

The family Nassariidae (Gastropoda: Buccinoidea) from the late Neogene of northwestern France

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In this paper we revise the nassariid Plio-Pleistocene assemblages of northwestern France. Twenty-eight species are recorded, of which eleven are described as new; *Nassarius brebioni* nov. sp., *Nassarius landreauensis* nov. sp., *Nassarius merlei* nov. sp., *Nassarius pacaudi* nov. sp., *Nassarius palumbis* nov. sp., *Nassarius columbinus* nov. sp., *Nassarius turpis* nov. sp., *Nassarius poteriensis* nov. sp., *Nassarius plainei* nov. sp., *Nassarius mariae* nov. sp., *Nassarius gendryi* nov. sp., five are left in open nomenclature. Two nassariid genera are recognised (*Nassarius* and *Demoulia*). The ‘Redonian’ assemblages and localities are grouped in four assemblages (Assemblages I – IV) corresponding to the four major stratigraphic groups of deposits recognised in the post mid-Miocene sequences of northwestern France. Assemblages I and II are not revised in this paper. Assemblage III contains a highly endemic nassariid species, known only from the northwestern French ‘Redonian’ deposits and is cool in character. Assemblage IV has the most diversified nassariid fauna, both in species, species groups, and contains the relatively thermophilic nassariid genus *Demoulia*. It is the most cosmopolitan in character, with the greatest affinity to the North Sea Basin fauna, but also shares common elements with the coeval Mediterranean assemblages. The high diversity and thermophilic character of this assemblage is unexpected, and cannot be explained at this time.

KEY WORDS: northwestern France, Plio-Pleistocene, Nassariidae, new taxa

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Introduction

In this paper we continue our studies on the Neogene gastropod fossil assemblages of northwestern France (see Ceulemans *et al.*, 2014; Van Dingenen *et al.*, 2014), this time reviewing the nassariids. We have expanded the stratigraphic scope of previous studies by including the nassariids from Pleistocene assemblages in the same geographical area. The importance of nassariids, namely for Neogene biogeography, has come to light in the last 15 years, proving the group not only to be far more diverse than previously thought, but also highly endemic. Moreover, most nassariid species have a much narrower geographical range than originally thought (Gili, 1991; Gürs, 2002; Wienrich, 2002; Złotnik, 2003; Harzhauser & Kowalke, 2004; Landau *et al.*, 2009).

The importance of the upper Miocene Messinian to lower Pleistocene Gelasian gastropod assemblages from northwestern France was discussed by Ceulemans *et al.* (2014). These gastropod faunas are known through the widely distributed doctoral thesis by Philippe Brébion (1964) of

the Centre National de la Recherche Scientifique, Paris. In this work he described, named and illustrated many new species from these deposits. Unfortunately, the thesis was never published and therefore names introduced in Brébion's (1964) work do not comply with article 13 of the ICZN code (1999), and must be considered *nomina nuda*. In this work we review the nassariids from what was known traditionally among French workers as the 'Redonien froid' (*i.e.*, Lauriat-Rage, 1981) in part, and expand it to include the Plio-Pleistocene assemblages of northwestern France. The revision of these northwestern French assemblages is a huge task, which will take several years. We have started the taxonomic revision with these Zanclean-Gelasian assemblages, as they are the ones we have extensive new material from. New excavations are planned in the younger deposits and their content will be revised as the material becomes available. The nassariids of Assemblages I and II will be published in a subsequent paper.

Age of the assemblages

According to Brébion (1964, p. 6), the term Redonian was coined by Dollfus (1900) for all the deposits of upper Miocene age of northwestern France. Subsequently, the term 'Redonian' has been used to characterise different facies, ages, and different formation-like units. Not only was the geological sense of the concept expanded, but also its geographical scope. Following Dollfus' (1900) description of the 'stratotype' of Apigné (Néraudeau *et al.*, 2003), most post-middle Miocene sequences in NW France were referred to as 'Redonian'. Brébion (1964) noted that the 'Redonian' was not homogenous, and recognised different ages, facies and provinces: a northern and a southern, thus expanding the sense of the term even further to represent a biogeographical unit (Brébion, 1964, p. 704).

Over one hundred years after its erection, there is still no consensus among workers of the meaning, geographical extent or age of the 'Redonian'. It has become a geological 'waste basket' for anything to do with the post-middle Miocene marine deposits of northwestern France. Although it would probably be better to abandon the term completely, in this paper we use the term 'Redonian' informally, and restrict its use to the sedimentary sequence described by Néraudeau *et al.* (2003) as 'le Redonien Stratotypique' in the region of Rennes.

The 'Redonien d'Anjou' we revert to the term post-Helvetian Anjou faluns.

Lauriat-Rage (1981) considered all 60 northwestern French post-Middle Miocene localities to form part of the 'Redonian' (some are marked in Fig. 1). Unlike Brébion (1964, p. 712) who recognised two transgressive cycles within the assemblages, Lauriat-Rage (1981) recognised a single transgressive cycle. The latter author considered the 'Redonian' entirely Pliocene in age based on its bivalve assemblages and divided the 'Redonian' sequence into an older, warmer 'Redonien chaud' and a younger, cooler 'Redonien froid'. The entire 'Redonian' sequence was considered to span a large section of the Pliocene (Lauriat-

Rage, 1981, fig.7). These informal terms, in our opinion, are not useful and add further confusion to the imprecise term 'Redonian', and are not adopted in this work.

From the gastropod molluscan palaeontology point-of-view, amongst these post middle-Miocene assemblages of NW France we recognise four main assemblages. In order to simplify the nomenclature and make it clear that we are talking about molluscan assemblages only, we name these assemblages I-IV (Fig. 2):

Assemblage I (Tortonian)

This assemblage congregates the post-Helvetian faluns assemblages from the Anjou region, occurring in the 'Redonien chaud' of Lauriat-Rage (1981). These assemblages were considered Tortonian to Messinian in age according to Courville & Bongrain (2003) and Néraudeau *et al.* (2003), but recent age reassessment places it in the Tortonian (Didier Néraudeau pers. comm. [BL], 2015) (Fig. 2). Typical localities of Maine-et-Loire (Anjou region): Sceaux d'Anjou, Saint-Clément-de-la-Place, Contigné, Renauleau (Brigné-sur-Layon), Saint-Michel-et-Chanveaux, Chalonnès-sur-Loire, Beaulieu-sur-Layon (Brébion, 1964, p. 15).

Assemblage II (Messinian)

This assemblage congregates the assemblages occurring in the 'Redonien Stratotypique' of Néraudeau *et al.* (2003) in the Rennes region. The 'Redonien Stratotypique' (herein simply referred to as Redonian) was considered to fall within the 'Redonien froid' of Lauriat-Rage (1981). Néraudeau *et al.* (2003) recognised two facies within the stratotype section: 'Redonien Stratotypique I' characterised by the presence of small shells less than a few centimetres in size and rich in fossils of corals, bryozoans, sharks teeth and otoliths. This older facies was dated as 6.5-7.0 Ma, lower Messinian. 'Redonien Stratotypique II' was characterised by bluish marls with large shells, with a poor associated fauna. This upper section dated as 6.0-6.5 Ma, upper Messinian. According to Néraudeau (pers. comm. [BL], 2015), the top of the Redonian in the Rennes region may even extend to the lowermost Pliocene and that these assemblages, such as at Apigné, characterise the 'Redonien froid' (Fig. 2).

Typical localities of Ille-et-Vilaine (Brittany region): Le Rheu (Apigné), Saint-Jacques-de-la-Lande (Lillion), Le Temple du Cerisier, Chartres-de-Bretagne, Moulin de Carcé, La Chaussairie (Brébion, 1964, p. 16-17).

Assemblage III (Zanclean)

This assemblage roughly corresponds to the assemblages occurring in the 'Redonien froid' of Lauriat-Rage (1981) in the region of Nantes and Vendée. These contain *Megacardita striatissima* (Cailliaud *in* Mayer, 1868), which was considered by Lauriat-Rage (1981) and Brault *et al.* (2004) to be a biostratigraphic index species for the lower

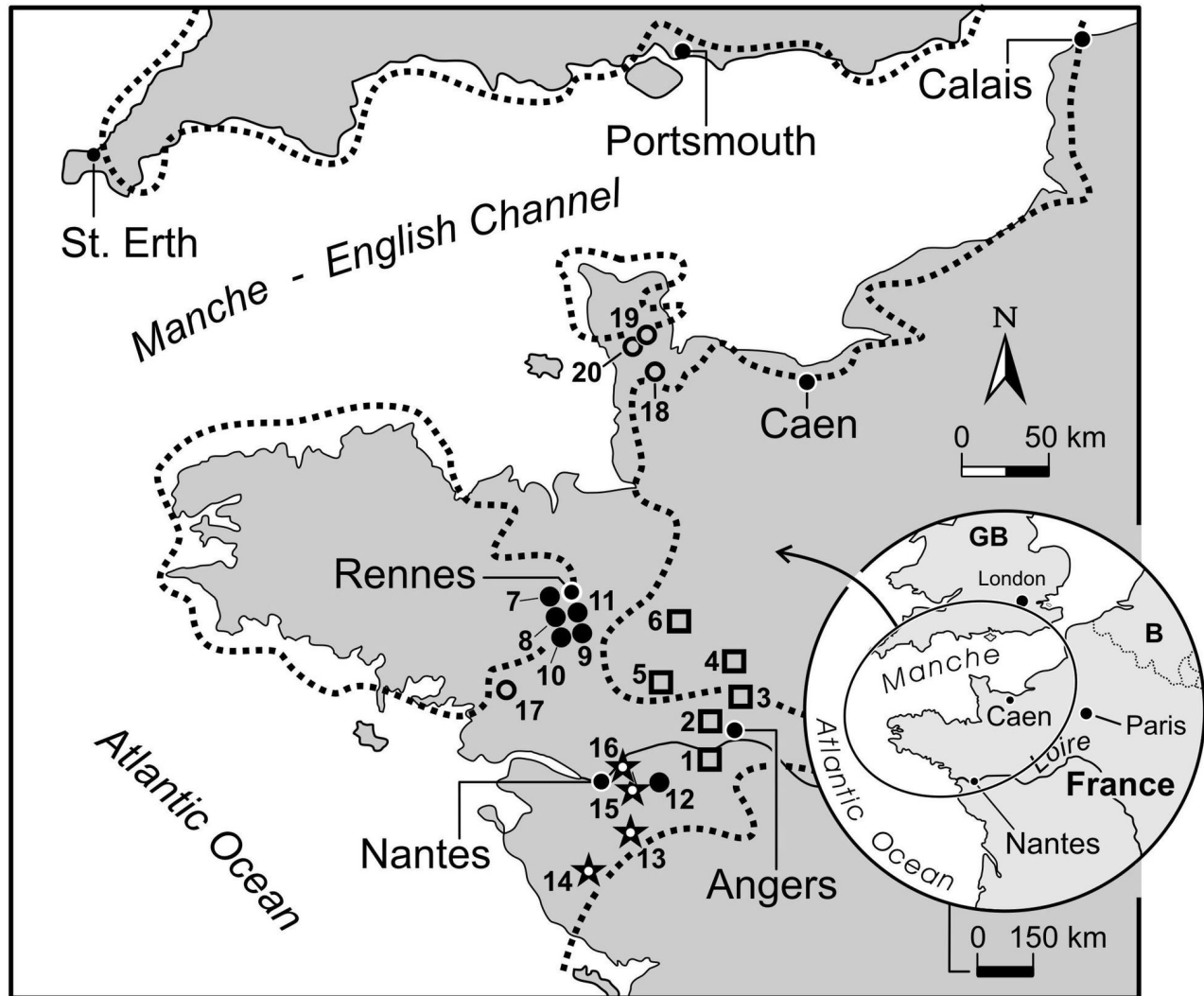


Figure 1. Geographical position of the NW French post-Middle Miocene molluscan outcrops.

Assemblage I localities in Maine-et-Loire (□): 1. Les Pierres Blanches & St. Anne (Chalonnnes-sur-Loire); 2. Le Grand Chauvereu (Saint-Clément-de-la-Place); 3. La Presselière (Sceaux d'Anjou); 4. Unspecified locality (Contigné); 5. La Mâne (Saint-Michel-et-Chanveaux); all Maine-et-Loire department; 6. La Chevalerie (Beaulieu-sur-Oudon, Mayenne department).

Assemblage II localities in Ille-et-Vilaine (●): 7. La Freslonnière & Apigné (Le Rheu) and Lillion (Rennes), 8. Le Temple du Cerisier (Saint-Jacques-de-la-Lande), 9. Vieux-Chartres (Chartres-de-Bretagne), 10. Moulin de Carcé (Bruz), 11. St. Jacques (Saint-Jacques-de-la-Lande), 12. La Chaussairie (Chartres-de-Bretagne) (all Ille-et-Vilaine department).

Assemblage III localities (★): 13. Le Girondor (Boufféré), 14. Le puits Martineau and Puits Total (Palluau) (both Vendée department), 15. Le Pigeon Blanc (Le Landreau), 16. La Dixmerie (Saint-Julien-de-Concelles) (both Loire-Atlantique department).

Assemblage IV localities (○): 17. Saint-Jean-la-Poterie (Morbihan department), 18. Bosq d'Aubigny (Saint-Martin-d'Aubigny), 19. La Sapinière (Gourbesville), 20. Selsoif (Saint-Sauveur-le-Vicomte) (all Manche department).

Dotted line represents approximate Zanclean (4 Ma) palaeogeography from van Vliet-Lanöe *et al.* (2002).

Pliocene in that region. (Fig. 2)

Typical localities of Loire-Atlantique and Vendée (Pays-de-Loire region): La Dixmerie (Nantes area, Loire-Atlantique), Le Girondor (Vendée), Palluau (Vendée), Le Pigeon Blanc (Le Landreau, Loire-Atlantique) (Brébion, 1964, p. 16).

Assemblage IV (Piacenzian-Gelasian)

This assemblage encompasses the 'Plio-Pleistocene as-

semblages' occurring in the 'Marnes à *Nassa*' assemblages of Brébion (1964) and 'Redonien froid' of Lauriat-Rage (1981) in the regions of Brittany and Normandy. (Fig. 2).

The sequence outcropping in Normandy, at Bosq d'Aubigny, Manche department, was considered Pliocene – circa 3.0 Ma – by Lauriat-Rage (1981, p. 138), slightly older than that of Gourbesville (Manche). It was recognised as the Bosq d'Aubigny Formation and considered 2.75-2.4 Ma by Clet & Farjanel (*in* Garcin *et al.*, 1997) and Reuverian b to Tiglian, by Dugué *et al.* (2000, 2009),

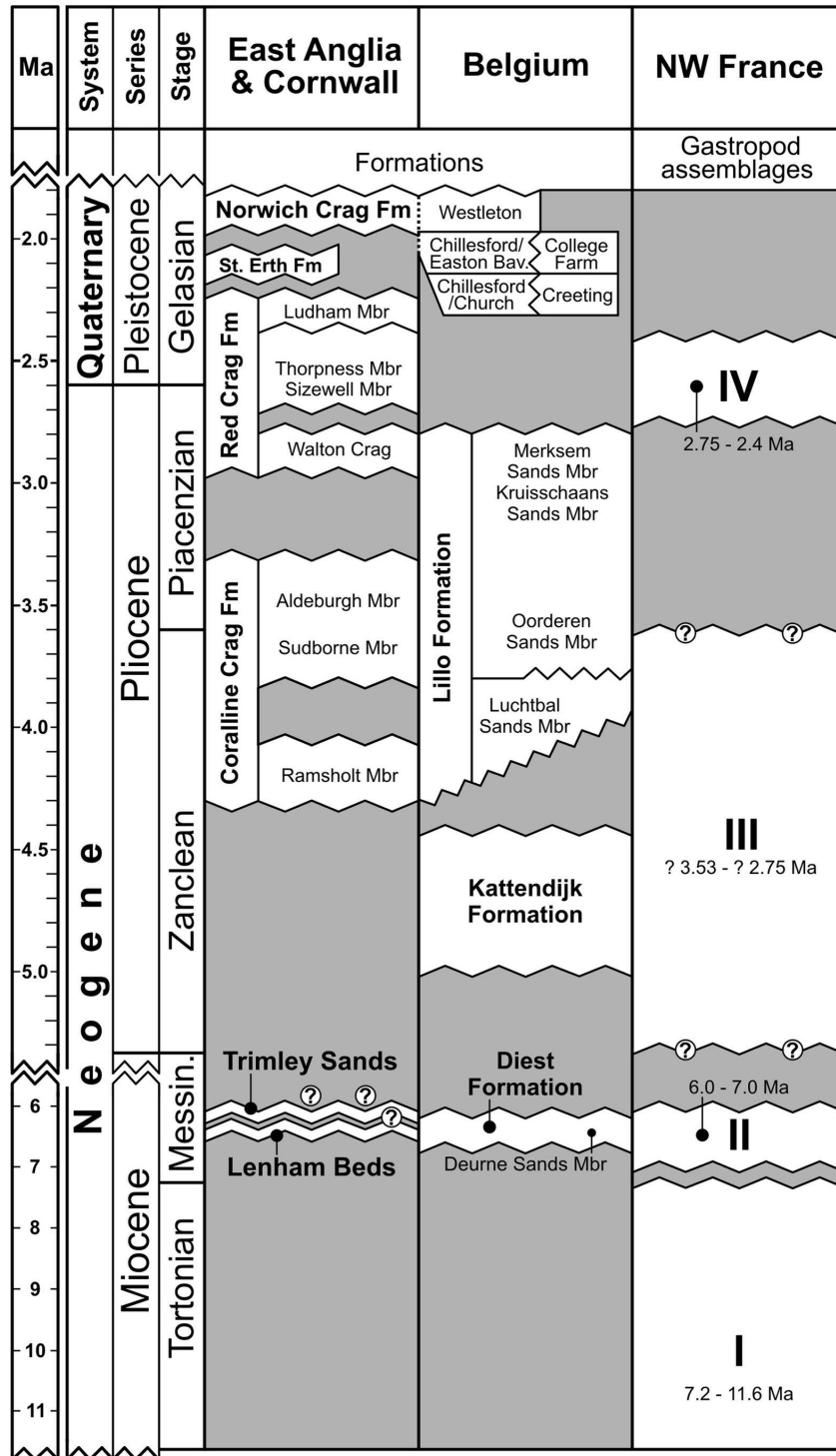


Figure 2. Stratigraphic correlation of the upper Miocene to lower Pleistocene formations of Cornwall and East Anglia in England and Belgium together with the range of the Mio-Pleistocene gastropod assemblages of northwestern France discussed in this paper. Stratigraphy of the formations of Cornwall and East Anglia in England and Belgium adapted from A.M. Wood *et al.* (2009). For the stratigraphy of NW France:

Assemblage I = Falun d'Anjou assemblages in the Anjou region ('Redonien chaud'). For age, D. Néraudeau pers. comm. [BL] (2015).

Assemblage II = 'Redonien Stratotypique' from Saint-Jacques-de-la-Lande (Ille-et-Villaine, Rennes area) ('Redonien froid'). For age, Néraudeau *et al.* (2003).

Assemblage III = Loire-Atlantique (Nantes area) and Vendée assemblages ('Redonien froid'). For age, Brault *et al.* (2004), Van Dingenen *et al.* (2014).

Assemblage IV = 'Plio-Pleistocene assemblages'. Saint-Jean-la-Poterie (Morbihan), for age D. Néraudeau pers. comm. [BL] (2015); Bosq d'Aubigny, for age Clet & Farjanel *in* Garcin *et al.* (1997), Dugué *et al.* (2000, 2009); Gourbesville, for age Dugué *et al.* (2009).

which makes it upper Piacenzian to lower Gelasian in age.

The outcrop of Saint-Jean-la-Poterie, in Brittany, was not discussed in detail by Lauriat-Rage (1981, p. 138), who considered it similar to that of Bosq d'Aubigny, but with an impoverished bivalve assemblage. It is now considered lower Gelasian, possibly uppermost Piacenzian (Didier Néraudeau pers. comm. [BL], 2015).

The Gourbesville sequence, Manche department, was considered to fall within the 'Redonien froid' by Lauriat-Rage (1981). In the author's stratigraphic sequence, based on palaeontological criteria, Gourbesville was the youngest of the 'Redonian' assemblages (Lauriat-Rage, 1981, fig. 7). According to Dugué *et al.* (2009), the Falun de Bohon Fm. Is upper Piacenzian-lower Gelasian in age (p.286-287). The Gourbesville locality was exploited for the presence of phosphorites (agricultural purposes). According to Prof. Claude Pareyn (Univ. Caen, pers. comm.; Janssen, 1988) material in older collections indicated with Gourbesville is frequently contaminated with specimens from other localities, and sold by the quarry workers for 'big money'.

Typical localities of Brittany and Normandy: Bosq d'Aubigny (Manche), Saint-Jean-La-Poterie (Morbihan), Gourbesville (Manche), and Pont l'Abbé (Manche).

Material and methods

The material described here is part of the Brébion collection at the Muséum national d'Histoire naturelle, Paris, France. It is the same material used by Brébion in his unpublished thesis (1964). In order to understand the species groups suggested by Brébion, we loaned the specimens illustrated by the author in his thesis from the MNHN Paris (collection de Paléontologie).

Wherever possible we have used Brébion's specimens as holotypes, renaming the species with names quite different from the manuscript names used by Brébion to avoid any confusion. The 'holotypes' of four of Brébion's 'species' are housed in the collections of the University of Rennes. We did not examine these specimens personally. New photographs of these specimens were kindly provided by Damien Gendry of the Rennes University.

The taxonomic part of this work is strongly centred on the Zanclean of Le Landreau, Le Pigeon Blanc (Nantes area, Loire-Atlantique), where the authors have collected further material.

Type material was deposited in the Muséum national d'Histoire naturelle, Paris (collection de Paléontologie) and the Naturhistorisches Museum Wien, Vienna, Austria. Further material is present in the private collections of Frank Van Dingenen, Brecht (Belgium) and Luc Ceulemans, Rixensart (Belgium) and Jaap van der Voort (Venne, Germany). Material from Bosc d'Aubigny and Selsoif in the Naturalis Biodiversity Center collection (Leiden, The Netherlands) (leg. A.W. Janssen, 1988-1989), was also consulted.

All photographs B. Landau, unless stated.

Abbreviations:

MNHN.F	Muséum national d'Histoire naturelle (collection de Paléontologie), Paris (France).
NHMW	Naturhistorisches Museum Wien collection, Vienna (Austria).
IGR-PAL	Institut de Géologie de Rennes collection, University of Rennes (France).
RGM	Naturalis Biodiversity Center, Fossil Mollusca collection, Leiden (The Netherlands).
FVD	Frank Van Dingenen private collection, Brecht (Belgium).
JvdV	Jaap van der Voort collection, Ostercappeln-Venne (Germany).
LC	Luc Ceulemans private collection, Rixensart (Belgium).

Systematic palaeontology

Superfamily Buccinoidea Rafinesque, 1815
 Family Nassariidae Iredale, 1916 (1835)
 Subfamily Nassariinae Iredale, 1916 (1835)
 Genus *Nassarius* Duméril, 1806

Nassarius Duméril, 1806, p. 166. Type species (by subsequent monotypy, von Froriep, 1806): *Buccinum arcularia* Linnaeus, 1758, present-day, Indo-West Pacific.

Note – The species discussed below are all placed within the genus *Nassarius* Duméril, 1806. As used here, *Nassarius* is most probably polyphyletic. However, at this point it is not possible to separate most of the European fossil to present-day nassariids based on shell characters (Landau *et al.*, 2009). Provisionally, we prefer to follow Adam & Glibert (1974, 1976), Gili (1991) and Landau *et al.* (2009) and assign them to species-groups with similar shell characters. We await genetic studies in order to determine which shell features are of generic importance.

