

Notes on the systematics, morphology and biostratigraphy of fossil holoplanktonic Mollusca, 3. Revision of M.-L. Tembrock's (1989) pteropod taxa¹

Arie W. JANSSEN

National Museum of Natural History, Palaeontology Department, P.O. Box 9517, 2300 RA Leiden,
The Netherlands
and 12, Triq il-Hamrija, Xewkija VCT 110, Gozo, Malta

Nine euthecosomatous gastropod taxa erected by M.L. Tembrock (1989) are revised, seven of which are either unrecognisable or junior synonyms of other species. Two taxa, *Spiratella flandrica* and *S. lotschi*, are accepted as valid. New illustrations of the type specimens, whenever available, are presented.

Key words: Gastropoda, Euthecosomata, Pteropoda, *Spiratella*, *Limacina*, systematics, Cainozoic, Germany.

HISTORY

In August 1989, Maria-Luise Tembrock published a short paper on new limacinid species from various localities in the NW. European Cainozoic. The manuscript of this paper had been available for almost twenty years, but although Dr. Tembrock and I had been corresponding, at irregular intervals, from 1968 onwards, I had no knowledge of that manuscript. The G.D.R. authorities never consented to its publication, for reasons '... of a misplaced state security policy' (Gründel, 1992: 38).

On December 13, 1988, however, Mrs. Tembrock wrote to me: '...vor etwa 14 Tagen bekam ich einen Anruf von meinem früheren Chef, daß ich alles jetzt veröffentlichen soll was ich liegen habe, auch alles halbfertiges fertig machen. Alles soll veröffentlicht werden. Als 1. mache ich die Spiratellen fertig. Ich habe die Arbeit gleich wieder durchgearbeitet, suche ergänzende Literatur usw.'.

From our later correspondence it appeared that Mrs. Tembrock planned a monograph on fossil pteropod material available to her. As such a monograph could not be realised within reasonable time (Mrs. Tembrock was aged 71 at the time and in very bad health), she intended to publish a shorter, preliminary paper comprising validations of new taxa only.

When I told Mrs. Tembrock that I had a similar paper on North Sea Basin pteropods in preparation, she initially was quite interested and even expressed a wish to visit the Leiden museum. As these were still G.D.R. days this visit could not take place and any matter-of-fact deliberation in correspondence appeared to be impossible, also on account of her deteriorating health. This made me speed up publication of new pteropod taxa available to me, and from the extensive manuscript on the North Sea Basin pteropod fauna, I selected the parts which contained descriptions of new species. This paper

¹ For no. 2 in this series see Basteria 62: 241-244, 1998.

appeared in September (Janssen, 1989). Not until December of that same year did I find out that Tembrock's paper had already been published in August.

Tembrock's paper comprises slightly more than one and a half pages of text and one plate. A new subgenus, seven new species, a new subspecies and a new variety, all placed in the genus *Spiratella* are introduced. Of each taxon a short diagnosis is given, and the new species are illustrated as rather rough outline drawings. Data presented are such that it is very difficult or even impossible to recognise the species.

In December 1989, I wrote to Mrs. Tembrock, and expressed my disappointment over the usefulness of her descriptions and illustrations, stating that for me it would be necessary to see and study the actual type specimens and re-illustrate them. In her reply (dated January 9, 1990) Mrs. Tembrock told me that she had not been allowed to publish more than the three pages, that more extensive descriptions could be expected in her final monograph, that the type specimens (housed in the Zentrales Geologisches Institut at Bernau, near Berlin) could not be received on loan, not even by herself, and that she thought it unnecessary that new drawings were made.

Consequently, I contacted the Z.G.I., expressed a wish to see the type material, and sought permission to study them during a planned visit to Berlin. To my surprise and annoyance, this request was refused, the reason given being that the material was still needed by Mrs. Tembrock, to finish her monograph. Mrs. Tembrock's health soon afterwards deteriorated rapidly, her last letter (dated January 21, 1991) coming from the Charité hospital at Berlin. She died of cancer on May 14, 1991 (Gründel, 1992).

