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Notes on the systematics, morphology and biostratigraphy of fossil holoplanktonic Mollusca, 19[1]. Pteropods (Gastropoda, Euthecosomata) from the Eocene Lillebaelt Clay Formation (Denmark, Jylland)

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Sideritic fossiliferous concretions from the Eocene Lillebaelt Clay Formation, collected ex situ on the beach at Trelde Næs (Jutland, Denmark) were found to yield two common pteropod species: *Heliconoides lillebaeltensis* spec. nov. and *H. mercinensis* (Watelet & Lefèvre, 1885), the latter known to date from a Late Palaeocene-Ypresian interval. A single further specimen might represent the species *Limacina pygmaea* (Lamarck, 1805), known only from the Lutetian. A study of the dinoflagellate assemblages in six of the concretions allowed an age assignment of Early Lutetian.

Key words: Gastropoda, Euthecosomata, *Heliconoides*, *Limacina*, taxonomy, dinoflagellates, biostratigraphy, Eocene, Lutetian, Denmark.

INTRODUCTION (K.I. Schnetler)

At Trelde Næs peninsula, North of Fredericia (Jutland, Denmark), Eocene fossil bearing sideritic concretions and pyritic moulds of fossils are found on the beaches, washed out of clays cropping out in coastal cliffs. In practically all concretions molluscs are poorly preserved, as the original aragonitic shell material is dissolved, leaving internal and external moulds allowing casting with silicone latex. Quite a number of them yielded pteropods, among which is an undescribed species.

Material has been collected since the 1960s (Bonde, 1968). A study of the benthic molluscs is forthcoming (Schnetler & Heilmann-Clausen, in prep.). Since the 1990s many concretions containing limacinid pteropod species were collected by two Danish private collectors, which are described here.

The following abbreviations are used: BMNH, The Natural History Museum, London, England; OB, colln O. Barsøe Hansen, Kolding, Denmark; ISL, colln K.I. Schnetler, Langå,

[1] For nr 18 in this series see Basteria 70: 85.

Denmark; MGUH, Geological Museum, Copenhagen, Denmark; MM, colln Mogens Madsen, Fredericia, Denmark; RGM, Nationaal Natuurhistorisch Museum *Naturalis* (Palaeontology Department) (formerly Rijksmuseum van Geologie en Mineralogie), Leiden, The Netherlands.

LOCALITY (K.I. Schnetler) (fig. 1)

The fossil bearing concretions originate from the southern coast of the Trelde Næs peninsula (fig. 1). Eocene sediments are present, underlying Quaternary deposits, throughout the country in NW-SE direction, connected with deposits of the same age in northern Germany (fig. 1). The deposits are the Røsnæs Clay, Lillebælt Clay and Søvind Marl formations, all of Eocene age. Previously also Late Oligocene sediments (Brejning Clay, Vejle Fjord Formation) were cropping out in the southern part of the cliff, near Kirstinebjerg Skov (Schnetler, 1985). The occurrence is now considered glacially transported.

As the concretions generally are found ex situ on the beach, it is difficult to refer them to one particular bed. Collins & Jakobsen (2003) thus considered a decapod fauna from the concretions to be of Ypresian/Lutetian age. In a number of concretions *Heliconoides* specimens were found co-occurring with decapods (Mogens Madsen, pers. comm., 2007, and observations by the second author). The concretions with *Heliconoides* species, as specified in the systematic part below, contained in only two cases other molluscs (*Volutocorbis* spec. and *Cuspidaria* spec.) and furthermore, the two *Heliconoides* species have been found together in just a few cases. The palaeodepth was estimated to be over 200 m (Heilmann-Clausen, 1995).

