

# The Microfauna of the Carpathian Sandstones from the environs of Dukla

by

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In the autumn of 1891, Prof. Dr. Szajnocha brought back several specimens of a very calcareous sandstone from his excursions in the Carpathians near a place known as "Na Foluszu" south of Dukla. Because of its great external similarity to the well-known sandstone from Wola Łużańska<sup>1</sup>, he suggested that I examine it in detail.

At first glance, it was possible to identify these sandstones with those from Wola Łużańska. Their weathered surface reveals a gray colour covered with white spots derived from fragments of *Lithothamnium*, which weathers white. On a freshly broken surface the colour is a uniform brownish-gray. It is transversed by numerous veins of crystalline calcite, which forms incrustations in fractures. This sandstone, if one can call it such because it contains no more than 30% quartz, is hard and dense. In thin section it turns out to be a conglomerate made of fine grains of calcite and sand with very little clay, which in places occurs as small lumps. The grains are held together with a calcareous cement stained with iron oxide, which is clearly visible in thin section.

The hard dense material was only suitable for examination in thin section. In the 50

thin sections I made there is a rich collection of microscopic fauna comprised of foraminifera and bryozoans. However because I had only thin sections of various orientation it was only possible to identify genera.

During a geological excursion in the environs of Krosno in 1892, I was able to easily find the locality where these sandstones were collected. This locality is a small quarry south of Dukla, to the northwest of the Chapel of Blessed John. Before the railway was built, this stone was quarried for the production of lime, which constitutes as much as 70% of the rock. The quarry has since grown over and is scarcely visible. However, I was able to conclude that the thickness of the sandstone bed does not exceed two meters. This bed is underlain by a gray, fine-grained sandstone that does not weather easily. These sandstones are interbedded with thin layers of red clays. Below the sawmill where the Hyrowski stream nears the road leading from Dukla there is an outcrop of Menilite shales with bedded cherts.

In the quarry, I found several strongly weathered pieces, and on the tailings pile I collected clumps that are nearly falling apart. As soon as I returned I washed a portion of this material, and placed the greater portion of it in a pot of water left outside for a whole winter. The action of thawing and freezing disintegrated this material into its

<sup>1</sup> [The work of Uhlig (1886) on the calcareous foraminiferal fauna from nearby Wola Luzanska was published only five years earlier.]

smallest constituents, which after washing yielded numerous well-preserved fossils.

The occurrence in Dukla of these calcareous fragments in association with red Eocene clays (upper hieroglyphic beds of Paul and Tietze) is in complete agreement with their occurrence in Wola Łużańska, Cieklin, and other localities reported by Uhlig [1886]. Furthermore, on a map of the area between Beskid and Dukla drawn by Uhlig [1883], Cieklin is indicated as the easternmost locality known by Uhlig where this limestone occurs. This locality lies in a belt of Eocene sandstones trending in the direction of 8 - 9 hours<sup>2</sup>, subdivided into two parallel belts separated by the Menilite shales. Uhlig's map only reaches to Iwla to the west of Dukla. Folsz, where the calcareous conglomerate occurs, lies exactly within the same belt. It would only be necessary to extend Uhlig's map toward the southeast to delineate the borders of the formation in this area. This continuity is confirmed by the similarity of the conglomerates with those described by Uhlig.

With regards to the fauna, this similarity is even more apparent. The microscopic fauna consists of foraminifera<sup>3</sup>, echinoderm spines and plates, bryozoans<sup>4</sup>, brachiopods, bivalves preserved as fragments, and ostracods. In addition to these are fish teeth (Selachii), elements of Balanidae shells, and fragments of jaws similar to worm jaws, which cannot be further determined.

The predominant component of the sandstone is the calcareous algae *Lithothamnium*.

<sup>2</sup> [Grzybowski used the "hour" notation to indicate strike. 8-9 hours = 120-135 degrees.]

<sup>3</sup> [The foraminifera from this horizon were subsequently examined by Smigielska (1961), who was able to find 22 of the species reported by Grzybowski. Although Smigielska did not provide illustrations, she revised the nomenclature of several of Grzybowski's taxa and her note constitutes a partial revision of Grzybowski's microfauna from Dukla.]

<sup>4</sup> [Subsequent studies of the bryozoans from this lithologic unit from a different locality (Skalnik, near Dukla) have been published by Malecki (1963).]

These are in the form of grains and branches reaching 4 mm in diameter, though fragments reaching 3-4 mm in size are rare. Their closer determination in washed residues is impossible. There is not a single larger specimen that provides any indication of the original morphology. Because the original rock specimens were to be investigated in thin section (several dozen were made), it was possible with the help of papers by Gumbel and Rothpletz to determine five species based on the dimensions of the chambers and reproductive structures.

The microfauna from Folsz is more varied than Uhlig's fauna from Wola Łużańska in terms of genera and species. Entire families are present here which are missing from Uhlig's fauna, such as Lituolidae (two genera and species), Buliminidae (one genus and three species), Globigerinidae (one genus and species), and Polymorphinidae (two genera and six species). Families poorly represented in the Wola Łużańska fauna such as Textularidae, Nodosarinae, and Lagenidae, are common in the fauna from Folsz. The most common family in terms of genera and species is the Rotalinae. Of the genera reported from Wola Łużańska, only two are missing here: *Carpenteria* and *Rupertina*<sup>5</sup>. The Nummulinidae, by contrast, are markedly more poorly represented. We know only six species, whereas Uhlig reported 15. The correlation table at the end of this paper best shows the relationship.

In terms of number of specimens, the most common species are: *Rotalia lithothamnica* Uhlig, *Pulvinulina concentrica* Parker and Jones, *Discorbina pusilla* Uhlig, *Discorbina uhligi* n.sp., *Gypsina globulus* Reuss, *Truncatulina hantkeni* Rzehak, and *Truncatulina rzehaki* n.sp. From the genus *Truncatulina*, the group especially well-developed is that of *T. lobatulus*. Species such as *T. communis*, *T. grosserugosa*, *T. omphalia*, *T. refulgens*, *T. rzehaki*, and *T. subrefulgens* constitute a

<sup>5</sup> [Larger foraminifera from the *Lithothamnium* limestone were studied by Bieda (1946) and Smigielska (1960, 1961).]

related group, and form a continuum to forms such as *Carpenteria* by increasing compression and enlargement of the test.

Of the forms that are either absent or poorly represented in Wola Łużańska, only *Globulina inflata*, *Polymorphina deflexa*, and *Hormosina lateralis* are more common, and these are only present in low numbers.

This fauna displays close ties with the fauna from the Clavulina szaboi beds described by Hantken (1875), which has 17 species in common. The closest connections, however, are observed between this fauna and those from Moravia and lower Austria described by Rzehak (1887a,b 1888a,b, 1891), from the Ligurian fauna of Nikoltschitz, and from the Bartonian nummulite beds in Waschberg and Michelsberg. Through the kind generosity of Prof. Dr. Rzehak, who has sent me his rich, yet-undescribed fauna for comparison, I have had the opportunity to compare both faunas.

This fauna shares with the Ligurian fauna from Nikoltschitz its lack of nummulites and Orbitoides, and its fauna of nodosariids and cristellariids that is rich in species but poor in the number of specimens, its weakly developed polymorphinids, and in the strong presence of rotaliids - especially the genus *Truncatulina*. Altogether there are 15 species in common.

With the Bartonian fauna [Rzehak, 1888a], this fauna shares its complete lack of miliolids. There are 12 species in common.

The opinion of Uhlig, who determined the age of this bed as near the boundary between the Eocene and Oligocene, appears to be accurate. Precisely determining whether this bed is either Eocene or Oligocene is impossible up to now. Although the fauna from Folsz is more similar to Rzehak's fauna from Nikoltschitz, it would remain doubtful to base conclusions on this fact, because the most important and most common forms occur also in the Bartonian stage.

Uhlig's conclusions about the nature of the seas at the time are not undermined by the more common occurrence of deep sea forms. Such genera and species, though more common

than in Wola Łużańska, are a distinct minority in comparison to the Littoral forms. These conclusions are corroborated by the fact that unlike the coeval Moravian and lower Austrian faunas, the Folsz fauna does not contain forms that are typically "pelagic" such as *Rhabdammina*, *Reophax*, or *Trochammina*.

Among the brachiopods, only *Cistella neopolitana* occurs commonly. I found only two specimens of *Thecidium mediterraneum* Rizzo, and a single specimen of the genus *Argiope*, but I was unable to precisely identify it.

Although the final result of this study was not definitive as originally anticipated because it was impossible to distinguish Eocene from Oligocene, the discovery of a rich fauna and its affinities to the faunas of Moravia and lower Austria provide rich expectations for continued studies in this field; especially in light of the fact that the localities known to contain foraminifera are not as isolated as once supposed. The extent of the outcrop belt has been extended towards the south from Cieklin in the direction of Dukla. It is probable that other localities with rich faunas are yet to be found, and it is likewise possible that the known occurrence of the belt can be extended farther towards the south.

Before I commence describing the species, which are arranged according to the systematics of Brady (1884), I wish to extend my gratitude to Prof. Dr. Szajnocha, who supplied the original material and interested me in the topic, for providing numerous valuable suggestions; to the Director of the Czartoryski Museum in Krakow for allowing me to use the Library, and to Prof. Dr. Rzehak in Brno, who has kindly sent me his valuable collection for comparison.

## FORAMINIFERA

### Lituolidae

#### a. Lituolinae

#### Genus *Placopsilina* d'Orbigny

1. *Placopsilina bulla* Brady  
pl. 1, fig. 1

*Placopsilina bulla* Brady, 1884, p. 315. pl. 35, fig. 16, 17.

