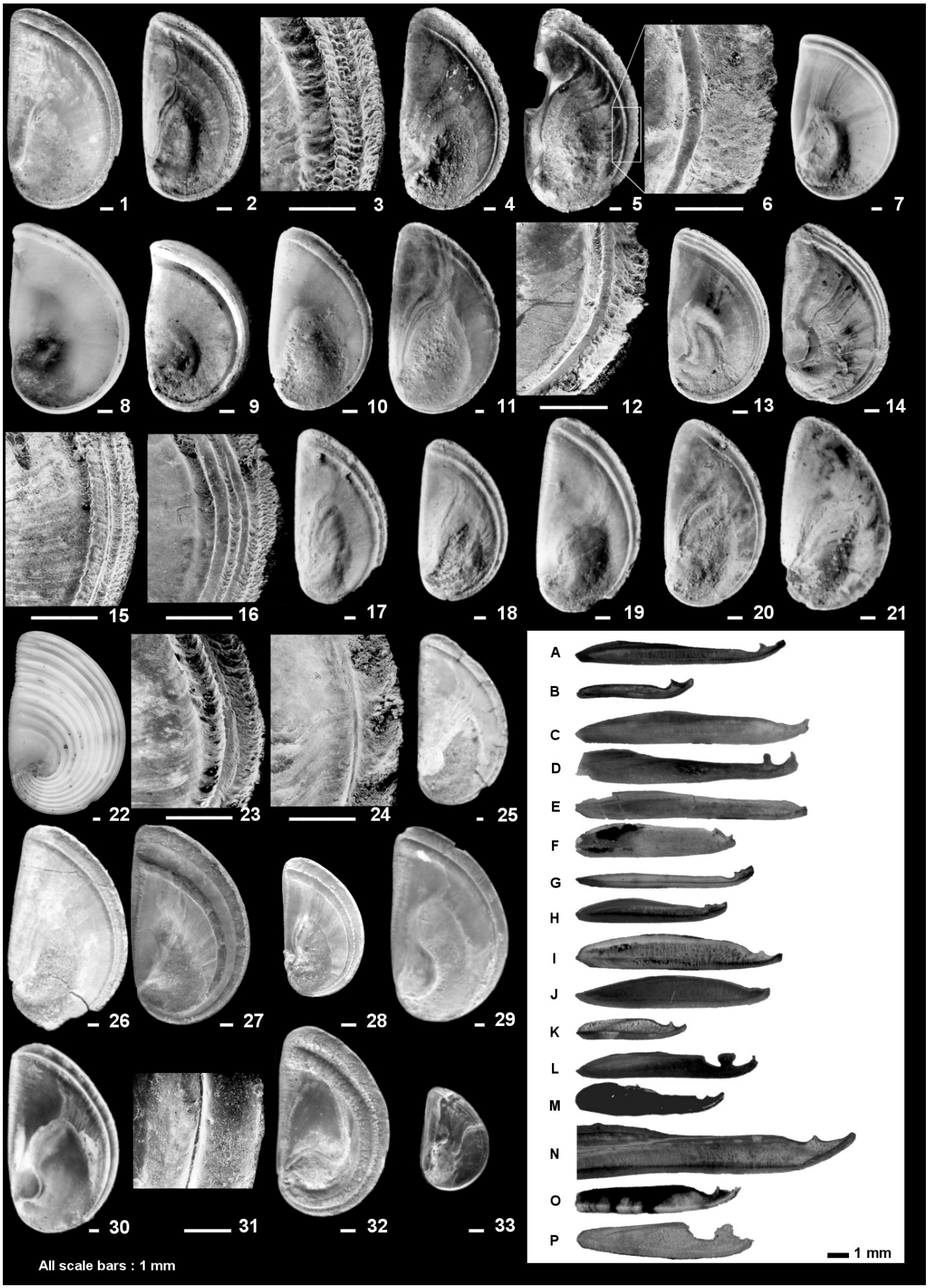
Remarks. The present taxon was originally established by Sacco (1891) as a variety of *Natica epiglottina* Lamarck, 1804 with which it is actually unrelated. In terms of teleoconch characters, *Cochlis strictiumbilicata* is much more similar to *Cochlis pseudoepiglottina* (Sacco, 1890), but this latter has a multispiral larval shell with small nucleus, while the protoconch of *strictiumbilicata* is paucispiral with large nucleus, this difference accounting for specific separation (Solsona & Martinell 1999). On the basis of the protoconch features, *Cochlis strictiumbilicata* is included in what we have informally called *raropunctata* group (see above). It is differentiated from the other species in this group primarily in that has the umbilical callus significantly greater (Fig. 13A) and a distinctive operculum (Tab. 10; Pl. 10, fig.

PLATE 10

Fig. 1 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II; operculum of specimen in Pl. 1, fig. 2.
Fig. 2 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8779; operculum.
Fig. 3 - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8780; detail of the marginal area of the operculum.
Fig. 4 - *Cochlis fulgurata* (Pecchioli, 1864). Marcialla; operculum of specimen in Pl. 1, fig. 10.
Fig. 5 - *Cochlis fulgurata* (Pecchioli, 1864). Calanco di San Martino; operculum of specimen in Pl. 1, fig. 9.
Fig. 6 - *Cochlis fulgurata* (Pecchioli, 1864). Detail of the operculum in fig. 5.
Fig. 7 - *Cochlis plicatula* (Bronn, 1831). Castell'Arquato. MPUM 8822; operculum.
Fig. 8 - *Cochlis canariensis* (Odhner, 1931). West Africa. MPUM 8828; operculum.
Fig. 9 - *Natica dillwyni* Payraudeau, 1826. Punta Ala. Private collection; operculum.
Fig. 10 - *Cochlis propinqua* (Pecchioli, 1864). Montezago; operculum of specimen in Pl. 2, fig. 16.
Fig. 11 - *Cochlis propinqua* (Pecchioli, 1864). Barca. MPUM 8839; operculum.
Fig. 12 - *Cochlis propinqua* (Pecchioli, 1864). Barca. Private collection; detail of the marginal area of the operculum.
Fig. 13 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino II. MPUM 8861; operculum.
Fig. 14 - *Cochlis pseudoepiglottina* (Sacco, 1890). San Lorenzo in Collina. MPUM 8863; operculum.
Fig. 15 - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino II. MPUM 8862; operculum.
Fig. 16 - *Cochlis pseudoepiglottina* (Sacco, 1890). San Lorenzo in Collina. MPUM 8864; operculum.
Fig. 17 - *Cochlis raropunctata* (Sasso, 1827). Bacedasco. MPUM 8908; operculum.
Fig. 18 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8909; operculum.
Fig. 19 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8910; operculum.
Fig. 20 - *Cochlis raropunctata* (Sasso, 1827). Linari. MPUM 8911; operculum.
Fig. 21 - *Cochlis raropunctata* (Sasso, 1827). Linari. MPUM 8912; operculum.
Fig. 22 - *Nerita canrena* Linnaeus, 1758. Gurarapari Channel, Espirito Santo, Brasil; operculum of specimen in Pl. 4, fig. 9.
Fig. 23 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8913; detail of the marginal area of the operculum.
Fig. 24 - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8914; detail of the marginal area of the operculum.
Fig. 25 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano; operculum of specimen in Pl. 4, fig. 11 (holotype).
Fig. 26 - *Cochlis raropunctata obliquicallosa* subsp. n. Ciuciano. Paratype, MPUM 8966; operculum.
Fig. 27 - *Cochlis strictiumbilicata* (Sacco, 1891). Caranchi; operculum of specimen in Pl. 4, fig. 20.
Fig. 28 - *Cochlis sulcogradata* sp. n. Montaione. Paratype, MPUM 8980; operculum.
Fig. 29 - *Cochlis undata* (Sasso, 1827). Rio Torsero; operculum of specimen in Pl. 5, fig. 9.
Fig. 30 - *Cochlis undata* (Sasso, 1827). Barca; operculum of specimen in Pl. 5, fig. 11.
Fig. 31 - *Cochlis undata* (Sasso, 1827). San Lorenzo in Collina. MPUM 8997; detail of the marginal area of the operculum.
Fig. 32 - *Natica virguloides* Sacco, 1890. Montaione; operculum of specimen in Pl. 6, fig. 11.
Fig. 33 - *Cochlis vittata* (Gmelin, 1791). La Catena; operculum of specimen in Pl. 6, fig. 2.