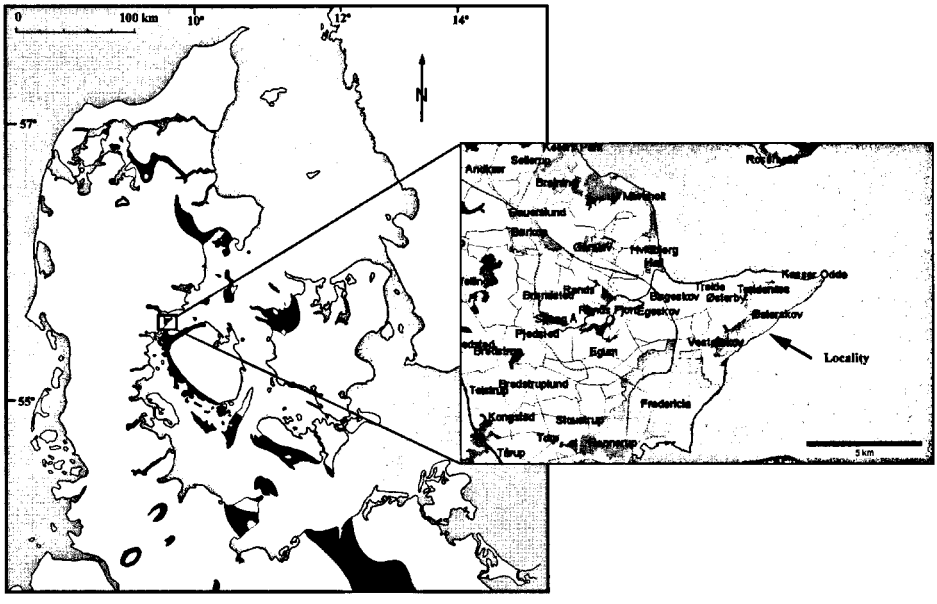


Fig. 1. Map showing the distribution of the Eocene deposits (in black), with location map of Trelde Næs (after Gravesen, 1993, and Collins & Jakobsen, 2003).

STRATIGRAPHY (C. Heilmann-Clausen) (fig. 2)

Provenance of the concretions. – The cliffs expose glacially disturbed beds from most of the Eocene Lillebælt Clay Formation, i.e., the Beds L2-L6 (Heilmann-Clausen et al., 1985) (fig. 2). On the opposite coast of Trelde Næs the lower part of the overlying Eocene