A small unilocular test, rounded in shape, attached on one side to some substrate, commonly branches of algae, etc. Rare.

b. Trochammininae

Genus *Hormosina* Brady

2. *Hormosina lateralis*<sup>6</sup> n.sp.

pl. 1, fig. 2

Test built of a series of chambers connected by channels. Chambers pear-shaped, constricted towards the initial portion, expanding towards the top. From one side of the chamber, and always from the same side, a canal runs off joining it with the succeeding chamber into which it merges and becomes wider, giving the test a knee-like appearance. On the side of the chamber opposite the canal, a slight convexity is visible with a centrally located slit. Of several sections only one passed through this convexity showing traces of the canals. This would therefore be the second aperture of the chamber. On the surface of the test, on the side of the canal, there are sometimes longitudinal furrows. The nearest form seems to be *Hormosina carpenteri* Brady, which differs in having canals that run straight from the chamber, and therefore run in a straight or curved line. Also, the ridges with a trace of an aperture are not observed. Found very frequently in fragments comprised most often of two chambers, rarely more chambers are found. Length of a single chamber 0.6 to 1.0 mm. Frequent.

Textularidae

a. Textularinae

Genus *Textularia* Defrance

3. *Textularia carinata* d'Orbigny

pl. 1, fig. 3a-c

*Textularia carinata* d'Orbigny. Hantken, 1875, p. 66, pl. 7, fig. 8.

Test elongate with flattened sides, with 11 biserial chambers that have sutures angled

toward the apex. Periphery acute with a wide keel. Aperture normal. Rare.

4. *Textularia sagittula* Defrance

pl. 1, fig. 4

*Textularia sagittula* Defrance. Brady, 1884, p. 361. Test wedge-shaped, biserial with 7-9 pairs of chambers separated by horizontal sutures. Periphery acute. A cross section across the final chambers is elliptical, acute at the ends of the long axis and flattened at the ends of the short axis of the ellipse. Common.

5. *Textularia conica* d'Orbigny

pl. 1, fig. 5

*Textularia conica* d'Orbigny. Brady, 1884, p. 365, pl. 43, fig. 13.

Test in the shape of a skewed cone, somewhat flattened. Biserial chambers separated by shallow sutures, with 6-7 chambers in each row. Sutures arched. The periphery is initially acute, later becoming rounded as chambers increase rapidly in size. In apertural view the test looks elliptical, with the long axis of the ellipse rounded. Length 1.4 mm, width across the last chambers 1.3 mm, thickness 0.8 mm. Common.

Genus *Schizophora* Reuss

6. *Schizophora haeringensis* (Gümbel)

pl. 1, fig. 6

*Venilina haeringensis* Gümbel, 1868, p. 649, pl. 2, fig. 84.7

*Schizophora haeringensis* Gümbel. Hantken, 1875, p. 68, pl. 3, fig. 3.

*Bignarina capreolus*. Uhlig, 1886, p. 165.

Test flattened, acute towards the bottom, on top bluntly angular. Initial chambers biserial with seven chambers in each row, with distinctly raised sutures. Sutures arched towards the top. Later chambers are uniserial, wide but thin, about four in number. A constriction is observed at the junction between the biserial and uniserial parts, later the periphery has

<sup>7</sup> [Grzybowski consistently reported the page numbers in the offprint rather than the pagination of the journal. These citations have been corrected throughout.]

<sup>6</sup> [These specimens are most likely fragments of bryozoans]

parallel sides. Aperture as a long narrow slit on top of the last chamber, which is in the shape of a rhomboid. Rare.

Genus *Gaudryina* d'Orbigny

7. *Gaudryina subrotundata* Schwager  
pl. 1, fig. 7

Synonyms listed by Brady, 1884, p. 300.

Test straight, with a sharp initial part increasing rapidly in width, then remaining equally wide. Chambers biserial with eight chambers in each row. Sutures distinct, angled towards the top. Periphery rounded, oval in cross-section. Aperture at the junction of the final two chambers. Common.

8. *Gaudryina chilostoma* Reuss  
pl. 1, fig. 8

*Gaudryina chilostoma* Reuss, 1866, p. 120, pl. 1, fig. 5-7.

Test conical, biserial with 8-9 rapidly enlarging chambers in each row. Final chambers are enlarged. Sutures arched. Cross-section round. Common.

9. *Gaudryina pupoides* d'Orbigny  
pl. 1, fig. 9

Synonyms listed by Brady, 1884.

Test small, with nearly parallel sides. Biserial chambers with six chambers in each row, separated by sutures distinct and depressed only in the younger part. In the older part they are less distinct. Sutures run parallel to the periphery and are arched downwards toward the centre. Periphery rounded, cross-section oval. Common.

Genus *Tritaxia* Reuss.

10. *Tritaxia* cf. *tricarinata*? Reuss<sup>8</sup>  
pl. 1, fig. 20

Synonyms listed by Brady, 1884.

Test small, triangular in cross-section, with two sides concave and one convex. Chambers are triserial, separated by sutures that are slightly raised. In the centre of each side,

arched sutures of the adjacent rows meet. Because of the poor preservation of the test, it cannot be positively identified. Rare.

b. Bulimininae

Genus *Bulimina* d'Orbigny

11. *Bulimina contraria* Reuss  
pl. 1, fig. 12

Test large, rounded, with the final two whorls visible on the spiral side, comprised of six chambers separated by depressed sutures. On the umbilical side, where only the final chamber is visible, the chambers do not meet evenly in the centre, but are separated by a depression that appears as an embayment. The aperture, on this side, at the periphery of the test, a slit at the base of the last chamber. Rare.

12. *Bulimina elongata* d'Orbigny  
pl. 1, fig. 10

*Bulimina elongata* d'Orbigny. Hantken, 1875. p. 61, pl. 10, fig. 7.

Test small, comprised of five whorls, with inflated, distinctly separated chambers. Aperture at the interior edge of the last chamber. Rare.

13. *Bulimina elongata* d'Orbigny var. *cylindrica* n.var.

pl. 1, fig. 14

Test comprised of five whorls. In the first whorl the chambers are so compressed that they look almost like a triangular blade. However, the test expands and retains its width to the end. The chambers, which are spherical in shape, are distinct but not inflated as in *Bulimina elongata* d'Orbigny. They remain uniform, which gives the test the shape of a cylinder covered by furrows. Chambers are clearly visible because of the uneven growth of the chambers. The final chamber, which is hemispherical, has an embayment at its contact with the preceding chamber where the aperture is situated. Length 1.6 - 2 mm. Rare.

14. *Bulimina truncana* Gümbel var. *angusta* n.var.

<sup>8</sup> [Smigielska (1961) placed this specimen in *Karrerella subglabra* (Gümbel).]

pl. 1, fig. 11

*Bulimina truncana* Gümbel, 1868, p. 644, pl. 2, fig. 77.  
*Bulimina truncana* Gümbel. Hantken, 1875, p. 61, pl. 7, fig. 5.

Test comprised of four whorls, with inflated, distinctly separated chambers. Beginning at the acute apex, numerous fine striations run the length of the test. Aperture at the interior side of the final chamber.

The affinity of this form to *Bulimina truncana* Gümbel is very clear. It is however, markedly narrower than Gümbel's form. The specimen given by Hantken also displays greater width, but it would not be necessary to designate it a new variety. Only the number of striations is nearly double that reported by Gümbel's (8-9), which prompted me to call it a new variety. Length 0.6 mm. Rare.

#### Lagenidae

##### a. Lageninae

Genus *Lagena* Walker and Jacob

##### 15. *Lagena globosa* Reuss<sup>9</sup>

pl. 1, fig. 15

*Lagena globosa* [Montagu]. Reuss, 1863. pl. 1, fig. 1-3.  
Test oval, somewhat flattened, with a distinct radial aperture.

##### 16. *Lagena sphaericostata* n.sp.

pl. 1, fig. 18

Test spherical. On the upper surface the aperture is present in the form of a small opening, just barely elevated above the test surface, and surrounded by a narrow lip. Somewhat wavy striations extend out from the radial aperture. Two of them are adjacent to one another and encircle the test equatorially. The neighbouring ones extend down toward the bottom axis, but then turn and run back to the aperture on the same side of the test. The degree of deflection away from the equatorial striation increases further away from it. At right angles to the equatorial striation, the striae terminate a certain distance away from the bottom axis. The shape and nature of the striations resemble the species *L. diversi-*

*costata* Reuss, but in that species the striations are fewer and resemble thick folds that give the test a star-shaped cross section. In my species, the striae are finer and more numerous. I only found one specimen. Diameter 0.6 mm.

##### 17. *Lagena synedra* Gümbel<sup>10</sup>

pl. 1, fig. 16, 17

*Lagena synedra* Gümbel, 1868, p. 608, pl. 1, fig. 10.  
Test elongated, spindle shaped, often corrugated, circular in cross-section. Both ends terminate in a sharp neck. Aperture small, barely visible on the terminal end. Surface coarse-grained. Rare.

##### 18. *Lagena hispida* Reuss

pl. 1, fig. 19

Synonyms listed by Brady, 1884, p. 459.  
Test pear shaped, compressed on both sides. Aperture on thinner side of the test as a small opening. Surface ornamented by delicate and minute pustulae and striations. Rare.

#### Genus *Valvatina* Bornemann

##### 19. *Valvatina umbilicata* Bornemann<sup>11</sup>

pl. 2, fig. 4

*Valvatina umbilicata* Bornemann, 1855, p. 319, pl. 12, fig. 5.

Test unilocular, spirally coiled with two whorls on the spiral side, separated by distinct sutures. The outer whorl has a suture as a depressed groove, the inner is not depressed. The umbilical side is convex, almost hemispherical, showing only the last whorl. This specimen differs somewhat from the one depicted by Bornemann. Its spiral side is nearly flat, only slightly convex near the centre. Despite this, I identified it as identical to the previous species because of the lack of additional specimens (only one was found). Diameter 0.9 mm.

##### b. Nodosarinae.

<sup>10</sup> [probably a specimen of *Ramulina*.]

<sup>11</sup> [The specimen illustrated by Bornemann (1855) is probably a pteropod.]

<sup>9</sup> [the proper citation is *Lagena globosa* (Montagu).]

Genus *Nodosaria* Lamarck.

20. *Nodosaria calomorpha* Reuss

pl. 2, fig. 6

*Nodosaria calomorpha* Reuss, 1866, p. 129, pl. 1, fig. 15-19.

Test comprised of three chambers. The initial chamber is larger than the others. On the final chamber there is a low protrusion where the aperture is located. Rare.