Opercular cross sections

A - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8781.
B - *Cochlis depressofuniculata* (Sacco, 1891). Pradalbino II. MPUM 8782.
C - *Cochlis fulgurata* (Pecchioli, 1864). Il Campino. MPUM 8792.
D - *Cochlis plicatula* (Bronn, 1831). Linari. MPUM 8823.
E - *Cochlis propinqua* (Pecchioli, 1864). Rio del Mulino di Serralunga. MPUM 8840.
F - *Cochlis propinqua* (Pecchioli, 1864). Balze di Caspreno. MPUM 8841.
G - *Cochlis pseudoepiglottina* (Sacco, 1890). Pradalbino II. MPUM 8866.
H - *Cochlis pseudoepiglottina* (Sacco, 1890). San Lorenzo in Collina. MPUM 8865.
I - *Cochlis raropunctata* (Sasso, 1827). Badagnano. MPUM 8915.
J - *Cochlis raropunctata* (Sasso, 1827). Pradalbino I. MPUM 8916.
K - *Cochlis raropunctata* (Sasso, 1827). Balzo del Musico. MPUM 8917.
L - *Cochlis strictiumbilicata* (Sacco, 1891). Rio Torsero. MPUM 8973.
M - *Cochlis sulcogradata* sp. n. Montaione. Paratype, MPUM 8981.
N - *Cochlis undata* (Sasso, 1827). San Lorenzo in Collina; cross section of operculum in fig. 31.
O - *Cochlis undata* (Sasso, 1827). Belveglio; MPUM 8998.
P - *Natica virguloides* Sacco, 1891. Le Grottine. MPUM 8752.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27, L). *Natica (Natica) epiglottina* var. *elatoligustica* Sacco (1891) is indistinguishable from *strictiumbilicata*.

Stratigraphic occurrence. *C. strictiumbilicata* (Sacco, 1891) is a Lower-Mid Pliocene element occurring uncommonly in a few localities in Southern France and Northern Italy (Liguria, Piedmont and Emilia regions).

Cochlis sulcogradata sp. n.

Pl. 5, figs 5-8; Pl. 7, figs 14, 15; Pl. 8, fig. 33; Pl. 9, fig. 24; Pl. 10, fig. 28, M

1914 *Natica millepunctata* - Cerulli-Irelli, p. 214 (pars), pl. 19, fig. 4 (not Lamarck, 1822).

1971 *Natica tigrina* - D'Alessandro, p. 380, 382, 385, pl. 1, fig. 2-2b (not Defrance, 1825).

Derivation of name. From Latin *sulcus* = furrow and *gradatus* = stepped, with reference to the opercular inner groove bounded adaxially by an abrupt, step-like angulation.

Holotype. Montaione: MPUM 8975 (Pl. 5, fig. 5).

Paratypes. Torrente Stirone: 1 spm., private collection (Pl. 5, fig. 8; Pl. 7, fig. 15). Bibbiano: 51 spms., NP 8787-8838; 2 spms., PPMM 48268-48269; 1 spm., MPUM 8977 (Pl. 5, fig. 7). Bibbiano: 2 spms., NP 8914-8915. Montaione: 75 spms., NP 8839-8913; 43 spms., PPMM 48270-48312; 1 spm., MPUM 8976 (Pl. 5, fig. 6; Pl. 8, fig. 33);

1 spm., MPUM 8978 (Pl. 7, fig. 14); 1 spm., MPUM 8979 (Pl. 9, fig. 24); 1 spm., MPUM 8980 (Pl. 10, fig. 28); 1 spm., MPUM 8981 (Pl. 10, fig. M); 11 spms., MPUM 8982; 5 spms., MGC 713-717.

Preservation. The bulk of the material is fairly well preserved.

Type-locality. Montaione (see Appendix).

Horizon. Gray medium to coarse pebbly sand of Zanclean age.

Diagnosis. Globose, low-spired and moderately depressed shell with wide to moderate umbilicus, thick funicle and broad umbilical callus separated from the parietal callus by a reverse J-shaped notch; marginal area of the operculum with 2 ridges and 2 broad furrows, the inner one bounded adaxially by an abrupt, step-like angulation.

Characters

Protoconch: small, depressed turbiniform of 1.25 gently convex, smooth whorls, tip large.

Shell: globose, moderately depressed, thin to solid.

Spire: low-conical, moderately depressed, whorls rather convex.

Suture: linear, slightly incised.

Body whorl: inflated, somewhat depressed, produced and moderately expanded toward the aperture, with poorly defined, gently sloping subsutural shelf.

Aperture: D-shaped, height about twice the width.

Parietal callus: rather thin and short, ending some distance from the basal fasciole; anterior lobe indistinct.

Umbilicus: wide to moderate.

Funicle: a thick, prominent cord, separated from the basal fasciole by a narrow, relatively deep furrow.

Umbilical callus: broad and moderately thick, prominently semicircular in outline, located nearly at the abapical one-third of the inner lip and separated from the parietal callus by a shallow and wide reverse J-shaped notch.

Basal fasciole: wide and blunt, defined abaxially by the deviation of the growth lines or by a spiral, incised line.

Surface: with dense and fine, gently prosocline growth lines, slightly stronger on subsutural shelf and basal fasciole; an exceedingly faint spiral striation occurs on body whorl.

Color: background light-brown, with reddish-brown pattern which may consist of

- usually crowded, small and even dots often arranged in collabral rows;
- large, even spots irregularly arranged in collabral rows;
- spirally elongated spots.

