

The Neritidae of the Barton Group (Middle Eocene) of the Hampshire Basin.

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Abstract: Gastropods of the family Neritidae in the Eocene Barton Group of the Hampshire Basin, southern England are reviewed and three previously undescribed taxa are described. New species: *Nerita (Amphinerita) bartonensis* and *Theodoxus (Pictoneritina) waltoni*. New subspecies: *Theodoxus (Pictoneritina) passyanus denslatus*. New combination and amended diagnosis: *Theodoxus globosus* (J. de C. Sowerby, 1823). Neotype designated for *Nerita globosa* J. de C. Sowerby, 1823. Amended diagnosis: subgenus *Amphinerita*. Amended diagnosis: subgenus *Pictoneritina*

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INTRODUCTION

The family Neritidae is poorly represented in the Barton Group but rare examples do occur in at least three horizons, namely beds A3, E and F of Burton (1933) but these have not been described in any detail. Examination of the material in the Department of Palaeontology, The Natural History Museum, London (hereinafter called: "BMNH") has shown several taxa to be present including two new species and a subspecies which are herein described. The operculum is often of importance in the classification of the Neritidae but unfortunately no operculum has yet been found, as far as I am aware, in the Barton Group.

Family NERITIDAE Rafinesque 1815

Genus NERITA Linné 1758

Type species, by subsequent designation, Montfort, 1810: *Nerita peloronta* Linné 1758. Recent, marine, Caribbean.

Subgenus AMPHINERITA Martens 1887

Type species, by subsequent designation, Baker, 1923: *Nerita umlaasiana* Krauss, 1848. Recent, marine, South Africa.

Diagnosis (Keen in Knight *et al.*, 1960: 1282): Smooth or finely striate, oblique; labial area smooth, margin weakly dentate.

Remarks: Martens' description is brief and of little assistance (Martens, 1887-9: 9) and I have used that given by Keen which appears to be based mainly on the characteristics of the type species. *N. umlaasiana* is also characterised by a thickened outer lip which is smooth within, lacking any teeth or striations. However, although the septum surface is generally smooth in *N. umlaasiana*, it is certainly not so in *Nerita atrata* Chemnitz, 1781 (= *Nerita senegalensis* Gmelin, 1791) which Martens included in his subgenus *Amphinerita*.

Nerita (Amphinerita) bartonensis sp. nov.

Pl. 1, figs 2-5

Derivatio nominis: Named after the Barton Group from which all the known specimens have come.

Holotype: BMNH 73209 (F.E. Edwards coll.). An adult of average size. (Pl. 1, fig. 2)

Stratum typicum: "Lower Barton Beds"; Barton Clay

Formation, from the condition and matrix, probably Bed A3 of Burton (1933).

Locus typicus: Highcliff, Hampshire.

Paratypes: BMNH GG22556 (H. Eliot Walton coll.), (Pl. 1, fig. 3), BMNH 3414 (Pl. 1, fig. 4), BMNH 3414 (Pl. 1, fig. 5).

Diagnosis: A rather small *Amphinerita* with a smooth exterior to the shell, the initial whorls, but not usually the last whorl, covering the spire. The septum surface has irregular folds and its edge is denticulate. The outer lip is smooth within.

Description: The shell is rather small, ovate in the adult stage, juveniles are broadly ovate in adapatural view. Juveniles are thin shelled but in the adults the outer lip is substantially thickened and bevelled at the edge. The initial whorls are completely obscured by the immediately succeeding whorls, which are entirely convex, but in some adults, including the holotype, the last whorl is slightly concave just below the suture and it does not obscure the penultimate whorl leaving a slightly exerted spire.

The external surface is polished and smooth except for fine, transverse, growth lines. The colour pattern is fairly constant consisting of two or three prominent, continuous, solid, whitish, spiral bands; these are interspersed with spiral strips, often of approximately similar width to the whitish bands but much broader in some specimens, brown in colour with white spots.

The aperture is slightly oblique and semilunar. The septum is broad with irregular folds and/or pustules in the centre of the upper surface. The central half of the septum edge is distinctly concave. The dentition consists of a series of small, regular teeth, up to eight in number, which occupy the concave central section. A very slight upper tooth, immediately adapical to the concave section, is also present in a few specimens. The outer lip is smooth within. There is a small, conoidal, apertural tooth below the abapical end of the septum.

Size: Height 10mm, width 7.6mm (holotype).

Remarks: The colour pattern of *N. bartonensis* is superficially similar to that of some specimens of *Theodoxus passyanus* (Deshayes, 1864) and this may be the reason for it having been overlooked as a separate taxon. However the whitish bands on *N. bartonensis* are solid and continuous whereas in those specimens of *T. passyanus* which are banded the bands are not always continuous and they are not solid but rather a concentration of white spots. The morphology of the two species is very different: juvenile *N.*

bartonensis can be readily separated by the spire being obscured by succeeding whorls and the adults by the thick, bevelled outer lip.

Range and distribution: I have not found this species in the collection of the Muséum National d'Histoire Naturelle in Paris (hereinafter called: "MNHN") and it appears to be confined to the Barton Group of the Hampshire Basin. Five specimens which have detailed provenance (BMNH Pal. TG 18286-18290 D. Curry coll.) are from bed A3 of Burton (1933). Others are labelled "Highcliff" and it seems likely from the state of preservation that most, if not all, are from bed A3.

Genus *THEODOXUS* Montfort 1810

Type species, by original designation: *Theodoxus lutetianus* Montfort 1810 (= *Nerita fluviatilis* Linné 1758). Recent, freshwater, Europe.

Diagnosis (Keen in Knight *et al.*, 1960: 1285): Small, obliquely ovate, spire low or elevated; labial area smooth, with smooth or dentate margin; operculum smooth.

Theodoxus globosus (J. de C. Sowerby 1823), **comb. nov.**

Pl. 1, fig. 1

Nerita globosa J. de C. Sowerby, 1823: 5: 29, pl. 424, fig. 1. (Text-fig. 1).

Diagnosis: The shell is subglobose, transversely sulcated; the spire is apparent; there is one tooth on the septum; the outer lip is plain within.

Type and locus typicus: The holotype was lost in the 19th century according to a manuscript note, "missing June 1889", alongside the figure of the holotype in the copy of *The Mineral Conchology of Great Britain* in the Cox Library, the Department of Palaeontology, BMNH. A recent search of relevant parts of the BMNH collection has failed to reveal any trace of the holotype. The type locality is not clearly specified but is apparently Hampshire since Sowerby's description was based on a unique specimen lent by the Rev. T. Cooke "who has taken much pains to fill up our list of Hampshire shells". No other information is given as to the locality of the holotype but Sowerby remarked that it contained two valves of *Corbula pisum*, which indicates that the holotype could well have come from the Barton Group. It is considered important to designate a neotype both to augment Sowerby's description with the intention of clarifying the generic position of this taxon and also to establish a type locality.