21. *Nodosaria columnaria* n.sp.

pl. 2, fig. 13

Test straight, cylindrical, comprised of four chambers. Large, rounded initial chamber, the next one smaller and the third one broadens slightly. Whereas the first three chambers merge such that only under very good illumination their divisions may be seen as weak suture lines, the fourth is clearly distinguished by a deep suture and by a constriction visible at that point. Aperture is a large opening on the top of the last chamber. Length 1.8 mm. Rare.

22. *Nodosaria exilis* Neugeboren

*Nodosaria exilis* Neugeboren, 1856, p. 75.<sup>12</sup>

*Nodosaria exilis* Neugeboren. Reuss, 1866, p. 130. pl. 2, fig. 17.

This form is known to me as a fragment consisting of two chambers. They are narrow but long, cylindrical with indistinct sutures. Length up to 1 mm. The distinctly shaped chambers make it possible to clearly identify this species even though only a fragment was found in our collections.

23. *Nodosaria longisulcata* n.sp.

pl. 2, fig. 5

Test straight, only slightly arched, comprised of six chambers, of which only the initial and final chambers are distinct. Initial chamber is large, acute at the initial end with a short spine. The suture between the first and second chambers is constricted. Sutures between the following chambers are only weakly visible,

and the test expands insignificantly in width until the penultimate chamber, where there is a marked constriction. Final chamber is pear-shaped and terminates in a produced neck where the aperture is situated. Costae run the length of the test. On both the convex and concave sides of the test the costae extend from the initial chamber to the aperture. On the lateral sides the costae that run from the apical spine are interrupted at the lower constriction. Above that, the costae bifurcate and other costae fill the space in between. Thirteen costae extend to the aperture. Length 2.1 mm. Rare.

Genus *Dentalina* d'Orbigny

Of the dozen or more specimens in my collection only one is complete. As far as I can determine from the fragments, there are at least four species.

24. *Dentalina gliricauda* Gümbel

*Dentalina gliricauda* Gümbel, 1868, p. 624, pl. 1, fig. 41.

Test slightly arched. Initial chamber is larger than succeeding chambers. The first chambers are straight, almost quadratic in cross section such that the early part of the test appears spindle-shaped. The later chambers are round with constrictions at the sutures. Several fragments, the largest of which is comprised of nine chambers.

25. *Dentalina intermedia* Hantken<sup>13</sup>

*Dentalina intermedia* Hantken, 1875, p. 30, pl. 3, fig. 8.

Several fragments comprised of four to 10 chambers. Initial chamber is round. Later chambers are separated by straight sutures, increase in size rapidly, and become rounded. Hantken mentioned in his text that the chambers do not differ in size, but his figure does not agree with the description because the dimensions of the final chamber are several times

<sup>12</sup> [= *Nodosaria exilis* Neugeboren, 1852, p. 51, pl. 1, fig. 25-26.]

<sup>13</sup> [Junior homonym of *Dentalina intermedia* Cornuel, 1848.]

greater than the initial ones. I also observe this in my specimens.

26. *Dentalina* cf. *filiformis*? d'Orbigny

I possess a fragment comprised of two chambers. Its concavo-convex outline, the expansion of the chambers on the ventral surface, and the position of the aperture near the dorsal margin suggest that this fragment belongs in this species. A second fragment comprised of seven chambers initially quadratic and later more elongate agrees with Brady's drawing of this species.

27. *Dentalina obliquata* (Reuss)

pl. 2, fig. 8

*Dentalina obliquata* Reuss, 1863, p. 46, pl. 2, fig. 28.<sup>14</sup> Test slightly arched, comprised of five chambers. With the exception of the final chamber, the chambers are all of approximately the same size. The initial chamber is rounded, the final one somewhat elongated, separated by an inclined suture, terminating in a neck upon which a radiate aperture is situated. Rare.

28. *Dentalina* cf. *soluta*? Reuss

pl. 2, fig. 9

*Dentalina soluta* Reuss, 1851, p. 60, pl. 3, fig. 4.  
*Nodosaria soluta* [Reuss]. Bornemann, 1855, p. 322. Test comprised of four chambers, slightly arched. Chambers increase rapidly in size, separated by depressed sutures. The final chamber is largest, elongated, and terminates in a neck. Septae between the chambers are thick and possess scattered channels. This specimen exists only as a thin section. Because of the lack of data on its external morphology, I am not certain of its identification. However it resembles the above form in both shape and in the size and arrangement of the chambers.

29. *Dentalina* cf. *abnormis* (Reuss)

pl. 2, figs. 10, 11

*Dentalina abnormis* Reuss, 1863, p. 46, pl. 1, fig. 12.<sup>15</sup> This form is also only present in my thin sections. The outline of the three-chambered specimen, the shape and arrangement of the chambers corresponds well to the diagnosis given by Reuss.

c. *Cristellarinae*

Genus *Cristellaria* Lamarck

30. *Cristellaria cymboides* d'Orbigny

pl. 2, fig. 1

*Cristellaria cymboides* d'Orbigny<sup>16</sup>. Hantken, 1875, p. 49, pl. 5, fig. 3.

Test rectilinear, flattened, with six chambers separated by sutures that are indistinct in early chambers. Sutures are inclined and quite deep. The two final chambers are quite large. Aperture radiate, on a neck. Rare.

31. *Cristellaria fragaria* (Gümbel)

pl. 2, fig. 3

*Marginulina fragaria* Gümbel, 1868, p. 635, pl. 1, fig. 58.

*Cristellaria fragaria* (Gümbel). Hantken, 1875, p. 53, pl. 6, fig. 1-3.

My specimen is damaged, the final chamber is missing. However the shape of the test, arrangement of chambers and sutures as well as the ornamentation of the test agree completely with the descriptions and figures of Gümbel and Hantken. Rare.

32. *Cristellaria* sp?

pl. 2, fig. 7

Test has a knee-like bend, comprised of five chambers. The bend is at the second chamber. Later chambers are separated by inclined sutures. The final chamber is the largest, comprises one-third of the test, is elongated, and has a produced neck that is bent slightly towards the dorsal side, upon which the aperture is located. Length 0.25 mm. A single specimen from a thin section.

<sup>14</sup> [= *Nodosaria* (*Dentalina*) *obliquata*, Reuss, 1863, p. 46, pl. 2, fig. 25.]

<sup>15</sup> [= *Nodosaria* (*Dentalina*) *abnormis*, Reuss, 1863.]

<sup>16</sup> [= *Cristellaria cymboides* d'Orbigny, 1846, p. 85, pl. 3, figs. 30-31.]

Genus *Marginulina* d'Orbigny33. *Marginulina ostiata* n.sp.<sup>17</sup>

pl. 2, fig. 12

Test straight, comprised of four chambers. The first chamber is in the shape of a spine. The next three are wider, but shorter. The aperture is on a small neck at the top of the last chamber. Each of the early chambers has a small, elongated scar. These are arranged in a straight line and are probably traces of previous apertures. The presence of such a scar on the bottom spine convinced me that this is the first chamber. Sutures distinct, slightly depressed. Length 1 mm. Rare.

Genus *Robulina* d'Orbigny34. *Robulina arcuato striata* Hantken

pl. 2, fig. 14

*Robulina arcuato striata* Hantken, 1875, pl. 7, fig. 2.*Robulina alatolimbata* Gumbel, 1868, pl. 5, fig. 70.

Test round, lenticular. The final whorl is comprised of six to eight chambers that arch towards the back. The periphery of the test is surrounded by a keel. The umbilical boss is distinct. Aperture radiate. Common.

35. *Robulina rotulata* Lamarck

pl. 2, fig. 15

Synonyms listed by Brady, 1884, p. 547.

Test round, lenticular. The final whorl is comprised of 10 - 12 narrow chambers separated by sutures that are indistinct near the umbilicus, but which become visible as weak bands towards the periphery. Periphery thickly keeled. The final chamber is somewhat truncated. Aperture is a finely radiate narrow slit. Diameter 0.7 - 1.8 mm. Common.

36. *Robulina crassa* d'Orbigny

pl. 2, fig. 16

Synonyms listed by Brady, 1884.

Test large, oval in outline. Chambers weakly visible, seven in the last whorl. The final chamber is the largest and occupies nearly

one-third of the whole test. Periphery acute. Aperture is a large oval opening, only slightly radiate near the edge of the test. Rare.

37. *Robulina subangulata* (Reuss)<sup>18</sup>

pl. 2, fig. 17

*Cristellaria subangulata* Reuss, 1866, p. 144, pl. 3, fig. 17.

Test round, with seven chambers in the last whorl and distinct sutures that extend to the umbilicus as arched lines. Periphery blunt. Aperture produced onto a small neck, radiate. Rare.

38. *Robulina radiata* Bornemann

pl. 2, fig. 18

*Robulina radiata* Bornemann, 1855, p. 334, pl. 15, fig. 1.

*Cristellaria radiata* (Bornemann). Uhlig, 1886, p. 169. Test round, lenticular. The final whorl is comprised of 10 - 11 chambers separated by arched sutures that extend from the small umbilical plate. The periphery is weakly keeled. Aperture radiate. Very common.

39. *Robulina cincta* n.sp.<sup>19</sup>

pl. 2, fig. 19

Test rounded, strongly convex on both sides, with eight chambers in the final whorl. Sutures extend out from the large but indistinct umbilical boss, arching back towards the keeled periphery. Aperture normal. This species resembles *Robulina radiata*, but differs in its large umbilical boss and greater thickness. Diameter 0.6 mm. Rare.

40. *Robulina fallax* n.sp.<sup>20</sup>

pl. 2, fig. 20

Test round, lenticular. Sutures are so indistinct, that on a large number of specimens they are not visible at all, and can only be observed in thin sections. Sutures eight in number, and

<sup>18</sup> [This species is known from the Lower Cretaceous. It was probably misidentified here.]

<sup>19</sup> [*Cristellaria cincta* (Grzybowski), Maslakova, 1955, p. 54, pl. 4, fig. 3, 4.]