Operculum:

- moderately thick, solid;
- central callus distinct, elongate, tongue-shaped;
- inner margin straight, with uneven granules more evident adapically;
- inner surface nearly flat, nucleus not protruding;
- outer surface planar, distinctly concave in small specimens, with 2 well defined marginal grooves and 2 ridges;
- grooves wide, regularly arched in cross section, with dense granules sometimes forming 1-2 secondary thin ridges; inner groove bounded adaxially by an abrupt angulation, sharper in young specimens;
- outer ridge sharp to round-topped;
- inner ridge laminar with toothed edge.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.429-0.544	0.820-0.975	9.48-19.88	9.05-19.05	1.55-4.55	7.71-15.55	4.26-10.54
0.466	0.886	14.68	14.05	3.05	11.63	7.40
UW	WUC	WAD	WAB	IS	SA	
2.97-9.37	0.67-2.55	1.30-4.50	0.78-2.54	16°-36°	116°-144°	
6.17	1.61	2.90	1.66	26°	130°	

Remarks. The present new species is characterized by the opercular features (Tab. 10, 16). It is of note that the first illustration of it was unawares provided by Cerulli Irelli (1914) who figured, from the "Calabrian" of Monte Mario, a nicely preserved shell (pl. 19, fig. 4) referred to as *Natica millepunctata* Lamarck, 1822. The operculum of that shell, still filling the aperture, exhibits the wide inner groove bounded adaxially by the abrupt angulation, which is the distinguishing character of *Cochlis sulcogradata* sp. n.

Cochlis sulcooperculata (Ruggieri, 1949), originally proposed as a variety of *Natica raropunctata* Sasso, 1827, appears to be closely related, but can be easily differentiated on the basis of the operculum (Fig. 15). In fact, the inner furrow is manifestly shallower and broader, at least twice as wide as the outer one, and is bordered adaxially by a very gentle slope, never by a step-like, sharp angulation as in *sulcogradata*. This difference proved to be quite stable and constant.

Ruggieri (1949, 1962) noted that the *sulcooperculata*-like opercula, already appeared during the Pliocene, largely replace those of *Natica raropunctata* by the Early Pleistocene. Thus, the author remarked the

possible stratigraphic bearing of these calcareous plates for the Pliocene-Pleistocene time span. Subsequent workers quoted *sulcooperculata* from Early Pleistocene deposits and some of them regarded it as a marker for this stage (cf. Di Geronimo 1969 and Barsotti et al. 1974). More recently, Pavia (1980) treated *sulcooperculata* as a form of *Naticarius tigrinus* (of the authors, not Defrance, 1825; see comments under *Cochlis raropunctata*) and acknowledged that the opercula of the former become more common in the Early Pleistocene concomitant with the decreasing abundance of those of the latter form, but put not much enphasis on this. It is noteworthy that the opercula figured by Pavia and referred to as *sulcooperculata* are herein considered to belong to *Cochlis undata* (Sasso, 1827). Our evidence suggests that *sulcooperculata* is a reliable Early Pleistocene marker. The Pliocene opercula formerly assigned to the latter species actually belong to *sulcogradata*, which co-occurred with *sulcooperculata* during the Pleistocene (cf. Cerulli Irelli 1914 and D'Alessandro 1971).

Stratigraphic occurrence. *C. sulcogradata* sp. n. had already appeared by the Lower Pliocene, as documented by our findings in Tuscany. It seems to have reached extinction toward the end of the Lower Pleistocene. The species appears to be restricted to Italy.

Cochlis undata (Sasso, 1827) comb. nov.

Pl. 5, figs 9-17; Pl. 7, figs 16, 17; Pl. 8, figs 34-37; Pl. 9, figs 25-27; Pl. 10, figs 29-31, N, O

1827 *Natica undata* Sasso, p. 477.

1890 *Natica (Natica) millepunctata* var. *epiglottinoformis* Sacco, p. 29.

not *Natica (Natica) millepunctata* var. *undata* - Sacco, p. 54 (= *Natica fulgurata* Pecchioli, 1864).

1891 *Natica* (*Natica*) *millepunctata* var. *epiglottinoformis* – Sacco, p. 55 (pars), pl. 2, fig. 21.

1891 *Natica* (*Natica*) *epiglottina* var. *perfuniculata* Sacco, p. 60.

1891 *Natica* (*Natica*) *epiglottina* var. *umbilicopatens* Sacco, p. 60.

1904 *Natica* (*Natica*) *epiglottina* var. *perfuniculata* Sacco, p. 102, pl. 22, fig. 23.

1980 *Naticarius tigrinus* – Pavia, p. 251 (pars), pl. 6, fig. 1 (not Defrance, 1825).

1980 *Naticarius tigrinus* morfotype *sulcooperculatus* - Pavia, p. 255, pl. 6, figs 4, 6; text-fig. 2F (not *Natica raropunctata* var. *sulcooperculata* Ruggieri, 1949).

1984 *Natica millepunctata* var. *epiglottinoformis* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

1984 *Natica epiglottina* var. *perfuniculata* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

1984 *Natica epiglottina* var. *umbilicopatens* - Ferrero Mortara, Montefameglio, Novelli, Opesso, Pavia & Tampieri, p. 30.

Uncertain references

Natica undata - Bronn, 1848: p. 788.

Natica millepunctata var. *raropunctata* - Fontannes, 1881: p. 111 (pars), pl. 7, fig. 8.

Natica millepunctata var. *epiglottiniformis* – Arduini, 1895: p. 184, n. 122.

Natica millepunctata - Cerulli-Irelli, 1914: p. 214 (pars), pl. 19, figs 3, 9.

Natica millepunctata var. *undata* - Hornung, 1920: p. 86.

Natica millepunctata epiglottinoformis - Caretto, 1963: p. 23, pl. 2, fig. 13.

Natica (Natica) millepunctata epiglottiniformis - Mastrorilli, 1963: 118, pl. 6, fig. 15.

Natica (Natica) tigrina - Malatesta, 1963: p. 236 (pars), pl. 18, fig. 8d.

Naticarius tigrinus var. *epiglottiniformis* - Pavia, 1980: p. 251.

Natica (Naticarius) tigrina - Cavallo & Repetto, 1992: text-fig. 121.

Type material. Not seen (syntypes of *Natica undata*, originally in Museo Civico di Storia Naturale "G. Doria", Genova, not found and possibly lost).

Other type material. The lectotype of *Natica (Natica) millepunctata* var. *epiglottinoformis* Sacco (here designated): the shell figured by Sacco (1891, pl. 2, fig. 21) and refigured herein (Pl. 5, fig. 12), MGPT BS.029.01.026 (Savona); 1 paralectotype, MGPT BS.029.01.026/02 (Savona Fornaci); 2 paralectotypes, MGPT BS.029.01.026/03 (Albenga); 5 paralectotypes, MGPT BS.029.01.026/06 (Villalvernia). The lectotype of *Natica (Natica) epiglottina* var. *perfuniculata* Sacco (here designated): the shell figured by Sacco (1904, pl. 22, fig. 23), MGPT BS.029.01.033 (Colli Astesi). The lectotype of *Natica (Natica) epiglottina* var. *umbilicopatens* Sacco (here designated), MGPT BS.029.01.034 (Albenga).

