

The lower Pliocene gastropods of Le Pigeon Blanc (Loire-Atlantique, northwest France). Part 5* – Neogastropoda (Conoidea) and Heterobranchia (*fine*)

Luc Ceulemans¹, Frank Van Dingenen² & Bernard M. Landau^{3,4}

¹ Avenue Général Naessens de Loncin 1, B-1330 Rixensart, Belgium; email: luc.ceulem@skynet.be

² Cambeenboslaan A 11, B-2960 Brecht, Belgium; email: fvd@telenet.be

³ Naturalis Biodiversity Center, P.O. Box 9517, 2300 RA Leiden, Netherlands; Instituto Dom Luiz da Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal; and International Health Centres, Av. Infante de Henrique 7, Areias São João, P-8200 Albufeira, Portugal; email: bernardmlandau@gmail.com

⁴ Corresponding author

Received 25 February 2017, revised version accepted 7 July 2018

In this final paper reviewing the Zanclean lower Pliocene assemblage of Le Pigeon Blanc, Loire-Atlantique department, France, which we consider the ‘type’ locality for Assemblage III of Van Dingenen *et al.* (2015), we cover the Conoidea and the Heterobranchia. Fifty-nine species are recorded, of which 14 are new: *Asthenotoma lanceolata* nov. sp., *Aphanitoma marqueti* nov. sp., *Clathurella pierreaimeii* nov. sp., *Clavatula helwerdae* nov. sp., *Haedropleura fratemcontii* nov. sp., *Bela falbalae* nov. sp., *Raphitoma georgesi* nov. sp., *Raphitoma landreauiensis* nov. sp., *Raphitoma palumbina* nov. sp., *Raphitoma turtaudierei* nov. sp., *Raphitoma vercingetorixi* nov. sp., *Raphitoma pseudoconcinna* nov. sp., *Adelphotectonica bieleri* nov. sp., and *Ondina asterixi* nov. sp. One new name is erected: *Genota maximeii* nov. nom. is proposed for *Pleurotoma insignis* Millet, non Edwards, 1861. *Actaeonidea achatina* Sacco, 1896 is considered a junior subjective synonym of *Rictaxis tornatus* (Millet, 1854).

The data presented here concur with that discussed in previous parts of this monograph, suggesting that average Sea Surface Temperatures off the NW French coast in the Zanclean early Pliocene may have been higher than they are at these latitudes today, possibly similar to those found today off the southern Portuguese coasts.

KEY WORDS: northwestern France, lower Pliocene, Neogastropoda, new taxa

Introduction

In this paper we continue our studies on Neogene gastropod fossil assemblages of northwestern France (see Ceulemans *et al.*, 2014, 2016a, b; Van Dingenen *et al.*, 2014, 2015, 2016, 2017): Gastropods of the order Neogastropoda (Conoidea) and Heterobranchia are revised. The study is restricted to the locality of Le Pigeon Blanc, which we consider to be the ‘type’ locality for Assemblage III gastropods (of Van Dingenen *et al.*, 2015).

In his unpublished thesis, Brébion (1964) of the Centre National de la Recherche Scientifique, Paris recorded 44 species within the groups covered in this paper from Le Pigeon Blanc and six from other Assemblage III localities, some of which were described as new. However, as the thesis was never published, the names do not comply with article 13 of the ICZN code (1999) and must be considered *nomina nuda*.

Geological setting, material and methods

(see Van Dingenen *et al.*, 2015: 75–79, figures 1, 2). Systematics are updated following Bouchet & Rocroi (2017).

Abbreviations:

IRScNB	Institut Royal des Sciences naturelles de Belgique, Brussels (Belgium).
MNHN.F	Muséum national d’Histoire naturelle (collection de Paléontologie), Paris (France).
NHMW	Naturhistorisches Museum Wien collection, Vienna (Austria).
FVD	Frank van Dingenen private collection, Brecht (Belgium).
LC	Luc Ceulemans private collection (Rixensart, Belgium).

* For nr 3 in this series see *Vita Malacologica* 15: 35–55.

Systematic palaeontology

Superfamily Conoidea Fleming, 1822

Family *Borsoniidae* Bellardi, 1875

Genus *Asthenotoma* Harris & Burrows, 1891

Type species – *Pleurotoma meneghinii* Mayer, 1868, by original designation, Miocene, Italy.

1875 *Oligotoma* Bellardi, p. 21. Type species (by original designation): *Pleurotoma meneghinii* Mayer, 1868, Miocene, Italy (*non* Westwood, 1836 [Insecta, Embioptera]).

1891 *Asthenotoma* Harris & Burrows, p. 113. *Nom. nov. pro* *Oligotoma* Bellardi, 1875, *non* Westwood, 1836 [Insecta, Embioptera].

***Asthenotoma lanceolata* nov. sp.**

Plate 1, figs 1-2

Type material – Holotype NHMW 2015/0133/0557, height 20.7 mm, width 5.6 mm (Pl. 1, fig. 1); paratype 1 NHMW 2015/0133/0558, height 20.8 mm, width 6.3 mm (Pl. 1, fig. 2).

Other material – Maximum height 20.8 mm. LC (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Etymology – Latin ‘*lanceola*, -ae’, diminutive of ‘*lancea*’, noun, meaning like a small lance. *Asthenotoma* gender feminine.

Locus typicus – Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Asthenotoma* species of medium-size, high conical spire composed of flat-sided whorls, finely reticulated sculpture composed of crowded spiral cords and strongly sinuous close-set axial ribs, short last whorl and siphonal canal, small aperture, outer lip lirated within, columella bearing broad fold.

Description – Shell medium-sized, high conical spire, 54% of total height. Protoconch not preserved. Teleoconch consisting of nine straight-sided whorls with periphery at abapical suture. Suture incised, shallow. Sculpture of low, narrow, close-set, strongly sinuous axial ribs crossed by fine, irregular, close-set spiral cords, somewhat more crowded on adapical half of whorl, forming fine reticulated surface pattern. Last whorl relatively short, 46% total height, adapical half straight-sided, broadly rounded at periphery, moderately constricted at base; base slightly concave, delimited abapically by poorly defined, low siphonal fasciole.

Anal sinus broadly U-shaped, with apex placed just above mid-whorl. Aperture small, 29% of total height,

relatively narrow, simple (edge damaged in all specimens), irregularly lirated within. Columella callus poorly expanded, closely appressed, thickened, bearing broad fold mid-aperture, developed to a variable degree. Siphonal canal short, open, slightly posteriorly recurved and notched at tip.

Discussion – *Asthenotoma lanceolata* nov. sp. co-occurs with *Asthenotoma ornata* (Defrance, 1826) in the lower Pliocene of northwestern France (see below) but is less common. It differs from *A. ornata* in being larger, in having a relatively higher spire, shorter last whorl and siphonal canal, the last whorl is less inflated mid-whorl and less constricted at the base and the sculpture is finer, especially the spiral cords, which are subequal and crowded, whereas in *A. ornata* they tend to be of alternate strength. The genus *Asthenotoma* in the Italian Neogene was reviewed by Gatto (1997). None of the species reviewed is as tall spired as *A. lanceolata*.

Distribution – Lower Pliocene: Atlantic, NW France (this paper).

***Asthenotoma ornata* (Defrance, 1826)**

Plate 1, figs 3-5

- *1826 *Pleurotoma ornata* Defrance, p. 390.
- 1848 *Peurotoma semicolon* (?) J. Sow. – S.V. Wood, p. 54, pl. 6, fig. 3b (*non* J. Sowerby, 1816).
- 1854 *Pleurotoma Ornata* Defr. – Millet, p. 161.
- non* 1877 *Pleurotoma ornata* Defr. – Bellardi, p. 238, pl. 7, fig. 25 (= *Asthenotoma bellardiana* Gatto, 1997).
- 1878 *Pleurotoma granulina* Nyst, pl. 3, fig. 7.
- 1882 *Pleurotoma granulina* Nyst, p. 43.
- non* 1890 *Pleurotoma (Oligotoma) ornata* Defr. – Hoernes & Auinger, pl. 34, figs 16, 17 [= *Asthenotoma colus* (Dujardin, 1837)].
- non* 1891 *Pleurotoma (Oligotoma) ornata* Defr. – Hoernes & Auinger, pl. 50, fig. 27 [= *Asthenotoma colus* (Dujardin, 1837)].
- non* 1912 *Asthenotoma ornata* Defr. – Friedberg, p. 221, pl. 14, fig. 2.
- non* 1915 *Oligotoma ornata* (Defrance) – Harmer, p. 216, pl. 27, figs 1, 2 [= *Asthenotoma colus* (Dujardin, 1837)].
- 1915 *Oligotoma festiva* (Döderlein in Hörnes) – Harmer (*partim*), p. 216, pl. 27, fig. 6 (only).
- 1915 *Oligotoma decorata* (A. Bell, MS) Harmer, p. 217, pl. 27, figs 3, 4.
- 1915 *Oligotoma bipunctula* (S.V. Wood, 1848) – Harmer, p. 218, pl. 27, figs 12-15, pl. 28, figs 5-8 (*non* *Pleurotoma bipunctula* S.V. Wood, 1848 = *Gemmula* sp. *fide* Gatto, 1997).
- 1915 *Oligotoma bipunctula* var. *proxima* Harmer, p. 219, pl. 28, figs 3, 4.
- non* 1937 *Asthenotoma ornata* Defr. – Montanaro, p. 166, pl. 7, fig. 72 (= *Asthenotoma bellardiana* Gatto, 1997).
- non* 1938 *Asthenotoma ornata* Defrance – Peyrot, p. 279 [=

- Asthenotoma colus* (Dujardin, 1837)].
- 1946 *Asthenotoma* (*Asthenotoma*) *bipunctula* (Wood, 1872) – Beets, p. 101, pl. 6, figs 2-4 (*non Pleurotoma bipunctula* S.V. Wood, 1848 = *Gemmula* sp. fide Gatto, 1997).
- 1954 *Asthenotoma ornata* Defrance, 1826 – Glibert (*partim*), p. 35, pl. 1, fig. 15, pl. 5, fig. 8a, c-e (not 8b).
- non 1963 *Asthenotoma* (*Asthenotoma*) *ornata* (Defr.) – Venzo & Pelosio, p. 126, pl. 11, fig. 12 (= *Asthenotoma falunica* Peyrot, 1938).
- 1964 *Asthenotoma ornata* Defrance, 1826 – Brébion, p. 568.
- 1997a *Asthenotoma bipunctula* (Wood, 1872) – Marquet, p. 130, pl. 1, fig. 4. (*non Pleurotoma bipunctula* S.V. Wood, 1848 = *Gemmula* sp. fide Gatto, 1997).
- 1997 *Asthenotoma ornata* (Defrance, 1826) – Gatto, p. 54, pl. 4, figs 1-11, pl. 8, figs 4-5.
- 1998b *Asthenotoma ornata* (Defrance, 1826) – Marquet, p. 168, fig. 141.

Material and dimensions – Maximum height 17.1 mm, width 5.2 mm. NHMW 2015/0133/0400 (1), NHMW 2015/0133/0401 (1), NHMW 2015/0133/0402 (1); NHMW 2015/0133/0403 (28), LC (50+), FVD (50+).

Discussion – Glibert (1954) redescribed and figured a lectotype for *Asthenotoma ornata* (Defrance, 1826) and showed the type locality to be Thorigné, a late Miocene Tortonian Assemblage I deposit, thus resolving the confused interpretation of this species made by previous authors (see chresonymy). The species is characterised by its paucispiral protoconch and moderate size slender biconic shell. The sculpture, although strongly variable (see Glibert, 1954; Gatto, 1997) is fine compared with many of its congeners. The Assemblage III specimens are relatively large and slender compared to specimens from other localities (see Gatto, 1997, p. 55, table 4). The teleoconch sculpture is invariably fine, similar to that of the lectotype of *Oligotoma decorata* Harmer, 1915, from the upper Pliocene of England which is considered a synonym and the form '*granulina*' Nyst, 1878 from the upper Pliocene of Belgium, also considered a synonym. The only discernable difference between the Assemblage III specimens and those from other localities is that the paucispiral protoconch seems to be taller and more loosely coiled (Pl. 1, fig. 5) than that illustrated by Gatto (1997, pl. 8, figs 4, 5) from the upper Pliocene of England or Marquet (1998a, p. 168, fig 141 c) from the upper Pliocene of Belgium. The species also occurs in the stratigraphically older upper Miocene Tortonian Assemblage I deposits where the protoconch is also lower, more dome-shaped and the whorls more tightly coiled, similar to those figured by Gatto and Marquet. However, Glibert also described the protoconch as loosely coiled '*Protoconque paucispirée, subcylindrique, formée de deux tours lisses, très convexes, bien détachés*' (1954, p. 35). Although Glibert described the protoconch as smooth, it is finely micropustular (Gatto, 1997, p. 61, pl. 8, fig. 5). Microsculpture is also present in the Assem-

blage I specimens (BL unpublished data) but not seen in the Le Pigeon Blanc specimen illustrated here, as the protoconch surface is abraded. For further comparison with its congeners see Gatto (1997).

Millet (1854, p. 161) recorded this species from Assemblage I localities (Renauleau, Sceaux-d'Anjou, Thorigné). Brébion (1964, p. 569) added St-Michel and Beaulieu, Assemblage II localities (Apigné, Le Temple du Cerisier) and Assemblage III (Le Pigeon Blanc, Le Girondor, Pal-luau).

Distribution – Upper Miocene: Atlantic (Tortonian): NW France (Glibert, 1954; Brébion, 1964). Lower Pliocene: Atlantic, NW France (Brébion, 1964); North Sea Basin, Coralline Crag, England (Harmer, 1915). Upper Pliocene: North Sea Basin, Red Crag, England (Harmer, 1915); Oorderen Sands, Belgium (Marquet, 1997a, 1998a). Pliocene (indeterminate): North Sea Basin, Netherlands (Beets, 1946).

Genus *Aphanitoma* Bellardi, 1875

Type species – *Turbinella labellum* Bellardi & Michelotti, 1840, by original designation, Miocene, Italy.

1875 *Aphanitoma* Bellardi, p. 22.

***Aphanitoma marqueti* nov. sp.**

Plate 1, figs 6, 7

1854 *Aphanitoma* cf. *labellum* (Bonelli) – Glibert, p. 42, pl. 5, fig. 16 (*non Aphanitoma labellum* Bellardi, 1877).

1964 *Aphanitoma gliberti* Brébion, p. 572 (*nomen nudum*).

Type material – Holotype IRScNB IST 4493, height 12.5 mm, width 4.2 mm (specimen figured by Glibert, 1954, pl. 5, fig. 16); paratype 1 NHMW 2015/0133/0556, height 10.8 mm, width 3.6 mm (Pl. 1, fig. 6); paratype 2 NHMW 2015/0133/0430, height 11.7 mm, width 4.1 mm (Pl. 1, fig. 7).

Other material – Maximum height 12.5 mm. LC (6), FVD (2).

Etymology – Named after Robert Marquet of the Institut Royal des Sciences Naturelles de Belgique in recognition of his many contributions to North Sea Basin fossil assemblages. *Aphanitoma* gender feminine.

Locus typicus – Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – Small *Aphanitoma* species with a stout biconic shell shape, protoconch of two smooth whorls,

predominantly spiral sculpture on teleoconch composed of narrow cords, weak opisthocline axial ribs developed on early whorls, weakening abapically, subobsolete on last two whorls, last whorl regularly convex, hardly constricted at base, outer lip denticulate within, two oblique columellar folds placed mid-aperture.

Description – Shell small, biconic, fusiform, relatively stout for genus. Protoconch dome-shaped, composed of two smooth whorls, with medium-sized nucleus. Teleoconch consisting of five weakly convex whorls with periphery a short distance above suture. Suture impressed, linear. Sculpture predominantly spiral, composed of narrow cords, eight on penultimate whorl, half width of their interspaces. Axial sculpture of weak opisthocline ribs present on early teleoconch whorls, weakens abapically, subobsolete on last two whorls. Last whorl slender, convex, hardly constricted at base. Aperture elongate, narrow, siphonal canal relatively short for genus. Outer lip not thickened, bearing elongated denticles within; adapical denticle strongest. Columella straight, bearing two prominent oblique folds mid-aperture. Columellar and parietal callus poorly developed, not thickened, narrow.

Discussion – *Aphanitoma marqueti* nov. sp. is characterised by its predominantly spiral sculpture, with axials restricted to the early teleoconch whorls and weakly convex whorls lacking a distinct shoulder. *Aphanitoma labellum* Bellardi, 1877 (lectotype figured by Ferrero Mortara *et al.*, 1981, p. 221, pl. 17, fig. 4) from the Tortonian upper Miocene Proto-Mediterranean of Italy and *A. arctata* Bellardi, 1877 from the Pliocene of Italy differ from *A. marqueti* in having sharper, more elevated sculpture, the axials persisting onto the last whorl. Numerous Italian upper Miocene *A. pecchiolii* Bellardi, 1877 and *A. breviata* Bellardi, 1877, and Pliocene species such as *A. imperati* (Scacchi, 1835), *A. pluriplicata* Bellardi, 1877, *A. targioniana* Bellardi, 1877 and *Aphanitoma* sp. 1 and 2 in Della Bella & Scarponi (2007) all differ from *A. marqueti* in having distinctly shouldered whorls. *Aphanitoma tumescens* Bellardi, 1877 (holotype figured by Ferrero Mortara *et al.*, 1981, p. 221, pl. 17, fig. 8) is similar in shape to *A. marqueti*, with weakly convex whorls and the base hardly constricted but differs in having orthocline axials persisting onto the last whorl. *Aphanitoma alterans* (Nordsieck, 1972) from the lower-middle Miocene Breda Formation of Miste, The Netherlands is also relatively squat with convex whorls and the base poorly delimited, but axial and spirals are well developed, the spirals wider spaced forming an evenly reticulated pattern. Two middle Miocene North Sea Basin species from Germany have predominantly spiral sculpture with the axials obsolete on the last two whorls; *A. ronaldi* Janssen, 1972 differs from *A. marqueti* in being relatively strongly constricted at the base and *A. fransi* Janssen, 1972 differs in having a much taller spire. A. W. Janssen (1972, p. 48) made a detailed study and comparison of the protoconch of numerous European *Aphanitoma* species. Unfortunately the protoconch is missing in the French Assemblage III material.

Distribution – Lower Pliocene: Atlantic, NW France (Glibert, 1954; Brébion, 1964).

Genus *Genota* H. Adams & A. Adams, 1853

Type species – *Murex mitriformis* W. Wood, 1828, by original designation, present-day, West Africa.

1853 *Genota* H. Adams & A. Adams, p. 89.

1883b *Genotia* Fischer, p. 589. Unjustified emendation of *Genota*.

***Genota maxime* nov. nom.**

Plate 1, figs 8, 9

1854 *Pleurotoma Insignis* Millet, p. 161 (*nomen nudum*).

1865 *Pleurotoma insignis* Millet, p. 587 (*non* Edwards, 1861).

1954 *Genota ramosa* cf. *valeriae* (Hörnes & Auinger) – Glibert, p. 22, pl. 4, fig. 6 [*non Genota valeriae* (Hoernes & Auinger, 1891)].

1964 *Genota ramosa* Basterot, 1825 – Brébion, p. 628.

1964 *Genota gliberti* Brébion, p. 628 (*nomen nudum*).

Material and dimensions – Maximum height 41.5 mm, width 11.6 mm. NHMW 2015/0133/0427-0428 (2), 2015/0133/0429 (25), LC (27), FVD (32). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Etymology – Named after Dr. Maxime Glibert (1905–1984), Director of the Laboratoire à l'Institut Royal des Sciences Naturelles de Belgique, in recognition of his enormous contribution to Neogene molluscan palaeontology. *Genota* gender feminine.

Locus typicus – Thorigné, Saint-Michel, Sceaux-d'Anjou, Maine-et-Loire, NW France.

Stratum typicum – Tortonian, upper Miocene.

Original description – ‘*Pleurotoma insignis*, Millet. Coq. fusiforme, aiguë au sommet; composée de neuf à dix tours de spire; le premier et le second sont lisses, les autres marqués de stries verticales d'accroissement, rapprochées entre elles, légèrement arquées, et se repliant en sens contraire sur l'espèce de gouttière formée par la prolongation du sinus que présente le bord droit, où sur cette gouttière elles forment des espèces d'arceaux croisés par des stries légères et très-rapprochées, et comme cela se voit sur toute la surface de la coquille. Ouverture oblongue, faisant plus de la moitié de la longueur totale de la coq. Grande et belle espèce, arrivant quelquefois à 5 centimètres de longueur et 15 millimètres de diamètre. Th., Saint-Michel, Sceaux’ (Millet, 1865, p. 587).

Description – Shell slender fusiform, with tall pointed

spire. Protoconch dome-shaped, composed of 2.5 whorls; nucleus small, last half-whorl bearing axial riblets (dp = 815 µm, hp = 990 µm). Teleoconch composed of eight angular whorls with broad, weakly concave, steeply sloping sutural ramp, delimited by relatively weakly tuberculate shoulder, whorl almost straight-sided below shoulder. Suture linear, weakly impressed. Axial ribs present only below shoulder, close-set, opisthocline, roughly every other rib forming weak tubercle at shoulder. Sutural ramp sculptured by weak crowded spiral threads and axial growth lines marking previous position of sinus, especially prominent just below suture, where a poorly delimited subsutural collar is weakly developed. Below shoulder spiral ornament consisting of close-set narrow flattened cords separated by narrow grooves, crossing axial ribs, axial sculpture predominant. Last whorl 66% of total height, sutural ramp concave, shoulder weakly nodular, whorl weakly convex below, hardly constricted at base. Aperture elongate, 50% of total height, outer lip simple, convex in profile. Anal sinus relatively narrow and deep, apex of sinus at lower third of sutural ramp. Siphonal canal relatively long, open, slightly recurved. Columella almost straight, smooth. Columellar callus very weakly developed and expanded.

Discussion – Millet (1954, 1865) recognised that the specimens from northwestern France constitute a distinct form; unfortunately the name proposed (*Pleurotoma insignis* Millet, 1865) is a junior homonym of *P. insignis* Edwards, 1861. Glibert (1954, p. 22) also recognised the Assemblage III specimens from Le Pigeon Blanc as distinct from those of stratigraphically older French deposits and illustrated a specimen as *Genota ramosa* cf. *valeriae* (Hoernes & Auinger). We consider the Assemblage I and III specimens conspecific and propose *Genota maximeii* nom. nov. for this species. There is a slight difference in the protoconch in the Assemblage III specimens, in which it is less dome-shaped; the first whorl is somewhat flattened and rapidly expanding, second whorl tall, weakly convex (Pl. 1, fig. 9). The number of protoconch whorls is the same and the teleoconch characters are identical, we therefore consider this difference insufficient to warrant separation.

In recent years it has become evident that the genus *Genota* H. Adams & A. Adams, 1853 is highly speciose in the European Neogene and that species are often highly endemic (Vera-Peláez & Lozano-Francisco, 2001b; Landau *et al.*, 2013). *Genota maximeii* differs from *G. ramosa* (de Basterot, 1825) from the lower Miocene of France in having stronger tubercles developed at the shoulder and stronger spiral sculpture, only slightly weaker than the axial ribs, forming a reticulated pattern below the shoulder. The anal sinus is of similar depth but broader than in *G. maximeii*. Despite numerous specimens at hand from several Aquitanian lower Miocene deposits, none has the protoconch preserved. As correctly noted by Glibert (1954) the Le Pigeon Blanc species is most similar to *Genota valeriae* (Hoernes & Auinger, 1891) from the middle Miocene Paratethys. The sculpture is almost identical, differing in details; the subsutural collar bear-

ing prominent axial lamellae seen in *G. maximeii* is absent in *G. valeriae*, the axial ribs below the shoulder are finer and the tubercles formed at the shoulder are sharper in *G. valeriae*, the last whorl is more constricted at the base and the columella and siphonal canal are more twisted in *G. valeriae*. Importantly, the anal sinus in *Genota maximeii* is deeper and narrower than in *G. valeriae*. Unfortunately, the protoconch is not preserved in any of the specimens of *G. valeriae* at hand. *Genota rudolfi* (Toula, 1901) from the middle Miocene eastern Proto-Mediterranean of Turkey has a protoconch of 2.75 whorls, far more elevated spiral sculpture forming a reticulated pattern below the shoulder on the last whorl, and a broader, shallower anal sinus. *Genota pseudoelisiae* Landau, Harzhauser, İslamoğlu & Silva, 2013, from the same deposits in Turkey has an even taller multispiral protoconch composed of 3.25 whorls, the teleoconch is squatter, the shoulder more sharply angled and, the anal sinus is shallower. The sculpture on the last whorl is similar to that of *G. valeriae* and *G. maximeii*. *Genota domenechae* Vera-Peláez & Lozano-Francisco, 2001 from the upper Pliocene lower Piacenzian of Estepona is immediately separated by its paucispiral mammillate protoconch composed of two whorls and subobsolete sculpture, which is only significantly developed at the shoulder. *Genota lusitaniae* Vera-Peláez & Lozano-Francisco, 2001 from the lower Pliocene Zanclean of the Guadalquivir Basin of Spain and upper Pliocene lower Piacenzian of the Mondego Basin of Portugal is a larger, more solid-shelled species, with a multispiral protoconch of three whorls, coarsely sculptured teleoconch with prominent nodes developed at the shoulder and raised cords, especially on the subsutural ramp. The anal sinus is broader and shallower than in *G. maximeii*. *Genota bonnani* Bellardi, 1877 from the Pliocene Mediterranean has a multispiral protoconch of three whorls, and stronger spiral sculpture.

Millet (1854, p. 161) recorded this species from Assemblage I localities (Thorigné, St-Michel, Sceaux-d'Anjou). Brébion (1964, p. 569) added and Beaulieu and Assemblage III (Le Pigeon Blanc, Palluau).

The genus *Genota* is a thermophilic element in the Assemblage I fauna. Today *Genota* is a West African genus not found further north than Western Sahara (Ardovini & Cossignani, 2004). The paucity of species in the Assemblage I fauna might suggest SSTs consistent with the colder most northern limit of the genus' distribution.

Distribution – Upper Miocene: Atlantic (Tortonian): northwestern France (Brébion, 1964). Lower Pliocene: Atlantic, NW France (Glibert, 1954; Brébion, 1964).

Family Clathurellidae H. Adams & A. Adams, 1853
Genus *Clathrella* Carpenter, 1857

Type species – *Clavatula rava* Hinds, 1843, by subsequent designation under plenary powers (ICZN, 1963, Opinion 666), present-day, Panamic Region.

1857 *Clathrella* Carpenter, p. 399. Originally estab-

lished as a *nom. nov. pro Defrancia* Millet, 1827 *non* Bronn, 1825 [Bryozoa], Opinion 666 (ICZN, 1963) ruled them to have different type species. Placed on the Official List by Opinion 666.

***Clathurella pierreaime* nov. sp.**

Plate 6, figs 3, 4

Type material – Holotype NHMW 2015/0133/0573, height 6.4 mm, width 3.8 mm (Pl. 6, fig. 3); paratype 1 NHMW 2015/0133/0572, height 7.5 mm, width 3.8 mm (Pl. 6, fig. 4).

Other material – Maximum height 7.5 mm. LC (4).

Etymology – Named after Pierre-Aimé Millet de la Turtaudière (1783-1873) in recognition of his work on the genus. *Clathurella* gender feminine.

Locus typicus – Le Pigeon Blanc, Le Landreau, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Clathurella* species of small size, squat, protoconch multispiral, last two whorls carinate, teleoconch of 4.5 rounded whorls, sculptured by 11 narrow axial ribs overrun by sharp spiral cords, three on first whorl, five on penultimate, surface covered in micropustules, outer lip strongly thickened, denticulate within, siphonal canal relatively short.

Description – Shell small, squat turriiform. Protoconch of about four whorls with last two whorls strongly carinate mid-whorl; surface poorly preserved. Junction with teleoconch sharp, delimited by beginning of adult sculpture. Teleoconch of 4.5 whorls, with three strong sharp, narrow primary spiral cords on first whorl, adapical cord delimiting narrow, smooth, concave subsutural ramp; abapically further primary cords appear at shoulder, strengthening abapically; five primary cords on penultimate whorl; no secondary spiral sculpture. Cords overrun 11 narrow orthocline axial ribs without becoming swollen or forming tubercles at intersections. Surface between spiral cords covered in dense micropustules. Last whorl squat, rounded at shoulder, strongly constricted at base, bearing 9-10 spiral cords, with a further five cords running over siphonal fasciole. Aperture ovate, narrow; outer lip strongly thickened by varix, bearing tubercular denticles within; adapical denticles strongest, four denticle below weakening abapically; anal sinus deep U-shaped, with apex on abapical half of subsutural ramp; siphonal canal relatively short, open. Columella narrowly excavated adapically, straight below; callus hardly developed.

Discussion – Although the teleoconch sculpture is similar to that seen in raphitomids, we have placed this species in the genus *Clathurella* Carpenter, 1857 based on the multispiral protoconch with a strongly carinate last

two whorls, U-shaped anal sinus and strong tubercular denticulation within the outer lip dominated by a stout apical tooth. Shells of the genera *Clathurella* and *Pleurotomoides* Bronn, 1831 seem to overlap in teleoconch characters, but the protoconch in *Clathurella* species is multispiral, of 3-4 whorls, with the last 1-2 whorls strongly carinate and axial lamellae on the lower half (Bernasconi & Robba, 1984), whereas those of *Pleurotomoides* have only 2-2.5 whorls, with only the last half whorl carinate and no axial sculpture (Powell, 1966). The protoconch in the specimens of *Clathurella pierreaime* nov. sp. at hand are not well preserved but are multispiral, smaller and more pointed than those of the northwestern French *Pleurotomoides* species and there are traces of axial riblets below the carina.

Clathurella speafici Bellardi, 1877 from the Mediterranean lower Pliocene of Italy has a similar profile but has wider spirals that become somewhat swollen where they overrun the axial ribs; two spirals predominant on the spire whorls, whereas in *C. pierreaime* the spirals are much narrower, sharp and equal strength. Other Mediterranean *Clathurella* species such as *C. scalaria* (De Cristofori & Jan, 1832), and the middle Miocene North Sea Basin *C. luisae* (Semper *in* von Koenen, 1872) have more slender shells with tall scalate spires, their teleoconch overlapping with forms of *Pleurotomoides* species but differing in the protoconch features discussed above.

Distribution – Lower Pliocene: Atlantic, NW France (this paper).

Genus *Pleurotomoides* Bronn, 1831

Type species – *Defrancia pagoda* Millet, 1827, by typification of replaced name, Miocene, France.

- 1827 *Defrancia* Millet, p. 437. Type species (by subsequent designation; Dall, 1908): *Defrancia pagoda* Millet, 1827, Miocene, France. Junior homonym of *Defrancia* Bronn, 1825 [Bryozoa].
- 1831 *Pleurotomoides* Bronn, p. 555. Substitute name for *Defrancia* Millet, 1827, *non* Bronn, 1825 [Bryozoa].

***Pleurotomoides hordeaceus* (Millet, 1827)**

Plate 6, figs 1, 2

- *1827 *Defrancia hordeacea* Millet, p. 440, pl. 7, fig. 3.
- 1854 *Defrancia Hordeacea* Millet – Millet, p. 161.
- 1954 *Pleurotomoides hordeaceus* Millet, 1826 [sic] – Glibert, p. 56, pl. 7, fig. 2.
- 1964 *Pleurotomoides hordaceus* [sic] Millet, 1826 [sic] – Brébion, p. 617.

Material and dimensions – Maximum height 13.6 mm, width 5.5 mm. NHMW 2015/0133/0528 (1), NHMW 2015/0133/0529 (11), LC (50), FVD (30). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Pleurotomoides hordeaceus* (Millet, 1827) is characterised by its relatively slender shell, round-shouldered whorls and sculpture composed of broad rounded ribs, 9–10 on the penultimate whorl; on the last whorl the ribs are obsolete on the subsutural platform and base, swollen mid-whorl, crossed by fine close-set spiral cords of alternate strength. The outer lip is alate, the aperture has a strong tooth on outer lip and on the parietal portion of the columella, delimiting a deep, U-shaped anal sinus. Numerous elongated denticles are developed below these stout teeth on either side of the aperture. Unfortunately the protoconch is not well preserved in any of the specimens at hand, but it is multispiral (Pl. 6, fig. 2d). Specimens from the Assemblage I deposit of St-Clément-de-la-Place show it to be of a planktotrophic type, with the last two whorls carinate. This and several other *Pleurotomoides* species from the Upper Miocene Assemblage I deposits of northwestern France were described by Millet (1827), and will be discussed and compared in the corresponding part of this work. This is the only *Pleurotomoides* in the Assemblage III fauna. Brébion (1964) described and illustrated *P. lecointrei* (*nomen nudum*) from Le Pigeon Blanc, but this is a raphitomid. Millet (1854) recorded this species from Assemblage I (Thorigné, Sceaux-d'Anjou, Renauleau), to which Brébion (1964, p. 618) added St-Clément-de-la-Place and Assemblage III (Le Pigeon Blanc).

Distribution – Upper Miocene: Atlantic (Tortonian), NW France (Millet, 1854; Brébion, 1964). Lower Pliocene: Atlantic, NW France (Glibert, 1954; Brébion, 1964).

Family Clavatulidae Gray, 1853
Genus *Clavatula* Lamarck, 1810

Type species – *Clavatula coronata* Lamarck, 1801, by monotypy, present-day, West Africa.

1810 *Clavatula* Lamarck, p. 84.

***Clavatula helwerdae* nov. sp.**
Plate 1, figs 10–12

1964 *Clavatula vasseuri* Brébion, p. 547, pl. 13, fig. 26 (*nomen nudum*).

Type material – Holotype NHMW 2015/0133/0431, height 57.3 mm, width 19.9 mm (Pl. 1, fig. 10); paratype 1 NHMW 2015/0133/0432, height 44.9 mm, width 16.0 mm (incomplete; Pl. 1, fig. 11); paratype 2 NHMW 2015/0133/0433, height 26.0 mm, width, 10.9 mm (spire fragment; Pl. 1, fig. 12).

Other material – Maximum height 57.7 mm, width 19.5 mm. NHMW 2015/0133/0434 (3 spire fragments), LC (2 complete adults + 9 subadults, and juveniles), FVD (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Etymology – Named after Renate Helwerda of the Naturalis Biodiversity Center, Leiden, The Netherlands, in recognition of her contributions to molluscan palaeontology. *Clavatula* gender feminine.

Locus typicus – Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – Medium-sized *Clavatula* species with much reduced sculpture; whorls bearing swollen smooth infra-sutural and beaded supra-sutural band, profile between concave, abapically beads on suprasutural band weaken, spiral sculpture of crowded threads somewhat stronger below periphery on last whorl, deep U-shaped anal sinus with apex mid subsutural ramp, last whorl strongly but narrowly swollen at periphery, constricted at base, siphonal canal long, broad.

Description – Shell of medium size and thickness, fusiform, with tall spire and long siphonal canal. Protoconch not preserved. Teleoconch consisting of eight whorls bearing swollen smooth infra-sutural and beaded supra-sutural band, whorl periphery concave between. Abapically beading on suprasutural band weakens, obsolete, or almost so, on penultimate whorl. Spiral sculpture consists of fine, crowded, irregular spiral threads. Suture impressed, linear. Last whorl 60% of total height, bearing swollen infrasutural band, concave subsutural ramp, shoulder placed low, almost mid-whorl, narrowly inflated and convex at periphery, strongly constricted at base; spiral sculpture somewhat reinforced below periphery. Aperture elongate, 47% of total height, outer lip simple, anal sinus U-shaped, narrow, deep with apex placed mid subsutural ramp, siphonal canal long, relatively broad, open, straight, recurved at tip. Columella excavated upper third, straight and smooth below. Columella callus moderately thickened and expanded over base, sharply delimited. Siphonal fasciole long, straight, rounded.

Discussion – *Clavatula helwerdae* nov. sp. is characterised above all by its reduced sculpture. Beading is only present on the suprasutural band and weakens abapically, absent from the penultimate whorl in adult specimens. The whorl profile is strongly concave between the infra- and supra-sutural bands and the swollen periphery on the last whorl is rather narrow. As pointed out by Brébion (1964, p. 548) this species is remarkably similar to *C. excavata* Bellardi, 1877 from the Miocene Proto-Mediterranean of Italy. The differences given ‘*Cl. excavata*...*n’a pas d’ornementation spirale, le canal est beaucoup plus court, les nodules moins nombreux*’ (Brébion, 1964, p. 548) are not convincing. Neither the canal nor the beading on the supra-sutural cord seem significantly different from that figured by Bellardi (1877, pl. 6, fig. 18). Unfortunately, we have not seen *C. excavata*, which does not seem to have been refigured. In his description Bellardi noted that fine spiral sculpture was present but obsolete between the cords bordering the suture. In his figure it

can be seen that the cords are also slightly reinforced below the periphery on the last whorl. Nevertheless, it is correct to say that although weak, the spiral sculpture is stronger in *C. helwerdae*. However, the siphonal fasciole in *C. helwerdae* is significantly broader than that of *C. excavata*. Although these differences are small, *Clavatula* species are highly endemic (Vera-Peláez & Lozano-Francisco, 2001a; Scarponi & Della Bella, 2003; Landau *et al.*, 2013) and it is unlikely that the two are conspecific. *Clavatula saubrigiana* (Grateloup, 1845) from the middle Miocene Aquitaine Basin also has modest sculpture but it is stronger than in *C. helwerdae*, the beading is tubercular, the apical angle is slightly narrower, the spire relatively longer and the siphonal fasciole somewhat shorter and narrower. *Clavatula salomacensis* Peyrot, 1931 also from the middle Miocene Aquitaine Basin also has stronger sculpture, coarser tubercles on the suprasutural cord, and the basal spiral cords are more prominent.

The genus *Clavatula* is a thermophilic element in the Assemblage III fauna. Today *Clavatula* is a West African genus not found further north than Western Sahara (Ardevini & Cossignani, 2004). The paucity of species in the Assemblage III fauna might suggest SSTs consistent with the colder most northern limit of the genus' distribution.

Distribution – Lower Pliocene: Atlantic, NW France (Brébion, 1964).

Genus *Fusiturris* Thiele, 1929

Type species – *Pleurotoma undatiruga* Bivona, 1838, by monotypy, present-day, West Africa.

1929 *Fusiturris* Thiele, p. 361.

1929 *Tyrrhenoturris* Coen, p. 297. Type species (by subsequent designation; Powell, 1942): *Pleurotoma undatiruga* Bivona, 1838, by monotypy, present-day, West Africa. Junior objective synonym of *Fusiturris* Thiele, 1929.

***Fusiturris strigosa* (Millet, 1865)**

Plate 1, figs 13-15

1854 *Pleurotoma Strigosa* Millet, p. 161 (*nomen nudum*).

*1865 *Pleurotoma strigosa* Millet, p. 588.

1964 *Turris* (*Fusiturris*) *aquensis* Grateloup, 1832 – Brébion, p. 554, pl. 13, figs 28, 29 [*non Fusiturris aquensis* (Grateloup, 1832)].

Material and dimensions – Maximum height 28.1 mm, width 7.3 mm. NHMW 2015/0133/0435-0437 (3), 2015/0133/0438 (19), LC (50+), FVD (49). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Original description – ‘*Pleurotoma strigosa*, Millet. Coq. très-allongée, fusiforme, à canal étroit, allongé, plus ou moins recourbé en dessus, composée de douze à treize

tours de spire, le dernier ne faisant pas la moitié de la longueur totale. Chaque tour est surélevé par la présence de petites varices sinueuses et décurrentes, formées par les tours d'accroissement que fournit le sinus du bord droit. Ces petites varices, dans la var., sont remplacées par des côtes noduleuses très-prononcées. Longueur: 35-38 millimètres; diamètre: 8-9 millimètres. Th., Sc., Ren., Saint-Michel’ (Millet, 1865, p. 588).

Discussion – To the above description we can add that the protoconch is paucispiral composed of 1.5-1.75 smooth whorls with a bulbous first whorl. This protoconch type is suggestive of non-planktotrophic development. Millet (1865) described this species from the upper Miocene Tortonian of northwestern France. We confirm that the lower Pliocene Zanclean Assemblage III specimens are conspecific. Brébion (1964, p. 554) considered this species a synonym of *F. aquensis* (Grateloup, 1832) from the lower Miocene Aquitaine Basin, also recorded from the lower-middle Miocene North Sea Basin (A.W. Janssen, 1984). However, despite the teleoconch of the two being similar, *F. aquensis* has a multispiral protoconch composed of four whorls (Glibert, 1954, p. 11; A.W. Janssen, 1984, pl. 10, fig. 13), suggestive of planktotrophic development. Although the teleoconch sculpture is somewhat variable in *F. aquensis* and similar to that of *F. strigosa* (Millet, 1865), the siphonal canal is shorter in *F. aquensis*.

Millet (1854, p. 161; 1865, p. 588) described this species from Assemblage I localities of Thorigné, Sceaux-d’Anjou, Renauleau, and Saint-Michel. Brébion (1964, p. 555) added St-Clément-de-la-Place and Beaulieu, Assemblage II (Apigné, Le Temple du Cerisier) and Assemblage III (Palluau, Le Pigeon Blanc).

Distribution – Upper Miocene: Atlantic (Tortonian and Messinian): northwestern France (Millet, 1854, 1865; Brébion, 1964). Lower Pliocene: Atlantic, NW France (Brébion, 1964).

Family Drilliidae Olsson, 1964

Genus *Crassopleura* Monterosato, 1884

Type species – *Pleurotoma maravignae* Bivona, 1838, by monotypy, Pleistocene, Italy.

1884 *Crassopleura* Monterosato, p. 127.

***Crassopleura clavulina brugnonesi* (Dollfus, 1907)**

Plate 2, figs 1-4

*1907 *Pleurotoma* (*Drillia*) *incrassata* var. *brugnonesi* Dollfus, p. 310.

1954 *Clavus* (*Cymatosyrinx*) *clavulina* forme *brugnonesi* Dollfus, 1906 [*sic*] – Glibert, p. 32, pl. 5, fig. 3b.

1964 *Clavus* (*Cymatosyrinx*) *clavulina* var. *brugnonesi* Dollfus, 1906 [*sic*] – Brébion (*partim*), p. 551.

Material and dimensions – Maximum height 10.6 mm, width 3.5 mm. NHMW 2015/0133/0439-0442 (4), 2015/0133/0443 (42), LC (50+), FVD (50+). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – As pointed out by Glibert (1954, p. 33), the differences between the lower Miocene Tortonian Assemblage I specimens of *Crassispira clavulina* (Desmoulins, 1842) and those from the lower Pliocene Zanclean Assemblage III locality of Le Pigeon Blanc are small but consistent. Both populations have a low dome-shaped paucispiral protoconch composed of about two smooth whorls (Pl. 2, fig. 4) and the teleoconch in both can have a more or less elevated spire and weaker or stronger sculpture. The number of ribs is also variable; some specimens have a greater number of ribs (Pl. 2, fig. 2) so that the shell superficially resembles *C. maravignae* (Bivona, 1838), but that species has a multispiral protoconch. However, the stratigraphically younger Le Pigeon Blanc specimens generally have a squatter shell, a more concave subsutural ramp, more convex whorls, the last whorl is comparatively larger and more inflated, the ribs are generally more strongly developed (although they are subobsolete in some specimens; Pl. 2, fig. 3), and the narrow U-shaped anal sinus is even deeper and more constricted in the Assemblage III specimens. Dollfus (1907) erected the name *Pleurotoma (Drillia) incrassata* var. *brugnonei* for the specimens from Le Pigeon Blanc, which we consider to be a valid chronosubspecies of *C. clavulina*. A lectotype was figured by Glibert (1954, pl. 5, fig. 3b). Brébion (1964, p. 552) recorded both *C. clavulina* and *C. clavulina brugnonei* from numerous Assemblage I localities and from Le Pigeon Blanc only *C. clavulina brugnonei*. Whilst we accept that some specimens might be difficult to clearly ascribe to one of the two subspecies, we here restrict *C. clavulina brugnonei* to the Assemblage III localities.

Distribution – Lower Pliocene: Atlantic, NW France (Glibert, 1954; Brébion, 1964).

Family Horaiclavidae Bouchet, Kantor, Sysoev & Puilandre, 2011
Genus *Haedroleura* Bucquoy, Dautzenberg & Dollfus, 1883

Type species – *Pleurotoma septangularis* Montagu, 1803, by original designation, present-day, Mediterranean.

1883 *Haedroleura* Bucquoy, Dautzenberg & Dollfus, p. 85, 110.

Note – Species within the genus *Haedroleura* are almost impossible to identify reliably without their protoconch (Scarponi & Della Bella, 2003). As in raphitomes, species pairs occur, one with a paucispiral protoconch, the other with a multispiral protoconch but with almost

identical teleoconch shells. At present three living European species are recognized (Micali, 2010): *H. secalina* (Philippi, 1844)/ *H. septangularis* (Montagu, 1803) form one species pair, the third species *H. flexicosta* Monterosato, 1884 has a paucispiral protoconch and is most similar to *H. contii* (Bellardi, 1877). At present protoconch type is considered a species specific character, although we stress the same comment made under the generic note for *Raphitoma* might apply here.

***Haedroleura fratemcontii* nov. sp.**

Plate 2, figs 5, 6

1954 *Haedroleura contii* Bellardi, 1877 – Glibert, p. 54, pl. 6, fig. 14 [*non Haedroleura contii* (Bellardi, 1877)].

1964 *Bellaspira (Haedroleura) contii* Bellardi, 1877 – Brébion, p. 566 [*non Haedroleura contii* (Bellardi, 1877)].

Type material – Holotype NHMW 2015/0133/0546, height 9.0 mm, width 3.7 mm (Pl. 2, fig. 5); paratype 1 NHMW 2015/0133/0547, height 8.4 mm, width 3.2 mm; paratype 2 NHMW 2015/0133/0559, height 13.9 mm, width 5.4 mm (Pl. 2, fig. 6).

Other material – Maximum height 14.1 mm. LC (15), FVD (5). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Etymology – Latin ‘*frater, fratris*’ brother, noun; borther of *H. contii*, reflecting the close similarity to that species. *Haedroleura* gender feminine.

Locus typicus – Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Haedroleura* species of small size, with smooth paucispiral protoconch of two whorls, convex teleoconch whorls with 12–13 narrow, slightly sinuous ribs, fine crowded spiral sculpture, relatively large aperture, moderately short siphonal canal, without parietal pad or tooth.

Description – Shell small, of moderate thickness, fusiform, relatively slender. Protoconch paucispiral, composed of two smooth whorls with large nucleus. Junction with teleoconch marked by beginning of axial sculpture. Teleoconch of 4.5 convex whorls, with periphery placed between mid-whorl and suture. Suture impressed, undulating. Axial sculpture of narrow, weakly opisthocline, slightly sinuous ribs, 12–13 on last whorl, not aligned axially, extending between sutures. Spiral sculpture of very fine, crowded, equal spiral cords covering entire surface. Last whorl convex, subsutural ramp narrow, hardly delimited, weakly constricted at base; base not sharply delimited, imperforate. Aperture ovate, relatively wide,

outer lip convex, thickened by narrow labial varix; anal canal not developed; siphonal canal moderately short, open, slightly recurved at tip. Columella weakly excavated. Columellar and parietal callus not expanded, forming very narrow callus rim visible only on side view.

Discussion – Glibert (1954, p. 54) identified some specimens from Le Pigeon Blanc as *Haedropleura contii* (Bellardi, 1877), originally described from the lower Pliocene Mediterranean of Italy. That species is characterised by its tall multispiral protoconch (holotype; protoconch: Bernasconi & Robba, 1984, pl. 3, fig. 1; teleoconch: Ferrero Mortara *et al.*, 1981, pl. 13, fig. 11). Its teleoconch is composed of more convex whorls than in the *H. secalina* (Philippi, 1844)/ *H. septangularis* (Montagu, 1803) species pair, with more numerous (11-14), narrower, slightly sinuous ribs that extend between the sutures but are not aligned axially, and the parietal callus and pad are hardly developed, whereas in both of *H. secalina* and *H. septangularis* a small parietal pad is present. The specimen illustrated by Glibert (1954, pl. 6, fig. 14) is also from Le Pigeon Blanc and identical to the specimen figured here with a paucispiral protoconch. Therefore it cannot be conspecific with *H. contii*.

However, we could consider *Haedropleura fratemcontii* nov. sp. the paucispiral species pair to *H. contii*. The teleoconch shells are almost identical; the siphonal canal is possibly slightly longer in *H. fratemcontii*.

Micali (2010, p. 5) drew attention to a third extant Mediterranean species with a paucispiral protoconch: *H. flexicosta* Monterosato, 1884. It differs from *Haedropleura fratemcontii* in being more solid, the subsutural ramp is concave and more obvious than in *H. fratemcontii*, the axial ribs are more sinuous and tend to be swollen on the abapical portion of the whorl and there is a small parietal swelling developed.

Distribution – Lower Pliocene: Atlantic, NW France (Glibert, 1954; Brébion, 1964).

***Haedropleura secalina* (Philippi, 1844)**

Plate 2, fig. 7

- *1844 *Pleurotoma secalinum* Philippi, p. 170, pl. 26, fig. 9.
- 1896 *Haedropleura septangularis* Montg. – Cossmann, p. 92, pl. 6, figs 14, 15 [*non Haedropleura septangularis* (Montagu, 1803)].
- 1904 *Bela* (*Haedropleura*) *septangularis* var. *parvulata* Sacco, p. 47, pl. 12, figs 53-54.
- 1910 *Bela* (*Haedropleura*) *septangularis* (Montagu) – Cerulli-Irelli, p. 51, pl. 4, figs 55-57 [*non Haedropleura septangularis* (Montagu, 1803)].
- ?1915 *Haedropleura septangularis* (Montagu) – Harmer, p. 251, pl. 27, fig. 27, pl. 29, figs 3, 4.
- 1915 *Haedropleura septangularis* var. *secalina* (Philippi) – Harmer, p. 253, pl. 29, figs 5, 6.
- non* 1954 *Haedropleura septangularis* f. *secalina* Philippi, 1844 – Glibert, p. 52, pl. 6, fig. 12a [= *Haedropleura*

leura septangularis (Montagu, 1803)].

- 1964 *Bellaspira* (*Haedropleura*) *septangularis* var. *secalina* Philippi, 1844 – Brébion, p. 565, pl. 13, fig. 38.
- non* 1984 *Haedropleura secalina* (Philippi, 1844) – Bernasconi & Robba, p. 279, pl. 3, fig. 2 [= *Haedropleura septangularis* (Montagu, 1803)].
- 1997 *Haedropleura secalina* (Philippi, 1844) – Chirli (*partim*), p. 36, pl. 9, figs 10-11 [not 12 = *Haedropleura bucciniformis* (Bellardi, 1877)].
- 2002 *Haedropleura septangularis* (Montagu, 1803) – Vera-Peláez, p. 201, pl. 3, fig. K [*non Haedropleura septangularis* (Montagu, 1803)].
- 2003 *Haedropleura secalina* (Philippi, 1844) – Scarponi & Della Bella, p. 55, figs 84a-b, 91.
- 2010 *Haedropleura secalina* (Philippi, 1844) – Sosso & Dell'Angelo, p. 45, p. 61 unnumbered fig. middle row centre.
- 2010 *Haedropleura secalina* (Philippi, 1844) – Micali, p. 4, figs 2-4.

Material and dimensions – Maximum height 10.0 mm, width 3.5 mm. NHMW 2015/0133/0542 (1), 2015/0133/0543 (2). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – Scarponi & Della Bella (2003, p. 55) and Micali (2010, p. 4) discussed the confusion surrounding this species, which has often been considered a subspecies of *Haedropleura septangularis* (Montagu, 1803). *Haedropleura secalina* (Philippi, 1844) and *H. septangularis* form a species pair; *H. septangularis* has a multispiral protoconch of about 2.5-3 whorls with sigmoid axial riblets on the last half whorl, whereas *H. secalina* has a paucispiral protoconch of 1.5-2.0 whorls covered with micropustular sculpture to a variable degree. Their teleoconch shells are difficult to separate consistently and rather variable. According to Scarponi & Della Bella (2003) in *H. secalina* the ribs are weaker but more numerous than in *H. septangularis* (9-11 vs. 7-8), and more flexuous according to Micali (8-10 vs. 7; 2010, p. 4), who gave a lower rib count for both species.

The shell surface of the specimens from Le Pigeon Blanc is somewhat abraded, making them poor to photograph, but both multispiral and paucispiral forms are present. In the material at hand the multispiral form (*H. septangularis*) has nine weaker ribs that persist onto the last whorl, and the paucispiral form (*H. secalina*) has eight broader ribs, one or two strongly varicose in some specimens, that weaken on the penultimate and are obsolete on the last whorl. This is opposite to what was reported by Scarponi & Della Bella (2003) for their Italian Pliocene material. This might suggest either that we are dealing with an even more diverse species complex than previously thought, or that this is a highly variable species, both in teleoconch and possibly protoconch morphology. We provisionally use the protoconch alone to distinguish the two forms, pending further molecular studies to verify the value of protoconch morphology in separating species pairs. In the chresonymy of the two species we have only included

references in which the protoconch is either visible or described. Therefore, the distribution may be incomplete. We have excluded Brébion's (1964, p. 566) records in the northwestern French upper Miocene Assemblage I and II and upper Pliocene-Pleistocene Assemblage IV faunas, which will be verified in subsequent papers.

Distribution – Upper Miocene: Atlantic (Tortonian and Messinian): NW France (Brébion, 1964); Proto-Mediterranean (Tortonian), Italy (Sacco, 1904). Lower Pliocene: Atlantic, NW France (Glibert, 1954; Brébion, 1964); central Mediterranean, Italy (Chirli, 1997; Scarponi & Della Bella, 2003). Upper Pliocene: North Sea Basin, Red Crag, England (Harmer, 1915); western Mediterranean, Estepona Basin (Vera-Peláez, 2002); central Mediterranean, Italy (Scarponi & Della Bella, 2003; Sosso & Dell'Angelo, 2010). Upper Pliocene-Pleistocene: Atlantic, NW France (Brébion, 1964). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1910). Present-day: western and central Mediterranean (Micali, 2010).

***Haedropleura septangularis* (Montagu, 1803)**

Plate 2, figs 8, 9

- *1803 *Murex septangularis* Montagu, p. 268, pl. 9, fig. 5.
- 1836 *Pleurotoma heptagona* Scacchi, p. 42, pl. 1, fig. 17.
- 1904 *Bela* (*Haedropleura*) *septangularis* (Mont.) – Sacco, p. 47, pl. 12, figs 51–52.
- 1954 *Haedropleura septangularis* f. *secalina* Philippi, 1844 – Glibert, p. 52, pl. 6, fig. 12a [*non Haedropleura secalina* (Philippi, 1844)].
- 1954 *Haedropleura septangularis* f. Montagu, 1803 – Glibert, p. 53, pl. 6, fig. 12b.
- 1966 *Haedropleura septangularis* (Montagu, 1803) – Powell, p. 83, pl. 12, fig. 18.
- 1984 *Haedropleura secalina* (Philippi, 1844) – Bernasconi & Robba, p. 279, pl. 3, fig. 2 [*non Haedropleura secalina* (Philippi, 1844)].
- 1985 *Haedropleura septangularis* (Montagu, 1803) – Fretter & Graham, p. 510, fig. 350.
- 1988 *Haedropleura septangularis* (Montagu, 1803) – Graham, p. 426, fig. 176.
- 1997 *Haedropleura septangularis* (Montagu, 1803) – Chirli, p. 37, pl. 10, figs 5–7.
- non* 2002 *Haedropleura septangularis* (Montagu, 1803) – Vera-Peláez, p. 201, pl. 3, fig. K [= *Haedropleura secalina* (Philippi, 1844)].
- 2003 *Haedropleura septangularis* (Montagu, 1803) – Scarponi & Della Bella, p. 55, figs 85–87, 92.
- 2010 *Haedropleura septangularis* (Montagu, 1803) – Micali, p. 3, fig. 1.
- 2011 *Haedropleura septangularis* (Montagu, 1803) – Landau *et al.*, p. 36, pl. 19, fig. 6 (on plate nrs. 6 and 7 inverted *lapsus*).

Material and dimensions – Maximum height 10.6 mm, width 3.9 mm. NHMW 2015/0133/0544 (1), 2015/0133/0545 (1), NHMW 2015/0133/0560 (1), LC (15), FVD (6). Le Pi-

geon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – see above under *Haedropleura secalina* (Philippi, 1844).

Distribution – Middle Miocene: Atlantic, Loire Basin (Glibert, 1954). Lower Pliocene: Atlantic, NW France (Brébion, 1964), Guadalquivir Basin (Landau *et al.*, 2011); central Mediterranean, Italy (Chirli, 1997; Scarponi & Della Bella, 2003). Upper Pliocene: central Mediterranean, Italy (Sacco, 1904; Scarponi & Della Bella, 2003). Present-day: northeastern Atlantic frontage, Norway to Madeira and Canaries, rare in the Mediterranean (Micali, 2010).

Family Mangeliidae Fischer, 1883

Genus *Agathotoma* Cossmann, 1899

Type species – *Mangelia angusta* Bellardi, 1847, by typification of replaced name, Pliocene, Italy.

- 1877 *Ditoma* Bellardi, p. 295. Type species (by monotypy): *Mangelia angusta* Bellardi, 1847, Pliocene, Italy (*non* Illiger, 1807, p. 320 [Coleoptera]).
- 1899 *Agathotoma* Cossmann, p. 45. *Nom. nov. pro Ditoma* Bellardi, 1877, *non* Illiger, 1807 [Coleoptera].

***Agathotoma angusta* Bellardi, 1847**

- 1842 *Pleurotoma angusta* Jan in Sismonda, p. 34 (*nomen nudum*).
- *1847 *Raphitoma angusta* Bellardi, p. 103, pl. 4, fig. 25.
- 1847 *Raphitoma angusta* Bell. – Sismonda, p. 35.
- 1877 *Mangelia angusta* (Jan) – Bellardi, p. 295, pl. 8, fig. 40.
- 1896 *Mangelia* (*Ditoma*) *angusta* Jan – Cossmann, p. 125, pl. 7, figs 29, 30.
- 1910 *Mangilia* (*Agathotoma*) *angusta* Jan – Cerulli-Irelli, p. 248, pl. 36, figs 20, 21.
- 1914 *Mangilia* (*Agathotoma*) *angusta* Jan – Cipolla, p. 148, pl. 13, fig. 19.
- 1937 *Mangelia costata* var. *angusta* (Jan) – Montanaro, p. 173, pl. 8, fig. 9.
- 1943 *Agathotoma angusta* (Jan) – Wenz, p. 1446, fig. 4092.
- 1960 *Mangelia* (*Agathotoma*) *angusta* Jan, 1842 – Glibert, p. 27, pl. 5, fig. 11.
- 1964 *Agathotoma angusta* Jan in Sismonda, 1842 – Brébion, p. 594.
- 1966 *Agathotoma angusta* (Jan in Bellardi, 1848 [*sic*]) – Powell, p. 99, pl. 15, fig. 15.
- 1974 *Agathotoma angusta* (Jan in Bellardi, 1848 [*sic*]) – Malatesta, p. 431, pl. 32, fig. 10.
- 1975 *Agathotoma angusta* (Jan) – Pavia, p. 113, pl. 8, fig. 21.
- 1992 *Mangelia angusta* (Jan, 1842) – Cavallo & Repetto, p. 142, fig. 385.

- 1997 *Agathotoma angusta* (Jan in Sismonda, 1842) – Chirli, p. 58, pl. 16, figs 4-7.
- 2002 *Agathotoma angusta* (Jan in Sismonda, 1842) – Vera-Peláez, p. 206, pl. 4, figs I, J.
- 2010 *Agathotoma angusta* (Jan, 1842) – Sosso & Dell’Angelo, p. 47, unnumbered fig. P. 63 top centre.
- 2010 *Agathotoma angusta* (Bellardi, 1847) – Scarponi & Della Bella, p. 81, figs 193-200.
- 2013 *Agathotoma angusta* (Bellardi, 1847) – Landau *et al.*, p. 263, pl. 44, fig. 3.