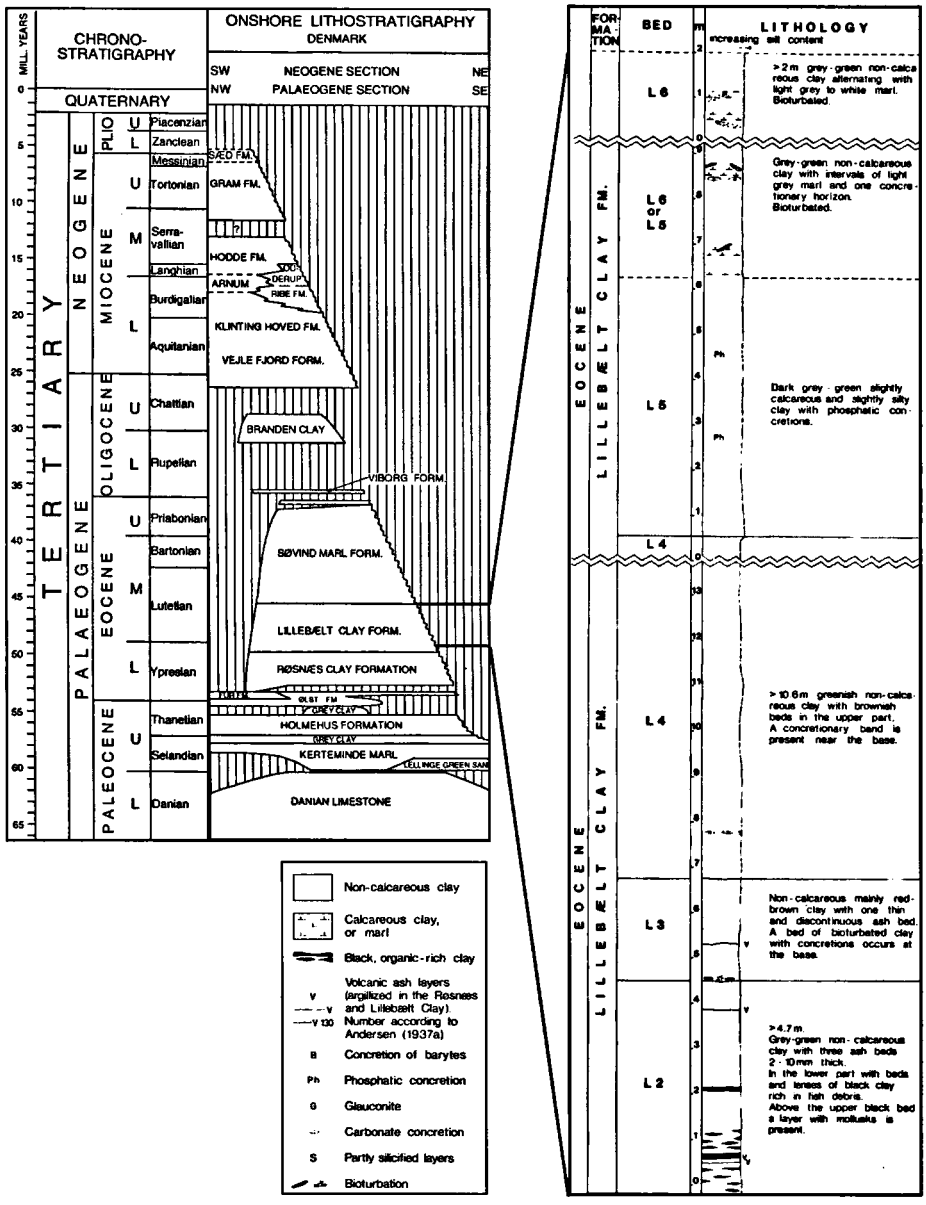


Fig. 2. Composite stratigraphic section of Lillebælt Clay Formation (right-hand column) at Trelde Næs (after Heilmann-Clausen et al., 1985, and Michelsen et al., 1998).

Søvind Marl Formation is exposed. The strata in the cliffs of Trelde Næs are very rich in dinoflagellate cysts, originally described in an unpublished master's thesis (Heilmann-Clausen, 1978). A subsequent study of the entire Danish Eocene led to a dinoflagellate zonation, partially with a first order calibration to the calcareous nannofossil zonation (Heilmann-Clausen, 1988). Finally, a detailed stratigraphic-systematic study of the dinoflagellate succession in a cored section of the Lutetian-basal Rupelian of Denmark is provided by Heilmann-Clausen & van Simaeys (2005).

For the present study dinoflagellate cysts have been examined from c. 12 g samples of two concretions, OB 1203 with *Heliconoides lillebaeltensis* spec. nov. and OB 689 with *Heliconoides mercinensis*. The carbonate of the concretions was dissolved with cold 5N HCl and after dilution with water the residues were sieved on 20 micron nylon filters. The sieved residues mainly consist of dinoflagellate cysts and were mounted in glycerine-jelly on slides for light-microscopy. Several thousand well preserved cysts were recovered from each sample.

Sample OB 1203 contains a rather typical assemblage of the *Wetzeliella articulata-ovalis* Zone of Heilmann-Clausen (1988), with 7% *Cleistosphaeridium diversispinosum* (formerly identified as *Systematophora placacantha*, see Heilmann-Clausen & van Simaeys, 2005), and 6% *Areosphaeridium diktyoplokum-michoudii* group. *Wetzeliella articulata-ovalis* is also common (4%). *Dracodinium samlandicum* and *Hystrichosphaeropsis costae* (= *H.* cf. *ovum* of Heilmann-Clausen, 1988) were not observed, probably excluding the lower part of the zone, which is also supported by the moderate abundance of *Cleistosphaeridium diversispinosum*. The assemblage clearly points to Bed L5 of the Lillebælt Clay Formation (Heilmann-Clausen, 1988).

Sample OB 689 contains an assemblage generally similar to that of sample OB 1203, except for the presence of *Wilsonidium echinosuturatum* and the absence of *Wetzeliella articulata-ovalis*. *Cleistosphaeridium diversispinosum* accounts for 9% of the assemblage. The absence of markers of older and younger zones (*Dracodinium pachydermum, Eatonicysta ursulae* and *Phthanoperidinium regalis*) clearly refers this assemblage to the *Wetzeliella articulata-ovalis* Zone. *W. echinosuturatum* has previously been recorded in the overlying *P. regalis* Zone (new name for the *P. geminatum* Zone of Heilmann-Clausen, 1988, see Heilmann-Clausen & van Simaeys, 2005) and may well occur sporadically in the upper part of the *W. articulata-ovalis* Zone as well. The sample probably originates from a level above sample OB 1203, and may lithostratigraphically be derived from Bed L5, or possibly Bed L6, of the Lillebælt Clay Formation.

Age of the concretions, based on dinoflagellate assemblages. – The base of the *Phthanoperidinium regalis* Zone in Denmark is probably near the base of the NP15 Zone, although previous nannofossil identifications correlated this level with NP14, see Heilmann-Clausen & van Simaeys (2005: 194). The *Wetzeliella articulata-ovalis* Zone with the two concretions can be correlated with the upper part of NP14 or lowermost part of NP15. The Ypresian-Lutetian boundary, as currently used, is in lower NP14, at a clearly older level than the *Wetzeliella articulata-ovalis* Zone. In conclusion, the concretions can be referred to the Early Lutetian, as currently defined (Luterbacher et al., 2004).