In the meantime, East and West Germany had been re-united and in the former G.D.R. numerous reorganisations took place, inclusive of the closing down of the Zentrales Geologisches Institut. Later the collections of the Z.G.I. were moved from Bernau to Berlin, where the Bundesanstalt für Geowissenschaften und Rohstoffe, Außenstelle Berlin (BGR), is now in charge. Because of rather chaotic conditions during the 'Wende' I did not find out about all this until 1994. In August of that year Dr. H.M. Schlüter finally consented the loan of seven primary types.

A provisional study of these type specimens revealed that, generally speaking, the new taxa had been based on rather poor material, in several cases obtained from gastropod shells infill. Furthermore it became clear that not all types were present among this material. Evidently, the missing types and additional samples available to Tembrock, were still housed in the Museum für Naturkunde der Humboldt-Universität (Berlin). To see the entire holoplanktonic molluscan material housed in the Berlin collections, I decided to visit Berlin in February 1997.

The study of the available material has led to the following notes on Tembrock's (1989) taxa.

SYSTEMATIC PART

In her introductory notes Tembrock (1989: 242) referred to 37 existing species of *Spiratella*, both Recent and fossil, assigned to five subgenera, viz. *Spiratella*, *Pygmella*, *Embolus*, *Heterofusus* and *Skaptotion*. Subgenera such as *Thilea* and *Munthea* apparently were unknown to her, thus demonstrating the dramatic lack of literature in the former G.D.R. For instance, the type species of *Thilea*, *Limacina helicoides* Jeffreys, was included in her new subgenus *Pygmella*, with a query. The name *Limacina*, a synonym of *Spiratella*, and more frequently used nowadays, does not occur in her paper.

Tembrock stated that Recent pteropod faunas comprise ten species of *Spiratella*, of

which *S. lesueuri* (d'Orbigny, 1836) ranges from the Late Miocene and *S. retroversa* (Fleming, 1823) from the late Middle Miocene to the present day. Both statements, however, are erroneous. Fossil specimens of *Limacina lesueuri* are known to me, but from Quaternary deposits only. Tembrock's statement about *L. retroversa* most probably refers to records of so-called *Spiratella stenogyra* (Philippi) (= *L. retroversa*) from the late Middle Miocene of the Central Paratethys (e.g. Krach, 1981), later interpreted as *Limacina gramensis* (Rasmussen) by Janssen & Zorn (1993).

My notes on Tembrock's taxa follow the names applied in her paper and in the same order. New illustrations of her type specimens, whenever available, are given here. As Tembrock's paper is quite inaccessible her drawings are copied to allow easy comparison.

Spiratella (Pygmaella) pygmaea var. *minor* Tembrock, 1989
figs. 1, 2

1989 *Spiratella (Pygmaella) pygmaea* var. *minor*, var. n., Tembrock, p. 242, fig. 1.

Holotype. — BGR X 2923 (not X 2924 = *S. flandrica*).

Type locality. — 'Bohrung Marnitz 2/55'. On the slide containing the holotype, the sampling depth in this borehole is indicated as 183.7-185.7 m below surface. Marnitz is situated in Mecklenburg-Vorpommern, some 30 km E. of Ludwigslust.