Material and dimensions – Height 8.3 mm, width 3.5 mm. IRScNB IST 5087 (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Agathotoma* Cossmann, 1899 species differ from *Mangelia* Risso, 1826 in having a much heavier labial varix, a much deeper anal sinus and a shorter siphonal canal. *Agathotoma angusta* (Bellardi, 1847) is a characteristic species that cannot be confused with other mangeliids. Apart from the generic characters, *A. angusta* has 14-15 sharp, narrow axial ribs that are elevated and lamellar at the suture, fine spiral sculpture; spiral cords are only developed over the siphonal fasciole, and a well developed stromboid notch abapically on the outer lip. The protoconch illustrated by Scarponi & Della Bella (2010, fig. 193) is multispiral, of about four convex whorls, with sinuous axial riblets on the last two whorls.

There is little to add to the discussion by Scarponi & Della Bella (2010, p. 82) on this very characteristic little turrid. *Raphitoma angusta* Jan in Sismonda, 1842 is a *nomen nudum* (Tucker, 2004). Brébion (1964, p. 594) did not find any further specimens and reproduced Glibert’s (1960) record for Le Pigeon Blanc. Like Brébion, despite extensive collecting, we have also been unable to find any further specimens.

Agathotoma pherousae (Glibert, 1960) from the upper Miocene Assemblage I deposits of northwestern France differs in being smaller, with fewer, thicker, rounded instead of sharp-edged axial ribs (9-10 vs. 14-15), even finer spiral sculpture and a weaker stromboid notch on the outer lip. For further comparison with congeners see Landau *et al.* (2013, p. 264).

Agathotoma angusta is a remarkably long-lived and widely distributed mangeliid that did not, however, survive cooling SSTs at the end of the lower Pleistocene.

Distribution – Lower Miocene: Proto-Mediterranean (Burdigalian), Colli Torinesi, Italy (Bellardi, 1877; Wenz, 1943). Middle Miocene: eastern Proto-Mediterranean (Serravallian), Karaman Basin, Turkey (Landau *et al.*, 2013). Upper Miocene: Atlantic (Tortonian): Algarve Basin (BL unpublished data; NHMW coll.); Proto-Mediterranean (Tortonian), Italy (Montanaro, 1937). Lower Pliocene: Atlantic, NW France (Glibert, 1960); central Mediterranean, Italy (Bellardi, 1877; Pavia, 1975; Chirli, 1997; Scarponi & Della Bella, 2010). Upper Pliocene: western Mediterranean, Estepona Basin, Spain (Vera-

Peláez, 2002); central Mediterranean, Italy (Bellardi, 1847; Cipolla, 1914; Malatesta, 1974; Cavallo & Repetto, 1992; Scarponi & Della Bella, 2010; Sosso & Dell’Angelo, 2010). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1910).

Genus *Bela* Leach in Gray, 1847a [October]

Type species – *Murex nebula* Montagu, 1803, by subsequent designation (Gray, 1847b [November]), present-day, British Isles.

- 1847a *Bela* Leach in Gray, p. 270.
- 1847 *Ichnusa* Jeffreys, p. 312. Unavailable, name introduced in synonymy.
- 1884 *Ginnania* Monterosato, p. 127. Type species (by subsequent designation; Crosse, 1885): *Pleurotoma fuscata* Deshayes, 1835, present-day, Mediterranean.
- 1901 *Petrafixia* Cossmann, 1901, p. 125, 127. Type species (by subsequent designation; Kantor *et al.*, 2014): *Fusus koeneni* Cossmann & Lambert, 1884, Oligocene, France.
- 1988a *Fehria* van Aartsen, p. 30. Type species (by original designation): *Ginnania taprurensis* Pallary, 1904, present-day, Eastern Mediterranean.

***Bela falbalae* nov. sp.**

Plate 2, figs 10-12

- ?1960 *Bela miranda* Peyrot, 1938 – Glibert, p. 28, pl. 5, fig. 15 [non *Raphitoma miranda* (Peyrot, 1938)].

Type material – Holotype MNHN.F.A66715, height 5.7 mm, width 2.0 mm (Pl. 2, fig. 12); paratype 1 MNHN.F.A66716, height 6.8 mm, width 1.9 mm; paratype 2 NHMW 2015/0133/0444, height 5.9 mm, width 2.0 mm (Pl. 2, fig. 10); paratype 3 NHMW 2015/0133/0445, height 5.7 mm, width 1.8 mm (Pl. 2, fig. 11).

Other material – Maximum height 8.6 mm, width 2.3 mm. NHMW 2015/0133/0446 (43), LC (50+), FVD (50+).

Etymology – Named after Falbala, the beautiful, tall, slender girl in the ‘Asterix’ comics. *Bela* gender feminine.

Locus typicus – Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – Small *Bela* species with slender shell, high spired, multispiral protoconch with tubercular sculpture on last whorl, four roundly angled teleoconch whorls with high-placed shoulder, narrow widely spaced axial ribs predominant, weak spiral sculpture of crowded narrow cords of alternating strength, wide, shallow U-shaped anal sinus, short siphonal canal.

Description – Shell small, slender, fusiform, with tall spire. Protoconch multispiral, consisting of about 3.5 whorls, with small nucleus; last whorl bearing five sub-obsolete spiral cords and close-set opisthocline ribs with rounded tubercles developed at intersections (hp = 580 μ m, dp = 650 μ m). Teleoconch consisting of four convex whorls, subsutural ramp convex, poorly delimited, roundly angled at shoulder. Suture impressed, shallowly undulating. Sculpture composed of narrow, elevated, widely spaced opisthocline ribs that extend between sutures, eight on second teleoconch whorl, ten on last whorl, and fine, close-set spiral cords of roughly alternating strength; shoulder cord slightly strengthened. Last whorl about 54% total height, subsutural ramp narrow, weakly convex to concave, roundly angled at high-placed shoulder, profile convex below, moderately constricted at base. Axials most strongly developed at periphery, weakening abapically, obsolete over base. Aperture short, about 35% total height, outer lip simple, anal sinus broadly and shallowly U-shaped, with apex mid subsutural ramp. Siphonal canal short, open. Columella smooth, weakly excavated. Colmellar and parietal callus forming narrow callus band.

Discussion – *Bela falbalae* nov. sp. belongs within the *Bela brachystoma* (Philippi, 1844) species group of Scarponi & Della Bella (2010), characterised by their small size, slender shape and relatively tall spire and short aperture. The protoconch in all species in this group is multispiral, with the last whorl bearing tubercular spiral sculpture. Within this group, *B. falbalae* has the finest spiral sculpture. It is most similar to the Italian Pliocene *B. fiorentina* Scarponi & Della Bella, 2010 which is also slender and has a similar number of fine axial ribs, but in the French species the spirals are even weaker and more numerous and the shoulder cord is less strongly developed. Apart from the difference in spiral sculpture, most of the Italian Pliocene species illustrated by Scarponi & Della Bella (2010) have squatter shells. Only *B. scalariforme* (Brugnone, 1862) is as slender with a tall spire but differs in having coarser, sharper spiral sculpture. This may be the same species as that figured by Glibert (1960, pl. 5, fig. 15) as *Bela miranda* (Peyrot, 1938) from the Langhian Middle Miocene Loire Basin of France. The specimen is worn but is similar in size, shape and sculpture (although the spiral sculpture is abraded). No discussion was offered by Glibert (1960, p. 28), but we are surprised by his interpretation of Peyrot's species. Peyrot (1938, p. 296, pl. 5, figs 6, 13) described *Daphnella* (*Raphitoma*) *miranda* and figured a shell we would also place in the Raphitomidae. Moreover, his text clearly describes a raphitomid protoconch '...protoconque à petit nucleus obtus; les suivants convexes séparés par de profondes sutures, postérieurement déprimés en un méplat finement guilloché par la rencontre de stries d'accroissement assez saillantes, quoique très étroites, et de deux filets spiraux très ténus;...' (1938, p. 296).

Distribution – Lower Pliocene: Atlantic, NW France (Glibert, 1954; Brébion, 1964).

***Bela trinacria* Mariottini & Smriglio, in Mariottini et al., 2009**

Plate 2, fig. 13; Plate 3, fig. 1

- 1877 *Raphitoma turgida* (Forb.) – Bellardi, p. 312, pl. 9, fig. 25 (*non* Reeve, 1844).
- 1904 *Raphitoma turgida* var. *pliospiralata* Sacc., Sacco, p. 56, pl. 14, figs 41-42.
- 1914 *Daphnella* (*Raphitoma*) *turgida* Forbes – Cipolla, p. 168, pl. 14, figs 17, 18 (*non* Reeve, 1844).
- 1937 *Daphnella* (*Raphitoma*) *turgida* (Forb.) – Montanaro, p. 189, pl. 8, fig. 71 (*non* Reeve, 1844).
- 1964 *Cythara* (*Mangelia*) *turgida* Forbes, 1843 [*sic*] – Brébion, p. 584, pl. 14, fig. 14 (*non* Reeve, 1844).
- 1964 *Cythara* (*Mangelia*) *turgida* var. *pliospiralata* Sacco, 1890 – Brébion, p. 584, pl. 14, fig. 15.
- 1992 *Bela turgida* (Forbes, 1843 [*sic*]) – González Delgado, p. 43, pl. 4, figs 11, 12 (*non* Reeve, 1844).
- 1992 *Bela* (*Ichnusa*?) *turgida* (Forbes in Reeve, 1844) – Cavallo & Repetto, p. 140, fig. 383 (*non* Reeve, 1844).
- 1997 *Bela turgida* (Forbes in Reeve, 1843 [*sic*]) – Chirli, p. 55, pl. 15, figs 9-12 (*non* Reeve, 1844).
- 2002 *Bela turgida* (Forbes, 1844) – Vera-Peláez, p. 208, pl. 4, figs X-Z, pl. 13, figs G, H (*non* Reeve, 1844).
- *2009 *Bela trinacria* Mariottini & Smriglio in Mariottini et al., p. 10, figs 17-25.
- 2011 *Bela turgida* (Reeve, 1844) – Landau et al., p. 34, pl. 17, fig. 13 (*non* Reeve, 1844).
- 2013 *Bela trinacria* Mariottini & Smriglio, 2009 – Landau et al., p. 268, pl. 44, fig. 10, pl. 71, fig. 6, pl. 72, fig. 1.

Material and dimensions – Maximum height 12.9 mm, width 5.8 mm. NHMW 2015/0133/0447-0048 (2), NHMW 2015/0133/0449 (9), LC (50+), FVD (14). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – This species of *Bela* is characterised by its biconic shape, elongate-fusiform solid shell and sculpture consisting of 7-8 broad ribs crossed by much finer, close-set spiral threads of primary and secondary strength. It belongs to the *Bela menkhorsti* species group. The name *Bela menkhorsti* van Aartsen (1988a) was proposed to replace *Pleurotoma nana* Scacchi, 1836, not of Deshayes, 1835. Members of this species group have often been reported in the literature as *Pleurotoma turgida* Reeve, 1844, which van Aartsen (1988a, b) considered to be a *nomen dubium*.

The *Bela menkhorsti* group was revised recently by Mariottini et al. (2009), who recognised four species. All have very similar teleoconch morphology, but two have paucispiral protoconchs: *B. zenetouae* (van Aartsen, 1988) and *B. taprurenensis* (Pallary, 1904), and two have multispiral protoconchs: *B. menkhorsti* and *B. trinacria*. The difference between the multispiral species was based on protoconch characters, as the protoconch is larger in *B. trinacria* (0.6-0.7 mm vs. 0.53-0.54 mm) than in *B. menkhorsti*, with a greater number of whorls in *B. tri-*

naeria (2.7-2.8 vs. 2.0-2.2). Mariottini *et al.* (2009) considered *B. trinacria* to be a fossil species present in the Italian Pliocene, whereas *B. menkhorsti* is the extant species.

The protoconch in the French Assemblage III material is not well preserved, but it seems to be multispiral and we consider them to represent *B. trinacria*. For further discussion see Mariottini *et al.* (2009) and Landau *et al.* (2013).

Brébion (1964, p. 584) distinguished the slightly larger more slender forms from Le Pigeon Blanc as var. *pliospiralata* Sacco, 1890 but as illustrated by Mariottini *et al.* (2009) relatively squatter and more elongated forms of *B. trinacria* occur. We have not seen the protoconch of a 'typical' var. *pliospiralata* and provisionally consider them conspecific. Brébion (1964, p. 584, 585) recorded this species from the Assemblage I locality of Thorigné and the Assemblage III locality of Le Pigeon Blanc.

Distribution – Middle Miocene: Proto-Mediterranean Sea (Serravallian): Karaman Basin, Turkey (Landau *et al.*, 2013). Upper Miocene: Atlantic (Tortonian), NW France (Brébion, 1964); Proto-Mediterranean Sea (Tortonian): Po Basin, Italy (Montanaro, 1937). Lower Pliocene: Atlantic, NW France (Brébion, 1964), Guadalquivir Basin, Spain (González Delgado, 1992; Landau *et al.*, 2011); central Mediterranean, Italy (Chirli, 1997). Upper Pliocene: northeastern Atlantic, Mondego Basin, Portugal (NHMW coll.); western Mediterranean, Estepona Basin (Vera Peláez, 2002); central Mediterranean, Italy (Bellardi, 1877; Sacco, 1904; Cipolla, 1914; Cavallo & Repetto, 1992).

Genus *Mangelia* Risso, 1826

Type species – *Mangelia striolata* Risso, 1826, by subsequent designation (Gray, 1847b), present-day, Mediterranean.

- 1826 *Mangelia* Risso, p. 219.
- 1875 *Cythereella* Monterosato, p. 73. Type species (by subsequent designation; Woodring, 1928): *Murex costatus* Pennant, 1777, present-day, British Isles.
- 1883b *Mangilia* Fischer, p. 593. Unjustified emendation of *Mangelia* Risso, 1826.
- 1883 *Mangiliella* Bucquoy, Dautzenberg & Dollfus, p. 85, 108. Type species (by original designation): *Pleurotoma multilineolata* Deshayes, 1835, present-day, Greece.
- 1884 *Smithia* Monterosato, 1884, p. 128. Type species (by monotypy): *Pleurotoma smithii* Forbes, 1840, present-day, British-Isles. Junior homonym of *Smithia* Milne-Edwards & Haime, 1851 [Cnidaria] and several others.
- 1884 *Villiersia* Monterosato, p. 128. Type species (by monotypy): *Murex attenuatus* Montagu, 1803, present-day, Mediterranean. Junior homonym of *Villiersia* d'Orbigny, 1837 [Nudibranchia].
- 1890 *Smithiella* Monterosato, p. 186. Type species (by

typification of replaced name): *Pleurotoma smithii* Forbes, 1840, present-day, British Isles. *Nom. nov. pro Smithia* Monterosato, 1884, *non* Milne-Edwards & Haime, 1851.

- 1890 *Villiersiella* Monterosato, p. 191. Type species (by typification of replaced name): *Murex attenuatus* Montagu, 1803, present-day, Mediterranean. *Nom. nov. pro Villiersia* Monterosato, 1884, *non* d'Orbigny, 1837.
- 1917 *Rissomangelia* Monterosato, p. 24. Type species (by subsequent designation; Dall, 1918): *Pleurotoma bertrandii* Payraudeau, 1826, present-day, Mediterranean.
- 1917 *Lyromangelia* Monterosato, p. 25. Type species (by monotypy): *Pleurotoma taeniata* Deshayes, 1835, present-day, Mediterranean.
- 1977 *Cyrtocythara* Nordsieck, p. 34. Type species (by original designation): *Pleurotoma albida* Deshayes, 1835 [*non* Perry, 1811, *non* Risso, 1826; = *Mangelia unifasciata* (Deshayes, 1835)], present-day, Mediterranean.
- 1977 *Rugocythara* Nordsieck, p. 35. Type species (by original designation): *Pleurotoma rugulosum* Philippi, 1843, Oligocene, Germany.

Note – According to D. Scarponi (personal communication, August 2017) *Villiersiella* Monterosato, 1890 with type species *Murex attenuatus* Montagu, 1803 should be considered a separate genus from *Mangelia* Risso, 1826, based mainly on radular characters. As far as we are aware, this position is not yet widely recognised and we provisionally interpret *Mangelia* as recognised by Bouchet & Gofas (WoRMS, 2011).

Mangelia attenuata (Montagu, 1803)

Plate 3, fig. 2

- *1803 *Murex attenuatus* Montagu, p. 266, pl. 9, fig. 6.
- 1829 *Pleurotoma Villiersii* Michaud, p. 262, pl. (un-numbered), figs 4, 5.
- 1836 *Pleurotoma gracile* Philippi, p. 198, pl. 11, fig. 23.
- 1836 *Pleurotoma gracilis* Scacchi, p. 13, note 21, fig. 21.
- 1838 *Pleurotoma vulpina* Bivona, p. 223, fig. 10.
- 1840 *Pleurotoma Bivonae* Maravigna, p. 326.
- 1904 *Raphitoma* (*Villiersiella*) *attenuata* (Montg.) – Sacco, p. 56, pl. 14, figs 43, 44.
- 1910 *Raphitoma attenuata* Mtg. – Cerulli-Irelli, p. 262, pl. 37, figs 52-58.
- 1914 *Daphnella* (*Raphitoma*) *attenuata* Montagu – Cipolla, p. 165, pl. 14, figs 14, 15.
- 1915 *Raphitoma attenuata* (Montagu) – Harmer, p. 256, pl. 30, figs 8, 9.
- 1954 *Mangelia striolata* Risso, 1826 – Glibert, p. 48, pl. 6, fig. 7 [*non* *Mangelia striolata* (Risso, 1826)].
- 1960 *Mangelia* (*Mangelia*) *attenuata* (Montagu, 1803) – Malatesta, p. 192, pl. 9, fig. 12.
- 1964 *Cythara* (*Mangelia*) *attenuata* Montagu, 1803 – Brébion, p. 577.

- 1974 *Mangelia attenuata* (Montagu, 1803) – Malatesta, p. 423, pl. 32, fig. 7.
 1975 *Cythara (Mangelia) attenuata* Montagu, 1803 – Pavia, p. 113, pl. 8, fig. 13.
 1982a *Cythara (Mangelia) attenuata* Montagu, 1803 – Martinell, p. 102, pl. 1, figs 9-10.
 1985 *Mangelia attenuata* (Montagu, 1803) – Fretter & Graham, p. 525, fig. 362.
 1987 *Mangelia (Mangelia) attenuata* (Montagu, 1803) – Cuerdo Barceló, p. 318, pl. 29, fig. 16.
 1992 *Mangelia attenuata* (Montagu, 1803) – Cavallo & Repetto, p. 142, fig. 387.
 1997 *Mangelia attenuata* (Montagu, 1803) – Chirli, p. 63, pl. 18, figs 3-5.
 2001 *Mangelia attenuata* (Montagu, 1803) – Silva, p. 539, pl. 25, figs 16-20.
 2002 *Mangelia attenuata* (Montagu, 1803) – Vera-Peláez, p. 205, pl. 4, figs A, B, pl. 13, figs A, B.
 2011 *Mangelia coarctata* (Forbes, 1840) – Landau *et al.*, p. 33, pl. 17, fig. 7.

Material and dimensions – Maximum height 9.0 mm, width 2.7 mm. NHMW 2015/0133/0450 (1), NHMW 2015/0133/0451 (6), LC (21), FVD (12). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Mangelia attenuata* (Montagu, 1803) is characterised by its slender elongated shell. The specimens from Le Pigeon Blanc have eight or nine elevated, opisthocline rounded axial ribs that extend between the sutures and fine spiral cords separated by narrow grooves. The siphonal canal is long and the outer lip is only slightly thickened by a relatively weak labial varix. The protoconch is very tall (npw = 4, hp = 1.02 mm, dp = 0.76 mm; Pl. 3, fig. 2d) and is larger than that described by Fretter & Graham (npw = 3-3.5, hp = 0.50 mm, dp = 0.50 mm; 1985, p. 525) but similar in shape, with sinuous axial riblets on the last half whorl. We note that the illustrated specimen from Le Pigeon Blanc has 0.5-1.0 whorl more than *Mangelia attenuata* (living specimens, *vide* Fretter & Graham, 1985). If the planktotrophic stage were longer it would grow an extra whorl and be broader and taller. We have not been able to find a range of protoconch size for *M. attenuata*, and it seems that Scarponi & Della Bella (2010) did not recognise this species in the Italian Plio-Pleistocene. We have insufficient material from Le Pigeon Blanc to ascertain if the protoconch figured is unusually tall for the population, or if it might represent yet another species. However, we would be very reluctant to describe a new species based on difference in protoconch size alone and provisionally consider the French Pliocene material to fall within the variability of *M. attenuata*.

Marquet (1998a, b) separated some of the Pliocene English and Belgian North Sea Basin specimens under the name *Mangelia gracilior* (Bell, 1871), said to differ from *M. attenuata* in being larger with a shallower suture. The protoconch is difficult to measure with the figured given, as no scale is provided, but it is multispiral with

fine axial riblets on the last half whorl, similar to that of *M. attenuata* and from the figure shows close to four whorls and not 2.5 as stated by Marquet (1998a, pl. 2, fig. 3a). We have compared specimens at hand from the upper Pliocene Oorderen Sands of Belgium and they are indeed larger than any *M. attenuata*. The suture does not seem to us shallower; they both have an impressed suture, but the whorls in *M. gracilior* are slightly less convex resulting in weaker constriction at the suture. We provisionally accept this separation as we have seen no intermediate specimens. It seems that the two species coexisted in the North Sea Basin Pliocene, as Harmer (1915, pl. 30, figs 8, 9) seem to represent *M. attenuata*. The slender specimens from the Guadalquivir Basin illustrated by Landau *et al.* (2011, pl. 17, fig. 7) are *M. attenuata* and not *M. coarctata* (Forbes, 1840).

Distribution – Middle Miocene: Atlantic, Loire Basin (Glibert, 1954). Upper Miocene: Atlantic (Tortonian), NW France (Glibert, 1954; Brébion, 1964). Lower Pliocene: Atlantic, NW France (Glibert, 1954; Brébion, 1964), Guadalquivir Basin, Spain (Landau *et al.*, 2011); North Sea Basin, Coralline Crag, England (Harmer, 1915); western Mediterranean, north eastern Spain (Martinell, 1982a); central Mediterranean, Italy (Pavia, 1975; Chirli, 1997). Upper Pliocene: Atlantic, Mondego Basin, Portugal (Silva, 2001); North Sea Basin, Red Crag, England (Harmer, 1915); western Mediterranean, Estepona Basin (Vera Peláez, 2002); central Mediterranean, Italy (Sacco, 1904; Cipolla, 1914; Cavallo & Repetto, 1992). Upper Pliocene-Pleistocene: Atlantic, NW France (Brébion, 1964). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1910). Upper Pleistocene: western Mediterranean, Balearic Islands (Cuerdo Barceló, 1987). Pleistocene (indeterminate): Atlantic, Ireland (Harmer, 1915); central Mediterranean, Italy (Malatesta, 1960). Present-day: Mediterranean, north Atlantic Frontage to Norway (Fretter & Graham, 1985).

Genus *Pyrgocythara* Woodring, 1928

Type species – *Pyrgocythara eminula* Woodring, 1928, by original designation, Pliocene, Jamaica.

1928 *Pyrgocythara* Woodring, p. 171.

Pyrgocythara rugosissima (Seguenza, 1875)

Plate 3, fig. 3

- 1862 *Pleurotoma rugosolum* Phil. var. B – Brugnone, p. 38, pl. 1, fig. 28 [*non* Philippi, 1844 = *Mangelia unifasciata* (Deshayes, 1835).
 *1875 *Mangelia rugosissima* Seguenza, p. 210.
 1877 *Mangelia rugosissima* (Brugn.) – Bellardi, p. 292, pl. 8, fig. 36.
 1877 *Mangelia contracta* Bellardi, p. 295.
 1904 *Mangilia contracta* Bell. – Sacco, p. 55, pl. 14, figs 35, 36.

- 1914 *Mangilia rugosissima* Brugnone – Cipolla, p. 139, pl. 13, fig. 7.
- 1975 *Cythara (Cytharella) rugosissima* (Bellardi) – Pavia, pl. 8, fig. 5.
- 1981 *Mangelia contracta* Bellardi, 1877 – Ferrero Mortara *et al.*, p. 91, pl. 17, figs 6, 7.
- 1992 *Mangelia contracta* Bellardi, 1877 – Cavallo & Repetto, p. 144, fig. 392.
- 1992 *Mangelia rugosissima* (Brugnone, 1862) – Cavallo & Repetto, p. 144, fig. 393.
- 1997 *Mangelia contracta* Bellardi, 1877 – Chirli, p. 66, pl. 19, figs 4-7.
- 1999 *Pyrgocythara (Glabrocythara) rugosissima* (Brugnone, 1862) – Vera-Peláez *et al.*, p. 12.
- 2001 *Pyrgocythara (Glabrocythara) cf. rugosissima* (Brugnone, 1862) – Silva, p. 545, pl. 25, figs 11-15.
- 2002 *Mangelia rugosissima* (Brugnone, 1862) – Vera-Peláez, p. 205, pl. 4, figs G, H.
- 2010 *Pyrgocythara rugosissima?* (Seguenza, 1875) – Scarponi & Della Bella, p. 95, figs 201-208.

Material and dimensions – Height 6.7 mm, width 2.7 mm. NHMW 2015/0133/0454 (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – Vera-Peláez *et al.* (1999) placed this species in the genus *Pyrgocythara* Woodring, 1928, a position followed by all subsequent authors except for Vera-Peláez (2002), who returned to its more traditional placement in the genus *Mangelia* Risso, 1826. *Pyrgocythara* is a western Atlantic Caribbean genus and although this species certainly fits within the genus description, especially in relation to the multispiral protoconch with sinuous riblets on the last two whorls, deep U-shaped sinus with a denticle placed immediately below on the outer lip (Powell, 1966, p. 117), these features are also present in other European Pliocene *Mangelia* species (see Scarponi & Della Bella, 2010) and may be convergent. Scarponi & Della Bella (2010) stressed the absence of type material and doubt over what specimen was referred to by the original description, but in our opinion all subsequent authors have attributed this name to the same species. The strong sculpture is characteristic of *P. rugosissima* (Seguenza, 1875) and separates it from all other mangeliids.

Distribution – Lower Pliocene: Atlantic, NW France (this paper); western Mediterranean, north eastern Spain (NHMW coll.); central Mediterranean, Italy (Bellardi, 1877; Sacco, 1904; Pavia, 1975; Chirli, 1997; Scarponi & Della Bella, 2010). Upper Pliocene: Atlantic, Mondego Basin, Portugal (Silva, 2001); western Mediterranean, Estepona Basin (Vera Peláez, 2002); central Mediterranean, Italy (Seguenza, 1875; Bellardi, 1877; Cipolla, 1914; Cavallo & Repetto, 1992; Scarponi & Della Bella, 2010).

Family *Mitromorphidae* Casey, 1904
Genus *Mitromorpha* Carpenter, 1865

Type species – *Daphnella filosa* Carpenter, 1864, by monotypy, present-day, California.

1865 *Mitromorpha* Carpenter, p. 182.

Subgenus *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, 1883

Type species – *Mitra olivoidea* Cantraine, 1835, by original designation, present-day, Mediterranean.

1883 *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, p. 115, 121.

Note – Species in the subgenus *Mitrolumna* Bucquoy, Dautzenberg & Dollfus, 1883 differ from *Mitromorpha* Carpenter, 1865 in having two columellar folds, whereas in *Mitromorpha* the columella lacks well defined folds. *Mitrolumna* was relegated to subgenus rank by Kilburn (1986) and Drivas & Jay (1986) based on having similar radular formulae.

***Mitromorpha (Mitrolumna) panaulax* Cossmann, 1901**
Plate 3, fig. 4

*1901 *Mitromorpha panaulax* Cossmann, p. 255, pl. 10, figs 16, 17.

1964 *Mitrolumna panaulax* Cossmann, 1901 – Brébion, p. 575, pl. 14, figs 4-7.

Material and dimensions – Maximum height 8.2 mm, width 3.7 mm. NHMW 2015/0133/0452 (1), NHMW 2015/0133/0453 (50+), LC (50+), FVD (50+). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Mitromorpha (Mitrolumna) panaulax* Cossmann, 1901 is characterised by its relatively solid biconic shell, low dome-shaped paucispiral protoconch composed of 1.75 smooth whorls with a large nucleus (dp = 580 µm, hp = 460 µm; dpl = 400 µm, dn = 230 µm), 5-6 teleoconch whorls, the surface is completely covered by narrow spiral cords separated by grooves; 7-8 on the penultimate whorl, 30-35 on the last whorl, axial sculpture is restricted to the first two whorls; strongly opisthocline axial ribs that rapidly weaken and disappear on the third teleoconch whorl, and its narrow aperture, the outer lip is arcuate in profile and denticulate within and two robust folds on the columella. The anal sinus is broad, shallow, the siphonal canal is relatively short, open and slightly recurved at the tip. The columellar callus is sharply delimited but narrow. Cossmann (1901) described a third anterior columellar fold visible only when the aperture is broken. The specimens from Le Pigeon Blanc show some variability in the broadness of the shell but the sculpture is constant.

The subgenus *Mitrolumna* is represented by several species in the middle Miocene to Pleistocene deposits of

northwestern France. Cossmann (1896) described *Mitromorpha* (*Mitrolumna*) *subulata* from the Assemblage IV locality of Gourbesville. This species differs in having coarser spiral sculpture, with a smooth mid-whorl on the last whorl. In *M. (M.) panaulax* the spiral sculpture covers the entire last whorl. Brébion (1964, p. 573) described a species from the Tortonian upper Miocene Assemblage I deposits as *M. (M.) lardeauxi*, which is a *nomen nudum*. That species has a protoconch of just over two whorls, more convex whorls, sharp spiral cords separated by wider interspaces and weaker columellar folds. It will be formally described in the corresponding part of this series. In the stratigraphically older Langhian middle Miocene deposits of the Loire Basin *M. (M.) dollfusi* Peyrot, 1938 is similar in sculpture and in having a regularly biconic shell shape but is smaller shelled, more slender, with weaker columellar folds.

The genus is represented by several species living in the Mediterranean and Atlantic North West African coasts that were revised by Mifsud (2001). Most are separated from *M. (M.) panaulax* by having fewer spiral cords (Mifsud, 2001, p. 29, table 3). The most similar is the Mediterranean Pliocene fossil and present-day *M. (M.) olivoidea* (Cantraine, 1835), which has the same number of teleoconch whorls and the same number of spiral cords on the penultimate whorl, but *M. (M.) olivoidea* is larger (8-10 mm), with fewer cords on the last whorl (26-30) and has a smaller protoconch (dp = 470 µm, dp1 = 350 µm) (Mifsud, 2001, tables 2, 3). The presence of *Mitromorpha* (*Mitrolumna*) in the north west of France during the lower Pliocene again suggests warmer SSTs than those found at these latitudes today.

Cossmann (1901, p. 255) described the species from Le Pigeon Blanc, although Brébion (1964, p. 576) reported it from most Assemblage III localities (Le Pigeon Blanc, Le Girondor, La Gauvinière, Palluau, Les Cléons).

Distribution – Lower Pliocene: Atlantic, NW France (Cossmann, 1901; Brébion, 1964).

Family *Pseudomelatomidae* Morrison, 1965
Genus *Crassispira* Swainson, 1840

Type species – *Pleurotoma bottae* (Valenciennes in Kienner, 1839), by subsequent designation (ICZN Opinion 754, 1965), present-day, tropical East Pacific.

1840 *Crassispira* Swainson, p. 153, 313.

***Crassispira pseudobeliscus* (Fischer & Tournouër, 1873)**

Plate 3, figs 5-9

- *1873 *Pleurotoma pseudobeliscus* Fischer & Tournouër, p. 130, pl. 17, fig. 21.
- 1931 *Drillia* (*Crassispira*) cf. *pseudobeliscus* Fischer et Tournouër – Peyrot, p. 104, pl. 8, figs 8, 19.
- 1938 *Drillia consanguinea* Peyrot, p. 271 (*non* E.A.

Smith, 1888).

- 1954 *Clavus* (*Crassispira*) *pseudobeliscus* Fischer & Tournouër, 1873 – Glibert, p. 29, pl. 4, fig. 14.
- 1964 *Crassispira pseudobeliscus* Fischer & Tournouër, 1873 – Brébion, p. 560.

Material and dimensions – Maximum height 31.6 mm, width 9.7 mm. NHMW 2015/0133/0455 (1), NHMW 2015/0133/0457-0459 (3), NHMW 2015/0133/0555 (1 juvenile), NHMW 2015/0133/0456 (22), LC (50+), FVD (50+). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Crassispira pseudobeliscus* (Fischer & Tournouër, 1873) is characterised by its fusiform shell shape, its concave subsutural ramp on which a subsutural collar is hardly or subobsoletely developed, and ribs forming relatively strong rounded tubercles at the shoulder but only developed mid-whorl on the last whorl, not persisting onto the base and in most specimens obsolete, or almost so, on the last half whorl. As discussed by Glibert (1954, p. 29) for the middle Miocene specimens, the number of axial ribs is rather variable in the lower Pliocene population from Le Pigeon Blanc, although with a narrower range (8-10 Le Pigeon Blanc vs. 8-13 Loire Basin). The spiral sculpture of narrow cords is weak and irregular, only moderately strongly developed on the last whorl. The protoconch is paucispiral, of about two whorls with a bulbous first whorl, suggestive of a non-planktotrophic development (Pl. 3, fig 9). The Le Pigeon Blanc specimens are a bit taller and more disjunct than that figured by Glibert (1954, pl. 1, fig. 11) for *C. pseudobeliscus* from the middle Miocene, but the protoconch is similar and the teleoconch characters probably fall within the range of those for *C. pseudobeliscus*. We therefore prefer to consider them conspecific.

Crassispira detrita (Peyrot, 1838), also from the middle Miocene Loire Basin has a similar number of axial ribs but differs from *C. pseudobeliscus* in having a more slender shell, a well-developed subsutural collar, a narrower subsutural ramp, stronger spiral sculpture and axials on the last whorl that persist onto the base. *Crassispira powelli* Glibert, 1954, another Loire Basin species has a squatter more pupoid shell and again a well-developed subsutural collar and very narrow subsutural ramp. *Crassispira chavani* Glibert, 1960 from the upper Miocene Tortonian Assemblage I deposits of northwestern France is closely similar to *C. powelli*, with which it was initially confused by Glibert but differs in subtle protoconch and teleoconch characters, and will be reviewed in the respective part of this series.

In the Italian Pliocene the only species that can be compared is *C. pseudosigma* (Brugnone, 1876) which also has paucispiral protoconch, and a slender shell with broad axial ribs and subdued spiral sculpture, but that species has even fewer and broader axial ribs (about seven on penultimate whorl) that persist onto the base and a moderately well-developed subsutural collar. All the other Italian Pliocene species reviewed by Scarponi & Della Bella (2003) are separated by their stronger spiral sculp-

ture and more or less well-developed subsutural collar but always better delimited than in *C. pseudobeliscus*.

Distribution – Middle Miocene: Atlantic, Loire Basin (Glibert, 1954), Aquitaine Basin, France (Peyrot, 1931). Upper Miocene: Atlantic (Tortonian and Messinian), NW France (Brébion, 1964). Lower Pliocene: Atlantic, NW France (Brébion, 1964).

Family *Raphitomidae* Bellardi, 1875

Genus *Clathromangelia* Monterosato, 1884

Type species – *Pleurotoma granum* Philippi, 1844, by monotypy, present-day, Mediterranean.

1884 *Clathromangelia* Monterosato, p. 131.

1896 *Clathromangilia* Cossmann, p. 118. Incorrect subsequent spelling.

***Clathromangelia fenestrata* (Millet, 1865)**

Plate 3, figs 10-12

1854 *Defrancia fenestrata* Millet, p. 161 (*nomen nudum*).

*1865 *Defrancia fenestrata* Millet, p. 589.

1964 *Clathromangelia quadrillum* var. *fenestrata* Millet, 1854 – Brébion (*partim*), p. 594, pl. 14, fig. 25.

Material and dimensions – Maximum height 7.1 mm, width 3.0 mm. NHMW 2015/0133/0527 (1), NHMW 2015/0133/0553-0554 (2), LC (23), FVD (7).

Original description – ‘*Defrancia fenestrata*. Millet. *Coq. petite, de la taille du D. variabilis, composée de six tours de spires un peu bombés, portant de petites côtes verticales; celles-ci croisées par des stries transversales, presque aussi fortes, au nombre de deux sur les premiers tours et en plus grande quantité sur le dernier, laissent entre elles et les côtes un espace carré assez régulier pour imiter un vitrage. Longueur: 8 millimètres; diamètre: 3 millimètres. Th., Sc, Ren.*’ (Millet, 1865, p. 589).

Revised description – Shell small, relatively slender, fusiform. Protoconch multispiral, composed of 2.5 tall whorls, nucleus bearing micropustules, after first half whorl wide-spaced narrow sinuous axial riblets develop; abaxially protoconch angular mid-whorl; ribs weaken above and below angulation but strengthen over angulation forming axially elongated, strongly prosocline irregular tubercles. Teleoconch boundary marked by beginning of adult sculpture. Teleoconch of four angular whorls with broad, flattened subsutural ramp, separated by superficial suture. Axial sculpture on spire whorls of 10-12 narrow, elevated orthocline ribs. Spiral sculpture of narrow cords overrun ribs, somewhat swollen at intersections, forming strongly cancellate sculpture with smooth concave interspaces; first whorl bears one strong cord at shoulder, second cord develops midway between

shoulder and abapical suture, rapidly strengthening to become equal to shoulder cord, subsequent spire whorls with two equal cords. Last whorl 65% of total height, with flattened subsutural ramp, angular at shoulder, convex below, constricted at base, bearing 16 axial ribs and four spiral cords. Base concave, siphonal fasciole bearing three tubercular spiral cords. Aperture ovate, 42% of total height. Outer lip strongly thickened by varix, bearing four stout denticles within, weakening abapically; anal sinus U-shaped, deep, with apex on adapical half of subsutural ramp; siphonal canal moderately long, open, slightly posteriorly recurved. Columella deeply excavated adapically, straight below, callus thickened, not expanded, forming narrow callus ridge.

Discussion – It is possible that when Glibert (1954, p. 54) and Oliverio (1995, p. 197) were describing *Clathromangelia quadrillum* (Dujardin, 1837) they were describing two different species. According to Oliverio (1995), the whereabouts of the type material of Dujardin from the middle Miocene Loire Basin of France is unknown and most probably lost. The protoconch of the ‘probable toptype’ from Pontlevoy illustrated and described by Oliverio (1995, figs 20-21), although incomplete, is of the planktotrophic type (multispiral of at least 2.5 whorls with riblets on the abapical half and diagonally cancellate sculpture on the adapical half) and a sinusigera outer lip at the protoconch-teleoconch boundary. Despite being incomplete, it is quite unlike that of the species described herein. We consider Oliverio’s specimens to represent *C. quadrillum*. Apart from these protoconch differences, according to the figures in Oliverio (1995, figs 4-6) *C. quadrillum* has an extra spiral cord on the penultimate and last whorls compared with *C. fenestrata*.

Glibert (1954), also based on material from Pontlevoy, described a paucispiral protoconch of two whorls with a micropustular nucleus, smooth first whorl and angular second whorl bearing axial riblets. Therefore it is likely that at least two distinct species occur at Pontlevoy. Indeed, Glibert (1954, p. 55) himself compared *C. quadrillum* with yet another more slender congener from Pontlevoy *C. clathrata* (de Serres, 1829) that has a more slender elongated teleoconch shell. This is not so strange, as we will show in a subsequent paper, in the upper Miocene Assemblage I localities of northwestern France at least five *Clathromangelia* species co-existed. Glibert’s protoconch description could possibly apply to that of *C. fenestrata*, although the author would almost certainly have noted the tubercles formed mid-whorl, but the teleoconch differs in the same way as the shell discussed above by Oliverio (1995); in having an extra spiral cord on the penultimate and last whorls. *Clathromangelia clathrata* illustrated by Glibert (1954, pl. 6, fig. 16) differs from *C. fenestrata* in being more fusiform and having fewer axial ribs.

It seems therefore that the genus is more speciose than previously thought and Oliverio’s (1995) scenario in which a planktotrophic Miocene and Pliocene fossil species *C. quadrillum* was superceded by a non-planktotrophic Pleistocene to Recent species *C. granum* (Philippi, 1844)

is probably an oversimplification.

Millet (1854, 1865) recorded this species from Assemblage I (Thorigné, Sceaux-d'Anjou and Renauleau), to which Brébion (1964, p. 596) added St-Clément-de-la-Place, St-Michel and Beaulieu, Assemblage II (Apigné, Carcé) and Assemblage IV (Gourbesville). We add the Assemblage III locality of Le Pigeon Blanc.

Distribution – Upper Miocene: Atlantic (Tortonian and Messinian), NW France (Millet, 1854, 1866; Brébion, 1964). Lower Pliocene: Atlantic, NW France (this paper). Upper Pliocene-Pleistocene: NW France (Brébion, 1964).

Genus *Raphitoma* Bellardi, 1847

Type species – *Raphitoma histrix* Bellardi, 1847, by subsequent designation, Monterosato, 1872, Pliocene, Italy.

- 1847 *Raphitoma* Bellardi, p. 16.
- 1875 *Homotoma* Bellardi, p. 22. Type species (by subsequent designation; Powell, 1966): *Murex reticulatus* Renier, 1804, present-day, Italy. Junior homonym of *Homotoma* Guérin-Méneville, 1844 [Hemiptera].
- 1884 *Cordieria* Monterosato, p. 131. Type species (by subsequent designation; Crosse, 1885): *Murex reticulatus* Brocchi, 1814, Pliocene, Italy. Junior homonym of *Cordieria* Rouault, 1848.
- 1884 *Leufroyia* Monterosato, p. 134. Type species (by subsequent designation; Crosse, 1885): *Pleurotoma leufroyi* Michaud, 1828, present-day, Mediterranean.
- 1884 *Philbertia* Monterosato, p. 132. Type species (by subsequent designation; Crosse, 1885): *Pleurotoma bicolor* Risso, 1826, present-day, Mediterranean.
- 1884 *Cirillia* Monterosato, p. 133. Type species (by subsequent designation; Crosse, 1885): *Murex linearis* Montagu, 1803, present-day, British Isles. Junior homonym of *Cirillia* Rondani, 1856 [Diptera].
- 1891 *Peratotoma* Harris & Burrows, p. 133. Type species (by subsequent designation; Powell, 1966): *Murex reticulatus* Renier, 1804, present-day, Italy. *Nom. nov. pro Homotoma* A. Bellardi, 1875, non Guérin-Méneville, 1844.
- 1905 *Cyrillia* Kobelt, p. 367. Type species (by typification of replaced name): *Murex linearis* Montagu, 1803, present-day, British Isles. Unjustified emendation of *Cirillia* Monterosato, 1884.
- 1967 *Cenodagreutes* E.H. Smith, p. 1. Type species (by original designation): *Cenodagreutes aethus* E.H. Smith, 1967, present-day, British Isles.
- 1968 *Cyrtoidea* Nordsieck, p. 176. Type species (by original designation): *Pleurotoma rudis* Scacchi, 1836, present-day, Mediterranean.
- 1977 *Lineotoma* Nordsieck, p. 59. Type species (by typification of replaced name): *Murex linearis* Montagu, 1803, present-day, British Isles. *Nom.*

nov. pro Cirillia Monterosato, 1884, *non* Rondani, 1856 [Diptera].

Note – The genus is well represented in the lower Pliocene of Le Pigeon Blanc by eight species, all except for one of which are endemic to northwestern France. Høisæter (2016) reviewed the present-day species in the northern European waters off Norway and recorded six species. It is interesting to note that whilst all the species reviewed by Høisæter were planktotrophic, seven of the eight species described here have protoconchs suggesting of non-planktotrophic development.

Marine shelled gastropods follow three types of development. The protoconch type gives an indication as to which type of development is followed, *i.e.* in direct developers the protoconch is paucispiral with a large nucleus, whereas in planktotrophic species the protoconch is multispiral with a small nucleus. It has been recognised in many gastropod groups, and especially in *Raphitoma*, that species pairs exist; one with a paucispiral protoconch, the other with a multispiral protoconch but with almost identical teleoconch shells. Indeed, Pusateri *et al.* (2013) recorded 11 species pairs of European *Raphitoma* species. It is generally accepted that protoconch type is species specific, and that once planktotrophy is lost it is irreversible (Bouchet, 1990). The use of the protoconch type to separate raphitomiids into genera: *Raphitoma* Bellardi, 1847 (with multispiral protoconch) and *Philbertia* Monterosato, 1884 (with a paucispiral protoconch) was found to be inconsistent (Pusateri *et al.*, 2013). Interestingly, Manousis *et al.* (2017) suggested that the protoconch type in *Raphitoma* may be attributed to a simple gene that functions in conjunction with others and environmental factors to exhibit a discontinuous multifactorial inheritance leading to poecilogony. The authors suggested their preliminary results supported their hypothesis but further genetic studies and interbreeding experiments were required. We provisionally follow conventional wisdom in considering the protoconch type to be species specific but would not be surprised if there is merit in Manousis *et al.*'s hypothesis.

***Raphitoma bertrandiana* (Millet, 1865)**

Plate 4, figs 1, 2

- 1854 *Buccinum Bertrandianum* Millet, p. 165 (*nomen nudum*).
- *1865 *Buccinum Bertrandianum* Millet, p. 596.
- 1964 *Raphitoma ligustica* var. *bertrandiana* Millet, 1854 – Brébion, p. 601, pl. 14, figs 29-31.

Material and dimensions – Maximum height 13.2 mm, width 5.8 mm. NHMW 2015/0133/0460-0461 (2), LC (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Original description – ‘*Buccinum Bertrandianum*, Millet. Coq. fusiforme, de moyenne grandeur, composée de 9 à 10 tours de spire, bombés et couverts, jusqu'au

pénultième, de petites côtes verticales qui disparaissent complètement sur les deux derniers; tous ces tours sont garnis de fines stries transversales de diverses grosseurs et en tel nombre qu'elles semblent se toucher. L'ouverture qui est très-ample, allongée, lisse, munie d'un sinus aigu, présente un pli sur le bord droit, qui est trenchant et sans que ce pli paraisse à l'extérieur. Canal court, droit et largement ouvert. Longueur: 18-22 millimètres; diamètre: 6-7 millimètres. Sc, Th.' (Millet, 1865, p. 596).

Discussion – *Raphitoma bertrandiana* (Millet, 1865) was described based on material from the upper Miocene Tortonian localities of Sceaux-d'Anjou and Thorigné, but it also occurs in the lower Pliocene of Le Pigeon Blanc. A revised description will be given in a subsequent monograph based on perfectly preserved material from the Assemblage I locality of Saint-Clément-de-la-Place. Although the protoconch is abraded in the Assemblage III material at hand, we note that based on the Saint-Clément-de-la-Place specimens it is paucispiral, consisting of two whorls with finely reticulated sculpture covering the entire protoconch. The teleoconch is rather inflated, although some specimens more than others. The axial ribs that extend between the sutures on early whorls can persist, albeit weakened, onto the adapical portion of the first half of the last whorl or become obsolete by the second half of the penultimate whorl. Brébion (1964, p. 601) suggested that Millet's taxon was a subspecies of the Pliocene Mediterranean *R. ligustica* (Bellardi, 1877) as they both have a similarly inflated shape and axial sculpture that tends to disappear on the last whorl, but that species has a multispiral protoconch (Chirli, 1997, p. 92). *Raphitoma stria* (Calcare, 1841), another species from the Mediterranean Pliocene, also has axial sculpture that weakens abapically, but the axials disappear earlier and are absent from the last three teleoconch whorls. Moreover, *R. stria* also has a multispiral protoconch (Chirli, 1997, p. 93). *Raphitoma pontileviensis* (Cossmann, 1896) from the older middle Miocene assemblages of the Loire Basin of France is another species in which the axial ribs do not persist onto the last whorl, but the teleoconch whorls are more convex, the axials and spirals sharper, of almost equal strength, forming a regular reticulated pattern on the spire whorls. Glibert (1954, p. 58) described the protoconch of *R. pontileviensis* as being multispiral, composed of 2.5 whorls covered in spiral threads with axial sculpture only appearing on the last half whorl, whereas in *R. bertrandiana* the protoconch has only two whorls and the entire surface is covered in fine axial and spiral sculpture.

Millet (1854, 1865) described the species from the Assemblage I localities of Sceaux-d'Anjou and Thorigné, to which Brébion (1964, p. 603) added Saint-Clément-de-la-Place and St-Michel and the Assemblage III locality of Le Pigeon Blanc.

Distribution – Upper Miocene: Atlantic (Tortonian), NW France (Millet, 1854, 1865; Brébion, 1964). Lower Pliocene: Atlantic, NW France (Brébion, 1964).

***Raphitoma georgesi* nov. sp.**

Plate 4, figs 3-5

1964 *Pleurotomides lecointrei* Brébion, p. 626, pl. 15, fig. 14 (*nomen nudum*).

Type material – Holotype NHMW 2015/0133/0530, height 6.3 mm, width 2.7 mm (Pl. 4, fig. 3); paratype 1 NHMW 2015/0133/0531, height 6.2 mm, width 2.5 mm (Pl. 4, fig. 4); paratype 2 NHMW 2015/0133/0532, height 6.3 mm, width 2.6 mm; paratype 3 NHMW 2015/0133/0533, juvenile with protoconch (Pl. 4, fig. 5).

Other material – Maximum height 6.3 mm, width 2.6 mm. NHMW 2015/0133/0534 (18), LC (41), FVD (22).

Etymology – Named after Georges Lecointre (1888-1972), ingénieur-géologique au Bureau des Recherches Géologiques et Géophysiques, respecting the wishes of Brébion (1964) who proposed the name *Pleurotomides lecointrei* (*nomen nudum*). *Raphitoma* gender feminine.

Locus typicus – Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Raphitoma* species of small size, multipiral protoconch of four whorls; first two with irregular spiral threads, last two with diagonal reticulated pattern, slender teleoconch, bearing about 12 axial ribs and spirals that form large tubercles at the intersections, narrow aperture, deep, narrow anal sinus delimited laterally by tooth within outer lip, short columellar callus that does not edge siphonal canal.

Description – Shell small, slender fusiform. Protoconch tall multispiral, composed of four whorls; last whorl carinate; sculpture on first two whorls consisting of irregular spiral threads, last two whorls bearing diagonal reticulated sculpture. Junction with teleoconch marked by end of carina and beginning of adult sculpture. Teleoconch of five whorls with narrow subsutural ramp, angular shoulder placed high, weakly convex below, separated by impressed weakly undulating suture. Axial sculpture of rounded, weakly opisthocline ribs, 12 on last whorl, roughly equal in width to their interspaces. Spiral sculpture of narrow cords that overrun ribs, forming large horizontally elongated tubercles at intersections, two on first two teleoconch whorls, three on third, four on penultimate whorl. Teleoconch surface covered in micropustular sculpture. Last whorl not globose, subsutural ramp narrow, concave, evenly convex below, moderately constricted at base; axials weakening over base, about 15 tubercular spirals on last whorl and siphonal fasciole. Aperture narrow, elongate, outer lip edge crenulated by spiral sculpture; anal sinus narrow, deep U-shaped, with apex mid-subsutural ramp, delimited laterally by moderately strong tooth within outer lip; siphonal canal long, twisted, open. Columel-

la deeply excavated in upper third. Columellar callus poorly developed, not extending over medial border of siphonal canal; parietal callus slightly thickened, forming small swelling.

Discussion – Only one juvenile specimen has the protoconch preserved. The surface is abraded, but it is multispiral with the last whorl strongly carinate. The surface sculpture is preserved showing irregular or interrupted spiral threads on the first two whorls and a diagonal reticulated pattern on the last two whorls (Pl. 4, figs 5a, b). The entire teleoconch is covered in micropustular sculpture (Pl. 4, fig. 5c). There is little intraspecific variability amongst the specimens at hand. *Raphitoma georgesi* nov. sp. is most similar to the present-day European *R. linearis* (Montagu, 1803), which has the same protoconch type (Høisæter, 2016, fig. 2A), but that species is more inflated and the tubercles formed at the sculptural intersections are not as large. In the fossil record *R. pseudohistrix* (Peyrot, 1938) from the Atlantic middle Miocene Loire Basin of France is most similar to *R. georgesi* but according to the original description has a paucispiral protoconch composed of two whorls and a broader teleoconch shell. *Raphitoma perpulchra* (S.V. Wood, 1848) from the British and Belgian Pliocene North Sea Basin also has a multispiral protoconch but differs in having the subsutural ramp hardly developed, weaker tubercles produced at the sculptural intersections and a shorter siphonal canal.

Distribution – Lower Pliocene: Atlantic, NW France (Brébion, 1964).

***Raphitoma landreauensis* nov. sp.**

Plate 4, figs 6-7

Type material – Holotype NHMW 2015/0133/0574, height 5.0 mm, width 2.2 mm (Pl. 4, fig. 6); paratype 1 NHMW 2015/0133/0575, height 5.0 mm, width 2.4 mm (Pl. 4, fig. 7).

Other material – Maximum height 5.0 mm. LC (8), FVD (1).

Etymology – Named after the type locality of Le Landreau. *Raphitoma* gender feminine.

Locus typicus – Le Pigeon Blanc, Le Landreau, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Raphitoma* species of small size, with paucispiral protoconch bearing tuberculous threads and cords, teleoconch of 3.5 angular whorls, sculptured by 11-12 axial ribs overrun by spiral cords of primary to tertiary strength, outer lip weakly thickened, smooth within, siphonal canal moderately long.

Description – Shell small, turritiform. Protoconch pau-

cispiral, with medium sized nucleus, composed of two whorls covered in spiral threads, tubercular on abapical half of second whorl, and irregular axial ribs or rugae; two carinae appear on last portion of protoconch. Junction with teleoconch sharp, delimited by beginning of adult sculpture. Teleoconch of 3.5 whorls, with two strong primary spiral cords; adapical delimiting moderately broad, flattened subsutural ramp, abapical cord forming periphery, whorl profile between concave; five further subequal secondary cords run over subsutural ramp, below shoulder cords of secondary and tertiary strength fill interspaces; on penultimate whorl third primary spiral cord appears just above suture. Axial sculpture of 11-12 narrow, elevated, orthocone ribs; spiral sculpture overruns ribs. Close-set axial growth lines give cords scabrous appearance, especially immediately below suture. Last whorl with flat subsutural ramp, weakly angled at shoulder, convex below, constricted at base. Aperture ovate, outer lip weakly thickened by varix, with crenulated edge, smooth within; anal sinus broad and shallowly U shaped, with apex mid-subsutural ramp; siphonal canal moderately long, open, slightly posteriorly recurved. Columella broadly, shallowly excavated. Columellar callus hardly developed, forming very narrow, sharply delimited callus rim.

Discussion – *Raphitoma landreauensis* nov. sp. is characterised by its dense spiral sculpture composed of cords of primary to tertiary strength and its paucispiral protoconch bearing tubercular cords. There is some intraspecific variability; the protoconch sculpture is coarser in the holotype (Pl. 4, fig. 6e, f) than in the paratype (Pl. 4, fig. 7e) and the teleoconch is squatter in the paratype, which has slightly more inflated whorls. This species is similar to two shells from the upper Miocene Tortonian Assemblage I locality of Sceaux-d'Anjou discussed by Brébion: *R. selecta* (Millet, 1865) and the shell illustrated as *R. (Leufroyia) leufroyi* var. *milleti* (*nomen nudum*) (1964, pl. 15, figs 6 and 7 respectively). Both of these were discussed by Brébion as varieties of the extant European *R. leufroyi* Michaud, 1828, which can immediately be separated by having a multispiral protoconch.

The protoconch was not available to Brébion (1964, p. 614), but specimens at hand we ascribe to *R. selecta* from St-Clément-de-la-Place have a protoconch of about two whorls bearing fine reticulated spiral sculpture. The teleoconch spiral sculpture is similar in being composed of primary to tertiary elements but with more numerous cords and the aperture is wider and larger. *Raphitoma landreauensis* forms part of a group of species present in the Assemblage I fauna that all have a reticulated protoconch of about two whorls and complex spiral sculpture. This group will be reviewed in the respective part of this series, however, provisionally we do not believe this species to be present in the Assemblage I deposits.

Distribution – Lower Pliocene: Atlantic, NW France (this paper).

***Raphitoma palumbina* nov. sp.**

Plate 4, figs 8, 9

Type material – Holotype NHMW 2015/0133/0535, height 5.2 mm, width 2.5 mm (Pl. 4, fig. 8); paratype 1 NHMW 2015/0133/0536, height 5.1 mm, width 2.6 mm (Pl. 4, fig. 9).

Other material – Maximum height 5.2 mm. LC (4), FVD (1).

Etymology – From Latin ‘*palumbes*, *palumbis*’, noun, wood-pigeon, ringdove; a reference to the type locality of Le Pigeon Blanc (the white pigeon). *Raphitoma* gender feminine.

Locus typicus – Le Pigeon Blanc, Le Landreau, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Raphitoma* species of small size, squat pupoid shape, with paucispiral protoconch covered in finely reticulated sculpture, teleoconch of three whorls, axial sculpture variably developed, 11 ribs, spiral sculpture of narrow cords not swollen or spinous at intersections, shallow anal sinus, short siphonal canal.

Description – Shell small, solid, squat, pupoid. Protoconch paucispiral, composed of two whorls covered in finely reticulated sculpture; spiral threads predominant on first whorl, ribs strengthening abapically, predominant at teleoconch junction. Junction with teleoconch not preserved. Teleoconch of three convex whorls with periphery at abapical suture; suture impressed, linear. Axial sculpture of low, rounded, slightly opisthocline ribs, developed to a variable degree, 11 on penultimate whorl, roughly equal in width to their interspaces. Spiral sculpture of two beaded subsutural cords, below narrow elevated cords that overrun ribs, hardly swollen at intersections, five on penultimate whorl. Last whorl globose, strongly and evenly convex, subsutural ramp not developed, moderately constricted at base; axials strongly developed to subobsolete, weakening over base, overrun by narrow spiral cords that cover entire last whorl, with secondaries developed in some interspaces. Siphonal canal short, bearing spirals. Aperture ovate, outer lip convex; anal sinus shallow U-shaped, delimited laterally by small swelling within outer lip; siphonal short, open, wide, bent abaxially. Columella moderately excavated in upper third, straight below. Columellar and parietal callus hardly thickened, forming narrow rim not extending over siphonal canal.

Discussion – *Raphitoma palumbina* nov. sp., with its squat pupoid shell shape, is quite unlike any of its congeners. The protoconch surface is too abraded to photograph. Although the shape and pair of subsutural beaded cords make it unmistakable, the scant material at hand suggests a highly variable sculpture. In the holotype (Pl.

4, fig. 8) the axials are low and become subobsolete on the penultimate whorl, and there are secondary spirals intercalated on the adapical portion and base on the last whorl, whereas in the paratype (Pl. 4, fig. 9) the axials are well developed to the aperture and only a few secondary spirals develop on the second half of the last whorl. The present-day European *R. concinna* (Scacchi, 1836) is similar in being solid shelled, in having low ribs crossed by narrow cords and a shallow anal sinus but is larger, fusiform, with more convex whorls separated by a deeper suture. Moreover, it has a multispiral protoconch (Høisæter, 2016, fig. 21). We find no other taxon with which we can usefully compare this species.

Distribution – Lower Pliocene: Atlantic, NW France (this paper).

***Raphitoma pseudohystrix* (Sykes, 1906)**

Plate 5, figs 1-3

- *1906 *Clathurella pseudohystrix* Sykes, p. 187.
- 1964 *Raphitoma hystrix* Jan, 1832 – Brébion, p. 603, pl. 14, figs 32-34 [*non Raphitoma hystrix* (De Cristofori & Jan, 1832)].
- 1984 *Raphitoma pseudohystrix* Sykes, 1906 [*sic*] – Carrozza, p. 152, figs 1, 2.
- 1984 *Raphitoma divae* Carrozza, p. 152, figs 3, 4.
- 1986 *Raphitoma pseudohystrix* Sykes, 1906 [*sic*] – Bogi *et al.*, p. 27, figs 9-16.

Material and dimensions – Maximum height 11.0 mm, width 3.8 mm. NHMW 2015/0133/0462-0463 (2), NHMW 2015/0133/0570 (1), NHMW 2015/0133/0464 (3), LC (50+), FVD (27). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Raphitoma pseudohystrix* (Sykes, 1906) is identified most easily by its high paucispiral protoconch consisting of 1.5-2.0 strongly convex whorls with a large nucleus. The entire surface is covered with fine reticulated microsculpture. The teleoconch characters seem to be rather variable. Carrozza (1984) described specimens with finer teleoconch sculpture as a distinct species; *R. divae*, further supporting the separation from *R. pseudohystrix* by pointing out minor differences in the protoconch (half whorl less and consequently somewhat lower). Bogi *et al.* (1986) illustrated numerous specimens of *R. pseudohystrix* illustrating considerable variation in both shell profile and sculpture, and concluded that *R. divae* was an extreme form of *R. pseudohystrix*. We consider this conclusion reasonable and follow it herein.