Note added in proof. – Four additional concretions with *Heliconoides* have been analysed for dinoflagellates; one concretion (2001/57) included both *H. lillebaeltensis* and *H. mercinensis*, and three concretions (2001/59, OB 932 and OB 982) contained *H. mercinensis*. The dinoflagellate assemblages are similar to those in the already studied concretions and compare to the higher part of the *W. articulata-ovalis* Zone. The concretions are therefore most probably washed out of Bed L5 (one of them, OB 982 with *W. echinosuturatum*, might come from Bed L6).

The additional concretions corroborate the upper Lillebælt Clay provenance and Early Lutetian age of the entire studied material from Trelde Næs.

SYSTEMATIC PART (A.W. Janssen)

The concretions containing (among other specimens) the holotype and the illustrated specimens, as well as almost all concretions collected by MM are housed in MGUH, five concretions (leg./don. MM), are in colln ISL, one concretion (leg./don. MM) is in colln RGM, all other concretions are in the OB private collection. Silicone casts of all specimens referred to are furthermore in colln ISL and RGM.

Family Limacinidae Gray, 1847

Heliconoides d'Orbigny, 1836

Type species – *Heliconoides inflata* (d'Orbigny, 1836), by subsequent designation (Herrmannsen, 1846) (Recent).

Heliconoides lillebaeltensis spec. nov. (figs 3-8, 12-13)

Holotype. – Figs 3 and 13, external mould of specimen in sideritic concretion nr OB 229, leg. O. Barsøe Hansen (Kolding, Denmark), 2004, colln MGUH 28735; silicone latex casts in colln ISL and RGM 541.508. The same concretion contains 13 further specimens (paratypes), three of which illustrated (figs 4-6).

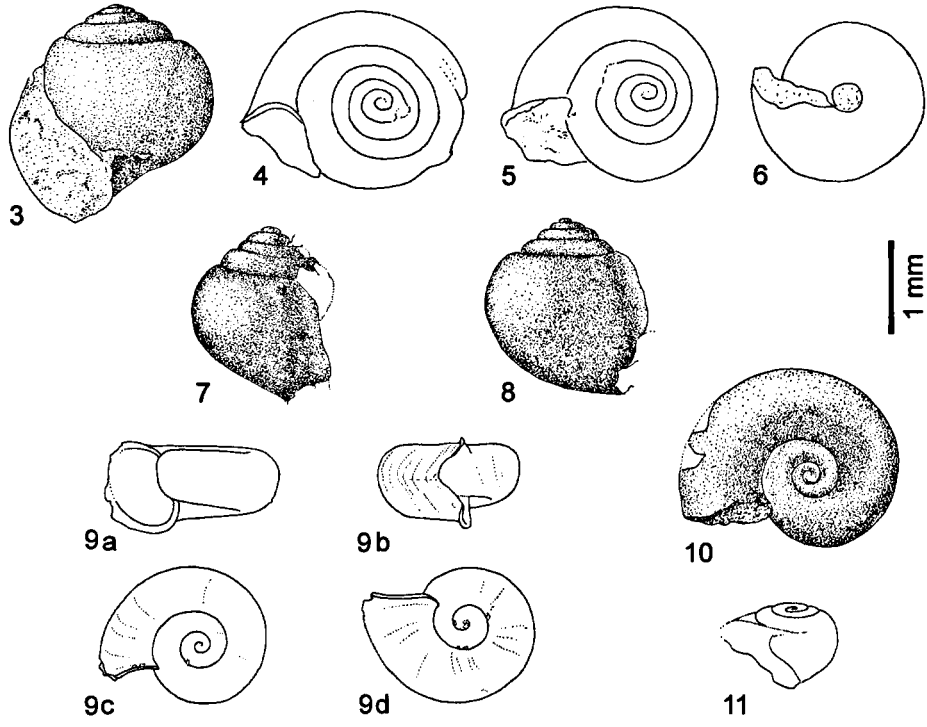
Locus typicus. – Trelde Næs, North of Fredericia, Jylland, Denmark, collected ex situ on foreshore.

Stratum typicum. – Lillebælt Clay Formation (Eocene).