Neotype (herein designated): BMNH GG22558 (A. G. Davis coll.), (Pl. 1, fig. 1). Labelled: "Lower Bartons, Highcliff, Hants". The state of preservation is consistent with material from a sandy lenticle within bed A3 of Burton (1933).

Original description: Three or four black bands and a few rows of oblong spots decorate the surface. The outer lip is rather thin and void of crenulations; the inner lip is narrow with only one very obtuse tooth near its upper end. Within the aperture, near its lower part is a conspicuous lamelliform tooth that regulates the opening of the operculum by confining the appendage that moves between it and the lip. The spire is not prominent.

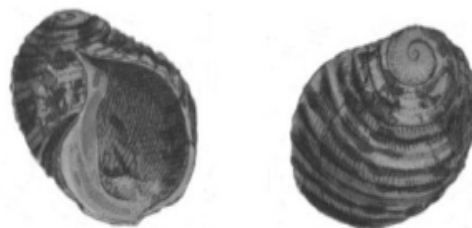
Amended diagnosis: The material from the Barton Group at BMNH includes a single broken specimen, the neotype, which matches closely the description and illustration in Sowerby although what Sowerby describes as "a very obtuse tooth" near the upper end of the septum appears in his accompanying figure (see Text-fig. 1) and in the neotype more as a slight swelling of the adapical end of the septum edge than as a parietal tooth in the usual sense.

In addition to Sowerby's description of the holotype, the following details are apparent from an examination of the neotype. The whorls are evenly rounded and convex except for a conspicuously concave section immediately below the suture; the suture itself is prominent and quite deep but this could be due to the worn condition of the neotype. The surface is covered by approximately 25 evenly spaced, low, rounded, fairly even sized, spiral ridges separated by narrow, shallow grooves, the ridges becoming flattened and less conspicuous on the upper half of the last 10mm or so of the final whorl; the spiral ridges are crossed by a few prominent growth lines interspersed by very fine, close, transverse lines. The "lamelliform tooth" within the aperture, noted by Sowerby and clearly visible in plate 1, figure 1a, consists of two raised ridges which meet to form two sides of a triangle with the open end towards the aperture and the apex pointing into the interior of the shell; the inner ridge is longer than the outer one and both increase in height as the apex is reached. The colour pattern consists of a dark brown background with white dashes and spots and three whitish, spiral bands.

Size: Height 18.2mm, width 13.8mm (neotype).

Remarks: Accordingly to Sherborne (1926, 2733), Férussac described a *Nerita globosa* at an unspecified date between 1800 and 1850 in his *Histoire naturelle générale et particulière des Mollusques*, pl. Nerites fossiles, fig. 14. Also, Keen in Knight *et al.* (1960, 1284) refers to *Nerita globosa* Férussac, 1823. However fig. 14 of the relevant plate shows *Nerita globulus* (= *Neritoplica uniplicata* (J. de C. Sowerby, 1823) Wenz, 1938). The folio edition of this work in the Mollusca Library, BMNH, omits the name of the species shown in fig. 14, presumably due to a printing error. Kennard (1942, 15) states that the caption for fig. 14 was "*Nerita globulus*". He also gives the date for publication of Férussac's livraison 20, which includes the Nerites fossiles plate, as 27th September 1823. Cleevely (1974, 444) puts the date of publication of Sowerby's description of *Nerita globosa* as 1st August 1823. Accordingly, regardless of whether Férussac used the specific name *globosa* or *globulus*, Sowerby's description was published first and is here given priority.

Although Sowerby placed this species in the genus *Nerita*, he himself commented that "The only circumstance in the form of this shell that induces us to determine it to be a *Nerita*, is the sulcated surface". The general appearance of



Text-figure 1. J. de C. Sowerby's figure of *Nerita globosa*

this species with its rather thin shell, the smooth, narrow septum and the absence of teeth on the outer lip are not at all characteristic of *Nerita*; also the apertural tooth is different in form from that of *Nerita* which consists of a single, usually conoidal, projection. The general appearance of the shell is very similar to *Neritodryas* Martens 1869 which genus also has a thin shell and a smooth, narrow septum and a surface which may be smooth or spirally grooved. However the apertural tooth is again different in *Neritodryas*.

Although I am satisfied that this species falls within the genus *Theodoxus* (in the sense used by Vaught, 1989: 13), it does not fit readily within any of the subgenera as currently constituted and it appears to require the erection of a new subgenus. I am unwilling to base a new subgenus on a single, worn and damaged specimen and I consider that this should be left until more material becomes available.

There is some superficial similarity between this species and large specimens of *Theodoxus passyanus* which raises the possibility that this is a worn or aberrant form of that species. However it differs in a number of important respects from *T. passyanus*: it is substantially larger than the biggest *T. passyanus*, the septum is narrow and lacks the typical dentition of *T. passyanus*, and the conspicuous spiral ridges are continuous, even and well formed showing no sign of having been caused by early damage to the shell; also at least two very similar specimens of this taxa have now been found, namely the lost holotype and the neotype.

This species is very close to *Theodoxus dutemplei* (Deshayes 1864) from the Sparnacian of the Paris Basin. The latter is also thin-shelled with a narrow, smooth, edentate septum and a prominent, similarly shaped apertural tooth. The size and general shape of the shell are also similar although *T. dutemplei* has a more prominent spire; the colour pattern of *T. dutemplei* is variable but often resembles that of *T. globosus*. However the outer surface of *T. dutemplei* is smooth and completely lacks the spiral ridges of *T. globosus*.

Range and distribution: The exact provenance of the holotype is uncertain. The only other known specimen, the neotype, is from the Barton Group at Highcliff, Hampshire; probably bed A3 of Burton (1933).

Subgenus *PICTONERITINA* Iredale 1936

Type species, by original designation, *Neritina oualaniensis* Lesson, 1831. Recent, in estuaries and brackish lagoons, Indo-Pacific.

Diagnosis: The shell is small and smooth. The septum is weakly arched with one large and several small teeth.

Remarks: The only description given by Iredale is that “the columellar dentition is very irregular and obscure and the painting consists of streaks” (Iredale, 1936: 288). Iredale mentioned Baker’s inclusion of *Theodoxus oualaniensis* in his section *Vittoclithon* but observed that Baker himself had remarked upon the notable differences between the radula of *T. oualaniensis* and that of other species in this section. (Baker 1923: 156).

In the absence of a more detailed description by Iredale the above diagnosis has been taken from that given by Keen in Knight *et al.* (1960: 1285). In the type species the large tooth is about a third of the distance from the apical end of

the septum with up to 5 small teeth abapical to it. The shell is glossy and the colour patterns are very variable.