As said above in the introduction, the nassariids of Assemblages I and II will be published in a subsequent paper.

Assemblage III nassariids

Nassarius brebioni nov. sp.

Plate 1, figs 1-3; Plate 8, fig. 5

1964 *Hinia* (*Tritonella*) cf. *kermondei* Kendall, 1894 – Brébion, p. 465, pl. 11, fig. 36 (*non* Kendall).

Type material – Holotype MNHN.F.A52564, height 15.9 mm; paratype 1 NHMW 2015/0133/0008, height 17.0 mm; paratype 2 NHMW 2015/0133/0009, height 15.3 mm; paratype 3 NHMW 2015/0133/0010, height 15.4 mm (missing apical whorls); paratype 4 NHMW 2015/0133/0011, (api-

cal whorls with protoconch)

Other material – NHMW 2015/0133/0012 (2 incomplete); LC coll. (15 + 30 incomplete); FVD coll. (5).

Etymology – Named after Philippe Brébion of the Museum National d'Histoire Naturelle, Paris, in recognition of his work on the French Redonian assemblages. *Nassarius* gender masculine.

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

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – A medium-sized *Nassarius* species with a solid shell, tall spire, an axial sculpture composed of eight narrow, elevated, continuous ribs, spiral sculpture of fine, close-set threads, a relatively short last whorl, small aperture, outer lip thickened, bearing four denticles within, columellar callus moderately expanded and a paucispiral protoconch.

Description – Shell medium sized, robust, with a tall conical spire. Protoconch smooth, paucispiral, consisting of 1.5 whorls with a large nucleus (dp = 670 μ m; hp = 690 μ m; dn = 490 μ m). Teleoconch consisting of seven convex whorls, with periphery just above abapical suture. Suture impressed, weakly undulating. Axial sculpture consisting of eight weakly opisthocline, narrow, continuous, rounded ribs. Spiral sculpture of very fine, close-set spiral threads covers whole shell surface. Last whorl relatively short, 53% of total height. Aperture small, outer lip strongly thickened with a beveled edge, weakly prosocline in profile, bearing four distinct denticles within, the adapical denticle placed mid-whorl most strongly developed; lower denticles weakening abapically. Anal canal narrow, clearly developed; siphonal canal short, open, twisted to the left. Columella regularly excavated, bearing two tubercles abapically, extending into the aperture in some specimens; small parietal tubercle adapically. Columellar callus thickened, moderately expanded, erect over base. Siphonal fasciole poorly developed, not delimited form base.

Discussion – Landau *et al.* (2009) were wrong to include these French Pliocene shells in the synonymy of *Nassarius strobelianus* (Cocconi, 1873). Although they undoubtedly belong within the same group of nassariids there are important and constant differences between the two. The French specimens differ 1) in being smaller shelled (maximum height about 17 mm vs. 29 mm in *N. strobelianus*); 2) in having fewer axial ribs (eight vs. 9-16 in *N. strobelianus*); 3) in having spiral sculpture composed of extremely fine spiral thread as opposed to broad flattened bands; 4) in having fewer denticles within the outer lip (four vs. five or six in *N. strobelianus*); 5) in having a less expanded columellar callus, with fewer tubercles and a weak parietal tubercle adapically as opposed to a well-developed, raised parietal ridge that extends into

the aperture, as seen in *N. strobelianus*; 6) the siphonal fasciole is not delimited from the base by a deep groove, as it is in *N. strobelianus*. We also note that whilst *N. strobelianus* is quite variable in sculpture (see Landau *et al.*, 2009, pl. 11, figs 3-5), the French shells are remarkably constant in size, shape and sculpture.

Brébion (1964) remarked on the similarity between this French specimens and those of *N. kermondei* Kendall, 1894, described from the lower Pleistocene Gelasian Isle of Man deposits, located in the Irish Sea. The specimen illustrated by Harmer (1914, pl. 13, fig. 17) is somewhat worn and is missing the apex. Indeed, most fossils from these deposits are abraded, making detailed characterisation of these taxa difficult. It is similar in size (height 16 mm) to the French shells, but differs: 1) in having fewer axial ribs [six or seven (not described in text; counted from illustrated specimen) vs. eight in all French specimens]; 2) in being shorter spired, with a slightly more globose last whorl; and 3) in having the columellar callus more thickened abapically, covering the ventral side of the siphonal fasciole. In the French shells the columellar callus is somewhat thickened abapically, but does not cover the siphonal fasciole. Harmer (1914, p. 75) remarked that all the Manx specimens known to him were totally devoid of spiral sculpture, whereas fine spiral threads are seen in all the French shells. We concur with Brébion (1964, p. 467) in considering it quite unlikely that the French and Manx shells are conspecific and assign the French fossils to a new species: *Nassarius brebioni* nov. sp. The paucispiral protoconch, with a large nucleus would suggest a non-planktotrophic mode of development. It is likely that this species had a narrow geographical and stratigraphical distribution, and was part of this endemic nassariid fauna fauna that thrived in the northeastern sector of the Golf of Biscay during the Zanclean.

Brébion (1964) reported this species from Le Pigeon Blanc, Palluau, Le Girondor (Loire-Atlantique) and St-Jean-la-Poterie (Brittany). It is unlikely that specimens from the other Assemblage III localities are mis-identified, as this species has a very distinctive shell. However, the St-Jean-la-Poterie assemblage is younger, uppermost Piacenzian-lower Gelasian, slightly older than that of the Isle of Man. These specimens need to be compared to the Manx shells of *N. kermondei*, and the shell herein described as *Nassarius* sp. B.

Distribution – Lower Pliocene: Zanclean: NW France (Brébion, 1964). ?Upper Pliocene-lower Pleistocene: Atlantic, uppermost Piacenzian-lower Gelasian, Manche, NW France (Brébion, 1964).

***Nassarius crebresulcatus* (Bellardi, 1882)**

Plate 1, figs 4-7; Plate 8, fig. 6

- *1882 *Nassa crebresulcata* Bellardi, p. 50, pl. 3, fig. 10.
- 1939 *Nassa (Hinia) crebresulcata* Bell. – Montanaro, p. 121, pl. 9, fig. 9.
- 1964 *Hinia crebresulcata* Bellardi, 1882 – Brébion, p. 446, pl. 11, fig. 14.

1981 *Nassa crebresulcata* Bellardi, 1882 – Ferrero Mortara *et al.*, p. 103, pl. 21, fig. 4.

Material – MNHN.F.A52549 (1), height 11.5 mm; MNHN.F.A52550 (6); NHMW 2015/0133/0017 (1), height 11.5 mm; NHMW 2015/0133/0018 (1), height 10.6 mm; NHMW 2015/0133/0019 (1), height 10.6 mm; NHMW 2015/0133/0044 (1); NHMW 2015/0133/0020 (13); LC coll. (33); FVD coll. (9); all Le Pigeon Blanc, Le Landreau, Nantes area, Loire Atlantique department, NW France.

Discussion – We must agree with Brébion (1964) in that the French shells from Le Pigeon Blanc cannot be separated from those of *Nassarius crebresulcatus* (Bellardi, 1882) from the Tortonian Upper Miocene of Italy. A synonym illustrated by Ferrero Mortara *et al.* (1981, pl. 21, fig. 4) is identical to the Redonian specimens figured herein (Plate 1, fig. 5). There is some variability in the density of axial ribs, as seen in the series illustrated (Plate 1, figs 4-7), but otherwise the shells are relatively constant in shape and in the characters of the well-developed labial teeth and parietal shield. This is the only ‘Redonian’ French Zanclean species with a Mediterranean Miocene record. The protoconch is not well preserved, but it is multispiral, consisting of at least 2.5-3 whorls, with a small nucleus (Plate 8, fig. 6).

Nassarius corrugatus (Brocchi, 1814) [*Nassarius cuvierii* (Payraudeau, 1826) is a junior synonym; see Landau *et al.*, 2009] from the Pliocene Mediterranean and present day European waters is closely similar, but differs in having a paucispiral protoconch and fewer axial ribs.

Nassarius crebresulcatus was recorded by Brébion (1964) only from the Le Pigeon Blanc Redonian assemblage.

Distribution – Upper Miocene: Tortonian, Italy (Bellardi, 1882; Montanaro, 1939). Lower Pliocene: Zanclean: NW France (Brébion, 1964).

***Nassarius landreauensis* nov. sp.**

Plate 1, figs 8-10; Plate 2, fig. 1; Plate 8, fig. 7

1964 *Hinia reticulata* var. *recta* Dollfus et Dautzenberg – Brébion (*partim*), p. 442, pl. 11, figs 7-8 (not fig. 9).

Type material – Holotype MNHN.F.A52544, height 11.6 mm; paratype 1 MNHN.F.A52543/1, height 10.7 mm; paratype 2 MNHN.F.A52543/2, height 10.2 mm; paratype 3 NHMW 2015/0133/0027, height 12.3 mm; paratype 4 NHMW 2015/0133/0028, height 11.9 mm; paratype 4 NHMW 2015/0133/0029, height 11.9 mm; paratype 5 NHMW paratype 4 NHMW 2015/0133/0030 (juvenile with protoconch).

Other material – NHMW 2015/0133/0031 (36); LC coll. (100); FVD coll. (28).

Etymology – Named after the type locality Le Landreau. *Nassarius* gender masculine.

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

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – A medium-sized *Nassarius* species with a solid shell, tall spire, predominantly axial sculpture composed of 12-14 narrow, elevated, continuous ribs, spiral sculpture of narrow cords, a relatively short last whorl, small aperture, outer lip thickened, bearing five or six denticles within, columellar callus shield moderately expanded and a tall pupoid protoconch composed of 2-2.5 whorls.

Description – Shell of medium size, robust, bucciniform, with a tall, conical spire and predominantly axial sculpture. Protoconch, consisting of 2-2.5 smooth convex whorls, with a small nucleus; whorls tall and rapidly expanding after first half whorl, giving somewhat pupoid shape to protoconch. Junction with teleoconch clearly delimited. Five weakly convex teleoconch whorls, with periphery just above abapical suture. Suture impressed. Axial sculpture of 12-14 narrow, rounded, orthocone, straight ribs, slightly narrower than their interspaces, continuous or almost so vertically; number of ribs not increasing abapically. Spiral sculpture overrides axial ribs, on spire whorls consisting of seven or eight narrow cords, roughly equal in width to their interspaces, 15-16 on last whorl. Last whorl evenly rounded, 60% of total height, constricted at base. Aperture pyriform, 30% of total height; outer lip thickened by labial varix, bearing five or six irregular denticles within, mid-aperture denticle more strongly developed; anal canal rounded, well developed; siphonal canal short, narrow, open. Columella excavated in mid-portion. Columellar callus sharply delimited, forming a small round-bordered callus shield closely appressed to venter, slightly erect over base; callus bearing three or four tubercles abapically and parietal tubercle. Siphonal fasciole flattened, separated from base by narrow groove.

Discussion – These specimens from Le Pigeon Blanc were identified as *Nassarius rectus* (Dollfus & Dautzenberg, 1886) by Brébion (1964, p. 442), although the author commented that the shells from this locality were somewhat different to those of other ‘Redonian’ deposits. *Nassarius rectus* is a Langhian-Serravallian species commonly found in the Loire Basin (Glibert, 1952, p. 337). The shells of *N. landreauensis* differ consistently from specimens of *N. rectus* at hand from several Loire Basin localities (Ferrière-Larçon, Pauvreley, Le Petit Bray) in: 1) being smaller shelled (adult *N. rectus* surpass 20 mm in height vs. maximum height of 12.3 mm for *N. landreauensis* nov. sp.); 2) in being more slender; *N. rectus* has a relatively inflated last whorl; 3) in having a higher spire and proportionally smaller last whorl and aperture; 4) in having narrower axial ribs; 5) the ribs being continuous vertically, whereas in *N. rectus* they are usually discontinuous; 6) in having narrow cords separated by wide interspaces, as opposed to broad ribs separated by

narrow interspaces, as seen in *N. rectus*; 7) in having a less expanded columellar callus shield; 8) the protoconch in *N. rectus* (specimen from Le Petit Bray; NHMW coll.) is low, dome-shaped, multispiral, composed of three whorls, whereas the protoconch of *N. landreauiensis* is pupoid, made up of 2-2.5 higher whorls.

Brébion (1964) described some variation between the shells of what he considered *N. rectus* from different 'Redonian' localities and reported this species from both Assemblage I localities (Saint-Michel-et-Chanveaux) and Assemblage II localities (Apigné, Le Girondor, Palluau). The shell illustrated by Brébion (1964, pl. 11, fig. 9) as form *insolita* Millet, 1854 does not seem to be conspecific with either *N. rectus* or *N. landreauiensis*, but further specimens would be required to be certain. Despite extensive collecting in Assemblage I localities (Sceaux d'Anjou, Renauleau), we have found neither *N. rectus* nor *N. landreauiensis* in these deposits. The shells recorded as *N. rectus* by Brébion (1964) from the younger uppermost Piacenzian-lower Gelasian St-Jean-la-Poterie assemblage indeed represent this species (see below).

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

***Nassarius merlei* nov. sp.**

Plate 2, figs 2-4; Plate 8, fig. 8

1964 *Hinia (Uzita) vasseuri* Brébion, p. 457, pl. 11, figs 24, 25 (*nomen nudum*).

Type material – Holotype MNHN.F.A52559, height 19.7 mm; paratype 1 MNHN.F.A52560, height 19.5 mm; paratype 2-4 MNHN.F.A52561/1-3, height 20.3 mm, 20.1 mm, 19.3 mm respectively; paratype 5 NHMW 2015/0133/0034, height 30.2 mm; paratype 6 NHMW 2015/0133/0035, height 24.7 mm; paratype 7 NHMW 2015/0133/0036, height 27.8 mm; paratype 8 NHMW 2015/0133/0037 (juvenile with protoconch).

Other material – NHMW 2015/0133/0038 (50+); LC coll. (100+); FVD coll. (100+).

Etymology – Named after Dr Didier Merle of the MNHN Paris for his help in finding Brébion's specimens and facilitating the loan of this material. *Nassarius* gender masculine.

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

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – A medium-large *Nassarius* species with a fragile shell, tall spire, axial sculpture that weakens abapically and is obsolete, or almost so, on the penultimate and/or last whorl, spiral sculpture composed of narrow flattened cords separated by narrow grooves, an inflated last whorl, a large aperture devoid of apertural armature and a multispiral protoconch of 2.75 whorls

with a small nucleus.

Description – Shell medium-large, relatively fragile, bucciniform, with a tall spire and predominantly axial sculpture. Protoconch dome-shaped, consisting of 2.75 smooth convex whorls, with a small nucleus (dp = 790 μ m, hp = 810 μ m, dp/hp = 0.98, dp1 = 270 μ m, dn = 110 μ m). Junction with teleoconch clearly delimited. Teleoconch consisting of six to seven convex whorls, with periphery at or just above abapical suture. Suture impressed, weakly undulating. On early teleoconch whorls, axial sculpture of 12-13 rounded, weakly opisthocline ribs, roughly equal in width to their interspaces. Abapically ribs weaken, to become obsolete, or almost so, on penultimate and/or last whorl. Spiral sculpture consisting of 11-12 narrow, flattened cords, separated by narrow grooves. Last whorl inflated, 65% of total height, constricted at base. Aperture ovate, relatively large, 40% of total height; outer lip thin, somewhat flared abapically, weakly lirate within; anal canal hardly developed; siphonal canal short, wide, open. Columella shallowly excavated in mid-portion. Columellar callus sharply delimited, forming narrow callus band, smooth, except for single fold abapically bordering siphonal canal. Siphonal fasciole rounded, separated from base by narrow groove.

Discussion – *Nassarius merlei* nov. sp. belongs to the *N. reticosus* (J. Sowerby, 1815) species-group, characterised by their medium-large fragile shells, axial sculpture that weakens on later adult whorls, and poorly developed apertural armature. *Nassarius reticosus* has an extremely variable shell (see discussion under that species). Nevertheless, *N. merlei* differs in 1) being smaller shelled (adults of *N. reticosus* often over 60 mm in height, whereas maximum height for *N. merlei* is 30 mm, with most specimens smaller); 2) in having finer and more regular spiral sculpture; 3) in having a multispiral protoconch composed of 2.75 whorls, with a small nucleus, whereas the protoconch of *N. reticosus* is paucispiral, composed of a single whorl with a large nucleus (Marquet, 1999, fig 125 E, G). *Nassarius merlei* is abundant at Le Pigeon Blanc. Brébion (1964) recorded it also from Le Girondor and la Dixmérie.

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

***Nassarius spectabilis vandewouweri* (Glibert, 1959)**

Plate 2, figs 7-9

1878 *Nassa pygmaea* Nyst, pl. 2, fig. 5 [*non Nassarius pygmaeus* (Lamarck, 1822)].

1881 *Nassa pygmaea* Nyst, p. 26 [*non Nassarius pygmaeus* (Lamarck, 1822)].

*1959 *Hinia (Uzita) vandewouweri* Glibert, p. 23, pl. 3, fig. 17.

1976 *Nassarius spectabilis vandewouweri* (Glibert, 1959) – Adam & Glibert, p. 43, pl. 2, fig. 5, pl. 6, figs 7, 8.

- 1997 *Nassarius spectabilis vandewouweri* (Glibert, 1959) – Marquet, p. 98.
 1998 *Nassarius spectabilis vandewouweri* (Glibert, 1959) – Marquet, p. 149, fig. 123.

Material – NHMW 2015/0133/0032 (1), height 18.7 mm; NHMW 2015/0133/0033 (1), height 20.0 mm; LC coll. (2); all Le Pigeon Blanc, Le Landreau, Nantes area, Loire Atlantique department, NW France.

Discussion – *Nassarius spectabilis* (Nyst, 1845) belongs to the *Nassarius clathratus* (Born, 1778) species-group of Adam & Glibert (1976). It is characterised by its shell with very convex whorls, predominant axial sculpture, very fine spiral sculpture and by the presence of strong varices on the later teleoconch whorls, which distinguishes it from all other members of the group.

Glibert (1959) described *Nassarius vandewouweri* from the lower Pliocene Zanclean Luchtbal Sands Member of the Lillo Formation of Belgium, which was said to differ from *N. spectabilis* in having lower, more convex whorls, having less prominent axial ribs and finer spiral cords, narrower than their interspaces. Later, Adam & Glibert (1976) considered the Belgian Zanclean taxon a subspecies of *N. spectabilis*, adding some small differences in protoconch detail; although they both have protoconchs of about three whorls and differences in sculpture; *N. spectabilis* has 13-20 axial ribs and 8-12 spiral cords, whereas *N. spectabilis vandewouweri* has 14-16 ribs and 12-14 cords.

We record *N. spectabilis* from both Assemblage I (Brigné-sur-Layon) and Assemblage III (Le Pigeon Blanc) localities. As noted by Brébion (1964), the specimens from the Assemblage I locality of Brigné-sur-Layon attain a slightly greater maximum height than specimens from the middle Miocene, Langhian, Loire Basin, but are otherwise indistinguishable, with 13-15 axial ribs and 9-11 spiral cords on the penultimate whorl. Specimens from Assemblage III, Le Pigeon Blanc, are even larger, have more convex whorls and prominent varices on the later whorls, with 16 axial ribs and 13-17 spiral cords, which places them within the variability of *N. spectabilis vandewouweri*. The protoconch is too abraded to offer a description.

It seems, therefore that *N. spectabilis spectabilis* survived into the Tortonian, but was replaced by *N. spectabilis vandewouweri* in the Zanclean. Brébion (1964) reported *N. spectabilis* from various Assemblage I localities (Sceaux, Thorigné, Saint-Michel-et-Chanveaux), which probably represent *N. spectabilis spectabilis*. This is the first record for the subspecies in NW France, or outside the Belgian Pliocene.

Distribution – Lower Pliocene: Zanclean, NW France (this paper); Luchtbal Sands, Belgium (Glibert, 1959), base of Oorderen Sands, Belgium (Marquet, 1998).

***Nassarius pacaudi* nov. sp.**

Plate 3, figs 1-4; Plate 8, fig. 9

- 1964 *Hinia (Tritonella) incrassata* Muller, 1776 [sic] - Brébion, p. 464, pl. 11, figs 32, 33 [*non Nassarius incrassatus* (Störm, 1786)].

Type material – Holotype MNHN.F.A53331, height 6.7 mm; paratype 1 MNHN.F.A53332, height 8.7 mm; paratype 2 NHMW 2015/0133/0021, height 8.8 mm; paratype 3 NHMW 2015/0133/0022, height 6.0 mm; paratype 4 NHMW 2015/0133/0023, height 8.2 mm; paratype 5 NHMW 2015/0133/0024, height 5.6 mm; paratype 6 NHMW 2015/0133/0025, height 7.0 mm.

Other material – NHMW 2015/0133/0026 (37); FVD coll. (27).

Etymology – Named after Jean-Michel Pacaud of the MNHN Paris for his help in finding Brébion's material and facilitating the loan of this material. *Nassarius* gender masculine.

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

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – A small *Nassarius* species with predominant axial sculpture consisting of 13-14 close-set, elevated ribs, spiral sculpture of very narrow flattened cords separated by grooves, a small aperture, a denticulate outer lip, a wide, deep, smooth groove separating the base from the siphonal fasciole and a multispiral protoconch of 3.5 whorls with a small nucleus.

Description – Shell small, robust, bucciniform, spire more or less elevated. Protoconch dome-shaped, consisting of 3.5 smooth convex whorls, with a small nucleus (dp = 850 µ, hp = 830 µ, dp/hp = 1.03, dn = 90 µ, dV1 = 155 µ). Junction with teleoconch marked by appearance of axial sculpture. Teleoconch consisting of four convex whorls, with periphery just below mid-whorl. Suture impressed, undulating. Axial sculpture consisting of 13 or 14 prominent, elevated, rounded, orthocline ribs, slightly narrower than their interspaces; ribs more or less continuous vertically. Spiral sculpture overrides axial ribs, consisting of numerous, narrow flattened cords separated by narrow incised grooves, eight on first teleoconch whorl, increasing abapically to 16-18 on last whorl. Aperture small, ovate, outer lip rounded, strongly thickened by labrial varix, seven or eight elongated denticles within, adapical denticle slightly more strongly developed; anal canal distinct, rounded; siphonal canal short, open. Columella strongly concave, narrowly callused, with a basal fold bordering the siphonal canal and a single parietal tooth. Siphonal fasciole flattened, bearing three narrow spiral cords, separated from base by a deep, wide, smooth groove.

Discussion – *Nassarius pacaudi* nov. sp. belongs within the *Nassarius serraticosta* (Bronn, 1831) species-group of Landau *et al.* (2009). This group of nassariids is char-

acterised by having small, relatively robust shells, with an elevated spire, convex whorls, sculpture made up of dense spiral cords and widely-spaced, prominent ribs. In most members of the group tubercles do not form at the sculptural intersections. The outer lip is strongly thickened by a prominent labial varix and the columellar callus is restricted to a narrow callus band that does not extend onto the venter. The most distinctive characters in *N. pacaudi* are the close-set axial ribs, denser than usual for the group and the relatively broad groove delimiting the base of the last whorl from the siphonal fasciole. The most variable character is the height of the spire, some specimens are somewhat squat (Plate 3, figs 1, 4), whilst others have a relatively tall spire (Plate 3, figs 2, 3), however, spire height is a highly variable intraspecific character within many nassariid species.