The lower Pliocene specimen illustrated here from Le Pigeon Blanc is most like the *R. divae* morphotype; tall, slender, with a moderately broad subsutural ramp and fine sculpture with small spines developed at the interspaces. The protoconch shows the same shape and sculpture as that illustrated by Carrozza (1984, fig. 2) for *R. pseudohystrix*. The number of ribs and cords on the last whorl fit within the range of variability given by Bogi *et*

species	number of protoconch whorls	last whorl	
		ribs	cords
<i>R. pseudohystrix</i> (Le Pigeon Blanc)	2.0	26	24
<i>R. pseudohystrix</i> (in Carrozza, 1984)	2.0	18	16
<i>R. divae</i> (in Carrozza, 1984)	1.5	27	24
<i>R. pseudohystrix</i> (Bogi <i>et al.</i> , 1986)	not stated	14-29	14-29
<i>R. antonjansei</i>	2.75	20	14
<i>R. hystrix</i>	3.5	13	12

Table 1: Comparison of some *Raphitoma* species of the *Raphitoma hystrix* De Cristofori & Jan, 1832 species group.

al. (1986, p. 29; see Table 1).

Raphitoma antonjansei Marquet, 1998 (corrected to *R. antonjansei* A.W. Janssen, 2008; = *R. hystrix* in Glibert, 1960, p. 17, pl. 4, fig. 18; *non* De Cristofori & Jan, 1832) from the Pliocene North Sea Basin of England and Belgium is similarly slender and has reticulated protoconch sculpture, but in that species the protoconch is multispiral, composed of 2.75 whorls, the last half whorl strongly carinate and the teleoconch sculpture is more coarsely reticulated composed of fewer axial and spiral elements (Table 1).

Raphitoma hystrix De Cristofori & Jan, 1832 from the Italian Pliocene (lectotype figured by Pinna & Spezia (1978, pl. 76, fig. 1) is much less slender with coarser sculpture. According to Marquet (1998a, p. 276) the protoconch is multispiral, composed of 3.5 whorls; the last half whorl carinate. This was confirmed by Vera-Peláez (2002, p. 231, pl. 17, figs G', H') based on specimens from the lower upper Pliocene of the Estepona Basin, southern Spain. More slender specimens with finer sculpture from the Italian Pliocene, similar in shape to the French Pliocene shell, were illustrated by Chirli (1997, pl. 23, figs 5-6). The protoconch is unfortunately cut off the illustrations, but Chirli (1997, p. 81) described it as multispiral, composed of 3.5 whorls. Therefore, the teleoconch sculpture may be variable as it is in *R. pseudohystrix*.

Brébion (1964, p. 604) recorded this species only from the Assemblage III locality of Le Pigeon Blanc. Today it has a more southern Atlantic distribution found in the Madeira Archipelago (Segers *et al.*, 2009).

Distribution – Lower Pliocene: Atlantic, NW France (Brébion, 1964). Present-day: Atlantic: Madeira (Segers *et al.*, 2009), Mediterranean (Carrozza, 1984; Bogi *et al.*, 1986).

***Raphitoma turtaudierei* nov. sp.**

Plate 5, fig. 4

Type material – Holotype NHMW 2015/0133/0571, height 7.1 mm, width 3.6 mm (Pl. 5, fig. 4).

Other material – Known only from holotype.

Etymology – Named after Pierre-Aimé Millet de la Turtaudière (1783-1873), French naturalist and Secrétaire Général de la Société d'Agriculture d'Angers, in recognition of his early works on the palaeontology of Maine-et-Loire. *Raphitoma* gender feminine.

Locus typicus – Le Pigeon Blanc, Le Landreau, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Raphitoma* species of small size, with paucispiral protoconch bearing axial rugae, teleoconch of four whorls, sculptured by 13 axial ribs overrun by narrow spiral cords of primary and secondary strength, outer lip thickened by varix, smooth within, siphonal canal moderate length.

Description – Shell small, broadly turritiform. Protoconch paucispiral, with medium sized nucleus, composed of two whorls covered in spiral threads and irregular axial rugae; three cords appear on last half whorl. Junction with teleoconch sharp, delimited by beginning of adult sculpture. Teleoconch of four whorls, with three narrow primary spiral cords; adapical one delimiting moderately broad, concave subsutural ramp, abapical cord forming periphery, whorl profile between concave; further subequal secondary cords run over subsutural ramp, below shoulder single narrow secondary in interspaces between primary cords. Axial sculpture of 13 narrow orthocline ribs; spiral sculpture overruns ribs. Close-set axial growth lines give cords scabrous appearance, especially immediately below suture. Last whorl with concave subsutural ramp, roundly angled at shoulder, inflated below, strongly constricted at base, siphonal fasciole not strongly delimited, bearing spiral cords. Aperture ovate, outer lip thickened by varix, with crenulated edge, smooth within; anal sinus broad and shallowly U-shaped, with apex mid-subsutural ramp; siphonal canal moderate length, open, slightly posteriorly recurved. Columella broadly, shallowly excavated. Columellar callus hardly developed, forming very narrow callus rim.

Discussion – Like *Raphitoma landreauensis* nov. sp.

this species has a rather squat fusiform shell shape and a protoconch of about two whorls. However, in *Raphitoma turtaudierei* nov. sp. the protoconch microsculpture differs in being predominantly axially rugose as opposed to spirally tubercular as in *R. landreauensis*. The teleoconch sculpture in *R. turtaudierei* is simpler, composed of narrow cords with fine secondaries in the interspaces as opposed to the complex spiral sculpture of primary to tertiary strength seen in *R. landreauensis*. The outer lip is also far more thickened in *R. turtaudierei*, with a deep anal sinus present on the outer lip apically absent in *R. landreauensis*, although it is possible that the lip is not quite complete in the specimens at hand. Several extant Mediterranean species with paucispiral protoconchs have been described; *R. albida* Pusateri & Guannuzzi-Savelli, 2016 (in Pusateri *et al.*, 2016) differs in having fine reticulated protoconch sculpture and more spinous teleoconch sculpture with narrower and more numerous axials, *R. spadiana* Pusateri & Guannuzzi-Savelli, 2012 (in Pusateri *et al.*, 2012) and *R. smriglioi* Pusateri & Guannuzzi-Savelli, 2013 (in Pusateri *et al.*, 2013) again have fine reticulated protoconch sculpture and denser spinous axial and spiral sculpture.

Distribution – Lower Pliocene: Atlantic, NW France (this paper).

***Raphitoma vercingetorixi* nov. sp.**

Plate 5, figs 5, 6

1964 *Raphitoma* (*Philbertia*) *purpurea* var. *gliberti* Brébion, p. 606, pl. 14, figs 36, 37 (*nomen nudum*).

Type material – Holotype NHMW 2015/0133/0538, height 8.4 mm, width 3.4 mm (Pl. 5, fig. 5); paratype 1 NHMW 2015/0133/0537, height 7.6 mm, width 3.3 mm (Pl. 5, fig. 6); paratype 2 NHMW 2015/0133/0539, height 8.6 mm, width 3.5 mm; paratype 1 NHMW 2015/0133/0540, height 14.2 mm, width 5.9 mm.

Other material – Maximum height 14.2 mm. NHMW 2015/0133/0441 (1), LC (30), FVD (15).

Etymology – Named after Vercingetorix (c. 82-46 BC), king and chieftain of the Arveni tribe, who united the Gauls in a revolt against Roman forces during the last phase of Julius Caesar's Gallic Wars. *Raphitoma* gender feminine.

Locus typicus – Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – Small *Raphitoma* species with paucispiral protoconch, first whorl finely reticulated, second with predominant axial riblets, teleoconch with strongly convex whorls, finely sculptured, with small spines developed at intersections, small shallow anal sinus delimited

internally on outer lip by denticle.

Description – Shell small, fusiform. Protoconch paucispiral, composed of two whorls; first whorl bearing finely reticulated sculpture, axial riblets strengthen abapically, dominant on second protoconch whorl, which also bears two subobsolete cords just below and above suture, angulating whorl. Junction with teleoconch marked by raised axial scar. Teleoconch of five strongly convex whorls, subsutural ramp and shoulder hardly delimited; suture impressed, linear. Axial sculpture of narrow, raised, rounded weakly opisthocline ribs, 15 on last whorl, about one-third width of interspaces. Spiral sculpture of narrow elevated cords that overrun ribs, weakly spinous at intersections, six primary cords on penultimate whorl with single secondary intercalated in some to all interspaces. Last whorl globose in adult specimens, strongly and evenly convex, subsutural ramp narrow and poorly delimited, moderately constricted at base; axials strongly developed and elevated, continuing onto base and siphonal fasciole, numerous, close-set narrow spiral cords cover entire last whorl, with threads developed in some interspaces. Siphonal canal relatively long, straight, bearing spirals slightly stronger than those on base. Aperture ovate, outer lip convex, obsoletely denticulate within some distance from lip edge; anal sinus small, shallow U-shaped, with apex just above mid-subsutural ramp, delimited laterally by double tooth within outer lip; siphonal canal long, straight open, delimited on outer lip by thickened tubercle. Columella moderately excavated in upper third, straight below. Columellar and parietal callus hardly thickened, forming narrow rim.

Discussion – Brébion (1964, p. 606) recognised this form as new and described it (*nomen nudum*) as a subspecies of the present-day European *R. purpurea* (Montagu, 1803), however, that species differs in having a multispiral protoconch (Høisæter, 2016, fig. 18). Species pairs amongst *Raphitoma* have been recognised (Pusateri *et al.*, 2012, 2013, 2016), one with a paucispiral, the other with a multispiral protoconch. Although at present protoconch type is considered species specific and is considered herein to be so, this has recently been questioned (see note under generic synonymy). Apart from the differences in protoconch morphology, *R. vercingetorixi* nov. sp. differs from *R. purpurea* in having fewer axial ribs and the denticles within the outer lip are weaker. The present-day Mediterranean *R. pupoides* (Monterosato, 1884) is also similar in sculpture but again differs in having a multispiral protoconch and a more elongated shell shape (Pusateri *et al.*, 2016). *Raphitoma alida* Pusateri & Giannuzzi-Savelli, 2016 was considered by the Pusateri *et al.* (2016) to be the paucispiral partner of *R. pupoides*. It differs from *R. vercingetorixi* in having more shouldered whorls, a more inflated last whorl, sharper spines developed at the sculptural interspaces, lacking secondary spiral sculpture and having the denticles within the outer lip more strongly developed. *Raphitoma spadiana* Pusateri & Giannuzzi-Savelli, 2016, another European species with a paucispi-

ral protoconch, differs in having denser spiral sculpture, all the cords of primary strength.

Distribution – Lower Pliocene: Atlantic, NW France (Brébion, 1964).

***Raphitoma pseudoconcinna* nov. sp.**

Plate 5, fig. 7

Type material – Holotype NHMW 2015/0133/0566, height 9.4 mm, width 3.9 mm (Pl. 4, fig. 7).

Other material – Maximum height 9.4 mm. LC (2).

Etymology – Name reflecting the close similarity to *Raphitoma concinna* (Scacchi, 1836). *Raphitoma* gender feminine.

Locus typicus – Le Pigeon Blanc, Le Landreau, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Raphitoma* species of small size, with paucispiral protoconch bearing axial rugae, teleoconch of four whorls, sculptured by 13 axial ribs overrun by narrow spiral cords of primary and secondary strength, outer lip thickened by varix, smooth within, siphonal canal moderate length.

Description – Shell medium-sized, turritiform. Protoconch paucispiral, with medium sized nucleus, composed of two whorls; microsculpture present but worn. Junction with teleoconch sharp, delimited by beginning of adult sculpture. Teleoconch of six whorls with narrow subsutural ramp, roundly shoulder placed high, convex below. Sculpture of broad, rounded prosocline axial ribs, 12 on penultimate whorl, that weaken on last whorl, crossed by dense, narrow spiral cords of alternate strength. Close-set axial growth lines elevated immediately below suture. Last whorl with narrow concave subsutural ramp, roundly angled at shoulder, convex below, moderately constricted at base, siphonal fasciole not strongly delimited, bearing spiral cords. Aperture broad, ovate, outer lip hardly thickened by varix, smooth within; anal sinus broad and shallowly U shaped, with apex mid-subsutural ramp; siphonal canal moderate length, open, slightly posteriorly recurved. Columella narrowly excavated mid-aperture. Columellar callus hardly developed.

Discussion – This species could be placed in the subgenus *Leufroyia* Monterosato, 1884 characterised by raphitomids with broad, wavy axial ribs, dense and numerous, low spiral cords, conspicuous, close-set growth lines, or rugae and no microsculpture of granules or pustules. Høisæter (2016, p. 25) stressed microsculptural differences in the multispiral protoconchs of *Raphitoma* and *Leufroyia* species from the present-day Norwegian coasts, where all raphitomids have multispiral protoconchs. However numerous pau-

cispiral raphitomids are reported from both the present-day and fossil European record and Bouchet & Gofas (2016) are probably correct to synonymise the two. The living species ascribed to *Leufroyia*; *R. leufroyi* (Michaud, 1828), *R. concinna* (Scacchi, 1836) and *R. erronea* (Monterosato, 1884) all differ from the French Pliocene species in having a multispiral protoconch. However, the teleoconch shape and sculpture of the new species is closely similar in to that of *R. concinna* (see Høisæter, 2016, figs A, C) and indeed the two could not be separated without their protoconchs. *Raphitoma pseudoleufroyi* Marquet, 1998 from the upper Pliocene North Sea Basin of Belgium has a similar shell profile and a paucispiral protoconch but differs in having the axial sculpture well-developed to the aperture and less crowded spiral sculpture.

Distribution – Lower Pliocene: Atlantic, NW France (this paper).

Family Terebridae Mörch, 1852

Subfamily Terebrinae Mörch, 1852

Genus *Terebra* Bruguière, 1789

Type species – *Buccinum subulatum* Linné, 1767, by subsequent designation, Lamarck, 1799, present-day, Indo-West Pacific.

1789 *Terebra* Bruguière, p. 15.

1810 *Terebrum* de Montfort, p. 431. Type species (by typification of replaced name): *Buccinum subulatum* Linné, 1767, present-day, Indo-Pacific. Unjustified emendation of *Terebra* Bruguière, 1789.

1817 *Subula* Schumacher, p. 70. Type species (by typification of replaced name): *Buccinum subulatum* Linné, 1767, present-day, Indo-Pacific. Unnecessary replacement name for *Terebra*.

1896 *Noditerebra* Cossmann, p. 47. Type species (by original designation): *Terebra geniculata* Tate, 1886, Eocene, southern Australia.

1923 *Myurellina* Bartsch, p. 62. Type species (by original designation): *Terebra ornata* Gray, 1834, present-day, Indo-Pacific.

1923 *Terebrina* Bartsch, p. 62. Type species (by original designation): *Terebra cingulifera* Lamarck, 1822, present-day, Pacific. Junior homonym of *Terebrina* Rafinesque, 1815.

1928 *Paraterebra* Woodring, p. 135. Type species (by original designation): *Terebra texana* Dall, 1898 [= *Terebra* (*Paraterebra*) *taurina* (Lightfoot, 1786), ?= *T. (P.) flammea* (Lamarck, 1822)], present-day, Florida, Caribbean.

1929 *Dimidacus* Iredale, p. 341. Type species (by typification of replaced name): *Terebra cingulifera* Lamarck, 1822, present-day, Indo-Pacific. *Nom. nov. pro Terebrina* Bartsch, 1923, *non* Rafinesque, 1815.

1967 *Panaterebra* Olsson, p. 14. Type species (by original designation): *Terebra robusta* Hinds, 1844, present-day, Panamic Pacific.

***Terebra exilis* Bell, 1871**

Plate 6, figs 5-9

- *1871 *Terebra exilis* Bell, p. 355.
 1914 *Terebra exilis* A. Bell – Harmer, p. 54, pl. 2, figs 4, 5.
 ?1920 *Terebra* (*Strioterebrum*) *Basteroti* (Nyst) – Harmer, p. 505, pl. 47, fig. 8 [*non Strioterebrum basteroti* (Nyst, 1845)].
 1964 *Terebra exilis* Bell, 1871 – Brébion, p. 636, pl. 15, figs 18-20.

Material and dimensions – Maximum height 20.5 mm, width 5.2 mm. NHMW 2015/0133/0492-0497 (6), NHMW 2015/0133/0498 (20), LC (15), FVD (15). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – We assume a single *Terebra* species with a paucispiral protoconch of about two whorls (Pl. 6, fig. 9c) occurs in the lower Pliocene assemblage of Le Pigeon Blanc, but as seen from the series illustrated, the teleoconch shape and sculpture is very variable. The spire is more or less slender, apical angle between 21-16.5°, the spire whorls weakly convex to straight-sided, in some specimens slightly concave adapically, the last whorl rounded to roundly angled at the base. Axial sculpture is present on the earliest whorls in all specimens but rapidly weakens in some specimens so that middle and later spire whorls are smooth, except for axial growth lines (Pl. 6, figs 5, 6), or can persist relatively well developed onto the last whorl (Pl. 6, fig. 7), or are developed just above and below the suture forming a row of small axially elongated tubercles (Pl. 5, figs 8, 9). We do not believe this to be conspecific with the Pliocene North Sea Basin species *T. canalis* S.V. Wood, 1848, which also has smooth and occasionally ribbed forms (see Harmer, 1914, pl. 2, figs 1, 2), as that species has a wider apical angle than the widest of the specimens from Le Pigeon Blanc. Specimens of *T. canalis* at hand from the upper Pliocene Red Crag of Gedgrave are also larger and more solid-shelled than those from Le Pigeon Blanc. There has been some discussion as to whether this rare form is just a dextral form of the North Sea Basin Pliocene sinistral species *T. inversa* Nyst, 1845, but Marquet (1997b, p. 104) reasonably argued for it to be separated based on the lack of a sub-sutural collar and near-absence of axial ornament. Bell (1871, p. 355) described a second form from the British Red Crag: *T. exilis*, which was said to differ from *T. canalis* in being smaller and more slender. Harmer (1914) did not describe any ribbed forms but later illustrated a shell from the Red Crag as *Terebra* (*Strioterebrum*) *basteroti* (Nyst) (Harmer, 1920, pl. 47, fig. 8), which is not that species but might well be a ribbed form of *T. exilis*. Brébion (1964, p. 636) identified these Assemblage III forms as *T. exilis*, a position followed here. Although Marquet (1997b) synonymized *T. exilis* with *T. canalis*, we prefer to provisionally consider them distinct for the reasons outlined above.

Brébion (1964, p. 638) recorded this species from the Assemblage I locality of St-Michel, Assemblage III (Le Pigeon Blanc, La Dixmérie) and Assemblage IV (Gourbesville).

Distribution – Upper Miocene: Atlantic (Tortonian), NW France (Brébion, 1964). Lower Pliocene: Atlantic, NW France (Brébion, 1964). Upper Pliocene: North Sea Basin, Red Crag, England (Bell, 1871, Harmer, 1914, ?1920). Upper Pliocene-Pleistocene: Atlantic, NW France (Brébion, 1964).

Subclass Heterobranchia Burmeister, 1837
 Superfamily Architectoniocoidea Gray, 1850
 Family Architectonicidae Gray, 1850

Note – For this section we adopt the shell structural nomenclature introduced by Bieler (1993, unnumbered loose text-fig.).

Genus *Adelphotectonica* Bieler, 1987

Type species – *Solarium reevei* Hanley, 1862, type species, by original designation, present-day, Australia.

1987 *Adelphotectonica* Bieler, p. 208.

***Adelphotectonica bieleri* nov. sp.**

Plate 6, figs 10, 11

1964 *Architectonica aloiteau* Brébion, p. 205, pl. 5, fig. 12 (*nomen nudum*).

Type material – Holotype NHMW 2015/0133/0423, height 11.7 mm, diameter 18.1 mm (Pl. 6, fig. 10); paratype 1 NHMW 2015/0133/0550, height 13.0 mm, diameter 19.25 mm; paratype 2 NHMW 2015/0133/0551, height 13.1 mm, diameter 19.0 mm.

Other material – Maximum height 12.1 mm, diameter 16.9 mm. NHMW 2015/0133/0424 (1 juvenile), LC (1 + 5 juveniles), FVD (1: Pl. 6, fig. 11 + 1, both adults).

Etymology – Named after Rudiger Bieler of the Department of Zoology, Field Museum of Natural History, Chicago, USA, in recognition of his work on the genus *Adelphotectonica* genus feminine.

Locus typicus – Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Adelphotectonica* species of medium size, with sculpture typical for genus: SSR and UPR narrow, beaded; MR and base subdivided by two narrow grooves into flattened bands, adapical bands half width of adapi-

cal band; LPR rounded, beaded, peripheral; IPR rounded, obsoletely beaded; PUR with wide-spaced crenae, umbilicus narrow.

Description – Shell medium-sized, depressed to relatively tall-domed. One smooth protoconch whorl visible. Teleoconch of about five weakly convex whorls; suture impressed, linear. Dorsal sculpture: SSR (subsutural rib) narrow, beaded, MR (midrib) area flattened, subdivided by two narrow grooves into three flattened bands, adapical bands half width abapical band; UPR (upper peripheral rib) beaded, slightly wider than SSR; LPR (lower peripheral rib) rounded, beaded, forming periphery; IPR (inferior peripheral rib) rounded, obsoletely beaded. Venter flattened, weakly convex; base between IPR and PUR (proxumbilical rib) smooth, subdivided by two faint grooves into three flattened bands; peripheral bands half width medial band, bearing weak axial folds, strengthening medially and finer axial growth lines most clearly developed near periphery. PUR delimited by deep, narrow groove; UC (umbilical crenae) broad, widely spaced. Umbilicus narrow, deep.

Discussion – Bieler (1987) included species from the Pacific, South Africa and southeastern Atlantic in his genus *Adelphotectonica*, but as far as we are aware this is the first record of the genus in the European faunas. The sculpture of *Adelphotectonica bieleri* nov. sp. fits closely with the schematic representation of the genus given by Bieler (1993, p. 99, fig. 76), the only detail to add is the MR is subdivided by two narrow grooves into flattened bands, the two adapical bands equal in width to the abapical; the base between IPR and PUR is similarly subdivided. From the type species *A. reevei* Hanley, 1862 the French species differs in having the MR area smoother, PUR bears wider spaced crenae and the umbilicus is narrower. It is difficult to compare to European architectonicids, as none are conspecific. The Atlantic lower Miocene species *Architectonica carocollata* (Lamarck, 1822) differs in having MR subdivided into beaded ribs and a wider umbilicus.

Distribution – Lower Pliocene: Atlantic, NW France (Brébion, 1964).

Genus *Heliacus* d'Orbigny in Sagra, 1842

Type species – *Solarium herberti* Deshayes, 1830 [= *Heliacus cylindricus* (Gmelin, 1791)], type species, by monotypy, present-day, Atlantic.

- 1840 *Torinia* Gray, p. 147, *nomen nudum*; 1842 [no nominal species included]. Type species (by secondary monotypy): *Trochus cylindraceus* Dillwyn, 1817 [= *Heliacus cylindricus* (Gmelin, 1791)], present-day, Atlantic. *Torinia* suppressed to insure stability (ICZN Opinion 2185, 2007).
- 1842 *Heliacus* d'Orbigny in Sagra, p. 68.

Subgenus *Torinista* Iredale, 1936

Type species – *Torinista popula* Iredale, 1936, type species, by original designation, present-day, Indo-Pacific.

- 1936 *Torinista* Iredale, p. 327.
- 1959 *Astronacus* Woodring, p. 168. Type species (by original designation): *Heliacus planispira* Pilsbry & Lowe, 1932, present-day, Panamic Pacific.

***Heliacus (Torinista) miser* (Dujardin, 1837)**

Plate 6, fig. 12

- *1837 *Solarium miserum* Dujardin, p. 254, pl. 19, fig. 11.
- 1919 *Solarium (Pseudotorinia) miserum* Dujardin – Cossmann & Peyrot, p. 472, pl. 15, figs 62-64 (?65-67).
- 1949 *Solarium (Pseudotorinia) miserum* Dujardin, 1837 – Glibert, p. 124, pl. 7, fig. 7.
- 1964 *Architectonica (Pseudotorinia) misera* Dujardin, 1837 – Brébion, p. 207.
- ?2001 *Nipteraxis* cf. *misera* (Dujardin, 1837) – Lozouet *et al.*, p. 73, pl. 36, fig. 2.

Material and dimensions – Maximum height 3.9 mm, diameter 8.5 mm. NHMW 2015/0133/0548 (1), NHMW 2015/0133/0549 (2), LC (12), FVD (5). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Heliacus (Torinista) miser* (Dujardin, 1837) [not: *miserus*; *miser* is the male adjective form of *miser*, *misera*, meaning poor, miserable, wretched] is characterised by its depressed disk-shaped shell, moderate width umbilicus. Dorsal sculpture: SSR (subsutural rib) broad, well developed, MR (midrib) area bearing two secondary ribs, UPR (upper peripheral rib) equal in strength to SSR, one secondary rib between UPR and LPR (lower peripheral rib), LPR forming periphery, one secondary rib between LPR and IPR (inferior peripheral rib); all dorsal ribs coarsely beaded by axial growth lines. Venter weakly convex, ventral sculpture: basal keel not developed, six ribs of roughly alternate strength between IPR and PUR (proxumbilical rib) beaded by axial growth lines, PUR bearing coarse UC (umbilical crenae), made bifid by narrow groove. This species is similar to *H. (T.) subvariegatus* (d'Orbigny, 1852) from the Italian Pliocene, but that species has more finely beaded ribs, more numerous ribs on the venter between IPR and PUR and a tertiary rib between LPR and the secondary peripheral rib and IPR.

Brébion (1964, p. 207) recorded this species from Assemblage III (Le Pigeon Blanc, Le Girondor, La Dixmérie).

Distribution – ?Lower Miocene: Atlantic, Aquitaine Basin, France (Lozouet *et al.*, 2001). Middle Miocene: Atlantic, Aquitaine Basin (Cossmann & Peyrot, 1919), Loire Basin, France (Glibert, 1949). Lower Pliocene: Atlantic, NW France (Brébion, 1964).

Superfamily Acteonoidea d'Orbigny, 1843

Family Acteonidae d'Orbigny, 1843

Subfamily Acteoninae d'Orbigny, 1843

Genus *Acteon* de Montfort, 1810

Type species – *Voluta tornatilis* Linnaeus, 1758, by original designation, present-day, European.

- 1810 *Acteon* de Montfort, p. 314.
- 1816 *Tornatella* Lamarck, pl. 452. Type species (by subsequent designation; Children, 1923): *Buccinum flammeum* Bruguière, 1789, present-day, Indo-Pacific.
- 1840 *Tournatella* Swainson, 1840. Incorrect subsequent spelling.

Note – Below we have placed the generic name *Acteon* de Montfort, 1810 within quotation marks, as shells of this and related genera are assigned to a particular genus based on their radula rather than on shell morphology.

'Acteon' semistriatus (Férussac, 1822)

Plate 7, fig. 1

- 1814 *Voluta tornatilis* L. – Brocchi, p. 643 (*partim*, pl. 15, fig. 14 only) [*non Acteon tornatilis* (Linnaeus, 1758)].
- *1822b *Tornatella semi-striata* Férussac, p. 108.
- 1854 *Acteon Clathratus* Millet, p. 155 (*nomen nudum*).
- 1865 *Acteon clathratus* Millet, p. 581.
- 1964 *Acteon semistriatus* Férussac, 1822 – Brébion, p. 643, pl. 15, figs 24-27.
- 2013 '*Acteon*' *semistriatus* (Férussac, 1822) – Landau *et al.*, p. 323, pl. 52, fig. 13 (*cum syn.*).

Material and dimensions – Maximum height 10.6 mm, width 4.9 mm. NHMW 2015/0133/0468 (1), NHMW 2015/0133/0469 (15), LC (25), FVD (14). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – The shells from Le Pigeon Blanc are small sized but otherwise typical of the Pliocene forms of '*Acteon*' *semistriatus* (Férussac, 1822), with their relatively low spire and sculpture developed over most, if not the whole, surface of the last whorl. The form described from the French Atlantic Miocene as *Actaeon burdigalensis* d'Orbigny, 1852 is characterised by its more slender shape, taller spire compared with typical '*A.*' *semistriatus*, and the absence of sculpture adapically on the last whorl (see Benoist, 1889, p. 52; Glibert, 1952a, p. 384). However, specimens with combinations of these characters can be found in Miocene assemblages (*i.e.*, Landau *et al.*, 2013, p. 323). Indeed, the extent of sculpture on the last whorl is very variable, which led Sacco (1896b) to describe numerous varieties based largely on this character. Peyrot (1932) synonymised the two forms and considered '*A.*' *semistriatus* to be a very variable, widespread and long-lived species, a position followed here.

Distribution – Lower Miocene: Atlantic (Aquitainian and Burdigalian): Aquitaine Basin, France (Benoist, 1889; Peyrot, 1933); Proto-Mediterranean Sea (Burdigalian): Colli Torinesi, Italy (Sacco, 1896b); Paratethys (Aquitainian and Burdigalian): Austria (Steininger, 1973; Harzhauser, 2002). Lower-middle Miocene: North Sea Basin (late Burdigalian-Langhian): Belgium (Glibert, 1952b), Denmark (Sorgenfrei, 1958), Germany (Anderson, 1964; Moths, 1989; Wienrich, 2007), Netherlands (Nordsieck, 1972a; A.W. Janssen, 1984). Middle Miocene: Atlantic (Langhian and Serravallian): Aquitaine Basin, France (Grateloup, 1846; Benoist, 1889; Peyrot, 1933), (Langhian): Loire Basin, France (Glibert, 1952a); Paratethys (Langhian-Serravallian): Austria (Hörnes, 1856), Bulgaria (Kojumdzieva & Strachimirov, 1960), Hungary (Kecskeméti-Körmeny, 1962; Strausz, 1966), Poland (Friedberg, 1928); Proto-Mediterranean Sea (Serravallian): Karaman Basin, Turkey (Landau *et al.*, 2013). Upper Miocene: North Sea Basin (Tortonian): Denmark (Rasmussen, 1968; Schnetler, 2005); Atlantic (Tortonian and Messinian): northwestern France (Millet, 1854, 1865; Brébion, 1964), Algarve Basin, Portugal (Dollfus *et al.*, 1903); Proto-Mediterranean Sea (Tortonian): Po Basin, Italy (Sacco, 1896b). Lower Pliocene: Atlantic, northwestern France (Brébion, 1964), Guadalquivir Basin, Spain (Ruiz Muñoz *et al.*, 1997; Landau *et al.*, 2011); western Mediterranean, northeastern Spain, (Martinell, 1982b), Roussillon Basin, France (Fontannes, 1880); central Mediterranean, Italy (Sacco, 1896b; Chirli, 2013), Tunisia (Fekih, 1975). Lower-upper Pliocene: western Mediterranean, Estepona Basin (NHMW collection), southern France (Chirli & Richard, 2008); central Mediterranean, Italy (Sacco, 1896b; Cavallo & Repetto, 1992).

Genus *Rictaxis* Dall, 1871

Type species – *Tornatella punctocoelata* Carpenter, 1863, by original designation. Present-day, California, USA.

- 1871 *Rictaxis* Dall, p. 136.
- 1873 *Actaeonidea* Gabb, p. 273. Type species (by monotypy): *Actaeonidea oryza* Gabb, 1873, Miocene, USA.

***Rictaxis tornatus* (Millet, 1854)**

Plate 7, fig. 2

- *1854 *Auricula Tornata* Millet, p. 154.
- 1865 *Auricula tornata* Millet – Millet, p. 579.
- 1896b *Actaeonidea achatina* (Bon.) Sacco, p. 36, pl. 3, figs 42-46.
- 1932 *Actaeonidea Benoisti* Peyrot, p. 336, pl. 14, figs 5-7.
- 1952a *Rictaxis achatinus* Bonelli, 1826 – Glibert, p. 386, pl. 13, fig. 6.
- 1964 *Rictaxis achatinus* Bonelli, 1826 – Brébion, p. 645.
- ?1975 *Rictaxis* (*Actaeonidea*) *achatina* (Sacco) – Pavia, p. 114, pl. 11, fig. 8.

- 1979 *Rictaxis* (*Actaeonidea*) *achatina* (Sacco) – Montefameglio *et al.*, p. 192.
- 1984 *Actaeonidea* *achatina* Sacco, 1897 [sic], Bonelli m.s. – Ferrero Mortara *et al.*, 283, pl. 52, fig. 1.
- ?1992 *Acteonidea* [sic] *achatina* Sacco, 1897 [sic], Bonelli m.s. – Cavallo & Repetto, p. 164, fig. 471.
- 1995 *Acteonidea* [sic] *achatina* Sacco – Tabanelli & Segurini, p. 13.
- 1997 *Acteonidea* [sic] *achatina* Sacco – Mancini, p. 41.
- 1997b *Acteonidea* [sic] *achatina* Sacco, 1897 [sic] – Marquet, p. 112.
- 1998b *Acteonidea* [sic] *achatina* Sacco, 1897 [sic] – Marquet, p. 210.
- ?1998 *Acteonidea* [sic] *achatina* Sacco – Ferrero Mortara *et al.*, p. 49, pl. 2, fig. 5.
- ?2010 *Acteonidea* [sic] *achatina* Sacco, 1897 [sic] Bonelli m.s. – Sosso & Dell’Angelo, p. 53, p. 68 unnumbered fig. top right.
- 2011 *Acteonidea* [sic] *achatina* Sacco, 1897 [sic] – Chirli & Linse, p. 215, pl. 85, fig. 3.
- 2011 *Acteonidea* [sic] *achatina* Sacco, 1897 [sic] – Landau *et al.*, p. 39, pl. 21, fig. 10.
- ?2013 *Acteonidea* [sic] *achatina* Sacco, 1897 [sic] – Chirli, p. 26, pl. 7, figs 18-23.

Material and dimensions – Height 13.1 mm, width 6.1 mm. NHMW 2015/0133/0470 (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Original description – ‘*Tornata*, Millet. — Comme dans *Auricula hordeola*, Lamk, cette espèce a la columelle garnie d’un seul pli; mais les stries élevées dont cette coquille est ornée, et la ponctuation que présente l’intervalle des stries, sont des caractères suffisants pour l’en distinguer. — Sceaux’ (Millet, 1854, p. 154).

Later augmented: ‘*Auricula tornata*. Millet. Coq. petite, hordeiforme, composée de 4-5 tours de spire; le dernier plus grand que tous les autres ensemble, est couvert de fines stries élevées, séparées les unes des autres par une série de points enfoncés. Ouverture allongée, garnie d’un seul pli sur la columelle comme dans l’*A. hordeola* Lamk. Bord droit denticulé. Longueur: 9-10 millimètres; diamètre: dans sa partie renflée, 3-4 millimètres. Sceaux’ (Millet, 1865, p. 579).

Discussion – Millet (1854) described this species as *Auricula tornata*, with one of the few valid descriptions given in that work. This was later supplemented by a slightly more detailed description (see above; Millet, 1865, p. 579). To our knowledge, this has not been used as a valid name after Millet (1865), which under ICZN Art. 23.9.1.1 (ICZN code, 1999) would make it possible to consider it a *nomen oblitum* and maintain nomenclatural stability. However, we cannot satisfy the second condition under ICZN Art. 23.9.1.2, in which the junior synonym has been used for this taxon, as its presumed valid name, in at least 25 works, published by at least 10 authors in the immediately preceding 50 years and encompassing a span of not less than 10 years (see chresonymy). Therefore,

we must resurrect the earlier name of *Rictaxis tornatus* (Millet, 1854) and consider *R. achatinus* (Sacco, 1896) a junior synonym.

The specimen figured here from Le Pigeon Blanc is almost identical in shape and sculpture to the holotype illustrated by Ferrero Mortara *et al.* (1984, pl. 52, fig. 1). The large specimen (18 mm height) from the lower Pliocene Guadalquivir Basin of southern Spain illustrated by Landau *et al.* (2011, pl. 21, fig. 10) has an even more elongated last whorl and is less constricted at the base, suggesting some degree of intraspecific variability. Specimens from the Italian Pliocene figured by Pavia (1975, pl. 11, fig. 8), Cavallo & Repetto (1992, fig. 471), Ferrero Mortara *et al.* (1998, pl. 2, fig. 5), Sosso & Dell’Angelo (2010, p. 68) and Chirli (2013, pl. 7, figs 18-23) seem to represent a single species but are considerably smaller (maximum height 4.0 mm) than typical *R. tornatus*; more slender, with relatively wider spaced spiral grooves, less pronounced axial growth lines, and have slightly different columellar characters. We are in doubt as to whether these specimens represent true *R. tornatus* but provisionally include them in the distribution.

Distribution – Lower Miocene: Atlantic, Aquitaine Basin (Peyrot, 1932). Middle Miocene: (Langhian): Aquitaine Basin (Peyrot, 1932), Loire Basin (France (Glibert, 1952a)). Upper Miocene: Atlantic, northwestern France (Brébion, 1964), Algarve Basin (Dollfus *et al.*, 1903). Lower Pliocene: Atlantic, northwestern France (this paper), Guadalquivir Basin, Spain (Landau *et al.*, 2011); central Mediterranean, Italy (Chirli, 2013). Upper Pliocene: western Mediterranean, Estepona Basin (NHMW collection), central Mediterranean, Italy (Sacco, 1896b; Cavallo & Repetto, 1992; Ferrero Mortara *et al.*, 1998; Sosso & Dell’Angelo, 2010). Pleistocene: eastern Mediterranean, Greece (Chirli & Linse, 2011).

Order Ringipleura Kano, Brenzinger, Nützel, Wilson & Schrödl, 2016

Superfamily Ringiculoidea Philippi, 1853

Family Ringiculidae Philippi, 1853

Genus *Ringicula* Deshayes in Lamarck, 1838

Type species – *Marginella auriculata* Ménéard de la Groye, 1811, by subsequent designation, Anton, 1838, present-day, Europe.

1838 *Ringicula* Deshayes in Lamarck, p. 342.

1884 *Ringiculina* Monterosato, p. 141. Type species (by original designation): *Ringicula leptocheila* Brugnone, 1873, Pleistocene, Italy.

1892b *Ringiculella* Sacco, p. 16. Type species (by subsequent designation, Cossmann, 1895): *Marginella auriculata* Ménéard de la Groye, 1811, present-day, Mediterranean.

1936 *Ringiculadda* Iredale, p. 332. Type species (by original designation): *Ringicula semisculpta* Hedley, 1911, present-day, Australia.

1972b *Plicatra* Nordsieck, p. 12. Type species (by origi-

- nal designation): *Ringicula admirabilis* Morlet, 1882, present-day, Mediterranean.
- 1972b *Ringactaeon* Nordsieck, p. 12. Type species (by original designation): *Ringicula pulchella* Morlet, 1880, present-day, eastern Atlantic, Europe.
- Ringicula buccinea* (Brocchi, 1814)**
Plate 7, fig. 3
- *1814 *Voluta buccinea* Brocchi, p. 319, pl. 4, fig. 9.
- 1848 *Ringicula buccinea* J. Sow.[sic] – S.V. Wood, p. 22, pl. 4, fig. 2.
- non 1853 *Ringicula buccinea* Desh. – Eichwald, p. 258 (non Brocchi, 1814) [= *Ringicula exilis* (Eichwald, 1829)].
- non 1866 *Ringicula buccinea* Desh. in Hörn. – Pereira da Costa (*partim*), p. 58, pl. 12, figs 1a, b (= *Ringicula cacellensis* Morlet, 1878) [not 2a, b = *Ringicula ventricosa* (J. Sowerby, 1824)].
- 1878 *Ringicula buccinea* Brocc. – Nyst (*partim*), pl. 7, fig. 20c, d [not a, b = *Ringicula ventricosa* (J. Sowerby, 1824)].
- 1878 *Ringicula buccinea* Brocchi – Morlet, p. 132, pl. 5, fig. 16.
- 1881 *Ringicula buccinea* Brocchi, 1814 – Seguenza (*partim*), p. 20, pl. 1, fig. 3.
- 1881 *Ringicula auriculata* Ménard, 1811 – Seguenza, p. 30, pl. 1, fig. 9, pl. 2, fig. 1.
- 1882 *Ringicula buccinea* (Brocchi) – Nyst (*partim*), p. 131.
- 1892b *Ringicula* (*Ringiculella*) *auriculata* var. *buccinea* (Br.) – Sacco, p. 20, pl. 1, fig. 7.
- 1893 *Ringicula ovalis* Bell, p. 631 (*nomen nudum*).
- 1898 *Ringicula ovalis* Bell in Etheridge & Bell, p. 158, pl. 3, fig. 11.
- 1910 *Ringicula* (*Ringiculella*) *auriculata* var. *buccinea* Br. – Cerulli-Irelli, p. 235, pl. 35, figs 30-32.
- 1923 *Ringicula buccinea* (Brocchi) – Harmer, p. 811, pl. 63, fig. 23.
- 1923 *Ringicula Searlesi* Harmer, p. 812, pl. 63, fig. 22.
- 1923 *Ringicula ovalis* Bell, 1898 – Harmer, 815, pl. 63, fig. 25.
- non 1932 *Ringicula* (*Ringiculella*) *buccinea* Brocchi – Peyrot, p. 308, pl. 11, figs 9, 14, 15.
- 1946 *Ringicula* (*Ringiculella*) *ovalis* Bell, 1898 – Beets, p. 113, pl. 6, figs 38-48.
- non 1954 *Ringicula* (*Ringiculella*) *auriculata buccinea* Brocchi, 1814 – Strausz, p. 38, pl. 5, fig. 117 [= *Ringicula exilis* (Eichwald, 1829)].
- non 1952b *Ringicula* (*Ringiculina*) *buccinea* Brocchi, 1814 – Glibert, p. 141, pl. 10, fig. 13.
- 1955 *Ringicula* (*Ringiculina*) *auriculata* var. *buccinea* Brocchi – Rossi-Ronchetti, p. 333, fig. 179.
- non 1956 *Ringicula* (*Ringiculella*) *auriculata buccinea* Br. – Csepregy-Meznerics, p. 436, pl. 12, figs 13-14 [= *Ringicula exilis* (Eichwald, 1829)].
- non 1958 *Ringicula buccinea* (Brocchi) – Sorgenfrei, p. 334, pl. 73, fig. 249.
- 1959 *Ringicula buccinea* Brocchi – Zbyszewski, p. 102, pl. 11, figs 49, 53.
- non 1962 *Ringicula* (*Ringiculina*) *auriculata buccinea* Brocchi – Strausz, p. 101, pl. 41, figs 3-6, pl. 72, figs 11-14 [= *Ringicula exilis* (Eichwald, 1829)].
- 1964 *Ringicula* (*Ringiculina*) *ovata* [sic] Etheridge & Bell, 1898 – van Regteren Altena *et al.*, p. 2, pl. 19, fig. 182.
- 1964 *Ringicula* (*Ringiculina*) *buccinea* Brocchi, 1814 – Brébion (*partim*), p. 649, pl. 15, figs 32-33 only.
- non 1964 *Ringicula* (*Ringiculina*) *buccinea* (Brocchi, 1814) – Anderson, p. 332, pl. 51, fig. 299.
- non 1966 *Ringicula* (*Ringiculina*) *auriculata buccinea* Brocchi, 1814 – Strausz, p. 469, pl. 41, figs 3-6, pl. 72, figs 11-14 [= *Ringicula exilis* (Eichwald, 1829)].
- non 1972a *Ringicula buccinea* (Brocchi, 1814) – Nordsieck, p. 122, pl. 31, fig. 210.
- 1974 *Ringicula* (*Ringiculina*) *buccinea* (Brocchi, 1814) – Malatesta, p. 445, pl. 32, fig. 21.
- 1975 *Ringicula buccinea* (Brocchi) – Fekih, p. 142, pl. 52, fig. 7.
- 1978 *Voluta buccinea* Brocchi, 1814 – Pinna & Spezia, p. 167, pl. 62, fig. 2.
- 1982 *Ringicula buccinea* (Brocchi) – Ciccone & Savona, pl. 1, fig. 2.
- 1982b *Ringicula* (*Ringiculina*) *buccinea buccinea* (Brocchi, 1814) – Martinell, p. 227, pl. 1, figs 16-17.
- non 1984 *Ringicula* (*Ringiculina*) *buccinea* (Brocchi, 1814) – A.W. Janssen, p. 369, pl. 13, figs 14-15.
- 1985 *Ringicula* (*Ringiculina*) *buccinea buccinea* (Brocchi, 1814) – Martinell & Domènech, p. 60, pl. 1, fig. 7.
- 1988 *Ringicula auriculata* (Ménard de la Groye, 1811) – Chirli, p. 24, pl. 11, fig. 20.
- 1988 *Ringicula buccinea* (Brocchi, 1814) – Chirli, p. 24, pl. 11, fig. 21.
- 1989 *Ringicula* (*Ringiculina*) *buccinea buccinea* (Brocchi) – Lauriat-Rage *et al.*, p. 150, pl. 8, fig. 22.
- 1992 *Ringicula auriculata* (Ménard de la Groye, 1811) – Cavallo & Repetto, p. 166, fig. 478 [non *R. auriculata* (Ménard de la Groye, 1811)].
- 1997b *Ringicula buccinea* (Brocchi, 1814) – Marquet, p. 113, pl. 11, fig. 3.
- 1997 *Ringicula buccinea* (Brocchi) – Ruiz Muñoz *et al.*, p. 188, pl. 41, fig. 9.
- 1998b *Ringicula buccinea* (Brocchi, 1814) – Marquet, p. 215, fig. 187.
- 2001 *Ringicula* (*Ringiculina*) *buccinea* (Brocchi, 1814) – Silva, p. 581, p. 27, figs 15-16.
- non 2007 *Ringicula* (*Ringiculina*) *buccinea* (Brocchi, 1814) – Wienrich, p. 772, pl. 133, fig. 5, pl. 170, figs 1-4.
- 2008 *Ringicula auriculata* (Ménard de la Groye, 1811) – Chirli & Richard (*partim*), p. 80, pl. 16, fig. 3 (only).
- non 2008 *Ringicula auriculata* var. *buccinea* (Brocchi, 1814) – Chirli & Richard, p. 80, pl. 16, fig. 5 [3 figures left = *R. auriculata* (Ménard de la Groye, 1811); 3 figures right = *R. ventricosa* (J. Sowerby, 1824)].
- non 2010 *Ringicula* (*Ringiculina*) *buccinea* (Brocchi, 1814) – Moths *et al.*, p. 89, pl. 25, fig. 3, pl. 46, fig. 8.

- 2011 *Ringicula buccinea* (Brocchi, 1814) – Sosso & Dell’Angelo, p. 54, p. 68 unnumbered fig bottom row left.
- 2011 *Ringicula buccinea* (Brocchi, 1814) – Landau *et al.*, p. 42, pl. 23, fig. 9.
- 2013 *Ringicula auriculata* (Ménard de la Groye, 1811) – Chirli, p. 26, pl. 8, figs 1-8 [*non R. auriculata* (Ménard de la Groye, 1811)].
- 2014 *Ringicula cf. buccinea* (Brocchi, 1814) – Brunetti, p. 75, unnumbered fig. top.

Material and dimensions – Maximum height 7.2 mm, width 4.3 mm. NHMW 2015/0133/0471 (1), NHMW 2015/0133/0472 (50+), LC (50+), FVD (50+). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – Landau *et al.* (2013, p. 326) suggested that *Ringicula buccinea*, which was described based on Italian Pliocene material, has been used as a dumping ground for *Ringicula* species with a plump last whorl, and the European Miocene reports of this species were probably not conspecific.

We (BL) have examined *R. buccinea* from numerous Atlantic and Mediterranean Pliocene assemblages and compared them with ‘*R. buccinea*’ from Miocene Atlantic and Paratethyan deposits. All the Miocene Atlantic and Paratethyan forms have spiral sculpture, even if it is weak or restricted to the spire and base of the last whorl. Furthermore, none of them have the last whorl as strongly globose as in Pliocene specimens of *R. buccinea*.

The middle Miocene Paratethyan records were considered by these authors to represent *R. exilis* (Eichwald, 1829), which differs from *R. buccinea* in having a taller spire, which is weakly spirally sculptured, whereas in *R. buccinea* there is no spiral sculpture at all, the last whorl is far more evenly globose in *R. buccinea*, whereas in *R. exilis* the ventral aspect is slightly flattened, the two species have a different last whorl profile, which is much more asymmetrical in *R. buccinea* than in *R. exilis*, due to a marked flare of the outer lip abapically in *R. buccinea*. The thickness of the outer lip and the columellar and parietal callus is somewhat variable in *R. buccinea*, however, the lip and apertural armature is thicker in most specimens and the columellar callus is expanded further over the venter in *R. exilis*. Lastly, the columellar folds tend to be coarser in *R. exilis*. The North Sea Basin shells illustrated by Glibert (1952b, pl. 10, fig. 13), A.W. Janssen (1984a), Schnetler (2005, pl. 9, fig. 18) and Wienrich (2007, pl. 170, figs 1-3), amongst others, are more like Pliocene specimens of *R. buccinea*, with a smooth last whorl. However, all specimens seen (Netherlands, Germany, Belgium, Denmark; NHMW collection) are consistently smaller than Pliocene shells, with a higher spire and weak striae, as opposed to smooth in Pliocene specimens of *R. buccinea*. The North Sea Basin shells probably represent yet another species. This group needs to be revised.

In regards to the Pliocene to present-day specimens *R. buccinea* is closely similar to the extant *R. auriculata*

(Ménard de la Groye, 1811). Whilst most authors have recognised *R. buccinea* in the Pliocene, Chirli (2013) illustrated typical ‘*R. buccinea*’ from the lower Pliocene of Italy under the name *R. auriculata*. It is unclear as to whether that author intended to synonymise the two forms, as Brocchi’s (1814) original description is not included in the chresonymy, although every subsequent record to *R. buccinea* is. No discussion is offered, however, we assume he did consider them synonyms, as the stratigraphic range is given as Miocene to present-day and the geographic range includes the Atlantic, Mediterranean and Paratethys. Mediterranean specimens of *R. auriculata* at hand all have some spiral sculpture on the spire, albeit weakly developed, the parietal pad and/or tooth are sharper and smaller; in *R. buccinea* the parietal pad is far thicker, triangular, with the tooth forming the apex, which in some specimens is enveloped by the parietal pad. The labial varix and columellar callus are also thicker in *R. buccinea*, together forming stronger apertural armature that narrows the aperture far more than in *R. auriculata*.

Brébion (1964, p. 651) recorded this species from Assemblages I, III and IV in northwestern France. We continue to restrict *R. buccinea* to the Pliocene and lower Pleistocene (Assemblage III: Le Pigeon Blanc, Palluau, Le Girondor, La Dixmérie; Assemblage IV: Gourbesville). The Assemblage I specimens recorded as *R. buccinea* will be reviewed in a subsequent paper.

Distribution – Lower Pliocene: North Sea Basin, Coraline Crag, England (S.V. Wood, 1848; Harmer, 1923), Belgium (Marquet, 1997b, 1998b); Atlantic, northwestern France (Brébion, 1964; Lauriat-Rage *et al.*, 1989), Guadalquivir Basin, Spain (Ruiz Muñoz *et al.*, 1997; Landau *et al.*, 2011); western Mediterranean, northeastern Spain, (Martinell, 1982b; Martinell & Domènech, 1985); central Mediterranean, Italy (Sacco, 1892b; Chirli, 2013), Tunisia (Fekih, 1975). Upper Pliocene: North Sea Basin, Red Crag, England (S.V. Wood, 1848; Harmer, 1923); Atlantic, Mondego Basin, Portugal (Zbyszewski 1959; Silva, 2001); western Mediterranean, Estepona Basin (NHMW collection), southern France (Chirli & Richard, 2008); central Mediterranean, Italy (Sacco, 1892b; Malatesta, 1974; Chirli, 1988; Cavallo & Repetto, 1992; Sosso & Dell’Angelo, 2010; Brunetti, 2014). Pliocene (indeterminate): North Sea Basin, Netherlands (Beets, 1946; van Regteren Altena *et al.*, 1964). Upper Pliocene-Pleistocene: Atlantic, northwestern France (Brébion, 1964). Lower Pleistocene: Atlantic, St Erth, England (Harmer, 1923); central Mediterranean, Italy (Cerulli-Irelli, 1910).

Ringicula ventricosa (J. Sowerby, 1824)

Plate 7, figs 4-6

- *1824 *Auricula ventricosa* J. Sowerby, p. 99, pl. 465, figs 1, 2.
- 1848 *Ringicula ventricosa* J. Sow. – S.V. Wood, p. 22, pl. 4, fig. 1.
- 1866 *Ringicula buccinea* Desh. in Hörn. – Pereira da

- Costa (*partim*), p. 58, pl. 12, figs 2a, b [*non Ringicula buccinea* (Brocchi, 1814)] (not 1a, b = *Ringicula cacellensis* Morlet, 1878).
- 1878 *Ringicula Brocchii* Seguenza ms. Morlet (*partim*), p. 277, pl. 8, fig. 2.
- 1878 *Ringicula Gaudryana* Morlet, p. 283, pl. 7, fig. 12.
- 1878 *Ringicula buccinea* Brocc. – Nyst (*partim*), pl. 7, fig. 20a, b [not c, d = *Ringicula buccinea* (Brocchi, 1814)].
- 1881 *Ringicula placentina* Seguenza, p. 32, pl. 2, fig. 2.
- 1881 *Ringicula Brocchii* Seguenza, 1875 – Seguenza, p. 34.
- 1881 *Ringicula Guadryana* L. Morlet, 1878 – Seguenza, p. 33, pl. 2, fig. 8.
- 1882 *Ringicula buccinea* (Brocchi) – Nyst (*partim*), p. 131 (*non* Brocchi, 1814).
- 1904 *Ringiculella auriculata* var. *ventricosa* (Sow.) – Sacco, p. 110, pl. 24, figs 25, 26.
- 1910 *Ringicula* (*Ringiculella*) *ventricosa* Sow. – Cerulli-Irelli, p. 236, pl. 35, figs 33-34.
- 1910 *Ringicula* (*Ringiculella*) *ventricosa* var. *Pauluciae* Morlet – Cerulli-Irelli, p. 237, pl. 35, figs 35-36.
- 1910 *Ringicula* (*Ringiculella*) *ventricosa* var. *globulina* Cerulli-Irelli, p. 237, pl. 35, fig. 37.
- 1910 *Ringicula* (*Ringiculella*) *ventricosa* var. *Gaudryana* Morl. – Cerulli-Irelli, p. 237, pl. 35, fig. 38.
- 1910 *Ringicula* (*Ringiculella*) *ventricosa* var. *placentina* Seg. – Cerulli-Irelli, p. 237, pl. 35, fig. 39.
- 1910 *Ringicula* (*Ringiculella*) *ventricosa* var. *incrasata* Seg. – Cerulli-Irelli, p. 238, pl. 35, figs 40-41 (?*non* Seguenza, 1881).
- 1923 *Ringicula ventricosa* (J. Sowerby) – Harmer, p. 813, pl. 63, fig. 24.
- 1952b *Ringicula* (*Ringiculina*) *ventricosa* Sowerby, 1824 – Glibert, p. 142, pl. 10, fig. 14.
- 1958 *Ringicula ventricosa* (Sowerby) – Sorgenfrei, p. 333, pl. 72, fig. 248.
- 1960 *Ringicula* (*Ringicula*) *ventricosa* (Sowerby, 1825) – Malatesta, p. 195, pl. 9, fig. 15.
- 1960 *Ringicula ventricosa* (Sowerby) – Pelosio, p. 152, pl. 2, fig. 12.
- 1963 *Ringicula* (*Ringiculina*) *ventricosa* (Sow.) – Venzo & Pelosio, p. 134, pl. 41, fig. 39.
- 1964 *Ringicula* (*Ringiculina*) *striata* Philippi, 1843 – Brébion (*partim*), p. 647 (*non* Philippi, 1843).
- 1964 *Ringicula* (*Ringiculina*) *auriculata ventricosa* (J. de C. Sow.) – van Regteren Altena *et al.*, p. 3, pl. 19, fig. 183.
- 1972a *Ringicula ventricosa* (Sowerby, 1824) – Nordsieck, p. 122, pl. 31, fig. 211.
- 1974 *Ringicula* (*Ringiculina*) *auriculata* (Ménard, 1811) – Malatesta, p. 444, pl. 32, fig. 20 [*non R. auriculata* (Ménard de la Groye, 1811)].
- 1975 *Ringicula* (*Ringiculella*) *ventricosa* (Sowerby) – Fekih, p. 142, pl. 52, fig. 6.
- 1976 *Ringicula ventricosa* – Caprotti, p. 13, pl. 17, fig. 6.
- 1982b *Ringicula* (*Ringiculina*) *ventricosa* (Sowerby, 1824) – Martinell, p. 229, pl. 1, figs 18-19.
- 1984 *Ringicula* (*Ringiculina*) *ventricosa* (Sowerby, 1824) – A.W. Janssen, p. 370, pl. 13, figs 16-17.
- 1992 *Ringicula ventricosa* (Sowerby, 1825 [*sic*]) – Cavallo & Repetto, p. 166, fig. 479.
- 2001 *Ringicula* (*Ringiculina*) *ventricosa* (Sowerby, 1824) – Silva, p. 582, p. 27, figs 13-14.
- 2007 *Ringicula* (*Ringiculina*) *ventricosa* (Sowerby, 1824) – Wienrich, p. 773, pl. 133, fig. 6, pl. 170, figs 5-6.
- 2008 *Ringicula auriculata* var. *buccinea* (Brocchi, 1814) – Chirli & Richard (*partim*), p. 80, pl. 16, fig. 5 [3 figures right only; 3 figures left = *R. auriculata* (Ménard de la Groye, 1811)] [*non Ringicula buccinea* (Brocchi, 1814)].
- 2010 *Ringicula* (*Ringiculina*) *ventricosa* (J. de C. Sowerby, 1824) – Moths *et al.*, p. 90, pl. 25, fig. 5.
- 2011 *Ringicula ventricosa* (Sowerby, 1825 [*sic*]) – Soso & Dell'Angelo, p. 54, p. 68 unnumbered fig bottom row middle.
- 2011 *Ringicula auriculata* (Ménard de la Groye, 1811) – Landau *et al.*, p. 42, pl. 23, fig. 9 [*non Ringicula auriculata* (Ménard de la Groye, 1811)].
- 2013 *Ringicula ventricosa* (Sowerby, 1823 [*sic*]) – Chirli, p. 31, pl. 8, figs 9-16.
- 2014 *Ringicula* sp. – Brunetti, p. 75, unnumbered fig. bottom.

Material and dimensions – Maximum height 5.2 mm, width 3.2 mm. NHMW 2015/0133/0473-0475 (3), NHMW 2015/0133/0476 (50+), LC (50+), FVD (50+). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – We follow Glibert (1952a, b) in considering *Ringicula ventricosa* (J. Sowerby, 1824) distinct from *R. striata* Philippi, 1843. *Ringicula ventricosa* in the Atlantic and Mediterranean has an upper Miocene to Pleistocene distribution, although it seems to have occurred as early as the late Burdigalian in the North Sea Basin, whereas *R. striata* occurs in the Atlantic and Mediterranean between the lower Miocene Aquitanian and middle Miocene Serravallian. *Ringicula ventricosa* differs in being larger shelled, the spire is shorter, less pointed, the last whorl more inflated, the two anterior columellar folds are thinner and further separated from each other than in *R. striata*, and the parietal pad is far less strongly developed; in *R. striata* the parietal tooth develops at the apex of a thickened subtriangular parietal pad. Chirli (2013) considered *R. striata* a synonym of *R. ventricosa*, and indeed there is some overlap in the distinguishing features discussed above, however, we provisionally consider them distinct.

The specimens from Le Pigeon Blanc are fairly typical for the species; there is little variability in spire height and inflation of last whorl, the whorls are entirely spirally striate, although the width of the cords can vary slightly. The most variable character is the thickness of the apertural callus. In some of the most strongly callused specimens a parietal pad is developed but usually weaker than in *R. striata*, although we admit there is some overlap.

Colour pattern of brown axial flammules is preserved in some specimens (Pl. 7, fig. 6). Some specimens of the present-day Mediterranean *Ringicula auriculata* (Ménard de la Groye, 1811) are also regularly spirally striate, but they do not show any colour pattern. Indeed, none of the extant European species show a colour pattern.