Any revision of the classification of the Neritidae is beyond the scope of this paper and I have simply followed that given by Keen in Knight *et al.* (1960) which in turn is followed, as far as the taxa in this paper are concerned, by Vaught (1989: 13). However I would just mention that Pace considered *Pictoneritina* to be an unnecessary taxon and followed Baker’s classification (Baker, 1923), leaving *T. oualaniensis* in subgenus *Vittoclithon* (Pace, 1973: 22). Also, in showing *Pictoneritina* as a subgenus of *Theodoxus*, Keen has apparently disregarded Andrews’ work. Whilst Baker’s classification was based almost entirely on the characteristics of the radula, Andrews’ work involved the study of the reproductive organs (Andrews, 1973a & b). Andrews identified anatomical differences between *Clithon* and *Theodoxus* which were considered sufficient by Pace to justify treating them as separate genera (Pace, 1973: 13); *Pictoneritina* would then become a subgenus of *Clithon*. This classification has been adopted by a number of prominent workers on recent freshwater mollusca; for examples see Benthem Jutting (1956: 271), Starmühlner (1976: 478) and Brown (1994: 43).

Theodoxus (Pictoneritina) passyanus (Deshayes 1864)

Pl. 1, figs 6-8, pl. 2, figs 9-14.

Neritina concava J. de C. Sowerby, 1823: (in part) 4: 118, pl. 385, fig. 2 only.

Neritina Passyana Deshayes, 1864: 3:24, pl 65, figs 11-13.

Neritina Passyi, Desh. Cossmann, 1888: 92.

Neritina Passyi, Desh. Cossmann & Pissarro 1910-1913 2 (1) pl. 6, fig. 39-12.

Neritina Passyana Desh. Cossmann 1925: 218, pl. 5, figs 32, 33. pl. 7, figs 20, 24.

Theodoxus cf passyanus (Deshayes); Curry, 1960 : 269.

Theodoxus (Vittoclithon) passyanus Deshayes; Le Renard, J. & Pacaud, J-M. 1995: 90.

Holotype: Location unknown.

Stratum typicum: “Sables moyens”, (Marinesian).

Locus typicus: Not precisely specified, either Montagny near Gisors, Le Fayel or Auvers, France.

Diagnosis: A medium to large *Pictoneritina* with a large tooth on the septum edge and several smaller denticulations abapical to it. The colour pattern is very variable.

Description: Shell medium to large for the genus, globular with a low spire. Whorls up to four in number, rapidly increasing in size, convex but slightly concave just below the suture in most specimens. Surface rather glossy in unworn individuals, smooth in appearance but with a sculpture of numerous, fine, closely spaced, transverse lines. Suture sharp, well defined but shallow.

The colour pattern is very variable: often consisting of dark, wavy lines, which may be very fine and closely spaced or broader and widely spaced, on a whitish background. Sometimes the lines interlace enclosing an irregular network of white spots. Some examples are almost entirely black, others have whitish or light brown splashes, on a darker background; these splashes may almost coalesce to

form two whitish, spiral, bands.

The aperture is oblique and semilunar. The columnellar septum is flat or slightly convex, smooth or with a few faint folds perpendicular to the septum edge. The septum edge is slightly convex in the centre with a prominent tooth at approximately one quarter of the distance from the posterior end and up to four small denticles abapical to it. The dentition is variable with the prominent tooth sometimes much reduced and the small denticles may be faint or even completely absent. However the position of the prominent tooth is always constant and there are never any denticles on the adapical side of it. The outer lip is evenly rounded, rather thin and smooth within. The apertural tooth consists of a narrow ridge at right angles to the septum edge, situated below the abapical end of the septum.

Size: Deshayes stated that this small shell was extremely rare and the largest specimen was 6mm long, 5mm wide and 3.5mm deep (Deshayes, 1864, 3: 24). Since then the species has been found in greater numbers in the Marinesian of the Paris Basin and a few specimens are considerably larger, that shown at Pl. 2, fig. 9 being 10.6mm in height and 9.5mm in width. Some of the specimens from the Barton Group are even larger measuring up to 15mm high and 12mm wide; the largest illustrated here is 14.3mm high and 11.4mm wide (Pl. 2, fig. 10).

Remarks: *Theodoxus passyanus* has been placed by Le Renard & Pacaud (1995: 90) in the subgenus *Vittoclython* Baker, 1923. Unfortunately Baker in defining his section *Vittoclython* of subgenus *Clithon* relied mainly on the radula and did not describe the teeth on the septum (Baker, 1923: 134). Keen in Knight et al (1960: 1285) described this subgenus as: "Small, smooth: inner lip weakly arched, with one tooth." However Baker designated *Neritina meleagris* Lamarck, 1822 as the type species and this species does not have just one tooth on the septum edge but instead four to ten small, irregular teeth (Russell, 1941: 380), which actually matches the illustration (but not the description) of *Vittoclython* in Knight et al (1960: 1281, fig. 183.12). This does not accord with *T. passyanus*, the principal feature of its dentition being one large tooth and several small ones, but *T. passyanus* does agree with subgenus *Pictoneritina* as described above.

Curry noted the similarity of shape between *T. passyanus* and the species from Barton and Highcliff but was uncertain of the identification as the colour pattern of the English material differed considerably from a series of *T. passyanus* in his collection from Le Quoniam (Val d'Oise, France), (Curry, 1960: 269). Deshayes himself described various colour patterns: sometimes blackish brown, marked with