Nassarius pacaudi is most similar to *N. serraticosta*, but has more numerous axial ribs (13-14 vs. 10-12), which are continuous vertically up the spire, whereas in *N. serraticosta* the ribs tend to be intercalated between those on the preceding whorl. The ribs do not have a tendency to become varicose, as they do in *N. serraticosta*, and *N. serraticosta* lacks the broad groove separating the base from the siphonal fasciole, which is so distinctive in *N. pacaudi*. *Nassarius manuelmolinai* Landau, Silva & Gili, 2009 from the Atlantic lower Pliocene Guadalquivir Basin of Spain is larger shelled, with fewer axial ribs. *Nassarius productus* (Bellardi, 1882), widespread in the Mediterranean and adjacent Atlantic Pliocene, is similar in size, but again has fewer axial ribs that are more exactly aligned vertically up the spire and does not have the siphonal fasciole so sharply delimited from the base. Brébion (1964, p. 464, pl. 11, figs 32, 33) described and illustrated specimens of this species from Le Pigeon Blanc as *Hinia (Tritonella) incrassata* Muller, 1776 [sic] [non *Nassarius incrassatus* (Störm, 1786)]. The resemblance is superficial, as this species typifies the *N. incrassatus* species-group (see below). As far as we know, *N. pacaudi* occurs only at Le Pigeon Blanc, where it is relatively abundant. In these deposits it can only be confused with *N. turonensis* (Peyrot, 1925), but again the resemblance is superficial, as *N. turonensis* also belongs within the *N. incrassatus* species-group, and can easily be separated based on sculptural and apertural characters.

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

***Nassarius palumbis* nov. sp.**

Plate 3, figs 5, 6, 7, 9; Plate 8, fig. 10; Plate 9, fig. 1

1964 *Hinia philippoti* Brébion, p. 447, pl. 11, fig. 15 (*nomen nudum*).

Type material – Holotype IGR-PAL-131890 (coll. Brébion IGR), height 7.8 mm; paratype 1 MNHN.F.2015/0133/0001, height 8.2 mm; paratype 2 NHMW 2015/0133/0004, height 8.3 mm; paratype 3 NHMW 2015/0133/0003, height 7.2 mm; paratype 4 NHMW 2015/0133/0005, height 8.0 mm;

paratype 5 IGR-PAL-131895 (coll. Brébion IGR), height 8.2 mm.

Other material – NHMW 2015/0133/0006 (3); LC coll. (23); FVD coll. (7).

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

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

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – A small *Nassarius* species with medium-height conical spire, axial sculpture restricted to the first 2.5 teleoconch whorls, spiral sculpture consisting of regular narrow flattened cords separated by grooves, covering entire whorl surface on all whorls, a small aperture, a denticulate outer lip with four or five denticles, the adapical denticle placed mid-aperture most strongly developed, a base that is poorly separated from the siphonal fasciole and an elevated protoconch of two whorls with a medium-sized nucleus.

Description – Shell small, of medium thickness, bucciniform, with a medium-height conical spire. Protoconch multispiral, tall dome-shaped, consisting of two smooth convex whorls, with a medium-sized nucleus. Junction with teleoconch worn. Teleoconch consisting of four weakly convex whorls, with periphery at abapical suture. Suture impressed, linear. Axial sculpture restricted to first 2.5 teleoconch whorls, consisting of 14 low, rounded ribs, roughly equal in width to their interspaces, ribs weaken abapically, obsolete on second half of third whorl. Spiral sculpture consisting of regular, narrow, flattened cords separated by narrow groove, ten on second teleoconch whorl, increasing to about 22 on last whorl. Last whorl 67% of total height, evenly rounded, weakly constricted at base. Aperture small, 37% of total height, subovate, outer lip thickened by labial varix, bearing four or five distinct denticles within, abapical denticle placed mid-aperture more strongly developed; anal canal shallow, poorly developed; siphonal canal short, narrow, open. Columella excavated in mid-portion. Columellar callus strongly thickened, clearly delimited, moderately expanded in the parietal region, further thickened and erect over base, with basal fold bordering siphonal canal, single tubercle placed just above fold, small parietal tubercle. Siphonal fasciole small, poorly delimited from base.

Discussion – *Nassarius palumbis* nov. sp. is included in the *N. semistriatus* (Brocchi, 1814) species-group of Landau *et al.* (2009). The protoconch of this new species is composed of two whorls with a medium sized nucleus. At first glance the shell of *Nassarius palumbis* resembles a small specimen of *N. macrodon macrodon* (Bronn, 1831) (Plate 3, fig. 7), but the Le Pigeon Blanc

species differs in 1) having a narrower conical spire, especially the early whorls (Plate 3, figs 7c, 8c); 2) having fewer axial ribs on the early teleoconch whorls (14 vs. 20 in *N. macrodon macrodon*); 3) having fewer cords on the early teleoconch whorls (10 vs. 6 in *N. macrodon macrodon*); 4) having regular spiral sculpture covering the entire whorl surface, whereas in *N. macrodon macrodon* the spiral sculpture is usually obsolete, or almost so, on the mid-portion of the last two whorls; 5) having fewer labial denticles (four or five vs. five to seven in *N. macrodon macrodon*); and 6) having a protoconch composed of two elevated whorls with a medium-sized nucleus, whereas *N. macrodon macrodon* has a much larger multispiral, dome-shaped protoconch composed of 3.5-4.0 whorls. *Nassarius macrodon macrodon* is an extinct subspecies known from the Mediterranean and adjacent Atlantic Neogene European deposits from the upper Miocene Tortonian to the lower Pleistocene Gelasian. The extant subspecies *N. macrodon recidivus* (von Martens, 1876) differs in having a shell with the axial sculpture persisting on a greater number of teleoconch whorls (Landau *et al.*, 2009, p. 18). Brébion (1964) also compared these specimens with those of *N. macrodon* and *Nassa recondita* Bellardi, 1882, which is a junior subjective synonym of *N. macrodon macrodon* (Landau *et al.*, 2009, p. 18). The author also compared them to *Nassarius atavus* (Bellardi, 1882) from the Pliocene of Italy, but this is quite a different species with axial ribs covering the entire shell surface.

The shell of *Nassarius notanda* (Bellardi, 1882) from the upper Miocene Tortonian of Tetti Borelli in Italy shows similar sculpture, but differs in having a lower spire, giving it a more globose appearance, denser axial sculpture on the early teleoconch whorls and a more widely expanded inner lip callus in the parietal region.

Nassarius palumbis is uncommon in the Le Pigeon Blanc deposits. Brébion (1964) also recorded one specimen from Le Girondor.

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

***Nassarius columbinus* nov. sp.**

Plate 4, figs 1-3; Plate 9, fig. 2

Type material – Holotype MNHN.F.A53333, height 10.3 mm; paratype 1 NHMW 2015/0133/0007, height 8.6 mm; paratype 2 NHMW 2015/0133/0040, height 7.8 mm.

Other material – LC coll. (5); FVD coll. (1).

Etymology – Latin “*columbinus, a, um*”, adjective, of pigeons; a reference to the type locality of Le Pigeon Blanc (the white pigeon). *Nassarius* gender masculine.

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

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – A small *Nassarius* species with low conical spire, globose last whorl, no axial sculpture, except growth lines, spiral sculpture consisting of regular narrow flattened cords separated by grooves, covering entire whorl surface on all whorls, a denticulate outer lip with seven denticles, the mid-apertural denticle most strongly developed, and a base that is poorly separated from the siphonal fasciole.

Description – Shell small, solid, globose, with a short conical spire. Protoconch consisting of 2.5 smooth whorls, with medium-sized nucleus. Junction with teleoconch marked by beginning of spiral sculpture. Teleoconch consisting of four low, weakly convex whorls, with periphery at abapical suture. Suture impressed, linear. Spiral sculpture consisting of regular, narrow, flattened cords separated by narrow groove, six on second teleoconch whorl, increasing to about 22 on last whorl. Axial sculpture absent, except for irregular growth lines interrupting the spiral cords, giving them a somewhat beaded appearance. Last whorl 78% of total height, evenly rounded, weakly constricted at base. Aperture 46% of total height, subovate, outer lip thickened by labial varix, bearing seven distinct denticles within, third tooth from apex placed just above mid-aperture more strongly developed; anal canal deep, rounded, well developed; siphonal canal short, narrow, open. Columella excavated in mid-portion. Columellar callus strongly thickened, clearly delimited, slightly expanded in the parietal region, further thickened and erect over base, with a basal fold bordering siphonal canal, single tubercle placed just above fold, small parietal tubercle. Siphonal fasciole small, poorly delimited from base.

Discussion – Adam & Glibert (1974, p. 6) and Landau *et al.* (2009, p. 9) discussed the difficulty in placing nassariids into sub-generic groups (*i.e.* *Amyclina* Iredale, 1918; *Uzita* H. Adams & A. Adams, 1853; *Telasco* H. Adams & A. Adams, 1853, amongst many) and placed almost all the European nassariids within the genus *Nassarius*. This does not signify that these authors and ourselves consider the group monophyletic, but rather that until further data, possibly molecular data, is available we cannot reliably identify monophyletic groups within European nassariids based on shell characters alone. Landau *et al.* (2009) preferred to use species groups, but even so, they highlighted numerous examples where species did not fit neatly within the species group’s characters [*i.e.* *Nassarius macrodon* (Bronn, 1831); Landau *et al.*, 2009, p. 18]. They did, however, recognise several other nassariid genera within the Nassariidae family, one of them being the thermophillic genus *Demoulia* Gray, 1838.

Nassarius columbinus nov. sp. again illustrates the difficulty in assigning European nassariids into genera. The shell of this species resembles a miniature *Demoulia* specimen, and it is almost through instinct rather than solid taxonomic criteria that we place it in *Nassarius* rather than *Demoulia*. This decision was taken based on two reasons: 1) The genus *Demoulia* is represented in the European Neogene by at least four species (Landau *et*

al., 2009), all of which are represented by considerably larger specimens than the ones of this new French taxon; 2) In all *Demoulia* species the base of the shell is clearly delimited from the siphonal fasciole by a deep groove. This groove is present in many, but not all *Nassarius* species. The examined specimens of *Nassarius columbinus* nov. sp. do not show this groove. We therefore place *N. columbinus* in the *N. semistriatus* (Brocchi, 1814) species group, most of which do not have this groove (see Landau et al., 2009, p. 12-21).

Indirectly supporting this taxonomic position, as mentioned above, it could be argued that *Demoulia* is a relatively thermophilic genus, which today is found only in the warmer, more southern Mauritanian-Senegalese biogeographical province. The Le Pigeon Blanc assemblage has very few taxa representing warm waters (no strombids or conids, one very small terebrid, one fcid). The most northern distribution of *Demoulia* in the Pliocene is central-west Portugal at Vale de Freixo, which has one species of *Demoulia* (no strombids, two conids, one terebrid and one fcid). It is therefore more likely to be a *Nassarius* species. Against this argument, *Demoulia* does occur in the upper Piacenzian-Gelasian of NW France and England (see below). However, the Le Pigeon Blanc nassariid fauna and that of Bosq d'Aubigny share nothing in common.

Nassarius columbinus is similar to *N. palumbis*, also endemic to the Le Pigeon Blanc assemblage (see above), but differs in 1) having a lower spire and more inflated last whorl, giving the shell a more globose shape; 2) lacking axial sculpture on the early teleoconch whorls; 3) having more numerous outer lip denticles (seven vs. four or five); and 4) the inner lip callus is less expanded in the parietal region. *Nassarius notanda* (Bellardi, 1882) from the Upper Miocene Tortonian of Tetti Borelli in Italy has a similar small, globose shell shape, but differs in having axial sculpture on the early teleoconch whorls and the inner lip callus is far more widely expanded in the parietal region and covers the ventral aspect of the siphonal fasciole, whereas in *N. columbinus* the siphonal fasciole is free of callus.

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

***Nassarius turpis* nov. sp.**

Plate 4, fig. 4

Type material – Holotype NHMW 2015/0133/0039, height 4.6 mm, width 3.2 mm.

Other material – Known only from holotype.

Etymology – Latin “*turpis*, e”, adjective, meaning foul, ugly, deformed, obscene, reflecting the strange ugly shape of this shell. *Nassarius* gender masculine.

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

Stratum typicum – Zanclean, lower Pliocene.

Diagnosis – A small, squat-shell *Nassarius* species with a low spire, the whorls bearing a prominent subsutural collar, sculpture of spiral cords covering entire surface and poorly developed axial ribs present only below the collar, a canaliculated suture, a small aperture with prominent apertural dentition and an extremely deep anal canal.

Description – Shell small, of medium thickness, squat bucciniform, with a depressed, scalate spire. Protoconch missing. Teleoconch consisting of three whorls, with strongly developed, rounded subsutural collar forming periphery, whorl slightly concave below. Suture deeply impressed, canaliculated. Axial sculpture present only below subsutural collar, consisting of low rounded ribs, roughly equal in width to their interspace. Spiral sculpture of narrow cords, roughly equal in width to their interspace, covers entire whorl surface. Last whorl inflated, with prominent, rounded subsutural collar, whorl profile concave immediately below collar, convex below, constricted at base. Aperture ovate, small; outer lip thickened, flared abapically, bearing four denticles within, the adapical denticle far more strongly developed; anal canal extremely deep, U-shaped, distorting aperture; siphonal canal short, narrow, open. Columella broadly excavated in mid-portion. Columellar callus sharply delimited, forming narrow callus band, bearing two stout tubercles abapically and a prominent parietal tooth. Siphonal fasciole broad, separated from base by narrow groove.

Discussion – *Nassarius turpis* nov. sp. has an extremely unusual shell for a nassariid. The combination of characters: the low scalate spire, canaliculated suture, prominent subsutural collar and the deepest anal canal of any nassariid we have seen, warrant description of this species despite being represented by a single incomplete specimen. We considered the possibility that this bizarre shell might represent a monstrosity, but there is no other Le Pigeon Blanc species it could be a teratological specimen of. We also considered it might be a columellid, but, whilst both groups have apertural dentition, the character of the dentition seen in this specimen is more closely similar to that of nassarids than it is to that of columbellids. Although the shell form of *N. turpis* deviates greatly from that of typical nassariids, *N. cotteri* Landau, Silva & Gili, 2009 from the lower Piacenzian Atlantic of the Mondego Basin, west central Portugal also has a canaliculated suture and subdued spiral sculpture that disappears with ontogeny. The similarity, however, ends there, as the Portuguese specimens of *N. cotteri* have a tall scalate spire, do not show a subsutural collar, the small aperture has weak apertural dentition, and the anal canal is small and shallow.

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

***Nassarius turonensis* (Deshayes, 1844)**

Plate 4, figs 5-8; Plate 9, fig. 3

- 1837 *Buccinum graniferum* Dujardin, p. 299, pl. 20, figs 10, 11 [*non Nassarius graniferus* (Kiener, 1834)].
- *1844 *Buccinum Turonense* Deshayes, p. 223 (*nom. nov. pro Buccinum graniferum* Dujardin, 1837).
- 1872 *Nassa granifera* Dujardin – S.V. Wood, p. 11, pl. 6, fig. 11 [*non Nassarius graniferus* (Kiener, 1834)].
- 1914 *Nassa turonica* (Deshayes) – Harmer, p. 85, pl. 5, figs 14, 15.
- 1918 *Nassa (Hima) turonica* (Deshayes) – Harmer, p. 328, pl. 34, figs 11-14.
- 1925 *Nassa (Hima) turonensis* (Deshayes) – Peyrot, p. 144, pl. 3, figs 34-36.
- 1952 *Nassa (Hima) verrucosa* Brocchi, sp. 1814 – Glibert, p. 340, pl. 10, fig. 5 (*non* Brocchi).

Material – NHMW 2015/0133/0013 (1), height 6.9 mm; NHMW 2015/0133/0014 (1), height 6.8 mm; NHMW 2015/0133/0015 (1), height 5.3 mm; NHMW 2015/0133/0041 (1), height 7.8 mm; NHMW 2015/0133/0016 (50+); FVD coll. (35), maximum height 6.8 mm; all Le Pigeon Blanc, Le Landreau, Nantes area, Loire Atlantique department, NW France.

Discussion – This species belongs within the *Nassarius incrassatus* (Störm, 1786) species-group of Landau *et al.* (2009). This group comprises numerous species with small, relatively robust shells, with a more or less elevated spire, convex whorls, reticulate sculpture and a strongly thickened outer lip, denticulated within. The protoconch in all species within this group is multispiral dome-shaped. The shells illustrated here from Le Pigeon Blanc are conspecific with those illustrated by Glibert (1952) from the Loire Basin Langhian as *Nassa (Hima) verrucosa* (Brocchi, 1814), however, deciding what is the correct name to use for this species is complicated.

Buccinum verrucosum Brocchi (1814, p. 650) was attributed to L. (Linnaeus) based on a figure in Gualtieri (1742, pl. 43, fig. M) and recorded by Brocchi in the present-day Adriatic and in the Pliocene fossil record from Piacentino (Italy). Brocchi's taxon is a junior homonym of *Buccinum verrucosum* Bruguière, 1789 [= *Nassarius graniferus* (Kiener, 1834); Cernohorsky, 1984]. Brocchi's name is also a junior homonym of *B. verrucosum* Gmelin (1791), who cited the same figure of Gualtieri's. According to Cernohorsky (1984, p. 217) Gualtieri's figure might represent a juvenile shell of another Indo-Pacific species. Two shells from the Upper Miocene Tortonian of Italy were illustrated by Bellardi (1882) as *Nassa verrucosa* (Brocchi) vars. a and b. These shells are similar to the Le Pigeon Blanc specimens, and obviously belong to the same species group. The name *Nassarius verrucosus* has rarely been used in the recent Italian fossil literature [exception: Brunetti & Soccio, 2006, p. 107, who attribute the name erroneously to Bellardi (1882). No illustration given]. Therefore, what Italian fossil specimens were assigned by Brocchi (1814) to *B. verrucosum* is unclear.

The next available name for the French fossil specimens is *Buccinum graniferum* Dujardin, 1837, described from the middle Miocene of Touraine. Unfortunately, this is a junior homonym of *Buccinum graniferum* Kiener, 1834, as discussed above. Deshayes (1844, p. 224), recognised this homonymy, and referring to Dujardin's *Buccinum graniferum* from Touraine, renamed it *Buccinum turonense*.

Peyrot (1925) argued that the French Miocene and Italian Pliocene shells were closely similar, but not conspecific, the French specimens having fewer axial ribs, which were less flexuous on the last whorl. The author commented that the Italian shells were from the upper Miocene Tortonian of Italy and not Pliocene, which suggests that he based his comments on the illustrations of *Nassa verrucosa* in Bellardi (1882, p. 115, pl. 7, figs 17, 18), which are Tortonian from Stazzano and Sta. Agata. Montanaro (1939, p. 124, pl. 15, figs 1, 2) also recorded and illustrated *N. verrucosa* from the Italian Tortonian of Montegibbio. Glibert (1952, p. 340, pl. 10, fig. 5) considered Peyrot's argument insufficient to separate the French and Italian shells, and considered them conspecific, using Brocchi's name *Nassa (Hima) verrucosa*. The author discussed the considerable variability seen in the French specimens from the Loire Basin Langhian, illustrating a squatter and a more elongate form.

This species is the most abundant nassariid in the Le Pigeon Blanc assemblage. Both the squatter (Plate 4, fig. 5) and slightly taller (Plate 4, fig. 7) forms are present, and in adult shells a large varix is formed on the venter of the last whorl, about 60° from the aperture. In some specimens a varix is also present on the penultimate whorl. The axial sculpture consists of 9-13 ribs and six or seven narrow cords separated by wider interspaces on the penultimate whorl. The last whorl is strongly convex, with a groove separating the base from the siphonal fasciole. The inner lip bears four or five irregular denticles a short distance within, the second denticles, placed mid-aperture, is more strongly developed. The medial side of the aperture is bordered by a thickened callus rim, which is not expanded onto the venter, and bears two strong abapical and one parietal tubercle. The protoconch is multispiral, dome-shaped, consisting of 3.5 smooth whorls with a small nucleus (dp = 832 µm, hp = 600 µm, dp/hp = 1.39, dp1 = 245 µm, dn = 150 µm; Plate 9, fig. 3).

We have compared these shells with specimens at hand from the middle Miocene Langhian of the Loire Basin (Le Petit Bray; NHMW coll.) and from Assemblage I localities (Sceaux, Renauleau; NHMW coll.), and can confirm that they are conspecific. There are small variations between populations in details of the number of tubercles on the columella, but we consider these minor.

We have also compared the French material with specimens from the Upper Miocene, Tortonian of Montegibbio, Italy, identified as '*Nassarius verrucosus* (Brocchi, 1814)' (NHMW coll.). These shells are identical to those illustrated by Bellardi (1882) and Montanaro (1939). In our opinion they are not conspecific with the French material. Not only are the observations made by Peyrot (1925) valid; *i.e.* fewer and more orthocone axial ribs in

the French specimens, but the base is not separated from the siphonal fasciole by a groove in the Italian shells as it is in the French ones, thus the base is less constricted. The absence of this groove also makes the siphonal fasciole less well developed and delimited than in the French shells. These differences are constant in all specimens examined. Harmer (1914) reported this species in the Plio-Pleistocene of England as *Nassa turonica* (Deshayes). Although we have not seen any British specimens, we accept Harmer's identification, as he describes the deep groove separating the base from the siphonal fasciole and compared his shells directly with specimens from Touraine (Harmer, 1914, p. 86).

In conclusion, we consider the correct name for the French middle Miocene to lower Pliocene species reported in the French literature as '*N. verrucosus* Brocchi' to be *Nassarius turonensis* (Peyrot, 1925). These French specimens are not conspecific with those from the upper Miocene of Italy reported in the Italian literature as '*N. verrucosus* Brocchi', which probably require a new name. This is beyond the scope of this work.

Distribution – Middle Miocene: Langhian, Loire Basin, NW France (Dujardin, 1837; Peyrot, 1925; Glibert, 1952; Harmer, 1914, 1918). Upper Miocene: Tortonian, NW France (this paper). Lower Pliocene: Zanclean, NW France (Brébion, 1964); Coralline Crag Formation, England (S.V. Wood, 1872; Harmer, 1914). Upper Pliocene: Red Crag Formation, England (S.V. Wood, 1872; Harmer, 1914). Lower Pleistocene: Gelasian, St. Erth Formation, England (Harmer, 1914, 1918).

Nassarius sp. A

Plate 2, figs 5, 6

Material – Maximum height 10.0 mm, LC coll. (2, possibly juveniles), Le Pigeon Blanc, Le Landreau, Nantes area, Loire Atlantique department, NW France.

Discussion – Two small shells are present in the LC collection representing a relatively thin-shelled *Nassarius* species with a thin outer lip and no apertural armature. These characters place it in the *N. reticosus* (J. Sowerby, 1815) species-group, but they are much smaller than typical members of this group. It is possible that the two shells at hand are not fully developed.

Both specimens are worn, with the protoconch missing. The teleoconch whorls bear a weakly concave subsutural ramp, are roundly shouldered at the periphery and convex below. Sculpture consists of nine elevated rounded ribs, weaker over the subsutural ramp, and regular spiral cords, roughly equal in width to their interspaces, eight on the penultimate whorl. The last whorl is somewhat inflated and constricted at the base. The outer lip is simple, lacking denticles. The columellar callus is not developed. The sculpture of these shells shows a superficial resemblance to that of *Nassarius kennardi* (Harmer, 1914) from the upper Pliocene of England and Belgium, but the specimens of *N. kennardi* do not have shouldered whorls and

has a narrow, but well developed columellar callus rim. We await more and better preserved material to identify these specimens.