We have not considered herein upper Miocene Assemblage I specimens, which will be discussed in the corresponding monograph. Therefore, we only include here the Assemblage III records of Le Pigeon Blanc and La Dixmérie (Brébion, 1964, p. 647).

Distribution – Lower-middle Miocene: North Sea Basin (late Burdigalian-Langhian): Belgium (Glibert, 1952b), Denmark (Sorgenfrei, 1958), Germany (Moths *et al.*, 2010; Wienrich, 2007), Netherlands (Nordsieck, 1972a; A.W. Janssen, 1984). Upper Miocene: Atlantic (Tortonian), Algarve Basin, Portugal (Pereira da Costa, 1866); Proto-Mediterranean (Tortonian), Italy (Venzo & Pelosio, 1963). Lower Pliocene: North Sea Basin, Coralline Crag, England (S.V. Wood, 1848; Harmer, 1923); Atlantic, northwestern France (Brébion, 1964), Guadalquivir Basin, Spain (Landau *et al.*, 2011); western Mediterranean, northeastern Spain, (Martinell, 1982b); central Mediterranean, Italy (Chirli, 2013), Tunisia (Fekih, 1975). Upper Pliocene: North Sea Basin, Red Crag, England (S.V. Wood, 1848; Harmer, 1923); Atlantic, Mondego Basin, Portugal (Silva, 2001); western Mediterranean, Estepona Basin (NHMW collection), southern France (Chirli & Richard, 2008); central Mediterranean, Italy (Sacco, 1904; Pelosio, 1960; Malatesta, 1974; Caprotti, 1976; Cavallo & Repetto, 1992; Sosso & Dell'Angelo, 2010; Brunetti, 2014). Pliocene (indeterminate): North Sea Basin, Netherlands (van Regteren Altena *et al.*, 1964). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1910). Pleistocene: North Sea Basin, England (Harmer, 1923); central Mediterranean, Italy (Malatesta, 1960).

Order Cephalaspidea Fischer, 1883

Superfamily Bulloidea Gray, 1827

Family Acteocinidae Dall in Eastman, 1913

Genus *Acteocina* Gray, 1847

Type species – *Acteon wetherelli* I. Lea, 1833, by original designation, Miocene, eastern United States.

1847b *Acteocina* Gray, p. 160.

1850 *Tornatina* A. Adams, p. 554. Type species (by subsequent designation, Cossmann, 1895): *Bulla voluta* Quoy & Gaimard, 1833, [junior homonym of *Bulla voluta* Gmelin, 1791, *nom. nov. pro Retusa gaimardi* Finlay, 1927 = *Acteocina decorata* (Pilsbry, 1904)], present-day, Pacific.

1924 *Didontoglossa* Annandale, p. 871. Type species (by original designation): *Tornatina estriata* Preston, 1914, present-day, India.

1925 *Utriculastra* Thiele, p. 235. Type species (by original designation): *Volvaria canaliculata* Say, 1826, present-day, western Atlantic.

1977 *Utriculastra* (*Tornastra*) Marcus, p. 5. Type species (by original designation): *Bulla eximia* Baird, 1863, present-day, northeastern Pacific.

***Acteocina lajonkaireana* (de Basterot, 1825)**

Plate 7, fig. 7

*1825 *Bullina Lajonkaireana* de Basterot, p. 22, pl. 1, fig. 25.

1964 *Acteocina lajonkaireana* Basterot, 1825 – Brébion, p. 653.

2013 *Acteocina lajonkaireana* (de Basterot, 1825) – Landau *et al.*, p. 333, pl. 53, figs 3-4, pl. 77, fig. 9 (*cum syn.*).

Material and dimensions – Height 2.4 mm (incomplete), width 1.0 mm. NHMW 2015/0133/0477 (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Acteocina lajonkaireana* (de Basterot, 1825) is characterised by its elongate ‘terebelliform’ shell, deeply canaliculate suture, almost straight outer lip, in having a fold on the columella and by the character of the protoconch, which is heterostrophic.

Brébion (1964, p. 653) recorded this species from the Assemblage III locality of Le Gironador, to which we add Le Pigeon Blanc. This is the only Pliocene occurrence of this widespread European Miocene species.

Distribution – Lower Miocene: northeastern Atlantic (Aquitainian-Burdigalian): Aquitaine Basin, France (Peyrot, 1932; Lozouet *et al.*, 2001); Paratethys (Burdigalian): Austria, (Harzhauser, 2002). Lower-middle Miocene: North Sea Basin (late Burdigalian-Langhian): Denmark (Sorgenfrei, 1958), Germany (Moths *et al.*, 2010). Middle Miocene: northeastern Atlantic (Langhian-Serravallian): Aquitaine Basin, France (Peyrot, 1932), (Langhian): Loire Basin, France (Glibert, 1952a); Proto-Mediterranean Sea (Burdigalian-Langhian): Colli Torinesi, Italy (Sacco, 1896b); Paratethys (Langhian-Serravallian): Austria (Hörnes, 1856; Berger, 1953; Papp, 1954), Poland (Friedberg, 1928), Hungary (Strausz, 1954, 1962, 1966), (Sarmatian): Austria (Harzhauser & Kowalke, 2002), Slovakia (Švagrovský, 1971), Romania (Simionescu & Barbu, 1940), Ukraine (Kolesnikov, 1935); Proto-Mediterranean Sea (Serravallian): Karaman Basin, Turkey (Landau *et al.*, 2013). Upper Miocene: northeastern Atlantic (Tortonian): Algarve Basin, Portugal (Dolfuss *et al.*, 1903); Proto-Mediterranean Sea (Tortonian): Po Basin, Italy (Sacco, 1896b; d’Amico *et al.*, 2012). Lower Pliocene: Atlantic, northwestern France (Brébion, 1964).

Family Retusidae Thiele, 1925

Genus *Retusa* Brown, 1827

Type species – *Bulla obtusa* Montagu, 1803, by subse-

quent designation, Iredale, 1915a, present-day, British Isles.

- 1827 *Retusa* Brown, pl. 38.
- 1844 *Utriculus* Brown, p. 101. Type species (by subsequent designation, Lemche, 1957): *Bulla obtusa* Montagu, 1803, present-day, British Isles. Junior homonym of *Utriculus* Schumacher, 1817 [Conidae] and junior objective synonym of *Retusa* Brown, 1827.
- 1883 *Coleophysis* Fischer, p. 555. Type species (by monotypy): *Bulla truncatula* Bruguière, 1792, present-day, Europe.
- 1883b *Cryptaxis* Jeffreys, p. 400. Type species (by original designation): *Cylichna parvula* Jeffreys, 1883, present-day, Mediterranean. Junior homonym of *Cryptaxis* Lowe, 1855, p. 168 [Helicoidea].
- 1884 *Cylichnina* Monterosato, p. 143. Type species (by subsequent designation, Crosse, 1885): *Cylichna laevisculpta* Granata-Grillo, 1877, present-day, Mediterranean.
- 1895 *Clistaxis* Cossmann, p. 90. Type species (by typification of replaced name): *Cylichna parvula* Jeffreys, 1883, present-day, Greece. *Nom. nov. pro* *Cryptaxis* Jeffreys, 1883b, *non* Lowe, 1855 [Helicoidea].
- 1972b *Mamilloretusa* Nordsieck, p. 36. Type species (by original designation): *Bulla mammillata* Philippi, 1836, present-day, Mediterranean.

***Retusa obtusa* (Montagu, 1803)**

Plate 7, fig. 9

- 1798 *Voluta alba* Kanmacher, p. 639, pl. 14, fig. 27 (see Lemche, 1957).
- 1798 *Bulla Regulbiensis* Kanmacher, p. 640, pl. 14, fig. 28 (see Lemche, 1957).
- *1803 *Bulla obtusa* Montagu, p. 223, pl. 7, fig. 3.
- 1843 *Bulla pertenuis* Mighels, p. 346, pl. 16, fig. 3.
- 1848 *Bulla Regulbiensis* Adams – S.V. Wood, p. 177, pl. 21, fig. 4.
- 1923 *Utriculus obtusus* (Montagu) – Harmer, p. 797, pl. 63, fig. 5.
- 1923 *Utriculus pertenuis* (Mighels) – Harmer, p. 798, pl. 63, fig. 6.
- 1964 *Retusa alba* (Kanmacher, 1798) – Regteren Altena *et al.*, p. 6, fig. 205.
- 1988 *Retusa obtusa* (Montagu, 1803) – T.E. Thompson, p. 32, fig. 7.
- 2001 *Retusa obtusa* (Montagu, 1803) – Oliverio & Tringali, p. 133, fig. 39.

Material and dimensions – Height 3.0 mm, width 1.5 mm. NHMW 2015/0133/0579 (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Retusa obtusa* (Montagu, 1803) is somewhat variable in shape and size; the apex more or less elevated

(see T.E. Thompson, 1988, fig. 7). The present-day Mediterranean *R. minutissima* (Monterosato, 1878), originally described as a subspecies of *R. obtusa*, was considered a distinct species by Oliverio & Tringali (2001), differing from *R. obtusa* in having a smaller teleoconch size, a more cylindrical shell shape, shallower suture and smaller protoconch. Both of the above species are devoid of any spiral sculpture, which separates them from *R. mamillata* (Philippi, 1836), which has fine spirals (see Oliverio & Tringali, 2001). The widespread European Miocene species *R. okeni* (Eichwald, 1830) differs in having a more scalate and taller spire, a more cylindrical last whorl with the outer lip ‘pinched’ mid-whorl.

Retusa obtusa has rarely been cited in the fossil literature and this seems to be the most southern record for this relatively cold-water species. Interestingly, it was recorded from the upper Pliocene to Pleistocene Assemblage IV localities of Bosq d’Aubigny by Dollfus (1880, p. 516) and Gourbesville by Harmer (1923, p. 798) but not by Brébion (1964). In the Assemblage III locality of Le Pigeon Blanc it is exceedingly uncommon but numerous specimens from La Dixmérie are at hand.

Distribution – Lower Pliocene: North Sea Basin, England (Harmer, 1923); Atlantic, northwestern France (this paper). Upper Pliocene: North Sea Basin, Red Crag, England (S.V. Wood, 1848). Upper Pliocene-Pleistocene: North Sea Basin, Holland (van Regetren Altena *et al.*, 1964); Atlantic, northeastern France (Dollfus, 1880). Upper Pleistocene: Atlantic, England, Ireland (Harmer, 1923). Present-day: Atlantic, British Isles, Greenland, Iceland to Scandinavia, Nova Scotia to Aleutian Islands (T.E. Thompson, 1988).

***Retusa truncatula* (Bruguière, 1792)**

Plate 7, fig. 8

- *1792 *Bulla truncatula* Bruguière, p. 377.
- 1923 *Utriculus truncatulus* (Bruguière) – Harmer, p. 794, pl. 63, fig. 1.
- 1964 *Retusa truncatula* Bruguière, 1792 – Brébion, p. 662.
- 2013 *Retusa truncatula* (Bruguière, 1792) – Landau *et al.*, p. 337, pl. 77, fig. 11 (*cum syn.*).

Material and dimensions – Maximum height 3.0 mm, width 1.3 mm. NHMW 2015/0133/0486 (1), NHMW 2015/0133/0487 (11), FVD (4). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – As discussed by Landau *et al.* (2013, p. 338) the shells recorded widely in the fossil literature as *Retusa truncatula* (Bruguière, 1792), represent either a species complex or an unusually long-lived and widely distributed species. The shells from Le Pigeon Blanc are slightly less truncated apically than usual (*i.e.* Chirli, 2013, pl. 11, figs 11-18) and the axial folds often present in this species are not clearly preserved, as the surface is

abraded in all specimens. However, the adapical tip of the outer lip rises above the apex, which is characteristic for the species. Two further closely similar European Recent species occur; *Retusa minutissima* (Monterosato, 1878) is very small, most specimens are about 2 mm in height, and have prominent axial ridges on the spire whorls; and *R. obtusa* (Montagu, 1803) has a shorter last whorl and the aperture attaches at three-quarters shell height, lower than in *R. mamillata* and *R. minutissima*, and the outer lip does not rise above the apex.

Brébion (1964, p. 662) recorded this species from the Assemblage I locality of St-Michel and Assemblage II locality of Apigné. The Assemblage III locality of Le Pigeon Blanc is added herein.

Distribution – Lower Miocene: Paratethys (Burdigalian): Austria, (Harzhauser, 2002). Middle Miocene: Atlantic (Langhian): Aquitaine Basin, France (Peyrot, 1932), (Langhian): Loire Basin, France (Peyrot, 1938; Glibert, 1952a); Paratethys (Langhian-Serravallian): Austria (Hörnes, 1856; Berger, 1953), Poland (Friedberg, 1928; Bałuk, 1970), Hungary (Strausz, 1954, 1966), Bosnia (Atanacković, 1985), eastern Paratethys (Iljina, 1993); Proto-Mediterranean Sea (Serravallian): Karaman Basin, Turkey (Landau *et al.*, 2013). Upper Miocene: Atlantic (Tortonian and Messinian) northwestern France (Brébion, 1964), (Tortonian), Algarve Basin, Portugal (NHMW collection); Proto-Mediterranean Sea (Tortonian and Messinian) Po Basin, Italy (Sacco, 1896b; Venzo & Pelosio, 1963; d'Amico *et al.*, 2012). Lower Pliocene: North Sea Basin, England (S.V. Wood, 1848; Harmer, 1923); Atlantic, northeastern France (this paper), Guadalquivir Basin, Spain (Landau *et al.*, 2011); western Mediterranean, northeastern Spain (Martinell, 1982b; Martinell & Domènech, 1984); central Mediterranean, Tunisia (Fekih, 1975). Lower-upper Pliocene: Atlantic, Mondego Basin, central west Portugal (Silva, 2001); western Mediterranean, Estepona Basin, Spain (NHMW coll.); central Mediterranean, Italy (Sacco, 1896b; Patrini, 1930; Aimassi & Ferrero Mortara, 1983; Cavallo & Repetto, 1992; Chirli, 2013). Lower Pleistocene: Atlantic, St. Erth, England (Harmer, 1923); central Mediterranean, Italy (Cerulli-Irelli, 1910). Lower-upper Pleistocene: central Mediterranean, Italy (Brambilla *et al.*, 1988). Upper Pleistocene: Atlantic, England, Ireland (Harmer, 1923). Present-day: Atlantic, British Isles, Norway, Baltic Sea to Canary Islands and Mediterranean (T.E. Thompson, 1988).

Family Rhizoridae Dell, 1956

Genus *Volvulella* Newton, 1891

Type species – *Bulla acuminata* Bruguière, 1792, by typification of replaced name, present-day, Mediterranean.

- 1850 *Volvula* A. Adams in G. B. Sowerby II, p. 555. Type species (by subsequent designation, A. Adams, 1862): *Bulla acuminata* Bruguière, 1792, present-day, Europe, *non* *Volvula* Gistel, 1848 [Diptera].

- 1891 *Volvulella* Newton, p. 268. *Nom. nov. pro* *Volvula* A. Adams, 1850, *non* Gistel, 1848 [Diptera].

***Volvulella acuminata* (Bruguière, 1792)**

Plate 7, fig. 10

- *1792 *Bulla acuminata* Bruguière, p. 376.
2013 *Volvulella acuminata* (Bruguière, 1792) – Landau *et al.*, p. 339, pl. 78, fig. 2 (*cum syn.*).

Material and dimensions – Maximum height 3.7 mm, width 1.5 mm. NHMW 2015/0133/0479 (1), NHMW 2015/0133/0480 (11), LC (20), FVD (11). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – As discussed by Landau *et al.* (2013, p. 340), *Volvulella acuminata* (Bruguière, 1792) is either a species complex or an unusually long-lived and widely distributed species. The shells from Le Pigeon Blanc are typical for the species; the apical rostration is variable in length and the last whorl varies slightly in slenderness. Similar variability is seen in both fossil and recent populations. This distinctive little species is widespread in the Mediterranean, northeastern Atlantic and North Sea Basin assemblages from the middle Miocene, and today occurs in the Atlantic from Norway southwards to Angola and throughout the Mediterranean. Interestingly, *Volvulella acuminata* is not present in the early to middle Miocene Aquitaine Basin of France. It is replaced by *Volvulella acuta* (Grateloup, 1828), which is more cylindrical, less convex, with a straighter aperture and a longer rostration.

Distribution – Lower Miocene: Proto-Mediterranean Sea (Burdigalian): Colli Torinesi, Italy (Sacco, 1896b). Lower-middle Miocene: North Sea Basin (late Burdigalian-Langhian): Netherlands (Nordsieck, 1972a; A.W. Janssen, 1984), Denmark (Ravn, 1907; Sorgenfrei, 1958), Germany (Anderson, 1964; Wienrich, 2007; Moths *et al.*, 2010). Middle Miocene: Paratethys (Langhian-Serravallian): Austria (Berger, 1953), Hungary (Strausz, 1962, 1966); Proto-Mediterranean Sea (Serravallian) Karaman Basin, Turkey (Landau *et al.*, 2013). Upper Miocene: Atlantic (Tortonian): Algarve Basin, Portugal (NHMW collection). Lower Pliocene: North Sea Basin, England (S.V. Wood, 1848; Harmer, 1925), Belgium (Nyst, 1845; Glibert, 1960; Marquet, 1997b); northeastern Atlantic, northwestern France (this paper), Guadalquivir Basin, Spain (Ruiz Muñoz *et al.*, 1997; Landau *et al.*, 2011); western Mediterranean, Tunisia (Fekih, 1975). Lower-upper Pliocene: Atlantic, Mondego Basin, central west Portugal (Silva, 2001); western Mediterranean, Estepona Basin (NHMW collection); central Mediterranean, Italy (Sacco, 1896b; Cavallo & Repetto, 1992; Sosso & Dell'Angelo, 2010; Chirli, 2013). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1910). Present-day: eastern Atlantic, Norway to Angola, into Mediterranean (T.E. Thompson, 1988).

Superfamily Cylichnoidea H. Adams & A. Adams, 1854
 Family Cylichnidae H. Adams & A. Adams, 1854
 Genus *Cylichna* Lovén, 1846

Type species – *Bulla cylindracea* Pennant, 1777, by subsequent designation (Hermannsen, 1852). Recent, British Isles.

- 1840 *Cylindrella* Swainson, p. 311. Type species (by monotypy): *Cylindrella alba* Swainson, 1840, present-day. Invalid; placed on the Official Index by Opinion 1030 (ICZN 1974).
- 1846 *Cylichna* Lovén, p. 142.
- 1891 *Bullinella* Newton, p. 265. *Nom. nov. pro Bullina* Risso, 1826, *non* de Férussac, 1822b [a misapplication by Risso of Férussac's name], and *Cylichna* Lovén, 1846, said to be preoccupied by Burmeister, 1844, who however established *Cyl-ichnus* [Insecta].
- 1952 *Eocylichna* Kuroda & Habe, p. 55. Not available (no diagnosis).
- 1971 *Eocylichna* Habe in Kuroda *et al.*, p. 293. Type species (by original designation): *Cylichna braunsi* Yokoyama, 1920, Pleistocene, Japan.

***Cylichna cylindracea* (Pennant, 1777)**

Plate 7, fig. 11

- *1777 *Bulla cylindracea* Pennant, p. 100, pl. 75, figs 5, 6.
- 1814 *Bulla convoluta* Brocchi, p. 277, pl. 1, fig. 7.
- 1848 *Bulla cylindracea* Penn. – S.V. Wood, p. 175, pl. 21, fig. 1.
- 1878 *Cylichna cylindracea* Pennant – Nyst, pl. 7, fig. 21.
- 1880 *Cylichna convoluta* Brocchi – Fontannes, p. 236, pl. 12, fig. 13.
- 1882 *Cylichna cylindracea* Pennant – Nyst, p. 132.
- 1896b *Bullinella cylindracea* (Penn.) – Sacco, p. 49, pl. 4, figs 8-10.
- 1910 *Bullinella cylindracea* Pennt. – Cerulli-Irelli, p. 229, pl. 35, figs 11-13.
- 1923 *Cylichna cylindracea* (Pennant) – Harmer, p. 803, pl. 63, fig. 12.
- non* 1925 *Bullinella cylindracea* Penn. – Kautsky, p. 299 [= *C. pseudoconvoluta* (d'Orbigny, 1852)].
- 1955 *Cylichna* (*Cylichna*) *convoluta* (Brocchi, 1814) – Rossi Ronchetti, p. 335, fig. 181.
- non* 1958 *Cylichna* cf. *cylindracea* (Pennant) – Sorgenfrei, p. 342, pl. 74, fig. 251 [= *C. pseudoconvoluta* (d'Orbigny, 1852)].
- 1960 *Cylichna cylindracea* (Pennant, 1777) – Malatesta, p. 196, pl. 9, fig. 17.
- non* 1964 *Cylichna cylindracea* (Pennant 1777) – Anderson, p. 333, pl. 51, fig. 300 [= *C. pseudoconvoluta* (d'Orbigny, 1852)].
- 1964 *Cylichna cylindracea* (Pennant, 1777) – van Regteren Altena *et al.*, p. 7, pl. 21, fig. 208.
- 1964 *Cylichna* cf. *cylindracea* Pennant, 1777 – Brébion, p. 654, pl. 15, figs 37, 38.

- non* 1970 *Cylichna convoluta* (Brocchi) – Baluk, p. 119, pl. 14, fig. 3 [*Cylichna subcylindrica* (d'Orbigny, 1852)].
- non* 1972a *Cylichna cylindracea* (Pennant, 1777) – Nord-sieck, p. 123, pl. 31, fig. 212 [= *C. pseudoconvoluta* (d'Orbigny, 1852)].
- 1975 *Cylichna* (*Cylichnina*) *cylindracea* (Pennant) – Fekih, p. 141, pl. 42, fig. 13.
- 1978 *Bulla convoluta* Brocchi, 1814 – Pinna & Spezia, p. 133, pl. 50, fig. 2.
- 1982b *Cylichna cylindracea* (Pennant, 1777) – Martinell, p. 230, pl. 1, figs 22, 23.
- 1988 *Cylichna cylindracea* (Pennant, 1777) – T.E. Thompson, p. 46, fig. 14.
- 1992 *Cylichna cylindracea* (Pennant, 1777) – Cavallo & Repetto, p. 170, fig. 489.
- 1997 *Cylichna cylindracea* (Brocchi) [sic] – Ruiz Muñoz *et al.*, p. 188, pl. 41, figs 10, 11.
- 1997b *Cylichna* (*C.*) *cylindracea* (Pennant, 1777) – Marquet, p. 116, pl. 11, fig. 8.
- 1998b *Cylichna* (*C.*) *cylindracea* (Pennant, 1777) – Marquet, p. 220, fig. 193.
- 2008 *Cylichna cylindracea* (Pennant, 1777) – Chirli & Richard, p. 81, pl. 16, fig. 7.
- 2010 *Cylichna cylindracea* (Pennant, 1777) – Sosso & Dell'Angelo, p. 54, p. 69 unnumbered fig. top right.
- 2011 *Cylichna cylindracea* (Pennant, 1777) – Landau *et al.*, p. 43, pl. 23, fig. 13.
- 2013 *Cylichna cylindracea* (Pennant, 1777) – Chirli, p. 36, pl. 9, figs 15-20.

Material and dimensions – Maximum height 13.0 mm, width 4.6 mm. NHMW 2015/0133/0425 (1), NHMW 2015/0133/0478 (50+), LC (50+), FVD (50+). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Cylichna cylindracea* (Pennant, 1777) is characterised by its relatively large, solid shell for the genus and elongated, narrow, regularly cylindrical shape, which is hardly inflated. Brébion (1964, p. 655) pointed out that in the specimens from Le Pigeon Blanc the upper margin of the outer lip rose above the apex and he stated that he had not seen that character in extant specimens. However, an expanded adapical outer lip is also seen in some present-day specimens (http://www.gastropods.com/3/Shell_6123.shtml). The holotype of *C. convoluta* (Brocchi, 1814) comes from the upper Pliocene of Italy, is incomplete and poorly preserved. We consider it synonym of *C. cylindracea*.

Brébion (1964, p. 655) recorded this species from the Assemblage III localities of Le Pigeon Blanc and Le Girondor. We provisionally exclude Brébion's upper Miocene Assemblage I records of *C. convoluta*. These shells will be reviewed in a subsequent paper. Other Miocene records for *C. cylindracea* and *C. convoluta* also need to be confirmed.

Distribution – Lower Pliocene: North Sea Basin, Cor-

alline Crag, England (S.V. Wood, 1848; Harmer, 1923), Kattendijk Formation, Belgium (Marquet, 1997b, 1998b); Atlantic, northwestern France (Brébion, 1964), Guadalquivir Basin, Spain (Ruiz Muñoz *et al.*, 1997; Landau *et al.*, 2011); western Mediterranean, northeastern Spain, (Martinell, 1982b), France (Fontannes, 1880); central Mediterranean, Italy (Sacco, 1896b; Chirli, 2013), Tunisia (Fekih, 1975). Upper Pliocene: North Sea Basin, Red Crag, England (S.V. Wood, 1848; Harmer, 1923), Oorderen Sands Formation, Belgium (Marquet, 1997b, 1998b); western Mediterranean, Estepona Basin (NHMW collection), southern France (Chirli & Richard, 2008); central Mediterranean, Italy (Sacco, 1896b; Cavallo & Repetto, 1992; Sosso & Dell'Angelo, 2010). Pliocene (indeterminate): North Sea Basin, Netherlands (van Regteren Altena *et al.*, 1964). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1910). Pleistocene: Atlantic, England, Ireland (Harmer, 1923); central Mediterranean, Italy (Malatesta, 1960). Present-day: Iceland, northeastern Atlantic frontage, Mediterranean, Azores and Canaries (T.E. Thompson, 1988).

Superfamily Haminoeidea Pilsbry, 1895
Family Haminoeidae Pilsbry, 1895
Genus *Haminoea* Turton & Kingston, 1830

Type species – *Bulla hydatis* Linnaeus, 1758, by monotypy, present-day, Mediterranean.

- 1830 *Haminoea* Turton & Kingston, p. F8.
- 1847a *Haminaea* Leach in Gray, p. 268. Incorrect subsequent spelling.
- 1847b *Haminea* Gray, p. 161. Incorrect subsequent spelling.
- 1921 *Haloea* Pilsbry, p. 367. Type species (by original designation): *Haminoea crocata* Pease, 1860, present-day, Hawaii.
- 1952 *Haloea* (*Sericohaminoea*) Habe in Kuroda & Habe, p. 150. Type species (by monotypy): *Haloea yamagutii* Habe, 1952, present-day, Taiwan.
- 1952 *Lamprohaminoea* Kuroda & Habe, p. 150. Type species (by original designation): *Bulla cymbalum* Quoy & Gaimard, 1833, present-day, Pacific.

***Haminoea hydatis* (Linnaeus, 1758)**

Plate 7, fig. 12

- *1758 *Bulla hydatis* Linnaeus, p. 726.
- 1896b *Haminea hydatis* (L.) – Sacco (*partim*), p. 48, pl. 4, figs 1-5.
- 1910 *Bulla* (*Haminea*) *hydatis* L. – Cerulli-Irelli, p. 229, pl. 35, fig. 10.
- 1923 *Haminea hydatis* (Linné) – Harmer, p. 807, pl. 63, fig. 16.
- 1965 *Haminea* (*Haminea*) *hydatis* (L.) – Ruggieri & Greco, p. 53, pl. 7, fig. 13.
- 1987 *Haminoea hydatis* (Linné, 1758) – Talavera *et al.*, p. 55, figs 1-4, 21.

- 1991 *Haminoea hydatis* (Linnaeus, 1758) – Poppe & Goto, p. 195, pl. 37, fig. 15.
- 1992 *Haminoea hydatis* (L., 1758) – Cavallo & Repetto, p. 166, fig. 480.
- 2011 *Haminoea hydatis* (Linnaeus, 1758) – Landau *et al.*, p. 42, pl. 23, fig. 10.

Material and dimensions – Height 8.5 mm, width 5.8 mm. NHMW 2015/0133/0425 (1), NHMW 2015/0133/0552 (1), LC (2), FVD (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – According to Talavera *et al.* (1987, p. 61), *Haminoea orbignyana* (de Férussac, 1822) is the only European *Haminoea* species that can be reliably distinguished by its shell, which is pyriform with a broad anterior part of the aperture, which does not fit the species found in Le Pigeon Blanc. The species *H. navicula* (da Costa, 1778) has a globose shell with conspicuous fine spiral striae visible in shells that are well preserved. In shells with an abraded surface, *H. navicula* and *H. hydatis* (Linnaeus, 1758) cannot be reliably separated, although *H. navicula* is said to be larger, more truncated, with a wider aperture and a more excavated columella. The Le Pigeon Blanc specimen has no trace of spiral sculpture (although we admit the surface is somewhat abraded) and a relatively narrow aperture. We therefore ascribe it to *H. hydatis*.

Berger (1953) separated Miocene specimens of *Haminoea hydatis* as the subspecies *H. hydatis miocaenica*, distinguished by having a smaller shell and alleged minor differences in the shape of the upper part of the aperture. He further commented that the transition from the Miocene to the Recent forms was gradual, Pliocene specimens being intermediate (for further discussion see Landau *et al.* (2013, p. 328). We therefore continue to separate the Miocene forms as the chronosubspecies *H. hydatis miocaenica*.

Distribution – Lower Pliocene: Atlantic, northwestern France (this paper), Guadalquivir Basin, Spain (Landau *et al.*, 2011). Upper Pliocene: Atlantic, western Mediterranean, Estepona Basin (NHMW collection); central Mediterranean, Italy (Sacco, 1896b; Cavallo & Repetto, 1992). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1910). Pleistocene: English Channel, England (Harmer, 1923); central Mediterranean, Italy (Ruggieri & Greco, 1965). Present-day: Atlantic southern coast of British Isles, Canaries, Mediterranean, Ascension Islands and St. Helena of coast of West Africa (Poppe & Goto, 1991).

Superfamily Philinoidea Gray, 1850 (1815)
Family Scaphandridae Sars, 1878
Genus *Scaphander* de Montfort, 1810

Type species – *Bulla lignaria* Linnaeus, 1758, by original designation, present-day, Europe.

- 1769 *Charta* Martini, p. 283. Type species (by monotypy): *Charta convoluta* Martini, 1769 [= *Scaphander lignarius* (Linnaeus, 1758)]. *Nomen oblitum* (Article 53.9, ICZN, 1999).
- 1788 *Tricla* Philipsson, 1788, p. 8. Type species (by monotypy): *Tricla gioeni* Philipsson, 1788, present-day, Mediterranean. Placed on the Official Index by Opinion 287 (ICZN 1954).
- 1789 *Gioenia* Bruguière, p. xii. Type species (by subsequent monotypy): *Gioenia sicula* Bruguière, 1792 [= *Scaphander lignarius* (Linnaeus, 1758)], present-day, Italy. Suppressed and placed on the Official Index by Opinion 287 (ICZN 1954).
- 1810 *Scaphander* de Montfort, p. 334.
- 1817 *Assula* Schumacher, p. 78, 258. Type species (by monotypy): *Assula convoluta* Schumacher, 1817, present-day, Middle East. *Assula convoluta* is a substitute name for *Bulla lignaria* Linnaeus, 1758; therefore junior objective synonym of *Scaphander*.
- 1890 *Bucconia* Dall, p. 16. Type species (by original designation): *Scaphander nobilis* Verrill, 1884, present-day, NE United States.
- 1908 *Scaphander* (*Sabatina*) Dall, p. 240. Type species (by original designation): *Scaphander planeticus* Dall, 1908, present-day, Mid-Pacific.
- 1915b *Brocktonia* Iredale, p. 340. Type species (by original designation): *Cryptaxis crebripunctatus* Jeffreys, 1883, present-day, NE Atlantic.
- 1952 *Eoscapander* Habe, p. 75. Type species (by monotypy): *Eoscapander fragilis* Habe, 1952, present-day, Japan.
- 1971 *Nipponoscapander* Kuroda & Habe in Kuroda *et al.*, p. 292. Type species (by original designation): *Scaphander japonica* A. Adams, 1862, present-day, Japan.
- 1972b *Bullocardia* Nordsieck, p. 29. Type species (by original designation): *Bulla millepunctata* Locard, 1897 [= *Scaphander nobilis* Verrill, 1884], present-day, NE Atlantic.
- Scaphander lignarius* (Linnaeus, 1758)**
Plate 7, fig. 13
- *1758 *Bulla lignaria* Linnaeus, p. 727.
- 1826 *Scaphander targionius* Risso, p. 51, pl. 2, fig. 13.
- 1848 *Bulla lignaria* Linn. – S.V. Wood, p. 173, pl. 21, fig. 8.
- non 1856 *Bulla lignaria* Linn. – Hörnes, p. 616, pl. 50, fig. 1 [= *Scaphander dertonensis* (Sacco, 1896)].
- 1878 *Scaphander lignaria* Linné. – Nyst, pl. 7, fig. 23.
- 1882 *Scaphander lignaria* Linné. – Nyst, p. 137.
- 1896b *Scaphander lignarius* L. – Sacco, p. 43, pl. 3, figs 94, 95.
- 1896b *Scaphander lignarius* var. *targionia* (Risso) – Sacco, p. 43, pl. 3, figs 96-99.
- 1896b *Scaphander lignarius* var. *parvulina* Sacco, p. 44, pl. 3, figs 100-101.
- non 1903 *Scaphander lignarius* Linné – Dollfus *et al.*, p. 22, pl. 36, figs 13, 14.
- 1910 *Scaphander lignarius* L. – Cerulli-Irelli, p. 227, pl. 35, figs 1-7.
- 1923 *Scaphander lignarius* (Linné) – Harmer, p. 806, pl. 63, figs 14, 15.
- non 1928 *Scaphander lignarius* L. – Friedberg, p. 546, pl. 36, figs 3-4 [= *Scaphander dertonensis* (Sacco, 1896)].
- non 1953 *Scaphander* (*Scaphander*) *lignarius lignarius* (Linnaeus) – Berger, p. 113, pl. 21, figs 104-105 [= *Scaphander dertonensis* (Sacco, 1896)].
- non 1954 *Scaphander lignarius* L. – Strausz, p. 38, 82, 116, pl. 9, fig. 166 [= *Scaphander dertonensis* (Sacco, 1896)].
- non 1955 *Scaphander lignarius* Linnaeus, 1766 – Moiescu, p. 176, pl. 15, fig. 7 [= *Scaphander dertonensis* (Sacco, 1896)].
- 1964 *Scaphander grateloupi* Michelotti, 1847 – Brébion, p. 658, pl. 15, fig. 40 [non Michelotti, 1847; = *Scaphander tarbelliana* (Grateloup, 1837)].
- 1964 *Scaphander lignarius* (Linnaeus, 1758) – van Regteren Altena *et al.*, p. 7, pl. 22, fig. 210.
- non 1966 *Scaphander lignarius* Linné, 1766 – Strausz, p. 477, pl. 75, figs 7, 8 [= *Scaphander dertonensis* (Sacco, 1896)].
- non 1970 *Scaphander lignarius* Linnaeus – Bałuk, p. 119, pl. 14, figs 1, 2 [= *Scaphander dertonensis* (Sacco, 1896)].
- 1974 *Scaphander* (*Scaphander*) *lignarius* (Linné, 1758) – Malatesta, p. 447, pl. 23, fig. 17.
- 1992 *Scaphander lignarius* (L., 1758) – Cavallo & Repetto, p. 170, fig. 491.
- 1997 *Scaphander lignarius* (Brocchi) [sic] – Ruiz Muñoz *et al.*, p. 188, pl. 41, figs 12, 13.
- 1997b *Scaphander lignarius* (Linnaeus, 1758) – Marquet, p. 116, pl. 11, fig. 6.
- non 1998 *Scaphander* (*Scaphander*) *lignarius lignarius* (Linné) – Schultz, p. 76, pl. 31, fig. 10 [= *Scaphander dertonensis* (Sacco, 1896)].
- 1998b *Scaphander lignarius* (Linnaeus, 1758) – Marquet, p. 221, fig. 194.
- 2008 *Scaphander lignarius* (Linné, 1758) – Chirli & Richard, p. 81, pl. 16, fig. 6.
- 2010 *Scaphander lignarius* var. *parvulina* Sacco, 1897 [sic] – Sosso & Dell'Angelo, p. 55, p. 69, unnumbered fig. middle row left.
- 2013 *Scaphander lignarius* (Linné, 1758) – Chirli, p. 45, pl. 10, figs 17-21.
- 2013 *Scaphander lignarius* (Linnaeus, 1758) – Landau *et al.*, p. 43, pl. 23, fig. 15.
- 2013 *Scaphander lignarius* (Linnaeus, 1758) – Eilertsen & Malaquias, p. 405, fig. 3/1-4 (*cum syn*; extant literature).

Material and dimensions – Maximum height 15.8 mm, width 8.4 mm. NHMW 2015/0133/0481 (1), NHMW 2015/0133/0482 (7), LC (40), FVD (30). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – Based on molecular studies, Eilertsen

& Malaquias (2013) revised the present-day Atlantic *Scaphander* de Montfort, 1810 species and concluded that four species occurred in the eastern Atlantic, of which only one is relatively shallow water: *S. lignarius* (Linnaeus, 1758). *Scaphander lignarius* is characterised by its relatively large (maximum height 70 mm) pyriform shell with the abapical part of the aperture flared. The adapical edge of the outer lip is rounded and usually does not protrude beyond the apex. The dorsum is covered by rounded punctuated striations, interconnected along the striae. The grooves formed by these striations are separated by interspaces much wider than the grooves themselves.

The shells from Le Pigeon Blanc are small and relatively fragile compared to those found in other Pliocene-extant faunas, but similarly small populations also occur elsewhere (i.e. lower upper Pliocene, Velerín Carretera assemblage of Estepona, southern Spain; BL personal observation). The small size probably led Brébion (1965, p. 658) to identify these specimens as *Scaphander grate-loupi* Michelotti, 1847 [= *Scaphander tarbelliana* (Grateloup, 1837)]. That species from the Atlantic early Miocene Aquitanian and Burdigalian of the Aquitaine Basin, France and late Burdigalian-Langhian of the North Sea Basin is indeed smaller, more fragile than *S. lignarius*, and the aperture does not rise above the apex, but it differs most notably in the punctuated striations, which in *Scaphander grate-loupi* are broader, the rounded punctations larger, widening the grooves.

Scaphander lignarius has been reported in the European literature from the early Miocene to the present-day. However, only the Pliocene-extant records are here considered to represent that species. Landau *et al.* (2013, p. 335) considered most of the middle-upper Miocene records to represent *Scaphander dertonensis* (Sacco, 1896). That species differs from *S. lignarius* in being thicker-shelled, in having a more conical shape, the aperture is narrower and less expanded anteriorly, the spiral grooves on the last whorl are more widely spaced, the outer lip rises considerably above the apex adapically, and the columellar callus is a thicker. The specimens from the Atlantic upper Miocene Tortonian of Portugal illustrated by Dollfus *et al.* (1903) as *S. lignarius* are neither that species nor *S. dertonensis*. It is a fairly large but thin-shelled species. The outer lip does not rise as far above the apex as in *S. dertonensis*, and the aperture is far wider, especially anteriorly, where it is greatly expanded in the Portuguese shells. Moreover, the spiral sculpture is obsolete, or almost so, whereas the spiral grooving is well-developed in *S. tarbelliana*, *S. dertonensis* and *S. lignarius*.

Brébion (1964, p. 659) recorded this species from the Assemblage III locality of Le Pigeon Blanc and the Assemblage IV locality of Gourbesville.

Distribution – Lower Pliocene: North Sea Basin, Coralline Crag, England (S.V. Wood, 1848; Harmer, 1923), Kattendijk Formation, Belgium (Marquet, 1997b, 1998b); Atlantic, northwestern France (Brébion, 1964), Guadalquivir Basin, Spain (Ruiz Muñoz *et al.*, 1997; Landau *et al.*, 2011); central Mediterranean, Italy (Sacco, 1896b;

Chirli, 2013). Upper Pliocene: North Sea Basin, Red Crag, England (S.V. Wood, 1848; Harmer, 1923), Oorderen Sands Formation, Belgium (Marquet, 1997b, 1998b); western Mediterranean, Estepona Basin (NHMW collection), southern France (Chirli & Richard, 2008); central Mediterranean, Italy (Sacco, 1896b; Malatesta, 1974; Cavallo & Repetto, 1992; Sosso & Dell'Angelo, 2010). Pliocene (indeterminate): North Sea Basin, Netherlands (van Regteren Altena *et al.*, 1964). Upper Pliocene-Pleistocene: Atlantic, northwestern France (Brébion, 1964). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1910). Pleistocene: Atlantic, England, Ireland (Harmer, 1923); central Mediterranean, Italy (Malatesta, 1960). Present-day: Iceland, British Isles, northeastern Atlantic frontage, Mediterranean and Canaries (T.E. Thompson, 1988).

Superorder Pylopulmonata Teasdale, 2017

Superfamily Pyramidelloidea Gray, 1840

Family Pyramidellidae Gray, 1840

Subfamily Odostomiinae Casey, 1904

Tribe Odostomiini Casey, 1904

Genus *Megastomia* Monterosato, 1884

Type species – *Odostomia conspicua* Alder, 1850, by original designation, present-day, British Isles, Europe.

1884 *Megastomia* Monterosato, p. 94.

1904 *Stomega* Dall & Bartsch, p. 13. Type species (by typification of replaced name): *Odostomia conspicua* Alder, 1850, British Isles, Europe. Established as a *nom. nov. pro. Megastomia* Monterosato, 1884, with the same type species, suggesting Dall & Bartsch considered it a junior homonym of *Megastoma* Swainson, 1837 [Aves].

1921 *Somatomega* Cossmann, p. 241. Suggested alternative spelling for *Stomega* Dall & Bartsch, 1904. Not available.

Note – *Megastomia* Monterosato, 1884 differs from *Odostomia* Fleming, 1813 in having a series of well developed, elongated lirae within the outer lip (Peñas & Rolán, 1999).

***Megastomia conoidea* (Brocchi, 1814)**

Plate 7, figs 14-17

*1814 *Turbo conoideus* Brocchi, p. 660, pl. 16, fig. 2.

1964 *Odostomia* (*Megastomia*) *conoidea* Brocchi, 1814 – Brébion, p. 286, pl. 7, figs 10, 11.

2013 *Megastomia conoidea* (Brocchi, 1814) – Landau *et al.*, p. 308, pl. 74, fig. 12 (*cum syn.*).

2014 *Megastomia conoidea* (Brocchi, 1814) – Giannuzzi-Savelli *et al.*, p. 56, figs 119-126.

Material and dimensions – Maximum height 5.7 mm, width 2.4 mm. NHMW 2015/0133/0511-0514 (4), NHMW 2015/0133/0515 (50+), LC (50+), FVD (50+). Le Pigeon

Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Megastomia conoidea* (Brocchi, 1814) is characterised by its helicoid protoconch of type A2, in having a relatively broad shell, in having orthocline growth lines and a strongly developed columellar tooth. The shell can be extremely variable (Peñas & Rolán, 1999), and the last whorl may be rounded (in littoral forms) or have a more or less pronounced carina (in deeper-water forms) (van Aartsen, 1987). The species in the Le Pigeon Blanc assemblage is equally variable, with both carinate and rounded form present. Lirae are present in almost all specimens but developed to a variable degree. For further discussion see Landau *et al.* (2013, p. 309).

Brébion (1964, p. 288) recorded this species from Assemblage I (Beaulieu, St-Clément-de-la-Place), Assemblage II (Apigné, Vieux Chartres), Assemblage III (Le Pigeon Blanc, Le Girondor, Palluau) and Assemblage IV (St-Jean-La-Poterie, Gourbesville).

Distribution – Middle Miocene: Paratethys (Langhian-Serravallian): Bulgaria (Kojumdzieva & Strachimirov, 1960), Poland (Friedberg, 1928); Proto-Mediterranean Sea (Serravallian): Antalya Basin (İslamoğlu & Taner, 2003), Karaman Basin, Turkey (Landau *et al.*, 2013). Upper Miocene: northeastern Atlantic (Tortonian): Algarve Basin, Portugal (Dollfus *et al.*, 1903); Proto-Mediterranean Sea (Tortonian and Messinian): Po Basin, Italy (Sacco, 1892a, 1904; Venzo & Pelosio, 1963), Turkey (early Tortonian): Antalya Basin (İslamoğlu & Taner, 2003). Lower Pliocene: North Sea Basin, British Isles (Harmer, 1920), Belgium (Marquet, 1998a); northeastern Atlantic, Guadalquivir Basin, Spain (Ruiz Muñoz *et al.*, 1997; Landau *et al.*, 2011); western Mediterranean, Estepona Basin (NHMW collection), northeastern Spain (Martinell, 1982b); central Mediterranean, Italy (Sacco, 1892a; Caprotti, 1974; Pavia, 1975; Chirli & Micali, 2011), Tunisia (Fekih, 1969). Lower-upper Pliocene: northeastern Atlantic, Mondego Basin, Portugal (Silva, 1992, 2001); central Mediterranean, Italy (Sacco, 1892a, 1904; Cavallo & Repetto, 1992; Sosso & Dell'Angelo, 2010). Upper Pliocene: North Sea Basin, British Isles (Harmer, 1920), Belgium (Marquet, 1993, 1998b). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1914; Pelosio, 1960). Lower-upper Pleistocene: North Sea Basin, British Isles (Harmer, 1920); western Mediterranean, Balearic Islands (Cuerda Barceló, 1987). Present-day: Norway to Mediterranean, absent in North Sea (Graham, 1988), Angola, Cape Verde Islands, São Tomé and Príncipe archipelagos (Rolán, 2005).

Genus *Ondina* de Folin, 1870

Type species – *Ondina semiornata* de Folin *in* de Folin & Périer, 1872, by subsequent monotypy, present-day, France (Atlantic).

1847b *Auriculina* Gray, p. 159. Type species (by origi-

nal designation): *Odostomia obliqua* Alder, 1844, present-day, British Isles. Junior homonym of *Auriculina* Grateloup, 1838 [Ringiculidae].

1870 *Ondina* de Folin, p. 200.

Ondina asterixi nov. sp.

Plate 7, fig. 18

Type material – Holotype NHMW 2015/0133/0516, height 4.0 mm, width 1.5 mm (Pl. 7, fig. 18); paratype 1 NHMW 2015/0133/0517, height 4.3 mm, width 1.5 mm.

Other material – Maximum height 4.0 mm. NHMW 2015/0133/0518 (4). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Etymology – Named after the heroic comic character Asterix, created by R. Goscinny and A. Uderzo, the valiant Gaul who resisted Julius Caesar from an unnamed village set not far from the study area. *Ondina* gender feminine.

Locus typicus – Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, NW France.

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – *Ondina* species of small size, with protoconch intorted, of type C, elongated slender teleoconch with spiral sculpture on spire whorls restricted to one or two incised spirals above suture, last whorl with spirals on lower third and base, aperture flared abapically, columella with weak fold.

Description – Shell elongated, relatively slender, with flat-topped conical spire. Protoconch intorted, of type C. Teleoconch consisting of about five almost flat-sided whorls, with periphery short distance above suture. Suture well marked, not deep, linear. Sculpture on first three spire whorls of one incised spiral just above suture; two on penultimate whorl and inconspicuous, weakly opisthocline, slightly sinuous growth lines with sinus near adapical suture. Last whorl tall, 57% of total height, rounded at periphery, bearing spiral cords on lower third and base, about 15 in total, narrowing and deeper incised towards umbilical chink; base rounded bearing relatively broad smooth umbilicus. Aperture relatively large, 37% total height; outer lip thin, edge damaged, flared abapically. Columella with weak fold mid-height, erect and somewhat everted abapically.

Discussion – The relationship between the genera *Ondina* de Folin *in* de Folin & Périer, 1870 and *Odetta* de Folin *in* de Folin & Périer, 1870 were discussed by van Aartsen (1984), and the European species were reviewed in a subsequent paper (van Aartsen, 1987). *Ondina* species are relatively thin shelled, with opisthocline growth lines, the sinus placed close to the adapical suture, they often bear spiral sculpture on the abapical part of the whorls, and the columellar fold is weakly developed. The new spe-

cies from France fits closely with the generic description. Several European and West African species have similar shell characters: *O. mosti* van Aartsen, Gittenberger & Goud, 1998 from the Cape Verde Islands is less slender, with a shorter spire and more inflated last whorl, larger aperture and more numerous spirals that occupy a great part of the whorl surface. The European species were illustrated by Giannuzzi-Savelli *et al.* (2014). Of these the most similar are *O. warreni* (W. Thompson, 1845) that differs in having a less intorted protoconch, fewer more convex teleoconch whorls, a more inflated last whorl and a greater number of weaker spirals that cover most of the surface, and *O. crystallina* Locard, 1892 that has a broader blunt apex and weaker spiral sculpture. In the Italian Plio-Pleistocene *O. cerullii* (Cossmann, 1921) is smaller-shelled, squatter, with coarser spiral sculpture (see Chirli & Micali, 2011, pl. 24, figs 1-3).

Distribution – Lower Pliocene: Atlantic, northwestern France (this paper).

Tribe Chrysallidini Saurin, 1958
Genus *Euparthenia* Thiele, 1929

Type species – *Parthenia bulinea* Lowe, 1841, by typification of replaced name, present-day, Madeira.

- 1841 *Parthenia* Lowe, p. 39 (pro parte). Type species (by subsequent designation, Monterosato, 1881: 255): *Parthenia bulinea* Lowe, 1841, present-day, Madeira. non obineau-Desvoidy, 1830 [Diptera].
- 1929 *Euparthenia* Thiele, p. 233. Nom. nov. pro *Parthenia* Lowe, 1841, non Robineau-Desvoidy, 1830 [Diptera].

Note – Thiele (1929, p. 233) introduced *Euparthenia* explicitly as a replacement name for *Parthenia* Lowe, 1841 (part), non Robineau-Desvoidy, 1830 [Diptera]. Although Bucquoy, Dautzenberg & Dollfus (1883) also introduced a name, *Parthenina*, to take the place of *Parthenia* Lowe, they did so explicitly as a new subgenus, not as a replacement name, designating as type *Turbo interstinctus* J. Adams, 1797, a species not among those originally included in *Parthenia* by Lowe. We consider *Parthenia bulinea* Lowe, 1841 and *Turbo interstinctus* J. Adams, 1797 to represent distinct genera. See below under *Parthenina* for further discussion.

***Euparthenia elegans* (Dollfus & Dautzenberg, 1886)**
Plate 8, figs 1, 2

- *1886 *Menestho elegans* Dollfus & Dautzenberg, p. 140.
- 1949 *Kleinella* (*Euparthenia*) *elegans* D. et D., 1886 – Glibert, p. 182, pl. 11, fig. 22.
- 1964 *Kleinella* (*Euparthenia*) *elegans* Dollfus & Dautzenberg, 1886 – Brébion, p. 283.

Material and dimensions – Maximum height 13.0 mm,

width 3.7 mm. NHMW 2015/0133/0499-0500 (2), LC (3 complete + 12 fragments), FVD (2). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Euparthenia elegans* Dollfus & Dautzenberg, 1886 is characterised by its solid, elongated, cylindrical shell, its sculpture of flattened cords separated by shallow, narrow grooves, axial sculpture relatively well developed on the adapical part of the spire whorls forming a reticulated pattern, weakening on the penultimate whorl in some specimens (Pl. 8, fig. 1) or persisting onto the last whorl in others (Pl. 8, fig. 2), and relatively strongly developed columellar fold. *Euparthenia turrita* (Dujardin, 1837), which occurs together with *E. elegans* in the middle Miocene Loire Basin, differs in having a squatter, less elongate shell, in having stonger spiral sculpture; the cords separated by deeper wider grooves, weaker axial sculpture and a less prominent columellar fold. *Euparthenia turrita* is more closely similar to the living European type species, *E. bulinea* Lowe, 1841 but differs in being larger shelled, broader, less conical in shape, with weaker axial sculpture and stronger and wider spaced spiral cords.

Brébion (1964, p. 284) recorded this species from Assemblage I (St-Michel), Assemblage II (Apigné, Le Temple du Cerisier, Vieux Chartres and Assemblage III (Le Pigeon Blanc, Le Girondor, Palluau, La Gauvinière).

Distribution – Middle Miocene: Atlantic, Loire Basin, France (Dollfus & Dautzenberg, 1886; Glibert, 1949). Upper Miocene: Atlantic (Tortonian and Messinian), northwestern France (Brébion, 1964). Lower Pliocene: Atlantic, northwestern France (Brébion, 1964).

Genus *Parthenina* Bucquoy, Dautzenberg & Dollfus, 1883

Type species – *Turbo interstinctus* J. Adams, 1797, by original designation, present-day, British Isles.

- 1827 *Jaminia* T. Brown, p. iv. Type species (by subsequent designation, Schander *et al.*, 1999, p. 150): *Turbo interstinctus* J. Adams, 1797, non Risso, 1826 [Enidae], present-day, British Isles.
- 1869 *Partulida* Schaufuss, p. 6. Unavailable, see *Partulida* Iredale, 1917 and discussion.
- 1870 *Elodia* de Folin, p. 200. Type species (by subsequent monotypy): *Elodia hortensiae* de Nansouty in de Folin & Périer, 1872, present-day, France. Junior homonym of *Elodia* Robineau-Desvoidy, 1863 [Diptera].
- 1883 *Parthenina* Bucquoy, Dautzenberg & Dollfus, p. 158, 168. Subgen. nov. pro *Parthenia* Lowe, 1841, non Robineau-Desvoidy, 1830 [Diptera].
- 1886 *Elodiamea* de Folin in Hoyle, p. 94. *Elodia hortensiae* de Nansouty in de Folin & Périer, 1872, present-day, France. Nom. nov. pro *Elodia* de Folin, 1870, non *Elodia* Robineau-Desvoidy, 1863 [Diptera].

- 1898 *Spiralina* Chaster, p. 20. Type species (by monotypy): *Turbo spiralis* Montagu, 1803, present-day, British Isles.
- 1901 *Spiralinella* Chaster, p. 8. *Nom. nov. pro Spirulina* Chaster, 1898 *non Spirulina* Hartmann, 1840 [Planorbidae]. Type species (by typification of replacement name): *Turbo spiralis* Montagu, 1803.
- 1917 *Partulida* Iredale, 1917, p. 325. Type species (by original designation) *Turbo spiralis* Montagu, 1803, present-day, British Isles.
- 1933 *Tiberia* (*Tiberiella*) Coen, p. 164. Type species (by monotypy): *Tiberia pretiosa* Coen, 1933, present-day, Mediterranean.
- 1958 *Egilina* (*Prestoniella*) Saurin, p. 65. Type species (by original designation): *Pyrgulina prestoni* Dautzenberg & H. Fischer, 1906, present-day, Viet Nam.

Pselliogyra Dall & Bartsch, 1909: 11, type species (by original designation): *Turbonilla monocycla* A. Adams, 1860, present-day, Japan, is removed from the synonymy of *Parthenina* (Gofas in WoRMS, 2018). An error as a result of confounding the type species, *Turbonilla monocycla* A. Adams, 1860 (p. 418; 1860b) with *Parthenia monocycla* A. Adams, 1860 (p. 479; 1860c).

Note – Bucquoy, Dautzenberg & Dollfus (1883, p. 158) introduced *Parthenina* as a *nom. nov. pro Parthenia* Lowe, 1841, which was preoccupied by *Parthenia* Robineau-Desvoidy, 1830, and designated *Turbo interstinctus* ‘Montagu, 1803’ [= J. Adams, 1797] as type species of *Parthenina*. However, *Turbo interstinctus* J. Adams, 1797 was not a species originally included in *Parthenia* by Lowe. If *Parthenina* is interpreted as a *nom. nov. pro Parthenia*, then it has the same type species. However, *Parthenina* is in current use with *Turbo interstinctus*. We do not consider *Parthenia bulinea* Lowe, 1841 and *Turbo interstinctus* congeneric, therefore if we consider *Parthenina* Bucquoy, Dautzenberg & Dollfus, 1883 a *nov. gen.* rather than a *nov. nom.*, as they did introduce a new type species, this would favour nomenclatural stability and ensure both group names can continue to be used as they are today.

Note – Bucquoy, Dautzenberg & Dollfus (1883, p. 158, 168) introduced *Parthenina* explicitly as a new subgenus ‘nov. s.-g.’ (of *Odostomia* Fleming, 1813) (p. 158), not a replacement name as stated by van Aartsen *et al.* (2000). *Parthenia* Lowe, 1841, is discussed, commenting that it would have been a suitable name for their concept if it had not been preoccupied by *Parthenia* Robineau-Desvoidy, 1830. The type species they designated, *Turbo interstinctus* ‘Montagu, 1803’ [= J. Adams, 1797], is not one of the species originally included by Lowe, 1841. See Landau & LaFollette (2015, p. 22) for a more extended discussion of *Parthenina*.

There has been confusion as to the type species and proper placement of *Jaminia* T. Brown, 1827 *non* Risso, 1826. Subsequent designation of a type species has often been

attributed J. E. Gray, 1847 but this is incorrect. Gray actually placed *Jaminia* T. Brown, 1827 (in part) as a synonym of three different genera, *Cominia* Brown, 1844 (p. 138), *Odostomia* Fleming, ‘1824’ [1813] (p. 159), and *Alexia* Leach MSS, 1819 (p. 179), in three different families. In each case, he gave an exemplar species that was one of the species originally included in *Jaminia* T. Brown. Taken individually, they look like type species designations but taken together, it is obvious that they cannot be. Subsequently, Schander, *et al.* (1999, p. 150) wrote ‘*Jaminia* Brown, 1827 *not* Risso, 1826. TS: *Turbo interstinctus* Montagu, 1803 (SD: J. E. Gray, 1847). = *Parthenina* Bucquoy, Dautzenberg, & Dollfus, 1883.’ At almost the same time, Martins (1999, p. 66) wrote in the synonymy of *Myosotella* Monterosato, 1906 [Ellobiidae] ‘*Jaminia* Brown, 1827, pl. 51. Type species by subsequent designation of Gray (1847): *Jaminia denticulata* (Montagu, 1803) ... *non* Risso, 1826.’ The date of publication of Schander *et al.*, was September 13, 1999; that of Martins, December, 1999. Schander, *et al.*, therefore made the first type designation that meets the requirements of the Code (ICZN, 1999, Art. 69.1 and 69.1.1) and *Turbo interstinctus* ‘Montagu, 1803’ with the author corrected to J. Adams, 1797 (ICZN, 1999, Art. 67.7) is the type species of *Jaminia* T. Brown, 1827 (*pers. com.* P. LaFollette, April 2018).

We consider *Turbo spiralis* Montagu, 1803, to fall within our concept of *Parthenina*, and therefore include it in the synonymy those genus group names that have *Turbo spiralis* as their type species. Schaufuss (1869) introduced *Partulida* Schaufuss, 1869 for ‘*Parthenia* Adams,’ presumably intending it to replace the unavailable misapplication of *Parthenia* Lowe, 1841, by H. & A. Adams (1853, p. 233), but his terse statement lacked a valid indication (ICZN, 1999, Art. 12.2.5). See Corgan (1973) for a detailed discussion. The name had not been mentioned in the literature for nearly fifty years until Iredale (1917) revived it, designating *Turbo spiralis* Montagu, 1803, as type species. That act made *Partulida* available as of Iredale, 1917. The name was subsequently used by a number of authors (e.g. Thiele, 1929; Winckworth, 1932; Wenz, 1940; Nordsieck, 1972b), incorrectly attributed to Schaufuss, 1869, not Iredale, 1917, as did Iredale himself. In the meantime, Chaster (1898) introduced *Spiralina* with *Turbo spiralis* Montagu, 1803, as type by monotypy. Believing this name to be a junior homonym of *Spiralina* Hartmann, 1840 [Planorbidae], he introduced the replacement *Spiralinella* Chaster, 1901, with the same type. *Spiralina* Hartmann, 1840, was not an available name, however, so *Spiralina* Chaster, 1898 is valid, and the replacement name unnecessary. Hartmann’s name was eventually made available by von Martens, 1899, by which time it had become a junior homonym of *Spiralina* Chaster, 1898.

***Parthenina decussata* (Montagu, 1803)**

Plate 8, fig. 3

*1803 *Turbo decussatus* Montagu, p. 322, pl. 12, fig. 4.