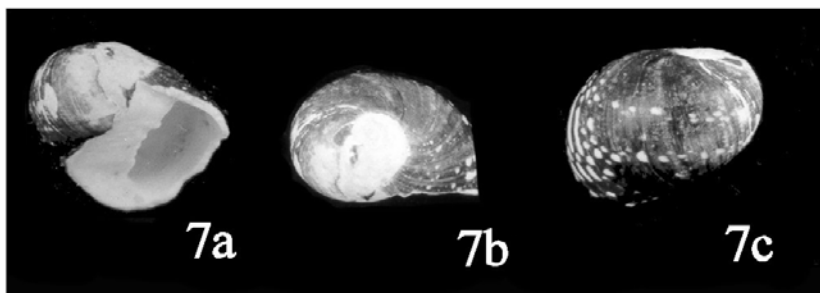
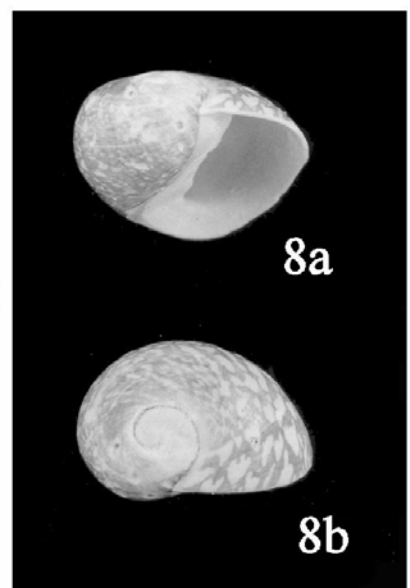
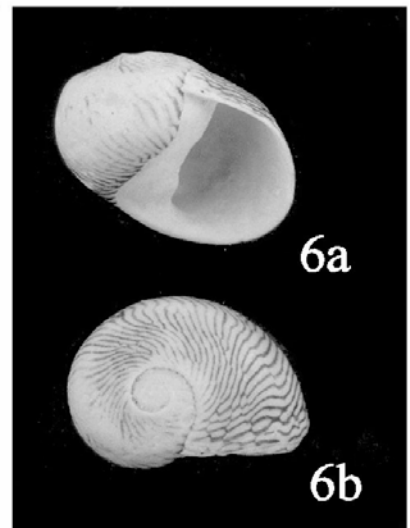
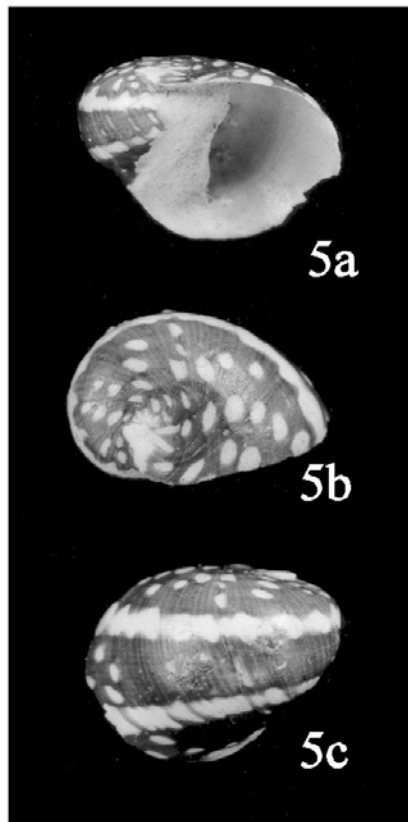
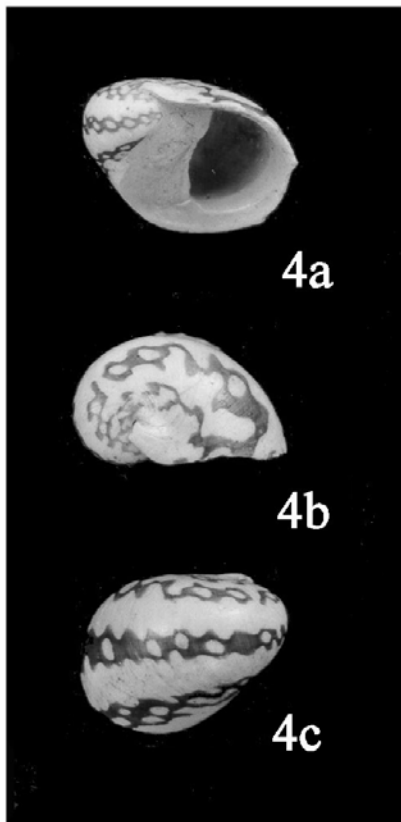
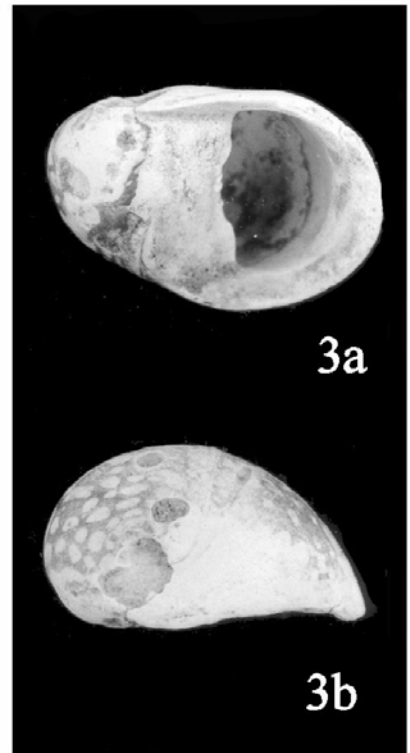
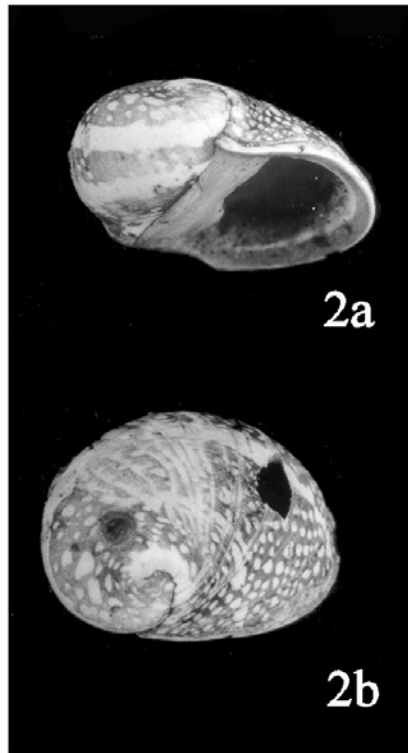
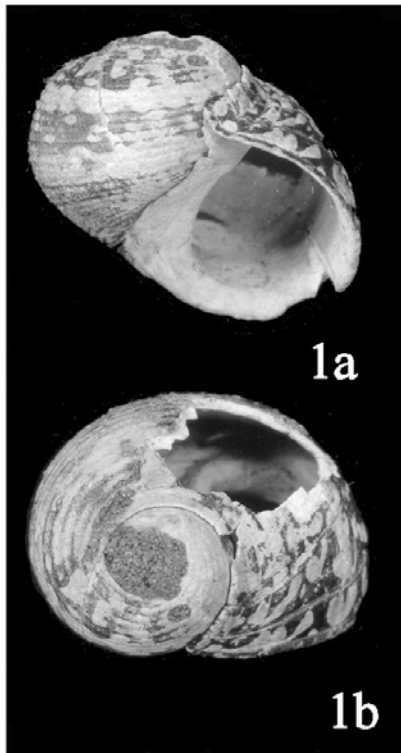
little white splashes, sometimes decorated with an irregular network formed by the interconnection of fine, transverse, lines of dark blackish brown on a fairly white background (Deshayes, 1864: 3: 24). I have examined some 120 specimens of *T. passyanus* from the Marinesian of Le Quoniam (Coll. J-M. Pacaud Lot no. P72956) as well as material from the Marinesian of: Le Ruel, Val d'Oise (Coll. J-M. Pacaud Lot no. P72954), Cresnes, Oise (Coll. J-M. Pacaud Lot no. P70438), Chars, Oise (Coll. J-M. Pacaud Lot no. P72957), Chavençon, Oise (Coll. J-M. Pacaud Lot no. P72955) and from the Auversian of Le Guépelle, Val d'Oise (Coll. J-M. Pacaud Lot no. P62952) and Hadancourt-le-haut-Clocher, Oise (Coll. J-M. Pacaud Lot no. P62953). The majority of the specimens which have the colour pattern preserved have wavy dark lines on a light background, unlike most of the English material. Some specimens from Le Quoniam and from Cresnes, however, have the same colour pattern of white splashes on a dark brown background as the majority of the English specimens, (see Pl. 2, fig 9 for a good example). A single specimen from bed E and another from bed F of Burton (1933) have light brown spots on a dark brown background but none exhibits the pattern of fine, wavy lines common amongst the specimens from the Paris Basin.