Other material examined. Belveglio: 15 spms. (NP 8921-8935), 1 spm. (MPUM 8998); Casa Bosco: 4 spms. (NP 8972-8975); Passerano: 1 spm. (NP 9102); Pino d'Asti: 4 spms. (NP 9103-9106); Rio del Mulino di Serralunga: 8 spms. (NP 9124-9131), 1 spm. (MPUM 8990), 11 spms. (MPUM 9002); Valleandona: 4 spms. (NP 9327-9330); Valle Botto: 16 spms. (NP 9331-9346); Villalvernia: 7 spms. (NP 9347-9353), 9 spms. (PPMM 48333-48341), 1 spm. (MPUM 8996); Rio Torsero (topotypes) 7 spms. (NP 9132-9138), 1 spm. (MPUM 8983), 1 spm. (MPUM 8986), 2 spms. (MPUM 8991-8992), 5 spms. (MPUM 9003); Castell'Arquato: 1 spm. (NP8976); La Valle: 6 spms. (NP 9078-9083), 1 spm. (MPUM 8984); Montemaggiore: 1 spm. (NP 9101); Pradalbino I: 1 spm. (MPUM 9001); San Lorenzo in Collina: 142 spms. (NP 9139-9280), 3 spms. (MPUM 8987-8989), 3 spms. (MPUM 8993-8995), 2 spms. (MPUM 8997-8998), 49 spms. (MPUM 9004), 54 spms. (MPUM 9005), 3 spms. (MGC 718-720); Balze di Caspreno: 5 spms. (NP 8916-8920), 2 spms. (MPUM 8999); Barca: 46 spms. (NP 9281-9326), 4 spms. (PPMM 48329-48332), 1 spm. (MPUM 8985), 8 spms. (MPUM 9006); Bibbiano: 36 spms. (NP 8936-8971); Casa Cuccule: 4 spms. (NP 9071-9074); Ciuciano: 29 spms. (NP 8977-9005); Corazzano: 4 spms. (NP 9006-9009); Guistrigona: 61 spms. (NP 9010-9070); Linari: 17 spms. (NP 9084-9100), 2 spms. (PPMM 48342-48343); Podere Cavallara: 17 spms. (NP 9107-9123); Torrita di Siena: 3 spms. (NP 9075-9077), 1 spm. (MPUM 9000).

Characters

Protoconch: small, depressed turbiniform of 1.75 gently convex, smooth whorls, tip medium-sized.

Shell: depressed globose, moderately thin to thick.

Spire: low-conical, moderately depressed, whorls convex.

Suture: linear, adpressed.

Body whorl: inflated, somewhat depressed, moderately produced but not expanded toward the aperture, with distinct, gently sloping subsutural shelf.

Aperture: D-shaped, height averaging 1.5 times the width.

Parietal callus: rather thick, subquadrangular, ending some distance from the basal fasciole; anterior lobe indistinct.

Umbilicus: wide, largely filled by the funicle in some specimens.

Funicle: usually stout to very stout, separated from the basal fasciole by a slit-like furrow.

Umbilical callus: large to very large, thick, with prominently arched outline, located at the abapical one-third of the inner lip and separated from the parietal callus by a rather deep and wide, reverse J-shaped notch.

Basal fasciole: wide, triflingly prominent or not prominent at all, defined abaxially by the sudden deviation of the growth lines or by an incised spiral line.

Surface: with fine, dense, slightly prosocline growth lines somewhat stronger on the subsutural shelf; a very faint spiral striation occurs on the body whorl.

Color: background pale brown with a reddish pattern, which may consist of

- gently undulating collabral lines occasionally interrupted or partially replaced by variously shaped spots;
- axially elongated, oval spots arranged in collabral rows.

Operculum:

- moderately thick, solid;
- central callus broad, tongue-shaped, very slightly prominent to not prominent at all;
- inner margin straight, smooth or with blunt transverse ridges;
- inner surface nearly flat except for a bulge at the level of the nucleus resulting in a obtuse abapical angulation;
- outer surface planar, with 2 marginal grooves and 2 ribs;
- outer and inner grooves similar, wide and shallow, regularly arched in cross section;
- outer and inner ridges also similar, sharp, subvertical.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.343*	0.910*	16.48-37.60	16.68-36.52	1.89-9.17	14.08-28.92	8.24-19.76
* 1 protoconch measurable		27.04	26.60	5.53	21.5	14.00
UW	WUC	WAD	WAB	IS	SA	
5.42-16.86	2.33-5.69	1.85-9.05	0.22-3.14	11°-39°	117°-141°	
11.14	4.01	5.45	1.68	25°	129°	

Remarks. The species was described on the basis of Lower Pliocene material of Rio Torsero (Western Liguria). In the quite short original description, reference is made to the wide umbilicus and to the color pattern of dark-red, undulating collabral lines. Actually, the color pattern is only an additional useful feature, whereas the truly distinctive characters are: 1) the protoconch dimensions (Tab. 1-3), 2) the large to very large, prominent umbilical callus (Pl. 8, figs 34-37), and 3) the operculum with both grooves and ridges that are remarkably twin (Tab. 10; Pl. 10, figs 29-31, N, O). It is worthy to note that the correct orthography of the author's name is Sasso instead of Sassi as written by some workers.

The assignment of the material commented by Sacco (1891) and referred to as *Natica millepunctata* var. *undata* Sasso, 1827 is considered under *Cochlis fulgurata*.

Sacco (1890) created the var. *epiglottinoformis* (of *Natica millepunctata* Lamarck, 1822) on the basis of color features quite similar to those of *Cochlis undata*. We have examined the four specimens from Savona still present in the Bellardi-Sacco collection (MGPT) and can note that the figured shell (BS.029.01.026, originally labeled "tipo figurato" by Sacco) shares the characters of *Cochlis undata*. The other three (BS.029.01.026/01) positively belong to *Cochlis raropunctata* Sasso, 1827. The varieties *perfuniculata* and *umbilicopatens*, both of Sacco (1891) and ascribed by him to *Natica epiglottina* Lamarck, 1822, were also examined and proved to belong to *Cochlis undata*. Both Lamarck's species show no relation with the forms considered herein (see discussion under *Cochlis raropunctata* and *Cochlis pseudoepiglottina*).

Stratigraphic occurrence. *C. undata* (Sasso) occurs in Lower-Mid Pliocene deposits of Piedmont, Liguria, Emilia and Tuscany regions.

Cochlis vittata (Gmelin, 1791) comb. nov.

Pl. 6, figs 1-10; Pl. 7, fig. 18, 19; Pl. 8, figs 38-40; Pl. 9, fig. 28; Pl. 10, fig. 33

1791 *Nerita vittata* Gmelin, p. 3674, n. 18.

1889 *Natica pantanellii* De Stefani, p. 221, pl. 11 figs 14-15.

1976 *Natica (Natica) vittata vittata* - Kilburn, p. 835, fig. 3, right.

1991 *Naticarius vittatus* - Poppe & Goto, p. 120, pl. 17, figs 17, 18.

1997 *Natica (Natica) vittata* - Giannuzzi-Savelli, Pusateri, Palmeri & Ebreo, figs 749-750, 795.

2001 *Natica (Natica) vittata* - Della Bella & Scarponi, p. 68.

Type material. Not seen. Possibly included in Adanson collection (Muséum d'Histoire Naturelle, Paris) or in Spengler collection (Zoological Museum, Copenhagen).

Other type material. The lectotype of *Natica pantanellii* De Stefani (designated herein and figured in Pl. 6, fig. 1) and 1 paralectotype in DS/MSNF, both labeled IGF8590E (Castagno near Siena).