- 1977 *Chrysallida decussata* (Montagu) – van Aartsen, p. 54, fig. 10.
 1986 *Chrysallida decussata* (Montagu, 1803) – Fretter *et al.*, p. 567, figs 384, 385.
 1988 *Chrysallida decussata* (Montagu, 1803) – Graham, p. 556, fig. 239.
 1992 *Chrysallida decussata* (Montagu) – van der Linden & Eikenboom, p. 38, figs 50.
 2014 *Parthenina decussata* (Montagu, 1803) – Gianuzzi-Savelli *et al.*, p. 70, fig. 193.

Material and dimensions – Maximum height 3.2 mm, width 1.0 mm. NHMW 2015/0133/0519 (1), NHMW 2015/0133/0520 (4), LC (5), FVD (2). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Parthenina decussata* (Montagu, 1803) is characterised by its ovoid-conical shell, its protoconch of type B, teleoconch of 3-4 tall, weakly convex whorls separated by a deep suture and sculpture of close-set, orthocline axial ribs equal in width to their interspaces and narrow spirals; 4-5 on penultimate whorl placed on abapical portion of whorl, 9-12 on last whorl extending from base to just below suture, forming regularly reticulated surface pattern. Umbilicus absent and columellar fold weakly developed. The ovate shape and relatively numerous spiral cords make this species easily recognisable. *Parthenina sarsi* (Nordsieck, 1972) from the northeastern Atlantic frontage and *P. juliae* (de Folin, 1872) both differ in having a protoconch type B tending to C, the teleoconch is more cylindrical, the apex is more obtuse, last whorl comparatively shorter and the axial ribs are more numerous and sinuous. We have not found another illustrated reference for this species in the fossil record.

Distribution – Lower Pliocene: Atlantic, northwestern France (this paper). Present-day: Eastern Atlantic frontage Shetlands to Mediterranean, absent in North Sea (Fretter *et al.*, 1986).

***Parthenina indistincta* (Montagu, 1808)**

Plate 8, fig. 4

- *1808 *Turbo indistinctus* Montagu, p. 129.
 1914 *Parthenina indistincta* Mtg. – Cerulli-Irelli, p. 435, pl. 54, figs 72-74.
 1914 *Parthenina indistincta* var. *transiens* Cerulli-Irelli, p. 436, pl. 22, figs 75, 76.
 1964 *Chrysallida* (*Pyrgulina*) *indistincta* (Montagu, 1808) – van Regteren Altena *et al.*, p. 3, pl. 19, fig. 185.
 1969 *Pyrgulina* (*Parthenina*) *indistincta* var. *transiens* Ceru. Irel. – Fekih, p. 20, pl. 3, fig. 5.
 1977 *Chrysallida indistincta* (Mont.) – van Aartsen, p. 55, fig. 14.
 1986 *Chrysallida indistincta* (Montagu, 1808) – Fretter *et al.*, p. 564, figs 381, 382.
 1988 *Chrysallida indistincta* (Montagu, 1808) – Gra-

ham, p. 552, fig. 237.

- 1992 *Chrysallida indistincta* (Montagu, 1808) – Cavallo & Repetto, p. 152, fig. 425.
 1992 *Chrysallida indistincta* (Montagu, 1808) – van der Linden & Eikenboom, p. 31, figs 11, 12, 43-45.
 1993 *Chrysallida indistincta* (Montagu, 1808) – Marquet, p. 94, pl. 4, figs 7, 8.
 1997b *Chrysallida indistincta* (Montagu, 1808) – Marquet, p. 105.
 1998b *Chrysallida indistincta* (Montagu, 1808) – Marquet, p. 190, fig. 162.
 1998 *Chrysallida indistincta* (Montagu) – Ferrero *et al.*, p. 49, 52, pl. 2, fig. 1.
 2011 *Chrysallida indistincta* (Montagu, 1808) – Chirli & Micali, p. 33, pl. 10, figs 11-15.
 2014 *Parthenina indistincta* (Montagu, 1808) – Gianuzzi-Savelli *et al.*, p. 70, figs 197, 198.

Material and dimensions – Maximum height 2.3 mm, width 1.1 mm. NHMW 2015/0133/0521 (1), NHMW 2015/0133/0522 (19), LC (15), FVD (8). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Parthenina indistincta* (Montagu, 1808) is characterised by its slender cylindrical to slightly conical shell with a blunt apex, type B protoconch, teleoconch composed of 4-7 flat sided to slightly convex whorls that are slightly inflated below mid-whorl and taper inwards abapically to the oblique suture, and sculpture of orthocline ribs, straight on early whorls, sinuous on later whorls and narrow spirals; 2-3 on early whorls, 3-4 on penultimate, 4-7 on last whorl. The umbilicus is hardly developed and columellar fold absent. For comparison with related species we refer to Van der Linden & Eikenboom (1992, p. 33) although we note that *P. flexuosa* (Monterosato, 1874) is not a synonym as suggested by those authors (see Lygre *et al.*, 2011).

Distribution – Lower Pliocene: Atlantic, northwestern France (this paper); western Mediterranean, Tunisia (Fekih, 1969); central Mediterranean, Italy (Chirli & Micali, 2011). Upper Pliocene: North Sea Basin, Oorderen Sands, Belgium (Marquet, 1993, 1997b, 1998b); central Mediterranean, Italy (Cavallo & Repetto, 1992; Ferrero *et al.*, 1998). Pliocene (indeterminate): North Sea Basin, Netherlands (van Regteren Altena *et al.*, 1964). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1914). Present-day: Eastern Atlantic frontage British Isles to Mediterranean (Fretter *et al.*, 1986), southern Norway (Graham, 1988).

***Parthenina* sp.**

Plate 8, fig. 5

Material and dimensions – Height 2.0 mm, width 0.8 mm. NHMW 2015/0133/0489 (1).

Description – Shell small, short cylindrical. Protoconch

almost completely intorted, broad first teleoconch whorl (type B of Van der Linden & Eikenboom, 1992, fig. 5). Teleoconch of 3.5 weakly convex whorls separated by deep V-shaped suture. Axial sculpture of 18 broad orthocline ribs, equal in width to their smooth interspaces, that persist weakening onto base. First whorl with one narrow spiral cord placed a short distance above suture; penultimate whorl second cord develops just above first. Last whorl relatively tall, convex; with three spiral cords developed, ribs persist weakening over base; no umbilical chink. Aperture ovate, outer lip simple, columellar tooth weak.

Discussion – The presence of three spiral cords on the last whorl place this species in the group of European and West African species including *Parthenina dollfusi* (Kobelt, 1903), *P. connexa* (Dautzenberg, 1912), *P. clathrata* (Jeffreys, 1848) and *P. intumescens* (Schander, 1994). The specimen of *P. dollfusi* from Angola illustrated by Peñas & Rolán (1998, figs 116, 117) is similar in size and shape but differs in having more numerous axial ribs (about 26). *Parthenina connexa* differs in having the adapical spiral cord strongly developed on all spire whorls and having a small but well developed umbilical chink. *Parthenina clathrata* is probably closest to the French fossil species but differs in having a slightly greater number of axial ribs (19–22; Graham, 1998, p. 554) and again a well developed umbilical chink. *Parthenina intumescens* has a squatter shell, a broader protoconch and the suture is deeply impressed but not V-shaped.

Distribution – Lower Pliocene: Atlantic, northwestern France (this paper).

Genus *Pyrgulina* A. Adams, 1863

Type species – *Chrysallida casta* A. Adams, 1861, by subsequent designation, Dall & Bartsch, 1904, present-day, Japan.

- 1863 *Pyrgulina* A. Adams, p. 1, 4.
- 1910 *Eupyrulina* Melvill, p. 198. Type species (by subsequent designation, Schander *et al.*, 1999): *Pyrgulina dautzenbergi* Melvill, 1910, present-day, India.
- 1956 *Contraxiala* Laseron, 1956. Type species (by original designation): *Contraxiala obliqua* Laseron, 1956, present-day, Queensland, Australia.

***Pyrgulina stefanisi* (Jeffreys, 1869)**

Plate 8, fig. 6

- 1848 *Rissoa costulata* S.V. Wood, p. 106, pl. 11, fig. 12 [non Alder, 1844, = *R. guerinii* C.A. Récluz, 1843].
- *1869 *Rissoa Stefanisi* Jeffreys, p. 208, pl. 6, fig. 31.
- 1871 *Menestho Jeffreysi* Bell, p. 360.
- 1878 *Rissoa Stefanisi* Jeffr. – Nyst, pl. 28, fig. 10.

- 1882 *Rissoa Stefanisi* Jeffr. – Nyst, p. 96.
- 1892a *Pyrgulina pygmaea* var. *postica* Sacco, p. 651, pl. 1, fig. 113.
- 1920 *Menestho Stefanisi* (Jeffreys) – Harmer, p. 584, pl. 50, fig. 5.
- 1920 *Menestho Jeffreysi* A. Bell – Harmer, p. 584, pl. 50, fig. 6.
- 1921 *Thapsiella menesthoides* Cossmann, p. 34, pl. 2, figs 25–26.
- 1952b *Chrysallida jeffreysi* Bell – Glibert, p. 55, pl. 4, fig. 7.
- 1958 *Chrysallida* (*Pyrgulina*) *jeffreysi* Bell. – Glibert, p. 17.
- 1964 *Chrysallida* (*Pyrgulina*) *jeffreysi* (A. Bell, 1871) – van Regteren Altena *et al.*, p. 3, pl. 19, fig. 187.
- 1964 *Turboella* (*Thapsiella*) *menesthoides* Cossmann, 1921 – Brébion, p. 177, pl. 4, fig. 33.
- 1977 *Chrysallida pygmaea* (Grat.) – van Aartsen, p. 54, fig. 11 [non *Acteon pygmaea* Grateloup, 1838, non Lea, 1833; = *Chrysallida interita* van der Linden & Eikenboom, 1992; junior synonym of *Pyrgulina longula* (Boettger, 1907)].
- 1992 *Chrysallida stefanisi* (Jeffreys, 1869) – van der Linden & Eikenboom, p. 42, figs 51–52.
- 1992 *Chrysallida jeffreysi* (A. Bell, 1871) – Crovato & Micali, p. 129, pl. 1, fig. 4.
- 1992 *Chrysallida stefanisi* (Jeffreys, 1869) – Cavallo & Repetto, p. 154, fig. 427.
- 1997b *Chrysallida stefanisi* (Jeffreys, 1869) – Marquet, p. 105, pl. 9, fig. 12.
- 1997 *Turbonilla rufa* (Philippi) – Ruiz Muñoz *et al.*, p. 188, pl. 41, fig. 2 [non *Pyrgiscus rufus* (Philippi, 1836)].
- 1998b *Chrysallida stefanisi* (Jeffreys, 1869) – Marquet, p. 191, fig. 163.
- 1998 *Chrysallida stefanisi* (Jeffreys, 1869) – Peñas & Rolán, p. 28.
- 2010 *Chrysallida stefanisi* (Jeffreys, 1869) – Sosso & Dell'Angelo, p. 51, unnumbered fig. p. 67 top left.
- 2011 *Chrysallida stefanisi* (Jeffreys, 1869) – Landau *et al.*, p. 40, pl. 22, fig. 11.
- 2011 *Chrysallida jeffreysi* *sensu* Crovato & Micali, 1990 [sic] – Landau *et al.*, p. 40, pl. 22, fig. 12.
- 2013 *Chrysallida jeffreysi* (A. Bell, 1872 [sic]) – Chirli & Micali, p. 39, pl. 12, figs 1–5.
- 2014 *Pyrgulina stefanisi* (Jeffreys, 1869) – Peñas *et al.*, p. 122, fig. 5H.

Material and dimensions – Maximum height 4.3 mm, width 2.0 mm. NHMW 2015/0133/0490 (1), NHMW 2015/0133/0491 (14), LC (5), FVD (3). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – Some authors have considered *Rissoa stefanisi* Jeffreys, 1869 and *Menestho jeffreysi* Bell, 1871 separate species (Harmer, 1920; Glibert, 1952b; Chirli & Micali, 2013), however, we agree with van der Linden & Eikenboom (1992) in considering them forms of a single taxon. This species is preceded in the Miocene by *Pyr-*

gulina longula (Boettger, 1907) (= *Chrysallida interita* van der Linden & Eikenboom, 1992; see Landau *et al.*, 2013, p. 313), which differs from *P. stefanisi* in having flatter whorls, a more scalate spire, more elevated ribs, and can also be separated based on shell morphometrics (van der Linden & Eikenboom, 1992, fig. 1). For further discussion see Landau *et al.* (2013, p. 313).

Cossmann (1921, p. 34, pl. 2, figs 25-26) described *Thapsiella menesthoides* from the Assemblage IV locality of Gourbesville and Brébion (1964, p. 176) added Bosq d'Aubigny. This species fits within the variability of *Pyr-gulina stefanisi* (Jeffreys, 1869) considered herein.

Distribution – Lower Pliocene: North Sea Basin, Coralline Crag, England (S.V. Wood, 1848; Harmer, 1920), Kattendijk Formation, Belgium (Glibert, 1958; Marquet, 1997b, 1998b); Atlantic, northwestern France (this paper), Guadalquivir Basin, Spain (Ruiz Muñoz *et al.*, 1997; Landau *et al.*, 2011); central Mediterranean, Italy (Chirli & Micali, 2011). Upper Pliocene: North Sea Basin, Red Crag, England (Harmer, 1923), Oorderen Sands Formation, Belgium (NHMW collection); western Mediterranean, Estepona Basin (NHMW collection); central Mediterranean, Italy (Sacco, 1892a; Cavallo & Repetto, 1992; Crovato & Micali, 1992; Sosso & Dell'Angelo, 2010). Pliocene (indeterminate): North Sea Basin, Netherlands (van Regteren Altena *et al.*, 1964). Upper Pliocene-Pleistocene: Atlantic, northwestern France (Cossmann, 1921; Brébion, 1964). Present-day: Mediterranean, Azores and Canaries (van der Linden & Eikenboom, 1992), West Africa to Ghana (Peñas & Rolán, 1998).

Genus *Tragula* Monterosato, 1884

Type species – *Odostomia fenestrata* Jeffreys, 1848, by original designation, present-day, British Isles.

- 1884 *Tragula* Monterosato, p. 86.
- 1915b *Burkillia* Iredale, p. 337. Type species (by original designation): *Odostomia fenestrata* Jeffreys, 1848, present-day, British Isles. Unnecessary *nom. nov. pro Tragula* Monterosato, 1884 by Iredale, assumed to be preoccupied by *Tragulus* Brisson, 1762 [Mammalia].

***Tragula fenestrata* (Jeffreys, 1848)**

Plate 8, fig. 7

- *1848 *Odostomia fenestrata* Jeffreys, p. 345.
- 1892a *Pyr-gulina (Tragula) fenestrata* var. *subalpina* Sacco, p. 69, pl. 1, fig. 114.
- 1914 *Parthenina (Tragula) fenestrata* Forbes – Cerulli Irelli, p. 266, pl. 23, figs 18, 19.
- 1921 *Tragula fenestrata* (Forbes) – Cossmann, p. 262, text-plate C, fig. 90fc.
- 1969 *Pyr-gulina (Tragula) fenestrata* (Forbes) – Fekih, p. 26, pl. 4, fig. 4.
- 1981 *Chrysallida fenestrata* (Forbes in Jeffreys, 1848) –

van Aartsen, p. 63, 65, pl. 1, fig. 1.

- 1984 *Tragula fenestrata* var. *subalpina* Sacco, 1892 – Ferrero Mortara *et al.*, p. 79, pl. 12, fig. 5.
- 1986 *Tragula fenestrata* (Jeffreys, 1848) – Fretter *et al.*, p. 578, figs 392, 393.
- 1988 *Tragula fenestrata* (Jeffreys, 1848) – Graham, p. 564, fig. 243.
- 1992 *Tragula fenestrata* (Jeffreys, 1848) – Cavallo & Repetto, p. 154, fig. 432.
- 1992 *Chrysallida fenestrata* (Jeffreys, 1848) – van der Linden & Eikenboom, p. 48, fig. 57.
- 1998 *Chrysallida fenestrata* (Jeffreys, 1848) – Peñas & Rolán, p. 14, figs 38-42.
- 2010 *Tragula fenestrata* (Jeffreys, 1848) – Sosso & Dell'Angelo, p. 52, p. 67 unnumbered fig. middle row second from left.
- 2011 *Chrysallida fenestrata* (Jeffreys, 1848) – Chirli & Micali, p. 27, pl. 8, figs 11-15.
- 2014 *Tragula fenestrata* (Jeffreys, 1848) – Giannuzzi-Savelli *et al.*, p. 76, figs 228-230.

Material and dimensions – Maximum height 2.5 mm (incomplete), width 1.2 mm. NHMW 2015/0133/0486 (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Tragula fenestrata* (Jeffreys, 1848) is characterised by its very elongate slender shell, its intorted protoconch of type B, strongly tending to A (see van der Linden & Eikenboom, 1992, figs 1-7 for terminology). The shell has 5-7 teleoconch whorls, in which the upper two-thirds of the whorl are straight-sided and the lower third is convex, the lower part bearing two spiral cords on spire whorls and three on the last whorl. Peñas & Rolán (1998, p. 15) reported some variability; the West Africa shells having a larger protoconch, a more cylindrical teleoconch composed of more convex whorls, a less angular base and weak spiral sculpture on the adapical part of the whorls. The specimen from Le Pigeon Blanc is incomplete but unmistakable and typical of the northwestern Atlantic form as illustrated by Graham (1998, fig. 243) and Peñas & Rolán (1998, fig. 38).

Distribution – Lower Pliocene: Atlantic, northwestern France (this paper); central Mediterranean, Italy (Chirli & Micali, 2013); western Mediterranean, Tunisia (Fekih, 1975). Upper Pliocene: central Mediterranean, Italy (Sacco, 1896b; Cavallo & Repetto, 1992; Sosso & Dell'Angelo, 2010). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1914). Present-day: Southwest of England and western Ireland (Graham, 1988), Mediterranean and southwards to Angola (Peñas & Rolán, 1998).

Subfamily Syrrolinae Saurin, 1958

Tribe Syrrolini Saurin, 1958

Genus *Syrnola* A. Adams, 1860

Type species – *Syrnola gracillima* A. Adams, 1860, by monotypy, present-day, Korea Strait.

- 1860a *Syrnola* A. Adams, p. 405.
 1903 *Heida* Dall, p. 1600. Type species (by monotypy): *Odontostomia attenuata* Dall, 1892, Pliocene, North Carolina, USA.
 1907 *Pachysyrnola* Cossmann, p. 213. Type species (by original designation): *Syrnola houdasi* Cossmann, 1907, Eocene, France.

***Syrnola* cf. *turonensis* (Glibert, 1949)**

Plate 8, fig. 8

- cf. 1949 *Odontostomia* (*Syrnola*) *subumbilicata turonensis* Glibert, p. 186, pl. 12, fig. 9.
 ?1964 *Syrnola* (*Pachysyrnola*) *gigantea* Brébion, p. 289, pl. 7, fig. 12 (*nomen nudum*).

Material and dimensions – Maximum height 6.6 mm, width 2.0 mm. NHMW 2015/0133/0525 (1), NHMW 2015/0133/0526 (15), LC (10), FVD (5). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Description – Shell elongate, slender, relatively solid. Protoconch not preserved. Teleoconch composed of up to eight whorls; early whorls convex, abapically whorls almost straight-sided, slightly swollen just above suture forming periphery. Suture impressed, linear, small V-shaped notch. Surface glossy, covered in microscopic spirals visible only under magnification and tangential light. Last whorl 40% of total height, straight sided, rounded to roundly angled at base; base weakly convex, imperforate. Outer lip simple, flared abapically. Columella bearing strong twisted columellar fold, everted abapically. Parietal callus not developed.

Discussion – The slender elongated shell shape, spiral microsculpture and strongly developed columellar fold place this species in the genus *Syrnola* A. Adams, 1860. There are no spirals present within the outer lip, which are often, although not always, present in members of this genus (Peñas & Rolán, 1999). We cannot ascribe the French Pliocene species to any known species but hesitate to describe it as new in the absence of its protoconch, which is not preserved in any of the specimens at hand. Glibert (1949) described two similar congeners from the middle Miocene Loire Basin of France. *Syrnola turonensis* (Glibert, 1949) was originally described as a subspecies of Atlantic lower Miocene Aquitanian and Burdigalian *S. subumbilicata* (Gratoloup, 1838) from the Aquitaine Basin but differing from the type in being broader shelled with a width/length ratio approx. 28%. In shell shape the specimen illustrated here is very similar, but Glibert described and illustrated the columellar fold as being weak, whereas all the specimens from Le Pigeon Blanc have a prominent elevated fold. The second, *S. wrigleyi* (Glibert, 1949) has a more pupoid shell shape, a weak columellar fold, and is obscurely angled at the periphery. We note that the Le Pigeon Blanc specimen here illustrated is similarly angled at the periphery, although

other specimens are rounded. This may be the same species described as *Syrnola* (*Pachysyrnola*) *gigantea* Brébion, 1964 (*nomen nudum*), based also on material from Le Pigeon Blanc, but none of our specimens approach the 18 mm in height recorded by Brébion (1964, p. 289).

The genus *Syrnola* is thermophillic. The only members present in European waters (Mediterranean) are Lessepsian immigrants (van Aartsen, 1994; Giannuzzi-Savelli *et al.*, 2014). Several species do occur further south off West Africa (Schander, 1994; Peñas & Rolán, 1999; van Aartsen *et al.*, 2000): most differ in having lirae within the outer lip. Species without lirae; *S. rugosa* de Folin, 1870 and *S. thielei* (Dautzenberg, 1912) both have a more pupoid shell with more convex whorls separated by a deeper suture. *Syrnola thomensis* Tomlin & Shackleforth, 1915 has a far taller last whorl and narrower aperture. Brébion (1964, p. 290) recorded this species from the Assemblage III localities of Le Pigeon Blanc and Palluau.

Distribution – Lower Pliocene: Atlantic, northwestern France (this paper).

Subfamily Turbonillinae Bronn, 1849

Tribe Turbonillini Bronn, 1849

Genus *Chemnitzia* D'Orbigny, 1840

Type species – *Melania campanellae* Philippi, 1836, by subsequent designation (Dall & Bartsch, 1909), present-day, Mediterranean.

1840 *Chemnitzia* D'Orbigny, p. 77.

Note – Species in this group are characterised by having prominent axial ribs, which fuse or terminate at the suture, deeply-sunken interspaces starting at the adapical suture and terminating at or just above the abapical suture, no spiral sculpture or microscopic spiral sculpture, a smooth base and a straight columella (Dall & Bartsch, 1909).

***Chemnitzia lactea* (Linnaeus, 1758)**

Plate 8, figs 9-11

- *1758 *Turbo lacteus* Linnaeus, p. 765.
 1803 *Turbo elegantissimus* Montagu, p. 298, pl. 10, fig. 2.
 1836 *Melania campanellae* Philippi, p. 156, pl. 9, fig. 5.
 1836 *Rissoa turritella* Scacchi, p. 15, note 29, fig. 24.
 ?non1848 *Chemnitzia elegantissima* Mont. – S.V. Wood, p. 81, pl. 10, fig. 5 (= *Chemnitzia elegantior* S.V. Wood, 1872).
 1892a *Turbonilla* (*Turbonilla*) *lactea* var. *Gastraldi* (Semp.) – Sacco, p. 654, pl. 2, fig. 44.
 1892a *Turbonilla* (*Turbonilla*) *lactea* var. *turritolonga* Sacco, p. 655, pl. 2, fig. 45.
 1892a *Turbonilla* (*Turbonilla*) *lactea* var. *pliosigmoidea* Sacco, p. 655, pl. 2, fig. 46.
 1892a *Turbonilla* (*Turbonilla*) *lactea* var. *intuspersulcata*

- Sacco, p. 655, pl. 2, fig. 47.
- 1892a *Turbonilla (Turbonilla) lactea* var. *pliosimilis* Sacco, p. 656, pl. 2, fig. 48.
- 1892a *Turbonilla (Turbonilla) lactea* var. *perplicatosulcata* Sacco, p. 656, pl. 2, fig. 49.
- 1892a *Turbonilla (Turbonilla) lactea* var. *convexulosulcata* Sacco, p. 656, pl. 2, fig. 50.
- 1892a *Turbonilla (Turbonilla) lactea* var. *pliogigantea* Sacco, p. 656, pl. 2, fig. 51.
- 1892a *Turbonilla (Turbonilla) lactea* var. *elegans* (Segu.) – Sacco, p. 656, pl. 2, fig. 52.
- 1892a *Turbonilla (Turbonilla) lactea* var. *paucicostata* (Segu.) – Sacco, p. 657, pl. 2, fig. 53.
- 1892a *Turbonilla (Turbonilla) lactea* var. *bevicostulata* Sacco, p. 657, pl. 2, fig. 54.
- 1892a *Turbonilla (Turbonilla) lactea* var. *pseudoflorentina* Sacco, p. 657, pl. 2, fig. 55.
- 1892a *Turbonilla (Turbonilla) lactea* var. *turritoparva* Sacco, p. 657, pl. 2, fig. 56.
- 1892a *Turbonilla (Turbonilla) lactea* var. *conicoparvula* Sacco, p. 657, pl. 2, fig. 57.
- 1904 *Chemnitzia Campanellae* (Phil.) – Sacco, p. 109, pl. 24, fig. 12.
- 1914 *Turbonilla lactea* L. – Cerulli-Irelli, p. 441, pl. 55, figs 20-29.
- 1914 *Turbonilla lactea* var. *hoernesiana* Sacco – Cerulli-Irelli, p. 442, pl. 55, figs 30, 31.
- 1920 *Turbonilla lactea* (Linné) – Harmer, p. 559, pl. 49, figs 17, 18.
- 1964 *Turbonilla elegantissima* var. *gastraldi* Semper, 1861 – Brébion, p. 293 [*non Chemnitzia gastraldii* (Semper, 1861)].
- 1969 *Turbonilla lactea* (Linné) – Fekih, p. 28, pl. 4, fig. 11.
- 1969 *Turbonilla lactea* var. *turritolonga* Sacco – Fekih, p. 28, pl. 4, fig. 12.
- 1969 *Turbonilla lactea* var. *hoernesiana* Sacco – Fekih, p. 28, pl. 4, fig. 13.
- 1974 *Turbonilla (Turbonilla) lactea* (Linné, 1758) – Malatesta, p. 439, pl. 32, fig. 15.
- 1986 *Turbonilla lactea* (Linnaeus, 1758) – Fretter *et al.*, p. 633, figs 441, 442.
- 1988 *Turbonilla lactea* (Linné, 1758) – Graham, p. 622, fig. 271.
- 1992 *Turbonilla lactea* (L., 1758) – Cavallo & Repetto, p. 162, fig. 461.
- 1997 *Turbonilla lactea* (Linné, 1758) – Peñas & Rolán, p. 24, figs 39-43.
- 1997 *Turbonilla lactea* (Linné) – Ruiz Muñoz *et al.*, p. 186, pl. 40, figs 18-19.
- 2005 *Turbonilla lactea* (Linnaeus, 1758) – Rolán, p. 197, fig. 904.
- 2011 *Turbonilla lactea* (Linnaeus, 1758) – Landau *et al.*, p. 41, pl. 22, fig. 15.
- 2011 *Turbonilla lactea* (Linné, 1758) – Chirli & Micali, p. 84, pl. 30, figs 7-18.
- 2014 *Turbonilla lactea* (Linné, 1757 [*sic*]) – Giannuzzi-Savelli *et al.*, p. 80, figs 249-252.

Material and dimensions – Maximum height 12.2 mm

(incomplete), width 3.1 mm. NHMW 2015/0133/0504-0506 (3), NHMW 2015/0133/0507 (30 fragments), LC (40 fragments), FVD (21 fragments). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Chemnitzia lactea* (Linnaeus, 1758) is characterised by its tall, slender shell, opisthocline axial ribs, each equal to broader in width than their interspaces, not extending onto the base on the last whorl but ending abruptly at the base, absence of umbilicus or columellar fold, and by its protoconch of type B of Van der Linden & Eikenboom (1992) (see Fretter *et al.*, 1986, fig. 442). Peñas & Rolán (1997, p. 25) noted that the protoconch size differed amongst extant populations. The protoconch here figured for the French Pliocene shells (Pl. 8, fig. 11) is typical for the species. The convexity of the spire whorls, number of ribs and their width is variable, as illustrated by the number of varieties described by Sacco (1892a).

Turbonilla campanellae (Philippi, 1836) is a tall slender form of *C. lactea* and considered a synonym. *Chemnitzia gastaldi* auct. (? *non* Semper, 1861) from the early-middle Miocene North Sea Basin has a shell similar to that of *C. lactea* (Linnaeus, 1758) but differs in having a slightly wider apical angle, squatter spire whorls, a more superficial suture, fewer but stronger axial ribs, and a protoconch of type A2, strongly helicoidal. Specimens from the North Sea Basin Miocene illustrated by Wienrich (2007, pl. 164, figs 5-6) show quite some variability in rib density, which is also true of *C. lactea* from the Italian Pliocene (Chirli & Micali, 2011, pl. 30, figs 7-18). Brébion (1964, p. 294) recorded this species from Assemblage III (Le Pigeon Blanc, Le Gironador, Palluau) and Assemblage IV (St-Jean-La-Poterie, Gourbesville). We have provisionally excluded the upper Miocene Assemblage I and II records until we can examine specimens with their protoconch intact, which will be done in a subsequent paper.

Distribution – Lower Pliocene: Atlantic, northwestern France (Brébion, 1964), Guadalquivir Basin, Spain (Ruiz Muñoz *et al.*, 1997; Landau *et al.*, 2011); western Mediterranean, Tunisia (Fekih, 1969); central Mediterranean, Italy (Sacco, 1892a; Chirli & Micali, 2011). Upper Pliocene: western Mediterranean, Estepona Basin (NHMW collection); central Mediterranean, Italy (Sacco, 1892a; Malatesta, 1974; Cavallo & Repetto, 1992). Upper Pliocene-Pleistocene: Atlantic, northwestern France (Brébion, 1964). Lower Pleistocene: Atlantic, St Erth, England (Harmer, 1920); central Mediterranean, Italy (Cerulli-Irelli, 1914). Upper Pleistocene: English Channel, England (Harmer, 1920). Present-day: Eastern Atlantic frontage from North Norway to British Isles, absent in North Sea, into Mediterranean (Graham, 1988), Canaries, Cabo Verde and São Tomé (Rolán, 2005; Peñas *et al.*, 2009).

Genus *Pyrgiscus* Philippi, 1841

Type species – *Melania rufa* Philippi, 1836, by subsequent

designation Dall & Bartsch *in* Arnold, 1903, present-day, Mediterranean.

- 1841 *Pyrgiscus* Philippi, p. 50.
 1841 *Ortostelis* Aradas & Maggiore, p. 27. Type species (by subsequent designation, Dall & Bartsch, 1909): *Melania rufa* Philippi, 1836, present-day, Mediterranean. Junior objective synonym of *Pyrgiscus* Philippi, 1841. Simultaneously published, *Pyrgiscus* given precedence by First Reviser's choice by Dall & Bartsch (1907, p. 504).
 1884 *Pyrgostelis* Monterosato, p. 89. Type species (by subsequent designation, Crosse, 1885): *Melania rufa* Philippi, 1836, present-day, Mediterranean. Junior objective synonym of *Pyrgiscus* Philippi, 1841 and *Ortostelis* Aradas & Maggiore, 1841.

Note – Species in this group are characterised by having shells with sculpture composed of axial ribs and strongly incised spiral grooves. These species do not have varices or internal liration on the outer lip (Dall & Bartsch, 1909).

***Pyrgiscus rufus* (Philippi, 1836)**

Plate 8, figs 12-14

- *1836 *Melania rufa* Philippi, p. 156, pl. 9, fig. 7.
 1844 *Chemnitzia densecostata* Philippi, p. 132, pl. 24, fig. 9.
 1848 *Odostomia formosa* Jeffreys, p. 347, pl. 26, fig. 10.
 1848 *Chemnitzia densecostata* Phil. – S.V. Wood, p. 82, pl. 10, fig. 8.
 1892a *Turbonilla (Strioturbonilla) densecostata* var. *plioastensis* Sacco, p. 678, pl. 2, fig. 115.
 1892a *Turbonilla (Strioturbonilla) densecostata* var. *subalpina* Sacco, p. 678, pl. 2, fig. 116.
 1892b *Turbonilla (Pyrgostelis) rufa* var. *praecedens* Sacco, p. 3 [pl. 2, fig. 117; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *exdensecostata* Sacco, p. 4 [pl. 2, fig. 118; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *dertodecussata* Sacco, p. 4 [pl. 2, fig. 119; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *miopersulcata* Sacco, p. 3 [pl. 2, fig. 120; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *amplisuturata* Sacco, p. 4 [pl. 2, fig. 121; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *decussata* (Bon.) – Sacco, p. 4 [pl. 2, fig. 122; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *paucidecussata* Sacco, p. 5 [pl. 2, fig. 123; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *multidecussata* Sacco, p. 5 [pl. 2, fig. 124; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *Bellardii* (Segu.) – Sacco, p. 5 [pl. 2, fig. 125; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *percostatoastensis* Sacco, p. 5 [pl. 2, fig. 126; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *giganteoastensis* Sacco, p. 6 [pl. 2, fig. 127; 1892a].
 1892b *Turbonilla (Pyrgostelis) rufa* var. *ligustica* Sacco, p. 6 [pl. 2, fig. 128; 1892a].
 1914 *Turbonilla densecostata* Phil. – Cerulli-Irelli, p. 444, pl. 55, figs 41-43.
 1914 *Turbonilla (Pyrgostelis) rufa* Phil. – Cerulli-Irelli, p. 445, pl. 55, figs 44-50.
 1920 *Turbonilla (Pyrgostelis) densecostata* (Philippi) – Harmer, p. 566, pl. 49, figs 24, 25.
 1920 *Turbonilla (Pyrgostelis) formosa* (Jeffreys) – Harmer, p. 569, pl. 49, fig. 30.
 1955 *Turbonilla (Turbonilla) densecostata* (Philippi) – Moroni, p. 102, pl. 5, fig. 26.
 non 1958 *Turbonilla rufa* (Philippi) – Sorgenfrei, p. 328, pl. 72, fig. C.
 1969 *Turbonilla (Pyrgostelis) rufa* (Philippi) – Fekih, p. 36, pl. 6, fig. 6.
 1974 *Turbonilla (Pyrgiscus) densecostata* (Philippi, 1844) – Malatesta, p. 440, pl. 32, fig. 18.
 1974 *Turbonilla (Pyrgiscus) rufa* (Philippi, 1836) – Malatesta, p. 441, pl. 32, fig. 13.
 1976 *Turbonilla (Pyrgiscus) densecostata* (Philippi) – Pavia, p. 114, pl. 11, fig. 15.
 1976 *Turbonilla (Pyrgiscus) rufa* (Philippi) – Pavia, p. 114, pl. 11, figs 28-30.
 1976 *Turbonilla (Pyrgiscus) rufa* (Philippi) – Marasti & Raffi, p. 196, pl. 2, fig. 10.
 1982b *Turbonilla (Pyrgiscus) rufa* (Philippi, 1836) – Martinell, p. 225, pl. 1, fig. 9.
 non 1984 *Turbonilla (Strioturbonilla) densecostata* (Philippi) – A.W. Janssen, p. 360, pl. 17, fig. 2 [= *Pyrgiscus borealis* (Kautsky, 1925)].
 1984 *Turbonilla (Strioturbonilla) densecostata* var. *subalpina* Sacco, 1892 – Ferrero Mortara *et al.*, p. 84, pl. 13, fig. 7.
 1987 *Turbonilla (Pyrgiscus) densecostata* (Philippi, 1844) – Cuerda Barceló, p. 329, pl. 30, fig. 14.
 1992 *Turbonilla rufa* (Philippi, 1836) – Cavallo & Repetto, p. 164, fig. 468.
 non 1997 *Turbonilla rufa* (Philippi) – Ruiz Muñoz *et al.*, p. 188, pl. 41, fig. 2 [= *Pyrgulina stefanisi* (Jeffreys, 1869)].
 1997 *Turbonilla rufa* (Philippi, 1836) – Peñas & Rolán (*partim*), p. 68, [non figs 194-198 = *Pyrgiscus cre-natus* (Brown, 1827)].
 2001 *Turbonilla rufa* (Philippi, 1836) – Silva, p. 572, pl. 27, figs 1, 2.
 2009 *Turbonilla rufa* (Philippi, 1836) – Peñas *et al.*, p. 34, figs 29-32.
 2011 *Turbonilla rufa* (Philippi, 1836) – Landau *et al.*, p. 41, pl. 22, fig. 18.
 2011 *Turbonilla rufa* (Philippi, 1836) – Chirli & Micali, p. 98, pl. 35, figs 13-18, pl. 36, 1-18.
 2014 *Pyrgiscus rufus* (Philippi, 1836) – Giannuzzi-Savelli *et al.*, p. 84, figs 278, 279, 281-284.

Material and dimensions – Maximum height 6.2 mm (incomplete), width 1.8 mm. NHMW 2015/0133/0501-0502 (2), NHMW 2015/0133/0503 (22), NHMW 2015/0133/0576 (1), LC (20 fragments), FVD (9 fragments). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – Two similar species occur in the European extant fauna; *Pyrgiscus rufus* (Philippi, 1836) and *P. crenatus* (Brown, 1827), which have sometimes been synonymised (i.e. van Aartsen, 1981, p. 75). Peñas *et al.* (2009, p. 34) argued for the separation of the two taxa: In the Mediterranean *P. rufus* with a smaller protoconch (255–260 μm) and a narrow shell and in the Atlantic *P. crenatus* with a larger protoconch (300–310 μm) and a broader shell. It is possible that such a distinction did not exist in the Pliocene, as many of the Italian Pliocene shells illustrated by Chirli & Micali (2011) are quite broad (pl. 35, fig. 13, pl. 36, fig. 15) and the shells illustrated here from the lower Pliocene Atlantic of northwestern France are of the narrow *rufus* form rather than the *crenatus* form, as would be expected in the Atlantic.

Indeed, the variability seen in the late Miocene and Pliocene Italian specimens is illustrated by the myriad of varieties described by Sacco (1892b). In view of this, we include Pliocene records that might refer to either form in the chresonymy. We note that we have excluded the lower Pleistocene North Sea Basin record given by Van Regteren Altena (1964, pl. 21, fig. 202) as *T. (Pyrgiscus) crenatus*, which has the characters of the broader Atlantic form. However, further assessment including protoconch measurements is necessary to see if the differences suggested by Peñas *et al.* (2009) hold true for stratigraphically older populations.

Distribution – Upper Miocene: Proto-Mediterranean (Tortonian and Messinian), Italy (Sacco, 1892b; Moroni, 1955). Lower Pliocene: North Sea Basin, Coralline Crag, England (S.V. Wood, 1848; Harmer, 1920); Atlantic, northwestern France (this paper), Guadalquivir Basin, Spain (Landau *et al.*, 2011); western Mediterranean, northeastern Spain, (Martinell, 1982b), Tunisia (Fekih, 1969); central Mediterranean, Italy (Sacco, 1892b; Pavia, 1976; Chirli & Micali, 2011). Upper Pliocene: Atlantic, Mondego Basin, Portugal (Silva, 2001); western Mediterranean, Estepona Basin (NHMW collection); central Mediterranean, Italy (Sacco, 1892a; Malatesta, 1974; Marasti & Raffi, 1976; Cavallo & Repetto, 1992). Lower Pleistocene: Atlantic, St Erth, England (Harmer, 1920); central Mediterranean, Italy (Cerulli-Irelli, 1914). Upper Pleistocene: English Channel, England (Harmer, 1920); western Mediterranean, Balearic Islands (Cuerda Barceló, 1987). Present-day: Possibly restricted to Mediterranean, Atlantic forms may all represent *P. crenatus* (Peñas *et al.*, 2009).

***Pyrgiscus* sp.**

Plate 8, figs 15, 16

Material and dimensions – Maximum height 9.8 mm, width 1.2 mm. NHMW 2015/0133/0508-0509 (2), NHMW 2015/0133/0510 (4). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Description – Shell small, relatively squat cylindrical pupoid. Protoconch type B. Teleoconch of up to seven almost straight-sided whorls separated by weakly im-

pressed suture. Sculpture of narrow orthocline ribs, half to one-third width of their interspaces, 16–18 on penultimate whorl, with spiral grooves in interspaces, of which one groove mid-whorl is wider. Last whorl, 34% of height, weakly convex, ribs weaken over base, mid-whorl and peribasal grooves broader; base covered in deep grooves. Aperture ovate, 17% of height, outer lip simple, weakly flared abapically. Columellar without fold, slightly thickened abapically; columellar and parietal callus forming narrow callus rim.

Discussion – *Pyrgiscus* sp. is characterised by its pupoid shape, almost straight-sided spire whorls separated by a weakly impressed suture, narrow vertical axial ribs and spiral grooves in the interspaces between the ribs of which the mid-whorl groove on the spire whorls is broader. Several similar extant West African species such as *C. inaequalis* (Peñas & Rolán, 1997), *C. subtilissima* (Dautzenberg, 1912), *C. swinneni* (Peñas & Rolán, 1997) and *C. costellifera* (E.A. Smith, 1871) with similar type B protoconchs and orthocline axial ribs were reviewed by Peñas & Rolán (1997), but none are as pupoid in shape as the French species.

Distribution – Lower Pliocene: Atlantic, northwestern France (this paper).

Tribe Eulimellini Saurin, 1958

Genus *Eulimella* Forbes & MacAndrew, 1846

***Eulimella acicula* (Philippi, 1836)**

Plate 8, fig. 17

- *1836 *Melania acicula* Philippi, p. 135, pl. 9, fig. 6.
- 1848 *Chemnitzia similis* Forbes – S.V. Wood, p. 84, pl. 10, fig. 11.
- 1892a *Eulimella acicula* var. *magnoturris* Sacco, p. 635, pl. 2, fig. 11.
- 1892a *Eulimella acicula* var. *postsubcylindrica* Sacco, p. 635, pl. 2, fig. 12.
- 1923 *Eulimella acicula* (Philippi) – Harmer, p. 845, pl. 64, fig. 30.
- 1952b *Eulimella acicula* Philippi, 1836 – Glibert, p. 56, pl. 4, fig. 2.
- 1963 *Eulimella (Eulimella) acicula* (Philippi) – Venzo & Pelosio, p. 78, pl. 34, figs 24–25.
- 1964 *Eulimella (Eulimella) laevis* (Brown, 1827) – van Regteren Altena *et al.*, p. 5, pl. 21, fig. 197.
- 1964 *Eulimella acicula* Philippi, 1836 – Brébion, p. 290, pl. 7, figs 13, 14.
- 1969 *Eulimella acicula* Philippi – Fekih, p. 50, pl. 10, fig. 5, pl. 11, fig. 6.
- 1984 *Eulimella (Eulimella) acicula* (Philippi, 1836) – Janssen, p. 346, pl. 16, fig. 6.
- 1986 *Eulimella laevis* (Brown, 1827) – Fretter *et al.*, p. 626, fig. 436.
- 1988 *Eulimella laevis* (Brown, 1827) – Graham, p. 614, fig. 268.

- 1992 *Eulimella acicula* (Philippi, 1836) – Cavallo & Repetto, p. 156, fig. 434.
 1994 *Eulimella acicula* (Philippi, 1836) – Van Aartsen, p. 96, fig. 15.
 1996 *Eulimella acicula* (Philippi, 1836) – Peñas *et al.*, p. 33, figs 69, 75.
 1997b *Eulimella* (*E.*) *acicula* (Philippi, 1836) – Marquet, p. 106, pl. 9, fig. 9.
 1998 *Eulimella* (*E.*) *acicula* (Philippi, 1836) – Marquet, p. 192, fig. 164.
 2005 *Eulimella* (*Eulimella*) *acicula* (Philippi, 1836) – Schnetler, p. 121, pl. 9, fig. 5.
 2011 *Eulimella acicula* (Philippi, 1836) – Chirli & Micali, p. 7, pl. 1, figs 12-15, pl. 2, figs 1-3.

Dimensions and material – Maximum height 5.5 mm. NHMW 2015/0133/0578 (1), NHMW 2015/0133/0580 (15), LC (15), FVD (3).

Discussion – *Eulimella acicula* (Philippi, 1836) is characterised by its helicoid protoconch set at 90° to the shell axis and very fine spiral sculpture. The specimen illustrated has the surface abraded, but in other specimens the spirals can be seen faintly. It is widely distributed both in the fossil and extant European record. Brébion (1964, p. 291) recorded this species from Assemblage II (Apigné), Assemblage III (Le Pigeon Blanc, Le Girondor) and Assemblage IV (Gourbesville).

Distribution – Lower-middle Miocene: North Sea Basin, Netherlands (Janssen, 1984). Upper Miocene: North Sea Basin (Tortonian), Denmark (Schnetler, 2005), Belgium (Glibert, 1952b); Atlantic (Messinian), northwestern France (Brébion, 1964); Proto-Mediterranean, Italy (Venzo & Pelosio, 1963). Lower Pliocene: North Sea Basin, Coralline Crag, England (S.V. Wood, 1848; Harmer, 1823), Kruisschans sands, Belgium (Marquet, 1998); Atlantic, northwestern France (Brébion, 1964); central Mediterranean (Chirli & Micali, 2011), Tunisia (Fekih, 1969). Upper Pliocene: North Sea Basin, Red Crag, England (Harmer, 1823), Oorderen sands (Marquet, 1998); central Mediterranean, Italy (Sacco, 1892; Cavallo & Repetto, 1992). Pliocene (indeterminate): North Sea Basin, Netherlands (Van Regteren Altena *et al.*, 1964). Upper Pliocene-Pleistocene: Atlantic, northwestern France (Brébion, 1964). Lower Pleistocene: North Sea Basin, Netherlands (Van Regteren Altena *et al.*, 1964); Atlantic, St Erth, England (Harmer, 1923). Upper Pleistocene: Atlantic, Ireland (Harmer, 1923). Present-day: Black Sea through Mediterranean, eastern Atlantic frontage to British Isles and southern Norway (Fretter *et al.*, 1986).

Eulimella scillae (Scacchi, 1835)

Plate 8, fig. 18

- *1835 *Melania Scillae* Scacchi, p. 51.
 1964 *Eulimella scillae* Scacchi, 1835 – Brébion, p. 291, pl. 7, figs 15-17.

- 2013 *Eulimella scillae* (Scacchi, 1835) – Landau *et al.*, p. 318, pl. 76, figs 3, 4 (*cum syn.*).

Dimensions and material – Maximum height 3.8 mm (incomplete). NHMW 2015/0133/0577 (1), NHMW 2015/0133/0581 (6), FVD (1).

Discussion – Although incomplete, the shell here illustrated shows the characters of *Eulimella scillae* (Scacchi, 1835): the rather large helicoid protoconch (see van Aartsen, 1994, fig. 1) and the angled periphery of the last whorl.

Brébion (1964, p. 292) recorded this species from the Assemblage II locality of Apigné and the Assemblage IV locality of Gourbesville, to which we add the Assemblage III locality of Le Pigeon Blanc.

Distribution – Lower-middle Miocene: North Sea Basin (late Burdigalian-Langhian): Germany (Moths, 1989; Wienrich, 2007), Netherlands (A.W. Janssen, 1984). Middle Miocene: Proto-Mediterranean Sea (Serravalian): Karaman Basin, Turkey (Landau *et al.*, 2013). Upper Miocene: North Sea Basin (Tortonian): Denmark (Rasmussen, 1956; Sorgenfrei, 1958; Schnetler, 2005); Atlantic (Messinian), northwestern France (Brébion, 1964); Proto-Mediterranean Sea (Tortonian): Po Basin (Sacco, 1892a). Lower Pliocene: Atlantic, northwestern France (this paper), Guadalquivir Basin, Spain (Landau *et al.*, 2011); western Mediterranean, Roussillon Basin, France (Chirli & Richard, 2008); central Mediterranean, Italy (Sacco, 1892a; Chirli & Linse, 2011), Tunisia (Fekih, 1969). Upper Pliocene: North Sea Basin, Netherlands (Beets, 1946); Atlantic, Mondego Basin, Portugal (NHMW collection); western Mediterranean, Estepona Basin, southern Spain (NHMW coll.); central Mediterranean, Italy (Sacco, 1892a; Cavallo & Repetto, 1992). Upper Pliocene-Pleistocene: Atlantic, northwestern France (Brébion, 1964). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1914). Present-day: northeastern Atlantic, Azores, Madeira, Canary and Cape Verde Islands, West Africa (Rolán, 2005).

Family Amathinidae Ponder, 1987

Genus *Clathrella* M.C. Récluz, 1864

Type species – *Nerita costata* Brocchi, 1814 (= *Fossarus clathratus* Philippi, 1844), by monotypy, Pliocene, Italy.

- 1864 *Clathrella* M.C. Récluz, p. 251.

- 1896a *Amathinoides* Sacco, p. 41. Type species (by original designation): *Nerita sulcosa* Brocchi, 1814, Pliocene, Italy.

Clathrella clathrata (Philippi 1844)

Plate 8, figs 19, 20

- 1814 *Nerita costata* Brocchi, 1814, p. 300, pl. 1, fig. 11 (junior homonym of *Nerita costata* Gmelin, 1791).

- 1828 *Turbo minutus* Michaud, p. 122, pl. unnumbered, figs 7-9 (junior homonym of *Turbo minutus* Brown & Allan, 1818).
- *1844 *Fossarus clathratus* Philippi, p. 148, pl. 25, fig. 5.
- 1854 *Delphinula Costata* Millet, p. 157 (*nomen nudum*).
- 1865 *Delphinula costata* Millet, p. 584 (*non* Danilo, 1856).
- 1964 *Phasianema costata* Brocchi, 1814 – Brébion, p. 281.
- 2013 *Clathrella clathrata* (Philippi 1844) – Landau *et al.*, p. 319, pl. 52, fig. 12 (*cum syn.*).
- 2014 *Clathrella clathrata* (Philippi 1844) – Brunetti, p. 74, unnumbered fig. bottom.
- 2014 *Clathrella clathrata* (Philippi 1844) – Giannuzzi-Savelli *et al.*, p. 92, figs 313-317.

Material and dimensions – Maximum height 9.4 mm, width 9.0 mm. NHMW 2015/0133/0465-0466 (2), NHMW 2015/0133/0467 (1), LC (15), FVD (8). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – We agree with Lozouet *et al.* (2001) that the French Atlantic early Miocene shells confused with *Clathrella clathrata* (Philippi, 1844) by many authors are not conspecific. The shell illustrated by Lozouet *et al.* (2001, pl. 36, fig. 5) differs in having only two elevated spiral cords on spire whorls, as opposed to three in *C. clathrata*, the cords on the last whorl are of subequal strength, whereas in *C. clathrata* the shoulder and peripheral cords are more prominent than the others, and the aperture is smaller and far less dilated than in *C. clathrata* (For further discussion see Landau *et al.*, p. 320).

In the lower Pliocene of Le Pigeon Blanc *C. clathrata* attains a moderate size; fragments at hand (LC coll.) suggest a maximum height of about 12.5 mm, and uncoiled gerontic specimens, similar to that illustrated by Landau *et al.* (2011, pl. 90, fig. 7) from the Atlantic lower Pliocene of the Guadalquivir Basin, southern Spain, can be found (Pl. 8, fig. 20).

Millet (1865, p. 584) described this species as *Delphinula costata* (junior homonym of *D. costata* Danilo, 1856) from the Assemblage I locality of Sceaux-d'Anjou, to which Brébion (1964, p. 282) added Renaudeau, St-Michel, Saint-Clément-de-la-Place, Les Pierres Blanches, Assemblage III localities (La Dixmérie, Le Pigeon Blanc, Le Girondor, Palluau) and Assemblage IV localities (St-Jean-La-Poterie, Gourbesville).

Distribution – Middle Miocene: Atlantic (Serravallian): Aquitaine Basin, (Cossmann & Peyrot, 1919), (Langhian): Loire Basin, France (Glibert, 1949); Paratethys (Langhian-Serravallian): Poland (Friedberg, 1923; Bałuk, 1995), Vienna (Hörnes, 1856), Hungary (Strausz, 1962, 1966), Ukraine (Zelinskaya *et al.*, 1968), Slovakia (Švagrovský, 1960); Proto-Mediterranean Sea (Serravallian): Karaman Basin, Turkey (Landau *et al.*, 2013). Upper Miocene: Atlantic (Tortonian): northwestern France (Millet, 1854, 1865; Brébion, 1964), (Tortonian): Algarve Basin, Portu-

gal (Dollfus *et al.*, 1904). Lower Pliocene: Atlantic, Guadalquivir Basin, Spain (González Delgado, 1988; Ruiz Muñoz *et al.*, 1997; Landau *et al.*, 2011); western Mediterranean, Roussillon Basin, France (Fontannes, 1880); central Mediterranean, Italy (Sacco, 1896a; Chirli, 2008); Tunisia (Fekih, 1975). Lower upper Pliocene: Atlantic, Mondego Basin, Portugal (Silva, 2001); western Mediterranean, Estepona Basin (NHMW collection), central Mediterranean, Italy (Sacco, 1896a; Caprotti, 1970, 1976; Cavallo & Repetto, 1992; Brunetti, 2014). Upper Pliocene-Pleistocene: Atlantic, northwestern France (Brébion, 1964). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1914). Present-day: Mediterranean (Peñas *et al.*, 1996).

Genus *Monotygmia* G. B. Sowerby II, 1839

Type species – *Monotygmia striata* Gray, 1847, by subsequent monotypy, present-day, Indo-West Pacific.

- 1839 *Monotygmia* G. B. Sowerby II, p. 127.
- 1842 *Monotygmia* G.B. Sowerby II, p. 305. Name attributed by Sowerby to Gray. Incorrect subsequent spelling in prevailing usage and considered to be the correct original spelling under Art. 33.3.1 (ICZN, 1999).
- 1885 *Actaeopyramis* P. Fischer, p. 787. Type species (by typification of replaced name): *Monotygmia striata* Gray, 1847, present-day, Indo-West Pacific. Unnecessary substitute name for *Monotygmia* G.B. Sowerby II, 1839, considered by Fischer an incorrect original spelling of *Monotygmia*, and therefore junior homonym of *Monotygmia* Lea, 1833 [Nassariidae].

Monotygmia ivolasi (Mayer-Eymar, 1900)

Plate 9, figs 1, 2

- *1900 *Sigaretus Ivolasi* Mayer-Eymar in Ivolas & Peyrot, p. 152, pl. 2, fig. 34.
- 1915 *Odontostomia* (*Noemia*) *Ivolasi* Mayer – de Morgan, p. 228, fig. 10.
- 1949 *Kleinella* (*Leucotina*) *ivolasi* Mayer, 1900 – Glibert, p. 180, pl. 11, fig. 20.
- 1964 *Kleinella* (*Acteopyramis*) nov. sp. Brébion, 282, pl. 7, fig. 7.

Material and dimensions – Maximum height 7.7 mm, width 3.6 mm. NHMW 2015/0133/0523-0524 (2), LC (2), FVD (1). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Monotygmia ivolasi* (Mayer-Eymar, 1900) is characterised by its relatively tall slender shell for the genus and elevated spire; the last whorl is inflated but less so that in its congeners. The few specimens available from Le Pigeon Blanc show the shell becomes more slender with ontogeny and there is some variability in the

width of the cords, especially on the adapical portion of the whorl below the suture. In some specimens the punctate grooves separating the cords are almost as wide as the cords.

Monotygmata elata (von Koenen, 1882) from the lower-middle Miocene North Sea Basin and Proto-Mediterranean is squatter shelled, with a shorter spire and a more inflated last whorl. *Monotygmata clavuliformis* (Boettger, 1902) from the middle Miocene Paratethys of Romania is also taller-spined and most similar to *M. ivolasi* but based on the figured at hand differs in having more convex spire whorls and a more inflated last whorl. *Monotygmata merignacensis* (Cossmann & Peyrot, 1917) from the early Miocene Burdigalian of the Aquitaine Basin, France is more slender than any of its European Neogene congeners, with an almost cylindrical shell shape composed of straight-sided whorls.

Glibert (1949, p. 181), suggested that Cossmann (1921, p. 274) might have made a *lapsus* when he erected the genus *Faluniella* Cossmann, 1921, type species *Leucotina falunica* de Morgan, from the Loire Basin, as Glibert could not find any reference to that species in de Morgan's works. Glibert suggested Cossmann might have been referring to de Morgan's *Leucotina ivolas*. However, a specimen of *L. falunica* is figured by Cossmann (1921, pl. 4, figs 49, 50) illustrating quite a different species. The confusion probably arose as the specimen is in the 'de Morgan collection' at the (MNHN) but authorship passes to Cossmann, 1921.

Distribution – Middle Miocene: Atlantic, Loire Basin, France (Ivolas & Peyrot, 1900; de Morgan, 1915; Glibert, 1949). Lower Pliocene: Atlantic, NW France (Brébion, 1964).

Superorder Eupulmonata Morton, 1955
Order Ellobiidae Pfeiffer, 1854 (1822)
Superfamily Ellobioidea Pfeiffer, 1854 (1822)
Family Ellobiidae Pfeiffer, 1854 (1822)
Subfamily Ellobiinae Pfeiffer, 1854 (1822)
Genus *Ellobium* Röding, 1798

Type species – *Bulla aurismidae* Linnaeus, 1758, by subsequent designation (Wenz, 1923), present-day, South-East Asia.

- 1798 *Ellobium* Röding, p. 105.
- 1799 *Alexia* (*Auricula*) Lamarck, p. 76. Type species (by monotypy): *Bulla aurismidae* Linnaeus, 1758, present-day, South-East Asia.
- 1810 *Auriculus* de Montfort, p. 310. Unjustified emendation of *Auricula* Lamarck, 1799.
- 1840 *Geovula* Swainson, p. 208, 209, 334. Type species (by monotypy): *Ellobium midae* Röding, 1798 [= *Bulla aurismidae* Linnaeus, 1758], present-day, South-East Asia. Junior objective synonym of *Ellobium*, with the same type species.
- 1868 *Autonoe* Guppy, p. 244. Type species (by monotypy): *Autonoe riparia* Guppy, 1868, present-day,

Trinidad. Junior homonym of *Autonoe* Leach, 1852 [Bivalvia].

- 1898 *Auricula* (*Auricella*) Möllendorff, p. 160. Type species (by original designation): *Auricula auricella* Férussac, 1821, present-day, Western Australia. Junior homonym of *Auricella* Jurine, 1817.
- 1898 *Auriculina* Kobelt, p. 77. Type species (by original designation): *Auricula gangetica* L. Pfeiffer, 1855, present-day, India. Junior homonym of *Auriculina* Grateloup, 1838 [Ringiculidae] and *Auriculina* Gray, 1847 [Pyramidellidae]
- 1928 *Auriculoides* Strand, p. 64. Type species (by typification of replaced name): *Auricula gangetica* L. Pfeiffer, 1855, present-day, India. *Nom. nov. pro* *Auriculina* Kobelt, 1898, *non* Grateloup, 1838 [Ringiculidae], *non* Gray, 1847b [Pyramidellidae], *non* Moquin-Tandon, 1856 [Carychiidae].
- 1947 *Autonoella* Wenz, p. 36. Type species (by typification of replaced name): *Autonoe riparia* Guppy, 1868, present-day, Trinidad. *Nom. nov. pro* *Autonoe* Guppy, 1868, *non* Leach, 1852 [Bivalvia].

***Ellobium pyramidale* (J. de C. Sowerby, 1822)**

Plate 9, figs 3-5

- *1822 *Auricula pyramidalis* J. de C. Sowerby, p. 109, pl. 379, fig. 12.
- 1845 *Auricula pyramidalis* J. Sow. – Nyst, p. 473, pl. 39, fig. 12.
- 1848 *Conovulus pyramidalis* J. Sow. – S.V. Wood, p. 11, pl. 1, fig. 13.
- 1878 *Conovulus pyramidalis* J. Sow. – Nyst, pl. 7, fig. 17.
- 1882 *Conovulus pyramidalis* J. Sow. – Nyst, p. 125.
- 1923 *Melampus pyramidalis* (J. Sowerby) – Harmer, p. 785, pl. 62, figs 19, 20.
- 1923 *Melampus pyramidalis* var. *conica* Harmer, p. 787, pl. 62, fig. 22.
- 1923 *Melampus pyramidalis* var. *striata* Harmer, p. 787, pl. 62, fig. 21.
- 1964 *Laemodonta* (*Proplecotrema*) *pyramidalis* Sowerby, 1822 – Brébion, p. 667, pl. 15, fig. 41.
- 1964 *Laemodonta* (*Proplecotrema*) *pyramidalis* var. *striata* Harmer, 1923 – Brébion, p. 669, pl. 15, fig. 42.
- 1964 *Ellobium pyramidale* (J. Sowerby, 1824 [*sic*]) – van Regteren Altena *et al.*, p. 8, pl. 21, fig. 213.
- 1997b *Ellobium pyramidale* (J. de C. Sowerby, 1822) – Marquet, p. 117, pl. 11, fig. 10.
- 1998b *Ellobium pyramidale* (J. de C. Sowerby, 1822) – Marquet, p. 225, fig. 196.