T. passyanus also occurs in the Hungarian Eocene along with several similar species. *Theodoxus csolnokensis* Bartha, 1963, from the Middle Eocene, was described as being close to *T. passyanus* in form but different in ornamentation with bold, dark, transverse stripes (Bartha & Kecskeméti-Körmeny, 1963: 465). However dark, transverse lines are characteristic of *T. passyanus* from the Paris Basin and the thicker lines on *T. csolnokensis* could be just an extreme example of typical *T. passyanus* ornamentation. *Neritina lutea* Zittel, 1862, from Dudar in Hungary, is also very similar to *T. passyanus* but differs in the distinctive spiral banding, which is more pronounced than in those examples of *T. passyanus* which have spiral lines of white dots, and in having more teeth on the septum edge than *T. passyanus* (Oppenheim, 1892: Pl. 31, figs 13a, 13b). Finally *Neritina dudariensis* Strausz, 1966, from the Lutetian of Dudar, also resembles *T. passyanus* (Strausz, 1966: Pl. 4, figs 6-8) but differs, according to Kecskeméti-Körmeny, in having a higher spire and only minute teeth on the septum edge (Kecskeméti-Körmeny, 1972: 219).

Ecology: Most of the largest English specimens from the Barton Group have a more or less pitted surface to the spire consistent with living in soft, fresh water which leaches calcium carbonate. This is not the case with the material from the Paris Basin, where many specimens are worn but not pitted. On the other hand some English specimens show repaired damage to the outer lip consistent with failed

Plate 1.

1. *Theodoxus globosus*, neotype, a. apertural, b. apical views, x2.5. Barton Clay Formation. BMNH GG22558 (A.G.Davis coll.)
2. *Nerita bartonensis*, holotype, a. apertural, b. apical views, x4. Barton Clay Formation. BMNH 73209 (F. E. Edwards coll.)
3. *Nerita bartonensis*, a. apertural, b. apical views, x5. Barton Clay Formation. BMNH GG22556 (H. Eliot Walton coll.)
4. *Nerita bartonensis*, juvenile, a. apertural, b. apical, c. abapertural views, x6. Barton Clay Formation. BMNH 3414.
5. *Nerita bartonensis*, juvenile, a. apertural, b. apical, c. abapertural views, x6. Barton Clay Formation. BMNH 3414.
6. *Theodoxus (Pictoneritina) passyanus*, a. apertural, b. apical views, x5. Le Quoniam. MNHN-LP R63016 (coll. J-M. Pacaud)
7. *Theodoxus (Pictoneritina) passyanus*, a. apertural, b. apical, c. abapertural views, x5. Le Quoniam. MNHN-LP R63017 (coll. J-M. Pacaud)
8. *Theodoxus (Pictoneritina) passyanus*, a. apertural, b. apical views, x5. Le Quoniam. MNHN-LP R63018 (coll. J-M. Pacaud)



attacks by a durophagous predator (for examples see Pl. 2, figs 10b, 11b & 13b), which is more typical of salt water. (Paul Jeffery, pers. comm.).

Range and distribution: The Barton Group, Hampshire; mostly from the lower beds at Highcliff. Those precisely recorded are from beds A3, E and F of Burton (1933). A single, small, juvenile specimen of *T. passyanus* was found by Jon Todd at Studley Wood in unit SW1 of the Studley Wood Member of the Selsey Formation and I believe this to be the only record of this species occurring in England outside the Barton Group. In France it is found in the Marinesian and the Auversian of the Paris Basin. In Hungary it occurs in the Middle Eocene of the Dorog Basin.

Theodoxus (Pictoneritina) passyanus denslatus subsp. nov.

Pl. 3, figs 15-17

Derivatio nominis: Latin “broad tooth”; a reference to the broad projection on the septum edge described below.

Holotype: BMNH 72306 (F.E. Edwards coll.), (Pl. 3, fig. 15).

Stratum typicum: : “Lower Barton Beds”; Barton Clay Formation, from the condition and matrix, probably Bed A3 of Burton (1933).

Locus typicus: Highcliff, Hampshire.

Paratypes: BMNH 72306 (F.E. Edwards coll.), (Pl. 3, fig. 16); BMNH 72306 (F.E. Edwards coll.), (Pl. 3, fig. 17).

Diagnosis: A distinctive subspecies in which the prominent tooth of the typical *T. passyanus* is extended apically to form a single broad projection occupying the apical quartile of the septum edge.

Description: A rather small shell, the largest in the BMNH collection being a little over 7mm in height and 6mm in width. The general shape and colour pattern are as in typical *T. passyanus* from the Barton Group. The form is characterised by the broad tooth occupying the upper quartile of the septum edge and separated from the outer lip by a shallow gutter. Apically the broad tooth is followed by another narrow gutter after which the septum edge may be smooth or occasionally may bear one or two very slight teeth. The septum callus is virtually flush with surface of the adjoining whorl and appears to have been etched into it; this results in the septum surface being flat or slightly concave unlike the convex surface of the typical *T. passyanus*.

Size: Height 7.3mm, width 5.5mm (holotype).

Discussion: This form is almost as frequent in the BMNH collection as the typical *T. passyanus* but I have not found it in the collections from the Paris Basin which I have examined. The features described above, in my view, merit description as a subspecies but are not, in themselves, sufficient to justify allocation to a higher rank. However comparison of opercula, if ever found, might show this to be a separate species or even genus.

Range and distribution: Apparently restricted to the Barton Group in the Hampshire Basin. Those specimens with more detailed provenance are from bed A3 of Burton (1933) or from the “lower Barton beds at Highcliff”.

Theodoxus (Pictoneritina) waltoni sp. nov.

Pl. 3, figs 18-19

Derivatio nominis: Named after H. Eliot Walton from whose collection the holotype is derived.

Holotype: BMNH GG22554 (H. Eliot Walton coll.), (Pl. 3, fig. 18).

Stratum typicum: Barton Clay Formation, possibly, from the state of preservation, Bed A3 of Burton (1933).

Locus typicus: Highcliff, Hampshire.

Paratype: BMNH GG22553 (C. D. Drake coll.), (Labelled “Beds B-D”), (Pl. 3, fig. 19).

Diagnosis: A medium sized, rather high spired *Pictoneritina* with a large tooth on the septum edge and several smaller teeth on each side of it. The colour pattern consists of narrow, closely spaced, wavy lines broken by two or three white, spiral bands.