Derivatio nominis. – The species is named after the Lillebælt sound, which gave its name to the Lillebælt Clay Formation, from which the present material originates.

Description. – Shell small (holotype: H 2.1 mm, W 2.2 mm), sinistral, rounded conical, slightly wider than high to slightly higher than wide, with about 5 whorls, attaching above the periphery of the foregoing whorl. The whorls increase slowly and gradually in diameter. The body whorl occupies c. 90% of the total shell height. The base of the shell is rounded, umbilicated; umbilicus approximately one fifth of body whorl diameter (fig. 4). The aperture is obliquely droplet-shaped, pointed above and rounded below, higher than wide, its height c. three quarters of the total shell height. The apertural margin is reinforced externally (not visible in the holotype, but observed in several paratypes, figs 2, 3, 5, 6) by a narrow ridge or margin-parallel fold that in some specimens seems to be slightly sigmoid. Columella invisible in all available specimens. Variability seems to be restricted to a slightly higher or lower spira.

Paratypes. – All specimens from the type locality: four concretions with 11 specimens, leg. M. Madsen, 2000-2006, colln MGUH, silicone casts in ISL 2007.1-3, 2007.5, and RGM 541.501-503, RGM 541.505. Four concretions with seven specimens, leg. M. Madsen, 1999, ISL 1999.56-57 and 1999.60-61, silicone casts in ISL and RGM 429.552-553, RGM 429.555-556. One concretion with ten specimens, leg. M. Madsen, 2006 (MM 2006/18), don. 2007, RGM 541.507 (this specimens also contains c. 55 specimens of *Heliconoides mercinensis*). Silicone cast in colln ISL 2007.7. One concretion with the holotype and 13 further speci-



Figs **3-11**. *Heliconoides* and *Limacina* spp. **3-8**, *Heliconoides lillebaeltensis* sp. nov., silicone latex casts of **3**, holotype and **4-6**, paratypes, all in concretion OB 229 (compare figs 12-13), RGM 541.508, original in MGUH 28735; **7**, paratype, silicone latex cast of specimen in OB 881, RGM 541.515, original in MGUH 28736; **8**, paratype, silicone latex cast of specimen in OB 1065, RGM 541.518, original in MGUH 28737, all leg./don. Ole Barsøe Hansen; **9-10**, *Heliconoides mercinensis* (Watelet & Lefèvre, 1885), **9**, BMNH GG 7117, leg. D. Curry; **10**, silicone latex cast of specimen in OB 868, RGM 541.514, original in MGUH 28738; **11**, *Limacina pygmaea* (Lamarck, 1805) ?, silicone latex cast of specimen in OB 1072, RGM 541.519, original in MGUH 28739, leg./don. Ole Barsøe Hansen. Figs 3-8 and 10-11 from Trelde Næs (Jutland, Denmark; Lillebaelt Formation, Early Lutetian), fig. 9 from Aizy-Jouy (Aisne, France; Sables de Cuise, Ypresian).

mens, leg. O. Barsøe Hansen, 2004 (OB 229, colln MGUH 28735), three concretions with c. 55 specimens (OB 577, 675, 851) (holotype and three specimens in OB 229 illustrated figs 3-6); silicone casts in ISL 2007.8-9, 2007.11, 2007.13 and RGM 541.508-509, RGM 541.511, RGM 541.513). Four concretions, with 33 specimens, leg./don. O. Barsøe Hansen, 2007 (OB 868, OB 881, OB 1065, OB 1072), colln MGUH (one specimen in OB 881 and one in OB 1065 illustrated figs 7-8, MGUH 28736-28737); silicone casts in ISL 2007.14-15, 2007.18-19 and RGM 541.514-515, RGM 518-519. Four concretions, with c. 37 specimens, leg. O. Barsøe Hansen, 2007 (OB 931, OB 982, OB 1127, OB 1199, OB 1214). Nrs OB 868, OB 881 and OB 931 also contain specimens of *Heliconoides mercinensis*, nr. OB 1072 also contains the single specimen of *Limacina* ? *pygmaea*; silicone casts in ISL 2007.16-17, 2007.20-21, 2007.23 and RGM 541.516-517, RGM 541.520-522). One concretion with c. 20 specimens, O. Barsøe Hansen, 2007 (OB 1203), silicone casts in ISL 2007.22 and RGM 541.523. From this concretion a sample of c. 12 g was isolated for dinoflagellate cyst study.