Other material examined. La Loggia: 1 spm. (NP 9432); Balzo del Musico: 1 spm. (MPUM 9018); Montezago: 1 spm. (NP 9509); Pradalbino II: 1 spm. (NP 9513); Rio Rosello: 1 spm. (PPMM 48240); Acquacalda: 11 spms. (NP 9354-9364), 6 spms. (MPUM 9017); Bibbiano: 7 spms. (NP 9365-9371), 2 spms. (NP 9510-9511), 2 spms. (MPUM 9022); Il Campino: 14 spms. (NP 9372-9385), 1 spm. (MPUM 9008), 1 spm. (MPUM 9016); Il Treppié: 44 spms. (NP 9386-9429), 3 spms. (MPUM 9012-9014), 1 spm. (MGC 721); La Catena: 2 spms. (NP 9430-9431), 1 spm. (MPUM 9007); La Serra: 1 spm. (NP 9433); Linari: 15 spms. (NP 9434-9448), 17 spms. (MPUM 9020); Montaione: 60 spms. (NP 9449-9508), 3 spms. (MPUM 9009-9011), 1 spm. (MPUM 9021), 2 spms. (MGC 722-723); Ponte a Elsa: 1 spm. (NP 9512); Fuengirola, Spain (Recent): 1 spm. (MPUM 9015), 1 spm. (MPUM 9019).

Characters

Protoconch: small, depressed turbiniform, of 2.20-2.25 gently convex, smooth whorls, tip very small.

Shell: slender-globose, moderately thick.

Spire: conical, rather elevated, whorls well convex.

Suture: linear, adpressed.

Body whorl: inflated, slightly depressed, moderately produced but not expanded toward the aperture, subsutural shelf indistinct.

Aperture D-shaped, height averaging 1.6 times the width.

Parietal callus: thin to moderately thick, ending some distance from the basal fasciole; anterior lobe small, pointed.

Umbilicus: rather small.

Funicle: from thread-like to thin, separated from the basal fasciole by a rather narrow groove.

Umbilical callus: small, moderately thick, asymmetrically semicircular to triangular in outline, located at the abapical one-third of the columellar lip and separated from the parietal callus by a moderately deep and narrow J-shaped notch.

Basal fasciole: poorly differentiated, defined abaxially by the bending of the growth lines.

Surface: with rather dense, very fine, slightly prosocline growth lines, more distinct toward the adapical suture; an exceedingly faint, uneven spiral striation occurs on the body whorl.

Color: background pinkish white with an irregular reddish brown reticulated pattern of interconnected polygons and 2-3 spiral rows of brown spots; a subsutural dark band is also present.

Operculum:

- relatively thin;
- central callus short, nearly oval;
- inner margin straight, with moderate, blunt transverse ridges on the adapical one half;
- inner surface nearly flat, nucleus only slightly prominent;
- outer surface gently concave (slightly more than that of *pseudoepiglottina*), with 3 marginal grooves and 3 ridges; the ridges as well as the median and outer grooves lie upon an elevated, sloping inward shelf;
- outer and middle grooves similar, narrow and well incised, attenuated during growth;
- inner groove somewhat wider, moderately excavated, with outer side subvertical or sloping outward;
- outer and inner ridges similar, thin, flat-topped;
- middle ridge wider, also flat-topped.

Dimensions (mm):

DHW	PD	H	D	SH	AH	AW
0.078-0.097	0.496-0.564	3.41-17.61	3.24-16.76	0.10-5.26	2.91-12.75	1.29-8.81
0.088	0.539	10.51	10.00	2.68	7.83	5.05
UW	WUC	WAD	WAB	IS	SA	
0.46-5.14	0.43-1.83	0.00-2.62	0.00-1.11	16°-44°	101°-133°	
2.8	1.13	1.22	0.45	30°	117°	

Remarks. The species is easily recognized in that has 3 ribs to the operculum. *Cochlis pseudoepiglottina* (Sacco, 1890) has also 3 ribs; its relations with the present taxon have been already discussed. De Stefani (1889) proposed the new species *Natica pantanellii* on the basis of Pliocene material from Castagno (Tuscany). We have seen De Stefani's material and can state that *Natica pantanellii* is indistinguishable from *Cochlis vittata*. The Recent *Cochlis carinifera* (Philippi, 1851), *Cochlis flammea* Röding, 1798 and *Cochlis intricatoides* (Hidalgo, 1873) are other junior synonyms (cf. Dixon & Ryall, 1985; Kabat, 1991; Poppe & Goto, 1991). We concur with Kilburn (1976) in considering *Natica textilis* Reeve, 1885 as a peripheral (southern) subspecies of *vittata*.

Stratigraphic occurrence. *C. vittata* (Gmelin) seems to have appeared in the Late Miocene (a single shell from the Messinian locality of Tetti Borelli in the authors' collection). Up to now, it was quoted only from the Lower Pliocene of Montaione (Tuscany) by Della Bella & Scarponi (2001). We recovered the species from several Lower-Mid Pliocene localities in Piedmont, Emilia and Tuscany. There are no records from Quaternary deposits. *C. vittata* is still living in the Western Mediterranean and Eastern Atlantic as far south as Senegal.

Problematic species and erroneous assignments

Natica auropunctata Meneghini (ms). This is an unpublished name said to have been introduced by Meneghini to designate fossil shells (supposedly Pliocene) in the collection of the "Museo della Regia Università di Pisa". Seguenza (1876, p. 10) listed *Natica auropunctata* and remarked that it is related to *Natica millepunctata* Lamarck, 1822, but has more prominent spire and thin umbilical callus. The only subsequent quotation is due to Sacco (1891, p.52) who guessed at its similarity to the new variety *elatospira* of *Natica millepunctata*, likely on the ground of Seguenza's statement. Neither Seguenza nor Sacco figured *Natica auropunctata* and nothing else is found about it later on in the literature. The material in the collection cited above is presently unavailable and possibly lost. In these circumstances, the name *auropunctata* is to be regarded as nomen dubium.

Natica globosa Grateloup, 1845. It was proposed on the basis of Lower Miocene material of France. Shortly after (1847), d'Orbigny introduced *Natica subglobosa*, which is a synonym of Grateloup's taxon (cf. d'Orbigny 1852 and Sacco 1891). Sacco (1891, part. 9, p. 7) regarded both *Natica globosa* and *Natica subglobosa* as synonyms of *Cernina compressa* (Basterot, 1825) and the same opinion was shared by Bronn (1848, p. 781). Regardless of the status of *Cernina* (cf. Kabat, 1991) and of the correct generic assignment of *Natica globosa*, it is

manifest that this species differs markedly from those considered herein primarily in having a massive callus shield obscuring the umbilicus. Nevertheless, specimens conchologically similar to those treated in this study and referred to as *globosa* Grateloup or *subglobosa* d'Orbigny were found in Museum collections. The Doderlein collection housed in MPM includes 6 shells (cat. n. 9799) originally labeled "*Natica millepunctata* Lk. var. *subglobosa densestriata* nobis" from Pliocene deposits of Castell'Arquato. Of these, 4 proved to belong to *Cochlis depressofuniculata* (Sacco, 1891), 1 to *Cochlis undata* (Sasso, 1827) and 1 cannot be assigned to species being badly damaged. Similarly, in MSNF, some Pliocene specimens from Val di Fine near Orciano are labeled "*Natica subglobosa* d'Orbigny-*globosa* Grateloup", but resulted to belong to *Cochlis depressofuniculata*. Thus, no evidence does exist to support the presence of *Natica globosa* in the Pliocene.