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

Nassarius labiosus (J. de C. Sowerby, 1824)

Plate 5, figs 1-3

- *1824 *Buccinum labiosum* J. Sowerby, p. 122, pl. 477, fig. 3.
- 1845 *Buccinum labiosum* J. Sow. – Nyst, p. 557, pl. 43, fig. 14.
- 1848 *Nassa labiosa* J. Sow. – S.V. Wood, p. 28, pl. 3, fig. 8.
- 1914 *Nassa (Amycla) labiosa* (J. Sowerby) – Harmer, p. 61, pl. 3, figs 4, 14-19.
- 1957 *Nassarius (Amyclina) labiosus* (J. de C. Sowerby, 1825) – van Regteren Altena, p. 68, pl. 14, fig. 133.
- 1959 *Amyclina labiosa* Sowerby – Glibert, p. 17, pl. 3, fig. 9.
- 1964 *Amyclina semistriata* v. *gigantula* Bonelli in Belardi [sic], 1882 – Brébion, p. 437, pl. 11, figs 1, 2 [non *Nassarius gigantulus* (Bonelli in Michelotti, 1840)].
- 1974 *Nassarius labiosus* (Sowerby, 1824) – Adam & Glibert, p. 39, pl. 1, fig. 4, pl. 4, fig. 12, text-fig. 11.
- 1997 *Amyclina labiosa* (J. de C. Sowerby, 1825 [sic]) – Marquet, p. 95, pl. 7, fig. 8.
- 1998 *Amyclina labiosa* (J. de C. Sowerby, 1825 [sic]) – Marquet, p. 142, fig. 116.
- 2014 *Amyclina labiosa* (J. de C. Sowerby, 1824) – Rijken & Pouwer, p. 46, fig. 1.

Material – MNHN.F.A52538 (1), height 16.0 mm; MNHN.F.A52539 (1), height 15.6 mm; all Palluau (Puits Martineau), Vendée department, Pays de la Loire, NW France (coll. Brébion). RGM.1008177-179 (3); RGM.1008180 (30+); RGM.1008181 (3 + 2 incomplete); RGM.1008183 (6); JvdV (28 + numerous fragments and juveniles); NHMW 2015/0133/46 (2, ex. JvdV coll.), maximum height 22.1 mm; all Bosq-d'Aubigny locality, Manche department, Basse-Normandie region, NW France.

Discussion – *Nassarius labiosus* (J. de C. Sowerby, 1824), best known from the North Sea Basin Pliocene, but also found in the middle Pleistocene, Sicilian of Sicily (Adam & Glibert, 1974), is indeed similar to *Nassarius semistriatus* (Brocchi, 1814), but differs in having spiral sculpture covering the whole whorl, whereas in *N. semistriatus* there is a smooth section mid-whorl following the second teleoconch whorl. In this respect it is closer to the Italian Pliocene *N. gigantulus* (Bonelli in Michelotti, 1840), which also has spiral sculpture covering all the whorls, but differs in having finer, more numerous spiral cords on the early spire whorls (6-8, vs. 4-6 in *N.*

gigantulus). The protoconch of *N. labiosus* is multispiral, consisting of about 3.5 whorls (Marquet, 1998), similar in number of whorls to that of *N. semistriatus* and *N. gigantulus*, but with a different profile, being much taller (Landau *et al.*, 2009).

The shells illustrated by Brébion (1964, pl. 11, figs 1, 2) are at hand. The protoconch and first teleoconch whorl are worn or missing in both specimens. The earliest preserved whorls have 6-7 narrow cords, and therefore suggest assignment to *N. labiosus* rather than to *N. gigantulus*. Moreover, the French shells are more slender when compared to specimens of *N. gigantulus* from Italy.

Brébion (1964) recorded this species from a single NW French deposit at Palluau (Puits Martineau), Vendée department, however, numerous specimens are present in the RGM collections from the younger upper Piacenzian-lower Gelasian deposits of Bosq d'Aubigny.

The Bosq d'Aubigny specimens have slightly stronger axial growth lines than usual for the species, which interrupt the predominant spiral cords, giving the surface a somewhat reticulated appearance (Plate 5, fig. 3). This type of sculpture is also seen in specimens from the Pliocene of Belgium, although not as accentuated (NHMW coll.). The stronger axial sculpture in these Bosq d'Aubigny specimens make the surface sculpture similar to that of *Nassarius lamellilabrus* (Nyst, 1835), which is sympatric with *N. labiosus* in the Oorderen Sands Member of the Lillo Formation of Belgium. However, this resemblance is superficial. *Nassarius lamellilabrus* differs from the Bosq d'Aubigny specimens in having a less elongated shell, with more convex whorls, the axial sculpture is more strongly developed into elevated and wider spaced axial ribs and the columellar callus is narrow and not developed into a parietal shield as it is in *N. labiosus*.

Distribution – Lower Pliocene: Zanclean, France (Brébion, 1964); Coralline Crag, England (Harmer, 1918). Upper Pliocene: Red Crag, England (S.V. Wood, 1848; Harmer, 1918); Oorderen and Kruisschans Sands, Belgium (Marquet, 1998). Pliocene (indeterminate): Netherlands (van Regteren Altena, 1957; Rijken & Pouwer, 2014). Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-lower Gelasian, Manche, NW France (this paper). Middle Pleistocene: Atlantic; Wexford Gravels, SE Ireland (Harmer, 1918); central Mediterranean; Sicily (Adam & Glibert, 1974).

Assemblage IV nassariids

1. Saint-Jean-la-Poterie (dep. Morbihan)

***Nassarius companyoi* (Fontannes, 1879)**

Plate 5, figs 4, 5

*1879 *Nassa mutabilis* var. *companyoi* Fontannes, p. 71, pl. 5, fig. 16.

1964 *Nassa mutabilis* Linné, 1766 [sic] – Brébion, p. 439, pl. 11, figs 3, 4 [*non Nassarius mutabilis*

(Linnaeus, 1758)].

2008 *Nassarius (Sphaeronassa) mutabilis* (Linné) – Chirli & Ricard, p. 48, pl. 9, figs 4, 5 [*non Nassarius mutabilis* (Linnaeus, 1758)].

2009 *Nassarius companyoi* (Fontannes, 1879) – Landau *et al.*, p. 57, pl. 12, figs 1-5, pl. 21, fig. 5 (*cum syn.*).

2011 *Nassarius companyoi* (Fontannes, 1879) – Landau *et al.*, p. 27, pl. 13, figs 8, 9.

Material – MNHN.F.A52540 (1), height 21.1 mm; MNHN.F.A52541 (1), height 21.3 mm; all Saint-Jean-la-Poterie, Morbihan, Bretagne, France (coll. Brébion).

Discussion – In the palaeontological literature this species has been considered synonymous, or a variety of, the living *Nassarius mutabilis* (Linnaeus, 1758). Gili (1991) separated the fossil group based on the protoconch morphology; consisting of about 2.5 whorls with a small nucleus, whereas the protoconch of the living species is paucispiral; 1.5 whorls with a large nucleus. Gili (1991) united all the Pliocene non-striated forms under the first varietal name available, *Nassarius companyoi* (Fontannes, 1879), expressing some reservation due to the great variation in shell morphology and the small number of fossil protoconchs examined.

The protoconch is preserved, but worn in one French specimen available (MNHN.F.A52541). The protoconch/teleoconch boundary is not preserved, but the nucleus is small and the protoconch shape is more like that of *N. companyoi*, which is to be expected, as *N. mutabilis* first appears in the fossil record in the mid-Pleistocene (Landau *et al.*, 2009).

Brébion (1964) recorded this species from a single French deposit: Saint-Jean-la-Poterie.

Distribution – Upper Miocene: Atlantic, Cacela, Algarve, S Portugal (NHMW coll.). Lower Pliocene: Guadalquivir Basin, SE Spain (González Delgado, 1989; Landau *et al.*, 2011); NE Spain (Gili, 1991), S. France (Fontannes, 1879); central Mediterranean, Italy (Caprotti, 1974; Pavia, 1975; Chirli, 1988, 2000), Tunisia (Fekih, 1975), Turkey (Erünal-Erentöz, 1958). Upper Pliocene: Mondego Basin, west central Portugal (Zbyszewski, 1959; Gili *et al.*, 1995; Silva, 2001), western Mediterranean, Estepona, S. Spain (Landau *et al.*, 2009); central Mediterranean, Italy (Bellardi, 1882; Sacco, 1904; Ruggieri *et al.*, 1959; Palla, 1967; Malatesta, 1974; Cavallo & Repetto, 1992). Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964); St Erth, England (Harmer, 1918); Morocco (Lecointre, 1952); central Mediterranean, Italy (Cerulli-Irelli, 1911).

***Nassarius poteriensis* nov. sp.**

Plate 5, Figs 6, 7

1964 *Hinia (Uzita) grueti* Brébion, p. 454, pl. 11, figs 20, 21 (*nomen nudum*).

Type material – Holotype MNHN.F.A52555, height 24.9

mm; paratype 1 MNHN.F.A52556, height 22.1 mm (coll. Brébion).

Other material – Brébion mentions one specimen from Palluau (Vendée) and abundant specimens from Saint-Jean-la-Poterie, possibly in the MNMN Paris collections.

Etymology – Named after the type locality, Saint-Jean-la-Poterie. *Nassarius* gender masculine.

Locus typicus – Saint-Jean-la-Poterie, Morbihan department, Bretagne, NW France.

Stratum typicum – Upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene.

Diagnosis – A medium-large *Nassarius* species with a scalate spire, shouldered spire whorls and globular last whorl, sculpture of low axial ribs obsolete over subsutural collar, a relatively small aperture with a denticulate outer lip and a thin columellar callus bearing prominent ridges and tubercles.

Description – Shell medium-large, relatively solid, bucciniform, with a tall spire and predominantly axial sculpture. Protoconch not preserved. Teleoconch consisting of six shouldered whorls, with periphery at or just above abapical suture. Suture impressed, weakly undulating. Axial sculpture consisting of 11-12 rounded, weakly prosocline ribs, narrower than their interspaces. Ribs obsolete over narrow, slightly concave subsutural collar. Spiral sculpture consisting of six narrow cords below shoulder, narrower than their interspaces, with two or three weaker cords on subsutural collar. Last whorl globose, 65% of total height, weakly constricted at base. Aperture ovate, 38% of total height; outer lip thin, flared abapically, bearing a row of small irregular denticles a variable distance within the lip edge; anal canal rounded, narrow; siphonal canal short, narrow, open. Columella excavated in mid-portion. Columellar callus thin, moderately expanded, poorly delimited, bearing an abapical fold delimiting the siphonal canal, three elongated parietal ridges and irregular tubercles. Siphonal fasciole rounded, separated from base by broad, shallow groove.

Discussion – We would agree with Brébion (1964) in considering this nassariid from Saint-Jean-la-Poterie an undescribed species. Brébion (1964) compared the French shells to *N. prismaticus* (Brocchi, 1814), but this species is quite different; it does not have a subsutural collar and has more numerous, but weaker axial ribs. The apertural characters are also quite different (see Adam & Glibert, 1976, pl. 6, figs 2-5; Landau *et al.*, 2009, pl. 1, figs 8-10). In our opinion, *Nassarius poteriensis* nov. sp. is more closely related to *N. reticosus* (J. Sowerby, 1815), especially the strongly axially sculptured forms, however, *N. reticosus* is larger and thinner shelled, the spire whorls of *N. reticosus* do not have a subsutural collar and the aperture is larger and lacks any apertural armature. We can find no other species with which to compare this new taxon.

Brébion (1964) reported this species as abundant at Saint-Jean-la-Poterie, and recorded one specimen from Palluau.

Distribution – Upper Pliocene-lower Pleistocene: upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964).

Nassarius rectus (Dollfus & Dautzenberg, 1886)

Plate 5, fig. 8

- 1837 *Buccinum variabile* Dujardin, p. 298, pl. 20, fig. 4 [non Philippi, 1836 = *Nassarius cuvierii* (Payraudau, 1826)].
- *1886 *Nassa (Hinia) recta* Dollfus & Dautzenberg, p. 103.
- 1925 *Nassa (Hinia) Rideli* Peyrot, p. 93, pl. 2, figs 123-125.
- 1927 *Nassa (Phrontis) Tournoueri* Peyrot, p. 131, pl. 2, figs 93-95.
- 1938 *Nassa (Hinia) reticulata* var. *ligeriana* Peyrot, p. 214, pl. 4, figs 52, 58, 63.
- 1938 *Nassa (Hinia) recta* Dollfus et Dautzenberg – Peyrot, p. 214.
- 1952 *Nassa (Hima) recta* Dollfus et Dautzenberg, 1886 – Glibert, p. 337, pl. 9, fig. 12.
- 1964 *Hinia reticulata* var. *recta* Dollfus et Dautzenberg – Brébion (*partim*), p. 442, (not pl. 11, figs 7-8 = *Nassarius landreaeuensis* nov. sp.; not fig. 9).

Material – IGR-131882 (34); IGR-135081 (1); IGR-135080 (1); maximum height 10.8 mm; all Saint-Jean-la-Poterie, Morbihan, Bretagne, NW France (coll. Brébion IGR).

Discussion – Dollfus & Dautzenberg (1886, p. 103) and Peyrot (1938, p. 214) discussed the differences between the French Ligerian shells and *N. reticulatus* (Linnaeus, 1758), pointing out that the French fossil shells were squatter, the axial ribs were fewer in number, but broader and more prominent, in some specimens subobsolete on the last whorl, and that the spiral sculpture was weaker. Glibert (1952, p. 337) highlighted the difficulties in clearly separating some shells of *Nassarius rectus* (Dollfus & Dautzenberg, 1886) from *N. reticulatus* (Linnaeus, 1758), and whilst considering *N. rectus* a valid species, concluded that the only constant difference was its smaller shell size. Brébion (1964) considered it a subspecies of *N. reticulatus* and adopted a very broad species concept for this taxon, including the specimens from Le Pigeon Blanc. As discussed above, the Le Pigeon Blanc shells differ significantly and consistently from specimens of *N. rectus* from the type middle Miocene Langhian Loire Basin localities, and are herein assigned to a distinct species: *N. landreaeuensis*.

Interestingly, specimens from the younger upper Piacenzian-lower Gelasian assemblage of Saint-Jean-la-Poterie represent true *N. rectus*. The specimen illustrated here shows the lower spire, more inflated last whorl, broader spiral cords separated by narrow grooves and slightly more expanded columellar callus shield that distinguish

N. rectus from *N. landreauensis*. The other records of *N. rectus* given by Brébion (1964, p. 443) from Saint-Michel-et-Chanveaux, Apigné and Palluau need to be confirmed.

Distribution – Middle Miocene: Langhian, Loire Basin (Dollfus & Dautzenberg, 1886; Glibert, 1952), Pyrénées-Atlantiques, France (Peyrot, 1925, 1927). Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964).

?*Nassarius reticosus* (J. Sowerby, 1815)

Plate 5, figs 9, 10; Plate 6, figs 1, 2

- ?1964 *Hinia (Uzita) durandae* Brébion, p. 459, pl. 11, figs 28, 29 (*nomen nudum*).
 ?1964 *Hinia (Uzita) miloni* nov. sp. Brébion, p. 461, pl. 11, figs 30, 31 (*nomen nudum*).

For full synonymy of *Nassarius reticosus* (J. Sowerby, 1815), see below.

Type material – *Hinia (Uzita) durandae* IGR-PAL-131873, height 17.3 mm; IGR-PAL-133113, height 16.7 mm (coll. Brébion IGR). *Hinia (Uzita) miloni* IGR-PAL-131876, height 17.3 mm; IGR-PAL-133114, height 17.5 mm (coll. Brébion IGR); all Saint-Jean-la-Poterie, Morbihan, Bretagne, NW France, upper Piacenzian-lower Gelasian, Upper Pliocene-lower Pleistocene.

Discussion – Brébion (1964) described two similar groups of specimens from Saint-Jean-la-Poterie differing in the number and strength of the axial ribs and the more or less scalate spire of their shells. We have not examined these specimens, which are in the IGR collection. However, the new photographs of Brébion's 'types' strike us by their similarities rather than their differences. They are characterised by their rather thin shell, the outer lip is not thickened by labial varix and is not denticulate or lirate within, and the columellar callus is hardly developed. Both species have shells with paucispiral protoconchs (Damien Gendry pers. comm. [BL], 2015). These are characters of the *Nassarius reticosus* (J. Sowerby, 1815) species-group (see below).

Nassarius reticosus is an extremely variable species, with almost smooth and strongly ribbed forms coexisting in the North Sea Basin Pliocene assemblages. Brébion's '*Hinia (Uzita) miloni*' is almost indistinguishable from the shell illustrated by Harmer (1918, pl. 46, fig. 10) as var. *tiara*. Similarly, Brébion's '*Hinia (Uzita) durandae*' is reminiscent of a slightly shouldered form of var. *rugosa* (Harmer, 1918, pl. 46, fig. 11). The shells from Saint-Jean-la-Poterie are, however, rather small for *N. reticosus*, both French forms being about 17.5 mm in height; *Nassarius reticosus* shows usually larger specimens, 35-50 mm in height. Further material would be necessary to ascertain if these French shells belong to *N. reticosus*.

Distribution – See below under *N. reticosus*.

***Nassarius solidus* (Bell, 1898)**

Plate 6, fig. 3

- *1898 *Nassa solida* Bell, p. 129, pl. I, fig. 6.
 1918 *Nassa solida* S.V. Wood, MS. – Harmer, p. 313, pl. 33, fig. 22.
 1964 *Nassarius solidus* var. *coxi* Brébion, p. 440, pl. 11, fig. 5 (*nomen nudum*).

Material – MNHN.F.A52542 (1), height 25.1 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, NW France (coll. Brébion). JvdV (1), height 34.0 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France.

Discussion – In the Saint-Jean-la-Poterie material at hand this species is represented by a single, well-preserved shell, with the apex abraded. The species is characterised by its solid, squat shell, with a short, regularly conical spire. The sculpture is much diminished, restricted to a few flattened cords and close-set axial ribs on the first two teleoconch whorls, the ribs obsolete by the antepenultimate whorl. The last whorl is tall in relation to the spire, regularly convex and not constricted at the base. The base bears a few weak, irregular flattened cords. The outer lip is thick, convex, not flared abapically, bordered by a deep anal sinus adapically, bearing a row of nine short teeth a short distance within the edge, which do not extend into the aperture. The teeth are slightly more strongly developed mid-aperture. The columellar callus is weakly expanded and appressed, bearing a broad fold delimiting the siphonal canal and is partially separated from the parietal callus, which is also weakly expanded and bears a small parietal tubercle. A second specimen from Bosq d'Aubigny is present in the JvdV collection, with an even more elevated spire, but the sculpture and apertural characters are similar to those of the Saint-Jean-la-Poterie specimen.

Brébion (1964, p. 440) rightly recognised the similarity between this shell and that figured by Harmer (1918, pl. 33, fig. 22) from the Gelasian, lower Pleistocene of St. Erth, Cornwall. However, he suggested the French shell differed in having a more elongated shape. Harmer's specimen is indeed slightly more globose, but coincides in the character of the sculptured early whorls, apertural dentition and non-flared outer lip. Spire height is often somewhat variable in nasariids, and we feel specific separation is not justified.

Nassarius solidus (Bell, 1898) is closely similar in size and shape to *N. bonellii* (Sismonda, 1847) from the Pliocene Lusitanian Atlantic and Mediterranean (Landau *et al.*, 2009), but differs in 1) having a squatter shell, with a shorter spire; 2) having axial sculpture on the first two teleoconch whorls, whereas *N. bonellii* is devoid of axial sculpture; 3) the outer lip bears a row of short denticles within, whereas the outer lip of *N. bonellii* is usually lirate within, exceptionally smooth; and 4) the outer lip is not flared abapically, whereas in *N. bonellii* the outer lip extends abapically a short distance below the siphonal tip. The character of the columellar and parietal calluses is similar in both species. Unfortunately the protoconch

of both species is unknown.

Distribution – Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964). Lower Pleistocene: Gelasian, St Erth, England (Harmer, 1918).

***Nassarius plainei* nov. sp.**

Plate 6, figs 4, 5

1964 *Hinia (Tritonella) chauveli* Brébion, p. 467, pl. 11, figs 34, 35 (*nomen nudum*).

Type material – Holotype IGR-PAL-131883, height 14.5 mm; paratype 1 IGR-PAL-133115, height 16.8 mm (coll. Brébion IGR).

Other material – Brébion mentions 23 specimens, whereabouts unknown.

Etymology – Named after Jean Plaine, curator of collections (Geology) at the University of Rennes, in recognition of his work on Armorican geology and the Redonian of Brittany. *Nassarius* gender masculine.

Locus typicus – Saint-Jean-la-Poterie, Morbihan department, Bretagne, NW France.

Stratum typicum – upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene.

Diagnosis – A small to medium-sized *Nassarius* species, with a tall, somewhat scalate spire made up of shouldered whorls with a weakly concave subsutural ramp, predominant axial sculpture made up of 11 or 12 narrow ribs overridden by weaker narrow flattened cords, a thickened outer lip, weakly denticulate within and a rim-like columellar callus bearing a small parietal tooth.

Description – Shell small to medium-sized, bucciniform, robust, spire tall, somewhat scalate. Protoconch not preserved. Teleoconch consisting of six shouldered whorls, with broad, steep, weakly concave subsutural ramp to shoulder, shoulder rounded, forming periphery, whorl profile weakly convex below to suture. Suture impressed, undulating. Axial sculpture consisting of 11 or 12 narrow, elevated, rounded, orthocone ribs, about one-third width of their interspaces, narrower over subsutural ramp. Spiral sculpture overrides axial ribs, consisting of numerous, narrow flattened cords separated by narrow incised grooves, 12 on penultimate whorl. On later whorls, cords placed at whorl periphery divided by secondary groove. Last whorl strongly constricted at base; axial sculpture weakening and spiral cords more elevated and wider-spaced over base. Aperture ovate, outer lip rounded, moderately thickened by labial varix, weakly denticulate within; anal canal poorly developed; siphonal canal short, open, recurved. Columella shallowly excavated, narrowly but strongly callused, bearing weak

parietal tooth. Siphonal fasciole flattened, not sharply delimited from base.

Discussion – The specimens were not examined by the authors. The description given above is based on new photographs of Brébion's 'types' kindly made available by IGR-PAL. These shells probably belong within the *N. serraticosta* species group, characterised by very small, relatively robust shells, with an elevated spire, convex whorls, sculpture made up of dense spiral cords and widely-spaced, prominent ribs. In most members of the group tubercles do not form at the sculptural intersections, the outer lip is strongly thickened by a prominent labral varix and the columella callus is restricted to a narrow callus band that does not extend onto the venter (Landau *et al.*, 2009, p. 40). The French specimens deviate from the typical members of the group in being larger-shelled and having the apertural dentition only weakly developed. It is similar to *N. manuelmolinae* Landau, Silva & Gili, 2009 from the Atlantic Guadalquivir Basin lower Pliocene Zanclean of southern Spain, but the French species is larger-shelled, with more shouldered whorls, has a narrower labial varix and weaker apertural dentition. This species was recorded by Brébion (1964) only from Saint-Jean-la-Poterie, where it does not seem to be uncommon. Although we have not examined these shells personally, we are fairly confident that they represent an undescribed taxon. In the spirit of this work in which we aim to stabilise Brébion's 'species', we formally describe these shells as *Nassarius plainei* nov. sp.

Distribution – Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964).