<sup>20</sup> [Maslakova (1955, p. 54) listed this as a synonym of *Cristellaria cincta* (Grzybowski)]

<sup>17</sup> [Liszka (1974) placed this species in the genus *Bicornifera* Lindenberg, 1965 (*Incertae sedis*). According to Szczechura (1992) it is probably a bryozoan.]

arch back towards the keeled periphery. The final chamber is rounded, and terminates in a low apertural neck with a radiate aperture. The keel that surrounds the aperture bifurcates and extends down the edges of the final chamber towards the centre. Similarly, along the wall of the visible chamber such a keel extends towards the umbilicus, thereby outlining a field in the shape of an arrowhead at the front of the test. Diameter 0.5 mm. Rare.

#### d. Polymorphininae

Genus *Globulina* d'Orbigny

#### 41. *Globulina inflata* Reuss

pl. 2, fig. 21

*Globulina inflata* Reuss, 1851, p. 81, pl. 6, fig. 45.

Test spherical, slightly compressed laterally, oval in outline. Sutures are indistinct. Aperture slightly elevated, radiate. Rare.

Genus *Polymorphina* d'Orbigny

#### 42. *Polymorphina deplanata* (Reuss)

pl. 2, fig. 22

*Guttulina deplanata* Reuss, 1856, p. 246, pl. 6, fig. 67.

Test elongated, tapered at both ends. Chambers are separated by distinct sutures. Aperture radiate, on a produced neck. Rare.

#### 43. *Polymorphina humboldti* Bornemann

pl. 2, fig. 24

*Polymorphina humboldti* Bornemann, 1855, p. 347, pl. 18, fig. 7.

Test broad, flattened on one side, convex on the other side. Three chambers are visible on the convex side, with a fourth indistinct. On the flattened side three chambers are visible. The final chamber ends in a produced neck, with a radiate aperture. Rare.

#### 44. *Polymorphina deflexa* n.sp.

pl. 3, figs. 1, 2

Test with elongated, inflated chambers separated by flush sutures. The four trochospiral chambers impart a curved aspect to the test. Aperture a narrow slit on a produced neck. The most closely allied species is *Polymorphina problema* d'Orbigny. Length 1.0 - 1.2 mm. Rare.

#### 45. *Polymorphina obovata* n.sp.

pl. 2, fig. 23

Test elliptical in outline. The slightly depressed suture between the ultimate and penultimate chambers gives the impression that the test is comprised of only two chambers, as in *Biloculina*. Three chambers are visible. The proloculus is indistinct. Aperture radiate, on a low, broad neck. The most closely allied species is *Polymorphina amplectens* Reuss. Length 1.2 mm. Rare.

#### 46. *Polymorphina lanceolata* Reuss

pl. 2, fig. 2

*Polymorphina lanceolata* Reuss, 1851, p. 83, pl. 6, fig. 50.

*Polymorphina lanceolata* Reuss. Brady, 1884, p. 564, pl. 74, figs. 5-6.

Test long, straight. Chambers are apparently biserial, with seven in each row, separated by slightly depressed sutures. Similar to *Cristellaria* in outline. Length 2.5 mm. Very rare.

#### Globigerinidae

Genus *Sphaeroidina* d'Orbigny

#### 47. *Sphaeroidina austriaca* d'Orbigny

pl. 1, fig. 13<sup>21</sup>

*Sphaeroidina austriaca* d'Orbigny.<sup>22</sup> Hantken, 1875, p. 62, pl. 10, fig. 4.

Test spherical, with four chambers clearly defined. Aperture at the edge of the last chamber. Rare.

#### Rotalidae

##### a. Rotalinae

Genus *Discorbina* Parker and Jones

#### 48. *Discorbina pusilla* Uhlig

pl. 3, figs. 3-7

*Discorbina pusilla* Uhlig, 1886, p. 42, pl. 5, figs. 12, 13.

Test circular or somewhat oval in outline. Umbilical side strongly convex, spiral side less convex. On the umbilical side only the

<sup>21</sup> [The figure is missing from the plate.]

<sup>22</sup> [= *Sphaeroidina austriaca* d'Orbigny, 1846, p. 284, pl. 20, figs. 19-20.]

last whorl is visible, with five or six chambers. Sutures on the umbilical side are visible usually as shallow depressions, less often as distinct lines. In the centre where the sutures meet there is a small, irregular, umbilical depression, formed by the surfaces of the triangular chambers, which do not extend exactly to the centre. At the edge of the last septum a narrow slit extends towards the periphery of the test, comprising the aperture. Two whorls are visible on the spiral side. The final whorl is comprised of distinct chambers with raised sutures that merge into the keel surrounding the test. The inner whorl also contains six chambers and a somewhat large proloculus. However, the inner whorl is not clearly visible in most cases. I had originally planned to separate my specimen with a distinct inner whorl as a different species. According to Uhlig's description it would be similar to *Discorbina floscellus* Schwager [1883], which he considers related to *D. pusilla*<sup>23</sup>. However, examination of additional specimens has brought to light the existence of intermediate forms between these two end members. Very common.

49. *Discorbina concinna* Brady

pl. 3, fig. 9

*Discorbina concinna* Brady, 1884, p. 646, pl. 90, fig. 7, 8.

Test round, umbilical side convex, spiral side flat. Two and one-half whorls are visible on the spiral side. The last whorl is comprised of six narrow and long chambers, separated by distinct, depressed, sutures that are slightly arched toward the back. The umbilical side resembles a shield, upon which sutures extend to a slightly depressed centre in a stellate pattern. Aperture at the edge of the umbilical side. Rare.

50. *Discorbina parisiensis* d'Orbigny

pl. 3, fig. 8

Synonyms are listed by Brady, 1884.

Test small, loaf-shaped. Umbilical side convex, comprised of 11 chambers separated by depressed sutures that strongly arch back towards the periphery. With the exception of the two final chambers, the chambers do not differ markedly in dimensions - they are low and wide. On the flat spiral side only one whorl is visible. Sutures on this side are arched and relatively deeply depressed. Aperture near the centre at the edge of the last chamber. Periphery rounded, slightly lobate. Rare.

51. *Discorbina uhligi* n.sp.

pl. 3, figs. 10, 11

Test conical with a rounded apex. Spiral side convex, umbilical side flat or somewhat concave. Three whorls are visible on the spiral side. The final two whorls contain eight chambers separated by flush sutures that arch slightly back. The chambers and sutures are only clearly visible on the last whorl. The remainder of the surface on the spiral side is covered with large pores, the orientation of which is so well-defined, that they give the impression of being short striations at the edge of a given whorl. The umbilical side is rarely distinct. Straight sutures extend out in a stellate pattern from the umbilical depression, which most often is covered with a porcellaneous substance and is only apparent after grinding. The area between the sutures is also filled with this porcellaneous substance, upon which are imprinted various lines, which are probably impressions of the base to which the test was attached. Periphery sharp, wedge-shaped, often slightly protruding. Aperture on the internal edge of the last chamber, near the centre.

This species is intermediate between *Discorbina turbo* d'Orbigny, and *Discorbina patelliformis*, from which it differs in possessing a complete periphery, whereas the former has an incised periphery. This is undoubtedly the same species that Uhlig [1886, p. 43] mentioned in his paper as a new, unnamed species. Similar to *Discorbina turbiformis* Rzehak. Diameter 0.5 - 1.0 mm. Very common.

<sup>23</sup> I have unfortunately not been able to obtain a copy of Schwager's paper.

Genus *Truncatulina* d'Orbigny

52. *Truncatulina tenella* Reuss

pl. 3, fig. 13

*Truncatulina tenella* Reuss, 1865, p. 477, pl. 5, fig. 6.  
Test round, with two whorls on the flat spiral side. Ten chambers are visible in the final whorl. On the umbilical side only the final whorl is visible. Chambers increase in width rapidly, and are separated by sutures that curve toward the back. Sutures depressed, extending to the umbilicus. Rare.

53. *Truncatulina lucilla* Rzehak<sup>24</sup>

pl. 3, fig. 16

*Truncatulina lucilla* Rzehak, 1887b, p. 135.  
Test round, surrounded by a keel. On the umbilical side one whorl is visible, comprised of 10 chambers. Chambers are separated by straight, deeply depressed sutures that extend to the centre of the test, resulting in a depression. On the spiral side, part of the interior whorl is visible. Aperture on the lower side of the last septum, near its edge. Some of Rzehak's specimens display coarse pores and a raised sculpture on the test. In my material, I found only two specimens: one of which is well-preserved but does not possess any raised sculpture. On the second the sculpture is present, but because it is damaged, it is not very distinct. Despite this, my specimens agree well with Rzehak's material. Rare.

54. *Truncatulina livida* n.sp.

pl. 4, fig. 19

Test round. On the umbilical side one whorl is visible, comprised of 13 low, wide chambers, separated by depressed, slightly curved, sutures. On the spiral side the chambers of the internal<sup>25</sup> whorl do not extend to the centre,

which leaves part of the interior whorl visible. Periphery sub-acute, slightly incised. Aperture as in *Truncatulina lucilla*. Diameter 0.8 mm. From the material of Rzehak, *Truncatulina indifferens* is the closest form. *Truncatulina livida* differs in its larger dimensions and incised periphery. Rare.

55. *Truncatulina hantkeni* Rzehak<sup>26</sup>

pl. 3, fig. 17

*Truncatulina hantkeni* Rzehak, 1888b, p. 228.  
Test round. On both sides the inner whorl is partially visible. The outer whorl contains six to eight chambers separated by straight, slightly depressed sutures. Aperture at the edge of the last chamber near the periphery of the test. Periphery weakly rounded. Most of the specimens in my collection display a slight deformation of the test, which does not occur in Rzehak's material (with the exception of a single specimen that shows slight deformation). Diameter 0.5 to 1.0 mm. Very common.

56. *Truncatulina communis* Römer

pl. 3, fig. 12

*Truncatulina communis* Römer<sup>27</sup>. Reuss, 1856, p. 242, pl. 5, fig. 56.

Test rounded. The spiral side is flattened and displays two whorls, with seven to eight chambers in the final whorl, separated by straight sutures. Only the final whorl is visible on the umbilical side. Sutures extend to the centre, forming a small umbilical depression. Aperture at the internal edge of the last chamber. Common.

57. *Truncatulina grosserugosa* Gümbel

*Truncatulina grosserugosa* Gümbel, 1868, p. 660, pl. 2, fig. 104.

*Truncatulina grosserugosa* Gümbel. Hantken, 1875, p. 175, pl. 2, fig. 16-21.