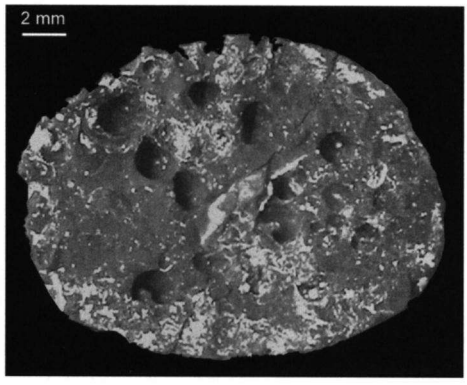


Fig. 12. Concretion OB 229 containing external moulds of the holotype and 13 paratypes of *Heliconoides lillebaeltensis* sp. nov. Coll. MGUH 28735, leg./don. Ole Barsøe Hansen, 2004. Photograph ISL.

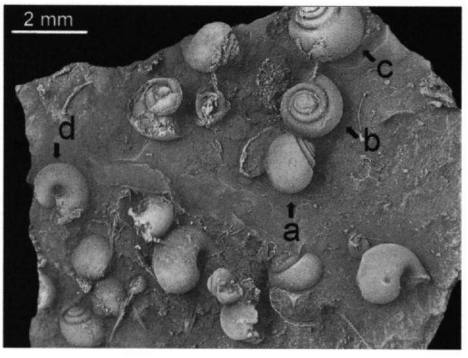


Fig. 13. Silicone latex cast of part of concretion OB 229, RGM 541.508, original concretion (see fig. 12) in MGUH 28735, leg./don. Ole Barsøe Hansen, 2004. Photograph courtesy of Sten Lennart Jakobsen, MGUH; a: holotype (see fig. 3), b-d: paratypes illustrated figs 4-6.

Discussion. – Among the Eocene species described from the North Sea Basin only *Limacina nemoris* Curry, 1965 resembles the present new species. However, that species remains smaller, its spira is more elevated, the aperture is more rounded and there are no apertural reinforcements.

None of the species described from the Ypresian of SW France by Curry (1982) demonstrates similarity with *Heliconoides lillebaeltensis*. From species recorded from the Eocene of the United States by Hodgkinson et al.(1992) only *H. stenzeli* (Garvie, in Hodgkinson et al., 1992) resembles the new species, but it is distinctly more slender, with the whorls attaching at or below the periphery, and its aperture reaches only half the shell height. Also its apertural margin seems to be differently shaped and thickened internally.

Distribution. – *Heliconoides lillebaeltensis* spec. nov. is exclusively known from its type locality.

Heliconoides mercinensis (Watelet & Lefèvre, 1885) (figs 7, 8)

Planorbis ikke ulig *Pl. vortex* men maaske en *Valvatina* – Mørch, 1874: 279.

Spirialis mercinensis Watelet & Lefèvre, 1885: 102, pl. 5 fig. 2a c; Korobkov, 1966: 73, 77, 78.

? *Valvatina mercinensis* Watelet et Lefèvre; Dollfus & Ramond, 1886: 42.

? *Valvatina merciniensis* (*sic*) Wat. et Lef.; Cossmann, 1892: 9; Cossmann, 1896: 93.

Valvatina raphistoma Stolley, 1900: 12, figs 1a-c, 2; Ravn, 1907: 368; Hucke & Voigt, 1967: 99, 104, pl. 45 fig. 1.

Valvatina merciniensis (*sic*) (Wat. et Lef.); Cossmann & Pissarro, 1913, expl. pl. 60, nr. Ptéropodes 2-2.

Solarium or *Homolaxis*, juvenile; Wrigley, 1924: 255 ?

Valvatina spec.; Davis & Elliott, 1951: 337.

Spiratella mercinensis (Watelet et Lefèvre, 1880); Glibert, 1962: 61; Curry, 1965: 366, figs 15a-b, 16; Cooper & Rundle, 1969: 191; Rundle & Cooper, 1970: 116, 118; James, Ward & Cooper, 1974: 55; King & King, 1976: 23; George & Vincent, 1977: 85, 86; Bristow, Ellison & Wood, 1980: 266, fig. 3; King, 1981: 124, 125, 131, figs 44, 45; Bernasconi & Robba, 1982: 213; King, 1984: 142, 143, fig. 10; Cooper, 1984: 8.