2. Gourbesville (dep. Manche)

***Nassarius corrugatus* (Brocchi, 1814)**

Plate 6, figs 6-8

- *1814 *Buccinum corrugatum* Brocchi, p. 652, pl. 15, fig. 16.
- 1826 *Buccinum Cuvierii* Payraudeau, p. 163, pl. 8, figs 17, 18.
- 1964 *Hinia corrugata* Brocchi, 1814 – Brébion, p. 444, pl. 11, figs 10-13.
- 2009 *Nassarius corrugatus* (Brocchi, 1814) – Landau *et al.*, p. 25, pl. 5, figs 1, 2, pl. 16, fig. 5, pl. 17, fig. 1 (*cum syn.*).

Material – MNHN.F.A52545 (1), height 11.0 mm; MNHN.F.A52546 (1), height 8.5 mm; all Boufféré (Le Girondor), Vendée department, Pays de la Loire, France. MNHN.F.A52547 (1), height 9.4 mm; MNHN.F.A52548 (1), height 9.9 mm; all Gourbesville, Manche department, Basse-Normandie, France (coll. Brébion).

Discussion – The shell of *Nassarius corrugatus* (Brocchi,

1814) is characterised by its paucispiral protoconch, its predominantly axial sculpture, composed of 13-15 narrow axial ribs, its strong apertural dentition, the denticle placed mid-aperture usually more strongly developed, its thickened columellar callus, usually bearing a couple of coarse tubercles abapically, and its shield-like parietal callus. Brébion (1964) illustrated several specimens from NW French localities attributed to this species. The author admitted that the poor preservation made definitive identification difficult, to which we agree. These French shells (illustrated here Plate 6, figs 6-8) certainly have the same number of axial ribs and the stronger mid-apertural labial denticles seen in *N. corrugatus*. We therefore provisionally follow Brébion in his attribution.

Brébion (1964, p. 446) recorded this species from St-Michel, Apigné (Ille-et-Villaine), Le Pigeon Blanc (Loire-Atlantique), Le Girondor and Palluau (Vendée) and Gourbesville (Manche). We have not found this species at Le Pigeon Blanc.

Distribution – Lower Pliocene: central Mediterranean (Chirli, 2000). Upper Pliocene: western Mediterranean, Estepona, S Spain (Landau *et al.*, 2009); central Mediterranean (Brocchi, 1814; Bellardi, 1882; Glibert, 1952). Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964). Present-day: Canaries and Madeira, into the Mediterranean, below tide line to a few meters (Poppe & Goto, 1992).

***Nassarius martae* nov. sp.**

Plate 6, figs 9, 10

1964 *Hinia (Uzita) gourbesvillensis* Brébion, p. 458, pl. 11, figs 26, 27 (*nomen nudum*).

Type material – Holotype MNHN.F.A52563, height 8.3 mm; paratype 1 MNHN.F.A52562, height 10.3 mm (coll. Brébion).

Other material – Brébion mentions 33 specimens.

Etymology – Named after Marta Camacho, an enthusiastic young Portuguese neuroscientist and friend of BL. *Nassarius* gender masculine.

Locus typicus – Gourbesville, Manche department, Basse-Normandie, NW France.

Stratum typicum – upper Piacenzian-Gelasian, Upper Pliocene-lower Pleistocene.

Diagnosis – A small *Nassarius* species with a regularly conical spire and globular last whorl, sculpture of low axial ribs and cords cutting ribs, giving surface a finely and regularly squared appearance, aperture small, bearing five denticles within, columellar callus narrow, and a multispiral protoconch.

Description – Shell small, of medium thickness, with a

regularly conical spire. Protoconch abraded, with teleoconch junction not preserved, but multispiral, consisting of at least 2.5 whorls with small nucleus. Teleoconch consisting of four weakly convex whorls, with periphery at abapical suture. Suture impressed, linear. Axial sculpture consisting of about forty low ribs. Spiral sculpture of five cords separated by narrow grooves, which cut axial sculpture forming small regular squares. Last whorl globular, strongly convex, not constricted at base. Aperture small; outer lip bearing five denticles within, the second most strongly developed. Anal canal marked by deep notch; siphonal canal very short, open. Columellar and parietal calluses sharply delimited forming narrow callus rim, not expanded over venter, bearing two tubercles abapically and parietal tubercle.

Discussion – Although the material at hand is scant, this species does not seem to be rare at Gourbesville, as Brébion (1964, p. 149) mentions 33 specimens in his collection. It is also a species with quite a distinctive small shell warranting description. The most striking character of these specimens is their sculpture composed of small regular squares. Several European Neogene species have similar sculpture. *Nassarius subtesselatus* (Peyrot, 1925) from the Aquitanian and the Burdigalian of the Aquitaine Basin, France differs in having a more slender shell, with a taller spire, and more numerous smaller denticles within the outer lip. It is also reminiscent of the fine sculptured Italian Pliocene *N. musivus* (Brocchi, 1814), but this species is larger shelled and has much finer denticles or lirae within the outer lip. Brébion (1964) considered *N. lamellilabrus* (Nyst, 1835) from the English and Belgian upper Pliocene North Sea Basin deposits the most similar species, but it is immediately separated by its coarser squared sculpture, its taller, more slender last whorl, larger aperture, and the outer lip, which is flared abapically and bears fine elongated teeth within.

Distribution – Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964).

***Nassarius cf. anomalus* (Harmer, 1914)**

Plate 6, figs 11, 12

cf. 1914 *Nassa limata* (Chemnitz) – Harmer, p. 69 (*partim*), pl. 4, fig. 1 (not fig 1 = *N. limatus*) [*non N. limatus* (Deshayes in Lamarck, 1844)].

cf. *1914 *Nassa limata* var. *anomala* Harmer, p. 70, pl. 4, fig. 3.

1964 *Hinia (Uzita) harmeri* Brébion, p. 456, pl. 11, figs 22, 23 (*nomen nudum*).

cf. 1976 *Nassarius anomalus* (Harmer, 1914) – Adam & Glibert, p. 46, pl. 2, fig. 6, pl. 6, figs 9, 10.

Material – MNHN.F.A52557 (1), height 15.1 mm (incomplete); MNHN.F.A52558 (1), height 14.5 mm (apertural fragment); all Gourbesville, Manche department, Basse-Normandie, NW France (coll. Brébion).

Discussion – This species is represented in the Brébion collection at the MNHN Paris by two fragments that do not seem to belong to the same shell. It belongs within the *N. clathratus* (Born, 1778) species-group of Adam & Glibert (1976) and Landau *et al.* (2009). As noted by Brébion (1964, p. 456) it is closely similar to *N. limatus* (Deshayes in Lamarck, 1844), but this species is restricted to the Mediterranean since the upper Pliocene, where it still exists today. Adam & Glibert (1976) considered the shells from the Coralline and Red Craggs to represent a separate species; *Nassarius anomalus* (Harmer, 1914), distinguished from *N. limatus* by the character of its higher, taller protoconch and, in the teleoconch, the anastomosis of some of the spiral cords to form wider cords. This is not seen in the shell fragments at hand from Gourbesville. It also does not belong to *Nassarius spectabilis vandewouweri* (Glibert, 1959), which shows axial varices. With the scant material available we cannot make a definitive identification.

Distribution – Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964).

3. *Selsoif (Saint-Sauveur-le-Vicomte, dep. Manche)*

Nassarius incrassatus (Ström, 1786)

Plate 7, fig. 1

- *1786 *Tritonium incrassatum* Ström, p. 369, pl. 16, fig. 25.
- 1914 *Nassa incrassata* (Ström) – Harmer, p. 88, pl. 5, figs 25, 26.
- 1918 *Nassa (Hima) incrassata* (Ström) – Harmer, p. 324, pl. 34, figs 8-10.
- non 1964 *Hinia (Tritonella) incrassata* Muller, 1776 [*sic*] - Brébion, p. 464, pl. 11, figs 32, 33 [*non Nassarius incrassatus* (Ström, 1786)] [= *Nassarius pacaudi* nov. sp.].
- 2009 *Nassarius incrassatus* (Ström, 1786) – Landau *et al.*, p. 33, pl. 6, figs 10-12 (*cum syn.*).
- 2014 *Nassarius incrassatus* (Ström, 1786) – Rijken & Pouwer, p. 49, fig. 19.

Material – RGM.1008174 (1), height 11.4 mm; RGM.1008175 (100+); JvdV (50+); NHMW 2015/0133/49 (3, ex. JvdV coll.), maximum height 12.2 mm; all Selsoif (Saint-Sauveur-le-Vicomte), commercial sand dredging in Marais de la Sensurière, collected from sediment dump, Manche department, NW France (Grand Marais Fm.; Tiglian C4, Pleistocene).

Discussion – The only shells from the Plio-Pleistocene of NW France we can unequivocally identify as *Nassarius incrassatus* (Ström, 1786) are specimens in the RGM collections from a sediment dump at Selsoif, Manche department, France. The protoconch is damaged in all specimens, but protoconch morphology is of little help

amongst members of the *N. incrassatus* species-group. They all have dome-shaped protoconchs of about 3-3.25 whorls of roughly similar dimensions. This species was fully discussed by Landau *et al.* (2009, p. 34).

Distribution – Lower Pliocene: Central Mediterranean, Italy (Chirli, 2000). Upper Pliocene: Red Crag, England (Harmer, 1914, 1918); western Mediterranean, Estepona, S Spain (Landau *et al.*, 2009). Pleistocene: Atlantic, NW France (this paper); Sicily (NHMW coll.). “Middle” Pleistocene: Wexford Gravels, SE Ireland, Isle of Man (Harmer, 1918); Netherlands (Rijken & Pouwer, 2014). Present-day: Iceland, Northern Norway to the Mediterranean, Canaries, intertidal to 200m (Poppe & Goto, 1991).

4. *Bosq d'Aubigny (Saint-Martin-d'Aubigny, dep. Manche)*

Nassarius gendryi nov. sp.

Plate 7, figs 2-4

- 1964 *Arcularia gibbosula* Linné, 1766 [*sic*] – Brébion, p. 434, pl. 10, figs 32, 33 [*non Nassarius gibbosulus* (Linnaeus, 1758)].

Type material – Holotype MNHN.F.A52536, height 25.3 mm; paratype 1 MNHN.F.A52537, height 27.4 mm, (coll. Brébion); paratype 2 RGM.1008170, height 25.8 mm; paratype 3 RGM.1008171, height 28.1 mm; paratype 4 RGM.1008172, height 26.9 mm; paratype 5 RGM.1008184, height 25.3 mm; paratype 6 NHMW 2015/0133/47, height 26.3 mm (ex. JvdV coll.).

Other material – RGM.1008173 (4 incomplete); JvdV (3 + several fragments).

Etymology – Named after Damien Gendry, associate curator, Institut de Géologie, University of Rennes, for his invaluable help and enthusiasm in finding and photographing some of Brébion's material. *Nassarius* gender masculine.

Locus typicus – Bosq d'Aubigny, Manche department, Basse-Normandie, NW France

Stratum typicum – Upper Piacenzian-Gelasian, Upper Pliocene-lower Pleistocene.

Diagnosis – A medium sized *Nassarius* species with a globular shell and glossy surface, sculpture restricted to subobsolete axial folds on the dorsum of the last whorl, a weakly thickened outer lip, which is smooth within, a deep anal canal, a deeply excavated columella bearing a strong parietal tooth and a greatly expanded, but thin ventral callus.

Description – Shell of medium size and thickness, glo-

bose, surface glossy in well-preserved specimens. Protoconch not preserved. Protoconch-teleoconch boundary not clearly delimited. Teleoconch consisting of four convex whorls, with periphery at abapical suture. Suture linear, superficial, ventrally obscured by callus. Last whorl globose, 80% of total height. Shell smooth, except for subobsolete axial folds on dorsum of last whorl. Aperture medium-sized, sub-elliptical. Outer lip hardly thickened by narrow labial varix, smooth within. Anal canal deep, narrow; siphonal canal short, open. Columella deeply concave in mid-portion, with one oblique fold abapically delimiting siphonal canal, strong parietal tooth. Columellar callus greatly expanded, weakly thickened, poorly delimited, covering entire venter, encircling margins, but without forming marginal callus, enveloping ventral portion of spire, but not reaching apex.

Discussion – Landau *et al.* (2009, p. 62) discussed the French specimens illustrated by Brébion (1964, pl. 10, figs 32, 33) as *Arcularia gibbosula* Linné, 1766 [*sic*], and pointed out that they did not represent *Nassarius gibbosulus* (Linnaeus, 1758), being closer to *N. soldanii* (Bellardi, 1882) and included them in the synonymy of this species, with some reservation.

Brébion's material consists of one complete specimen (MNHN.F.A52536, height 25.3 mm) and one larger specimen missing its dorsum (MNHN.F.A52537, height 27.4). The larger shell has a more strongly developed ventral callus covering the entire venter and extending adapically almost to the tip of the spire. We have found further material from Bosq d'Aubigny in the RGM and JvdV collections consisting of seven complete adults and several incomplete specimens.

The French shells are relatively large; much larger than the shells of any fossil (maximum height about 15 mm) or present-day *N. gibbosulus* (maximum height about 20 mm). They are indeed closer in shape to *N. soldanii*, however, this larger series has allowed us to conclude that they are not conspecific. The French specimens differ from *N. soldanii* in 1) being considerably larger (25.3-28.1 mm vs. maximum height *N. soldanii* 18.4 mm); 2) they have subobsolete axial folds on the dorsum (not clearly seen in the photographs, but easily felt), but no distinct dorsal gibbosity, whereas *N. soldanii* has a weak dorsal hump; *N. gibbosulus* has an even stronger dorsal hump; 3) the venter is rounded and not depressed as it is in *N. soldanii*; 4) there is no dimple on the ventral callus, which is developed in *N. soldanii* (see Ferrero Mortara *et al.*, 1981, pl. 19, fig. 11) and even more strongly in *N. gibbosulus*; and 5) the parietal tooth is more strongly developed, below which the columella is more deeply excavated in the mid-portion. Therefore, although this French species belongs within the *Nassarius gibbosulus* species group (of Landau *et al.*, 2009), we consider it a distinct species: *Nassarius gendryi* nov. sp. It is the larger-shelled member of the species group. Apart from Bosq d'Aubigny, where the species is not uncommon, Brébion (1964, p. 435) records it also from St-Jean-la-Poterie.

Distribution – Upper Pliocene-lower Pleistocene: At-

lantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964).

Nassarius reticosus (J. Sowerby, 1815)

Plate 7, figs 5-8

- *1815 *Buccinum reticosum* J. Sowerby, p. 17, pl. 110, fig. 2.
- 1845 *Buccinum elongatum* J. Sow. vars. a & b Nyst, p. 572, pl. 45, figs 1-3.
- 1848 *Nassa reticosa* J. Sow., plus vars. *vulgaris*, *rugosa*, *elongata*, *thiara*, *fenestralis*, *deformis*, *concinna*, *costata*, *perversa* – S.V. Wood, p. 33, pl. 3, figs 10a-i.
- 1914 *Nassa reticosa* (J. Sowerby), plus vars. *pulchra*, *lineata*, *cancellata*, *costata*, *incisa* – Harmer, p. 61, pl. 3, figs 4, 14-19.
- 1920 *Nassa (Uzita) reticosa* (J. Sowerby), plus vars. *rugosa*, *Woodi*, *elongata*, *costata*, *tiara*, *fenestralis*, *concinna*, *deformis* – Harmer, p. 517, pl. 46, figs 1-7, 9-11.
- 1957 *Nassarius (?Hinia) reticosus* (J. Sowerby, 1815), plus vars. *reticosa*, *fenestralis*, *tiara* – van Regteren Altena (*partim*), p. 68, pl. 14, figs 135a, b, d, e (*non forma woodi* fig. 135c = *Nassarius scaldisianus* Adam & Glibert, 1976).
- 1976 *Nassarius reticosus* (Sowerby, 1815) – Adam & Glibert, p. 56, pl. 2, fig. 9, pl. 6, fig. 6.
- 1997 *Nassarius (Uzita) reticosus* (J. Sowerby, 1815) – Marquet, p. 98, pl. 12, fig. 5.
- 1998 *Nassarius (Uzita) reticosus* (J. Sowerby, 1815) – Marquet, p. 151, figs 125a-g.
- 2014 *Nassarius reticosus* (J. Sowerby, 1815) – Rijken & Pouwer, p. 46, figs 3-7.

Material – MNHN.F.A52551 (1), height 40.5 mm; MNHN.F.A52552 (1), height 35.5 mm; MNHN.F.A52553 (1), height 30.9 mm; MNHN.F.A52554 (1), height 27.4 mm (coll. Brébion); RGM.1008162 (50+); RGM.1008163 (50+); RGM.1008169 (2 + 1 juvenile); RGM.1008182 (6 + 5 juvenile); maximum height 38.5 mm, RGM.1008167 (30+, juveniles); JvdV (50 + numerous fragments and juveniles); NHMW 2015/0133/45 (3, ex. JvdV coll.); all Bosq d'Aubigny, Manche department, Basse-Normandie, NW France. RGM.1008166 (1) height 33.7 mm (incomplete), Cricqueville-en-Bessin, Normandy, NW France, Pliocene?

Discussion – *Nassarius reticosus* (J. Sowerby, 1815) is the largest nassariid in the NW French Plio-Pleistocene assemblages. It is characterised by its rather thin shell, relatively slender form and large aperture. Having said this, it is also the most variable of all nassariids in shell shape and this has led to the proliferation in the literature of so-called “forms”. The sculpture of *N. reticosus* consists of fine spiral cords and rounded axial ribs. The ribs can be relatively strongly raised (*i.e.*, in “form” *costata*), or more numerous and flattened (*i.e.*, “form” *concinna*); they extend across the whole shell in most forms, although in some the ribs weaken and become obsolete on the last whorl (*i.e.*, “form” *elongata*). The whorls can be regularly

rounded (*i.e.*, “form” *reticosa*) or strongly shouldered a short distance below the suture (*i.e.*, “form” *tiara*). Rijken & Pouwer (2014, p. 47) tentatively separated *Nassarius fenestralis* (S.V. Wood, 1848) as a distinct species found only in the lower Pliocene Oorderen Sand Member of Belgium. Whilst it is possible that we are dealing with a cluster of cryptic species rather than a single taxon, in the English deposits of Walton-on-the-Naze, Essex, most of these so-called “forms” co-occur (S.V. Wood, 1848), as they seem to do at Bosq d’Aubigny.

The protoconch in the typical specimens of this species is paucispiral (Marquet, 1998, figs 125 e, g), consisting of just over one whorl with a large nucleus, suggesting non-planktotrophic development. Numerous specimens from Le Bosq d’Aubigny have their apex preserved, and show a similar paucispiral protoconch.

In the French assemblages *N. reticosus* occurs most commonly at Bosq d’Aubigny and Gourbesville. Brébion (1964, p. 454) also recorded small numbers from Le Girondor, Palluau and Le Pigeon Blanc. Despite intensive collecting, we have not found this species in the Le Pigeon Blanc deposits. Brébion (1964) recognised the forms *reticosa*, *rugosa* and *woodi* in the NW French material. Although these forms have no taxonomic rank, the observation shows a similar range in shell variability in NW France as seen elsewhere.

Distribution – Lower Pliocene: Atlantic; Coralline Crag, England (Harmer, 1914). Upper Pliocene: Red Crag, England (S.V. Wood, 1848; Harmer, 1914); Oorderen, Kruis-schans and Merkssem Sands, Belgium (Marquet, 1998). Pliocene (indeterminate): Netherlands (van Regteren Altena, 1957). Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964; Adam & Glibert, 1976). Lower Pleistocene: Atlantic; Norwich Crag, England (Harmer, 1914; Rijken & Pouwer, 2014). Middle Pleistocene: Wexford Gravels, SE Ireland (Harmer, 1914); Isle of Man deposits, Wales (Harmer, 1914).

Nassarius reticulatus (Linnaeus, 1758)

Plate 8, fig. 1

- *1758 *Buccinum reticulatum* Linnaeus, p. 740.
- 2009 *Nassarius reticulatus* (Linnaeus, 1758) – Landau *et al.*, p. 29, pl. 5, figs 15-18, pl. 6, fig. 1, pl. 17, fig. 5 (*cum syn.*).
- 2011 *Nassarius reticulatus* (Linnaeus, 1758) – Landau *et al.*, p. 25, pl. 12, fig. 13.
- 2014 *Nassarius reticulatus* (Linnaeus, 1758) – Rijken & Pouwer, p. 54, fig. 35.

Material – RGM.1008164 (1), height 24.0 mm; RGM.1008163 (5); JvdV (9 + 2 fragments and juveniles); NHMW 2015/0133/48 (1, ex. JvdV coll.), maximum height 31.6 mm; all Bosq d’Aubigny, Manche department, Basse-Normandie, France. JvdV (8), maximum height 30.9 mm, Selsoif (Saint-Sauveur-le-Vicomte), commercial sand dredging in Marais de la Sensurière, collected

from sediment dump, Manche department, NW France (Grand Marais Fm.; Tiglian C4, Pleistocene).

Discussion – As discussed by Rolán & Luque (1994), *N. reticulatus* and *N. nitidus* (Jeffreys, 1867) are separable on shell, soft parts and egg capsule morphology. *N. nitidus* has a protoconch with less than two whorls, *N. reticulatus* more than two. The teleoconch differences are subtle, and overlap, but in *N. nitidus* the number of axial ribs is usually less (11-19 vs. 16-23) and the spire is somewhat scalate. The dentition within the outer lip is more regular in *N. nitidus*, often the mid-apertural denticles are more strongly developed in *N. reticulatus*. The specimens from Bosq d’Aubigny have a conical spire, about 20-23 axial ribs, and the mid-apertural denticle is more strongly developed, and therefore identified as *N. reticulatus*. Unfortunately the protoconch is not preserved in the specimens in the RGM collection.

Distribution – Lower Pliocene: Atlantic, Guadalquivir Basin, SE Spain (González Delgado, 1989; Landau *et al.*, 2011); western Mediterranean, NE Spain (Gili, 1991), Roussillon Basin, SE France (Fontannes, 1879), Alpes-Maritimes, SE France (Cossmann, 1901); central Mediterranean, Italy (Bellardi, 1882; Chirli, 2000), Tunisia (Fekih, 1975). Upper Pliocene: Atlantic, Mondego Basin, west central Portugal (Zbyszewski, 1959; Gili *et al.*, 1995; Silva, 2001); western Mediterranean, Estepona, S Spain (Landau *et al.*, 2009); central Mediterranean, Italy (Bellardi, 1882; Malatesta, 1974). Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (this paper). Lower Pleistocene: central Mediterranean, Italy (Cerulli-Irelli, 1911). “Middle” Pleistocene: Atlantic, Wexford Gravels, SE Ireland (Harmer, 1916); Isle of Man deposits, Wales (Harmer, 1916). Pleistocene (indeterminate): Netherlands (Rijken & Pouwer, 2014). Present-day: Atlantic, western Mediterranean (Rolán & Luque, 1994).

Nassarius cf. turonensis (Deshayes, 1844)

Plate 8, fig. 2

Material – RGM.1008176 (1), height 10.8 mm; JvdV (3), maximum height 10.4 mm; all Bosq d’Aubigny, Manche department, Basse-Normandie, France.

Discussion – The shells from the Bosq d’Aubigny assemblage are similar to *Nassarius turonensis* (Deshayes, 1844) specimens; same size, number of ribs and cords, has the base delimited by a deep groove and has the same number and disposition of stout teeth within the outer lip. It differs in not having a varix (occasional specimens of *N. turonensis* do not have varices either) and in having slightly broader spiral cords, broader than their interspaces, whereas *N. turonensis* has cords that are narrower than their interspaces. The protoconch in the Bosq d’Aubigny specimen is preserved, and is dome-shaped, multispiral, consisting of 3.5 whorls with a small nucleus, similar to that of most nassariids of the *N. incrassatus*

species group. Harmer (1918, pl. 34, fig. 11) illustrated a specimen of *N. turonensis* from the slightly younger Gelasian assemblage of St. Erth in Cornwall, southwest England. This specimen does have a varix and is more typical of the species. We provisionally identify the French shell as *N. cf. turonensis* pending further material. For further discussion see under *N. turonensis*.