<sup>24</sup> [Rzehak (1887) only listed this name in a table, and the species is considered *nomen nudum* under the rules of the ICZN. Because Grzybowski provided the first valid description, authorship of the species has been transferred to him under Art. 21 of the ICZN.]

<sup>25</sup> [perhaps this is a misprint and Grzybowski means "external"?]

<sup>26</sup> [Authorship of this species has been transferred to Grzybowski under Art. 21 of the ICZN. Maslakova (1955) transferred the species to *Anomalina*]

<sup>27</sup> [= *Truncatulina communis* Römer, 1838, p. 389, pl. 3, fig. 56.]

Test oval in outline. Umbilical side strongly convex, spiral side flat. On the spiral side two whorls are weakly visible, with 8 - 9 chambers in the outer whorl. On the umbilical side only the final whorl is visible, with very poorly defined sutures. Common.

58. *Truncatulina omphalia* n.sp.

pl. 3, fig. 14

Test oval in outline. On the convex umbilical side only the final whorl is visible, consisting of 10 low, wide chambers that are nearly triangular. Their shoulders meet near the centre, forming a deep umbilicus. The spiral side is concave and irregularly bent, indicating that this side was attached to the substrate. Sutures extend in straight lines, and only a single whorl is visible. Periphery acute, keeled. The keel bifurcates at the top of the last chamber and surrounds the apertural face. On the spiral side, the keel runs along the edge of the last chamber, finally bending towards the centre of the test. The keel that runs along the edge of the umbilical side turns towards the older part of the test after reaching the umbilicus, and extends towards the periphery. Aperture a distinct opening at the edge of the last chamber, visible from the spiral side as a wide slit beneath the keel.

This species resembles *T. grosserugosa* Gumbel in the shape and number of chambers, concavity of the spiral side, and in the shape of the aperture. However, the presence of a depressed umbilicus and a bifurcating keel are the distinguishing traits of this species. Rare.

59. *Truncatulina refulgens* Monfort

pl. 3, fig. 15

Synonyms are listed by Brady, 1884, p. 659.

Test oval. Umbilical side convex, spiral side depressed. On the umbilical side seven chambers are visible in the last whorl. Chambers are separated by clearly defined, flush sutures which become wavy near the periphery. On the spiral side traces of the previous whorl are seen. Sutures are not very distinct, and are obscured by traces of the substrate to which it was attached. Periphery acute. Aperture a

narrow slit at the edge of the last chamber. Rare.

60. *Truncatulina rzehaki* n.sp.<sup>28</sup>

pl. 4, figs. 1-5

Test oval. The shape of the test is quite variable, being elongated in one or another direction depending on the substrate upon which it grew. Umbilical side convex, spiral side depressed, bent in various ways. On the umbilical side one whorl is visible, with five to six chambers and depressed sutures. The spiral side is furrowed, and the sutures are indistinct. Periphery acute. Aperture as in *T. refulgens*. Diameter 0.6 - 1.0 mm. Very common.

61. *Truncatulina subrefulgens* Rzehak<sup>29</sup>

pl. 4, figs. 6, 10, 11

*Truncatulina subrefulgens* Rzehak, 1887b, p. 135.

Test concavo-convex, with indeterminate structure. On the spiral side, sutures are not distinct, deformed by the substrate to which it was attached. On the umbilical side 7 - 8 chambers are visible. The direction of coiling is difficult to follow because one or two chambers are attached to the sides and do not extend to the umbilicus, or the test is covered with adjacent chambers. Periphery sharp. Aperture very indistinct, at the border between two chambers. Diameter 1.5 - 2.0 mm.

My specimens differ somewhat from Rzehak's, which possess more characters that show affinity to *T. rzehaki*. However because traits suggesting a greater degree of compression and a more flaring test are only sporadic, I retained the name given by Rzehak. Common.

Genus *Pulvinulina* Parker and Jones<sup>30</sup>

62. *Pulvinulina concentrica* Parker and Jones

pl. 4, fig. 9<sup>31</sup>

<sup>28</sup> [Vasilenko (1955, p. 137, pl. 21, figs. 4,5) transferred this species to *Cibicides*.]

<sup>29</sup> [Authorship of this species has been transferred to Grzybowski under Art. 21 of the ICZN.]

<sup>30</sup> [Grzybowski did not list the authorship.]

<sup>31</sup> [Smigielska (1961) regarded this to be a specimen of *Schlosserina asterites* (Gumbel)]

*Pulvinulina concentrica* Parker and Jones.<sup>32</sup> Uhlig, 1886, pl. 3, fig. 3, 4.

This species is found in massive numbers. It corresponds precisely to the description and drawings given by Uhlig, with the exception that he reported its dimensions as 0.5 -1.2 mm. In my material, specimens as large as 2.0 mm are not uncommon. Very common.

63. *Pulvinulina bimammata* (Gümbel)

*Rotalia bimammata* Gümbel, 1868, p. 649, pl. 2, fig. 85.

*Pulvinulina bimammata* (Gümbel). Uhlig, 1886, p. 192, pl. 3, fig. 7, 8.

Test round, unevenly biconvex. On the spiral side, which is less convex, there are three to four narrow whorls. Chambers very numerous, as many as 18 in the last whorl, separated by distinct backward-inclined sutures. On the more convex umbilical side only one whorl is visible. The umbilicus has a distinct plate, from which the sutures radiate, then bifurcate, and connect with the adjacent ones. Aperture a narrow slit on the internal surface of the last chamber. Common.

64. *Pulvinulina rotula* Kaufmann

*Rotalia campanella* Gümbel, 1868, p. 650 pl. 2, fig. 86.

*Pulvinulina rotula* Kaufmann. Uhlig, 1886, p. 193, pl. 3, fig. 5-6.

Similar to the above species [*Pulvinulina bimammata*], differing only in its less convex spiral side, more convex umbilical side, and smaller size. Periphery acute. Common.

65. *Pulvinulina oblonga* Williamson

pl. 4, fig. 8.

Synonyms are listed by Brady, 1884.

Test elongated, oval. Two whorls are visible on the spiral side, with nine chambers in the last whorl. Sutures distinct, gently arched towards the back. Chambers increase in size rapidly. Their width is double the height. Only the final whorl is visible on the umbilical side. On that side the last chamber appears to occupy nearly one-half of the test.

Aperture on the internal surface of the last chamber on the umbilical side. Rare.

66. *Pulvinulina herculea* n.sp.

pl. 4, fig. 7

Test oval. Only one whorl visible on either side. The spiral side displays six low, rapidly enlarging, triangular, chambers separated by slightly depressed sutures. The chambers on this side do not differ greatly in size from one another - only the final ones are somewhat larger and more rounded. Sutures extend at an angle towards the periphery. On the umbilical side the chambers extend to the centre of the test. Chambers are narrower. The final chamber occupies nearly one-half of the test, and extends down to cover the inner whorl. Aperture a slit at the edge of the last chamber on the umbilical side. Length 0.8 mm. Rare.

Genus *Rotalia* Lamarck<sup>33</sup>

67. *Rotalia romeri* Reuss

*Rotalia romeri* Reuss, 1856, p. 240 pl. 4, fig. 52.

Test round, lenticular. On the spiral side two whorls are visible, with seven to eight chambers in the last whorl. Sutures are only distinct between the final chambers. Only the final whorl is visible on the umbilical side, comprised of triangular chambers that meet in the centre to form an umbilical depression. Aperture at the edge of the internal margin of the last chamber. Rare.

68. *Rotalia grata* Reuss

pl. 4, fig. 15

*Rotalia grata* Reuss, 1866, p. 163, pl. 4, fig. 17.

Test round, flattened on the spiral side, convex on the umbilical side. On that side two whorls are visible, with five chambers in the last whorl, separated by sutures inclined towards the back. On the umbilical side the sutures extend to the centre as wavy lines. Aperture a narrow slit at the edge of the last chamber. Common.

69. *Rotalia lithothamnica* Uhlig

<sup>32</sup> [= *Pulvinulina concentrica* Parker & Jones, 1864, p. 470, pl. 48, fig. 14.]

<sup>33</sup> [Grzybowski did not list the authorship.]

pl. 4, fig. 13, 14

*Rotalia lithothamnica* Uhlig, 1886, p. 195, pl. 5, fig. 9, 11.

Test rounded, lenticular. On the spiral side two to three whorls are visible. The last whorl has 9 - 11 chambers separated by sutures inclined towards the back. On the umbilical side the sutures connect with a large, narrow furrow surrounding the umbilicus. On that side numerous small furrows extend out from the sutures. On some specimens they are irregular, and join up with the furrows from adjacent sutures. On other specimens, they are arranged like the veins on a feather, and in the area between the sutures they alternate with others. The furrows reach the periphery of the test, where they are most apparent. Occasionally individual furrows cross over to the spiral side. Aperture a narrow slit at the edge of the last chamber. Very common.

70. *Rotalia orbicularis* d'Orbigny

pl. 4, fig. 16

*Rotalia orbicularis* d'Orbigny. Brady, 1884, p. 706, pl. 115, fig. 6.

Test round, biconvex. The spiral side is conical, with two whorls visible. The outside whorl consists of 12 narrow chambers, separated by flush, angular sutures. The umbilical side is loaf-shaped with a depression in the centre, formed by the sutures of the final visible whorl. Aperture as in the previous species [*Rotalia lithothamnica*]. Rare.

71. *Rotalia truncana* Gümbel

pl. 4, fig. 18

*Rotalia truncana* Gümbel, 1868, p. 653, pl. 2, fig. 93a-c. Test round, biconvex. The spiral side consists of about 2 1/2 whorls with numerous chambers separated by angular sutures. On the umbilical side I counted 17 chambers in the last whorl. The sutures are flush, and are curved toward the back, and form a small umbilical depression. The periphery is acute, keeled. This form differs from the one given by Gümbel in possessing 17, rather than 10, chambers. Gümbel's figures, however, are ambiguous. In his description, Gümbel reports "numerous chambers", and in one of his figures

he depicts 18 chambers on the spiral side. However, the umbilical side possesses only 10 chambers. With the exception of this difference, my form agrees with Gümbel's description of the species. Rare.