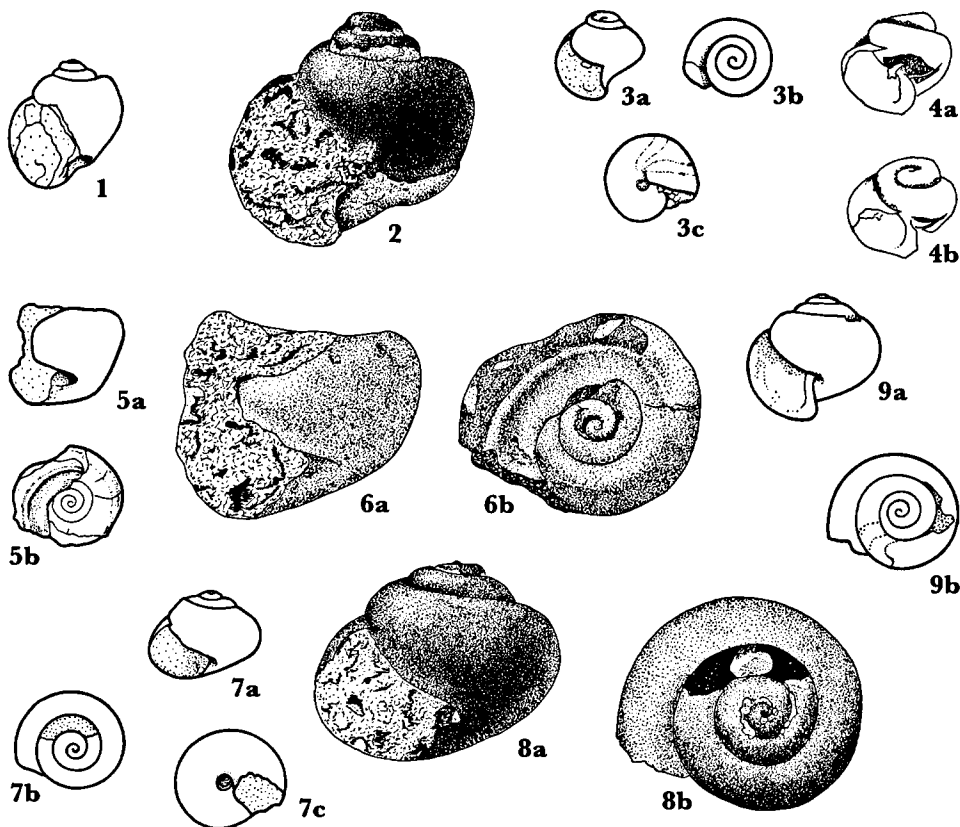
Stratum typicum. — 'Obere Marnitzer Schichten', late Early Eocene, but on the slide the type level is indicated as 'Obere Nedlitzer Schichten'.

According to Dr. W. von Bülow (in litt.) the boundary between Middle Eocene ('untere Draguner Schichten') and Early Eocene ('obere Marnitzer Schichten') is situated in this borehole at a depth of 183.7 m below surface.

Remarks. — Although Tembrock stated to have used an SM 20 binocular with a Meopta camera lucida device her drawing (fig. 1) does not represent the specimen in its natural height/width ratio. According to the measurements given (1.25 x 1.10 mm), this ratio should be 1.14, but in reality (compare fig. 2) this is 1.03, the specimen being only very slightly higher than wide. No additional material was found in the Berlin collections, although reference was made to specimens from the late Middle Eocene 'Obere Sernoer Schichten'.

The holotype does not demonstrate the shouldered shell form so typical of *Limacina pygmaea* (Lamarck, 1805), nor does it show the presence or absence of a columellar fold, as found in that species. An elevated spire occurs frequently in *L. pygmaea*; such forms are usually indicated as f. *bernayi* (De Laubrière, 1881). As only the holotype is available, from a level (of apparently Ypresian age) in which *L. pygmaea* is not known to occur (Janssen & King, 1988), I hesitate to include the specimen in *L. pygmaea*.

The name *minor* Tembrock, 1989 was introduced as a variety and therefore has no nomenclatorial status (ICZN, art. 16, 48g). In conclusion, *Spiratella pygmaea* var. *minor* Tembrock, 1989 can only be referred to as *Limacina* ? *pygmaea*.



Figs. 1-9. Tembrock's pteropod taxa. 1-2. *Limacina* ? *pygmaea* (Lamarck, 1805); 1: original illustration of *Spiratella* (*Pygmella*) *pygmaea* var. *minor* Tembrock, 1989; 2: holotype of var. *minor* Tembrock, 1989 BGR X 2923, x 25. 3-4. *Limacina flandrica* (Tembrock, 1989); 3a-c: original illustration of *Spiratella* (*Pygmella*) *flandrica* Tembrock, 1989; 4a-b: holotype BGR X 2924, x 25. 5-6. *Limacina umbilicata* (Bornemann, 1855); 5a-b: original illustration of *Spiratella* (*Spiratella*) *gruendeli* Tembrock, 1989; 6a-b: holotype BGR X 2913, x 25. 7-8. *Limacina valvatina* (Reuss, 1867); 7a-c: original; illustration of *Spiratella* (*Spiratella*) *krutzschi* Tembrock, 1989; 8a-b: holotype BGR X 2925, x 25. 9. *Limacina valvatina* (Reuss, 1867); 9a-b: original illustration of *Spiratella* (*Spiratella*) *praerangi praerangi* Tembrock, 1989; holotype lost.