Distribution – Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (this paper).

Nassarius sp. B

Plate 8, fig. 3; Plate 9, fig. 4

Material – RGM.1008168 (1), height 16.6 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, NW France.

Description – Shell medium sized, relatively robust, with a tall conical spire. Protoconch incomplete, but consisting of at least 2.5 tall whorls. Teleoconch consisting of five convex whorls, with periphery below mid-whorl. Suture impressed, weakly undulating. Axial sculpture consisting of 11 weakly opisthocline, narrow, rounded ribs. Spiral sculpture of very fine, close-set spiral cords, roughly equal in width to their interspaces, covers whole shell surface. Last whorl 60% of total height. Aperture relatively small, outer lip thickened, bearing five distinct denticles within, the second denticle placed mid-whorl most strongly developed; lower denticles weakening abapically. Anal canal rounded, clearly developed; siphonal canal short, open, twisted to the left. Columella weakly excavated (abapical portion missing), bearing small parietal tubercle. Columellar callus thickened, sharply delimited, weakly expanded. Siphonal fasciole narrow, delimited form base by a broad groove.

Discussion – This species is represented by a single shell in the RGM collection, which misses the tip of its protoconch and the abapical portion of the columella. Although it superficially resembles *Nassarius prismaticus* (Brocchi, 1814), it probably belongs to the *N. turritus* (Borson, 1820) species-group, together with *N. strobilianus* (Cocconi, 1873) and *N. brebioni* nov. sp., on account of its conical spire, small aperture, and large denticles within the outer lip. Members of the *N. prismaticus* species-group tend to have numerous lirae within the outer lip that extend deep into the aperture, as opposed to prominent short denticles restricted to just within the lip margin. The shells of this species are most similar to those of *N. brebioni* from the older lower Pliocene of Le Pigeon Blanc, but differs in 1) having a proportionately shorter spire; 2) having a more inflated last whorl (60% of total height vs. 53% in *N. brebioni*); 3) having more numerous axial ribs (11 vs. 8 in *N. brebioni*); 4) having more prominent spiral sculpture; 5) having five denticles within the outer lip and not four, of which the second is most strongly developed as opposed to the first in *N. brebioni*; and 6)

although the protoconch is incomplete, it seems to have one more whorl than that of *N. brebioni*. *Nassarius kermondei* Kendall, 1894 from the middle Pleistocene of the Isle of Man also belongs within this species-group, but has even fewer axial ribs (six or seven) and much weaker spiral sculpture. We await further material to formally describe this species.

Distribution – Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (this paper).

Genus *Demoulia* Gray, 1838

- 1838 *Demoulia* Gray, p. 29. Type species (by subsequent designation): *Buccinum retusum* Lamarck, 1822 = *Nassa ventricosa* Lamarck, 1816. Recent, South Africa. For discussion on the many spellings for this genus taxon see Cernohorsky (1984, p. 206).
- 1847 *Desmoulea* Gray, p. 114 (invalid emendation).
- 1851 *Desmoulinia* Woodward, p. 112 (*nom. subst. pro Desmoulea* Gray, 1847).
- 1856 *Streptorhega* Bronn, p. 563 (*nom. subst. pro Desmoulea* Gray, 1847).
- 1874 *Moulinia* Tournouer, p. 295 (*nom. subst. pro Desmoulea* Gray, 1847).

Demoulia pupa (Brocchi, 1814)

Plate 8, fig. 4

- *1814 *Buccinum pupa* Brocchi, p. 335, Plate 4, fig. 14.
- 1882 *Nassa conglobata* Brocch. var. A – Bellardi, p. 83 [*non Demoulia conglobata* (Brocchi, 1814)].
- 1904 *Nassa (Desmoulaea[sic]) conglobata* var. *subobsoletocostata* Sacco, p. 67, pl. 15, figs 63-64 [*non Demoulia conglobata* (Brocchi, 1814)].
- 1955 *Nassa (Desmoulea) pupa* (Brocchi, 1814) – Rossi-Ronchetti, p. 213, fig. 113.
- 1959 *Nassa (Desmoulea) conglobata pupa* (Brocchi) – Ruggieri *et al.*, p. 44, pl. 10, fig. 58 [*non Demoulia conglobata* (Brocchi, 1814)].
- 1963 *Nassa conglobata* (Br.) *subobsoletocostata* Sacco – Caretto, p. 21, pl. 3, fig. 10 [*non Demoulia conglobata* (Brocchi, 1814)].
- 1964 *Desmoulea conglobata* Brocchi, 1814 – Brébion, p. 433, pl. 10, fig. 31 [*non Demoulia conglobata* (Brocchi, 1814)].
- ?1974 *Demoulia conglobata* (Brocchi, 1814) – Malatesta, p. 322, pl. 26, fig. 5 [*non Demoulia conglobata* (Brocchi, 1814)].
- 1978 *Buccinum pupa* Brocchi, 1814 – Pinna & Spezia, p. 132, pl. 10, fig. 3.
- 1992 *Demoulia conglobata* (Brocchi, 1814) – Cavallo & Repetto, p. 104, fig. 243 [*non Demoulia conglobata* (Brocchi, 1814)].
- 2000 *Demoulia conglobata* (Brocchi, 1814) – Chirli (*partim*), p. 109, pl. 42, figs 13-14 [*non Demoulia conglobata* (Brocchi, 1814)].

2009 *Demoulia pupa* (Brocchi, 1814) – Landau *et al.*, p. 67, pl. 13, fig. 8.

Material – MNHN.F.A52535 (1), height 46.9 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, NW France (coll. Brébion).

Discussion – As discussed by Landau *et al.* (2009), in the European Pliocene the genus *Demoulia* is represented by several species. *Demoulia pupa* (Brocchi, 1814) has a higher spired shell than *D. conglobata* (Brocchi, 1814), with a higher last whorl and a proportionately shorter aperture. The spiral sculpture is very weakly developed, obsolete on later whorls, whereas in *D. conglobata* the spiral cords are narrow and well-developed, often of alternating strength. The outer lip is almost straight adapically and strongly flared abapically, with about ten strongly developed, but shorter denticles within. There are no secondary denticles developed. In *D. conglobata* the outer lip is regularly convex, with about 12 narrow primary denticles with many secondary denticles in the interspaces. The columella in *D. pupa* bears a few tubercles but no folds, apart from a strong parietal ridge delimiting the anal canal, whereas in *D. conglobata* the columella bears numerous irregular folds and tubercles. Lastly, in the shell of *D. pupa* the siphonal canal is slightly more open than in *D. conglobata*.

The single specimen available from Bosq d'Aubigny, illustrated by Brébion (1964, pl. 10, fig. 31), is missing its ventral portion. Nevertheless, the dorsum is well developed and shows this shell to belong to *D. pupa* and not *D. conglobata*, as suggested by Brébion (1964, p. 433).

Distribution – Lower Pliocene: central Mediterranean, Italy (Chirli, 2000). Upper Pliocene: western Mediterranean, Estepona, S Spain (Landau *et al.*, 2009); central Mediterranean; Italy (Bellardi, 1882; Sacco, 1904; Ruggieri *et al.*, 1959; Caretto, 1963; ?Malatesta, 1974; Cavallo & Repetto, 1992). Upper Pliocene-lower Pleistocene: Atlantic, upper Piacenzian-Gelasian, Manche, NW France (Brébion, 1964).

Discussion

In his thesis Brébion (1964) recorded 28 'Redonian' nassariid species and subspecies from the Mio-Pleistocene of northwestern France. Of these, 12 species occurred in what later Lauriat-Rage (1981) considered the 'Redonien chaud' (described herein as Assemblage I), 11 in the 'Redonien froide' (assemblage III herein), and 15 in the Pleistocene assemblages (Assemblage IV).

In this work we record and describe specimens from Assemblages III and IV. Among these specimens, we identified 11 species from the Assemblage III Le Pigeon Blanc locality, of which seven are new and one is left in open nomenclature: *Nassarius brebioni* nov. sp., *Nassarius crebresulcatus* (Bellardi, 1882), *Nassarius landreauensis* nov. sp., *Nassarius merlei* nov. sp., *Nassarius* sp. A, *Nassarius spectabilis vandewouweri* (Glibert, 1959),

Nassarius pacaudi nov. sp., *Nassarius palumbis* nov. sp., *Nassarius columbinus* nov. sp., *Nassarius turpis* nov. sp., *Nassarius turonensis* (Deshayes, 1844), plus one species *Nassarius labiosus* (J. de C. Sowerby, 1824), which was recorded from the roughly coeval assemblage of Palluau – also included in Assemblage III –, but not occurring at Le Pigeon Blanc.

Seventeen species were recorded from the uppermost Piacenzian-Gelasian assemblages of northwestern France, *i.e.* included herein in Assemblage IV, of which four are described as new and four are left in open nomenclature: *Nassarius companyoi* (Fontannes, 1879), *Nassarius poteriensis* nov. sp., *Nassarius rectus* (Dollfus & Dautzenberg, 1886), ?*Nassarius reticosus* (J. Sowerby, 1815), *Nassarius solidus* (Bell, 1898), *Nassarius plainei* nov. sp., *Nassarius corrugatus* (Brocchi, 1814), *Nassarius martae* nov. sp., *Nassarius* cf. *anomalous* (Harmer, 1914), *Nassarius incrassatus* (Ström, 1786), *Nassarius gendryi* nov. sp., *Nassarius reticosus* (J. Sowerby, 1815), *Nassarius* cf. *turonensis* (Deshayes, 1844), *Nassarius* sp. B, and *Demoulia pupa* (Brocchi, 1814).

For the species occurrences in the various northwestern French localities, we have relied on the distribution given by Brébion (1964). Unfortunately we do not have all of Brébion's material at hand, and have relied on his identifications, except where we disagree with his conclusions, in which case the distribution has been modified. For example, Brébion (1964, p. 443) records *Hinia reticulata* var. *recta* (Dollfus & Dautzenberg, 1886) from numerous localities. We agree with his classification for the Falun d'Anjou (Assemblage I) and for St.-Jean-la-Poterie (Assemblage IV). However, as shown here, the Le Pigeon Blanc (Assemblage III) specimens do not belong to this species. Therefore for this species we would record *Nassarius rectus* from Assemblage I (= 'Redonien chaud') and Assemblage IV (Gelasian), *N. landreauensis* from Assemblage III (= 'Redonien froid').

The stratigraphy and the dating of the northwestern French post-Middle Miocene 'Redonian' deposits is not at present as clear and precise as that of roughly coeval sequences in England, Belgium and The Netherlands. Nevertheless, based on the available literature data, these deposits (as well as the molluscan gastropod assemblages found in them) may be grouped into four juxtaposing stratigraphic sequences.

The assemblages used in this paper to try organise the wealth of molluscan gastropod fossil records known from the 'Redonian' of northwestern France roughly represent four distinct time slabs: Assemblage I, Tortonian; Assemblage II, Messinian; III, Zanclean and Assemblage IV, upper Piacenzian to Gelasian. Keeping this in mind, none of the species reported and discussed in this paper occurred from the Tortonian through the Gelasian (except possibly *N. turonensis*), and few occurred in more than one of these time slices.

Assemblage I (Tortonian):

The post-Helvetian species from Anjou faluns listed by

Brébion and adapted herein, but not revised, are: *Nassarius* cf. *lambertiei* (Peyrot, 1927), *N. instabilis* (Bellardi, 1882), *N. rectus*, *N. corrugatus* (Brocchi, 1814), *N. prismaticus* (Brocchi, 1814), *N. caroli* (Dollfus & Dautzenberg, 1886), *N. spectabilis spectabilis* (Nyst, 1843), *N. blesensis* (Mayer, 1862), *N. turonensis*, *N. contortus* (Dujardin, 1837), *N. milleti* (*nomen nudum*) and *N. emilianus* (Mayer, 1872). Six of these species were recorded by Glibert (1952) from the middle Miocene Loire Basin of France. Of these Anjou species, three occur in Assemblage II and only one, *N. turonensis*, is also found in Assemblages II, III and possibly IV.

Assemblage I (Tortonian) shows a diverse fauna of nassariids, not just in species, but also in species groups. Fifty percent of species are also present in the older middle Miocene assemblages of the Loire Basin. The taxonomy requires revision, but many of the species recorded are also known from the Neogene Mediterranean. This would agree with Lauriat-Rage's (1981, p. 148) observation of a stronger southern influence in the 'early Redonian'.

Assemblage II (Messinian):

This assemblage is also not reviewed in this paper. Brébion (1964) listed *N. rectus*, *N. corrugatus*, *N. turonensis* from Apigné, with *N. prismaticus* and *N. caroli* from Apigné marked with an (x) where the number of specimens was meant to be indicated. We assume this means that these species were cited in the literature, but Brébion did not have any specimens from this locality at hand, and therefore their occurrences are not confirmed. Of these, *N. rectus*, *N. corrugatus*, *N. turonensis* also occur in Assemblage I and one; *N. turonensis* occurs in Assemblage III and possibly IV.

Assemblage II (Messinian) has a poor nassariid fauna, which shares 100% of species with Assemblage I. Within the limitations of the small amount of data available, and based purely on the nassariids, there would be no justification for separating Assemblages I and II. However, although the species in Assemblage II also occur in Assemblage I, it is far less diversified. Whether this separation is justified or not will depend on analysis of the rest of the molluscan assemblage of the 'Redonien Stratotypique'.

Assemblage III (Zanclean):

Assemblage III nassariids are highly restricted stratigraphically. In the Le Pigeon Blanc, of the 11 nassariids described, eight occur exclusively in northwestern French Zanclean deposits. Only *N. turonensis* is found in all four assemblages, and possibly *Nassarius brebioni* nov. sp. is also found in Assemblage IV, if the specimens from St.-Jean-la-Poterie prove to be conspecific with those from Le Pigeon Blanc. *Nassarius labiosus* (J. de C. Sowerby, 1824) occurring in Palluau, but not in Le Pigeon Blanc, does occur in the North Sea Basin Pliocene.

Assemblage III (Zanclean) is composed of highly endemic nassariid species, known only from the northwest-

ern French 'Redonian' deposits. Moreover, few species of this assemblage also occur in older or younger deposits. Although diverse in species, it is relatively poor in species-groups and the species tend to be represented by specimens of small dimensions. This is not only true of the nassariids, but also within other gastropod groups. There are a large number of endemics, which will be dealt with in subsequent papers. The assemblage has fewer thermophilic elements compared to that of Assemblage I. This cooler-water trend is not seen clearly in the nassariids, although Assemblage III is poor in species groups and lacks warm-water nassariid groups. The cooler influence is more evident in other gastropod groups. Therefore, whilst our interpretation agrees with Lauriat-Rage's (1981) in considering this a cooler-water assemblage, at least in the nassariids, we do not see a strong southern or northern influence.

Assemblage IV (Piacenzian-Gelasian):

Assemblage IV has the most diversified nassariid fauna, both in species, species groups (*sensu* Landau *et al.*, 2009) and genera. 18 species are recorded from the various localities in Brittany and Normandy. Of these four are endemic, seven species also occur in the Pleistocene Atlantic English assemblages of St Erth and/or the Isle of Man and five in the Pliocene North Sea basin. Five species also occur in the Mediterranean Neogene.

Interestingly enough, Assemblage IV shows the highest nassariid diversity of all northwestern France 'Redonian' assemblages and also shares most species with neighbouring geographic regions. This diversity is not only in species numbers, but also in species groups and genera. Thirty-nine percent of the species are shared in common with the North Sea Basin and 28% with the Mediterranean. This is the only post-Middle Miocene NW French assemblage in which the genus *Demoulia* occurs. Therefore, within the nassariids, whilst we see an increasing northern influence over time, as described by Lauriat-Rage (1981, p. 148), there is still a considerable southern influence present.

This assemblage is dated as upper Piacenzian to Gelasian. Landau *et al.* (2009, text-fig 4, appendix 3.1) showed that present-day nassariid diversity diminishes progressively along the northeastern Atlantic frontage with increasing latitude. Today only four nassariid species occur at the latitude of northwestern France and the Channel region. Although there were relatively warmer and cooler periods within the Gelasian, it is unlikely that sea surface temperatures were significantly greater than they are today. Therefore, this high diversity is unexpected if the assemblage was Gelasian. As far as we are aware, Assemblage IV faunas have none of the other taxa we typically associate with thermophilic environments (i.e. cypraeids, strombids, conids, terebrids, architectonicids). Having said this, the British localities including the Wexford Gravels, Isle of Man beds and St Erth Formation, which have also been dated as Gelasian (Roe *et al.*, 1999; A.M. Wood *et al.*, 2009), also have a large number of nas-

sariids (Harmer, 1914, 1918). Therefore this high diversity of nassariids is hard to explain. One possibility is that the Assemblage IV faunas are upper Piacenzian rather than Gelasian. The Red Crag of England and the Merksem and Kruisschands Sands Members of the Lillo Formation of Belgium still have a large number of nassariid species (Harmer, 1914, 1918; Marquet, 1998, p. 230), and several species from Assemblage IV are also found in these upper Pliocene North Sea Basin assemblages.

As can be seen from Fig. 3, the relationships between Assemblages III-IV and the faunas from neighbouring geographical regions changed over time. Assemblage III is highly endemic, with few species sharing their distribution with either the Mediterranean or North Sea basin. Unfortunately, there are no coeval Atlantic assemblages on the British Isles. As shown by Van Vliet Lanöe (2002, fig. 3) connection existed between the North Sea Basin (NSB) and the Atlantic in the English Channel region following the Messinian. This is not strongly reflected in the nassariid content of Assemblage III, as only one *Nassarius* species is found in both the NSB and northwestern France (*N. labiosus*), but numerous other species found in Le Pigeon Blanc are well-known NSB taxa (*i.e.* *Cirsotrema funiculus* (Wood, 1842), *Cirsotrema fimbriosum* (S.V. Wood, 1872), *Seila suttonensis* Marquet, 2001, *Pterylopsis minor* (Harmer, 1914), *Terebra exilis* Bell, 1871, amongst others).

Assemblage IV has a far more cosmopolitan character, with the greatest affinity to the NSB fauna. It also shares common elements with the coeval Mediterranean assemblages.

From a biogeographical standpoint, the study assemblages represent faunas that occurred roughly in the transition zone between two biogeographical provinces at least since Miocene times. In the Miocene the study area lies between the subtropical Boreal-Celtic Province to the North and the tropical European West African Province to the south. During the Pliocene it lies between the warm temperate Boreal-Celtic Province to the North and the subtropical French-Iberian Province to the South. Since the Pleistocene the study area lies between the cool temperate Boreal-Celtic Province to the North and the warm temperate French-Iberian Province to the South (Neogene molluscan biogeographic provinces after Silva & Landau, 2007. Present-day bioprovinces and climatic zones after Raffi *et al.*, 1985).

Conclusions

In this paper we revise the nassariid Plio-Pleistocene assemblages of northwestern France. The gastropod content of these assemblages had not been revised since Brébion (1964), whose thesis was not published and therefore the new names he introduced are not valid. As a result of this work 28 nassariid species are recorded, of which 11 are described as new, five are left in open nomenclature. Two nassariid genera are recognised (*Nassarius* and *Demoulia*) and the *Nassarius* species are assigned to species groups (of Adam & Glibert, 1974, 1976; Gili, 1991;

Landau *et al.*, 2009) whenever possible. The taxonomic part of this work has been greatly assisted by the recent comprehensive and coherent revisions of the Pliocene NSB, Mediterranean and adjacent Atlantic nassariids (Marquet, 1998; Landau *et al.*, 2009; Rijken & Pouwer, 2014).

In this paper we attempt to organise the gastropod fossil wealth of records and localities known to date from the 'Redonian', by grouping them in four assemblages (Assemblages I – IV) corresponding to the four major stratigraphic groups of deposits recognised in the post mid-Miocene sequences of northwestern France. These assemblages should be seen as 'working hypotheses' that will be tested for usefulness and coherence in future papers focussing on other gastropod families from the 'Redonian' fossil record.

Assemblages I and II are not revised in this paper. Assemblage III is composed of highly endemic nassariid species, known only from the northwestern French 'Redonian' deposits. There are no elements within the nassariid fauna that would suggest thermophilia. Assemblage IV has the most diversified nassariid fauna, both in species, species groups, and contains the relatively thermophilic nassariid genus *Demoulia*. It is the most cosmopolitan in character, with the greatest affinity to the NSB fauna, but it also shares common elements with the coeval Mediterranean assemblages. This high diversity is unexpected at a time when relatively cool waters prevailed.

This is the third paper of a series of taxonomic works on the northwestern French post mid-Miocene assemblages. In future works we will turn our attention to other groups in the hope that they will shed further light on the relationship between these Assemblages and possibly shed light on the issues raised herein, namely the unexpected high diversity of nassariids in Assemblage IV, the youngest of the all.

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Species	Geographical distribution					Stratigraphical distribution							
	1	2	3	4	A/M	Miocene Lower	Miocene Middle	Miocene Upper	Pliocene Lower	Pliocene Upper	Pleistocene Lower	Pleistocene Upper	Hol
<i>Nassarius brebioni</i> nov. sp.			●		A				■	■	■	■	
<i>Nassarius crebresulcatus</i> (Bellardi, 1882)			●	●	A			■	■				
<i>Nassarius landreauensis</i> nov. sp.			●		A				■				
<i>Nassarius merlei</i> nov. sp.			●		A				■				
<i>Nassarius</i> sp.			●		A				■				
<i>Nassarius spectabilis vandewouweri</i> (Glibert, 1959)	●		●		A				■				
<i>Nassarius pacaudi</i> nov. sp.			●		A				■				
<i>Nassarius palumbis</i> nov. sp.			●		A				■				
<i>Nassarius columbinus</i> nov. sp.			●		A				■				
<i>Nassarius turpis</i> nov. sp.			●		A				■				
<i>Nassarius turonensis</i> (Deshayes, 1844)	●	●	●		A	■	■	■	■	■	■	■	
<i>Nassarius labiosus</i> (J. de C. Sowerby, 1824)	●	●	●	●	A				■	■	■	■	
<i>Nassarius companyoi</i> (Fontannes, 1879)		●	●	●	A			■	■	■	■	■	
<i>Nassarius poteriensis</i> nov. sp.			●		A					■	■	■	
<i>Nassarius rectus</i> (Dollfus & Dautzenberg, 1886)		●			A	■	■	■	■	■	■	■	
? <i>Nassarius reticosus</i> (J. Sowerby, 1815)			●		A					■	■	■	
<i>Nassarius solidus</i> (Bell, 1898)		●	●		A					■	■	■	
<i>Nassarius plainei</i> nov. sp.			●		A					■	■	■	
<i>Nassarius corrugatus</i> (Brocchi, 1814)			●	●	A				■	■	■	■	■
<i>Nassarius martae</i> nov. sp.			●		A					■	■	■	
<i>Nassarius</i> cf. <i>anomalous</i> (Harmer, 1914)			●		A				■				
<i>Nassarius incrassatus</i> (Ström, 1786)	●	●	●	●	A				■	■	■	■	■
<i>Nassarius gendryi</i> nov. sp.			●		A					■	■	■	
<i>Nassarius reticosus</i> (J. Sowerby, 1815)	●	●	●		A				■	■	■	■	
<i>Nassarius reticulatus</i> (Linnaeus, 1758)	●	●	●	●	A				■	■	■	■	■
<i>Nassarius</i> cf. <i>turonensis</i> (Deshayes, 1844)			●		A				■				
<i>Nassarius</i> sp. B			●		A					■	■	■	
<i>Demoulia pupa</i> (Brocchi, 1814)			●	●	A					■	■	■	

Figure 3. Geography, stratigraphy and distribution of the nassariid species found in the Pliocene and Pleistocene NW French assemblages. For geographic distribution 1 = Mediterranean, 2 = NW France, 3 = Atlantic coasts British Isles, 4 = North Sea Basin. For stratigraphic distribution black signified Atlantic distribution (A), grey Mediterranean distribution (M).