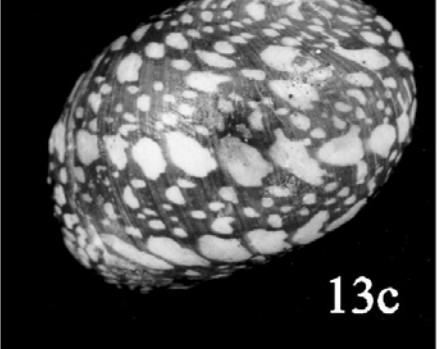
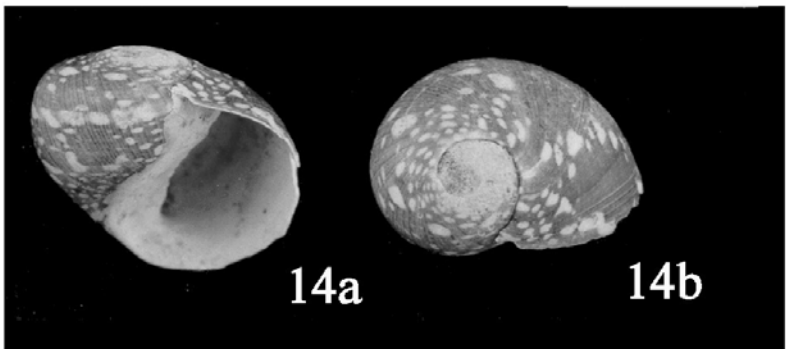
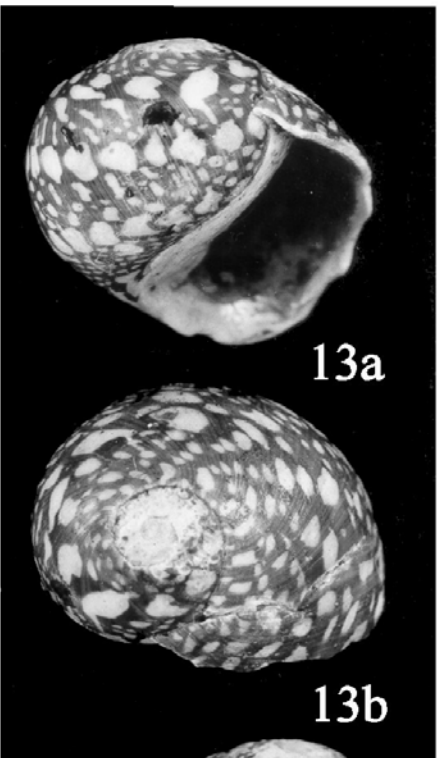
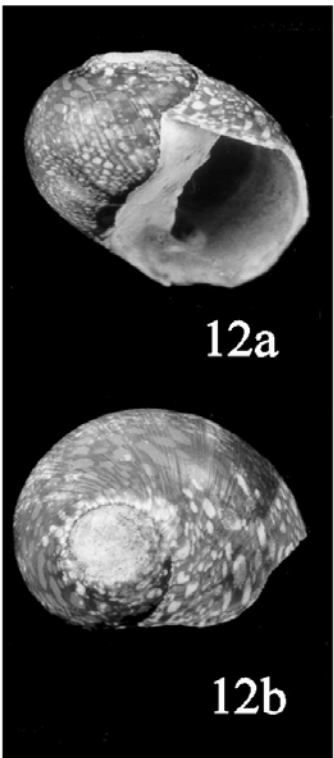
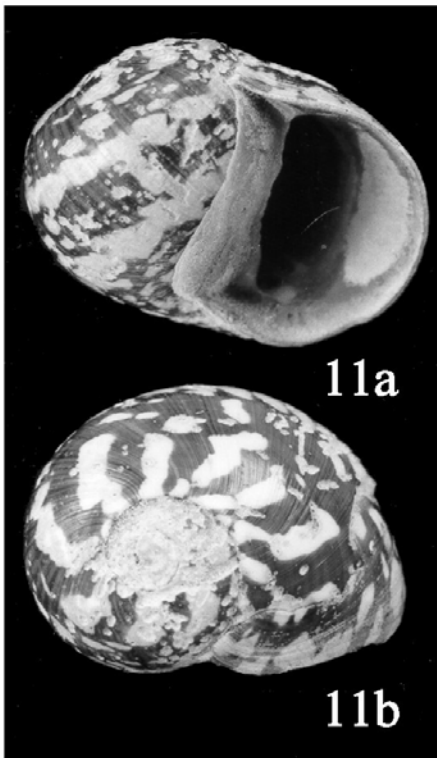
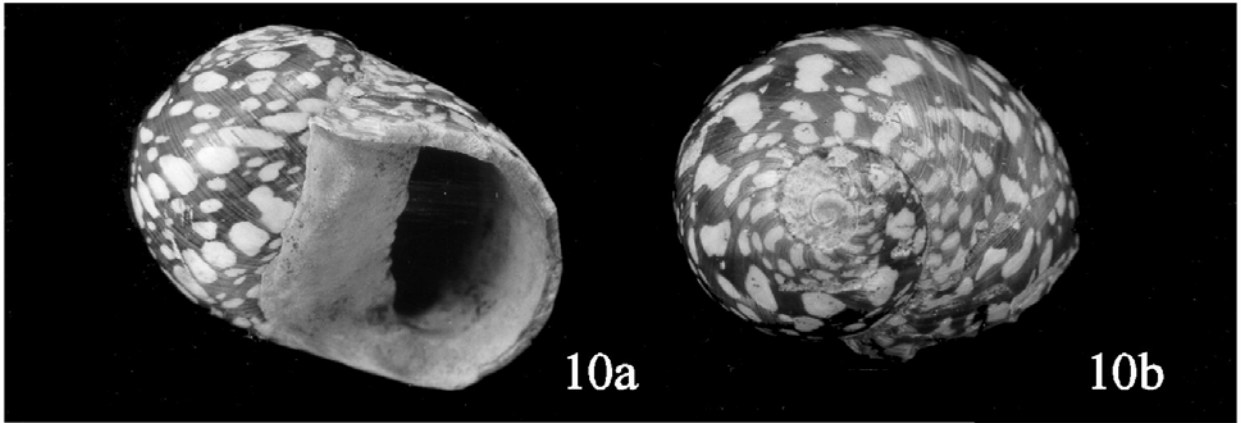
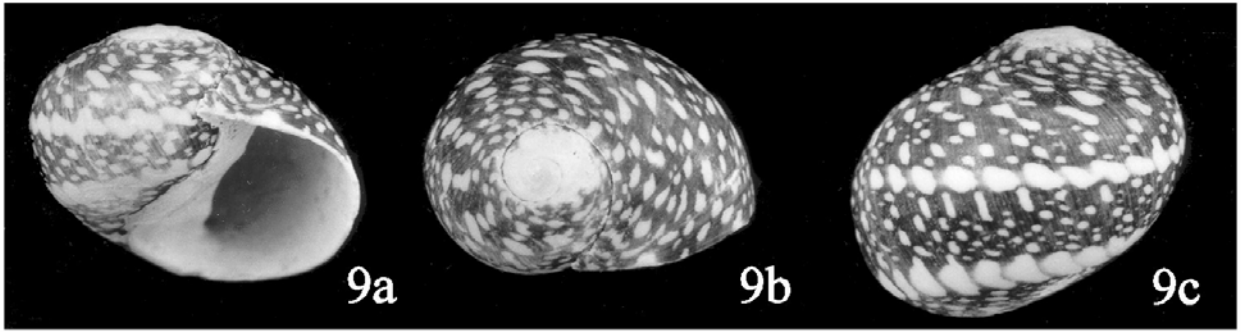
Description: The shell is of medium size for the subgenus, ovate, with a prominent spire the apex of which has been eroded in the only known specimens. The external surface is glossy and smooth, except for faint growth lines; the whorls are convex becoming distinctly concave immediately below the suture. The suture is well defined but shallow.