72. *Rotalia hantkeni* n.sp.

pl. 4, fig. 17

Test round, equally biconvex. The spiral side displays two whorls, with 12 - 13 narrow chambers in the last whorl, separated by angular sutures. Only the final whorl is visible on the umbilical side, with straight sutures developed as light bands comprised of a porcellaneous substance, which differ markedly from the thinner material of the areas between. These bands end at the umbilicus, where they form a small depression around a small umbilical knob made out of the same porcellaneous substance. Periphery acute, with an angular keel on the older portion of the test. Aperture near the edge of the last chamber. Diameter 0.8 mm. Rare.

b. Tinoporinae

Genus *Gypsina* Carter

73. *Gypsina globulus* Reuss

*Gypsina globulus* Reuss. Uhlig, 1886, p. 197.

*Gypsina globulus* Reuss. Brady, 1884, p. 717, pl. 101, fig. 8.

This form is very common and corresponds exactly to Uhlig's description, with specimens exceeding 1.4 mm in diameter.

Nummulitidae

a. Nummulininae

Genus *Operculina* d'Orbigny

74. *Operculina* sp. ?

Several fragments belonging to this genus are in my collection. One whole specimen is poorly preserved, but has an overall shape and sutures similar to *Operculina ammonaea* Leymerie<sup>34</sup>.

<sup>34</sup> [Grzybowski incorrectly cited the authorship of this species - the correct citation is given here. *Operculina ammonaea* Leymerie, 1846 is the type species of *Frillia* de Gregorio, 1894, regarded by

Genus *Heterostegina* d'Orbigny

75. *Heterostegina* n.sp. ind.<sup>35</sup>  
pl. 4, fig. 21

I possess only a broken, flattened specimen that is thickened near the proloculus. Sutures are very strongly arched towards the back. Near the umbilicus, these sutures become folded and lose themselves among the pustules covering the umbilicus.

Genus *Nummulites* Lamarck

76. *Nummulites boucheri* de la Harpe  
pl. 4, fig. 20

*Nummulites striata* var. Hantken, 1875, p. 85, pl. 12, fig. 5.

*Nummulites boucheri* de la Harpe<sup>36</sup>. Uhlig, 1886, p. 65, pl. 2, figs. 7, 8, 10.

Test lenticular. Surface covered with extensions of the internal septae radiating out from the centre. Diameter 1.0 - 2.5 mm. A specimen 2.5 mm in diameter had four visible whorls, with 21 chambers in the last whorl. Common.

77. *Nummulites semicostata* Kaufmann

*Nummulites semicostata* Kaufmann. Uhlig, 1886, p. 207, pl. 2, figs. 9, 13, 14.

Test lenticular, thick, somewhat more inflated on the centre of one side. Internal septae are very weakly visible on the surface. Diameter 1.0 - 1.2 mm. Two-millimetre specimens consist of 3 1/2 whorls with 17 chambers in the last whorl. The proloculus is comparatively large. Rare.

## b. Cycloclypeinae

Genus *Orbitoides* d'Orbigny

78. *Orbitoides stellata* d'Archiac

*Orbitoides stellata* d'Archiac. Gümbel, 1868, p. 713 pl. 2, fig. 115; pl. 4, figs. 5-7.

*Orbitoides stellata* d'Archiac. Hantken, 1875, p. 84, pl. 9, fig. 9.

*Orbitoides stellata* d'Archiac. Uhlig, 1886, p. 203.

I only found five specimens, only one of which is complete.

79. *Orbitoides aspera* Gümbel

*Orbitoides aspera* Gümbel, 1868, p. 698, pl. 3, figs. 1, 2, 30, 31.

*Orbitoides aspera* Gümbel. Hantken, 1875, p. 82, pl. 9, fig. 4.

A single well-preserved specimen. Diameter 4 mm.

## Ostracoda

Genus *Cytherella* Bosquet

80. *Cytherella compressa* Bosquet<sup>37</sup> var.  
pl. 5, fig. 6

*Cytherella compressa* Bosquet, 1852, p. 28, pl. 1, fig. 13.

*Cytherella compressa* Bosquet. Egger, 1858, p. 404, pl. 14, fig. 2.

Carapace oval, Dorsal margin nearly straight, falling in a gentle arch toward the ventral side. Posterior margin rounded, ventral straight. Surface simple, only on the ventral side two or three ridges are visible, which are parallel to the ventral margin and extend farther to the posterior than to the anterior. The presence of these ridges and the slightly greater width of the carapace are traits that distinguish this variety from Bosquet's species. However, these differences are too subtle to warrant creating a new species. Rare.

Genus *Cythere* Müller

81. *Cythere striato reticulata* n.sp.  
pl. 5, fig. 1

Carapace elongated. Dorsal and ventral margins are parallel. The dorsal margin is longer, and curves toward the posterior in a narrow arch. The posterior margin curves toward the ventral margin in a sharper, longer arch. The ventral margin is bent slightly inwards. The

Loeblich and Tappan (1964) as a junior synonym of *Nummulites* Lamarck, 1801.]

<sup>35</sup> [Smigielska (1961) regarded this to be a specimen of *Grzybowskia multifida* Bieda, 1950. Loeblich and Tappan (1988) listed *Grzybowskia* as a synonym of *Heterostegina* d'Orbigny, 1826.]

<sup>36</sup> [= *Nummulites boucheri* de la Harpe, 1879, p. 146, pl. 1, figs. 1-10.]

<sup>37</sup> [The correct citation is *Cytherella compressa*, Münster, 1830. Bosquet, 1852.]

anterior margin is symmetrical to the dorsal and ventral margins. The right valve slightly overlaps the left valve at the dorsal and ventral margins. The surface is covered by ridges that run parallel to the margins. Smaller zigzag transverse ridges intersect these ridges, forming an irregularly hexagonal network. On the dorsal and ventral sides, the parallel ridges are more distinct, and the carapace appears to be covered with concentric arches that are aligned to the medial axis. The same is visible in anterior view. In posterior view, where the carapace is narrow, they give the impression that the valves are open. Cross section is rounded. Length 1.0-1.3 mm, thickness about half as much. Differs from *C. striatopunctata* Roemer (Bosquet, 1852, p. 31, pl. 3, fig. 1) in the lack of transverse ridges. Common.

82. *Cythere areata* n.sp.

pl. 5, fig. 2

Carapace small, lower at the front than at the back. The dorsal margin is wide, angled toward the front, forming a beak from which the anterior margin gently arches toward the ventral margin. The ventral margin is slightly concave, shorter, and arches gently into the posterior margin, which forms a nearly right angle with the dorsal margin. The carapace is inflated on both sides, in two wings that diverge strongly from the anterior margin, and gently flatten out toward posteriorly. The peripheral margin is of even thickness around the carapace. The margins of the valves that form the periphery diverge on the ventral side, and converge again at the anterior margin, creating a rhomboid space between them. The surface is covered with a network of ridges as in the preceding species [*C. striato reticulata*], but because of the convexity of the carapace, they appear less regular. The closest species is *C. truncana* Reuss, 1850. Length 0.8 - 1.0 mm. Very common.

Genus *Bairdia* McCoy<sup>38</sup>

83. *Bairdia marginata* Bosquet

pl. 5, fig. 3

Carapace elongated, highest in the centre, rounded toward the anterior, forming a beak that lies closer to the dorsal margin on the posterior end. Surface smooth. The left valve almost wholly embraces the right one. Cross section ovoid to heart-shaped. Very common

84. *Bairdia acuta* Bosquet

pl. 5, fig. 5

*Bairdia acuta* Bosquet, 1858, p. 33, pl. 5, fig. 14.

Carapace elongated, resembling a piece of a circle in lateral view. Dorsal margin straight, ventral arched. Anterior and posterior margins tapering. Common.

85. *Bairdia retracta* n.sp.

pl. 5, fig. 4

Carapace elongated. Dorsal margin straight, anterior gently rounded, ventral arched. Posterior margin arches to the dorsal in a gentle curve, to the ventral it has a gentle transition. In dorsal view, the left valve strongly overlaps the right valve only in the centre. On the ventral side, it overlaps along its whole length. Rare.

*Lithothamnium* Philippi<sup>39</sup>

1. *Lithothamnium nummuliticum* Gumbel

pl. 5, figs. 7, 8

*Lithothamnium nummuliticum* Gumbel, 1871, p. 37, pl. 1, fig. 2.

*Lithothamnium nummuliticum* Gumbel. Rothpletz, 1891, p. 316, pl. 17, fig. 5.

Fragments of this species resemble an irregular net in thin section, with cells 13-15  $\mu\text{m}$  and even 20  $\mu\text{m}$  wide, and with a perithallium to 30  $\mu\text{m}$  long. In one specimen, tetraspores 40-45  $\mu\text{m}$  wide, 75-80  $\mu\text{m}$  long were found which were ovoid in shape with acute margins. They

<sup>38</sup> [Grzybowski consistently used the spelling "Bayrdia".]

<sup>39</sup> [The genus *Lithothamnium* Philippi, 1837 was rejected by Woelkerling (1985) in favour of *Lithothamnium* Heydrich, 1897 because of the lack of a type species.]

were aligned in arches and separated from one another by thickened walls that comprised of several (6-10) rows of somewhat compressed cells. On one thin section the fan-shaped structure of the branches is clearly visible. In a cross-section of one of these branches, the interior cells form a network of hexagonal cells 15  $\mu\text{m}$  in diameter. Adjacent cells, cut at an angle, appear as hexagons that are elongated in one direction. External cells cut longitudinally appear rectangular. Interior of the cells is filled with calcite.

2. *Lithothamnium suganum* Rothpletz  
pl. 5, fig. 10

*Lithothamnium suganum* Rothpletz, 1891, p. 319, pl. 17, fig. 4.

Very numerous fragments comprised of cells 9  $\mu\text{m}$  wide and 13  $\mu\text{m}$  long. The cells are arranged concentrically. Some consist of somewhat compressed and shorter cells, and form especially on thicker slides, dark concentric rings. Rothpletz mentioned such a structure in his paper, and regarded this trait to be important enough to create a new species, but did not formally separate it from among the 13 species he described. In two specimens, conceptacles were found, which convinced me to place this form in *L. suganum*. These are elongated, 100  $\mu\text{m}$  high, 250  $\mu\text{m}$  long, in only one case reaching 300  $\mu\text{m}$ . From the floor to the roof, several rows of cells occur which are in the shape of poles supporting the roof. This type of structure is the distinguishing feature of the species according to Rothpletz.