Material and dimensions – Maximum height 15.5 mm, width 8.8 mm. NHMW 2015/0133/0483-0484 (2), NHMW 2015/0133/0485 (10), LC (15), FVD (9). Le Pigeon Blanc, Le Landreau, Nantes area, Loire-Atlantique department, NW France.

Discussion – *Ellobium pyramidale* (J. de C. Sowerby,

1823) is a well-known species from the Pliocene North Sea Basin, characterised by its medium sized (15-22 mm height) globular shell, teleoconch composed of about eight smooth whorls, except for a well developed subsutural cord; spire whorls flat-sided, last whorl inflated, its elongated ovate aperture with two narrow columellar teeth and a narrow, deep umbilicus.

Harmer (1923, p. 787) described *Laemodonta* (*Proplecotrema*) *pyramidalis* var. *striata* from the lower Pleistocene of St. Erth, Cornwall, said to differ from the type in being smaller shelled (14-15 mm height) and having spiral sculpture. Harmer (1923) noted a couple of unconfirmed reports of the striated form in the English North Sea Basin Coralline Crag. We are not aware of any reports of the striated form in the Belgian or Dutch Pliocene.

The shells from Le Pigeon Blanc are similar in size to those from St. Erth and most show signs of spiral sculpture consisting of a stronger subsutural band and narrow, flattened cords below, separated by narrow grooves (Pl. 9, fig. 4). However, some specimens only have a subsutural cord developed (Pl. 9, fig. 3), and are identical to the usual North Sea Basin form of *E. pyramidale*. One specimen has an unusually tall spire and does not seem to have the subsutural cord developed (Pl. 9, fig. 5). The outer lip remains unthickened; therefore this shell might represent an aberrant or subadult form. Brébion (1964, p. 667) recorded typical *E. pyramidale* from the upper Pliocene to Pleistocene Assemblage IV locality of Gourbesville and the form *striata* from the older lower Pliocene Assemblage III locality of Le Pigeon Blanc and a possible record from La Dixmérie. As the two forms overlap both stratigraphically and geographically, we consider them to represent a single species.

Distribution – Lower Pliocene: North Sea Basin, Red Crag, England (Harmer, 1923); Atlantic, northwestern France (Brébion, 1964). Upper Pliocene: North Sea Basin, Red Crag, England (S.V. Wood, 1848; Harmer, 1923), Oorderen Sands, Belgium (Marquet, 1997b, 1998b). Pliocene (indeterminate): North Sea Basin, Netherlands (van Regteren Altena *et al.*, 1964). Upper Pliocene-Pleistocene: Atlantic, northwestern France (Brébion, 1964). Lower Pleistocene: Atlantic, St Erth, England (Harmer, 1923).

Discussion

In this paper we record 59 species of Conoidea and Heterobranchia, of which two are left in open nomenclature, representing 41 genera. Fourteen species are described as new: *Asthenotoma lanceolata* nov. sp., *Aphanitoma marqueti* nov. sp., *Clathurella pierreaime* nov. sp., *Clavatula helwerdae* nov. sp., *Haedropleura fratemcontii* nov. sp., *Bela falbalae* nov. sp., *Raphitoma georgesi* nov. sp., *Raphitoma landreauiensis* nov. sp., *Raphitoma palumbina* nov. sp., *Raphitoma turtaudierei* nov. sp., *Raphitoma vercingetorixi* nov. sp., *Raphitoma pseudoconcinna* nov. sp., *Adelphotectonica bieleri* nov. sp. and *Ondina asterixi* nov. sp. Over one-third (25) of the species (42%) occur exclusively in northwestern French Assemblage I-III de-

posits and are therefore restricted stratigraphically and geographically.

Stratigraphically (see Text-fig. 1), 14 (23%) of the species found at Le Pigeon Blanc are found in the middle Miocene Langhian of the Loire Basin (see Glibert, 1949, 1952), 23 (39%) are also present in the Assemblage I (sensu Van Dingenen *et al.*, 2015) of northwestern France, 25 (42%) are also recorded in the Miocene to present-day Mediterranean, 20 (34%) are shared with the North Sea Basin and 9 (15%) with the Atlantic coasts of the British Isles.

As with previous parts of this series (Ceulemans *et al.*, 2016; Van Dingenen *et al.*, 2016, 2017), an important number of genera such as *Asthenotoma*, *Genota*, *Clavatula*, *Fusiturris*, *Crassispira*, *Pleurotomoides* and *Terebra* are present in European and West African waters but with a more southern distribution, again suggesting that average Sea Surface Temperatures were higher than they are at these latitudes today, at least as warm as those found off the southern Portuguese coasts at present time. A full synthesis of the Assemblage III fauna, including palaeobiogeography, will be presented in a separate paper.

Acknowledgements

We would like to thank Jean-Michel Pacaud of the MNHN (Paris) for his help. Rudiger Bieler (Department of Zoology, Field Museum of Natural History, Chicago, U.S.A.) and Patrick I. LaFollette (research associate, Malacology Department, Natural History Museum of Los Angeles, California) for some taxonomic advice. Carlos Marques da Silva of the University of Lisbon, Portugal, for his advice and help with graphics. To Arie W. Janssen (Naturalis Biodiversity Center, Leiden, The Netherlands) for agreeing to pre-edit this and other parts of this series, despite entering his well-earned retirement from Cainozoic Research. Thanks also to the referees: Ingemann Schnetler and Arie Janssen, for their helpful comments. Special thanks should be given to the families Provost (Le Pigeon Blanc, Le Landreau, France) and Madeleineau (L'Errière, Le Landreau, France) for allowing us to excavate on their properties, without them this publication would not have been possible. In this and other parts of this series we would like to thank Philippe Bouchet of the MNHN (Paris) for allowing us the use of his manuscript 'Rocroi Index: Genus-Group Names, 2017'.

References

- Aartsen, J.J. van 1977. European Pyramidellidae, 1. *Chrysallida*. *Conchiglie* 13: 49-64.
- Aartsen, J.J. van 1981. European Pyramidellidae, 2. *Turbonilla*. *Conchiglie* 17: 61-88.
- Aartsen, J.J. van 1984. The Pyramidellid genera described by the marquis L. de Folin. *Bollettino Malacologico* 20: 5-8.
- Aartsen, J.J. van 1987. European Pyramidellidae, 3. *Odostomia* and *Ondina*. *Conchiglie* 23: 1-34.
- Aartsen, J.J. van 1988a. European Mollusca: notes on less well-known species. 12. *Bela menckhorsti* nom. nov. = *Pleurotoma nana* Scacchi, 1836 not Deshayes, 1835 and *Fehria*

Species	Geographical distribution					Stratigraphical distribution							
						Miocene		Pliocene		Pleistocene		Hol	
	1	2	3	4	A/M	Lower	Middle	Upper	Lower	Upper	Lower	Upper	
<i>Asthenotoma lanceolata</i> nov. sp.			●		A				■				
<i>Asthenotoma ornata</i> (DeFrance, 1826)	●		●		A			■	■				
<i>Aphanitoma marqueti</i> nov. sp.			●		A				■				
<i>Genota maximeii</i> nov. nom.			●		A			■	■				
<i>Clathurella pierreaimeii</i> nov. sp.			●		A				■				
<i>Pleurotomoides hordeaceus</i> (Millet, 1827)			●		A			■	■				
<i>Clavatula helwerdae</i> nov. sp.			●		A				■				
<i>Fusiturris strigosa</i> (Millet, 1865)			●		A			■	■				
<i>Crassopleura clavulina brugnonesi</i> (Dollfus, 1907)			●		A				■				
<i>Haedropleura fratemcontii</i> nov. sp.			●		A				■				
<i>Haedropleura secalina</i> (Philippi, 1844)	●		●	●	A/M			■	■	■	■	■	■
<i>Haedropleura septangularis</i> (Montagu, 1803)			●	●	A/M	■	■	■	■	■	■	■	■
<i>Agathotoma angusta</i> Bellardi, 1847			●	●	A/M	■	■	■	■	■	■	■	■
<i>Bela falbalae</i> nov. sp.			●		A				■				
<i>Bela trinacria</i> Mariottini & Smriglio, 2009			●	●	A/M			■	■				
<i>Mangelia attenuata</i> (Montagu, 1803)	●	●	●	●	A/M	■	■	■	■	■	■	■	■
<i>Pyrgocythara rugosissima</i> (Seguenza, 1875)			●	●	A/M				■	■			
<i>Mitromorpha (Mitrolumna) panaulax</i> Cossmann, 1901			●		A				■				
<i>Crassispira pseudobeliscus</i> (Fischer & Tournouër 1873)			●		A			■	■				
<i>Clathromangelia fenestrata</i> (Millet, 1865)			●		A			■	■	■	■	■	■
<i>Raphitoma bertrandiana</i> (Millet, 1865)			●		A			■	■				
<i>Raphitoma georgesi</i> nov. sp.			●		A				■				
<i>Raphitoma landreauensis</i> nov. sp.			●		A				■				
<i>Raphitoma palumbina</i> nov. sp.			●		A				■				
<i>Raphitoma pseudohystrix</i> (Sykes, 1906)			●	●	A/M				■	■	■	■	■
<i>Raphitoma turtaudierei</i> nov. sp.			●		A				■				
<i>Raphitoma vercingetorixi</i> nov. sp.			●		A				■				
<i>Raphitoma pseudoconcinna</i> nov. sp.			●		A				■				

Text-figure 1. Geography, stratigraphy and distribution of species found in the Pliocene of Le Pigeon Blanc. For geographic distribution 1 = North Sea Basin, 2 = Atlantic coasts British Isles, 3 = NW France, 4 = Mediterranean. For stratigraphic distribution black signifies Atlantic distribution (A), grey Mediterranean distribution (M).

Species	Geographical distribution	Stratigraphical distribution												
							Miocene		Pliocene		Pleistocene		Hol.	
		1	2	3	4	Lower	Middle	Upper	Lower	Upper	Lower	Upper		
<i>Terebra exilis</i> Bell, 1871		●		●	A									
<i>Adelphotectonica bieleri</i> nov. sp.				●	A									
<i>Heliacus (Torinista) miser</i> (Dujardin, 1837)				●	A	?		■ ■						
' <i>Acteon</i> ' <i>semistriatus</i> (Férrusac, 1822)		●		●	A									
<i>Rictaxis tornatus</i> (Millet, 1854)				●	A									
<i>Ringicula buccinea</i> (Brocchi, 1814)				●	A									
<i>Ringicula ventricosa</i> (J. Sowerby, 1824)		●		●	A									
<i>Acteocina lajonkaireana</i> (de Basterot, 1825)		●		●	A									
<i>Retusa obtusa</i> (Montagu, 1803)		●		●	A									
<i>Retusa truncatula</i> (Bruguière, 1792)		●	●	●	A									
<i>Volvulella acuminata</i> (Bruguière, 1792)		●		●	A									
<i>Cylichna cylindracea</i> (Pennant, 1777)		●	●	●	A									
<i>Haminoea hydatis</i> (Linnaeus, 1758)			●	●	A									
<i>Scaphander lignarius</i> (Linnaeus, 1758)		●	●	●	A									
<i>Megastomia conoidea</i> (Brocchi, 1814)		●		●	A									
<i>Ondina asterixi</i> nov. sp.				●	A									
<i>Euparthenia elegans</i> (Dollfus & Dautzenberg, 1886)				●	A									
<i>Parthenina decussata</i> (Montagu, 1803)				●	A									
<i>Parthenina indiscinta</i> (Montagu, 1803)		●		●	A									
<i>Parthenina</i> sp.				●	A									
<i>Pyrgulina stefanisi</i> (Jeffreys, 1869)		●		●	A									
<i>Tragula fenestrata</i> (Jeffreys, 1848)				●	A									
<i>Syrnola</i> cf. <i>turoniensis</i> (Glibert, 1949)				●	A									
<i>Chemnitzia lactea</i> (Linnaeus, 1758)		●	●	●	A									
<i>Pyrgiscus rufus</i> (Philippi, 1836)		●	●	●	A									
<i>Pyrgiscus</i> sp.				●	A									
<i>Eulimella acicula</i> (Philippi, 1836)		●	●	●	A									
<i>Eulimella scillae</i> (Scacchi, 1835)		●		●	A									
<i>Clathrella clathrata</i> (Philippi, 1844)				●	A									
<i>Monotygma ivolasi</i> (Mayer-Eymar, 1900)				●	A									
<i>Ellobium pyramidale</i> (J. de C. Sowerby, 1822)		●	●	●	A									

- (nov. gen.) *zenetouae* nov. spec. *La Conchiglia* 20(232-233): 30-31.
- Aartsen, J.J. van 1988b. Nomenclatural notes, 7. Forbes' Aegean Turridae. *Bollettino Malacologico* 24: 141-144.
- Aartsen, J.J. van 1994. European Pyramidellidae: 4. The genera *Eulimella*, *Anisocyla*, *Syrnola*, *Cingulina*, *Oscilla* and *Careliopsis*. *Bollettino Malacologico* 30(5-9): 85-109.
- Aartsen, J.J. van, Gittenberger, E. & Goud, J. 1998. Pyramidellidae (Mollusca, Gastropoda, Heterobranchia) collected during the Dutch CANCAP and MAURITANIA expeditions in the south-eastern part of the North Atlantic Ocean, 1. *Zoologische Verhandelingen* 321: 3-57.
- Aartsen, J.J. van, Gittenberger, E. & Goud, J. 2000. Pyramidellidae (Mollusca, Gastropoda, Heterobranchia) collected during the Dutch CANCAP and MAURITANIA expeditions in the south-eastern part of the North Atlantic Ocean, 2. *Zoologische Mededelingen* 74: 1-50.
- Adams, A. 1850. Monograph of the family Bullidae. In Sowerby, G.B. II (ed.) *Thesaurus Conchyliorum*, 2: 553-608, pls. 119-125.
- Adams, A. 1860a. On some new genera and species of Mollusca from Japan. *Annals and Magazine of Natural History* 3: 405-413.
- Adams, A. 1860b. On a new genus and some new species of Mollusca from Japan. *Annals and Magazine of Natural History* 3(36): 414-422.
- Adams, A. 1860c. LI – Mollusca Japonica: New species of *Chrysallida* and *Parthenia*. *Annals and Magazine of Natural History* 3(530): 477-479.
- Adams, A. 1861. On some new genera and species of Mollusca from the north of China and Japan. *Annals and Magazine of Natural History* 3(8): 299-309.
- Adams, A. 1862. On some new species of Cylichnidae, Bullidae and Phyllinidae from the seas of China and Japan. *Annals and Magazine of Natural History* 3(9): 150-161.
- Adams, A. 1863. On the species of Pyramidellinae found in Japan. *Journal of the Proceedings of the Linnean Society of London* 7: 1-6.
- Adams, H. & Adams, A. 1853-1858. *The genera of recent Mollusca; arranged according to their organization*. London (John van Voorst), 1:1-256, pls. 1-32, 1853, 257-484, 1854; 2:1-284, pls. 33-96, 1855, 285-412, pls. 97-112, 1856, 413-540, pls. 113-128, 1857, 541-660, pls. 129-138, 1858.
- Adams, J. 1797. XV. The specific characters of some minute shells discovered on the coast of Pembrokeshire, with an account of a new marine animal. *Transactions of the Linnean Society of London* 3(1): 64-69, pl. 13.
- Aimassi, G. & Ferrero Mortara, E. 1983. Osservazioni paleoecologiche e biostratigrafiche su una malacofauna pliocenica dell'Astigiano (Buttiglieria d'Asti). *Bollettino Malacologico* 19: 177-206.
- Alder, J. 1844. Descriptions of some new British species of *Rissoa* and *Odostomia*. *Annals and Magazine of Natural History* 13: 323-328.
- Alder, J. 1850. Additions to the Mollusca of Northumberland and Durham. *Transactions of the Tyneside Naturalists' Field Club* 1: 358-365.
- Amico, C. d', Esu, D. & Girotti, O. 2012. Tortonian gastropods and bivalves from a transgressive succession near Cessaniti (Italy: Calabria). *Archiv für Molluskenkunde* 141: 155-195.
- Anderson, H.J. 1964. Die miocene Reinbek-Stufe in Nord- und Westdeutschland und ihre Mollusken-Fauna. *Fortschritte in der Geologie von Rheinland und Westfalen* 14: 31-368.
- Annandale, N. 1924. Fauna of Chilka Lake: Mollusca Gastropoda (revision). *Memoirs of the Indian Museum* 5: 853-874.
- Anton, H.E. 1838. *Verzeichniss der Conchylien welche sich in der Sammlung von H.E. Anton befinden*. Halle: xvi + 110 pp.
- Aradas, A. & Maggiore, G. 1840-1844. Catalogo ragionato delle conchiglie viventi e fossili di Sicilia *Atti dell'Accademia Gioenia di Scienze Naturali* 15: 187-217, 349-366 (1840); 16: 49-87 (?1841); 17: 53-106 (?1841); 17: 163-205 (?1842); 20: 101-142, 343-360 (1844).
- Ardovini, R. & Cossignani, T. 2004. *West African seashells (including Azores, Madeira and Canary Is.) = Conchiglie dell'Africa Occidentale (incluse Azzorre, Madeira e Canarie)*. English-Italian edition. Ancona (L'Informatore Pice-no), 319 pp.
- Arnold, R. 1903. The paleontology and stratigraphy of the marine Pliocene and Pleistocene of San Pedro, California. *Memoirs of the California Academy of Sciences* 3: 1-420, 37 pls.
- Atanacković, M.A. 1985. *Mekušci Morskog Miocena Bosne*. Sarajevo (Geoinženjering): 305 pp.
- Baird, W. 1863. Descriptions of some new species of shells, collected at Vancouver Island and in British Columbia by J. K. Lord, Esq., naturalist to the British North-American Boundary Commission, in the years 1858-1862. *Proceedings of the Zoological Society of London* 1863: 66-70.
- Bałuk, W. 1970. The Lower Tortonian at Niskowa near Nowy Sacz, Polish Carpathians. *Acta Geologica Polonica* 20: 101-157.
- Bałuk, W. 1995. Middle Miocene (Badenian) gastropods from Korytnica, Poland, 2. *Acta Geologica Polonica* 45: 1-255.
- Bartsch, P. 1923. A key to the family Terebridae. *The Nautilus* 37: 60-64.
- Basterot, B. de 1825. *Mémoire géologique sur les environs de Bordeaux. Première partie, comprenant les observations générales sur les mollusques fossiles, et la description particulière de ceux qu'on rencontre dans ce bassin*. Paris (J. Tastu): 100 pp. (reprinted from *Mémoires de la Société d'Histoire Naturelle de Paris* 2: 1-100).
- Beets, C. 1946. The Pliocene and Lower Pleistocene gastropods in the collections of the Geological Foundation in The Netherlands (with some remarks on other Dutch collections). *Mededeelingen van de Geologische Stichting* (C-IV-I)6: 1-166.
- Bell, A. 1871. Contributions to the Crag Fauna, 2. *Annals and Magazine of Natural History* 4(7): 351-362.
- Bell, A. 1893. Notes on the correlation of the later and post-Pliocene Tertiaries on either side of the Irish Sea, with a reference to the fauna of the St. Erth valley, Cornwall. *Proceedings of the Royal Irish Academy* 3(2): 620-642.
- Bellardi, L. 1847. Monografia delle pleurotome fossili del Piemonte. *Memorie della Reale Accademia delle Scienze di Torino* (2)9: 531-650 (R. Janssen, 1993, said that the journal issue was published in 1848, but that a separate was distributed in 1847; the title and pagination for the separate are: *Monografia delle pleurotome fossili del Piemonte*. Torino: 119 pp.).

- Bellardi, L. 1875. *Novae pleurotomidarum Pedimonti et Liguria fossilium: dispositionis prodromus. Bullettino della Società Malacologica Italiana* 1: 16-24.
- Bellardi, L. 1877. I molluschi dei terreni terziari del Piemonte e della Liguria, 2. Gasteropoda (Pleurotomidae). *Memorie della Reale Accademia delle Scienze di Torino* (2)29 (1878): 1-264 (reprint 264 pp.) (June 30, 1877).
- Bellardi, L. & Michelotti, G. 1840. Saggio oritografico sulla classe dei gasteropodi fossili dei terreni terziari del Piemonte. *Memorie della Reale Accademia delle Scienze di Torino* (2)3: 93-174 (also issued as a separate, pp. 1-82).
- Benoist, E.A. 1889. Description des céphalopodes, ptéropodes et gastéropodes opisthobranches (Acteonidae). Coquilles fossiles des terrains tertiaires moyens du Sud-Ouest de la France. *Actes de la Société Linnéenne de Bordeaux* 42: 11-84.
- Berger, W. 1953. Die Bullaceen aus dem Tertiär des Wiener Beckens. *Archiv für Molluskenkunde* 82: 81-129.
- Bernasconi, M.P. & Robba, E. 1984. The Pliocene Turridae from western Liguria, 1. Clavinae, Turrinae, Turriculinae, Crassispirinae, Borsoniinae, Clathurellinae. *Bollettino Museo Regionale di Scienze Naturali di Torino* 2: 257-358.
- Bieler, R. 1987[1986]. Die Gattungen der Architectonicidae (Gastropoda: Allogastropoda). Teil 4: *Heliacus* (*Pyrgoheliacus*) n. subgen. und *Architectonica* (*Adelphotectonica*) n. subgen. *Archiv für Molluskenkunde* 117(4/6): 203-215, pls 1-2.
- Bieler, R. 1993. Architectonicidae of the Indo-Pacific (Mollusca, Gastropoda). *Abhandlungen des Naturwissenschaftlichen Vereins in Hamburg* (Neue Folge) 30: 1-376.
- Bivona-Bernardi And., 1838. Generi e specie di molluschi descritti dal Barone Antonio Bivona e Bernardi. Lavori postumi pubblicati dal figlio Andrea dottore in medicina con note ed aggiunte. *Giornale di Scienze Lettere e Arti per la Sicilia* 61: 211-227 [stated date March 1838] 63: 319-324 [stated date september 1838] [also as reprint, 16 pp, 1 pl., tipografia del Giornale Letterario, Palermo].
- Boettger, O. 1902. Zur Kenntnis der Fauna der mittelmiozänen Schichten von Kostež im Krassó-Szörényer Komitat. Mit einem Situationsplan der Fundpunkte, 2. *Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für Naturwissenschaften zu Hermannstadt* 51 (1901): 1-200.
- Boettger, O. 1906-1907. Zur Kenntnis der Fauna der mittelmiozänen Schichten von Kostež im Krassó-Szörényer Komitat. Gasteropoden und Anneliden, 3. *Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für Naturwissenschaften zu Hermannstadt* 54/55: i-viii, 1-99 (1906); 101-244 (1907).
- Bogi, C., Coppini, M. & Margelli, A. 1986. Contributo alla conoscenza della malacofauna dell'Alto Tirreno. *La Conchiglia* 206/207: 26-29.
- Bouchet, P. 1990. Turrid genera and mode of development: The use and abuse of protoconch morphology. *Malacologia* 32: 69-77.
- Bouchet, P. & Gofas, S. 2011. *Mangelia*. In: MolluscaBase 2017. Accessed through: World Register of Marine Species at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=137820>.
- Bouchet, P. & Gofas, S. 2016. *Leufroyia* Monterosato, 1884. In: MolluscaBase (2017). Accessed through: World Register of Marine Species at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=195915> on 2018-01-06.
- Bouchet, P., Kantor Yu.I., Sysoev, A. & Puillandre, N. 2011. A new operational classification of the Conoidea. *Journal of Molluscan Studies* 77: 273-308.
- Bouchet, P. & Rocroi, J. P. 2017. Revised classification, nomenclator and typification of gastropod and monoplacophoran families. *Malacologia* 61(1-2): 1-526.
- Brambilla, G., Galli, C. & Santi, G. 1988. La fauna marina pleistocenica del Colle di Castenedolo (Brescia, Italia Settentrionale). Osservazioni cronologiche ed ambientali. *Natura Bresciana. Annale del Museo Civico di Storia naturale* 25: 35-62.
- Brébion, P. 1964. Les gastéropodes du Redonien et leur signification, 1-2. Thèse de doctorat ès-Sciences. Paris (Faculté des Sciences de l'Université de Paris: 775 pp., 15 pls (27 June 1964, unpublished).
- Brisson, A.D., 1762. *Regnum Animale in classes IX. Distributum sive synopsis methodica sistens generalem animalium distributionem in classes IX., duarum primarum classium quadrupedum scilicet & cetaceorum, particularem divisionem in ordines, sectiones, genera & species. Cun brevi cujusque speciei descriptione, citationibus auctorum de iis tractantium, nominibus eis ab ipsis & nationibus impositis, nominibusque vulgaribus*. Lugdunum Batavorum (T. Haak): 296 pp.
- Brocchi, G. 1814. *Conchiologia fossile subapennina, con osservazioni geologiche sugli Apennini e sul suolo adiacente*, 1-2. Milano (Stamperia Reale): 1-240 (1); 241-712 (2), 16 pls.
- Bronn, H.G. 1831. *Italiens Tertiär-Gebilde und deren organische Einschlüsse*. Heidelberg (Karl Groos): xii + 176 pp. (part of: Bronn, H.G. 1831. *Ergebnisse meiner naturhistorisch-ökonomischen Reisen*. Heidelberg & Leipzig, 2 vols).
- Bronn, H.G. 1849. *Handbuch der Geschichte der Natur*. 3(3). *Index Palaeontologicus*. Stuttgart: 980 pp.
- Brown, T. 1827. *Illustrations of the conchology of Great Britain and Ireland. Drawn from nature*. Edinburgh (W.H. Lizars), London (D. Lizars & S. Highley): 144 pp.
- Brown, T. 1837-1849. *Illustrations of the fossil conchology of Great Britain and Ireland, with descriptions and localities of all the species*. London (Smith, Elder): i-viii, 1-273, pls 1-117. [1-36, 1837; 37-52; 1838; 53-60, 1839; 61-108, 1843; 109-116, 1844; 117-136; 1845; balance of publication completed by 1849.
- Brugnone, G.A. 1862. *Memoria sopra alcuni pleurotomi fossili dei dintorni di Palermo*. Palermo (F. Lao): 41 pp.
- Brugnone, G.A. 1873-1876. *Miscellanea malacologica*, 1-2. Palermo, 1: 15 pp. (1873); 2: 25 pp. (1876).
- Bruguière, J.G. 1789-1792. *Encyclopédie méthodique ou par ordre de matières. Histoire naturelle des vers*, 1-2. Paris (Panckoucke), 1: xviii + 1-344 (1789); 2: 345-757 (1792).
- Brunetti, M.M. 2014. *Conchiglie fossili di Monte Antico (Grosseto, Italia)*. Privately published, 118pp.
- Bucquoy, F., Dautzenberg, P. & Dollfus, G. 1882-1886. *Les mollusques marins du Rousillon, 1. Gastropodes, avec atlas de 66 planches photographées d'après nature*. Paris (J.B. Baillière & Dautzenberg): 1-84 (1882), 85-196 (1883), 197-342 (1884), 343-418 (1885), 419-570 (1886).
- Burmeister, H. 1837. *Handbuch der Naturgeschichte*, 2 Berlin (Enslin): i-xii, 369-858.

- Calcara, P. 1841. *Memoria sopra alcune conchiglie fossili rinvenute nella contrada di Altavilla*. Palermo (Stamp d'Antonio Muratori): 86 pp.
- Cantraine, F.J. 1835. Diagnoses ou descriptions succinctes de quelques espèces nouvelles de mollusques. *Bulletin de l'Académie Royale des Sciences et Belles-lettres de Bruxelles* 2(11): 380-411.
- Caprotti, E. 1970. Mesogastropoda della stratotipo piacentiano (Castell'Arquato, Piacenza). *Natura, Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* 61: 121-187.
- Caprotti, E. 1974. Molluschi del Tabianiano (Pliocene inferiore) della Val d'Arda. Loro connessioni temporali e spaziali. *Conchiglie* 10: 1-47.
- Caprotti, E. 1976. Malacofauna dello stratotipo piacentiano (Pliocene de Castell'Arquato). *Conchiglie* 12: 1-56.
- Carpenter, P.P. 1857. *Catalogue of the collection of Mazatlan Mollusca in the British Museum collected by Frederick Reigen*. London, xvi + 552 pp.
- Carpenter, P.P. 1863. Review of Prof. C.B. Adams's 'Catalogue of the Shells of Panama', from the type specimens. *Proceedings of the Zoological Society of London* 1863: 339-369.
- Carpenter, P.P. 1864. A supplementary report on the present state of our knowledge with regard to the Mollusca of the west coast of North America. *Report of the British Association for the Advancement of Science* 1863: 517-686.
- Carpenter, P.P. 1865. Diagnoses of new forms of Mollusca from the west coast of North America, first collected by Col. E. Jewett. *Annals and Magazine of Natural History* 3(15): 177-182.
- Carrozza, F. 1984. *Raphitoma divae* n. sp. *Bollettino Malacologico* 20(5-8): 151-154.
- Casey, T.L. 1904. Notes on the Pleurotomidae with descriptions of some new genera and species. *Transactions of the Academy of Science of St. Louis* 14: 123-170.
- Cavallo, O. & Repetto, G. 1992. Conchiglie fossili del Roero. Atlante iconografico. *Associazione Naturalistica Piemontese Memorie* (Associazione Amici del Museo 'Federico Eusebio') 2: 1-251.
- Cerulli-Irelli, S. 1910. Fauna malacologica mariana, 4. (Dentaliidae, Stenogyridae, Gadiniidae, Actaeonidae, Tornatinidae, Scaphandridae, Bullidae, Ringiculidae, Philinidae, Umbrellidae, Conidae, Pleurotomidae. *Paleontographia Italica* 16: 215-262.
- Cerulli-Irelli, S. 1914. Fauna malacologica mariana, 7. Melaniidae, Fossaridae, Solariidae, Rissoidae, Capulidae, Calyptraeidae, Xenophoridae, Lamellariidae, Naticidae, Scalidae, Aclisidae, Eulimidae, Pyramidellidae. *Paleontographia Italica* 20: 357-451.
- Ceulemans, L., Landau, B.M. & Van Dingenen, F. 2014. *Cari-nofusus* gen. nov. from the Mio-Pliocene transition of western France. *Vita Malacologica* 12: 23-30.
- Ceulemans, L., Van Dingenen, F. & Landau, B.M. 2016a. The lower Pliocene gastropods of Le Pigeon Blanc (northwest France). Patellogastropoda and Vetigastropoda. *Cainozoic Research* 16: 51-100.
- Ceulemans, L., Van Dingenen, F., Merle, D. & Landau, B.M. 2016b. The lower Pliocene gastropods of Le Pigeon Blanc (Loire-Atlantique, northwest France), 3 – Muricidae. *Vita Malacologica* 15: 35-55.
- Chaster, G.W. 1898. A report upon the Mollusca (excluding the Cephalopoda and Nudibranchiata) obtained by the Royal Irish Academy Cruises of 1885, 1886 and 1888. *Proceedings of the Royal Irish Academy* (3)5: 1-33.
- Chaster, G.W. 1901. Changes in generic names in the Pyramidellidae. *Journal of Conchology* 10: 8.
- Children, J.G. 1822-1823. Lamarck's genera of shells. *Quarterly Journal of Science, Literature and the Arts (London)* 14(27): 64-87, pl. 3-4 [October 1822]; 14(28): 298-322, pl. 5-6 [January 1823]; 15(29): 23-52, pl. 2-3 [April 1823]; 15(30): 216-258, pl. 7-8 [July 1823]; 16(31): 49-79, pl. 5 [October 1823]; 16(32): 241-264, pl. 6 [December 1823].
- Chirli, C. 1988. *Malacofauna pliocenica di Poggibonsi, Cava delle Piaggiole*. Poggibonsi (Lalli Ed.): 1-89.
- Chirli, C. 1997. *Malacofauna Pliocenica Toscana 1. Superfamiglia Conoidea*. Firenze (C. Chirli): 129 pp.
- Chirli, C. 2008. *Malacofauna Pliocenica Toscana, 6. Neotaenioglossa*. Firenze (C. Chirli): 128 pp.
- Chirli, C. 2013. *Malacofauna Pliocenica Toscana, 9. Gastropoda fine Scaphopoda*. Firenze (C. Chirli): 169 pp.
- Chirli, C. & Linse, U. 2011. *The Pleistocene marine Gastropods of Rhodes Island (Greece)*. Grafiche PDB, Tavarnelle V.P. Firenze: 262 pp, 90 pls.
- Chirli, C. & Micali, P. 2011. *Malacofauna Pliocenica Toscana, 8. Pyramidelloidea*. Firenze (C. Chirli): 132 pp, 40 pls.
- Chirli, C. & Richard, C. 2008. *Les mollusques plaisanciens de la Côte d'Azur*. Tavarnelle (C. Chirli): 128 pp.
- Ciccone, G. & Savona, S. 1982. Il genere *Ringicula* Deshayes, 1848 nel Mediterraneo. *Bollettino Malacologico* 18: 17-34.
- Cipolla, F. 1914. Le pleurotomidi del Pliocene di Altavilla (Palermo). *Palaeontographia Italica* 20: 105-181.
- Cleevely, R.J. 1974. The Sowerbys, the Mineral Conchology, and their fossil collections. *Journal of the Society for the Bibliography of Natural History* 6: 418-481.
- Coen, G. 1929. Gen. *Pleurotoma* Lamarck 1799 nov. sub. gen. *Tyrrhenoturris* (con una tavola). *Atti della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale in Milano* 68(3-4): 297.
- Coen, G. 1933. Saggio di una Sylloge Molluscorum Adriaticorum. *Memorie del Regio Comitato Talassografico Italiano* 192: i-vii, 1-186.
- Corgan, J.X. 1973. The names *Partulida* Schaufuss, 1869 and *Spiralinella* Chaster, 1901 (Gastropoda, Pyramidellacea). *Journal of Conchology* 28: 9-10.
- Cossmann, M. 1895. *Essais de paléoconchologie comparée*, 1. Paris (The author and Société d'Éditions Scientifiques): 159 pp, 7 pls.
- Cossmann, M. 1896. *Essais de paléoconchologie comparée*, 2. Paris (The author and Société d'Éditions Scientifiques): 180 pp., 8 pls.
- Cossmann, M. 1899. Rectifications de nomenclature. *Revue Critique de Paléozoologie* 3(1): 45-46.
- Cossmann, M. 1901. *Essais de paléoconchologie comparée*, 4. Paris (The author and Société d'Éditions Scientifiques): 293 pp., 10 pls.
- Cossmann, M. 1907 [1906]. Catalogue illustré des coquilles fossiles de l'Eocène des environs de Paris (Appendice no. 4). *Annales de la Société Royale Zoologique et Malacologique de Belgique* 41: 186-286, pls 6-10.

- Cossmann, M. 1921. *Essais de paléoconchologie comparée*, 12. Paris (The author and Société d'Éditions Scientifiques): 348 pp., 6 pls.
- Cossmann, M. & Lambert, J. 1884. Étude paléontologique et stratigraphique sur le terrain oligocène marin aux environs d'Étampes. *Mémoires de la Société Géologique de France* 3(3): 1-187.
- Cossmann, M. & Peyrot, A. 1909-1935 (after 1924 continued by A. Peyrot). Conchologie néogénique de l'Aquitaine. *Actes de la Société Linnéenne de Bordeaux*, 63: 73-293 (1909); 64: 235-400 (1910), 401-445 (1911); 65: 51-98 (1911). 99-333 (1912); 66: 121-232 (1912), 233-324 (1913); 68: 5-210, 361-435 (1914); 69: 157-365 (1917); 70: 5-180 (1918), 181-491 (1919) 73: 5-321 (1922); 74: 257-342 (1923); 75: 71-318 (1924); 77: 51-256 (1925); 78: 199-256 (1926); 79: 5-263 (1928); 82: 73-126 (1931); 83: 5-116 (1931); 84: 5-288 (1933); 85: 5-71 (1933); 86: 257-353 (1935). Also published as a 6 volume book with different pagination as Édition in-8°, *Extrait des Actes de la Société Linnéenne de Bordeaux ('Ouvrages couronnés par l'Académie des Sciences, Arts et Belles-Lettres de Bordeaux')*, 1: 1-220 (1909); 221-428 (1911); 429-718 (1912); 2: 1-204 (1913); 205-496 (1914); 3: 1-384 (1917); 385-695 (1919); 4: 1-322 (1922); 323-610 (1924); 5: 1-206 (1927); 207-465 (1928); 6: 1-294 (1931); 295-541 (1932).
- Costa, E.M. da 1778. *Historia naturalis testaceorum Britanniae*. London (Millan, White, Elmsley & Robson): xii + 254 + viii pp.
- Cristofori, J. de & Jan, G. 1832. *Catalogus in IV sectiones divisus rerum naturalium in Museo Exstantium Josephi de Christofori et Georgio Jan Plurinum Acad. Scient. et Societ. Nat. Cur. Sodalium ecc*, 2(1). *Conchylia fossilia ex formatione telluris tertiaria in collectione nostra exstantia*. Parma (Carmignani): 16 pp.
- Crosse, H. 1885. Nomenclatura generica e specifica par le marquis de Monterosato. *Journal de Conchyliologie* 33: 139-142.
- Crovato, C. & Micali, P. 1992 [1990]. Contributo alla conoscenza delle Chrysallidinae del Pliocene e del Pleistocene Italiano. *Lavori della Società Italiana de Malacologia* 24: 119-133.
- Csepregy-Meznerics, I. 1956. Die Molluskenfauna von Szob und Letkés. *Magyar Állami Földtani Intézet Évkönyve (Annales de l'Institut de Géologie Publique de Hongarie)* 45: 361-477.
- Cuerda Barceló, J. 1987. *Molluscos marinos y salobres del Pleistoceno Balear*. Palma de Mallorca (Publ. Caja de Baleares 'Sa Nostra'): 421 pp.
- Dall, W.H. 1871. Descriptions of sixty new forms of mollusks from the west coast of America and the north Pacific Ocean, with notes on others already described. *American Journal of Conchology* 7: 93-160.
- Dall, W.H. 1890. Contributions to the Tertiary fauna of Florida with especial reference to the Miocene silex-beds of Tampa and the Pliocene beds of the Caloosahatchie River, 1. Pulmonate, opisthobranchiate and orthodont gastropods. *Transactions of the Wagner Free Institute of Sciences, Philadelphia* 3(1): 1-200, pls 1-12.
- Dall, W.H. 1892. Contributions to the Tertiary fauna of Florida, with especial reference to the Miocene silex-beds of Tampa and the Pliocene beds of the Caloosahatchie River, 2. Strep-todont and other gastropods, concluded. *Transactions of the Wagner Free Institute of Science of Philadelphia* 3(2): 201-473, pls 13-22.
- Dall, W.H. 1898. A new species of *Terebra* from Texas. *The Nautilus* 12: 44-45.
- Dall, W.H. 1903. Contributions to the Tertiary fauna of Florida, 6. *Transactions of the Wagner Free Institute of Science of Philadelphia* 3(6): 1219-1654, pls 48-60.
- Dall, W.H. 1908. Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U.S. Fish Commission Steamer 'Albatross', during 1891, Lieut. Commander Z.L. Tanner, U.S.N., commanding, 37. Reports on the scientific results of the expedition to the eastern tropical Pacific, in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer "Albatross", from October, 1904, to March, 1905, Lieut. Commander L.M. Garrett, U.S.N., commanding.; 16. The Mollusca and the Brachiopoda. *Bulletin of the Museum of Comparative Zoology* 43(6): 205-487.
- Dall, W.H. 1918. Notes on the nomenclature of the mollusks of the family Turritidae. *Proceedings of The United States National Museum* 54: 313-333.
- Dall, W.H. & Bartsch, P. 1904. Synopsis of the genera, subgenera and sections of the family Pyramidellidae. *Proceedings of the Biological Society of Washington* 17: 1-16.
- Dall, W.H. & Bartsch, P. 1907. The pyramidellid mollusks of the Oregonian faunal area. *Proceedings of the United States National Museum* 33 (1574): 491-534, pls 14-18.
- Dall, W.H. & Bartsch, P. 1909. A monograph of West American pyramidellid mollusks. *Bulletin of the United States National Museum* 68: i-xii, 1-258, 30 pls.
- Danilo, F. 1856. Elenco nominale dei gasteropodi testacei marini raccolti nei dintorni di Zara, e determinati dal Sig. Giovanni Battista Sandri e dal Prof. Dr. Francesco Danilo. *Programma dell'I.R. Ginnasio completo di prima classe in Zara alla fine dell'anno scolastico 1855-1856*. Zara (tipogr. govern.): 107-150.
- Dautzenberg, P. 1912 [1913]. Mission Gruvel sur la côte occidentale d'Afrique (1909-1910): Mollusques marins. *Annales de l'Institut Océanographique, Paris* (Nouvelle Série) 5(3): 1-111, pls 1-3 [Title page dated 1913; published December 1912].
- Dautzenberg, P. & Fischer, H. 1907 ["1906"]. Contribution à la faune malacologique de l'Indo-Chine. *Journal de Conchyliologie* 54(3): 145-226, pls 5-7.
- Defrance, M.J.L. [D.F.] 1816-1830. In: Cuvier, F. (ed.). *Dictionnaire des sciences naturelles, dans lequel on traite méthodiquement des différens êtres de la nature, considérés soit en eux-mêmes, d'après l'état actuel de nos connoissances, soit relativement à l'utilité qu'en peuvent retirer la médecine, l'agriculture, le commerce et les arts. Suivi d'une biographie des plus célèbres naturalistes. Ouvrage destine aux médecins, aux agriculteurs, aux commerçans, aux artistes, aux manufacturiers, et à tous ceux qui ont intérêt à connoître les productions de la nature, leurs caractères génériques et spécifiques, leur lieu natal, leurs propriétés et leurs usages*, 1-60, 12 unnumbered volumes of plates. Strasbourg (F.G. Levrault) & Paris (Le Normant).

- Dell, R.K. 1956. The archibenthal Mollusca of New Zealand. *Dominion Museum Bulletin* 18: 1-235.
- Della Bella, G. & Scarponi, D. 2007. *Molluschi marini del Plio-Pleistocene dell'Emilia-Romagna e della Toscana. Superfamiglia Conoidea, 2-Conidae* 1., Ancona (Museo Geologico Giovanni Capellini): 93 pp.
- Deshayes, G.P. 1830. *Encyclopédie Méthodique. Histoire naturelle des vers.*, Paris (Mme Veuve Agasse): 2(1), 1-256.
- Deshayes, G.P. 1835. Mollusques. In: Bory de Saint-Vincent J.B.G.M. (ed.), *Expédition scientifique de Morée. Section des Sciences Physiques*, 3(1). Zoologie, 1. Animaux vertébrés, Mollusques et Polypiers. Paris (Levrault): 81-203, pl. 18-26.
- Desmoulins, C. 1842. Révision de quelques espèces de pleurotomes. *Actes de la Société Linnéenne de Bordeaux* 12: 109-181.
- Dillwyn, L.W. 1817. *A descriptive catalogue of recent shells, arranged according to the Linnean method; with particular attention to the synonymy*, 2., London (John and Arthur Arch): 581-1092.
- Dollfus, G. 1880. XI. Marnes à Nassa de Saint-Martin-d'Aubigny. In: Exposition géologique et paléontologique du Havre. *Bulletin de la Société Géologique de Normandie* 6 (1879): 516-517.
- Dollfus, G. 1907 [1906]. Faune malacologique du Miocène supérieur de Beaulieu (Mayenne) (Étage Redonien). *Association Française pour l'Avancement des Sciences, Compte Rendu* 35: 304-315.
- Dollfus, G.F., Cotter, J.C.B. & Gomes, J.P. 1903-1904. Mollusques tertiaires du Portugal. Planches de céphalopodes, gastéropodes et pélecypodes laissées par F.A. Pereira da Costa. Accompagnées d'une explication sommaire et d'une esquisse géologique. *Mémoires de la Commission du Service Géologique du Portugal* 34: 6 + 46 + 65 pp.
- Dollfus, G. & Dautzenberg, P. 1886. Étude préliminaire des coquilles fossiles des faluns de la Touraine. *La Feuille des Jeunes Naturalistes* 16(189): 101-105.
- Drivas, J. & Jay, M. 1986. Shells of Reunion. 8. Family Turridae Swainson, 1840. *Conchiglie* 18(208/209): 8-10.
- Dujardin, F. 1837. Mémoire sur les couches du sol en Touraine et description des coquilles de la craie et des faluns. *Mémoire de la Société Géologique de la France* 2: 211-311.
- Eastman, C.R. 1913. *Text-book of paleontology edited by C. R. Eastman adapted from the German of K.A. von Zittel, 2nd edition revised and enlarged by the editor in collaboration with the following named specialists: R.S. Bassler, W.H. Dall, C.D. Walcott*, 1. London (MacMillan & Co.): xii + 839 pp.
- Edwards, F.E. 1861. *A monograph of the Eocene Mollusca, or descriptions of shells from the older Tertiaries of England*, (3)3. *Prosobranchiata (continued)*. London (Palaeontographical Society): 241-330, pls. 28-33.
- Eichwald, E. 1829. *Naturhistorische Skizze von Lithauen, Volhynien und Podolien in geognostisch-mineralogischer, botanischer und zoologischer Hinsicht*. Wilna (Eichwald): 256 pp.
- Eichwald, E. 1853. *Lethaia Russica ou Paléontologie de la Russie*. Stuttgart (Schweizerbart): 533 pp.
- Eilertsen, M.H. & Malaquias, M.A. 2013. Systematic revision of the genus *Scaphander* (Gastropoda, Cephalaspidea) in the Atlantic Ocean, with a molecular phylogenetic hypothesis. *Zoological Journal of the Linnean Society* 167: 389-429.
- Etheridge, R. & Bell, A. 1898. On the Pliocene shell-beds at St Erth. *Transactions of the Royal Geological Society of Cornwall* 12: 111-166.
- Evenhuis, N.L. 2003. Dating and publication of the *Encyclopédie Méthodique* (1782-1832), with special reference to the parts of the *Histoire Naturelle* and details on the *Histoire Naturelle des Insects*. *Zootaxa* 166: 1-48.
- Evenhuis, N.L. & Petit, R.E. 2003. Corrections and additions to the dating of the 'Histoire Naturelle des Vers' and the *Tableau Encyclopédie* (Vers, coquilles, mollusques et polypiers) portions of the *Encyclopédie Méthodique*. *Zootaxa* 207: 1-4.
- Fekih, M. 1969. Pyramidellidae récoltés dans le Pliocène de l'Oued el Galaa (Menzel Bourguiba). *Notes du Service Géologique de Tunis* 29: 5-58.
- Fekih, M. 1975. Paleoecologie du Pliocène marin au nord de la Tunisie. *Annales des Mines et de la Géologie* 27: 1-195.
- Ferrero, E., Merlino, B. & Provera, A. 1998. Malacofauna pliocénica astigiana concentrata da eventi ad alta energia. *Bollettino Malacologico* 33: 43-57.
- Ferrero Mortara, E.L., Montefameglio, L., Pavia, G. & Tampieri, R. 1981. Catalogo dei tipi e degli esemplari figurati della collezione Bellardi e Sacco, 1. *Museo Regionale di Scienze Naturali di Torino, Cataloghi* 6: 1-327.
- Ferrero Mortara, E.L., Montefameglio, L., Novelli, M., Opresso, G., Pavia, G. & Tampieri, R. 1984. Catalogo dei tipi e degli esemplari figurati della collezione Bellardi e Sacco, 2. *Museo Regionale di Scienze Naturali, Cataloghi* 7: 1-484.
- Férussac A.E.J. 1821-1822a. *Tableaux systématiques des animaux mollusques suivis d'un prodrome général pour tous les mollusques terrestres ou fluviatiles vivants ou fossiles*, 1. *Tableaux systématiques généraux*, pp. i-xlvii. *Deuxième partie, Tableaux particuliers des mollusques terrestres et fluviatiles, Classe des Gastéropodes*. 1. *Tableau de la famille des limaces*, pp. 1-28. 2. *Tableau de la famille des limaçons*, pp. 1-92. 3. *Tableau de la famille des auricules*, pp. 93-114. Paris (Arthus-Bertrand). [For details of dates of publication see Kennard A.S., 1942].
- Férussac, J.B.L. d'Audebard de 1822b. *Bulle. Bulla*. Moll. In: Bory de Saint-Vincent (ed.). *Dictionnaire classique d'Histoire naturelle*, 2. Paris (Rey et Gravier & Baudouin Frères): 571-579.
- Finlay, H.J. 1927. New specific names for Austral Mollusca. *Transactions of the New Zealand Institute* 57: 488-533.
- Fischer, P. 1880-1887. *Manuel de conchyliologie et de paléontologie conchyliologique, ou histoire naturelle des mollusques vivants et fossiles*, 1-11. Paris (F. Savy), 1: xxiv + 1-112 (1880); 2: 113-192 (1881); 3: 193-304 (1881); 4: 305-416 (1882); 5: 417-512, (1883); 6: 513-608 (1883); 7: 609-688 (1884); 8: 689-784 (1885); 9: 785-896, (1885); 10: 897-1008 (1886); 11: 1009-1369 (1887); 23 pls.
- Fischer, P. 1883c. Diagnoses d'espèces nouvelles de mollusques recueillis dans le cours des expéditions scientifiques de l'avis le Travailleur (1882), 2. *Journal de Conchyliologie* 30: 273-277.
- Fischer, P. & Tournouër, R. 1873. Invertébrés fossiles du Mont Léberon (Vaucluse). In: Gaudry, A., Fischer, P. & Tour-

- noüer, R. (eds). *Animaux fossiles du Mont Léberon*, 1, Paris (Société Géologique de France): 13-171.
- Fleming, J. 1813. Conchology. *Brewster's Edinburgh Encyclopedia* 7: 55-107.
- Fleming, J. 1822. *The philosophy of zoology, a general view of the structure, functions and classification of animals*, 2. Edinburgh (Constable & Co.): 618 pp.
- Folin, L. de 1870. D'une méthode de classification pour les coquilles de la famille des Chemnitzidae. *Annales de la Société Linnéenne du Maine-et-Loire* 12: 191-202.
- Folin, L. de & Périer, L. 1867-1887. *Les fonds de la mer*, 1-4 Paris (Savy). 1: 1-48 (1867), 49-112 (1868), 113-176 (1869), 177-256 (1870), 257-272 (1872), pls 1-32; 2: 1-64 (1872), 65-112 (1873), 113-124 (1874), 125-160 (1875), 161-208 (1873), 209-304 (1874), 305-360 (1875), 361-365 (1876), pls 1-11; 3: 1-96 (1876), 97-208 (1877), 209-304 (1879), 305-337 (1880), pls 1-9; 4: 1-32 (1881), 33-148 (1881-1884), 149-192 (1884-1887), 192-224 (May-Jul. 1887), 225-240 (Jul.-Aug 1887), pls 1-15 (Dates after Rehder, 1946).
- Fontannes, F. 1879-1880. *Les invertébrés du bassin tertiaire du Sud-Est de la France. Les mollusques pliocènes de la Vallée du Rhône et du Roussillon*, 1. *Gastéropodes des formations marines et saumâtres*. Paris (Georg, Lyon & F. Savy): viii + 276 pp., 12 pls (pp. 1-76 published in 1879, remainder in 1880).
- Forbes, E. 1840. On some new and rare British Mollusca. *Annals and Magazine of Natural History* (1)5: 102-108.
- Forbes, E., & MacAndrew, R. 1846. Notes on new and rare animals observed during cruises in the British seas since the last meeting. *Athenaeum* 988: 1027.
- Fretter, V. & Graham, A. 1985. The prosobranch molluscs of Britain and Denmark, 8. Neogastropoda. *The Journal of Molluscan Studies* suppl. 15: 435-556.
- Fretter, V., Graham, A. & Andrews, E.B. 1986. The prosobranch molluscs of Britain and Denmark, 9. Pyramidellacea. *The Journal of Molluscan Studies* suppl. 16: 557-649.
- Friedberg, W. 1911-28. *Mięczaki mioceneskie ziem Polskich (Mollusca Miocaenica Poloniae)*, 1. *Ślimaki i łódkonogi*, 1. *Gastropoda et Scaphopoda*. Lwow (Muzeum Imienia Dzieduszyckich): 631 pp. (issued in parts: 1, 1-112, pls 1-5 (1911); 2, 113-240, pls 6-14 (1912); 3, 241-360, pls 15-20 (1914); 4, 361-440, pls 21-26 (1923); 5, 441-631, pls 27-38 (1928). Reprinted 1951-55 with slightly different title and pagination, Warszawa (Wydawnictwa Geologiczne).
- Gabb, W.M. 1873. Description of some new genera of Mollusca. *Proceedings of the Academy of Natural Sciences of Philadelphia* 1872 24: 270-274, pls 9-11.
- Gatto, R. 1997. Systematic revision of the conoidean species of the genus *Asthenotoma* Harris and Burrows, 1891 from the Italian Neogene. *Memorie di Scienze Geologiche* 49: 37-64.
- Giannuzzi-Savelli, R., Pusateri, F., Micali, P., Nofroni, I., Bartolini, S. 2014. *Atlante delle conchiglie marine del Mediterraneo*, 5 (*Heterobranchia*). Palermo (Danaus): 111 pp., 41 unnumbered pls (figs 1-363), appendix 1-91 pp.
- Gistel, J., 1848. *Naturgeschichte des Thierreichs für höhere Schulen*. Stuttgart (Hoffman): 216 pp.
- Glibert, M. 1949. Gastropodes du Miocène moyen du Bassin de la Loire, 1. *Memoires de l'Institut Royal des Sciences Naturelles de Belgique* 2(30): 1-240.
- Glibert, M. 1952a. Gastropodes du Miocène moyen du Bassin de la Loire, 2. *Memoires de l'Institut Royal des Sciences Naturelles de Belgique* 2(46): 241-450.
- Glibert, M. 1952b. Faune malacologique du Miocène de la Belgique, 2. Gastropodes. *Memoires de l'Institut Royal des Sciences Naturelles de Belgique* 121: 1-197.
- Glibert, M. 1954. Pleurotomes du Miocène de la Belgique et du Bassin de la Loire. *Mémoires de l'Institut Royal des Sciences Naturelles de Belgique* 129: 1-75.
- Glibert, M. 1958. Gastropodes du Diestien, du Scaldisien et du Merxémien de la Belgique, 2. *Bulletin de l'Institut royal des Sciences Naturelles de Belgique* 34(15): 1-36.
- Glibert, M. 1960. Gastropodes du Diestien, du Scaldisien et du Merxémien de la Belgique, 4(fin). Annexe. Additions aux pleurotomes du Neogène du Bassin de la Loire. *Bulletin de l'Institut royal des Sciences naturelles de Belgique* 36: 1-44.
- Gmelin, J.F. 1791. *Caroli a Linnei systema natura per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, disserentis, synonymis, locis etc. Editio decima tertia, aucta, reformata, cura J.F. Gmelin*, 1(6). *Vermes testacea*. Lipsiae (G.E. Beer): 3021-4120.
- Gofas, S. in WoRMS 2018. *Parthenina* Bucquoy, Dautzenberg & Dollfus, 1883. Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=565557> on 2018-04-23.
- González-Delgado, J.A. 1988. Estudio sistemático de los gasterópodos del Plioceno de Huelva (SW de España), 3. Mesogastropoda (Scalacea-Tonnacea). *Studia Geologica Salamanticensia* 25: 109-159.
- González-Delgado, J.A. 1992. Estudio sistemático de los gasterópodos del Plioceno de Huelva (SW de España), 5. Neogastropoda (Volutacea, Conacea). *Studia Geologica Salamanticensia* 28: 7-69.
- Graham, A. 1988. *Molluscs: Prosobranch and pyramidellids gastropods. Synopses of the British Fauna* (new series). In: Kermack, D.M. & Barnes, R.S.K (eds); second edition, published for The Linnaean Society of London and The Estuarine and Brackish-Water Sciences Association. Leiden (E.J. Brill/Dr. W. Backhuys): 662 pp.
- Granata-Grillo, G. 1876-1877. Contribuzione pella fauna dei molluschi del Mediterraneo. Catalogo delle conchiglie di Messina e dintorni. *Il Barth, Giornale di Medicina e Scienze Naturali, Malta* 4: 73-78 (1876); 143-147 (1877, pre-August); 5: 17-20 (1877, post-August).
- Grateloup, J.P.S. de 1828-35. Tableau des coquilles fossils qu'on rencontre dans les terrains calcaire tertiaires (faluns) des environs de Dax, dans le Département des Landes, 1-12. *Bulletins d'Histoire Naturelle de la Société Linnéenne de Bordeaux* 2(9): 72-109 (1828a) (1); 2(10): 123-158 (1828b) (2); 2(10): 192-204 (1828c) (3). *Actes de la Société Linnéenne de Bordeaux* 5(27): 192-204 (1832a) (4); 5(29): 263-282 (1832b) (5); 5(30): 314-344 (1832c) (6); 6(32): 31-48 (1833a) (7); 6(33): 90-100 (1833b) (8); 6(34): 159-164 (1833c) (9); 6(35): 188-212 (1834a) (10); 6(37): 270-320 (1834b) (11); 7(39): 101-114 (1835) (12).
- Grateloup, J.P.S. de 1838. Conchyliologie fossile du Bassin de l'Adour, 5. Famille des Plicacés (Trachélipodes LAM.). *Actes de la Société Linnéenne de Bordeaux* 10: 251-290, pl. 6.
- Grateloup, J.P.S. de 1845-1847. *Conchyliologie fossile des ter-*

- rains tertiaires du Bassin de l'Adour (environs de Dax), 1. *Univalves. Atlas*. Bordeaux (Th. Lafargue): pls 1-45 (1840); i-xx, 12 pp.; pls 46-48 (1846). Note: For dates of the plates we follow Lesport *et al.* (2012). All plates published 1845, except plates 2, 4, 11 (1847).
- Gray, J.E. 1827. Plate Mollusca [= plate 3], plate Mollusca III [= plate 4], plate Mollusca IV [= plate 6]. In: Smedley, E. Rose, H.J. & Rose H.J. (eds.). *Encyclopaedia Metropolitana* 7. Plates to Zoology.
- Gray, J.E. 1834. Enumeration of the species of the genus *Terebra*. *Proceedings of the Zoological Society of London for 1834*: 59-63.
- Gray, J.E. 1840. Shells of molluscous animals. In: *Synopsis of the contents of the British Museum* 42: 105-152.
- Gray J.E. 1842. [Mollusca]: 48-92. In: *Synopsis of the contents of the British Museum* (44th ed.) London (G. Woodfall & Son): iv + 308 p.
- Gray, J.E. 1847a. The classification of the British Mollusca, by W. E. Leach, M. D. *Annals and Magazine of Natural History* 20: 267-273 [October].
- Gray, J.E. 1847b. A list of the genera of Recent Mollusca, their synonyma and types. *Proceedings of the Zoological Society of London* (1847): 129-219 [November].
- Gray, J.E. 1850. *Figures of molluscous animals selected from various authors. Etched for the use of students by M.E. Gray*, 4. London (Longman, Brown, Green & Longmans): iv + 219 pp.
- Gray, J.E. 1852 (W.E. Leach, manuscript). *Molluscorum Britanniae. Synopsis of the Mollusca of Great Britain*. London (J. van Voors): i-xvi, 1-376: 13 pls.
- Gray, J.E. 1853. On the division of ctenobranchous gasteropodous Mollusca into larger groups and families. *Annals and Magazine of Natural History* (2)11: 124-132.
- Guppy, R.J.L. 1868. Further additions to the catalogue of the land and freshwater Mollusca of Trinidad. *Proceedings of the Scientific Association of Trinidad* 1: 237-245.
- Habe, T. 1952. Descriptions of new genera and species of the shell-bearing opisthobranchiate molluscs from Japan (Cephalaspidea, Tectibranchia). *Venus* 17: 69-77.
- Hanley, S. 1862. Description of new *Solaria*, chiefly in the collection of H. Cuming, Esq. *Proceedings of the Zoological Society of London for 1862* (2): 204-206.
- Harmer, F.W. 1914-1925. The Pliocene Mollusca of Great Britain, being supplementary to S.V. Wood's monograph of the Crag Mollusca, 1. *Monographs of the Palaeontographical Society*, 1(1): 1-200 (1914); 1(2): 201-302 (1915), 1(3): 303-461 (1918), 1(4): 463-483 (1919), 2(1): 485-652 (1920), 2(2): 653-704 (1921), 2(3): 705-856 (1923), 2(4): 857-900 (1925).
- Harris, G.F. & Burrows, H.W. 1891. *The Eocene and Oligocene Beds of the Paris Basin*. London (Geological Association of London): viii + 129 pp.
- Hartmann, J.D.W., 1840. *Erd- und Süßwasser-Gasteropoden*. St. Gallen (Scheitlin & Zollikofer), xx + 227 pp., 84 pls.
- Harzhauser, M. 2002. Marine und brachyhaline Gastropoden aus dem Karpatium des Korneuburger Beckens und der Kreuzstettener Bucht (Österreich, Untermiozän). *Beiträge zur Paläontologie* 27: 61-159.
- Harzhauser, M. & Kowalke, T. 2002. Sarmatian (late middle Miocene) gastropod assemblages of the Central Paratethys. *Facies* 46: 57-82.
- Hedley, C. 1911. Report on the Mollusca obtained by the F.I.S. 'Endeavour' chiefly off Cape Wiles South Australia, 1. *Zoological Results of the Fisheries Experiments carried out by F.I.S. 'Endeavour'* 1: 89-114.
- Herrmannsen, A.N. 1846-1852. *Indicis generum malacozoorum primordia. Nomina subgenerum, generum, familiarum, tribuum, ordinum, classium: adjectis auctoribus, temporibus, locis systematicis atque literariis, etymus, synonymis. Praetermittuntur Cirripedia, Tunicata et Rhizopoda*, 1-2. Cassel (T. Fischer): 1-232 (1846), 233-637 (1847) (1); 1-352 (1847), 353-492 (1848), 493-717 (1849) supplement (1852).
- Hinds, R.B. 1843. On new species of *Pleurotoma*, *Clavatula*, and *Mangelia*. *Proceedings of the Zoological Society of London* 11: 36-46.
- Hinds, R.B. 1844. Descriptions of new shells, collected during the voyage of the Sulphur, and in Mr. Cumings's late visit to the Philippines. *Proceedings of the Zoological Society of London* 11: 149-168.
- Hoernes, R. & Auinger, M. 1879-91. Die Gasteropoden der Meeres-Ablagerungen der ersten und zweiten Miocänen Mediterran-Stufe in der Österreichisch-Ungarischen Monarchie. *Abhandlungen der Kaiserlich-Königlichen Geologischen Reichsanstalt*, 12: 1-382, 50 pls. Published in parts: 1-52, pls 1-6 (1879); 53-112, pls 7-12 (1880); 113-152, pls 13-16 (1882); 153-192, pls 17-22 (1884); 193-232, pls 23-28 (1885); 233-282, pls 29-36 (1890); 283-330, pls 37-42 (1891); 331-382, pls 43-50 (1891).
- Høisæter, T. 2016. A taxonomic review of the Norwegian species of *Raphitoma* (Gastropoda: Conoidea: Raphitomidae). *Fauna Norvegica* 36: 9-32.
- Hörnes, M. 1851-1870. Die fossilen Mollusken des Tertiär-Beckens von Wien. *Abhandlungen der Kaiserlich-Königlichen Geologischen Reichsanstalt*, 3-4: 1-42, pl. 1-5 (1851), 43-208, pl. 6-20 (1852), 209-296, pl. 21-32 (1853), 297-382, pl. 33-40 (1854), 383-460, pl. 41-45 (1855), 461-736, pl. 46-52 (1856) (3); 1-479, pls 1-85 (1870) (4).
- Hoyle, W.E. 1886. Mollusca. *Zoological record*. 22, for 1885.
- ICZN [International Commission on Zoological Nomenclature] 1954. Opinion 287. Validation, under the plenary powers, of the generic name 'Scaphander' Montfort, 1810 (class Gastropoda, order Tectibranchiata). *Opinions and Declarations rendered by the International Commission on Zoological Nomenclature* 8: 4962.
- ICZN [International Commission on Zoological Nomenclature] 1963. Opinion 666. *Clathurella* Carpenter (Gastropoda): designation of a type-species under the Plenary Powers. *Bulletin of Zoological Nomenclature* 20: 267-269.
- ICZN [International Commission on Zoological Nomenclature] 1965. Opinion 754. *Crassispira* Swainson, 1840 (Gastropoda): designation of a type-species under the Plenary Powers. *Bulletin of Zoological Nomenclature* 22: 228-229.
- ICZN [International Commission on Zoological Nomenclature] 1974. Opinion 1030. *Cylindrella* Swainson, 1840 (Mollusca, Gastropoda): suppressed under the Plenary Powers. *Bulletin of Zoological Nomenclature* 31: 190-191.
- ICZN [International Commission on Zoological Nomenclature] 1999. *International Code of Zoological Nomenclature. Fourth Edition*. London (International Trust for Zoological Nomenclature): xxix + 306 pp.