The colour pattern consists of fine, close, wavy, dark lines on a whitish background, the lines sometimes merging in places to form a fine network of white spots on a dark background; with two or three white, evenly spaced, spiral bands.

The aperture is very oblique and semilunar. The columnar septum surface is slightly convex with

Plate 2.

9. *Theodoxus (Pictoneritina) passyanus*, a. apertural, b. apical, c. abapertural views, x4. Le Quoniam. MNHN-LP R63019 (coll. J-M. Picaud)
10. *Theodoxus (Pictoneritina) passyanus*, a. apertural, b. apical views, x4. Barton Clay Formation. BMNH GG22560 (J. C. Daniels coll.)
11. *Theodoxus (Pictoneritina) passyanus*, a. apertural, b. apical views, x4. Barton Clay Formation, A3. BMNH GG22557 (M. J. Hoare coll.)
12. *Theodoxus (Pictoneritina) passyanus*, a. apertural, b. apical views, x4. Barton Clay Formation, F. BMNH GG22559 (Paul Jeffery coll.)
13. *Theodoxus (Pictoneritina) passyanus*, a. apertural, b. apical, c. abapertural views, x4. Barton Clay Formation. BMNH GG22561 (E. St John Burton coll.)
14. *Theodoxus (Pictoneritina) passyanus*, a. apertural, b. apical views, x5. Barton Clay Formation. BMNH GG22555 (H. Eliot Walton coll.).



prominent, curved, parietal folds in the central area. The septum edge is slightly concave with a prominent tooth at about a quarter of the distance from the apical end, two or three smaller but clearly defined teeth adapical to it and three to five similar size teeth abapical to it, of the latter some may be bifurcate. The outer lip is rounded, rather thin and smooth within. The apertural tooth, situated below the abapical end of the septum, is in the form of a ridge describing a parabola with the open end facing the aperture and the adapical side longer than the other.

Size: Holotype, height 7.8mm, width 6.1mm. Paratype, height 11mm, width 8.1mm.

Remarks: This species is unlike any other of the Neritidae from the Barton Group or the Marinesian of the Paris Basin. There is considerable similarity in the shape of the shell and the colour pattern to large specimens of the Palaeocene species *Theodoxus pisiformis* (Férussac, 1823). However *T. pisiformis*, as well as being smaller, has less pronounced septum teeth and lacks the prominent parietal folds of *T. waltoni*.

Range and distribution: Barton Clay Formation of Highcliff, Hampshire. The holotype possibly from bed A3 of Burton (1933) and the paratype from a higher level between beds B to D inclusive, according to its label.

DOUBTFUL SPECIES

Theodoxus planulatus (Edwards 1866)

A tube of mainly *Theodoxus passyanus* (BMNH 72306 F. E. Edwards coll.) contains two specimens of *Theodoxus planulatus*. This species is common in the Hatherwood Limestone Member of the Headon Hill Formation where molluscs are usually exceptionally well preserved. The state of preservation of the two specimens of *T. planulatus* is entirely consistent with material from the Hatherwood Limestone and I think it is likely they were indeed from there and were wrongly included with *Theodoxus* from the Barton Group.

Theodoxus concavus (J. de C. Sowerby 1823)

A tube labelled "Highcliff" (BMNH - A. G. Davis coll.) contains four specimens each of which is *Theodoxus concavus*. The matrix in the aperture of one specimen and the preservation of each is reminiscent of the Lower Neritina Bed in the Colwell Bay Member where this species is abundant. I believe the tube has been wrongly labelled and that these specimens are from the Colwell Bay Member of the Headon Hill Formation. A further two specimens labelled "Barton, Hants" (BMNH - H. Eliot Walton coll.), although damaged, also show preservation more in keeping with the Colwell Bay Member than the Barton Clay Formation. A worn specimen of *T. concavus*, according to

the label, from bed A3 (BMNH - C. D. Drake coll.), does look from its state of preservation as though it could have come from this bed but the matrix in the aperture is unlike typical bed A3. I am not convinced that this species occurs in the Barton Group; if it does it is obviously extremely rare.

Theodoxus apertus (J. de C. Sowerby 1823)

There is a single specimen of this species in a tube of *T. passyanus* (BMNH 72306 F. E. Edwards coll.) labelled "Lower Barton, Highcliff". Although it is slightly worn, the preservation of this specimen is similar to those from the Colwell Bay Member of the Headon Hill Formation in the Isle of Wight where this species is common. I think it probable that this single specimen came from the Colwell Bay Member and was inadvertently mixed with material from the Barton Group.

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I am grateful to the Natural History Museum, London for access to the collections of *Neritidae*, both fossil and recent, and for the provision of facilities to study them. All the figures in this paper are photographs taken by the Natural History Museum's Photographic Unit. I am also grateful to the Muséum National d'Histoire Naturelle, Paris for allowing me to inspect the collections of *Neritidae*, and especially to Didier Merle for his assistance and to Jean-Michel Pacaud for the loan of specimens of *T. passyanus*. Steve Tracey, Jon Todd and John Cooper have each contributed advice and helpful comments and especial thanks are due to Paul Jeffery for continuing help and encouragement throughout my research.

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Plate 3.