Spiratella (*Pygmella*) *flandrica* Tembrock, 1989
figs. 3, 4

1989 *Spiratella* (*Pygmella*) *flandrica* sp. n., Tembrock, p. 242, fig. 2a-c.

Holotype. — BGR X 2924 (not X 2925 = *S. krutzschi*).

Type locality. — Rupelmonde, Belgium.

Stratum typicum. — 'Mitteloligozän, Rupelton' = Boom Clay Formation.

Remarks. — The holotype is a very juvenile specimen with a height/width ratio of

0.83. Again Tembrock illustrated (compare figs. 3a and 4a herein) the specimen as comparatively too high. Its height is almost exactly 0.5 mm, and not 0.84. The specimen has not suffered damage since its original description, as the number of whorls agrees with Tembrock's illustration.

The specimen is not preserved as a pyritic mould, nor is it filled with pyrite, as is always the case in pteropods from the Boom Clay Formation. Tembrock wrote on the slide that the shell was collected from the contents of a specimen of the gastropod *Charonia flandrica* (De Koninck, 1837), a species well-known from the Boom Clay. Only two species of limacinids are known from that interval, viz. *Limacina hospes* Rolle, 1861, and *L. umbilicata* (Bornemann, 1855), the latter, which differs markedly from the *S. flandrica* holotype, being only known from the upper levels of the Boom Clay and therefore not to be expected in the Rupelmonde area. *Spiratella flandrica*, however, cannot be interpreted as a juvenile specimen of *L. hospes*, on account of its flattened initial whorl and deeply incised suture. The holotype is the only specimen known. The taxon thus remains an enigma.

Spiratella (*Spiratella*) *gruendeli* Tembrock, 1989
figs. 5, 6

1989 *Spiratella* (*Spiratella*) *gruendeli* sp. n., Tembrock, p. 242, fig. 3a-b.

Holotype. — BGR X 2913.

Type locality. — 'Bohrung Marnitz 2/55' (see above); sampling depth, as indicated on the slide containing the holotype: 190.1-199.15 m below surface.

Stratum typicum. — 'Obere Marnitzer Schichten', late Early Eocene, but on the slide the type level is indicated as 'Obere Nedlitzer Schichten'.

Remarks. — In Tembrock's illustration (fig. 5a herein), the specimen is again too high, and the dimensions are completely erroneous. The correct measurements are H 1.1 W 1.26 mm, and not 0.22 x 0.56 mm. Tembrock's fig. 3b (fig. 5b herein) represents the shell in apical view and suggests that a peculiar spiral ridge occurs on the lower inner shell wall. In the text this is described as 'Nabel mäßig gross, gegen die Seitenwände schwach verrundet abgesetzt und sich nach innen in eine faltenartige Vorwölbung der Spindel erweiternd' (translated: Umbilicus moderately large, slightly rounded against the side walls, and widening inwards as a foldlike frontal vault of the columella). This observation, however, is erroneous, as is clear from the new drawing (fig. 6b herein). The spiral ridge is not internal, and does not occur on the lower columellar part of the shell wall, but is situated on the upper part of the body whorl and in fact is the boundary of the flattened apical shell part. It is present on the last half whorl of the shell, to beyond the point where, in Tembrock's drawing, it becomes visible in apical view.

A spiral ridge as the one present in the holotype of *S. gruendeli* is frequently found in specimens of the Rupelian species *Limacina umbilicata* (Bornemann, 1855) and the other characteristics agree as well. I consider *S. gruendeli* to be a junior synonym of *L. umbilicata*. It is undoubtedly of Rupelian age, implying that its occurrence in the Eocene levels of the Marnitz borehole is due to downhole contamination. Rupelian deposits are present in this borehole between 38 and 155.5 m below surface (W. von Bülow, in litt.)