Natica maculata Deshayes in Lamarck, 1838. It was subsequently regarded either as a synonym of *Nerita hebraea* Martyn, 1784 (cf. Sowerby 1883; Sacco 1891; Settepassi 1972) or as a variety of *Natica millepunctata* Lamarck, 1822 (cf. Bronn 1848; Fontannes 1879-82). The species was recorded from the Pliocene of Diolo by Cocconi (1873). Lamarck's diagnosis reads "...opercolo calcareo multifisso clausa"; in the description, the author pointed out that "...elle est fermée par un opercule calcaire chargé dans presque toute son étendue de fines stries, très profondes et comme tranchées". On the basis of the opercular features, *Natica maculata* appears to differ from the species considered herein and likely belongs to the genus *Naticarius* Duméril, 1806. Again, specimens in museum collections referred to as *maculata* Deshayes proved to have been erroneously identified. DO/MPM includes 14 shells (cat. n. 9802) originally labelled "*N. millepunctata* var. maculis rar. majoribus – var. *maculata* (Desh.)" from Pliocene deposits of Castell'Arquato, which proved to belong to *Cochlis raropunctata* (Sasso, 1827). Another 9 shells (cat. n. 9814) are labelled "*N. millepunctata* var. *pliomaculata* Sacco - *N. maculata* Desh.". Of these, 2 belong to *Cochlis depressofuniculata* (Sacco, 1891), 1 to *Cochlis pseudoepiglottina* (Sacco, 1890), 5 to *Cochlis raropunctata* and 1 to *Cochlis undata* (Sasso, 1827).

Natica maculosa Lamarck, 1822. Coppi (1869, p. 35) quoted this species from Miocene and Pliocene deposits and subsequently (1881) regarded it as a Pliocene variety of *Natica millepunctata* Lamarck, 1822; in the 1881 paper, Coppi made reference to Cocconi (1873) who actually cited *Natica maculata* Deshayes in Lamarck, 1838 and not *Natica maculosa*. Also Mazzetti (1874) reported on the presence of *Natica maculosa* in the Pliocene of Modena area. We have examined the material in Coppi and Doderlein collections (MPM) and could note that different species had been erroneously assembled under the name *Natica maculosa*. The Doderlein collection contains 35 shells (cat. n. 9800) labelled "*N. millepunctata* Lk. var. *maculosa* - maculis rarioribus majoribus t. jun. et pulla" from Pliocene outcrops near Castell'Arquato; of these, 14 belong to *Cochlis depressofuniculata* (Sacco, 1891), 8 to *Cochlis pseudoepiglottina* (Sacco, 1890), 22 to *Cochlis raropunctata* (Sasso, 1827) and 1 to *Cochlis undata* (Sasso, 1827). The Coppi collection includes 4 shells (cat. n. 13735) labelled "*N. millepunctata* var. *maculosa*" recovered from Pliocene localities in Modena and Piacenza areas, all referable to *Cochlis raropunctata*.

It is to be noted that *Natica maculosa* was considered by Dixon (1984) as a synonym of *Paratectonatica tigrina* (Röding, 1798), an Indo-West Pacific species quite different from those covered in this study.

Natica pliocenica Seguenza, 1876. The original diagnosis is very meager; its English translation reads: "similar to *Natica auropunctata*, less slender spire, narrower umbilicus, broader cylindrical funicle". In a subsequent paper (1880), Seguenza recorded *Natica pliocenica* from the Late Miocene of Benestare (p. 111) and from the Pliocene of Gallina near Reggio Calabria (p. 264). Sacco (1891, p. 56) simply guessed at its similarity to the Pliocene variety *epiglottinoformis* Sacco, 1890 of *Natica millepunctata*, which we have included in the synonymy of *Cochlis undata* (Sasso, 1827). *Natica pliocenica* was not cited subsequently up to 1991 when Di Geronimo published a record of the new Pliocene and Quaternary species introduced by Seguenza in the 1858-1881 time span. Di Geronimo just quoted the species and reported the original diagnosis. Neither accurate description nor illustrations of *Natica pliocenica* are available so far and the original material went lost during the 1908 Messina earthquake. Consequently, it seems advisable to consider the name *pliocenica* as nomen dubium.

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APPENDIX (Locality data)

Piedmont

1. **Belveglio** (Asti Province). Small outcrops near Freto, approximately 1.5 km southwest of Belveglio. Yellow, medium sand belonging to the formation known as Sabbie di Asti (Asti Sand); the age is Late Zanclean to Early Piacenzian (cf. Ferrero & Pavia 1996 and Pavia 1996).

2. **Casa Bosco**, Monale (Asti Province). Diggings at Casa Bosco, approximately 1 km north of the village of Monale, on the left of the road connecting Monale to Cortandone. Yellow, medium to coarse sand (Sabbie di Asti) of Late Zanclean to Early Piacenzian age (cf. Caretto 1989).

3. **Cassine** (Alessandria Province). Active quarry (brick factory) south-southwest of Cassine, at the junction of the road from S. Andrea to road 30 connecting Alessandria to Acqui Terme. Gray, unbedded silty clay belonging to the Argille di Lugagnano (Lugagnano Clay) of Zanclean age. For additional information, reference to Robba (1990).

4. **Castello di Annone** (Asti Province). Road cut at the northwestern edge of the town, between railway and state road 10. The cut exposes 3 m of grey, silty-sandy clay forming the uppermost part of the Argille di Lugagnano; the age is likely latest Zanclean to early Piacenzian.

5. **Cossato** (Biella Province). Diggings in the village, on the left bank of Torrente Strona, have exposed 0.50 m of fine, gray fine sand of Middle Pliocene age. For additional information, reference to Aimone & Ferrero Mortara (1983).

6. **Le Grottine**, Monale (Asti Province). Excavation at Santa Fiora, along the road connecting Monale to Baldichieri d'Asti. Yellow sand of Late Zanclean to Early Piacenzian age (cf. Pavia 1980 and Caretto 1989).

7. **La Loggia** (Torino Province). Diggings in the bed of Po River, approximately 2 km northeast of La Loggia (south of Turin). Medium to fine, fossiliferous gray sand of Late Zanclean to Early Piacenzian age. For additional information, reference to Tropeano et al. (1984).

8. **Passerano** (Asti Province). Stream between the villages of Passerano and Schierano, west of road 458 connecting Asti to Chivasso. Alternating yellow medium sand and gray clay of Early Pliocene age.

9. **Pino d'Asti** (Asti Province). Outcrops southeast of Pino d'Asti, near the cemetery. Fine, light-greenish sand of Late Zanclean to Early Piacenzian age.

10. **Rio del Mulino di Serralunga,** Tigliole (Asti Province). A small digging along the stream Rio del Mulino, near the locality of Serralunga, approximately 2 km west northwest of the village of Tigliole. Gray, fine sand presumably of Late Zanclean to Early Piacenzian age (cf. Caretto 1989).

11. **San Pietro** (Asti Province). Diggings at San Pietro, on the left of the road connecting Villanova d'Asti to San Damiano d'Asti, have exposed 1 m of yellow, medium sand of Late Zanclean age (cf. Caretto 1989).