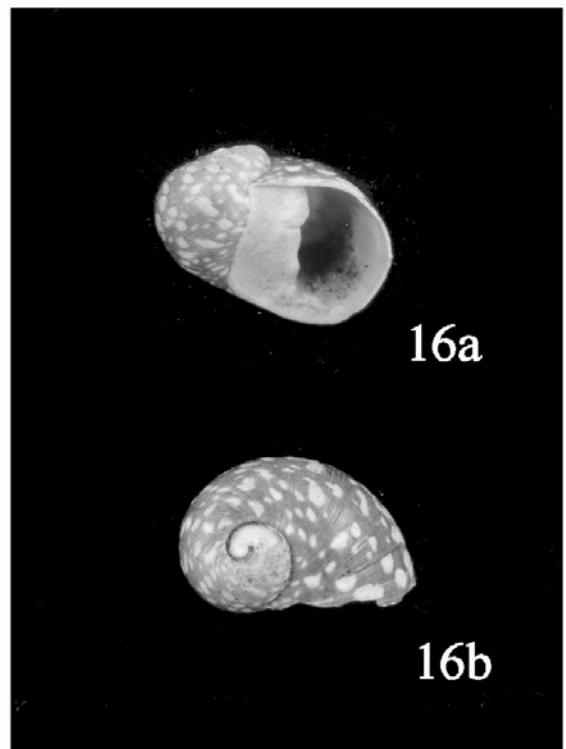
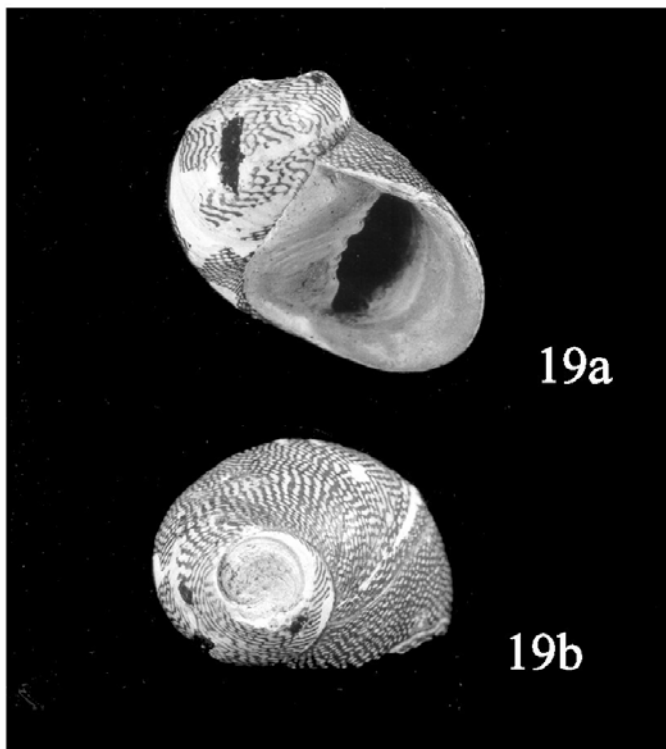
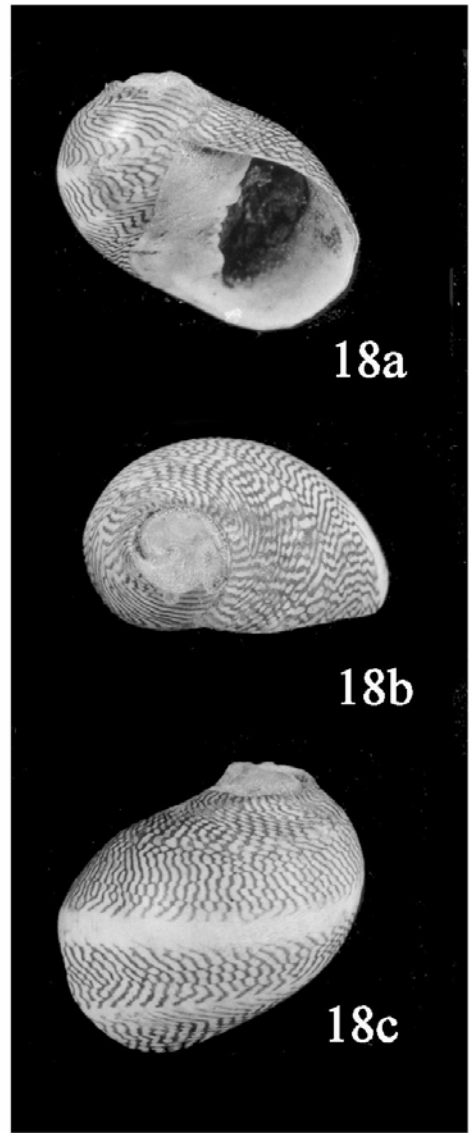
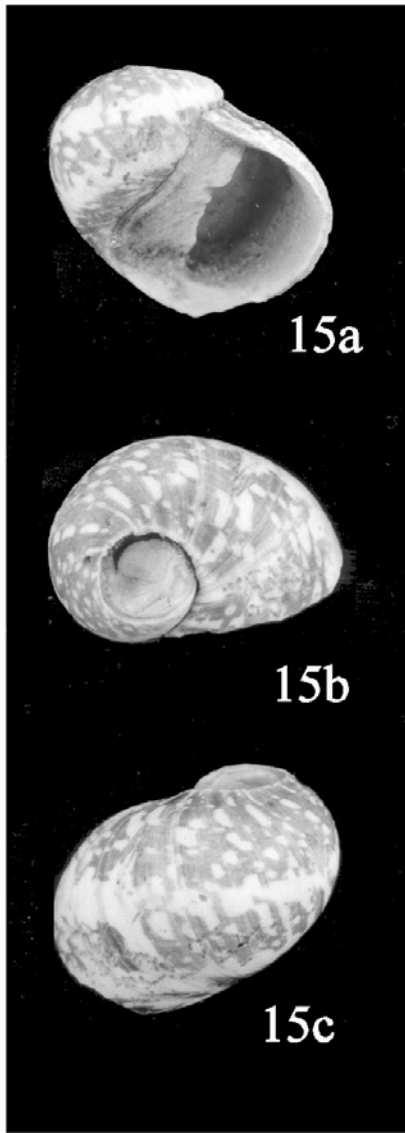
15. *Theodoxus (Pictoneritina) passyanus denslatus*, holotype, a. apertural, b. apical, c. abapertural views, x5. Barton Clay Formation. BMNH 72306 (F. E. Edwards coll.).

16. *Theodoxus (Pictoneritina) passyanus denslatus*, a. apertural, b. apical views, x5. Barton Clay Formation. BMNH 72306 (F. E. Edwards coll.).

17. *Theodoxus (Pictoneritina) passyanus denslatus*, a. apertural, b. apical, c. abapertural views, x6. Barton Clay Formation. BMNH 72306 (F. E. Edwards coll.).

18. *Theodoxus (Pictoneritina) waltoni*, holotype, a. apertural, b. apical, c. abapertural views, x4. Barton Clay Formation. BMNH GG22554 (H. Eliot Walton coll.).

19. *Theodoxus (Pictoneritina) waltoni*, a. apertural, b. apical views, x4. Barton Clay Formation. BMNH GG22553 (C. D. Drake coll.).



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This paper was written and submitted in 2000 and does not take into account the classification proposed by Bandel in 2001. (**BANDEL, K. 2001.** The history of *Theodoxus* and *Neritina* connected with description and systematic evaluation of related Neritimorpha (Gastropoda). *Mitteilungen aus dem Geologisch-Paläontologischen Institut der Universität Hamburg*, **85**: 65-164)