No additional specimens were encountered in the Berlin collections, in spite of the fact that the species was recorded by Tembrock from various stratigraphic levels.

Spiratella (Spiratella) korobkovi Tembrock, 1989

- 1966 *Spiratella (Spiratella) fuchsi* Oppenheim (*Valvatina*). Korobkov, p. 78, pl. 1 fig. 2a-b; pl. 4 fig. 1 (non Oppenheim?).
- 1989 *Spiratella (Spiratella) korobkovi* sp. n., Tembrock, p. 242, fig. 4a-b (incorrectly redrawn after Korobkov, 1966, pl. 1 fig. 2a-b).

Remarks. — Tembrock introduced the name *S. korobkovi* because of a presumed erroneous identification as *S. fuchsi* Oppenheim of Eocene specimens from the Prearal area by Korobkov (1966). In Tembrock's opinion, *S. fuchsi* Oppenheim was based on protoconchs of the gastropod genus *Turbonilla*.

Oppenheim's (1922: 84, pl. 7 fig. 8a-c) illustrations are very small and show few details of the actual specimen. Still, they demonstrate clearly a shell with protruding apex, convex whorls and a relatively wide umbilicus, that in my opinion might very well represent a euthecosomatous pteropod. This matter can only be settled, however, through a renewed study of the actual specimens.

Quite another thing, of course, is the question whether or not the specimens described by Korobkov are identical to what Oppenheim had before him. Again, this can only be decided through a study of the actual specimens, and it might appear that Tembrock's name *S. korobkovi* indeed is available and valid. The introduction of a new species, of course, without a study of the specimens involved, was premature.

The illustrations given by Tembrock are evidently copied from Korobkov's pl. 1 fig. 2a-b, in such a way, that the species looks completely different from Korobkov's photograph. In Tembrock's interpretation the outline of the aperture is triangular, and the apertural margin is thickened, but both features are not seen in Korobkov's illustration.

Spiratella (Spiratella) krutzschi Tembrock, 1989
figs. 7, 8

- 1989 *Spiratella (Spiratella) krutzschi* sp. n., Tembrock, p. 242, fig. 5a-c.

Holotype. — BGR X 2925.

Type locality. — Gorlosen 2/56 borehole, depth (as indicated on the collection slide) 570 m below surface. Gorlosen is situated in Mecklenburg-Vorpommern, c. 15 km S. of Ludwigslust.

Stratum typicum. — Not indicated, as the sample originates from a straight flush borehole. As the holotype was found together with Middle Oligocene spiratellids the age was assumed to be Middle Oligocene. On the slide the level is indicated as 'Kahlpfuhler Schichten'.

Remarks. — Dimensions given by Tembrock are erroneous, they are H 1.00 W 1.25 mm, instead of 0.80 x 1.10 mm. In the drawing the shell is represented as having flat whorls, which is incorrect. The description is very generalised, and not suited for differentiating the species. The general outline of the holotype is very typical for the Late Oligocene-Late Miocene species *L. valvatina* (Reuss, 1867), which admittedly shows a rather wide variation in H/W ratio. Without hesitation, I consider *S. krutzschi* to be a junior synonym of that species. This would mean that its occurrence in the Gorlosen borehole sample is due to downhole contamination. The Miocene-Late Oligocene interval in this borehole is found between 70 and 263 m below surface (W. von Bülow, in litt.).

Spiratella (Spiratella) praerangi praerangi Tembrock, 1989
fig. 9

1989 *Spiratella (Spiratella) praerangi praerangi* sp. n., Tembrock, p. 244, fig. 6a-b.

Holotype. — BGR X 2928; the specimen is lost.

Type locality. — Borehole WM 14/64 at Krembs (= presumably Krembz, in Mecklenburg-Vorpommern, c. 30 km W. of Schwerin), depth not indicated.