3. *Lithothamnium aschersoni* Schwager<sup>40</sup>  
pl. 5, fig. 11

*Lithothamnium aschersoni* Schwager. Rothpletz, 1891, p. 316.

This species appears in thin section as a net comprised of nearly square cells 12  $\mu\text{m}$  wide and 15  $\mu\text{m}$  long. In the perithallium, very closely adjacent tetraspores are found, arranged in an arch. The tetraspores are 36  $\mu\text{m}$

wide, 75  $\mu\text{m}$  long, are ovoid in shape and have sharpened points.

4. *Lithothamnium racemus* Areschoug  
pl. 5, fig. 9

*Lithothamnium racemus* Areschoug. Rothpletz, 1891, p. 320, pl. 16, figs. 4, 7, 8, 11, 12, 15.

Within a meshwork of cells 10-12  $\mu\text{m}$  wide, 15  $\mu\text{m}$  long conceptacles are found that are 200  $\mu\text{m}$  high and 450  $\mu\text{m}$  long. The hypothallium sometimes grows over the perithallium, covering its surface and thereby forming two distinctly separated layers.

5. *Lithothamnium* sp. ?  
pl. 5, figs. 12-13.

In addition to the species above, I encountered other forms in my slides which cannot be placed in named species. These are in the form of club-shaped branches, which in longitudinal section consist of both a perithallium and hypothallium. In the hypothallium cells are 12  $\mu\text{m}$  wide and 45  $\mu\text{m}$  long. In some specimens they are arranged in an arch from the centre to the perithallium, in others they are sinuous. This gives the specimens the look of a fabric that is made of bent, long and narrow tubes. In the perithallium the cells are nearly square, 12  $\mu\text{m}$  wide and 15  $\mu\text{m}$  long. Because of the lack of reproductive structures, I hesitate to place these specimens in a new species.

To end this description of the species found in the Carpathian sandstones from Folsz, I present in the table below a comparison between various foraminiferal faunas. I have considered (1) the fauna from Wola Łużańska, (2) the fauna of the *Clavulina szaboi* beds described by Hantken, (3) the Bartonian fauna from Waschberg and Michelsberg described by Rzehak, and (4) the Ligurian fauna from Nikoltschitz, also described by Rzehak.

<sup>40</sup> [Now placed in *Sporolithon* Heydrich, 1897 based on a revision of type material by Moussavian and Kuss (1990).

Table 1. A list of foraminiferal species identified in this paper, with a comparison to previously described faunas. W.L. = Wola Łużańska; Cl.S. = Clavulina szaboi beds; W.M. = Waschberg and Michelsberg; Nik = Nikolschütz.

Species	Abund.	Pl.	Fig.	W.L.	Cl.S.	W.M.	Nik.
<b>A. Lituolidae</b>							
a. Lituolinae							
<i>Placopsilina bulla</i> Brady	v.r.	1	1	-	-	-	-
b. Trochammininae							
<i>Hormosina lateralis</i> sp.	A	1	2	-	-	-	-
<b>B. Textularidae</b>							
a. Textularinae							
<i>Textularia carinata</i> d'Orbigny	v.r.	1	3	-	C	-	-
<i>Textularia sagittula</i> Defrance	R	1	4	-	-	-	-
<i>Textularia conica</i> d'Orbigny	R	1	5	-	-	-	-
<i>Schizophora haeringensis</i> (Gümbel)	v.r.	1	6	R	C	-	-
<i>Gaudryina subrotundata</i> Schwager	C	1	7	-	-	-	-
<i>Gaudryina chilostoma</i> Reuss	C	1	8	-	-	-	-
<i>Gaudryina pupoides</i> d'Orbigny	R	1	9	-	-	-	R
<i>Tritaxia</i> cf. <i>tricarinata</i> ? Reuss	v.r.	1	20	-	-	v.r.	-
b. Bulimininae							
<i>Bulimina contraria</i> Reuss	v.r.	1	12	-	-	-	-
<i>Bulimina elongata</i> d'Orbigny	v.r.	1	10	-	C	-	-
<i>Bulimina elongata</i> d'Orbigny var. <i>cylindrica</i> n.var.	v.r.	1	14	-	-	-	-
<i>Bulimina truncana</i> Gümbel var. <i>angusta</i> n.var.	v.r.	1	11	-	C	-	-
<b>C. Lagenidae</b>							
a. Lageninae							
<i>Lagena globosa</i> [Montagu]	C	1	15	R	R	-	-
<i>Lagena sphaericostata</i> n.sp.	v.r.	1	18	-	-	-	-
<i>Lagena synedra</i> Gümbel	R	1	16,17	-	-	-	-
<i>Lagena hispida</i> Reuss	v.r.	1	19	-	-	-	v.r.
<i>Valvatina umbilicata</i> Bornemann	v.r.	1	4	-	-	-	-
b. Nodosarinae.							
<i>Nodosaria calomorpha</i> Reuss	v.r.	2	6	-	-	-	v.r.
<i>Nodosaria columnaria</i> n.sp.	v.r.	2	13	-	-	-	-
<i>Nodosaria exilis</i> Neugeboren	v.r.	-	-	-	-	-	-
<i>Nodosaria longisulcata</i> n.sp.	R	2	5	-	-	-	-
<i>Dentalina gliricauda</i> Gümbel	R	-	-	-	-	-	R
<i>Dentalina intermedia</i> Hantken	R	-	-	-	R	v.r.	R
<i>Dentalina</i> cf. <i>filiformis</i> ? d'Orbigny	v.r.	-	-	R	-	-	-
<i>Dentalina obliquata</i> Reuss	v.r.	2	8	-	-	-	-
<i>Dentalina</i> cf. <i>soluta</i> ? Reuss	v.r.	2	9	-	C	-	-
<i>Dentalina</i> cf. <i>abnormis</i> (Reuss)	v.r.	2	10,11	-	R	-	-
c. Cristellarinae							
<i>Cristellaria cymbooides</i> d'Orbigny	v.r.	2	1	-	R	-	-
<i>Cristellaria fragaria</i> (Gümbel)	v.r.	2	3	-	C	R	v.r.
<i>Cristellaria</i> sp?	v.r.	2	7	-	-	-	-
<i>Marginulina ostiata</i> n.sp.	v.r.	2	12	-	-	-	-
<i>Robulina arcuato striata</i> Hantken	C	2	14	R	C	-	-
<i>Robulina rotulata</i> Lamarck	C	2	15	R	-	v.r.	v.r.
<i>Robulina crassa</i> d'Orbigny	v.r.	2	16	-	-	v.r.	R
<i>Robulina subangulata</i> (Reuss)	R	2	17	-	-	-	-

Table 1. [continued]

Species	Abund.	Pl.	Fig.	W.L.	C.I.S.	W.M.	Nik.
<i>Robulina radiata</i> Bornemann	C	2	18	R	-	C	v.r.
<i>Robulina cincta</i> n.sp.	v.r.	2	19	-	-	-	-
<i>Robulina fallax</i> n.sp.	R	2	20	-	-	-	-
d. Polymorphininae							
<i>Globulina inflata</i> Reuss	C	2	21	-	-	-	-
<i>Polymorphina deplanata</i> (Reuss)	R	2	22	-	-	-	-
<i>Polymorphina humboldti</i> Bornemann	R	2	24	-	-	-	-
<i>Polymorphina deflexa</i> n.sp.	C	3	1,2	-	-	-	-
<i>Polymorphina obovata</i> n.sp.	C	2	23	-	-	-	-
<i>Polymorphina lanceolata</i> Reuss	R	2	2	-	-	-	-
<b>D. Globigerinidae</b>							
<i>Sphaeroidina austriaca</i> d'Orbigny	R	1	13	-	C	-	-
<b>E. Rotalidae</b>							
a. Rotalinae							
<i>Discorbina pusilla</i> Uhlig	A	3	3-7	A	-	-	-
<i>Discorbina concinna</i> Brady	R	3	9	-	-	-	-
<i>Discorbina parisiensis</i> d'Orbigny	R	3	8	-	-	-	-
<i>Discorbina uhligi</i> n.sp.	A	3	10,11	A	-	-	-
<i>Truncatulina tenella</i> Reuss	C	3	13	-	-	-	-
<i>Truncatulina lucilla</i> Rzehak	v.r.	3	16	-	-	-	C
<i>Truncatulina livida</i> n.sp.	R	4	19	-	-	-	-
<i>Truncatulina hantkeni</i> Rzehak	A	3	17	-	-	R	-
<i>Truncatulina communis</i> Römer	R	3	12	-	-	-	-
<i>Truncatulina grosserugosa</i> Gümbel	C	-	-	A	C	v.r.	-
<i>Truncatulina omphalia</i> n.sp.	v.r.	3	14	-	-	-	-
<i>Truncatulina refulgens</i> Monfort	R	3	15	-	-	-	-
<i>Truncatulina rzehaki</i> n.sp.	A	4	1-5	-	-	-	-
<i>Truncatulina subrefulgens</i> Rzehak	A	4	6,10,11	-	-	-	C
<i>Pulvinulina concentrica</i> Parker and Jones	A	4	9	C	-	-	-
<i>Pulvinulina bimammata</i> (Gümbel)	C	-	-	A	-	-	v.r.
<i>Pulvinulina rotula</i> Kaufmann	C	-	-	A	-	R	R
<i>Pulvinulina oblonga</i> Williamson	v.r.	4	8	-	-	-	-
<i>Pulvinulina herculea</i> n.sp.	v.r.	4	7	-	-	-	-
<i>Rotalia romeri</i> Reuss	R	4	12	-	-	-	-
<i>Rotalia grata</i> Reuss	R	4	15	-	-	-	-
<i>Rotalia lithothamnica</i> Uhlig	A	4	13,14	C	-	C	C
<i>Rotalia orbicularis</i> d'Orbigny	R	4	16	-	-	-	-
<i>Rotalia truncana</i> Gümbel	v.r.	4	18	-	-	-	-
<i>Rotalia hantkeni</i> n.sp.	v.r.	4	17	-	-	-	-
b. Tinoporinae							
<i>Gypsina globulus</i> Reuss	A	-	-	A	-	-	-
<b>F. Nummulitidae</b>							
a. Nummulininae							
<i>Operculina</i> sp.	v.r.	-	-	-	-	-	-
<i>Heterostegina</i> n.sp. ind.	v.r.	-	-	-	-	-	-
<i>Nummulites boucheri</i> de la Harpe	R	4	21	A	C	R	-
<i>Nummulites semicostata</i> Kaufmann	C	4	20	A	-	-	-
b. Cycloclypeinae							
<i>Orbitoides stellata</i> d'Archaic	R	-	-	A	C	-	R
<i>Orbitoides aspera</i> Gümbel	v.r.	-	-	-	C	A	-