12. **Valleandona** (Asti Province). A 28 m thick section observable at the southern end of the village of Valleandona, near the locality named Castello, on the right of the road from the village to the state road 10. The medium to fine yellow sand (Sabbie di Asti) forms the stratotype of the Astian stage of earlier authors; the age was supposed to be Late Zanclean or Early Piacenzian (cf. Sampò et al. 1968 and Colalongo et al. 1972).

13. **Valle Botto** (Asti Province). A small valley drained by the stream Rio di Valle Botto, located approximately 1.4 km east of Valleandona, between C.na Manina and C.na Baloia. The yellow, fine to coarse sand, observable at several exposures, has an overall thickness of about 20 m and most likely of the same age of the Valleandona section. For additional information, reference to Caretto (1963, 1975).

14. **Villalvernia** (Alessandria Province). Exposure on the right bank of the stream Rio Vaccaruzza, northeast of the village of Villalvernia. Fine sand, more or less clayey, pertaining to the uppermost part of the Argille di Lugagnano; the age is likely Piacenzian. For additional information, reference to Brambilla (1976).

15. **Volpedo** (Alessandria Province). A 30.5 m thick section exposed on the left side of the stream Rio Limbione, between La Cascinetta and Cascina Piani, 2 km east of the village of Volpedo. Silty sand is the dominant lithotype, with minor intercalations of sandy silt and sandstone, likely forming the transition between the Argille di Lugagnano and the Sabbie di Asti; this section was assigned a general Pliocene age. For additional information, reference to Benigni & Corselli (1982).

Liguria

16. **Caranchi**, Albenga (Savona Province). The outcrop, presently hindered by a slide, is located on the right side of the stream Rio Torsero, along a rodlet about 0.4 km west of Casa Bruno. Gray silty clay belonging to the Argille di Ortovero (Ortovero Clay); the age is MPL 4, i.e. early Piacenzian (cf. Violanti 1987 and Bernasconi & Robba 1994).

17. **Garlenda**, Albenga (Savona Province). The outcrop is located north of Garlenda, on the right of the road to Ligo, approximately 0.5 km northeast of this latter village. Gray silty clay (Argille di Ortovero) of Zanclean age (cf. Robba 1990).

18. **Rio Torsero**, Albenga (Savona Province). The Pliocene deposits crop out on both sides of the stream Rio Torsero, where the A 10 highway bridges the stream, southwest of the village of Ceriale near Albenga. The section exposes 8.50 m of light gray, very sandy clayey silt forming the uppermost part of the Argille di Ortovero. The clayey silt yielded planktonic foraminiferal assemblages pointing toward a MPL3 to MPL4, i.e. a late Zanclean to early Piacenzian age. For additional information, reference to Violanti (1987) and Bernasconi & Robba (1994).

Emilia

19. **Arda,** Castell'Arquato (Piacenza Province). At the foot of gully on the left side of Torrente Arda, along the road connecting Castell'Arquato to Lugagnano, approximately 2 km southwest of the former village. Gray sandy clay (Argille di Lugagnano) of Piacenzian age (cf. Rio et al. 1988).

20. **Bacedasco** (Piacenza Province). Gully on the left side of Torrente Ongina, south of Costa Stradivari, about 1.5 km southwest of the village of Bacedasco. Gray sandy clay (Argille di Lugagnano) of Zanclean age (cf. Monegatti & Raffi 1996 and Monegatti et al. 2001).

21. **Badagnano** (Piacenza Province). Gully named Rio dei Carbonari, on the right side of Torrente Chero, about 0.5 km southeast of the village of Badagnano. Gray sandy clay belonging to the Formazione di Castell'Arquato (Castell'Arquato Formation); the age is likely Piacenzian (cf. Raffi 1982).

22. **Balzo del Musico,** Monte S. Pietro (Bologna Province). Slope cut (presently hindered by a wall) for housing project on the left of the road connecting Rivabella to Monte S. Pietro, about 0.35 km southwest of Landa. Gray clayey sand of Piacenzian age. The locality was dealt with by Busacchi (1896).

23. **Castell'Arquato** (Piacenza Province). Outcrop (presently hindered by a gabion barrier) on the right bank of Torrente Arda, at the bridge leading to Castell'Arquato. Gray sand of the lower member of the Formazione di Castell'Arquato; the age is Piacenzian (cf. Raffi 1982 and Raffi et al. 1989).

24. **Chiavenna Rocchetta** (Piacenza Province). Gully near the church of the village. Yellow medium sand (lower member of the Formazione di Castell'Arquato) of Piacenzian age (cf. Raffi 1982).

25. **Diolo** (Piacenza Province). Cliff on the left side of Torrente Chiavenna, right southwest of the village of Diolo. Gray sandy clay (Argille di Lugagnano) of Piacenzian age (cf. Raffi 1982).

26. **La Valle** (Piacenza Province). Small gully on the left side of the stream named Torrente Vezzeno, close to the village of La Valle. Gray sand and sandy clay (lower member of the Formazione di Castell'Arquato) of Piacenzian age (cf. Raffi 1982).

27. **Montemaggiore** (Bologna Province). Small gully just behind (north) the church of the village of Montemaggiore, 2.5 km north of Monte S. Pietro. Gray sandy clay overlain by yellow, medium to very coarse sand. The naticids were recovered from the clayey layer. According to the Geological Map of Italy (scale 1:100,000, Sheet 87, Bologna), the age is Piacenzian.

28. **Montezago** (Piacenza Province). Small gully near Chiesa di Montezago. Yellow, medium sand (lower member of the Castell'Arquato Formation) of early Piacenzian age (cf. Raffi 1982).

29. **Pradalbino I** (Bologna Province). Gully southwest of the ruined church of Pradalbino, 4.5 km south southeast of Crespellano. Bluish-gray, sandy clay of Piacenzian age. For additional information, reference to Bongiorni (1963).

30. **Pradalbino II** (Bologna Province). Wide gully northeast of the ruined church of Pradalbino exposing bluish-gray silty clay of Piacenzian age. For additional information, reference to Bongiorni (1963).

31. **Rio Rosello**, near Sariano (Piacenza Province). Right bank of Rio Rosello, about 280 m south west of Case Badini di Sopra. Lenticular body of clayey sand belonging to the Monte Zago Unit of Piacenzian age. For additional information, reference to Pedriali & Robba (2001).

32. **San Lorenzo in Collina** (Bologna Province). Wide gully north of the church of the village of San Lorenzo in Collina, east of Pradalbino. According to the Geological Map of Italy (scale 1:100,000, Sheet 87, Bologna), the age of the bluish-gray clay is Piacenzian.

33. **Torrente Olivetta**, Mongardino (Bologna Province). Outcrops on the left side of the stream near la Collina, approximately 2.5 km southwest of the village of Mongardino. Stiff blue-gray sandy clay of Zanclean age. The locality was dealt with by Cavara (1886).

34. **Torrente Samoggia**, località Molino Borzago (Bologna Province). Outcrops rising from the river bed opposite to Molino Borsaga, 2.25 km southeast of Monteveglio. Chestnut-gray, medium sand of Piacenzian age.