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Plate 1

1. *Nassarius brebioni* nov. sp., holotype MNHN.F.A52564, height 15.9 mm (coll. Brébion; pl. 11, fig. 36 of Brébion, 1964, as *Hinia* (*Tritonella*) cf. *kermondei*).
2. *Nassarius brebioni* nov. sp., paratype 1 NHMW 2015/0133/0008, height 17.0 mm.
3. *Nassarius brebioni* nov. sp., height 17.0 mm (coll. LC).
4. *Nassarius crebresulcatus* (Bellardi, 1882), NHMW 2015/0133/0017, height 6.8 mm, height 9.6 mm.
5. *Nassarius crebresulcatus* (Bellardi, 1882), MNHN.F.A52549, height 11.5 mm (coll. De l'Île du Dréneus; pl. 11, fig. 14 of Brébion, 1964).
6. *Nassarius crebresulcatus* (Bellardi, 1882), NHMW 2015/0133/0018, height 12.0 mm.
7. *Nassarius crebresulcatus* (Bellardi, 1882), NHMW 2015/0133/0019, height 10.6 mm.
8. *Nassarius landreauensis* nov. sp., holotype MNHN.F.A52544, height 11.6 mm (coll. Brébion; pl. 11, figs 7-8 of Brébion, 1964, as *Hinia reticulata* var. *recta*).
9. *Nassarius landreauensis* nov. sp., paratype 3 NHMW 2015/0133/0027, height 12.3 mm.
10. *Nassarius landreauensis* nov. sp., paratype 5 NHMW 2015/0133/0029, height 8.9 mm.

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

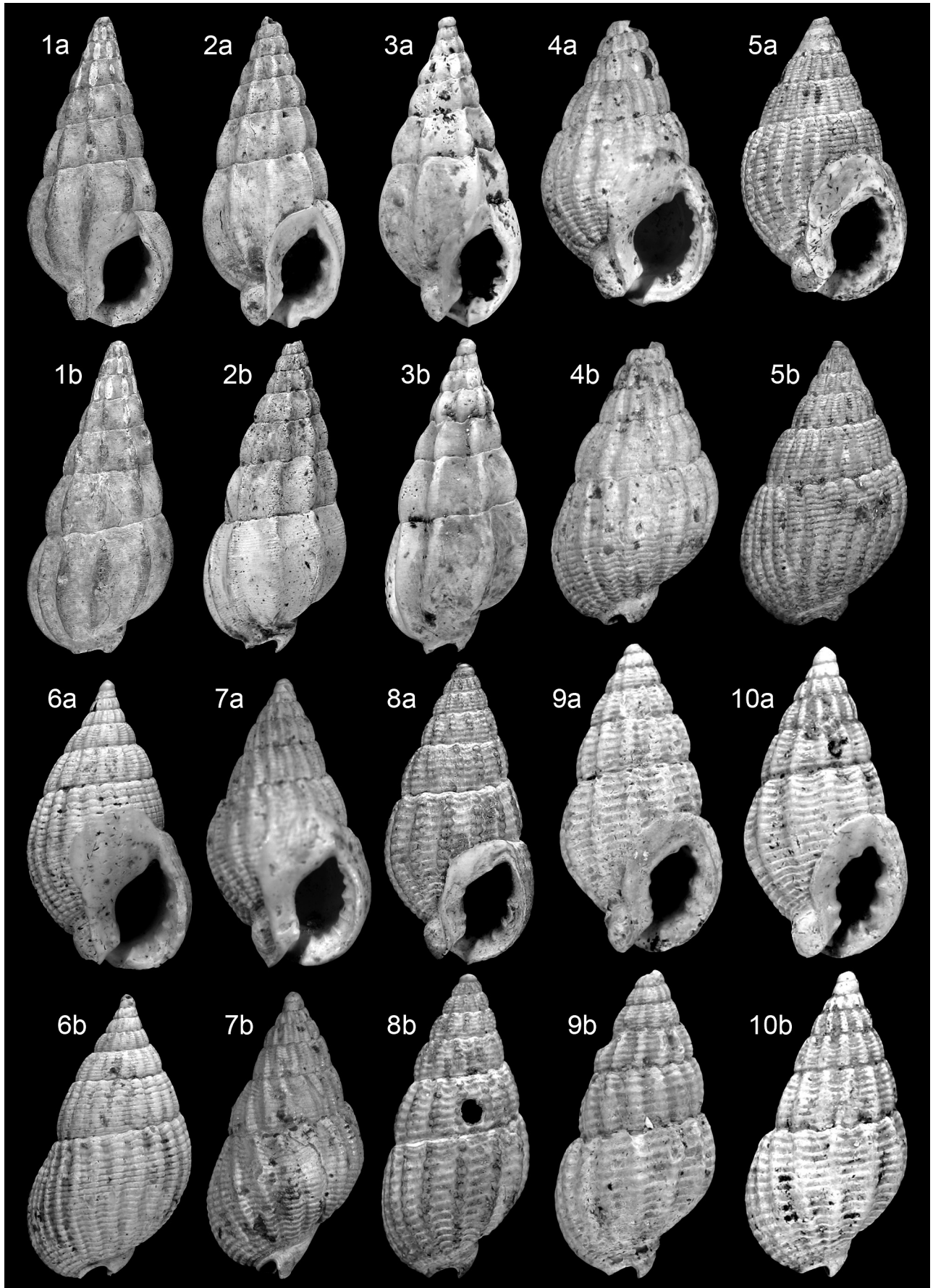


Plate 1

Plate 2

1. *Nassarius landreauensis* nov. sp., paratype 4 NHMW 2015/0133/0028, height 11.9 mm.
2. *Nassarius merlei* nov. sp., holotype, MNHN.F.A52559, height 19.7 mm (coll. Brébion; pl. 11, figs 24-25 of Brébion, 1964, as *Hinia (Uzita) vasseuri* nov. sp.).
3. *Nassarius merlei* nov. sp., paratype 5 NHMW 2015/0133/0035, height 24.7 mm.
4. *Nassarius merlei* nov. sp., paratype 6 NHMW 2015/0133/0036, height 30.2 mm.
5. *Nassarius* sp. A, height 8.7 mm (coll. LC).
6. *Nassarius* sp. A, height 10.1 mm (coll. LC).
7. *Nassarius spectabilis vandewouweri* (Glibert, 1959), NHMW 2015/0133/0032, height 18.7 mm.
8. *Nassarius spectabilis vandewouweri* (Glibert, 1959), NHMW 2015/0133/0033, height 20.0 mm.
9. *Nassarius spectabilis vandewouweri* (Glibert, 1959), height 15.4 mm (coll. LC).

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

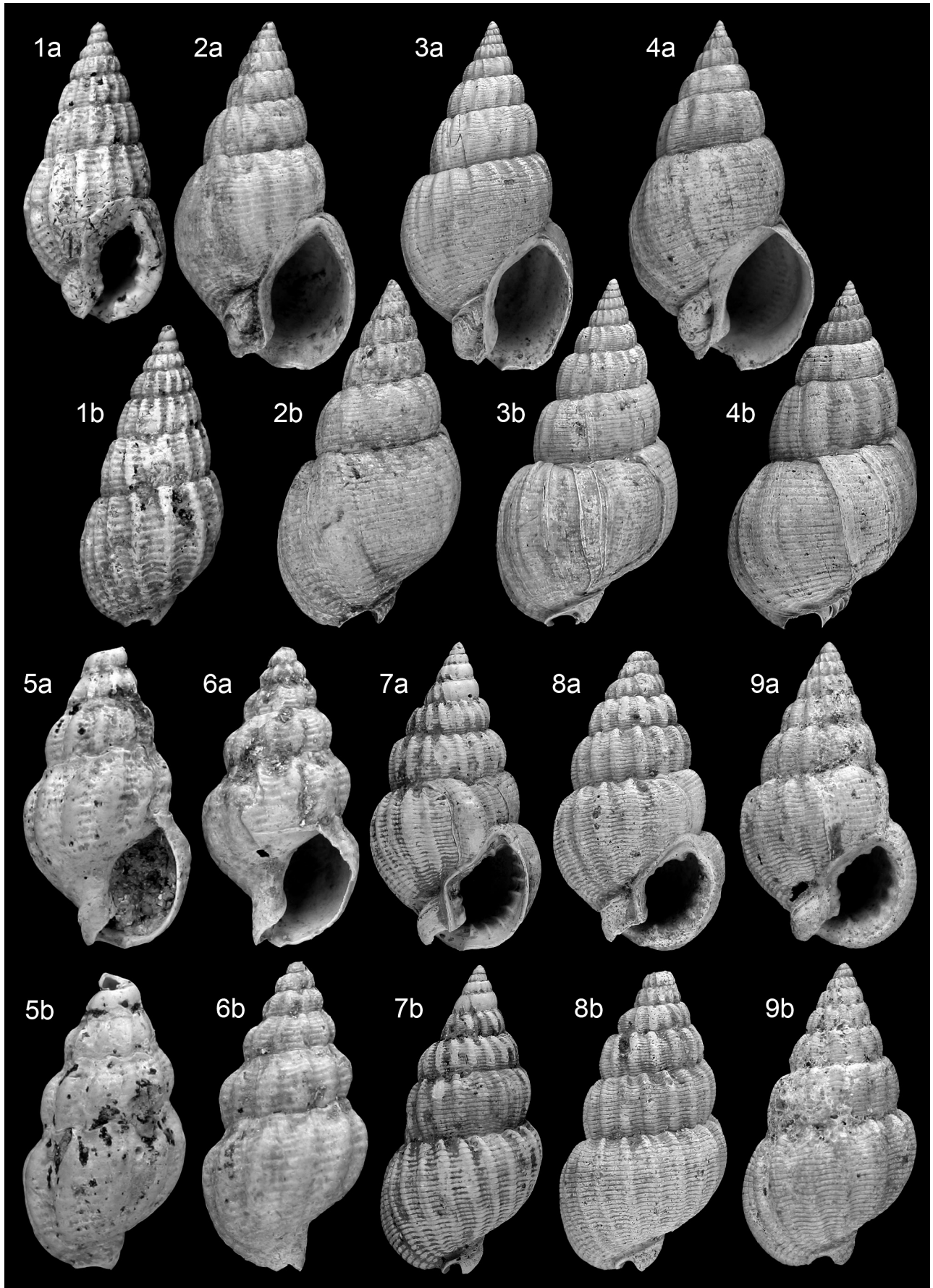


Plate 2

Plate 3

1. *Nassarius pacaudi* nov. sp., holotype MNHN.F.A53331, height 6.7 mm.
2. *Nassarius pacaudi* nov. sp., paratype 1 MNHN.F.A53332, height 8.7 mm.
3. *Nassarius pacaudi* nov. sp., paratype 2 NHMW 2015/0133/0021, height 8.8 mm.
4. *Nassarius pacaudi* nov. sp., paratype 3 NHMW 2015/0133/0022, height 6.0 mm.
5. *Nassarius palumbis* nov. sp., holotype IGR-PAL-131890, height 7.8 mm (photo Damien Gendry).
6. *Nassarius palumbis* nov. sp., paratype 1 NHMW 2015/0133/0001, height 8.2 mm.
7. *Nassarius palumbis* nov. sp., paratype 2 NHMW 2015/0133/0004, height 8.3 mm.
8. *Nassarius macrodon* (Bronn, 1831), NHMW 2015/0133/0002, height 10.3 mm, Banyul dels Aspres, River Têt, Roussillon, France (Zanclean, lower Pliocene).
9. *Nassarius palumbis* nov. sp., paratype 3 NHMW 2015/0133/0003, height 7.2 mm.

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

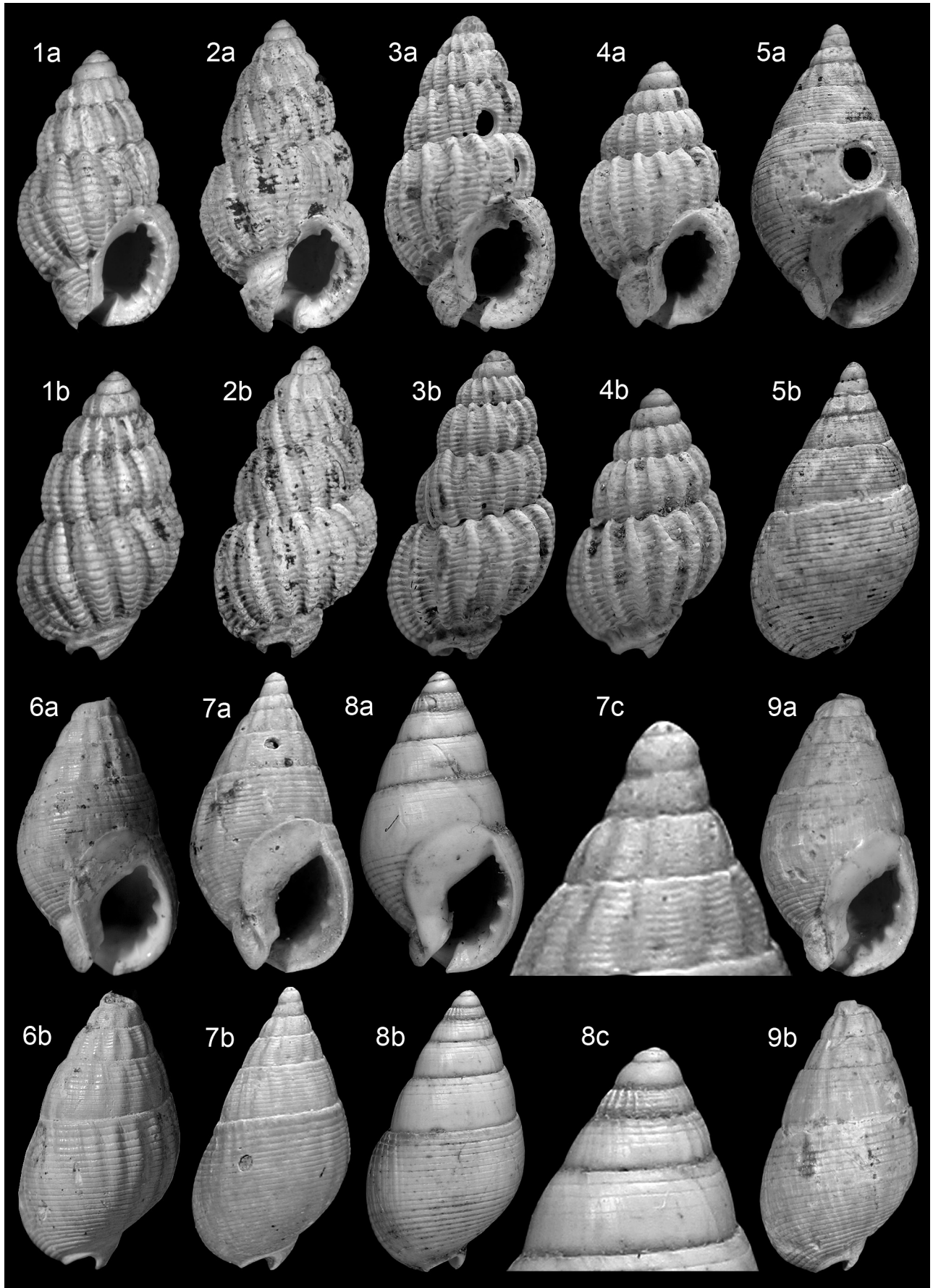


Plate 3

Plate 4

1. *Nassarius columbinus* nov. sp., holotype MNHN.F.A53333, height 10.3 mm.
2. *Nassarius columbinus* nov. sp., paratype 1 NHMW 2015/0133/0007, height 8.6 mm.
3. *Nassarius columbinus* nov. sp., paratype 2 NHMW 2015/0133/0040, height 7.8 mm.
4. *Nassarius turpis* nov. sp., holotype NHMW 2015/0133/0039, height 4.6 mm.
5. *Nassarius turonensis* (Deshayes, 1844), NHMW 2015/0133/0013, height 6.9 mm.
6. *Nassarius turonensis* (Deshayes, 1844), NHMW 2015/0133/0014, height 6.8 mm.
7. *Nassarius turonensis* (Deshayes, 1844), NHMW 2015/0133/0041, height 7.8 mm.
8. *Nassarius turonensis* (Deshayes, 1844), NHMW 2015/0133/0042, height 8.1 mm, Le Louroux, Le Petit Bray, Indre et Loire, France, Langhian, Middle Miocene.
9. *Nassarius turonensis* (Deshayes, 1844), NHMW 2015/0133/0043, height 7.1 mm, Renauleau, Loire-Atlantique, France, Tortonian, Upper Miocene.

All (except Figs 8 and 9): Le Landreau, Le Pigeon Blanc, Loire-Atlantique department, France (Zanclean, lower Pliocene).

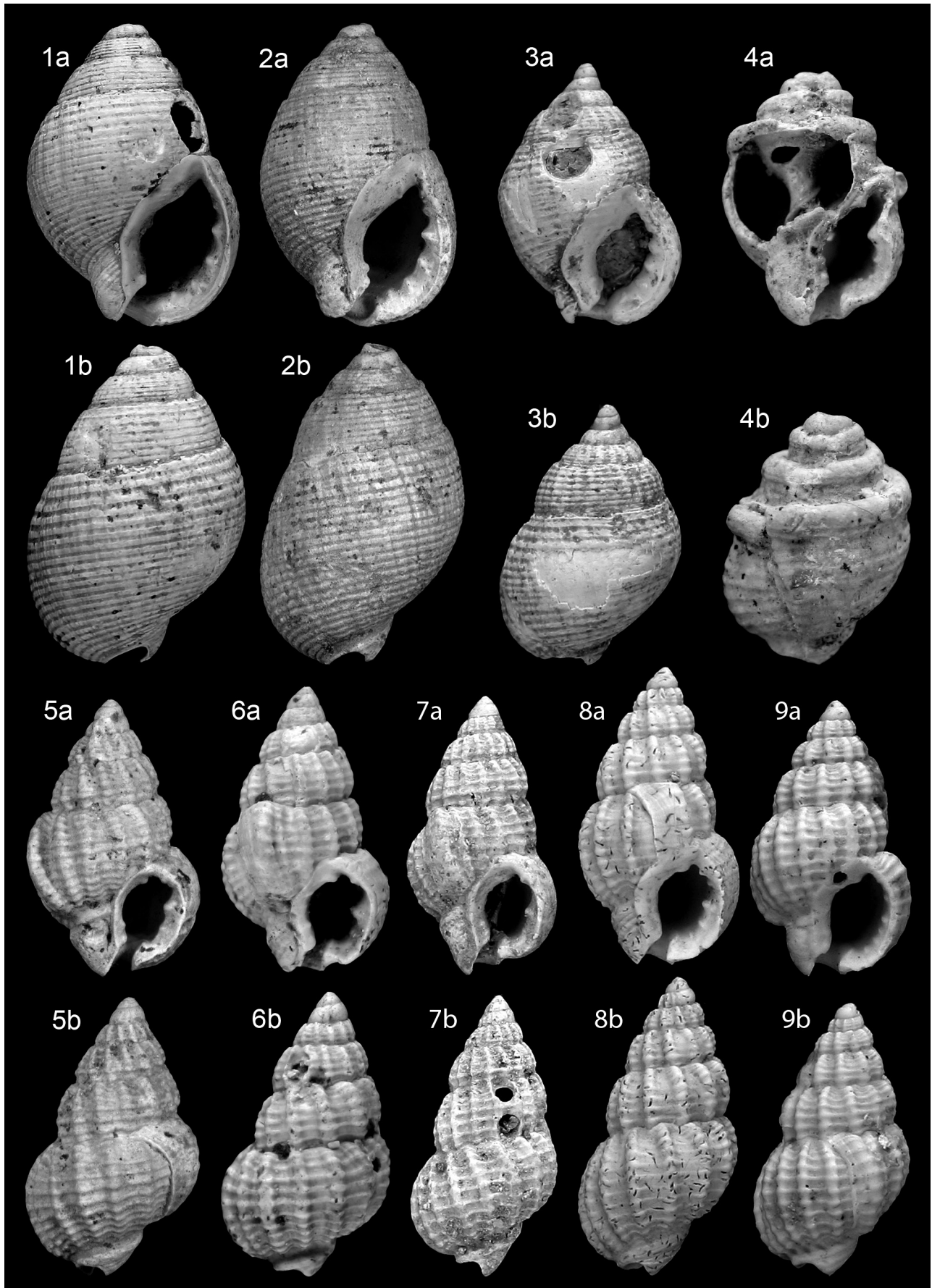


Plate 4

Plate 5

1. *Nassarius labiosus* (J. de C. Sowerby, 1824), MNHN.F.A52538, height 16.0 mm, Palluau (Puits Martineau), Vendée department, Pays de la Loire, France (Zanclean, lower Pliocene) (coll. Brébion; pl. 11, figs 1-2 of Brébion, 1964, as *Amyclina semistriata* v. *gigantula*).
2. *Nassarius labiosus* (J. de C. Sowerby, 1824), MNHN.F.A52539, height 15.6 mm, Palluau (Puits Martineau), Vendée department, Pays de la Loire, France (Zanclean, lower Pliocene) (coll. Brébion, *Amyclina semistriata* v. *gigantula*).
3. *Nassarius labiosus* (J. de C. Sowerby, 1824), RGM.1008177, height 19.3 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene).
4. *Nassarius companyoi* (Fontannes, 1879), MNHN.F.A52540, height 21.1 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, figs 3-4 of Brébion, 1964, as *N. mutabilis*).
5. *Nassarius companyoi* (Fontannes, 1879), MNHN.F.A52541, height 21.3 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion, as *N. mutabilis*).
6. *Nassarius poteriensis* nov. sp., holotype MNHN.F.A52555, height 24.9 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (latest Piacenzian-lower Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 21 of Brébion, 1964, as *Nassarius grueti* nov. sp.).
7. *Nassarius poteriensis* nov. sp., paratype 1 MNHN.F.A52556, height 22.1 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 20 of Brébion, 1964, as *Nassarius grueti* nov. sp.).
8. *Nassarius rectus* (Dollfus & Dautzenberg, 1886), IGR-PAL-135080, height 10.8 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion IGR; photo Damien Gendry).
9. ?*Nassarius reticosus* (J. Sowerby, 1815), IGR-PAL-131873, height 17.3 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion IGR; pl. 11, fig. 28 of Brébion, 1964, as *Hinia (Uzita) durandae* nov. sp.) (photo Damien Gendry).
10. ?*Nassarius reticosus* (J. Sowerby, 1815), IGR-PAL-133113, height 16.7 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion IGR; pl. 11, fig. 29 of Brébion, 1964, as *Hinia (Uzita) durandae* nov. sp.) (photo Damien Gendry).