? *Valvatina* spec. – Venables, 1963: 262.
Limacina mercinensis (Watelet & Lefèvre, 1885); Janssen & King, 1988; Janssen, 1990: 65; Zorn, 1991: 11, 12; Natural History Museum website, 2007, fig.
Limacina planidorsalis Hodgkinson; Hodgkinson et al., 1992: 19, pl. 3 figs 11-13 (?).
Heliconoides mercinensis (Watelet & Lefèvre, 1880); Janssen, 2007, website, fig.
non: *Spiratella mercinensis* (Watelet & Lefèvre); Curry, 1982: 36, pl. 1 fig. 1a-b (= *Heliconoides* spec. nov. ?).

Description. – Shell sinistral, planorboid, with approximately 3½ rounded whorls in a regular spiral. Initial whorl not protruding, apical plane slightly concave. Aperture rounded in frontal view, only very slightly highter than penultimate whorl. The basal part of the aperture is lowered beyond the base of the foregoing whorl. Apertural margin with a rounded v-shaped incision (lateral view), internally thickened. Umbilicus wide and shallow.

Material examined. – Two concretions with respectively many and two specimens, leg./don. M. Madsen, 2000, colln MGUH, silicone casts in ISL 1999.56 and 1999.58, and RGM 429.552, and 429.554. The concretion with many specimens also contains four paratypes of *Heliconoides lillebaeltensis* spec. nov. Three concretions with five specimens, leg./don. M. Madsen, 2006, colln MGUH, silicone casts in ISL 2007.3-4 and 2007.6 and RGM 541.503-504, RGM 541.506. One concretion also contains eight specimens of *Heliconoides lillebaeltensis* spec. nov. One concretion with c. 55 specimens, leg./don. M. Madsen, 2006, colln RGM 541.507, also containing ten specimens of *Heliconoides lillebaeltensis* spec. nov.; silicone cast in ISL 2007.7. Two concretions with *c.* 30 and *c.* 20 specimens, leg. O. Barsøe Hansen, 2004 (OB 608, OB 676) Silicone casts in ISL 2007.10 and 2007.12, and RGM 541.510 and RGM 541.512.Two concretions with five specimens leg./don. O. Barsøe Hansen, 2007 (OB 868, OB 881), colln MGUH; one specimen in OB 868 illustrated Fig. 10 (MGUH 28738); silicone casts in ISL 2007.14-15 and RGM 541.514-515. Both concretions also contain specimens of *Heliconoides lillebaeltensis* spec. nov. Two concretions with one and c. 35 specimens, leg. O. Barsøe Hansen, 2007 (OB 931, OB 982); silicone casts in ISL 2007.16-17 and RGM 541.516-517); OB 931 also contains 8 specimens of *Heliconoides lillebaeltensis* spec. nov.

Discussion. – Although quite a number of specimens are present in the available concretions the apertural reinforcements are not visible in any of the silicone latex casts. Still, the general shape is so typical that the identification cannot be doubted. *Heliconoides mercinensis* was originally described from Ypresian ('Cuisian') deposits of Mercin, Paris Basin (France, department of Aisne). The present specimens reach slightly larger dimensions than the Paris Basin shells (W = 2.3 mm, specimen illustrated herein fig. 10).

According to Curry (1965: 366) the six syntype specimens are absent from the Watelet collection, housed in the Musée de Soissons, France. In the original description no mention is made of the apertural morphology, for which reason Curry (1965, fig. 16) illustrated a specimen from the Sables de Cuise at Aizy-Jouy (just 20 km from the type locality). His drawing demonstrates clearly the v-shaped incision of the apertural margin, but not the internal apertural ridge. We reproduce here some drawings (fig. 9a-d) of the same specimen (BMNH GG 7117, leg. D. Curry) from Aizy-Jouy, in which this feature is clearly seen.

The taxon *Spirialis 'subanguostus'* Watelet & Lefèvre (1885: 102, fig.1a-c), obviously a lapsus for *S. subangulosus*, as seen in the explanation of their fig. 1, described on the basis of a single specimen (also not found in the Watelet collection), from the same locality Mercin, was considered by Curry (1965) with some doubt to be a synonym of the present species. However, considering the shape of the aperture, as illustrated by Watelet & Lefèvre, showing a subangular abaxial margin never seen in *Heliconoides mercinensis*, this

seems unlikely. The choice of the name *'subangulosus'* indicates that the shape of the aperture is not only an unsuccessful drawing (unless, of course, the description was based on the drawing !). Also the size (W = 2.5 mm) exceeds that of *H. mercinensis* from the Paris Basin. Dollfus & Ramond (1885: 39), by the way misspelling the name as *Spirialis 'subangulatus'*, considered it a synonym of the freshwater gastropod *Planorbis hemistoma* Sowerby, 1815. The original description of *P. hemistoma* in Sowerby (1815: 91, pl. 140 fig. 6), however, is too short and the illustrations are too small to be certain about this.