35. **Torrente Stirone** (Parma Province). A Plio-Pleistocene section crops out on both banks of the stream, southwest of the town of Fidenza. The naticids were recovered northwest of the church named San Nicomede, from the lower part of level 3 of Papani & Pelosio (1962); the clayey lithotype is of Gelasian age. For additional information, reference to Papani & Pelosio (1962) and Pelosio & Raffi (1977).

Tuscany

36. **Acquacalda** (Siena Province). Deep plowings near the sports ground of Acquacalda, on the left of motorway connecting Firenze to Siena. Blackish, slightly sandy clay likely of Middle Pliocene age.

37. **Balze di Caspreno** (Siena Province). Gully on the left side of the Arbia River, approximately 0.5 km south of the village of Vico d'Arbia and about 5 km east of Siena. Gray sandy clay of Lower Pliocene age. For further information, reference to Manganelli & Giusti (1997).

38. **Barca**, Castelnuovo Berardenga (Siena Province). Excavation near Barca, approximately 4 km west of Castelnuovo Berardenga. Yellow, medium sand presumably of Lower Pliocene age.

39. **Bibbiano**, Poggibonsi (Siena Province). Outcrops (Pietrafitta, Fosso di Libbiano, Podere Melograni, Poggio alla Staffa) around the village of Bibbiano, 4 km southwest of Poggibonsi. Yellow medium sand, locally gray sandy clay reported to be of Middle Pliocene age (cf. Bogi et al. 2002).

40. **Calanchi di San Martino**, Castelfiorentino (Firenze Province). Gully along the road connecting San Martino to Pian Grande, approximately 0.7 km west of the former locality. Greenish-yellow coarse sand; the age is Lower-Mid Pliocene (cf. Dominici et al. 1997).

41. **Calanco di Casale**, Certaldo (Firenze Province). Wide gully west of the village of Casale and adjacent to it. Yellowish-brown coarse sand reported to be of Lower-Mid Pliocene age (cf. Dominici et al. 1997).

42. **Casa Cuccule,** Larniano (Siena Province). Deep plowings in the farm area have unearthed fossiliferous light-gray clay of Upper Pliocene age (cf. Bogi et al. 2002).

43. **Cava di Certaldo**, frazione Montebello (Firenze Province). Decommissioned quarry north of the village of Certaldo. Dark-gray clay of Lower-Mid Pliocene age (cf. Dominici et al. 1997).

44. **Cava I Sodi** (Siena Province). Wide active quarry (brick factory) near the railway station of Castelnuovo Berardenga. Gray clay of Lower Pliocene age (cf. Bogi et al. 2002).

45. **Ciuciano** (Siena Province). Deep plowings in the area locally called Uliveta, 0.4 km west of the village of Ciuciano have unearthed yellowish rather fine sand of Lower Pliocene age. For additional information, reference to Forli & Dell'Angelo (2000).

46. **Corazzano**, San Miniato (Pisa Province). Deep plowings approximately 2.5 km southeast of Corazzano, on the left side of the road leading to Castelfiorentino. Yellow medium sand reported to be of Lower-Mid Pliocene age (cf. Dominici et al. 1997).

47. **Guistrigona**, Castelnuovo Berardenga (Siena Province). Deep plowings throughout the area of Guistrigona, 3 km southwest of Castelnuovo Berardenga, on the right of road 326 connecting Siena to Rapolano Terme, have unearthed fossiliferous gray clay and sandy clay of Lower-Mid Pliocene age (cf. Bogi et al. 2002).

48. **Il Campino**, Rapolano Terme (Siena Province). Small outcrop in the area locally named Terre Rosse, along the road connecting Siena to Monte S. Savino, approximately 1.5 km near the junction to road 326. Yellow clayey sand of late Zanclean age. For additional information, reference to Laghi (1984).

49. **Il Treppié**, Poggibonsi (Siena Province). Approximately 2.5 km northwest of Poggibonsi, on the right of the road connecting Poggibonsi to Certaldo, at the level of Linari. A small outcrop exposes about 2 m of unbedded fine to medium, more or less clayey sand of Upper Zanclean age. For further information, reference to Pantoli & Raffi (1981).

50. **La Catena**, San Miniato (Pisa Province). Small gully southwest of the hamlet named La Catena. Gray sandy clay of Middle Pliocene age (cf. Bogi et al. 2002).

51. **La Serra**, San Miniato (Pisa Province). Small quarry adjacent to the hamlet of La Serra. Light-gray sandy clay and clayey fine sand of Middle Pliocene age. For additional information, reference to Benvenuti et al. (1997).

52. **Linari**, Barberino Val d'Elsa (Firenze Province). Deep plowings 0.5 km south of the hamlet of Linari, on the left of the road leading to state road 429, have unearthed yellow medium sand of Middle Pliocene age (cf. Bogi et al. 2002).

53. **Marcialla** (Firenze Province). Slope cut west of the village of Marcialla and adjacent to it. Gray clayey sand of Lower-Mid Pliocene age (cf. Dominici et al., 1997).

54. **Montaione** (Firenze Province). Deep plowings in front of the country-house Villa Filicaia, approximately 0.5 km southeast of the village of Montaione, have unearthed gray medium to coarse pebbly sand belonging to the unit named Sabbie di Gambassi (Gambassi Sand). According to Dominici et al. (1997), the age is Lower Pliocene. For additional information, reference to Della Bella & Scarponi (2000).

55. **Podere Cavallara**, Castelnuovo Berardenga (Siena Province). Approximately 2 km northwest of Guistrigona, along the roadlet connecting Pieve di Pacina to Montaperti. Yellow-reddish, medium sand, presumably of Lower Pliocene age.

56. **Poggio Armaiolo** (Siena Province). Outcrop along road 326, between Km 29 and km 30, in the area locally named Due Madri, approximately 0.3 km from Armaiolo. Gray clay of Middle Pliocene age (cf. Bogi et al. 2002).

57. **Ponte a Elsa**, San Miniato (Pisa Province). Quarry west of Ponte a Elsa and adjacent to it. Grey sandy to silty clay forming the basal part of the exposed section. The age is Piacenzian. For further information, reference to Valleri et al. (1990).

58. **San Benedetto**, San Gimignano (Siena Province). Deep plowings at the locality named San Benedetto, approximately 1 km southeast of San Gimignano have unearthed gray sandy clay of Lower-Mid Pliocene age (cf. Dominici et al. 1997).

59. **Spicchio**, Empoli (Firenze Province). Decommissioned quarry of a brick factory in the northern suburbs of Empoli, near the small village of Spicchio. Gray sandy clay of Mid Pliocene age (cf. Dominici et al. 1997).

60. **Torrita di Siena** (Siena Province). Deep plowings throughout the area between Torrita di Siena and Ciliano have unearthed yellow medium to coarse sand likely of Zanclean age.

61. **Ulignano** (Siena Province). The place is located northeast of San Gimignano, approximately halfway between this latter locality and Ulignano, on the left side of the stream B.ro Vergaia, at the junction with the road to Casaglia. Gray clayey sand of Middle Pliocene age (cf. Bogi et al. 2002).

Latium

62. **Guidonia** (Roma Province). Wide quarry near Guidonia, in the locality named Formello. Dark-gray clay and sandy clay of Zanclean or early Piacenzian age. For further information, reference to Mancini (1997).