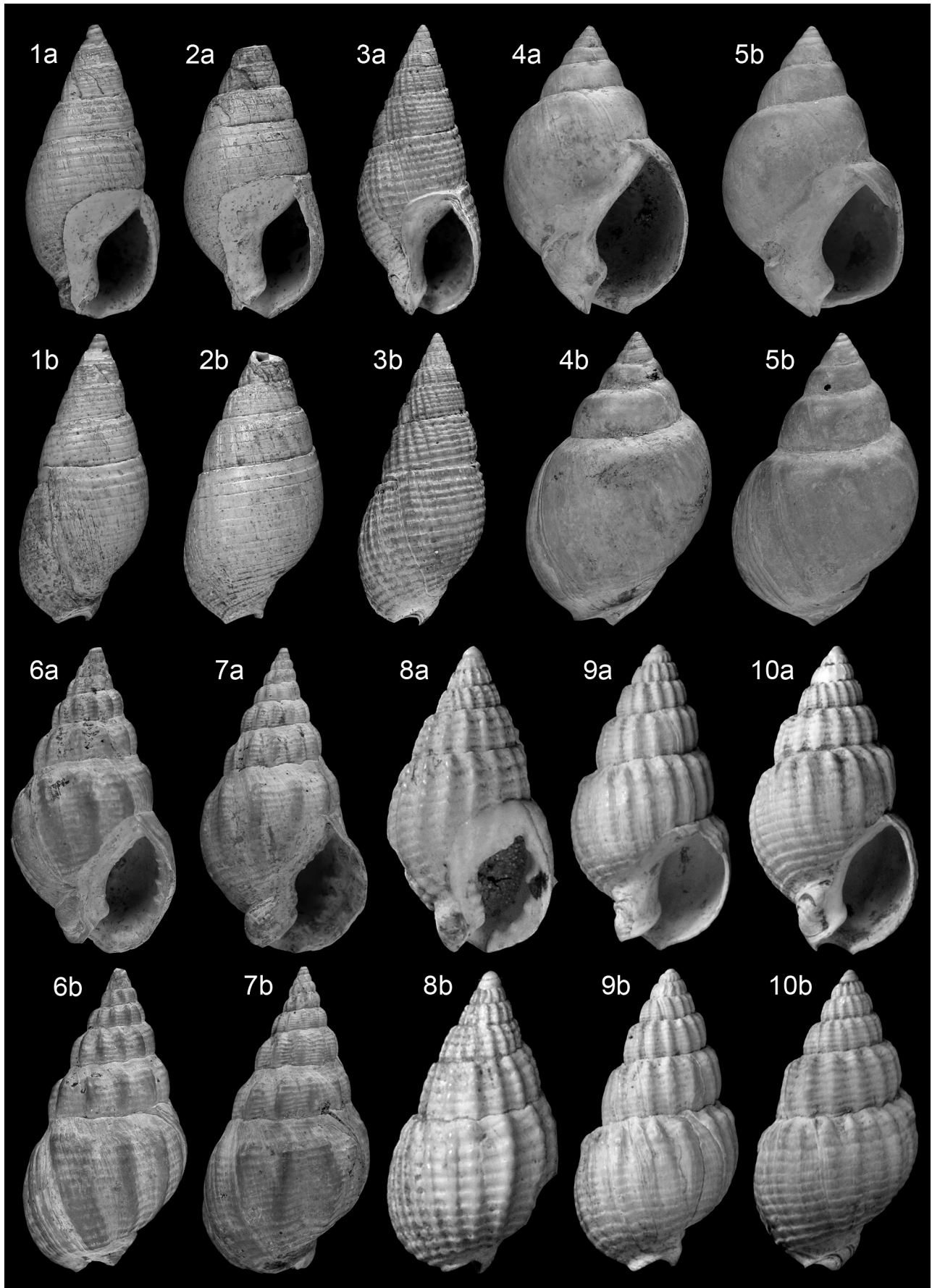


Plate 5

Plate 6

1. *?Nassarius reticosus* (J. Sowerby, 1815), IGR-PAL-131876, height 17.3 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion IGR; pl. 11, fig. 30 of Brébion, 1964, as *Hinia (Uzita) miloni* nov. sp.) (photo Damien Gendry).
2. *?Nassarius reticosus* (J. Sowerby, 1815), IGR-PAL-133114, height 17.5 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion IGR; pl. 11, fig. 31 of Brébion, 1964, as *Hinia (Uzita) miloni* nov. sp.) (photo Damien Gendry).
3. *Nassarius solidus* (Bell, 1898), MNHN.F.A52542, height 25.1 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 5 of Brébion, 1964, as *Nassarius solidulus* v. *coxi* Brébion n. var.).
4. *Nassarius plainei* nov. sp., holotype IGR-PAL-131883, height 14.5 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion IGR; pl. 11, fig. 34 of Brébion, 1964, as *Hinia (Tritonella) chauveli* nov. sp.) (photo Damien Gendry).
5. *Nassarius plainei* nov. sp., paratype 1 IGR-PAL-133115, height 16.8 mm, Saint-Jean-la-Poterie, Morbihan department, Bretagne, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion IGR; pl. 11, fig. 35 of Brébion, 1964, as *Hinia (Tritonella) chauveli* nov. sp.) (photo Damien Gendry).
6. *Nassarius corrugatus* (Brocchi, 1814), MNHN.F.A52548, height 9.9 mm, Gourbesville, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion).
7. *Nassarius corrugatus* (Brocchi, 1814), MNHN.F.A52547, height 9.4 mm, Gourbesville, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion).
8. *Nassarius corrugatus* (Brocchi, 1814), MNHN.F.A52545, height 11.0 mm, Boufféré (Le Girondor), Vendée department, Pays de la Loire, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 11 of Brébion, 1964, as var. C).
9. *Nassarius martae* nov. sp., holotype MNHN.F.A52563, height 8.3 mm, Gourbesville, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 27 of Brébion, 1964, as *Hinia (Uzita) gourbesvillensis* nov. sp.).
10. *Nassarius martae* nov. sp., paratype 1 MNHN.F.A52562, height 10.3 mm, Gourbesville, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 26 of Brébion, 1964, as *Hinia (Uzita) gourbesvillensis* nov. sp.).
11. *Nassarius* cf. *anomalous* (Harmer, 1914), MNHN.F.A52557, height 15.1 mm, Gourbesville, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 22 of Brébion, 1964, as *Nassarius harmeri* nov. sp.).
12. *Nassarius* cf. *anomalous* (Harmer, 1914), MNHN.F.A52558, height 14.5 mm, Gourbesville, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 23 of Brébion, 1964, as *Nassarius harmeri* nov. sp.).

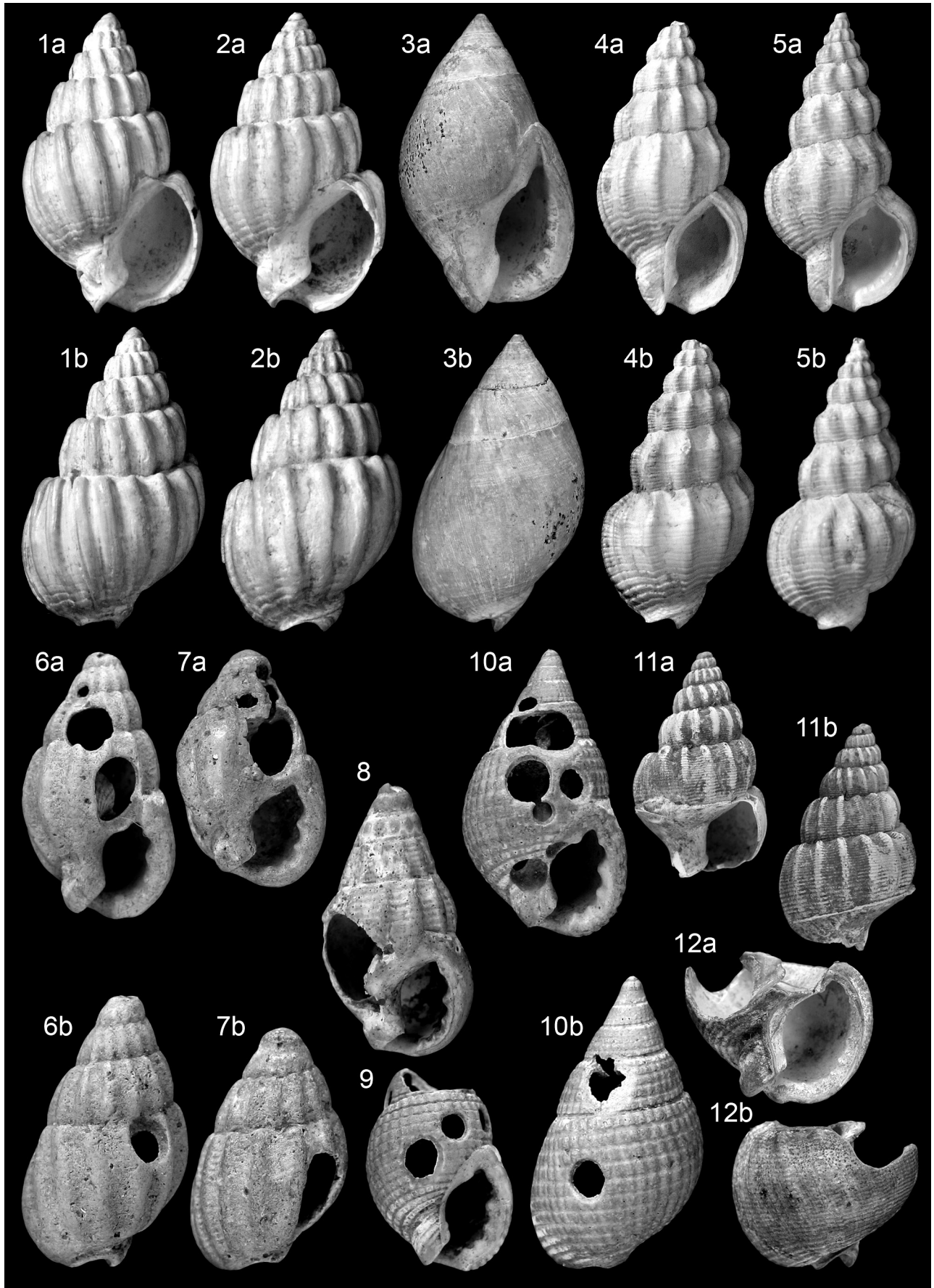


Plate 6

Plate 7

1. *Nassarius incrassatus* (Ström, 1786), RGM.1008174, height 11.4 mm, Selsoif, commercial sand dredging in La Sensurière, collected from sediment dump, Marais de la Sensurière, Manche department, France (Tiglian, Pleistocene).
2. *Nassarius gendryi* nov. sp., holotype MNHN.F.A52536, height 25.3 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 10, fig. 32 of Brébion, 1964, as *Arcularia gibbosula*).
3. *Nassarius gendryi* nov. sp., paratype 1 MNHN.F.A52537, height 27.4 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 10, fig. 33 of Brébion, 1964, as *Arcularia gibbosula*).
4. *Nassarius gendryi* nov. sp., paratype 2 RGM.1008170, height 25.8 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene).
5. *Nassarius reticosus* (J. Sowerby, 1815), MNHN.F.A52553, height 30.9 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 18 of Brébion, 1964, as forma *aubignensis* Deshayes nomen nudum).
6. *Nassarius reticosus* (J. Sowerby, 1815), MNHN.F.A52551, height 40.5 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 16 of Brébion, 1964, as forma *rugosus*).
7. *Nassarius reticosus* (J. Sowerby, 1815), MNHN.F.A52552, height 35.5 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 17 of Brébion, 1964, as forma *rugosus*).
8. *Nassarius reticosus* (J. Sowerby, 1815), MNHN.F.A52554, height 27.4 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 11, fig. 19 of Brébion, 1964, as forma *woodi*).

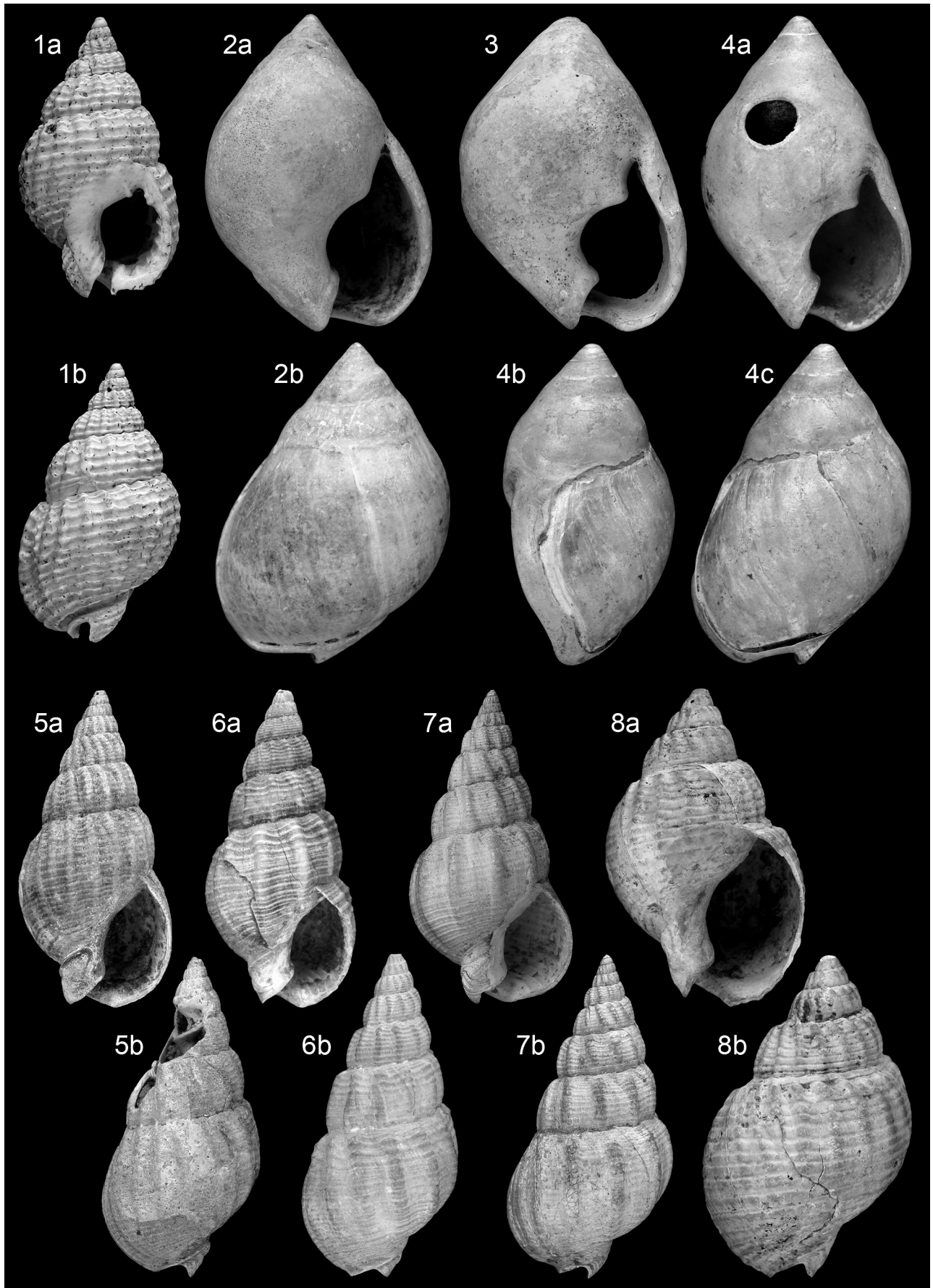


Plate 7

Plate 8

1. *Nassarius reticulatus* (Linnaeus, 1758), RGM.1008164, height 24.0 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene).
2. *Nassarius* cf. *turonensis* (Deshayes, 1844), RGM.1008176, height 10.8 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene).
3. *Nassarius* sp. B, RGM.1008168, height 16.6 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene).
4. *Demoulia pupa* (Brocchi, 1814), MNHN.F.A52535, height 46.9 mm, Bosq d'Aubigny, Manche department, Basse-Normandie, France (upper Piacenzian-Gelasian, upper Pliocene-lower Pleistocene) (coll. Brébion; pl. 10, fig. 31 of Brébion, 1964, as *Desmoulia* [sic] *conglobata*).
5. *Nassarius brebioni* nov. sp., paratype 4 NHMW 2015/0133/0011 (SEM).
6. *Nassarius crebresulcatus* (Bellardi, 1882), NHMW 2015/0133/0044 (SEM).
7. *Nassarius landreauensis* nov. sp., paratype 3 NHMW 2015/0133/0030 (SEM).
8. *Nassarius merlei* nov. sp., paratype 8 NHMW 2015/0133/0037 (SEM).
9. *Nassarius pacaudi* nov. sp., paratype 5 NHMW 2015/0133/0024 (SEM).
10. *Nassarius palumbis* nov. sp., paratype 2 NHMW 2015/0133/0004. (digital camera)

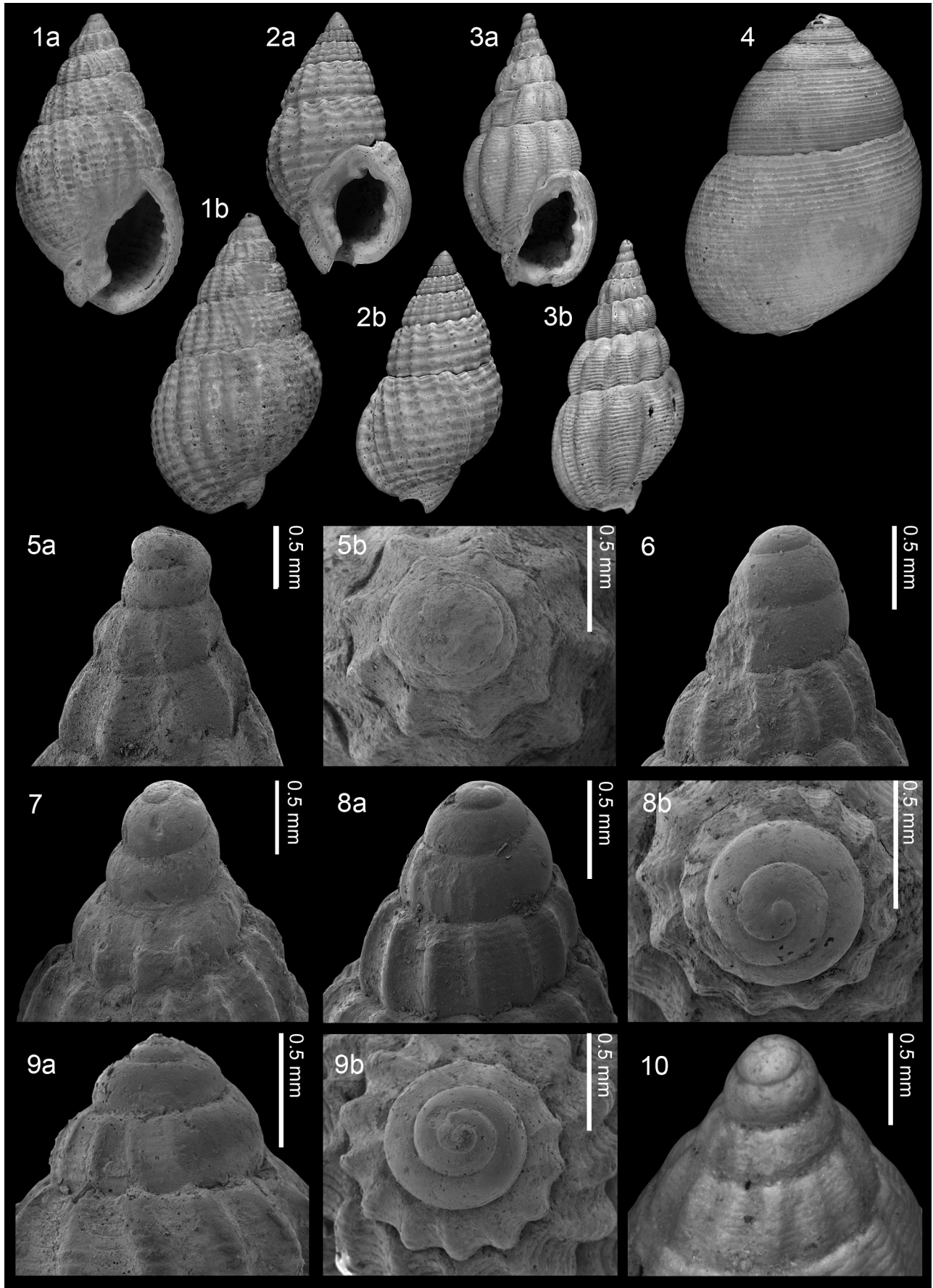


Plate 8

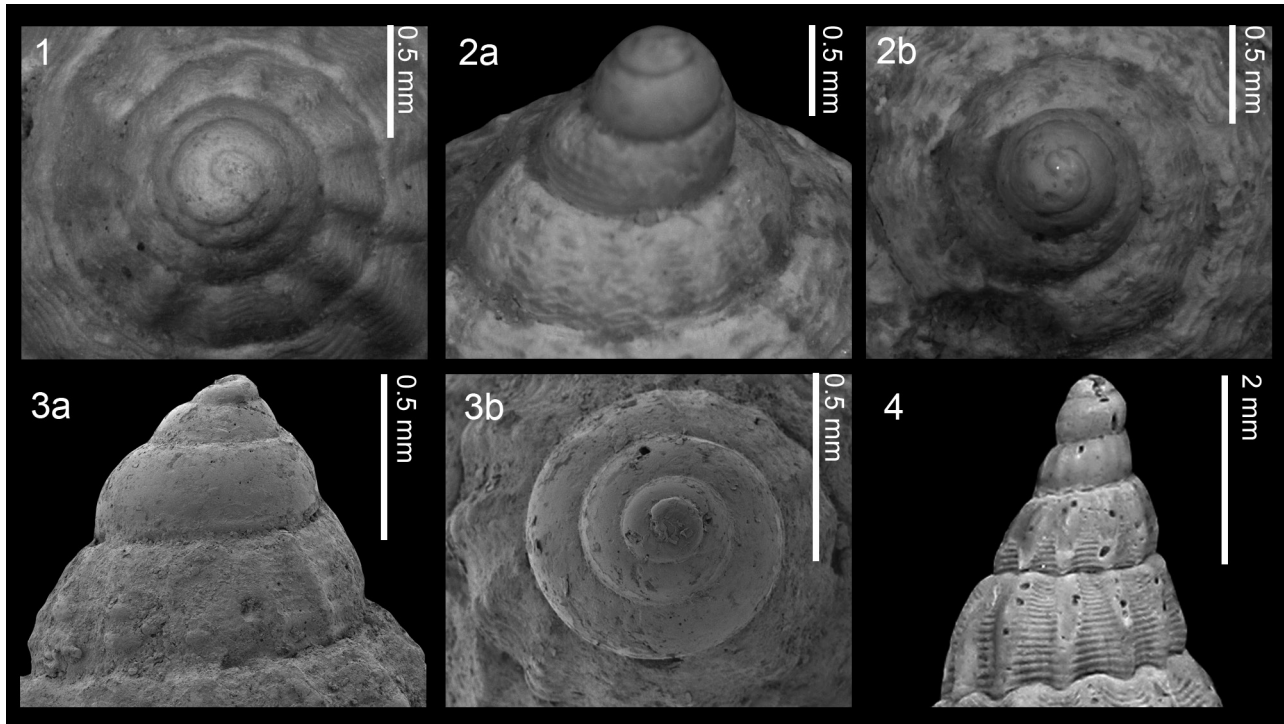


Plate 9

1. *Nassarius palumbis* nov. sp., paratype 2 NHMW 2015/0133/0004 (digital camera) (digital camera).
2. *Nassarius columbinus* nov. sp., paratype 2 NHMW 2015/0133/0040 (digital camera).
3. *Nassarius turonensis* (Deshayes, 1844), NHMW 2015/0133/0015 (SEM).
4. *Nassarius* sp., RGM.1008168 (digital camera).