Stratum typicum. — Early Miocene, Brooker Schichten.

Remarks. — Tembrock's illustration represents a quite typical specimen of *Limacina valvatina* (Reuss, 1867), which agrees with the age of the holotype. This is also clearly demonstrated by additional material present in the collections of the Museum für Naturkunde der Humboldt-Universität, all identified as *S. praerangi praerangi*, from localities where *Limacina valvatina* is known to occur, such as Hemmoor and Dingden (both Germany), Edegem (Belgium), and the boreholes Beesel and Beeringen (The Netherlands). Other samples, e.g. from Gühlitz and Lüneburg (Late Miocene), are identified as *Spiratella (Spiratella) praerangi caliduphila* Tembrock ms.

Spiratella (Spiratella) praerangi weinbrechti Tembrock, 1989
fig. 10, 11

1989 *Spiratella (Spiratella) praerangi weinbrechti* ssp. n., Tembrock, p. 244, fig. 7a-c.

Holotype. — BGR X 2930.

Type locality. — 'Hohenwoos', no doubt from the former clay pit there. Hohen Woos is situated in Mecklenburg-Vorpommern, c. 20 km SW. of Ludwigslust.

Stratum typicum. — 'Obermiozän' (= 'Prietzirer Schichten' = Miocene, Levensauian; W. von Bülow, in litt.).

Remarks. — The measurements of the holotype are H 1.15 W 1.36 mm, agreeing quite well with Tembrock's data (1.14 x 1.41 mm). Her drawing is fairly accurate, but represents the shell with an apex which is too strongly pointed. The shell undoubtedly belongs to *Limacina valvatina* (Reuss, 1867). The name *weinbrechti* could, at best, be maintained for reference to rather depressed forms of this quite variable species.

Spiratella (Spiratella) lotschi Tembrock, 1989
figs. 12, 13

1989 (August) *Spiratella (Spiratella) lotschi* sp. n., Tembrock, p. 244, fig. 8a-d.

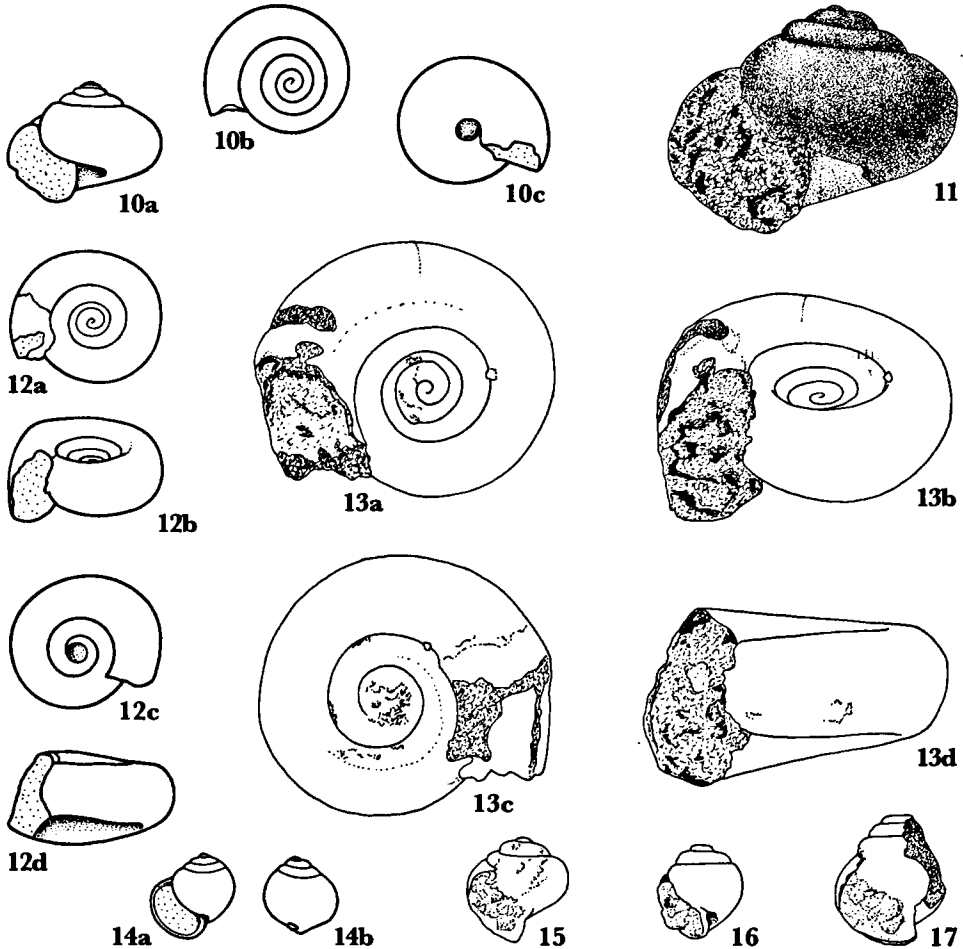
1989 (September) *Limacina jessyae* sp. nov., Janssen, p. 107, pl. 3 figs. 1-3, pl. 4 fig. 1