- ICZN [International Commission on Zoological Nomenclature] 2007 Opinion 2185. (Case 3340) *Helicacis* d'Orbigny, 1842 (Mollusca, Gastropoda): conserved. *Bulletin of Zoological Nomenclature* 64(4): 263-264.
- Ilijina (Il'ina), L.B. 1993. Handbook for identification of marine middle Miocene gastropods of Southwestern Eurasia. *Trudi Palaeontological Institute* 255: 1-149 (in Russian).
- [Illiger, J.K.W.], 1807. Vorschlag zur Aufnahme im Fabricischen Systeme fehlender Käfergattungen. *Magazin für Insektenkunde* 6: 318-349.
- Iredale, T. 1915a. Some more misused molluscan generic names. *Proceedings of the Malacological Society of London* 11(5): 291-309.
- Iredale, T. 1915b. Notes on the names of some British marine Mollusca. *Proceedings of the Malacological Society of London* 11(6): 329-342.
- Iredale, T. 1917. Molluscan name-changes, generic and specific. *Proceedings of the Malacological Society of London* 12: 322-330.
- Iredale, T. 1929. Strange mollusks in Sydney Harbour. *The Australian Zoologist* 5: 337-352.
- Iredale, T. 1936. Australian molluscan notes, 2. *Records of the Australian Museum* 19: 267-340, pls 20-24.
- İslamoğlu, Y. & Taner, G. 2003. Antalya Miyosen havzasının Gastropoda faunası (Batı-Orta Toroslar, GB. Türkiye) (Gastropod fauna of Antalya Miocene basin (Western-central Taurids, SW Turkey)). *Bulletin of Mineral Research and Exploration* 127: 29-65 (in Turkish).
- Ivolas, J. & Peyrot, A. 1900. Contribution à l'étude paléontologique des faluns de la Touraine. *Actes de la Société Linéenne de Bordeaux* 55: 99-249.
- Janssen, A.W. 1972. Die Mollusken-Fauna der Twistringer Schichten (Miocän) von Norddeutschland. *Scripta Geologica* 10: 1-95.
- Janssen, A.W. 1984. *Mollusken uit het Mioceen van Winterswijk-Miste. Een inventarisatie, met beschrijvingen en afbeeldingen van alle aangetroffen soorten*. Amsterdam (Koninklijke Nederlandse Natuurhistorische Vereniging, Nederlandse Geologische Vereniging & Rijkmuseum van Geologie en Mineralogie): 451 pp.
- Janssen, A.W. 2008. What's in a name? That what we call a rose bij [*sic*] any other name *Afzettingen van de Werkgroep voor Tertiaire en Kwartaire Geologie* 29(1): 3-7.
- Jeffreys, J.G. 1847. Descriptions and notices of British shells. *Annals and Magazine of Natural History* 19: 309-314.
- Jeffreys, J.G. 1848. On the recent species of *Odostomia*, a genus of gasteropodous mollusks inhabiting the seas of Great Britain and Ireland. *Annals and Magazine of Natural History* (2)2: 330-350.
- Jeffreys, J.G. 1862-1869. *British Conchology*. London, van Voorst: 1: cxiv + 341 [1862]; 2: 479 [1864: titlepage states date as 1863, but published 1864]; 3: 394 [1865]; 4: 487 [1867]; 5: 259 [1869].
- Jeffreys, J.G. 1878-1885. On the Mollusca procured during the H.M.S. 'Lightning' and 'Porcupine' expedition, 1-9. *Proceedings of the Zoological Society of London* 1878: 393-416, pls 22-23 (1); 1879: 553-588, pls 45-46 (October 1879) (2); 1881: 693-724, pl. 61 (3); 1881: 922-952, pls 70-71 (4); 1882: 656-687, pls 49-50 (1883) (5); 1883a: 88-115, pls 19-20 (6); 1884: 111-149, pls 9-10 (7); 1884: 341-372, pls 26-28 (8); 1885: 27-63, pls 4-6 (9).
- Jeffreys, J.G. 1883b. Mediterranean Mollusca N. 3 and other Invertebrata. *Annals and Magazine of Natural History* (5)11: 393-401, pl. 16.
- Jurine, L. 1817. Verzeichniss der Weichthiere, welche zu und um Genf zu Land und zu Wasser gefunden werden. *Helvetischer Almanach* 1817: 14-37.
- Kanmacher, F. 1798. *Second edition of Adams J, Essays on the microscope: containing a practical description of the most improved microscopes; a general history of insects, their transformations, peculiar habits, and oeconomy: an account of the various species, and singular properties, of the hydrae and vorticellae: a description of three hundred and eighty-three animalcula: with a concise catalogue of interesting objects: a view of the organization of timber, and the configuration of salts, when under the microscope*. London (Dillon & Keating): 592-644.
- Kano, Y., Brenzinger, B., Nützel, A., Wilson, N.G. & Schrödl, M. 2016. Ringiculid bubble snails recovered as the sister group to sea slugs (Nudipleura). *Scientific Reports* 6: 30908; doi:10.1038/srep30908.
- Kantor, Y., Lozouet, P., Puillandre, N. & Bouchet, P. 2014. Lost and found: The Eocene family Pyramimitridae (Neogastropoda) discovered in the Recent fauna of the Indo-Pacific. *Zootaxa* 3754: 239-76.
- Kautsky, F. 1925. Das Miocän von Hemmoor und Basbeck-Osten. *Abhandlungen der Preussischen Geologischen Landesanstalt* 97: 1-225.
- Kecskeméti-Körmendy, A. 1962. Neue Molluskenarten aus dem Mittelmiozän von Várpalota, I Gastropoden. *Földtani Közlöny* 92: 81-99.
- Kennard, A.S. 1942. The Histoire and Prodrome of Ferrusac, 3. The divisional names. *Proceedings of the Malacological Society of London* 25(1): 12-17; 25(3): 105-118.
- Kiener, L.C. 1839. *Spécies général et iconographie des coquilles vivantes comprenant la collection du Muséum d'Histoire Naturelle de Paris, collection Lamarck, celle du Prince Masséna et les découverts récente des voyageurs. Genre pleurotome*. (Pleurotoma, Lam.) 5. Paris (Rousseau): 1-84, pls. 1-27.
- Kilburn, R.N. 1986. Turridae (Mollusca: Gastropoda) of southern Africa and Mozambique, 3. Subfamily Borsoniinae. *Annals of the Natal Museum* 27: 633-720.
- Kobelt, W. 1887-1908. *Iconographie der schalentragende europäischen Meeresconchylien*. Fischer, Cassel. 1: 1-171 pl. 1-28 [1887]; 2: 1-16 pl. 29-32 [1888] 17-40 pl. 33-38 [1889] 41-104 pl. 39-50 [1900] 105-139 pl. 51-58 [1901]; 3: 1-24 pl. 59-62 [1902] 25-200 pl. 63-78 [1903] 201-272 pl. 79-84, 86-87 [1904] 273-406 [1905]; 4: 1-80 pl. 99-114 [1906] 81-172 pl. 115-126 [1908].
- Kobelt, W. 1897-1901, *Die Familie Auriculacea*. 1(16): 1-76, pls. 10, 11, 13 [1897]; 77-228, pls. 12, 14-30 [1898]; 229-268, pls. 31, 32 [1900]; 269-316, pl. 33 [1901], In Martini, F.H.W. & Chemnitz, J.H. *Systematisches Conchylien-Cabinet*. Nürnberg (Verlag von Bauer & Raspe) (Emil Küster).
- Koenen, A. von 1872. Das Miozän Nord-Deutschlands und seine Mollusken-Fauna, 1. Einleitung und Palaeontologische Beschreibung der Syphonostomen Gastropoden. *Schriften der Gesellschaft zur Beförderung der Gesamten Naturwissenschaften zu Marburg* 10: 139-262.

- Koenen, A. von 1882. Das Miocän Nord-Deutschlands und seine Mollusken-Fauna, 2. Die Gastropoda holostomata und tectibranchiata, Cephalopoda und Pteropoda des Nord-deutschen Miocän. *Neues Jahrbuch für Mineralogie, Geologie und Paläontologie* 2: 223-367.
- Kojumdgieva, E.M. & Strachimirov, B. 1960. Les fossiles de Bulgarie, 7. Tortonien. Sofia (Académie des Sciences de Bulgarie): 317 pp.
- Kolesnikov, V. 1935. Sarmatische Mollusken. *Paläontologie der USSR* 10: 1-416 (in Russian with German descriptions).
- Kuroda, T. & Habe, T. 1952. *Check list and bibliography of the Recent marine Mollusca of Japan*. Tokyo (Leo W. Stach): 210 pp.
- Kuroda, T., Habe, T. & Oyama, K. 1971. *The sea shells of Sagami Bay*. Tokyo (Maruzen): xix + 741 pp. (in Japanese), 489 pp (in English), 51 pp., 121 pls.
- Lamarck, J.B.P.A. de M. 1799. Prodrome d'une nouvelle classification des coquilles, comprenant une rédaction appropriée des caractères génériques, et l'établissement d'un grand nombre de genres nouveaux. *Mémoires de la Société d'Histoire Naturelle de Paris* 1: 63-91.
- Lamarck, J.B.P.A. de M. 1801. *Système des animaux sans vertèbres, ou tableau général des classes, des ordres et des genres de ces animaux; présentant leurs caractères essentiels et leur distribution, d'après la considération, et suivant l'arrangement établi dans les galeries du Muséum d'Histoire Naturelle, parmi leurs dépouilles conservées; précédé du discours d'ouverture du cours de zoologie, donné dans le Muséum National d'Histoire Naturelle l'an 8 de la république*. Paris (Lamarck & Deterville): viii + 432 pp.
- Lamarck, J.B.P.A. de M. 1810. Descriptions des coquilles fossiles des environs de Paris. *Annales du Muséum National d'Histoire Naturelle de Paris* 15: 422-440.
- Lamarck, J.B.P.A. de M. 1816. *Tableau encyclopédique et méthodique des trois règnes de la nature ...*, 23. Mollusques et polypes divers. Liste des objets représentés dans les planches de cette livraison. Paris (Mme Veuve Agasse): 16 pp., pls. 391-488, 431 pls, 431 pls* (14 December 1816; see Evenhuis, 2003; Evenhuis & Petit, 2003, for history of publication, and dates and parts of the whole work).
- Lamarck, J.B.P.A. de M. 1822. *Histoire naturelle des animaux sans vertèbres, présentant des caractères généraux et particuliers de ces animaux, leur distribution, leurs classes, leurs familles, leurs genres, et la citation des principales espèces qui s'y rapportent, précédée d'une introduction offrant la détermination des caractères essentiels de l'animal, sa distinction du végétal et des autres corps naturels; enfin, l'exposition des principes fondamentaux de la zoologie*, 7. Paris (de Lamarck): 711 pp.
- Lamarck, J.B.P.A. de 1838. In: Deshayes, G.P. & Milne Edwards, H. (eds). *Histoire naturelle des animaux sans vertèbres présentant les caractères généraux et particuliers de ces animaux, leur distribution, leurs classes, leur familles, leurs genres, et la citation des principales espèces qui s'y rapportent; précédée d'une introduction offrant la détermination des caractères essentiels de l'animal, sa distinction du végétal et des autres corps naturels; enfin l'exposition des principes fondamentaux de la zoologie. Deuxième édition revue et augmentée de notes présentant les faits nouveaux dont la science s'est enrichie jusqu'à ce jour*, 8. Paris (Baillière): (iv) + 1-660.
- Landau, B.M., Harzhauser, M., Islamoğlu, Y. & Silva, C.M. da 2013. Systematics and palaeobiogeography of the gastropods of the middle Miocene (Serravallian) Karaman Basin, Turkey. *Cainozoic Research* 11-13: 3-584.
- Landau, B.M. & LaFollette, P.I. 2015. The Pyramidellidae (Mollusca: Gastropoda) from the Miocene Cantaure Formation of Venezuela. *Cainozoic Research* 15(1-2): 13-54.
- Landau, B., Silva, C.M. da & Mayoral, E. 2011. The lower Pliocene gastropods of the Huelva Sands Formation, Guadalquivir Basin, southwestern Spain. *Palaeofocus* 4: 1-90.
- Laseron, C.F. 1956. The families Rissoinidae and Rissoidae (Mollusca) from the Solanderian and Dampierian zoogeographical provinces. *Australian Journal of Marine and Freshwater Research* 7(3): 384-484.
- Lauriat-Rage, A., Brébion, P., Buge, E., Chaix, C., Chevalier, M., Margerel, J.P., Pajaud, D., Pouit, D., Roman, J. & Viaud, J.M. 1989. Le gisement redonien (Pliocène) de la Marnière (La Limouzinière, Loire-Atlantique). Biostratigraphie, paléobiologie, affinités paléobiogéographiques. *Géologie de la France* 1989 (1-2): 117-152.
- Lea, I. 1833. *Contributions to geology*. Philadelphia (Carey, Lea and Blanchard): 227 pp., 6 pls.
- Lemche, H. 1957. Proposed use of the Plenary Powers to secure that the specific name *obtusa* Montagu 1803, as published in the combination *Bulla obtusa*, shall be the oldest available name for the species currently known by that name (class Gastropoda, order Tectibranchiata). *The Bulletin of Zoological Nomenclature* 12(12): 323-327.
- Lesport, J.F., Cluzaud, A. & Verhecken, A. 2012. Les publications du Docteur Jean-Pierre Sylvestre de Grateloup sur les mollusques fossiles du Bassin d'Aquitaine (S.-O. France): dates de parutions et commentaires. *Bulletin de la Société Linéenne de Bordeaux* (n.s.) 40: 417-485.
- [Lightfoot, J.] 1786. (Descriptions of species). In: *A catalogue of the Portland Museum, lately the property of the Dowager Duchess of Portland, deceased, which will be sold at auction, by Mr. Skinner & Co*. London: viii + 194 pp.
- Linden, J. van der & Eikenboom, J.C.A. 1992. On the taxonomy of the Recent species of the genus *Chrysallida* Carpenter from Europe, the Canary Islands and the Azores. *Basteria* 56: 3-64.
- Linnaeus, C. 1758. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*, 1. Editio decima, reformata. Holmiae (Laurentii Salvii): 824 pp. [facsimile reprint, British Museum (Natural History), 1956].
- Linné, C. a 1767. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*, 1(1-2). Editio duodecima, reformata. Holmiae (Laurentii Salvii): 1-532 (1), 533-1327, 1-37 (2).
- Locard, A. 1892. *Les coquilles marines des côtes de France*. Paris (J.B. Baillière & fils): 384.
- Locard, A. 1897-1898. *Expéditions scientifiques du Travailleur et du Talisman pendant les années 1880, 1881, 1882 et 1883. Mollusques testacés*. Paris (Masson): 1: 1-516 pls 1-22 [1897]; 2: 1-515, pls 1-18 [1898].
- Lovén S.L. 1846. Malacologiska Notiser [listed in index as 'Om de nord. arterna af Turbonilla'] Öfversigt af Kongl.

- Vetenskaps-Akademiens Förhandlingar* 3(2): 46-50.
- Lowe, R.T. 1841. On *Parthenia*, a new genus of Recent marine shells or mollusks, containing British species. *Proceedings of the Zoological Society of London* 8(88-89): 39-42.
- Lowe, R.T., 1855. Catalogus Molluscorum Pneumonitorum Insularum Maderensium: or A list of all the land and fresh-water shells, recent and fossil, of the Madeiran Islands: arranged in groups according to their natural affinities; with diagnoses of the groups, and of the new or hitherto imperfectly defined species. *Proceedings of the Zoological Society of London* 22: 161-218.
- Lozouet, P., Lesport, J.F., & Renard, P. 2001. Révision des Gastropoda (Mollusca) du stratotype de l'Aquitainien (Miocène inf.): site de Saucats 'Larrey', Gironde, France. *Cossmanniana* (hors série 3): 189 pp.
- Lygre, F., Schander, C., Kongsrud, J.A. & Krakstad, J.O. 2011. Three species of *Parthenina* (Chrysallidinae, Pyramidelloidea) new to West Africa. *Journal of Conchology* 40(4): 477-481.
- Marcus Ev. du B.-R. 1977. On the genus *Tornatina* and related forms. *The Journal of Molluscan Studies* suppl. 2: 1-35.
- Malatesta, A. 1960. Malacofauna pleistocenica di Grammichele (Sicilia). *Memorie per Servire alla Carta Geologica d'Italia* 12: 1-196.
- Malatesta, A. 1974. Malacofauna pliocenica Umbra. *Memorie per Servire alla Carta Geologica d'Italia* 13: 1-498.
- Mancini, A. 1997. I molluschi fossili della Cava di Formello (Guidonia, Roma). *Annali dell'Associazione Nomentana di Storia ed Archeologia* 3: 35-44.
- Manousis, T., Kontadakis, C., Mbazios, G., Polyzoulis, G. & Galinou-Mitsoudi, S. 2017. Possible poecilogony due to discontinuous multifactorial inheritance in some Mediterranean species of *Raphitoma* (Mollusca, Conoidea, Raphitomidae). *Organismal and Molecular Malacology*, Prof. Sajal Ray (ed.), InTech, <https://www.intechopen.com/books/organismal-and-molecular-malacology/possible-poecilogony-due-to-discontinuous-multifactorial-inheritance-in-some-mediterranean-species-o>.
- Marasti, R. & Raffi, S. 1976. Osservazioni biostratigrafiche e paleoecologiche sulla malacofauna del Piacenziano di Maiatico (Parma, Emilia Occidentale). *Bollettino della Società Paleontologica Italiana* 15: 189-214.
- Maravigna, C. 1840. Description de plusieurs coquilles nouvelles. *Revue Zoologique de la Société Cuvierienne* 1840: 325-326.
- Mariottini, P., Smriglio, C., Di Giulio, A. & Oliverio, M. 2009. A new fossil conoidean from the Pliocene of Italy, with comments on the *Bela menckhorsti* complex (Gastropoda: Conidae). *Journal of Conchology* 40: 5-14.
- Marquet, R. 1993. The molluscan fauna of the Kruisschans Member (Lillo Formation, late Pliocene) in the Antwerp area (Belgium). *Contributions to Tertiary and Quaternary Geology* 30: 83-103.
- Marquet, R. 1997a. The Pliocene turrid gastropods of Belgium, 1. Drilliidae, Turridae, Conidae (genus *Bela*). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre* 67: 119-151.
- Marquet, R. 1997b. Pliocene gastropod faunas from Kallo (Oost-Vlaanderen, Belgium), 3-4. Caenogastropoda: Aporrhaidae to Muricidae (3); Buccinidae to Helicidae (4). *Contributions to Tertiary and Quaternary Geology* 34: 69-149.
- Marquet, R. 1998a. The Pliocene turrid gastropods of Belgium, 2. Conidae (genera *Asthenotoma*, *Comarmondia*, *Cythereella*, *Mangelia*, *Lusitanops*, *Raphitoma* and *Philbertia*). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre* 68: 263-287.
- Marquet, R. 1998b. *De Pliocene gastropodenfauna van Kallo (Oost-Vlaanderen, België)*. Antwerpen (Belgische Vereniging voor Paleontologie v.z.w.): 1-246.
- Martens, E. von. 1899. In: Carlgren, O., Hilgendorf, F., Martens, E. von, Matschie, P., Tornier, G. & Weltner, W. (eds.). *Symbolae physicae seu icones adhuc ineditae corporum naturalium novorum aut minus cognitorum, quae ex itinere per Libyam, Aegyptum etc. cl. F.G. Hemprich et C.G. Ehrenberg annis MDCCCXX-MDCCCXXV redierunt. Zoologica*. Berlin (G. Reimer) [Mollusca, pp. 11-12, pl. 3].
- Martinell, J. 1982a. Estudio de los Conacea (Neogastropoda, Gastropoda) del Plioceno de l'Empordà (Catalunya). Descriptiva y sistemática. *Iberus* 2: 95-119.
- Martinell, J. 1982b. Euthyneura del Plioceno del Empordà (Girona). Descriptiva y sistemática. *Studia Geologica Salmanticensia* 16: 223-233.
- Martinell, J. & Domènech, R. 1984. Malacofauna del Plioceno de Sant Onofre (Baix Ebre; Tarragona). *Iberus* 4: 1-17.
- Martinell, J. & Domènech, R. 1985. Caractéristiques tafonomiques i paleoecologiques del Pliocè Marí de l'Empordà. *Centre d'Investigaciones Arqueològiques, sèrie monogràfica* 4: 5-69.
- Martini, F.H.W. 1769-1777. *Neues Systematisches Conchylien-Cabinet* 1-3. G.N. Raspe.
- Martins, A.M. de F. 1999. On the generic separation of *Ovatella* Bivona, 1832 and *Myosotella* Monterosato, 1906 (Pulmonata, Ellobiidae). *Iberus* 17(2): 59-75.
- Mayer, K. 1868. Description de coquilles fossiles des terrains tertiaires supérieurs (suite). *Journal de Conchyliologie* 16: 102-112.
- Melville, J.C. 1910. A revision of the species of the family Pyramidellidae occurring in the Persian Gulf, Gulf of Oman and North Arabian Sea, as exemplified mostly in the collections made by Mr. F.W. Townsend (1893-1900), with descriptions of new species. *Proceedings of the Malacological Society of London* 9: 171-207, pls 4-6.
- Ménard de la Groye, F.J.B. 1811. Sur un petit coquillage de la Méditerranée qui est analogue à des fossiles des environs de Paris et de Bordeaux. *Annales du Museum d'Histoire Naturelle, Paris* 17: 331-332.
- Micali, P. 2010. Nota sul genere *Haedropleura* B.D.D., 1883 nel Mediterraneo. *Malacologia Mostra Mondiale* 67: 3-5.
- Michaud, A.L.G. 1828. Description de plusieurs espèces de coquilles vivantes de la Méditerranée. *Bulletin d'Histoire Naturelle de la Société Linnéenne de Bordeaux* 2: 119-122 (reprinted 1845).
- Michaud, A.L.G. 1829. Description de plusieurs espèces nouvelles de coquilles vivantes. *Bulletin d'Histoire Naturelle de la Société Linnéenne de Bordeaux* 3: 260-276, 1 pl. (un-numbered).
- Michelotti, G. 1847. Description des fossiles des terrains miocènes de l'Italie septentrionale. *Natuurkundige Verhandelingen van de Hollandsche Maatschappij der Wetenschappen te Haarlem* (2)3: 408 pp. Also as: Ouvrage publié par

- la Société Hollandaise des Sciences, et accompagné d'un atlas de 17 planches. Leiden (A. Arns & Compie): 408 pp.
- Mifsud, C. 2001. *The genus Mitromorpha Carpenter, 1865 (Neogastropoda, Turridae), and its sub-genera with notes on the European species*. Rabat (Mifsud): 32 pp.
- Mighels J.W. 1843. Descriptions of six species of shells regarded as new. *Boston Journal of Natural History* 4: 345-350, pl. 16.
- Millet [de la Turtaudière], P.A. 1827. Mémoire sur un nouveau genre (*Defrancia*) de coquilles de la famille de Zoophages. *Mémoires de la Société Linnéenne de Paris* 5: 437-441, pl. 9 (usually cited with the year 1826, the paper was read at the 18 May 1826 session of the Société Linnéenne de Paris, but was only included in the Mémoires volume 5 [for the year 1826], published in 1827).
- Millet de la Turtaudière, P.A. 1854. *Paléontologie de Maine-et-Loire*. Angers (Cosnier et Lachèse): 187 pp.
- Millet de la Turtaudière, P.A. 1865. *Indicateur du Maine-et-Loire ou indications par commune de ce que chacune d'elles renferme*, 2. Angers (Cosnier et Lachèse): 616 pp.
- Milne-Edwards, [A.] & Haime, J., 1851. Monographie des polypiers fossiles des terrains paléozoïques, précédée d'un tableau général de la classification des polypes. *Archives du Muséum d'Histoire Naturelle de Paris* 5: 1-502.
- Moiescu, G. 1955. *Stratigrafia și fauna de moluște din depozitele tortonien și sarmatien din regiunea Bujturi, Republica Populară Română*. București (Editura Academiei Republicii Populare Române): 5-230.
- Möllendorff, O von. 1898. Verzeichniss der auf den Philippinen lebenden Landmollusken. *Abhandlungen der Naturforschenden Gesellschaft zu Görlitz* 22: 25-208.
- Montagu, G. 1803. *Testacea Britannica, or natural history of British shells, marine, land and the fresh-water, including the most minute: systematically arranged and embellished with figures*. London (Romsey): xxxvii + 606 pp.
- Montagu, G. 1808. *Supplement to Testacea Britannica with additional plates*. Exeter (Woolmer): v + 183 pp, pls 17-30.
- Montanaro, E. 1937. Studi monografici sulla malacologia Miocenica Modenese, 1. I molluschi Tortoniani di Montegibbio. *Palaeontographia Italica*, 37 (nuova serie 5): 115-191.
- Montefameglio, L., Pavia, G. & Rosa, D.A. 1979. Associazione a molluschi del Tortoniano del Basso Monferrato (Alba, Italia NW). *Bollettino della Società Paleontologica Italiana* 18(2): 173-199.
- Monterosato, T.A. di 1872. *Notizie intorno alle conchiglie fossili di Monte Pellegrino e Ficarazzi*. Palermo (Ufficio Tipografico Michele Amenta): 44 pp.
- Monterosato T.A. di 1874. Recherches conchyliologiques, effectuées au Cap Santo Vito, en Sicile. (Traduz. dall'italiano di H. Crosse). *Journal de Conchyliologie* 22(3): 243-282.
- Monterosato, T.A. di 1875. Note intorno ad alcuni articoli di Conchiologia Mediterranea pubblicati nel Jahrbucher der deutschen Malakozoologische Gesellschaft dal Sig. H. C. Weinkauff e dal Dott. Kobelt. *Bollettino della Società Malacologica Italiana* 1: 68-73.
- Monterosato, T.A. di 1878. Note sur quelques coquilles draguées dans les eaux de Palerme. (Trad. H. Crosse). *Journal de Conchyliologie* 26: 143-160.
- Monterosato, T.A. di 1880. Nota sopra alcune conchiglie coralligene del Mediterraneo. *Bollettino della Società Malacologica Italiana* 6: 243-259.
- Monterosato, T.A. di 1884. *Nomenclatura generica e specifica di alcune conchiglie mediterranee*. Palermo (Virzi): 152 pp.
- Monterosato, T.A. di 1890. Conchiglie della profondità del mare di Palermo. *Naturalista Siciliano* 9(6): 140-151 [1 March]; 9(7): 157-166 [1 April]; 9(8): 181-191 [1 May].
- Monterosato, T.A. di 1906. Articolo sulle Auriculidae, Assimnidae e Truncatellidae dei mari d'Europa. *Naturalista Siciliano, Palermo* 18(6): 125-130.
- Monterosato, T.A. di 1917. Molluschi viventi e quaternari raccolti lungo le coste della Tripolitania dall'Ing. Camillo Crema. *Bollettino della Società Zoologica Italiana* (3)4: 1-28.
- Montfort, D. de 1810. *Conchyliologie systématique, ou classification méthodique des coquilles; offrant leurs figures, leur arrangement générique, leurs descriptions caractéristiques, leurs noms; ainsi que leur synonymie en plusieurs langues. Ouvrage destiné à faciliter l'étude des coquilles, ainsi que leur disposition dans les cabinets d'histoire naturelle. Coquilles univalves, non cloisonnées. Coquilles univalves, non cloisonnées*. Paris (F. Schoell): 676 pp.
- Moquin-Tandon, A. 1856. *Histoire naturelle des mollusques terrestres et fluviatiles de la France contenant des études générales sur leur anatomie et leur physiologie et la description particulière des genres, des espèces et des variétés*, 2. Paris (Baillière): 646 pp.
- Morgan, J. de 1915. Observations sur la stratigraphie et la paléontologie du Falunien de la Touraine. *Bulletin de la Société Géologique de France* (4)15: 217-241.
- Morlet, L. 1878. Monographie du genre *Ringicula*, Deshayes, et descriptions de quelques espèces nouvelles. *Journal de Conchyliologie* 28: 150-181, pls 5-6.
- Morlet, L. 1880. Supplément à la monographie du genre *Ringicula*, Deshayes. *Journal de Conchyliologie* 26: 113-135, pls 5-8.
- Morlet, L. 1882. Deuxième supplément à la monographie du *Ringicula* Deshayes. *Journal de Conchyliologie* 30: 200-215.
- Morrison, J.P.E. 1965. On the families of Turridae. *The American Malacological Union, Annual Reports for 1965*: 1-2.
- Mörch, O.A.L. 1852. *Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra & Gadea Comes de Yoldi, regis danicae cubiculariorum princeps, ordinis dannebrogi in prima classe & ordinis Caroli Tertii Eques*, 1. *Cephalophora*. Hafniae (Ludovici Kleini): (iv) + 170 pp.
- Moroni, M.A. 1955. La macrofauna saheliana del Messiniano inferiore della Repubblica di S. Marino. *Giornale di Geologia* (2)25: 81-162.
- Morton, J. 1955. The evolution of the Ellobiidae with a discussion on the origin of the Pulmonata. *Proceedings of the Zoological Society of London* 125(1): 127-168.
- Moths, H. 1989. Die Molluskenfauna des miozänen Glimmertons aus Gross Pampau (Krs. Hzgt. Lauenburg BRD). *Der Geschiebesammler* 22: 105-162.
- Moths, H., Albrecht, F. & Stein, G. 2010. Die Molluskenfauna (Hemmoorium, Untermiozän) aus der Kiesgrube Krinke bei Werder (Nordwest-Niedersachsen). *Palaeofocus* 3: 1-155.
- Newton, R.B. 1891. *Systematic list of the F. E. Edwards collection of British Oligocene and Eocene mollusca in the*

- British Museum (Natural History), with references to the type-specimens from similar horizons contained in other collections belonging to the Geological Department of the Museum.* London (British Museum): xxviii + 365 pp.
- Nordsieck, F. 1968. *Die europäischen Meeres-Gehäuseschnecken (Prosobranchia). Vom Eismeer bis Kapverden und Mittelmeer.* Stuttgart (Gustav Fischer): viii + 273 pp.
- Nordsieck, F. 1972a. *Die miozäne Molluskenfauna von Miste-Winterswijk NL.* Stuttgart (Fischer): 187 pp.
- Nordsieck, F. 1972b. *Die Europäischen Meeresschnecken (Opisthobranchia mit Pyramidellidae; Rissoacea).* Stuttgart (Gustav Fischer Verlag): 327 pp.
- Nordsieck, F. 1977. *The Turridae of the European seas.* Roma (Ed. la Piramide): 131 pp.
- Nyst, P.H. 1845. Description des coquilles et des polypiers fossils des terrains tertiaires de la Belgique. *Mémoire couronné de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles* 17: 1-697, pls. 1-15 (title page dated 1843, but not published until 1845. Also published in book form [Bruxelles (Hayez), in several parts and 33 additional plates 1845-1846]; for additional data, see H. J. Anderson 1964: 121.
- Nyst, P.H. 1878. Conchyliologie des terrains tertiaires de la Belgique, 1 Terrain Pliocène Scaldisien. *Annales du Musée Royal d'Histoire Naturelle de Belgique, série Paléontologique* 3: atlas, 28 pls.
- Nyst, P.H. 1882. Conchyliologie des terrains tertiaires de la Belgique, 1. Terrain Pliocène Scaldisien. *Annales du Musée Royal d'Histoire Naturelle de Belgique, série Paléontologique* 3: text, 1-263.
- Oliverio, M. 1995. The systematics of the radula-less gastropod *Clathromangelia* (Caenogastropoda, Conoidea). *Zoologica Scripta* 24(3): 193-201.
- Oliverio, M. & Tringali, L.P. 2001. The types of marine molluscan species described by Monterosato, in the Museo Civico di Zoologia, Roma. General scope of the work, and part 1: the opisthobranch gastropods. *Bollettino Malacologico* 37(5-8): 121-142.
- Olsson, A.A. 1964. *Neogene Mollusks from northwestern Ecuador.* New York (Paleontological Research Institution, Ithaca): 256 pp.
- Olsson, A.A. 1967. *Some Tertiary mollusks from south Florida and the Caribbean.* Ithaca, N.Y (Paleontological Research Institution): 61 pp., 9 pls. [Reprinted 1993 in *Paleontological Research Institution Special Publication* 19].
- Orbigny, A. d' 1837. Mémoire sur des espèces et sur des genres nouveaux de l'ordre des nudibranches observés sur les côtes de France. *Magasin de Zoologie* 7, classe 5: 1-16, pl. 102-109.
- Orbigny, A. d' 1840. *Mollusques, Echinodermes, Foraminifères et Polypiers recueillis aux Iles Canaries par MM. Webb et Berthelot.* In: Webb, P.B. & Berthelot, S. Histoire Naturelle des Îles Canaries. Paris, 2(2): 152 p., 14 pls.
- Orbigny A. d' 1839-1842. *Mollusques, echinodermes, foraminifères et polypiers recueillis aux Iles Canaries par MM. Webb et Berthelot et décrits par Alcide d'Orbigny.* *Mollusques.* Paris (Béthune): 117 p., pl. 1-7, 7B (p. 1-24 [Aug. 1839], 25-48 [Sept. 1839], 49-72 [Oct-1839], 73-104 [Jan. 1840], 105-136 [Mar. 1840], 137-143 [Apr. 1840], 145-152 [Aug. 1842] pl. 1 [Jul. 1836], 2 [Dec. 1836], 3 [May 1842], 4-5 [June 1840], 7 [May 1842], 6, 7B [Aug. 1842].
- Orbigny, A. d' 1843. *Paléontologie française. Description zoologique et géologique de tous les animaux Mollusques et Rayonnés fossiles de France.* 3. Terrains crétacés. Paris (Arthus Bertrand): 1-807.
- Orbigny, A. d' 1852. *Prodrome de paléontologie stratigraphique universelle des animaux mollusques et rayonnés, faisant suite au cours élémentaire de paléontologie et de géologie stratigraphique,* 3. Paris (Victor Masson): 1-196, index 1-189.
- Pallary, P. 1904-1906. Addition à la faune malacologique du Golfe de Gabès. *Journal de Conchyliologie* 52: 212-248, pl. 7 (1904); 54: 77-124, pl. 4 (1906).
- Papp, A. 1954. Die Molluskenfauna im Sarmat des Wiener Beckens. *Mitteilungen der Geologischen Gesellschaft in Wien* 45 (1952): 1-112.
- Patrini, P. 1930. La fauna nana pliocenica del colle di S. Colombano al Lambro. *Rivista Italiana di Paleontologia* 36: 33-44.
- Pavia, G. 1975. I molluschi del Pliocene inferiore di Monteu Roero (Alba, Italia NW). *Bollettino della Società Paleontologica Italiana* 14: 99-175.
- Payraudeau, B.C. 1826. *Catalogue descriptif et méthodique des annélides et des mollusques de l'île de Corse.* Paris (Bachelot, Levraut, Paschoud, Treuttel & Wurtz): 218 pp. + 8 pls.
- Pease, W.H. 1860. Descriptions of new species of Mollusca from the Sandwich Islands. *Proceedings of the Zoological Society of London* 28: 18-36, 141-148.
- Pelosio, G. 1960. Affioramenti fossiliferi del Calabrian nel Preappennino Parmense. *Giornale di Geologia* 28: 131-174.
- Pennant, T. 1777. *The British zoology,* 4. Crustacea, Mollusca, Testacea. London (Benjamin White): xviii + 156 pp.
- Peñas, A. & Rolán, E. 1997. La familia Pyramidellidae Gray, 1840 (Mollusca, Gastropoda, Heterostropha) en Africa occidental, 2. Los generos *Turbonilla* y *Eulimella*. *Iberus* suppl. 3: 1-105.
- Peñas, A. & Rolán, E. 1998. La familia Pyramidellidae Gray, 1840 (Mollusca, Gastropoda) en África Occidental, 3. El género *Chrysallida* s.l. *Iberus* suppl. 4: 1-73.
- Peñas, A. & Rolán, E. 1999. La familia Pyramidellidae Gray, 1840 (Mollusca, Gastropoda, Heterostropha) en Africa Occidental, 4. Los géneros *Megastomia*, *Odostomia*, *Ondina*, *Noemiamea* y *Syrnola*. *Iberus* suplemento 5: 1-150.
- Peñas, A., Rolán, E., & Almera, J. 2009. Fauna malacologica de un fondo detrítico fangoso en El Maresme, Barcelona (nordeste de la Península Ibérica). *Iberus* 27(1): 19-56.
- Peñas, A., Rolán, E. & Swinnen, F. 2014. The superfamily Pyramidelloidea Gray, 1840 (Mollusca, Gastropoda, Heterobranchia) in West Africa, 11. Addenda 3. *Iberus* 32(2): 105-206.
- Peñas, A., Templado, J. & Martínez, J.L. 1996. Contribución al conocimiento de los Pyramidelloidea (Gastropoda: Heterostropha) del Mediterráneo español. *Iberus* 14: 1-82.
- Pereira da Costa, F.A. 1866-1867. Molluscos fosseis. Gastropodes dos depositos terciarios de Portugal. *Memória Comissão Geologica de Portugal* 4(1): 1-116 (1866); (2): 117-252 (1867).
- Perry, G. 1811. *Conchology, or the natural history of shells: containing a new arrangement of the genera and species, illustrated by colored engravings executed from the natu-*

- ral specimens, and including the latest discoveries.* London (William Miller) 4 pp. + unpaginated captions to 61 pls.
- Peyrot, A. 1938. Les mollusques testacés univalves des dépôts Helvétiques du Bassin Ligérien. Catalogue critique, descriptive et illustré. *Actes de la Société Linnéenne de Bordeaux* 89: 5-361.
- Pfeiffer, L. 1854. Synopsis Auriculaceorum. *Malakozoologische Blätter* 1: 145-156.
- Pfeiffer, L. 1855. Descriptions of six new species of Auriculacea from the collection of H. Cuming. *Proceedings of the Zoological Society of London* 22: 121-122.
- Philippi, R.A. 1836. *Enumeratio molluscorum Siciliae cum viventium tum in tellure tertiaria fossilium, quae in itinere suo observavit*, 1. Berolini (Schropp): xiv + 267 pp., pls 1-12.
- Philippi, R.A. 1841. Zoologische Bemerkungen. *Archiv für Naturgeschichte* 7: 42-59.
- Philippi, R.A. 1842-1850. *Abbildungen und Beschreibungen neuer oder wenig gekannter Conchylien unter mithilfe mehrerer deutscher Conchyliologen*, 1-3. Cassel (T. Fischer): 1: 1-20 (1842), 21-76 (1843), 77-186 (1844), 187-204 (1845); 2: 1-64 (1845), 65-152 (1846), 153-232 (1847); 3: 1-50 (1847), 51-82 (1848), 1-88 (1849), 89-138 (1850); 144 pls.
- Philippi, R.A. 1853. *Handbuch der conchyliologie und malacozoologie*. Halle (Anton): xx + 547 pp.
- Philipsson, L.M. 1788. *Dissertatio historico naturalis sistens testaceorum genera, ad publicum examen defert Laurentius Münster Philipson scanus*. Lundae (Typis Berlingianis): 23 pp.
- Pilsbry, H.A. 1893-1895. *Manual of conchology, structural and systematic, with illustrations of the species*, (1)15. Polyplacophora (chitons). Acanthochitidae, Cryptoplacidae and appendix. Tectibranchiata. Philadelphia (Conchological Section, Academy of Natural Sciences): 1-64 [1893], 65-180 [1894], 181-436 [1895], pl. 1-10 [1893], 11-42 [1894], 43-50, 59-61 [1895].
- Pilsbry, H.A. 1904. New Japanese marine Mollusca: Gastropoda. *Proceedings of the Academy of Natural Sciences of Philadelphia* 56: 3-37, 6 pls.
- Pilsbry, H.A. 1921. Marine mollusks of Hawaii, 14-15. *Proceedings of the Academy of Natural Sciences* 72: 360-383.
- Pilsbry, H.A. & Lowe, H.N. 1932. West Mexican and Central American mollusks collected by H.N. Lowe, 1929-1931. *Proceedings of the Academy of Natural Sciences Philadelphia* 84: 33-144, pls 1-17.
- Pinna, G. & Spezia, L. 1978. Catalogo dei tipi del Museo Civico di Storia Naturale di Milano, 5. I tipi dei Gasteropodi fossili. *Atti della Società Italiana di Scienze naturali Museo Civico di Storia naturale* 119: 125-180.
- Ponder, W.F. 1987. The anatomy and relationships of the pyramidellacean limpet *Amanthina tricarinata* (Mollusca: Gastropoda). *Asian Marine Biology* 4: 288-317.
- Poppe, G.T. & Goto, Y. 1991. *European seashells*, 1. Polyplacophora, Caudofoveata, Solenogastrea, Gastropoda. Wiesbaden (Verlag Christa Hemmen): 352 pp.
- Powell, A.W.B. 1942. The New Zealand Recent and fossil Mollusca of the family Turridae with general notes on turrid nomenclature and systematics. *Bulletin of the Auckland Institute and Museum* 2: 1-188.
- Powell, A.W.B. 1966. The molluscan families Speightiidae and Turridae: an evaluation of the valid taxa, both Recent and fossil, with lists of characteristic species. *Bulletin of the Auckland Institute and Museum* 5: 1-184.
- Preston, H.B. 1914. Mollusca from the Chilka Lake on the East Coast of India. *Records of the Indian Museum* 10: 297-310.
- Pusateri, F., Giannuzzi-Savelli, R. & Bartolini, S. 2016. A revision of the Mediterranean Raphitomidae, 3. On the *Raphitoma pupoides* (Monterosato, 1884) complex, with the description of a new species (Mollusca Gastropoda). *Biodiversity Journal* 7(1): 103-115.
- Pusateri, F., Giannuzzi-Savelli, R. & Oliverio, M. 2012. A revision of the Mediterranean Raphitominæ, 1. On the sibling species *Raphitoma contigua* (Monterosato, 1884) and *Raphitoma spadiana* n. sp. (Gastropoda, Conoidea). *Iberus* 30(1): 41-52.
- Pusateri, F., Giannuzzi-Savelli, R. & Oliverio, M., 2013. A revision of the Mediterranean Raphitomidae, 2. On the sibling species *Raphitoma lineolata* (B.D.D., 1883) and *Raphitoma smriglioi* n. sp. *Iberus* 31: 11-20.
- Quoy, J.R.C. & Gaimard, J.P. 1832-1835. *Voyage de découvertes de l'"Astrolabe" exécuté par ordre du Roi, pendant les années 1826-1829, sous le commandement de M. J. Dumont d'Urville. Zoologie*. Paris (Tastu): 1: i-1 + 1-264; 2(1): 1-321 [1832]; 2(2): 321-686 [1833]; 3(1): 1-366 [1834]; 3(2): 367-954 [1835]; Atlas (Mollusques): pls 1-93 [1833].
- Rafinesque, C.S. 1815. *Analyse de la nature ou tableau de l'univers et des corps organisés*. Palermo (Rafinesque): 223 pp.
- Rasmussen, L.B. 1956. The marine Upper Miocene of South Jutland and its molluscan fauna. *Danmarks Geologiske Undersøgelse* 2(81): 1-166.
- Rasmussen, L.B. 1968. Molluscan faunas and biostratigraphy of the marine younger Miocene formations in Denmark. 2. Palaeontology. *Danmarks Geologiske Undersøgelse* 2(92): 1-265.
- Ravn, J.P.J. 1907. Molluskfaunaen i Jyllands Tertiæraflejringer, en palæontologisk-stratigrafisk Undersøgelse. *Det kongelige Danske Videnskabernes Selskabs Skrifter* 3: 217-384. Also published as *Muséum de Minéralogie et de Géologie de l'Université de Copenhague, Communications Paléontologie* 7: 1-180.
- Récluz C.A. 1843. Catalogue descriptif de plusieurs nouvelles espèces de coquilles de France suivi d'observations sur quelques autres. *Revue zoologique, par la Société Cuvierienne* 6: 5-12, 104-112, 228-238, 257-261.
- Récluz, M.C. 1864. Observations sur le genre *Fossar* (Fossarus). *Journal de Conchyliologie* 12: 247-251.
- Reeve, L.A. 1843-1846. *Monograph of the genus Pleurotoma. Conchologia Iconica, or Illustrations of the Shells of Molluscos Animals*, 1. London (Reeve Brothers): 40 pls. + index and errata. Published in parts; 1843: pls. 1-18 (January-December 1843); 1844: pl. 19 (January 1844); 1845: pls. 20-33 (October-December 1845); 1846: pls. 34-40, index and errata (January-April 1846).
- Regteren Altena, C.O. van, Bloklander, A. & Pouderoyen, L.P. 1964. De fossiele schelpen van de Nederlandse stranden en zeegaten, 6. *Basteria* 28: 1-9, pls 21-22.
- Rehder, H.A. 1946. Additional notes on the dates of publication of Les fonds de la mer. *Proceedings of the Malacological Society of London* 27: 74-75.
- Renier, S.A. 1804. *Prodromo di osservazioni sopra alcuni es-*

- seri viventi della classe dei vermi, abitanti nel mare Adriatico, nelle lagune e nei litorali veneti, 1. Tavola alfabetica delle Conchiglie Adriatiche. Venezia: 15 pp.
- Risso, A. 1826. *Histoire naturelle des principales productions de l'Europe méridionale et principalement de celles des environs de Nice et des Alpes-Maritimes*, 4. Mollusques. Paris (Levrault): i-vii, 1-439.
- Robineau-Desvoidy, J.B. 1830. Essai sur les Myodaires. *Mémoires présentés par divers Savans à l'Académie Royale des Sciences de l'Institut de France, Sciences Mathématiques et Physiques* 2: 3-813.
- Robineau-Desvoidy, [J.B.] 1863 (oeuvre posthume). *Histoire naturelle des diptères des environs de Paris*. Paris (Masson), Leipzig (F. Wagner), London (W. Norgate): xvi + 1143 pp.
- Röding, P.F. 1798. *Museum Boltenianum, sive catalogus cimeliorum e tribus regnis naturae quae olim collgera Joa. Fried. Bolten, M.D.p.d. per XL annos proto physicus Hamburgensis*, 2. *Conchylia sive Testacea univalvia, bivalvia et multivalvia*. Hamburgi (Johan. Christi. Trappii): 199 pp.
- Rolán, E. 2005. *Malacological fauna from the Cape Verde Archipelago*. Vigo (ConchBooks): 455 pp.
- Rossi-Ronchetti, C. 1955. I tipi della 'Conchiologia Fossile Subappennina' di G. Brocchi, 2. Gastropodi, Scafopodi. *Rivista Italiana di Paleontologia e Stratigrafia, Memorie* 5: 91-343.
- Rouault, A. 1848. Description des fossiles du terrain Éocène des environs de Pau (extrait). *Bulletin de la Société Géologique de France* 2(5): 204-210.
- Ruggieri, G. & Greco, A. 1965. Studi geologici e paleontologici su Capo Milazzo con particolare riguardo al Milazziano. *Geologica Romana* 4: 41-88.
- Ruiz Muñoz, F., González-Regalado Montero, M.L. & Redondo Sanz, J.L. 1997. *Guía de fósiles del sur de la provincial de Huelva*. Diputación Provincial de Huelva (Imprenta Diputación): 204 pp.
- Sacco, F. 1892a. I molluschi dei terreni terziarii del Piemonte e della Liguria, 11. Eulimidae e Pyramidellidae (parte). *Memorie della Reale Accademia delle Scienze di Torino*, (2) 42: 585-682 (reprint 100 p.), 2 pls (June 30, 1892).
- Sacco, F. 1892b. I molluschi dei terreni terziarii del Piemonte e della Liguria, 12. (Pyramidellidae (fine), Ringiculidae, Solariidae e Scaliariidae (agg.). *Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Università di Torino*, 7 (121): 54-57 (published consecutively with part 11) (April 30, 1892).
- Sacco, F. 1896a. I molluschi dei terreni terziarii del Piemonte e della Liguria, 20. (Caecidae, Vermetidae, Phoridae, Calyptraeidae, Capulidae, Hipponycidae e Neritidae). *Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Università di Torino*, 11 (267): 82-84 (published consecutively with parts 19, 21, 22) (December 14, 1896).
- Sacco, F. 1896b. I molluschi dei terreni terziarii del Piemonte e della Liguria, 22. Gasteropoda (fine) (Pleurotomariidae, Scissurellidae, Haliotidae, Fissurellidae, Tecturidae, Patellidae, Oocorythidae, Cyclophoridae, Cyclostomidae, Aciculidae, Truncatellidae, Actaeonidae, Tornatinidae, Scaphandridae, Bullidae, Cyclichnidae, Philenidae, Umbrellidae). – Pulmonata (Testacellidae, Limacidae, Vitrinidae, Helicidae, Pupidae, Stenogyridae, Succineidae, Auriculidae, Limnaeidae, Physidae; Siphonariidae). Amphineura (Chitonidae). Scaphopoda (Dentaliidae). *Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Università di Torino*, 11 (267): 89-98 (published consecutively with parts 19-21) (December 14, 1896).
- Sacco, F. 1904. I molluschi dei terreni terziarii del Piemonte e della Liguria, 30. Aggiunte e correzioni (con 1400 figure). Considerazioni generali. Indice generale dell'opera. Torino (C. Clausen): 203 + xxxvi pp., 31 pls.
- Sars, G.O. 1878. *Bidrag til Kundskaben om Norges Arktiske Fauna*, 1. *Mollusca regionis arcticae norvegiae*. Christiania (A.W. Brøgger): xiii + [3] + 466 pp., 18 pls.
- Saurin, E. 1958. Pyramidellidae de Pho-Hai (Sud Viet-Nam). *Annales de la Faculté des Sciences de Saigon* 1958: 63-86.
- Say, T. 1826. Descriptions of marine shells recently discovered on the coast of the United States. *Journal of the Academy of Natural Sciences of Philadelphia* 5(2):207-221.
- Scacchi, A. 1835. Notizie intorno alla conchiglie ed a zoofiti fossili che si trovano nelle vicinanze di Gravina in Puglia. *Annali Civili del Regno delle Due Sicilie* 6: 75-84; 7: 5-18.
- Scacchi, A. 1836. *Catalogus conchyliorum regni neapolitani quae usque reperit*. Neapoli (Typis Filiatre-Sebetii): 18 pp.
- Scarponi, D. & Della Bella, G. 2003. *Molluschi marini del Plio-Pleistocene dell'Emilia-Romagna e della Toscana. Conoidea*, 1. *Drilliidae e Turridae*. Bologna (Museo Geologico Giovanni Capellini): 96 pp.
- Scarponi, D. & Della Bella, G. 2010. *Molluschi marini del Plio-Pleistocene dell'Emilia-Romagna e della Toscana. Conoidea*, 3. *Conidae*, 2. (Sottofamiglia *Mangeliinae*, 1). Bologna (Museo Geologico Giovanni Capellini): 128 pp.
- Schander, C. 1994. Twenty-eight new species of Pyramidellidae (Gastropoda, Heterobranchia) from West Africa. *Notiziario CISMA* 15: 11-78.
- Schander, C., van Aartsen, J.J., & Corgan, J.X. 1999. Families and genera of the Pyramidelloidea (Mollusca: Gastropoda). *Bollettino Malacologico* 34: 145-166.
- Schauafuss, L.W. (ed). 1869. *Molluscorum systema et catalogus. System una Aufzählung sämtlicher Conchylien der Sammlung von Fr. Paetel*. Dresden: 4 pp unpaginated, i-xiv, 1-119.
- Schnetler, K.I. 2005. The mollusca from the stratotype of the Gram Formation (late Miocene, Denmark). *Palaeontos* 7, 62-189.
- Schumacher, C.F. 1817. *Essai d'un nouveau système des habitations des vers testacés*. Copenhagen (Schultz): 287 pp.
- Segers, W., Swinnen, F. & Abreu, A. 2009. An annotated checklist of the marine molluscs from the Archipelagos of Madeira and the Selvagens (NE Atlantic Ocean). *Bocagiana* 226: 1-60.
- Seguenza, G. 1875. Studii stratigrafici sulla formazione pliocenica dell'Italia meridionale (partim). *Bullettino del Reale Comitato Geologico d'Italia* (1875), 18-31 (1-2); 82-89 (3-4); 145-153 (5-6); 204-211 (7-8); 276-283 (9-10); 340-345 (11-12).
- Seguenza, G. 1881. Le Ringicole italiane; ovvero ricerche speologiche e stratigrafiche intorno alle Ringicole raccolte negli stratti terziarii d'Italia. *Memorie della Classe di Scienze Fisiche Matematiche e Naturali della Regia Accademia del Lincei* 9:344-390, 2 pls.
- Semper, O. 1861. Beiträge zur Kenntniss der Tertiärformation. *Archiv des Vereins der Freunde der Naturgeschichte in Mecklenburg* 15: 221-409.