Limacina planidorsalis Hodgkinson (in Hodgkinson et al., 1992: 18, pl. 3 figs 11-13), from Early to Middle Eocene of some off-shore wells E of Canada, resembles *Heliconoides mercinensis* closely and might be a synonym. The apertural features, however, are not preserved in the type specimens.

Distribution. – The presence of this species in sediments of Early Lutetian age is surprising. *Heliconoides mercinensis* is the oldest pteropod species known. Apart from the Ypresian occurrences in the Paris Basin this species is also known from the earliest Ypresian of Denmark (Fur Formation, Mo Clay), from the Late Palaeocene (Tuscahoma Sand Formation, Bear Creek Marls) of Alabama (USA), from the Ypresian (London Clay Formation) in England, from the Ypresian (Panisel and Flanders formations) in Belgium, and from supposed Ypresian sediments in The Netherlands (Opende borehole) (most of these colln RGM).

Specimens recorded from the Ypresian of Gan (Aquitaine Basin, France) by Curry (1982) belong to another species (see Janssen & Cahuzac, in prep.).

Limacina Bosc, 1817

Type species: *Limacina helicina* (Phipps, 1774), by monotypy (Recent).

Limacina pygmaea (Lamarck, 1805) ? (fig. 11)

Ampullaire pygmée, *Ampullaria (pygmaea)*; Lamarck, 1805: 30.
Ampullaire pygmée, *Ampullaria pygmæa*; Lamarck, 1806, pl. 61. fig. 6a-b.
Spiratella pygmaea (Lamarck) 1804; Curry, 1965: 362, figs 18a-b, 19 (with further synonymy).

Description. – A single, poorly preserved specimen has a very low spira, considerably lower than all specimens of the accompanying species *Heliconoides lillebaeltensis* spec. nov., and might belong to this well-known Lutetian species. Its apertural features are not visible.

Material examined. – One specimen from the type locality of *Heliconoides lillebaeltensis* spec. nov., co-occurring with 15 specimens of that species in concretion OB 1072, leg./don. O. Barsøe Hansen, 2007, colln MGUH 28739; silicone casts in ISL 2007.19 and RGM 541.519.

Distribution. – Eocene (Lutetian) of the Paris and North Sea basins. Also recorded (Curry, 1982) from the Ypresian of Gan (Aquitaine Basin) and from the Middle Eocene (Bartonian) of Texas (USA). The illustrations, however, of the latter occurrence in Hodgkinson et al. (1992, pl. 3 figs 14, 15) represent another species. *Spiratella pseudopygmaea* Eames (1952: 150, pl. 6 fig. 146a-b), based on juvenile specimens from the Eocene of India/Pakistan, might be related or even identical.

BIOSTRATIGRAPHICAL NOTES (A.W. Janssen)

The pteropod assemblage found in the Trelde Næs concretions yielded two common pteropod species, and a single doubtful specimen of a third species. The most abundant species, *Heliconoides mercinensis*, is an extremely common species in several deposits of Late Palaeocene to Early Eocene (Ypresian) age and is also known from Cuisian (= Ypresian) sediments in the Paris Basin. Janssen & King (1988) recorded occurrences of this species in pteropod zones 6 to 9, covering a Late Palaeocene-Ypresian age. The present study includes a reliable age assignment of the concretions as Early Lutetian, which extends the range of *H. mercinensis* upwards, as the species had not been found in Middle Eocene deposits so far.

The fact that the new species *Heliconoides lillebaeltensis* is common in the present samples, and co-occurs with *H. mercinensis* in a number of concretions, is striking. It indicates that in a (maybe relatively short) Eocene interval the species occurred quite abundantly in the North Sea Basin. Still, in the UK, in Denmark and The Netherlands, where pteropods from the Eocene are well-studied, the species has never been found so far. Most probably the occurrences have to be included in the basal part of Pteropod Zone 9 of Janssen & King (1988), but other species known from this interval, such as *Limacina taylori* (Curry, 1965), *L. tutelina* (Curry, 1965), *Euchilotheca succincta* (Defrance, 1828) and/or *Camptoceratops prisca* (Godwin-Austen, 1882), were not found.

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