Holotype. — BGR X 2943.

Type locality. — 'Bohrung Nedlitz 1'. On the slide the borehole number is stated to be Nedlitz 1/59, and the sampling depth as 322.4-326.7 m below surface. The type locality Nedlitz is in Brandenburg, immediately North of Potsdam.

Stratum typicum. — Late Eocene or Early Oligocene 'Obere Schönwalder Schichten'.

Remarks. — The measurements of the holotype are H 0.90 x W 1.52 mm, agreeing fairly well with those given by Tembrock (0.84 x 1.48 mm). The illustrations are simple,



Figs. 10-17. Tembrock's pteropod taxa. 10-11. *Limacina valvatina* (Reuss, 1867); 10a-c: original illustration of *Spiratella (Spiratella) praerangi weinbrechti* Tembrock, 1989; 11: holotype BGR X 2930, x 25. 12-13. *Limacina lotschi* (Tembrock, 1989); 12a-d: original illustration of *Spiratella (Spiratella) lotschi* Tembrock, 1989; 13a-d: holotype BGR X 2943, x 25. 14. *Limacina valvatina* (Reuss, 1867); 14a-b: original illustration of *Spiratella (Spiratella) lueneburgensis* Tembrock, 1989; holotype lost. 15-17. *Limacina valvatina* (Reuss, 1867) transitional to *L. gramensis* (Rasmussen, 1968); non-syntypical specimens identified *Spiratella (Spiratella) lueneburgensis* Tembrock, 1989, x 25.

but allow the species to be interpreted correctly. For instance, the characteristically wider second whorl is distinctly indicated as such. Incorrect is the frontal view (Tembrock's fig. 8d = fig. 12d herein) which shows convex upper and lower outlines of the body whorl. Such errors arise when there is not enough focusing of the binoculars with camera lucida device. Also fig. 8c (fig. 12c herein) is incorrect, as it shows the first visible

whorl as appearing from below the next whorl, which is not the case. In the actual specimen this part of the shell is covered with sediment.

Without doubt, *Spiratella lotschi* is a senior synonym of *Limacina jessyae* Janssen, 1989, which was described from Rupelian/Latdorfian deposits in The Netherlands and Denmark.

Spiratella (Heterofusus) lueneburgensis Tembrock, 1989
figs. 14-17

1989 *Spiratella (Heterofusus) lueneburgensis* sp. n., Tembrock, p. 244, fig. 9a-b.

Holotype.— Museum für Naturkunde der Humboldt Universität, Berlin, no. MB-Ga 240; specimen missing.

Type locality. — Lüneburg (situated in Niedersachsen, c. 40 km SE. of Hamburg).
Stratum typicum. — ‘Oberes Mittelmiozän’ (= Middle Miocene, Lüneburgian, or Langenfeldian III; W. von Bülow, in litt.).