- Serres, M. de 1829. *Géognosie des terrains tertiaires, ou tableau des principaux animaux invertébrés des terrains marins tertiaires du Midi de la France*. Montpellier (Pomathio-Durville): 276 pp.
- Silva, C.M. da 1992. Moluscos pliocénicos da região de Caldas da Rainha-Marinha Grande-Pombal (Portugal), 2. Mesogastropoda. Architectonicidae. *Publicações Ocasionalis da Sociedade Portuguesa de Malacologia* 16: 1-8.
- Silva, C.M. da 2001. Gastrópodes pliocénicos marinhos de Portugal: sistemática, paleoecologia, paleobiologia, paleogeografia. Dissertação de doutoramento. Faculdade de Ciências da Universidade de Lisboa, Lisboa: 747 pp. (unpublished).
- Simionescu, I. & Barbu, I.Z. 1940. La faune sarmatienne de Roumanie. *Memoriile Institutului Geologic al României* 3: 1-194, 11 pls.
- Sismonda, E. 1842. *Synopsis methodica animalium invertebratorum pedemontii fossilium*. Augustae Taurinorum (Typis Regiis): 1-44.
- Sismonda, E. 1847. *Synopsis methodica animalium invertebratorum pedemontii fossilium (exceptis speciebus ineditis)*. Augustae Taurinorum (Typis Regiis): i-viii, 1-62.
- Smith, E.A. 1871. A list of species of shells from West Africa, with descriptions of those hitherto undescribed. *Proceedings of the Zoological Society of London* (1871): 727-739, pl. 75.
- Smith, E.A. 1888. Diagnoses of new species of Pleurotomidae in the British Museum. *Annals and Magazine of Natural History* 6(2): 300-317.
- Smith, E.H. 1967. Two new species of British turrids. *The Veliger* 10(1): 1-4.
- Sorgenfrei, T. 1958. Molluscan assemblages from the marine middle Miocene of South Jutland and their environments, 1-2. *Danmarks Geologiske Undersøgelse* (2)79: 1-503.
- Sosso, M. & Dell'Angelo, B. 2010. *I fossili del Rio Torsero*. Prato (Editing Marginalia, Cartotecnica Beusi srl): 95 pp.
- Sowerby, G.B., II 1839. *A conchological manual*. London (G.B. Sowerby): v + 130 pp., 24 pls.
- Sowerby, G.B., II 1850. Adams A. In. *Thesaurus Conchyliorum*, Monograph of the family Bullidae, 2 (11). London (Sowerby): 553-608, pls 119-125.
- Sowerby, J. 1812-1845, continued by J. de C. Sowerby. *The mineral conchology of Great Britain; or coloured figures and descriptions of those remains of testaceous animals or shells, which have been preserved at various times and depths in the earth*. London (Sowerby), 1-7 (for authorship, collation and dates of parts see Cleavelly, 1974, and *Bulletin of Zoological Nomenclature* 1987, 44: 64-67).
- Steininger, F. 1973. Die Molluskenfaunen des Ottnangien. In: Seneš, J. (ed.). *Chronostratigraphie und Neostatotypen. Miozän der zentralen Paratethys*, 3. In: Papp, A., Rögl, F. & Seneš, J. (eds). *M2 Ottnangien. Die Innviertler, Salgótarján, Bántapusztaer Schichtengruppe und die Rzehakia Formation*. Bratislava (Verlag der Slowakischen Akademie der Wissenschaften): 380-615.
- Strand, E. 1928. Miscellanea nomenclatoria zoologica et palaeontologica 1-2. *Archiv für Naturgeschichte* 92A: 30-75.
- Strausz, L. 1954. Várpalotai Felső-Mediterrán Csigák (Les gastropods du Méditerranéen Supérieur (Tortonien) de Varpalota). *Geologica Hungarica* 25: 1-150.
- Strausz, L. 1962. *Magyarországi Miozén-Mediterrán Csigák Határozója*. Budapest (Akadémiai Kiadó): 370 pp.
- Strausz, L. 1966. *Die Miozän-Mediterranen Gastropoden Ungarns*. Budapest (Akadémiai Kiadó): 692 pp.
- Švagrovský, J. 1960. Biostratigrafia a fauna mäkkýšov vrchného tortónu východného upätia Slanských Hor. *Geologické Práce* 57: 1-156.
- Švagrovský, J. 1971. Das Sarmat der Tschechoslowakei und seine Molluskenfauna. *Acta Geologica et Geographica Universitatis Comenianae, Geologica* 20: 1-473.
- Swainson, W., 1837. *The natural history and classification of birds*, 2. London (Longman, Rees, Orme, Brown, Green, Longman & Taylor): vi + 398 pp.
- Swainson, W. 1840. *A treatise on malacology or shells and shell-fish*. London (Longman): viii + 419 pp.
- Sykes, E.R. 1906. On the Mollusca procured during the 'Porcupine' expeditions 1869-1870. Supplemental notes, 3. *Proceedings of the Malacological Society of London* 7: 173-190, pl. 16.
- Tabanelli, C. & Segurini, R. 1995 [1994]. Nota preliminare alla malacofauna di Rio Albonello (Faenza). *Quaderno di Studi e Notizie di Storia naturale della Romagna* 3: 3-22.
- Talavera, P., Murillo, L. & Templado, J. 1987. The genus *Haminoea* Turton & Kingston, 1830 (Opisthobranchia, Bullemorpha) in the South East of Spain with the description of a new species. *Bollettino Malacologico* 23: 53-68.
- Tate, R. 1886. List of the Australian Terebridae. *Southern Science Record for 1886*: 1-8.
- Teasdale, L.C. 2017. Phylogenomics of the pulmonate land snails. PhD Thesis, University of Melbourne. 199 pp. <http://hdl.handle.net/11343/128240>.
- Thiele, J. 1925. Gastropoda der deutschen Tiefsee-Expedition, 2. *Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer 'Valdivia' 1898-1899* 17: 1-348.
- Thiele, J. 1929-1935. *Handbuch der systematischen Weichtierkunde*, 1-2. Jena (Fischer): 1(1): 1-376 (1929); 1(2): 377-778 (1931); 2(3): 779-1022 (1934); 2(4) 1023-1154 (1935).
- Thompson, T.E. 1988. *Molluscs: Benthic opisthobranchs (Mollusca: Gastropoda)*. In: Kermack, D.M. & Barnes, R.S.K (eds). *Synopses of the British Fauna (new series)* 8 (second edition). Leiden (E.J. Brill/Dr. W. Backhuys): 356 pp.
- Thompson, W. 1845. Additions to the fauna of Ireland, including descriptions of some apparently new species of Invertebrata. *Annals and Magazine of Natural History* 15: 308-321, pl. 19.
- Tomlin, J.R.L.B. & Shackelford, L.J. 1914-1915. The marine Mollusca of São Thomé, 1. *Journal of Conchology* 14(8): 239-256 [1914]; 14(9): 267-276 [1915].
- Toula, F. 1901. Eine marine Neogenfauna aus Cilicien. *Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt* 51: 247-263.
- Tucker, J.K. 2004. Catalog of Recent and fossil turrids (Mollusca: Gastropoda). *Zootaxa* 682: 1-1295.
- Turton, W. & Kingston, J. F. 1830. *The natural history of the district; or, lists of different species of animals, vegetables, and minerals, and their respective localities, scientifically arranged; with references to the best standard works in which they are figured and described: together with a geological account of the rock strata, and the fossils contained in them*. In: Carrington, N.T. *The Teignmouth, Dawlish and*

- Torquay guide*, 2. Teignmouth (E. Croydon): 225 unnumbered pages.
- Van Dingenen, F., Ceulemans, L. & Landau, B.M. 2014. *Euroscaphella* nov. gen. (Gastropoda: Volutidae) in the Neogene of Europe, with the description of a new species: *Euroscaphella namnetensis* nov. sp. from the Mio-Pliocene transition of northwestern France. *Cainozoic Research* 14: 101-111.
- Van Dingenen, F., Ceulemans, L., Landau, B.M. & Silva, C.M. da 2015. The family Nassariidae (Gastropoda: Buccinoidea) from the late Neogene of northwestern France. *Cainozoic Research* 15: 75-122.
- Van Dingenen, F., Ceulemans, L. & Landau, B.M. 2016. The lower Pliocene gastropods of Le Pigeon Blanc (Loire-Atlantique, northwest France), 2. Caenogastropoda. *Cainozoic Research* 16(2): 109-219.
- Van Dingenen, F., Ceulemans, L. & Landau, B.M. 2017. The lower Pliocene gastropods of Le Pigeon Blanc (Loire-Atlantique, northwest France), 4. Neogastropoda (in part). *Cainozoic Research* 17(1): 23-61.
- Venzo, S. & Pelosio, G. 1963. La malacofauna Tortoniana del Colle di Vigoleno (Preappennino Piacentino). *Palaeontographia Italica* 58: 43-213.
- Vera-Peláez, J.L. 2002. Revisión de la familia Turridae, except Clavatulinæ (Gastropoda, Prosobranchia) en el Plioceno de las cuencas de Málaga y Vélez Málaga (Málaga, S España) con la descripción de 26 especies nuevas. *Pliocénica, Publicaciones del Museo Municipal Paleontológico de Estepona* 2: 176-262.
- Vera-Peláez, J.L. & Lozano-Francisco, M.C. 2001a. Revisión de la subfamilia Clavatulinæ (Gastropoda, Turridae) con ocho especies nuevas en el Plioceno andaluz (sur de España). *Pliocénica, Publicaciones del Museo Municipal Paleontológico de Estepona* 1: 1-67.
- Vera-Peláez, J.L. & Lozano-Francisco, M.C. 2001b. Revisión del género *Genota* Adams & Adams, 1853 (Gastropoda, Turridae, Conorbinae) con 3 especies nuevas del Plioceno andaluz Adams, 1853 (Gastropoda, Turridae, Conorbinae) con 3 especies nuevas del Plioceno andaluz (S. España). *Pliocénica, Publicaciones del Museo Municipal Paleontológico de Estepona* 1: 68-84.
- Vera-Peláez, J.L., Martinell, J. & Lozano-Francisco, M.C. 1999. Turridae (Gastropoda, Prosobranchia) del Plioceno inferior de Málaga (España). *Iberus* 17: 1-19.
- Verrill, A.E. 1884. Second catalogue of mollusca recently added to the fauna of the New England coast and the adjacent parts of the Atlantic, consisting mostly of deep sea species, with notes on others previously recorded. *Transactions of the Connecticut Academy of Arts and Sciences* 6(1): 139-294, pls 28-32.
- Wenz, W. 1923-1930. *Fossilium Catalogus I: Animalia. Gastropoda extramarina tertiaria*. In 11 parts. Berlin (W. Junk).
- Wenz, W. 1938-1944. Gastropoda. Prosobranchia. In: Schindewolf, O.H. (ed.) *Handbuch der Paläozoologie*, 6. Berlin (Gebrüder Borntraeger): 1201-1505. (pagination from H.J. Anderson, 1964, for Wenz's contribution to the entire work is: 1-240, figs 1-471, March 1938 (1); 241-480, figs 472-1235, October 1938 (2); 481-720, figs 1236-2083, July 1939 (3); 721-960, figs 2084-2787, August 1940 (4); 961-1200, figs 2788-3416, October 1941 (5); 1201-1505, figs 3417-4211, October 1943 (6); xii + 1507-1639, November 1944 (7).
- Wenz, W. 1947. Zur Taxonomie der Euthyneura. *Archiv für Molluskenkunde* 76: 36.
- Westwood, J.O. 1836. On *Diopsis*, a genus of dipterous insects, with descriptions of twenty-one species. *Transactions of the Linnean Society of London* 17: 283-312, pl. 9.
- Wienrich, G. 2007. *Die Fauna des marinen Miozäns von Kevelaer (Niederrhein)*, 4. *Gastropoda ab Mitridae*. (Turridae by Janssen, R. & Wienrich, G.). Leiden (Backhuys Publishers BV): 640-954.
- Winckworth, R. 1932. The British marine mollusca. *Journal of Conchology* 19: 211-252.
- Wood, S.V. 1848. A monograph of the Crag Mollusca, or description of shells from the middle and upper Tertiaries of the east of England, 1. Univalves. *Monographs of the Paleontographical Society*: i-xii, 1-208.
- Wood, S.V. 1872-1874. Supplement to the monograph of the Crag Mollusca, with descriptions of shells from the upper Tertiaries of the east of England, 3. Univalves and bivalves, with an introductory outline of the geology of the same district, and map. *Monographs of the Paleontographical Society*: i-xxxi + 1-99 (1872), 100-231 (1874).
- Wood, W. 1828. *Supplement to the Index Testaceologicus; or a catalogue of shells, British and foreign. Illustrated with 480 figures*. London (Richard Taylor for W. Wood): vi + 59 pp.
- Woodring, W.P. 1928. *Miocene mollusks from Bowden, Jamaica*, 2. *Gastropods and discussion of results*. Washington (Carnegie Institution of Washington, DC): 564 pp.
- Woodring, W.P. 1959. Geology and paleontology of the Canal Zone and adjoining parts of Panama. Description of the Tertiary Mollusks (Gastropods: Vermetidae to Thaididae). *United States Geological Survey Professional paper* 306-B: 147-239.
- Yokoyama, M. 1920. Fossils from the Miura Peninsula and its immediate north. *Journal of the College of Science, Imperial University of Tokyo* 39: 1-193, pls 1-20.
- Zbyszewski, G. 1959. Étude structurale de l'aire typhonique de Caldas da Rainha. *Memória Serviços Geológicos de Portugal* (n.s.)3: 1-182.
- Zelinskaya, V.A., Kulichenko, V.G., Makarenko, D.E. & Sorochan, E.A. 1968. *Paleontologicheskii Spravochnik*, 2. *Bruyukhonogiye 'lopatonogiye mollyuski paleogena' miotsena Ykranini*. (Paleontological Reference Book, 2. *Gastropoda and scaphopod mollusks of the Paleogene and Miocene of Ukraine*). Kiev (Academy of Sciences, Ukrainian SSR, Institute of Geological Sciences): 281 pp.

Plate 1

1. *Asthenotoma lanceolata* nov. sp., holotype NHMW 2015/0133/0557, height 20.7 mm, width 5.6 mm.
2. *Asthenotoma lanceolata* nov. sp., paratype 1 NHMW 2015/0133/0558, height 20.8 mm, width 6.3 mm.
3. *Asthenotoma ornata* (Defrance, 1826), NHMW 2015/0133/0400, height 15.2 mm, width 5.1 mm.
4. *Asthenotoma ornata* (Defrance, 1826), NHMW 2015/0133/0401, height 15.4 mm, width 5.2 mm.
5. *Asthenotoma ornata* (Defrance, 1826), NHMW 2015/0133/0402, detail of protoconch (SEM image).
6. *Aphanitoma marqueti* nov. sp., paratype 1, NHMW 2015/0133/0556, height 10.8 mm, width 3.6 mm.
7. *Aphanitoma marqueti* nov. sp., paratype 2 NHMW 2015/0133/0430, height 11.7 mm, width 4.1 mm.
8. *Genota maxime* nov. nom., NHMW 2015/0133/0427, height 38.6 mm, width 10.4 mm.
9. *Genota maxime* nov. nom., NHMW 2015/0133/0428, height 24.2 mm, width 7.1 mm, detail of protoconch (juvenile).
10. *Clavatula helwerdae* nov. sp., holotype NHMW 2015/0133/0431, height 57.3 mm, width 19.9 mm.
11. *Clavatula helwerdae* nov. sp., paratype 1 NHMW 2015/0133/0432, height 44.9 mm, width 16.0 mm.
12. *Clavatula helwerdae* nov. sp., paratype 2 NHMW 2015/0133/0433, height 26.0 mm, width 10.9 mm.
13. *Fusiturris strigosa* (Millet, 1865), NHMW 2015/0133/0435, height 23.5 mm, width 6.2 mm.
14. *Fusiturris strigosa* (Millet, 1865), NHMW 2015/0133/0437, height 21.3 mm, width 6.0 mm, detail of protoconch.
15. *Fusiturris strigosa* (Millet, 1865), NHMW 2015/0133/0436, height 22.9 mm, width 6.3 mm.

All: Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).

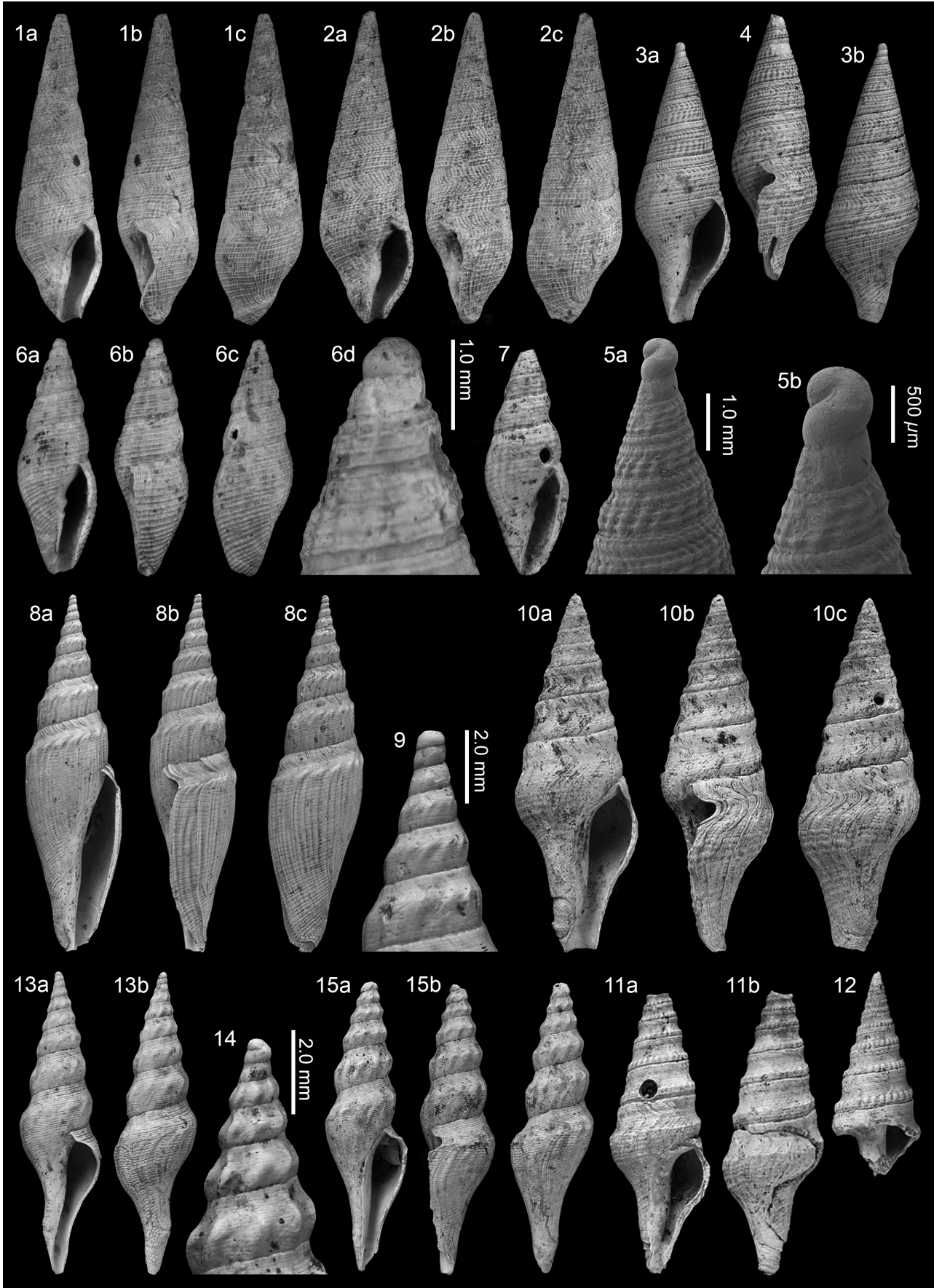


Plate 1

Plate 2

1. *Crassopleura clavulina brugnonesi* (Dollfus, 1907), NHMW 2015/0133/0439, height 9.9 mm, width 3.2 mm.
2. *Crassopleura clavulina brugnonesi* (Dollfus, 1907), NHMW 2015/0133/0440, height 8.8 mm, width 2.9 mm.
3. *Crassopleura clavulina brugnonesi* (Dollfus, 1907), NHMW 2015/0133/0441, height 8.2 mm, width 2.9 mm.
4. *Crassopleura clavulina brugnonesi* (Dollfus, 1907), NHMW 2015/0133/0442, height 8.3 mm, width 2.9 mm, detail of protoconch (SEM image).
5. *Haedropleura fratemcontii* nov. sp., holotype NHMW 2015/0133/0546, height 9.0 mm, width 3.7 mm. 5d, detail of protoconch.
6. *Haedropleura fratemcontii* nov. sp., paratype 2 NHMW 2015/0133/0559, height 13.9 mm, width 5.4 mm.
7. *Haedropleura secalina* (Philippi, 1844), NHMW 2015/0133/0542, height 10.0 mm, width 3.5 mm.
8. *Haedropleura septangularis* (Montagu, 1803), NHMW 2015/0133/0560, height 9.3 mm, width 3.5 mm. 8d, detail of protoconch.
9. *Haedropleura septangularis* (Montagu, 1803), NHMW 2015/0133/0544, height 10.6 mm, width 3.9 mm.
10. *Bela falbalae* nov. sp., paratype 2 NHMW 2015/0133/0444, height 5.9 mm, width 2.0 mm.
11. *Bela falbalae* nov. sp., paratype 3 NHMW 2015/0133/0445, height 5.7 mm, width 1.8 mm.
12. *Bela falbalae* nov. sp., holotype MNHN.F.A66715, height 5.7 mm, width 2.0 mm. 12 c, detail of protoconch (SEM image).
13. *Bela trinacria* Mariottini & Smriglio, 2009, NHMW 2015/0133/0447, height 9.4 mm, width 4.5 mm.

All: Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).

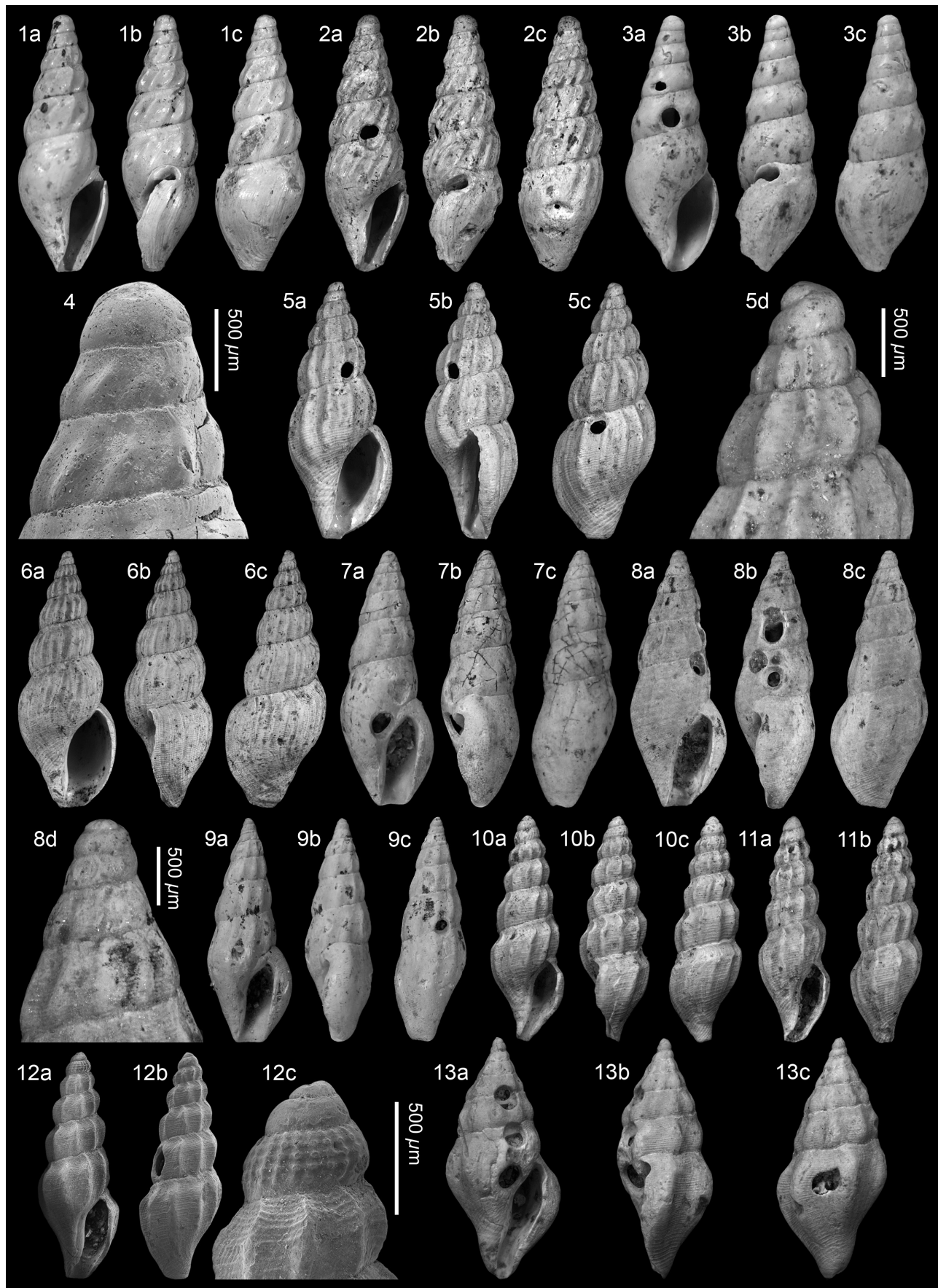


Plate 2

Plate 3

1. *Bela trinacria* Mariottini & Smriglio, 2009, NHMW 2015/0133/0448, height 11.4 mm, width 4.8 mm.
2. *Mangelia attenuata* (Montagu, 1803), NHMW 2015/0133/0450, height 7.8 mm, width 2.6 mm. 10d, detail of protoconch.
3. *Pyrgocythara rugosissima* (Seguenza, 1875), NHMW 2015/0133/0454, height 6.7 mm, width 2.7 mm. 1d, detail of protoconch.
4. *Mitromorpha* (*Mitrolumna*) *panaulax* Cossmann, 1901, NHMW 2015/0133/0452, height 8.2 mm, width 3.7 mm. 2d-e, detail of protoconch.
5. *Crassispira pseudobeliscus* (Fischer & Tournouër, 1873), NHMW 2015/0133/0455, height 25.6 mm, width 8.3 mm.
6. *Crassispira pseudobeliscus* (Fischer & Tournouër, 1873), NHMW 2015/0133/0457, height 26.8 mm, width 8.8 mm.
7. *Crassispira pseudobeliscus* (Fischer & Tournouër, 1873), NHMW 2015/0133/0458, height 26.8 mm, width 8.3 mm.
8. *Crassispira pseudobeliscus* (Fischer & Tournouër, 1873), NHMW 2015/0133/0459, height 27.9 mm, width 9.4 mm.
9. *Crassispira pseudobeliscus* (Fischer & Tournouër, 1873), NHMW 2015/0133/0555, detail of protoconch (juvenile).
10. *Clathromangelia fenestrata* (Millet, 1865), NHMW 2015/0133/0553, height 6.3 mm, width 2.9 mm.
11. *Clathromangelia fenestrata* (Millet, 1865), NHMW 2015/0133/0527, height 4.4 mm, width 2.2 mm.
12. *Clathromangelia fenestrata* (Millet, 1865), NHMW 2015/0133/0554, detail of protoconch (juvenile, SEM image).

All: Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).

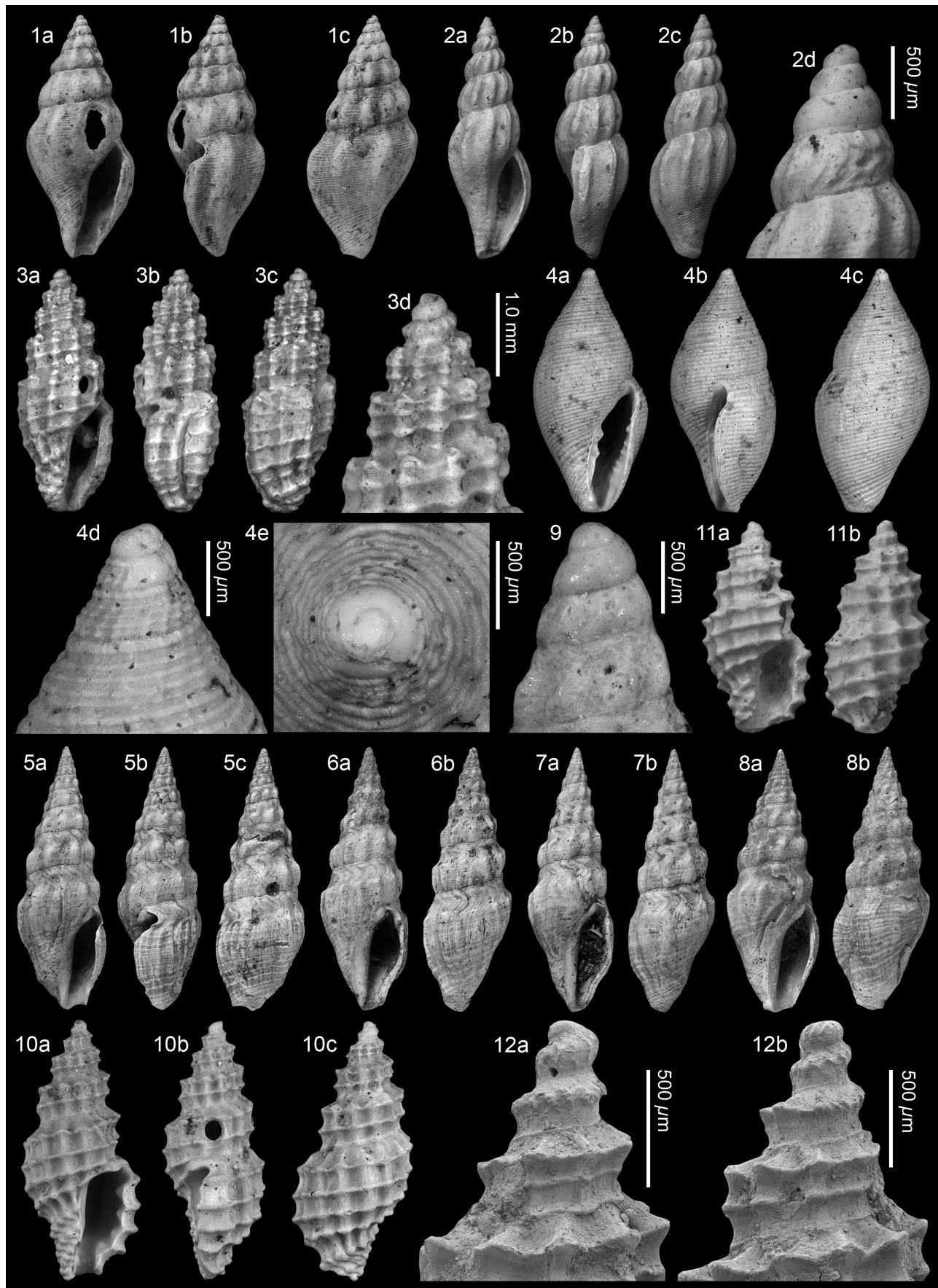


Plate 3

Plate 4

1. *Raphitoma bertrandiana* (Millet, 1865), NHMW 2015/0133/0460, height 13.2 mm, width 5.8 mm.
2. *Raphitoma bertrandiana* (Millet, 1865), NHMW 2015/0133/0461, height 12.6 mm, width 5.1 mm.
3. *Raphitoma georgesi* nov. sp., holotype NHMW 2015/0133/0530, height 6.3 mm, width 2.7 mm.
4. *Raphitoma georgesi* nov. sp., paratype 1 NHMW 2015/0133/0531, height 6.2 mm, width 2.5 mm.
5. *Raphitoma georgesi* nov. sp., paratype 3 NHMW 2015/0133/0533, juvenile. 5a, b, detail of protoconch. 5c, detail of teleoconch microsculpture (SEM image).
6. *Raphitoma landreauensis* nov. sp., holotype NHMW 2015/0133/0574, height 5.0 mm, width 2.2 mm. 6 e, f, detail of protoconch (figs 6d-f SEM images).
7. *Raphitoma landreauensis* nov. sp., paratype 1 NHMW 2015/0133/0575, height 5.0 mm, width 2.4 mm. 7e, detail of protoconch (figs 7d, e SEM images).
8. *Raphitoma palumbina* nov. sp., holotype NHMW 2015/0133/0535, height 5.2 mm, width 2.5 mm. 8d, detail of protoconch (SEM image).
9. *Raphitoma palumbina* nov. sp., paratype 1 NHMW 2015/0133/0536, height 5.1 mm, width 2.6 mm.

All: Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).

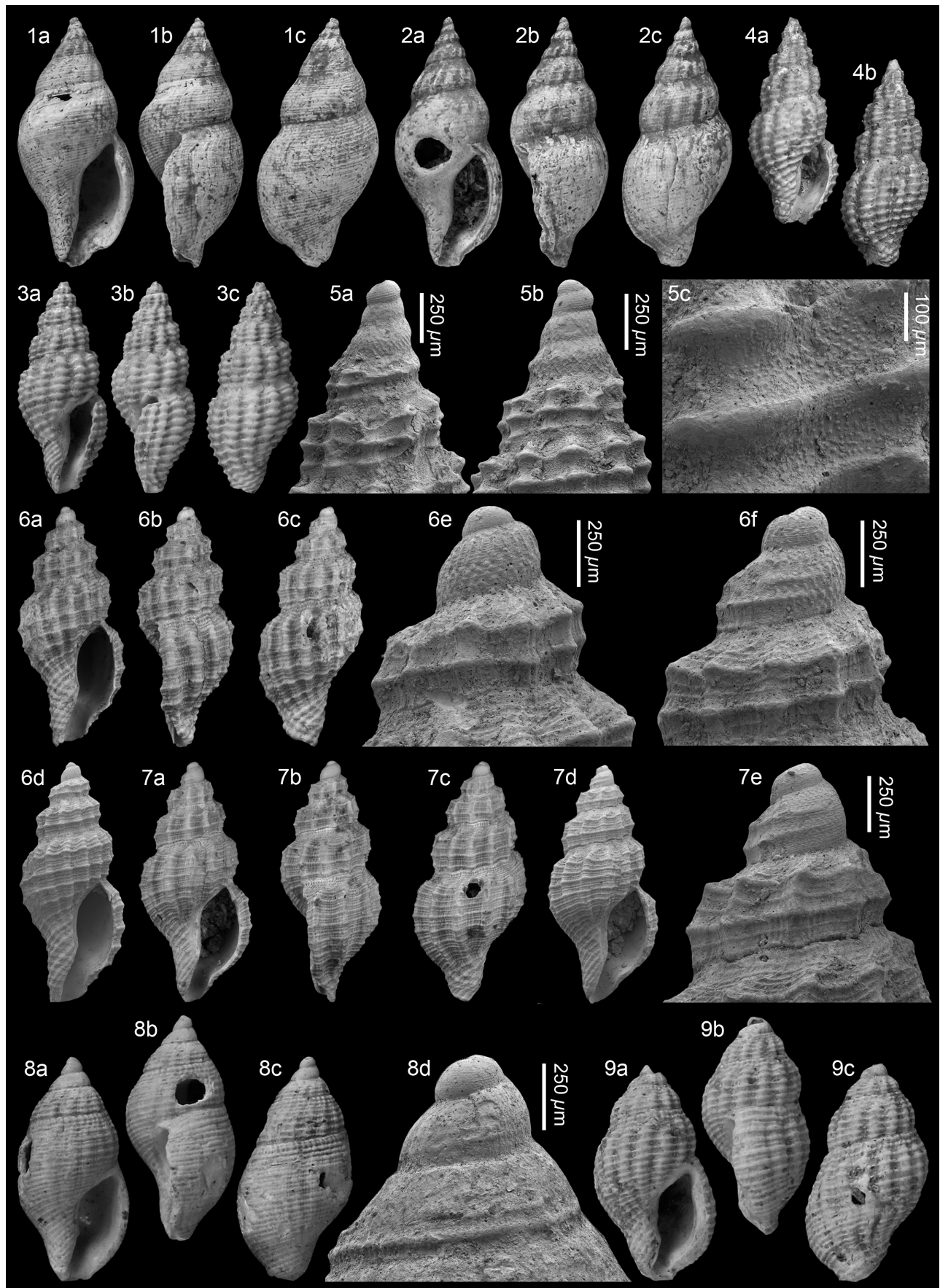


Plate 4

Plate 5

1. *Raphitoma pseudohystrix* (Sykes, 1906), NHMW 2015/0133/0462, height 11.0 mm, width 3.8 mm.
2. *Raphitoma pseudohystrix* (Sykes, 1906), NHMW 2015/0133/0463, detail of protoconch (SEM image).
3. *Raphitoma pseudohystrix* (Sykes, 1906), NHMW 2015/0133/0570, height 9.5 mm, width 3.5 mm.
4. *Raphitoma turtaudierei* nov. sp., holotype NHMW 2015/0133/0571, height 7.1 mm, width 3.6 mm.
5. *Raphitoma vercingetorixi* nov. sp., holotype NHMW 2015/0133/0538, height 8.4 mm, width 3.4 mm. 5d, detail of protoconch.
6. *Raphitoma vercingetorixi* nov. sp., paratype 1 NHMW 2015/0133/0537, height 7.6 mm, width 3.3 mm.
7. *Raphitoma pseudoconcinna* nov. sp., holotype NHMW 2015/0133/0566, height 9.4 mm, width 3.9 mm.

All: Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).

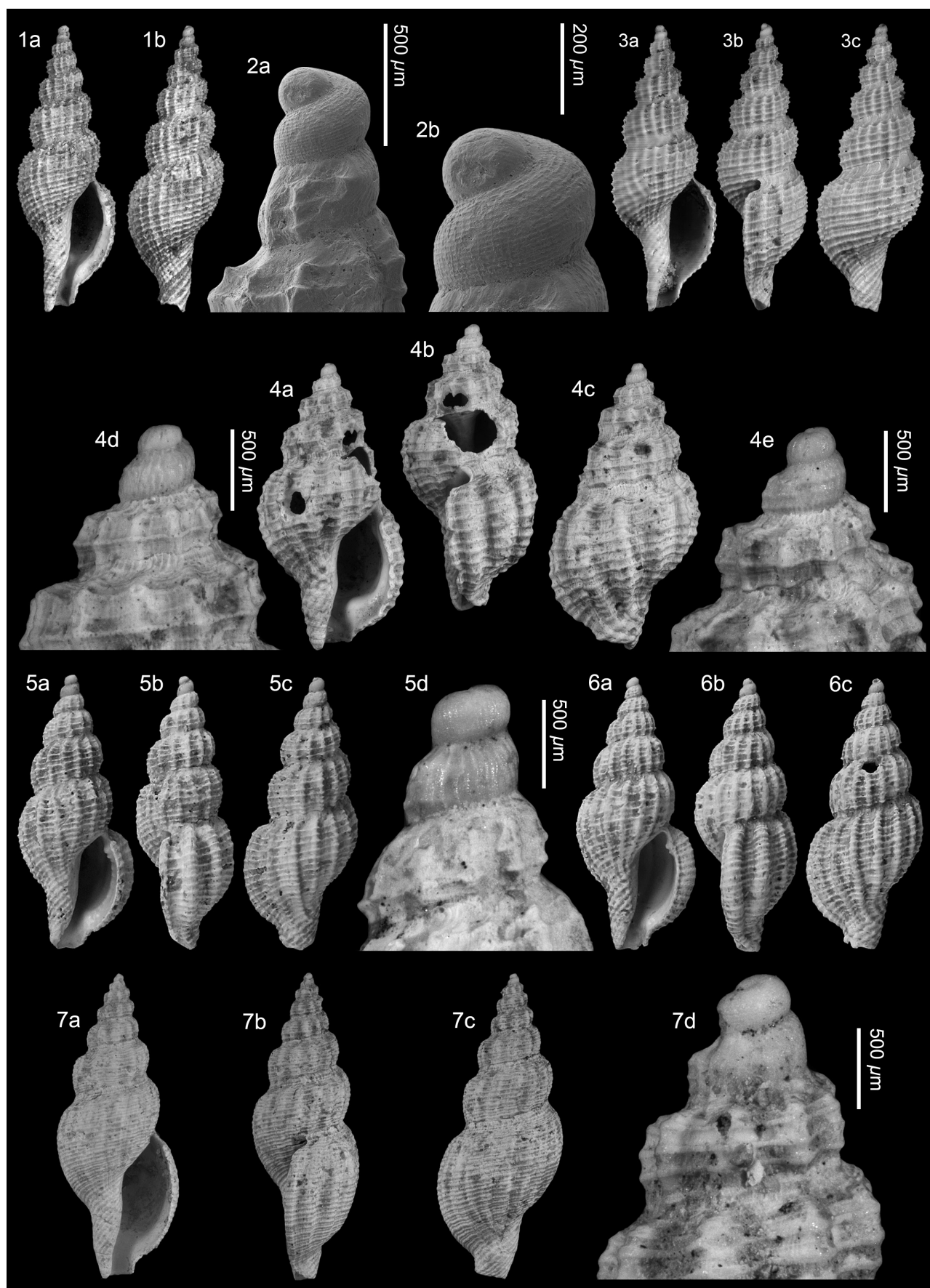


Plate 5

Plate 6

1. *Pleurotomoides hordeaceus* (Millet, 1827), NHMW 2015/0133/0528, height 12.2 mm, width 5.2 mm.
2. *Pleurotomoides hordeaceus* (Millet, 1827), NHMW 2015/0133/0562, height 12.7 mm, width 5.6 mm; 2d, detail of protoconch.
3. *Clathurella pierreaime* nov. sp., holotype NHMW 2015/0133/0572, height 7.5 mm, width 3.8 mm.
4. *Clathurella pierreaime* nov. sp., paratype 1 NHMW 2015/0133/0572, height 7.5 mm, width 3.8 mm.
5. *Terebra exilis* Bell, 1871, NHMW 2015/0133/0493, height 15.5 mm, width 4.5 mm.
6. *Terebra exilis* Bell, 1871, NHMW 2015/0133/0494, height 15.4 mm, width 4.1 mm.
7. *Terebra exilis* Bell, 1871, NHMW 2015/0133/0495, height 20.5 mm, width 5.2 mm.
8. *Terebra exilis* Bell, 1871, NHMW 2015/0133/0496, height 17.1 mm, width 4.0 mm.
9. *Terebra exilis* Bell, 1871, NHMW 2015/0133/0497, height 14.1 mm, width 3.5 mm. 9c, detail of protoconch.
10. *Adelphotectonica bieleri* nov. sp., holotype NHMW 2015/0133/0423, height 11.7 mm, diameter 18.1 mm.
11. *Adelphotectonica bieleri* nov. sp. FVD coll., height 12.1 mm, diameter 16.9 mm.
12. *Heliacus (Torinista) miser* (Dujardin, 1837), NHMW 2015/0133/0548, height 3.9 mm, diameter 8.5 mm.

All: Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).

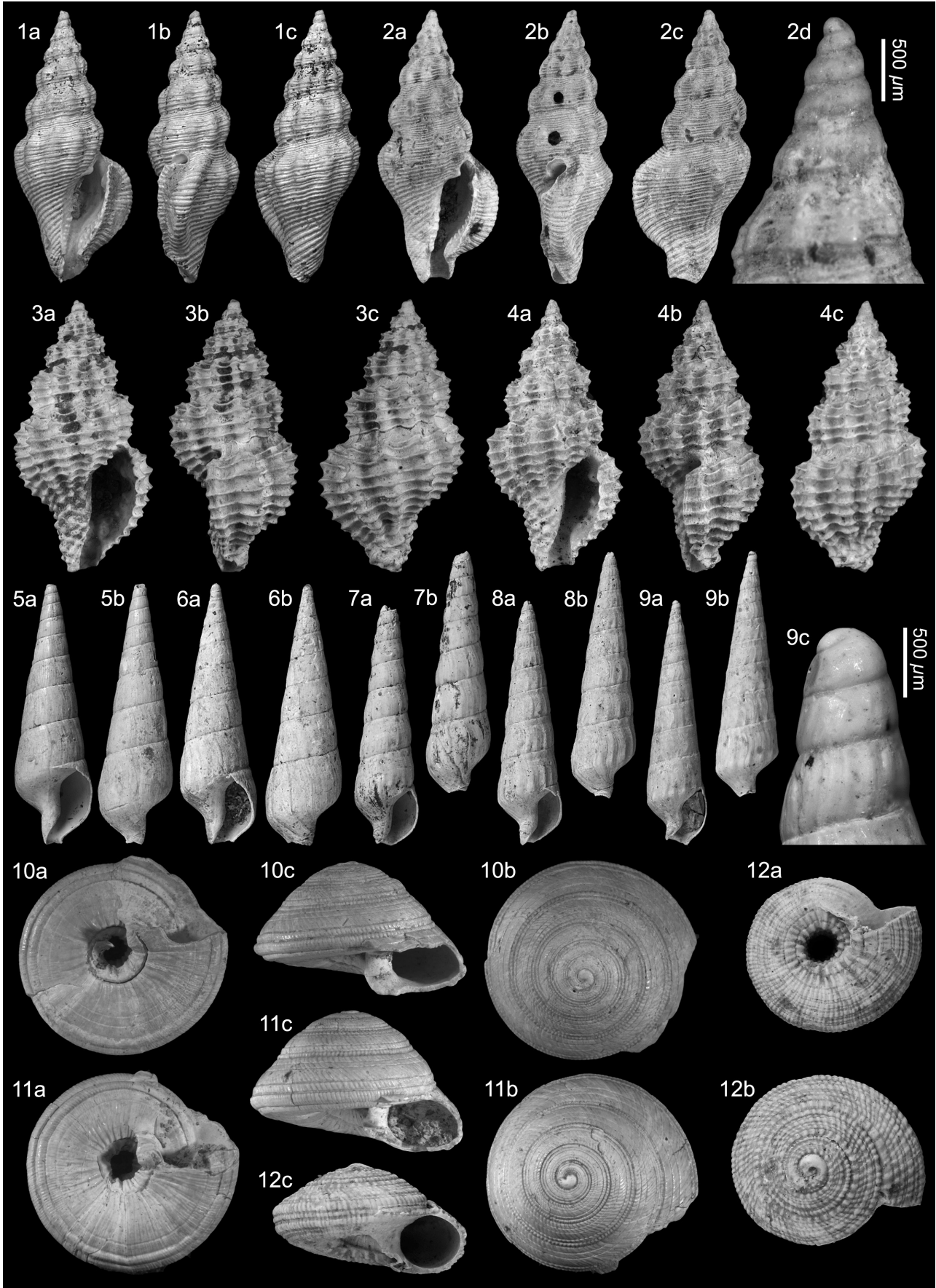


Plate 6

Plate 7

1. *'Acteon' semistriatus* (Férussac, 1822), NHMW 2015/0133/0468, height 10.6 mm, width 4.9 mm.
2. *Rictaxis tornatus* (Millet, 1854), NHMW 2015/0133/0470, height 10.6 mm, width 4.9 mm.
3. *Ringicula buccinea* (Brocchi, 1814), NHMW 2015/0133/0471, height 7.2 mm, width 4.3 mm.
4. *Ringicula ventricosa* (J. Sowerby, 1824), NHMW 2015/0133/0473, height 5.2 mm, width 3.2 mm.
5. *Ringicula ventricosa* (J. Sowerby, 1824), NHMW 2015/0133/0474, height 5.0 mm, width 3.1 mm (SEM image).
6. *Ringicula ventricosa* (J. Sowerby, 1824), NHMW 2015/0133/0475, height 5.0 mm, width 3.1 mm.
7. *Acteocina lajonkaireana* (de Basterot, 1825), NHMW 2015/0133/0477, height 2.4 mm, width 1.0 mm (SEM image).
8. *Retusa truncatula* (Bruguière, 1792), NHMW 2015/0133/0486 (1), height 3.0 mm, width 1.3 mm.
9. *Retusa obtusa* (Montagu, 1803) NHMW 2015/0133/0579, height 3.0 mm, width 1.5 mm (SEM image).
10. *Volvulella acuminata* (Bruguière, 1792), NHMW 2015/0133/0479, height 3.7 mm, width 1.5 mm (SEM image).
11. *Cylichna cylindracea* (Pennant, 1777), NHMW 2015/0133/0425, height 12.3 mm, width 4.2 mm.
12. *Haminoea hydatis* (Linnaeus, 1758), NHMW 2015/0133/0425, height 8.5 mm, width 5.8 mm.
13. *Scaphander lignarius* (Linnaeus, 1758), NHMW 2015/0133/0481, height 14.2 mm, width 7.6 mm.
14. *Megastomia conoidea* (Brocchi, 1814), NHMW 2015/0133/0511, height 5.7 mm, width 2.4 mm.
15. *Megastomia conoidea* (Brocchi, 1814), NHMW 2015/0133/0512, height 3.4 mm, width 1.3 mm.
16. *Megastomia conoidea* (Brocchi, 1814), NHMW 2015/0133/0513, height 3.1 mm, width 1.2 mm (SEM image).
17. *Megastomia conoidea* (Brocchi, 1814), NHMW 2015/0133/0514, height 3.0 mm, width 1.3 mm (SEM image).
18. *Ondina asterixi* nov. sp., holotype NHMW 2015/0133/0516, height 4.0 mm, width 1.5 mm.

All: Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).

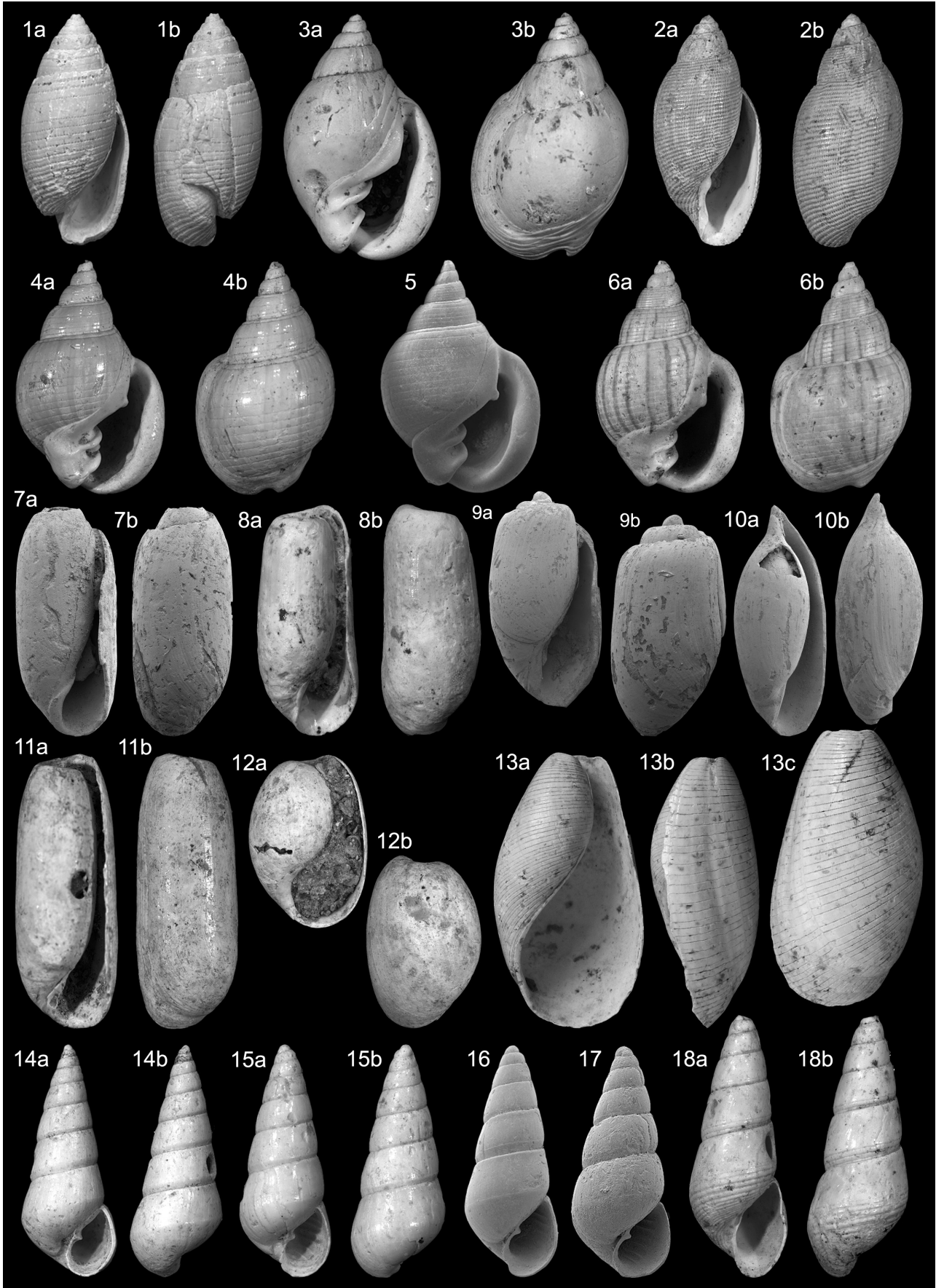


Plate 7

Plate 8

1. *Euparthenia elegans* (Dollfus & Dautzenberg, 1886), NHMW 2015/0133/0499, height 13.0 mm, width 3.7 mm.
2. *Euparthenia elegans* (Dollfus & Dautzenberg, 1886), NHMW 2015/0133/0500, height 12.1 mm, width 3.5 mm.
3. *Parthenina decussata* (Montagu, 1803), NHMW 2015/0133/0519, height 3.2 mm, width 1.0 mm. 3 c, d SEM images.
4. *Parthenina indistincta* (Montagu, 1808), NHMW 2015/0133/0521, height 2.3 mm, width 1.1 mm.
5. *Parthenina* sp., NHMW 2015/0133/0489, height 2.0 mm, width 0.8 mm (SEM image).
6. *Pyrgulina stefanisi* (Jeffreys, 1869), NHMW 2015/0133/0490, height 4.3 mm, width 2.0 mm.
7. *Tragula fenestrata* (Jeffreys, 1848), NHMW 2015/0133/0486, height 2.5 mm, width 1.2 mm (SEM image).
8. *Syrnola* cf. *turoniensis* (Gilibert, 1949), NHMW 2015/0133/0525, height 6.6 mm, width 2.0 mm.
9. *Chemnitzia lactea* (Linnaeus, 1758), NHMW 2015/0133/0504, height 12.0 mm, width 2.9 mm.
10. *Chemnitzia lactea* (Linnaeus, 1758), NHMW 2015/0133/0505, height 10.3 mm, width 2.6 mm.
11. *Chemnitzia lactea* (Linnaeus, 1758), NHMW 2015/0133/0506, detail of protoconch (SEM image).
12. *Pyrgiscus rufus* (Philippi, 1836), NHMW 2015/0133/0501, height 6.2 mm, width 1.8 mm.
13. *Pyrgiscus rufus* (Philippi, 1836), NHMW 2015/0133/0502, height 5.7 mm, width 1.5 mm.
14. *Pyrgiscus rufus* (Philippi, 1836), NHMW 2015/0133/0576, height 5.5 mm, width 1.2 mm.
15. *Pyrgiscus* sp. NHMW 2015/0133/0508, height 9.8 mm, width 1.2 mm. 15b, detail of protoconch.
16. *Pyrgiscus* sp. NHMW 2015/0133/0509, height 3.9 mm, width 1.1 mm.
17. *Eulimella acicula* (Philippi, 1836), NHMW 2015/0133/0578, height 5.5 mm, width 1.2 mm.
18. *Eulimella scillae* (Scacchi, 1835), NHMW 2015/0133/0577, height 3.8 mm, width 1.2 mm.
19. *Clathrella clathrata* (Philippi 1844), NHMW 2015/0133/0465, height 7.8 mm, width 5.1 mm.
20. *Clathrella clathrata* (Philippi 1844), NHMW 2015/0133/0466, height 9.4 mm, width 9.0 mm.

All: Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).

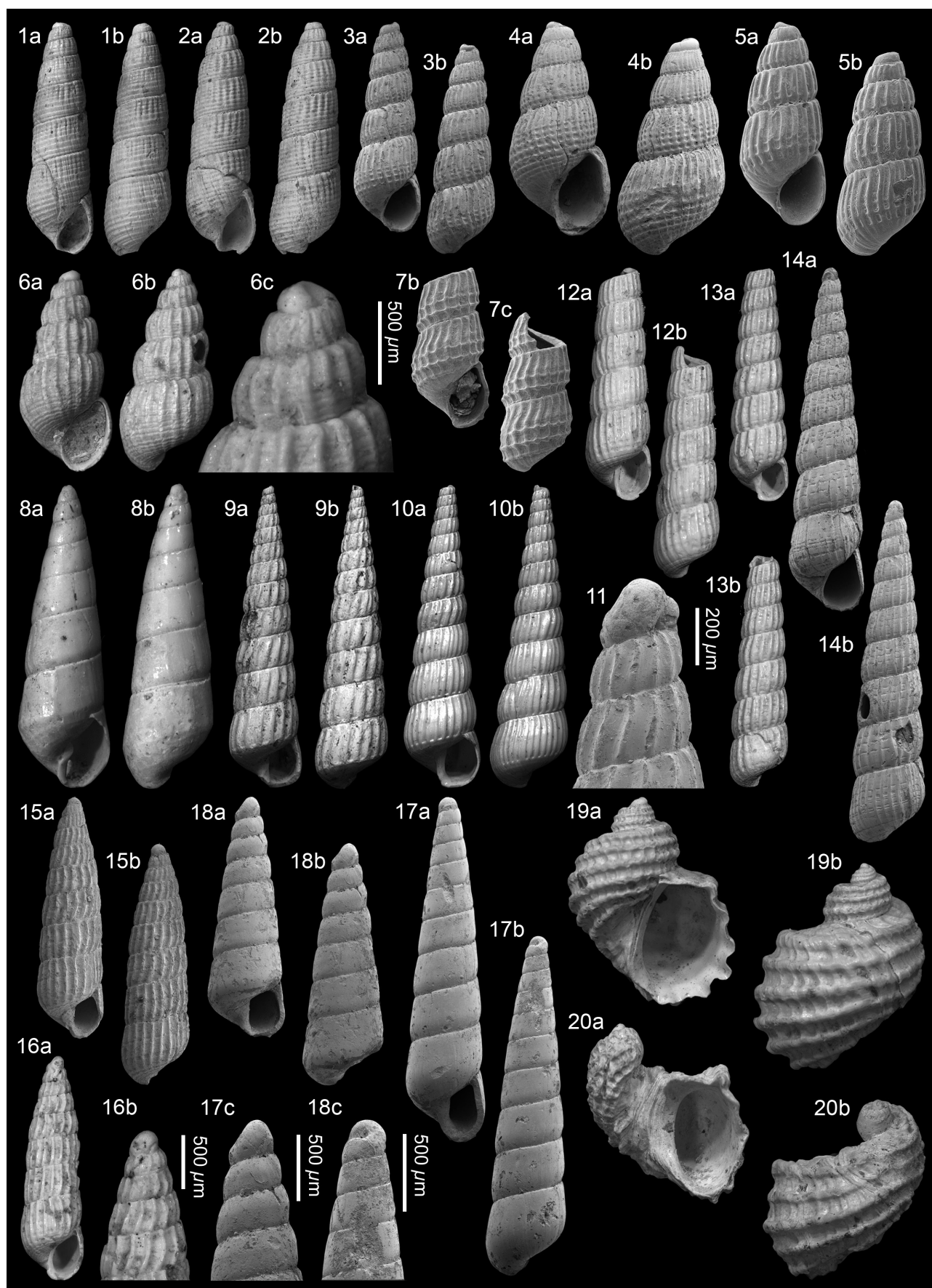


Plate 8

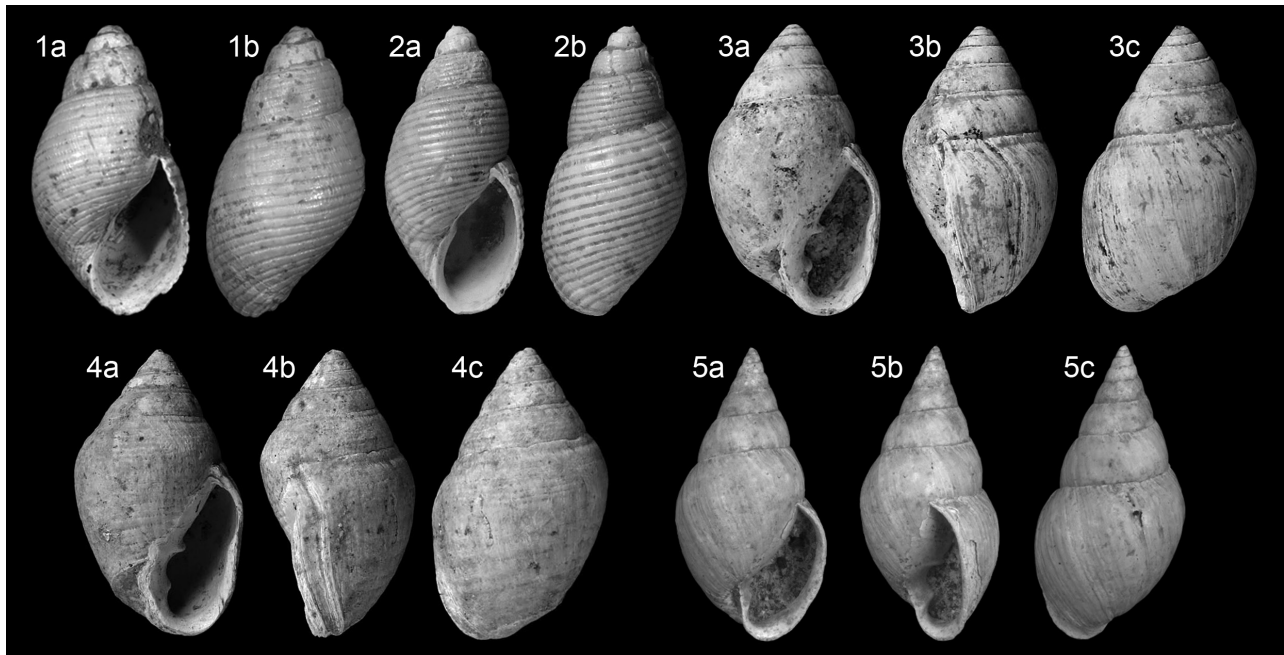


Plate 9

1. *Monotygma ivolasi* (Mayer-Eymar, 1900), NHMW 2015/0133/0523, height 7.7 mm, width 3.6 mm.
2. *Monotygma ivolasi* (Mayer-Eymar, 1900), NHMW 2015/0133/0524, height 6.5 mm, diameter 3.3 mm.
3. *Ellobium pyramidale* (J. de C. Sowerby, 1822), NHMW 2015/0133/0483, height 15.5 mm, width 8.8 mm.
4. *Ellobium pyramidale* (J. de C. Sowerby, 1822), NHMW 2015/0133/0484, height 13.3 mm, width 7.5 mm.
5. *Ellobium pyramidale* (J. de C. Sowerby, 1822), NHMW 2015/0133/0422, height 11.6 mm, width 7.0 mm.

All: Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).