Remarks. — The illustration of the holotype (compare fig. 14 herein) is not recognisable and seems to be highly unrealistic. Fortunately there is a further sample of eight juvenile specimens available, labelled ‘*Spiratella lueneburgensis* - paratypes’. These, however, are no paratypes, as they were not mentioned in Tembrock’s paper. Three specimens from this sample are illustrated here. Because of their juvenile condition, these specimens are difficult to interpret, but it is clear that most of them (figs 16, 17) are transitional forms in the evolutionary lineage of *Limacina valvatina* (Reuss, 1867) to *L. gramensis* (Rasmussen, 1968) (fide Janssen & Zorn, 1993). If the measurements of the holotype (0.73 x 0.71 mm) are correct, that specimen had a H/W ratio of 1.03 and thus belonged to *Limacina valvatina*.

Tembrock’s paper contains an additional fig. 10a-b, not referred to in the text. This is not reproduced here.

CONCLUSIONS

In summary, Tembrock’s (1989) taxa are revised as follows:

Tembrock, 1989	this paper
<i>Spiratella (Pygmella) pygmaea</i> var. <i>minor</i> Tembrock, 1989	<i>Limacina?</i> <i>pygmaea</i> (Lamarck, 1805)
<i>Spiratella (Pygmella) flandrica</i> Tembrock, 1989	<i>Limacina flandrica</i> (Tembrock, 1989)?
<i>Spiratella (Spiratella) gruendeli</i> Tembrock, 1989	<i>Limacina umbilicata</i> (Bornemann, 1855)
<i>Spiratella (Spiratella) korobkovi</i> Tembrock, 1989	<i>Limacina fuchsi</i> (Oppenheim, 1922)?
<i>Spiratella (Spiratella) praerangi praerangi</i> Tembrock, 1989	<i>Limacina valvatina</i> (Reuss, 1867)
<i>Spiratella (Spiratella) praerangi weinbrechti</i> Tembrock, 1989	<i>Limacina valvatina</i> (Reuss, 1867)

Tembrock, 1989

this paper

*Spiratella (Spiratella) lotschi**Limacina lotschi* (Tembrock, 1989)

Tembrock, 1989

*Spiratella (Heterofusus) lueneburgensis**Limacina valvatina* (Reuss, 1867)

Tembrock, 1989

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REFERENCES

- GRÜNDEL, J., 1992. Obituary notice (M.L. Tembrock). - Contributions to Tertiary and Quaternary Geology 29: 1, 38.
- JANSSEN, A.W., 1989 (September). Some new pteropod species from the North Sea Basin Cainozoic (Mollusca: Gastropoda, Euthecosomata). — Mededelingen van de Werkgroep voor Tertiaire en Kwartaire Geologie 26: 91-133.
- , & C. KING, 1988. Planktonic molluscs (Pteropods). In: R. VINKEN et al., eds., The northwest European Tertiary Basin. Results of the International Geological Correlation Programme Project no. 124. — Geologisches Jahrbuch (A) 100: 356-368.
- , & I. ZORN, 1993. Revision of Middle Miocene holoplanktonic gastropods from Poland, published by the late Wilhelm Krach. In: A.W. JANSSEN & R. JANSSEN, eds., Proceedings Symposium 'Molluscan Palaeontology', 11th International Malacological Congress, Siena, Italy, 30th August-5th September 1992. — Scripta Geologica Special Issue 2: 155-236.
- KOROBKOV, I.A., 1966. Krylonogie (Mollusca Pteropoda) Paleogenovykh otlozhenij juga S.S.S.R. — Voprosy Paleontologii 5: 71-92 (in Russian).
- KRACH, W., 1981. Slimaki skrzydlonogi (Pteropoda) w Miocenie Polski i ich znaczenie stratygraficzne (The pteropods in the Miocene of Poland and their stratigraphic significance) (Polish with English summary). — Prace Geologiczne Polska Akademia Nauk 121: 116-140.
- OPPENHEIM, P., 1922. Über Alter und Fauna des Tertiärhorizontes der Niemtschitzer Schichten in Mähren. 1-106. Berlin, Oppenheim.
- TEMBROCK, M.L., 1989 (August). Neue Spiratella-Arten (Gastropoda, Opisthobranchier, Pteropoda). — Zeitschrift für angewandte Geologie 35: 242-244.