# PLATES

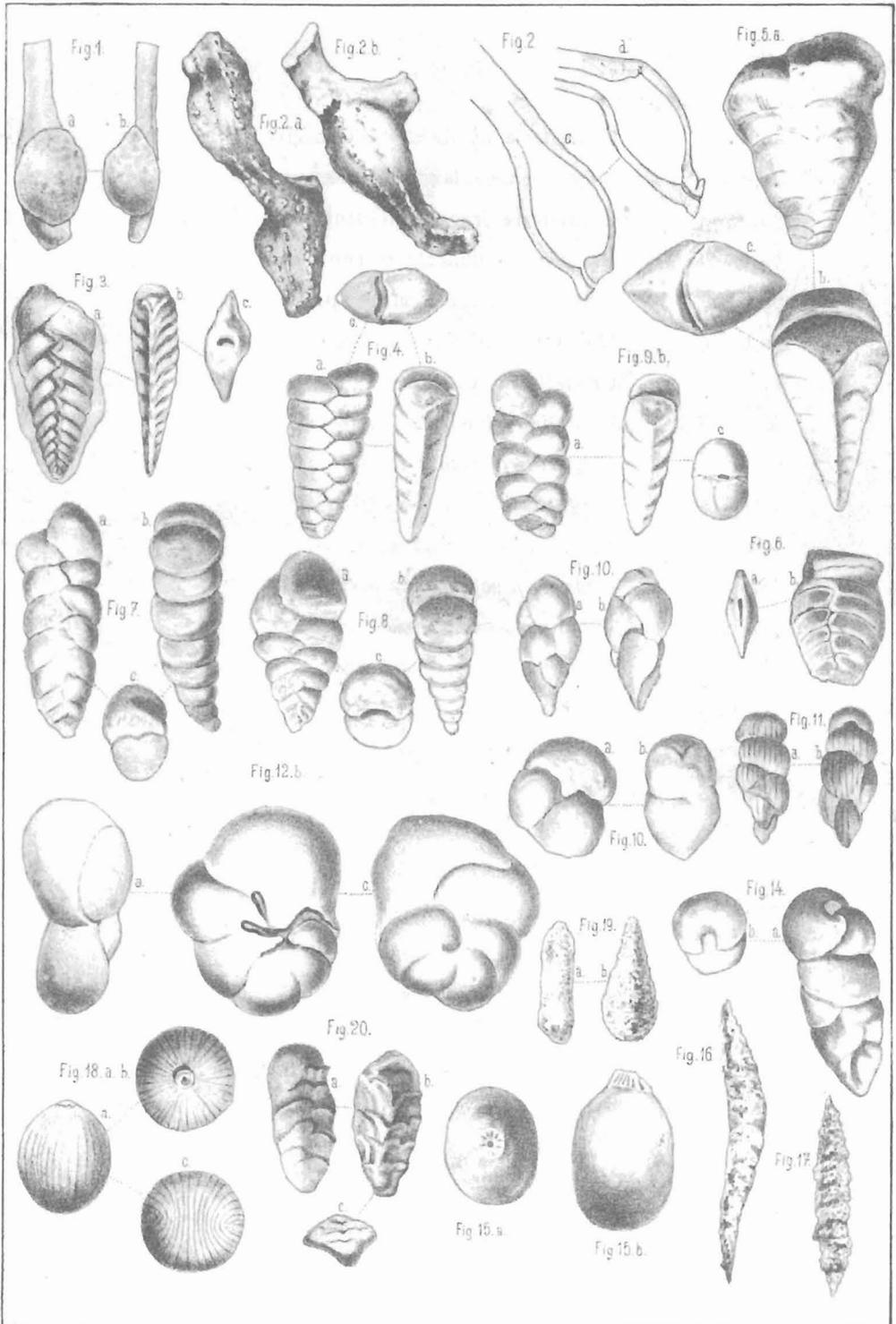


Explanations to plates

Plate 1

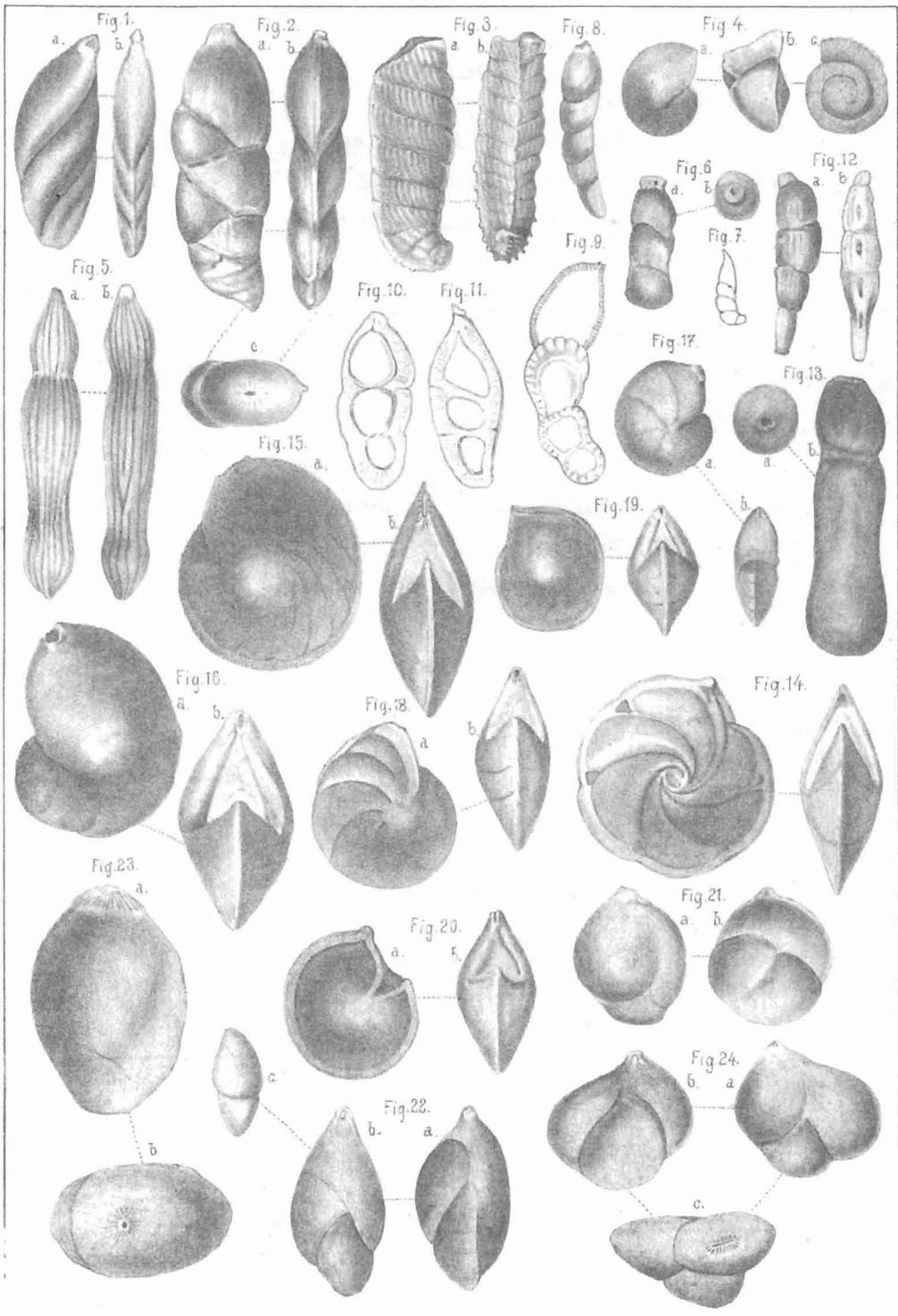
[Magnifications not given]

- |        |  |
|--------|--|
| 1a,b.  | <i>Placopsilina bulla</i> Brady                                  |
| 2a-d.  | <i>Hormosina lateralis</i> n.sp.                                 |
| 3a-c.  | <i>Textularia carinata</i> d'Orbigny                             |
| 4a-c.  | <i>Textularia sagittula</i> Defrance                             |
| 5a-c.  | <i>Textularia conica</i> d'Orbigny                               |
| 6a,b.  | <i>Schizospora haeringensis</i> (Gümbel)                         |
| 7a-c.  | <i>Gaudryina subrotundata</i> Schwager                           |
| 8a-c.  | <i>Gaudryina chilostoma</i> Reuss                                |
| 9a-c.  | <i>Gaudryina pupoides</i> d'Orbigny                              |
| 10a,b. | <i>Bulimina elongata</i> d'Orbigny                               |
| 11a,b. | <i>Bulimina truncana</i> Gümbel var. <i>angusta</i> n.var.       |
| 12a-c. | <i>Bulimina contraria</i> Reuss                                  |
| 14a,b. | <i>Bulimina elongata</i> d'Orbigny var. <i>cylindrica</i> n.var. |
| 15a,b. | <i>Lagena globosa</i> [Montagu]                                  |
| 16,17. | <i>Lagena synedra</i> Gümbel                                     |
| 18a-c. | <i>Lagena sphaericostata</i> n.sp.                               |
| 19a,b. | <i>Lagena hispida</i> Reuss                                      |
| 20a-c. | <i>Tritaxia</i> cf. <i>tricarinata</i> Reuss                     |



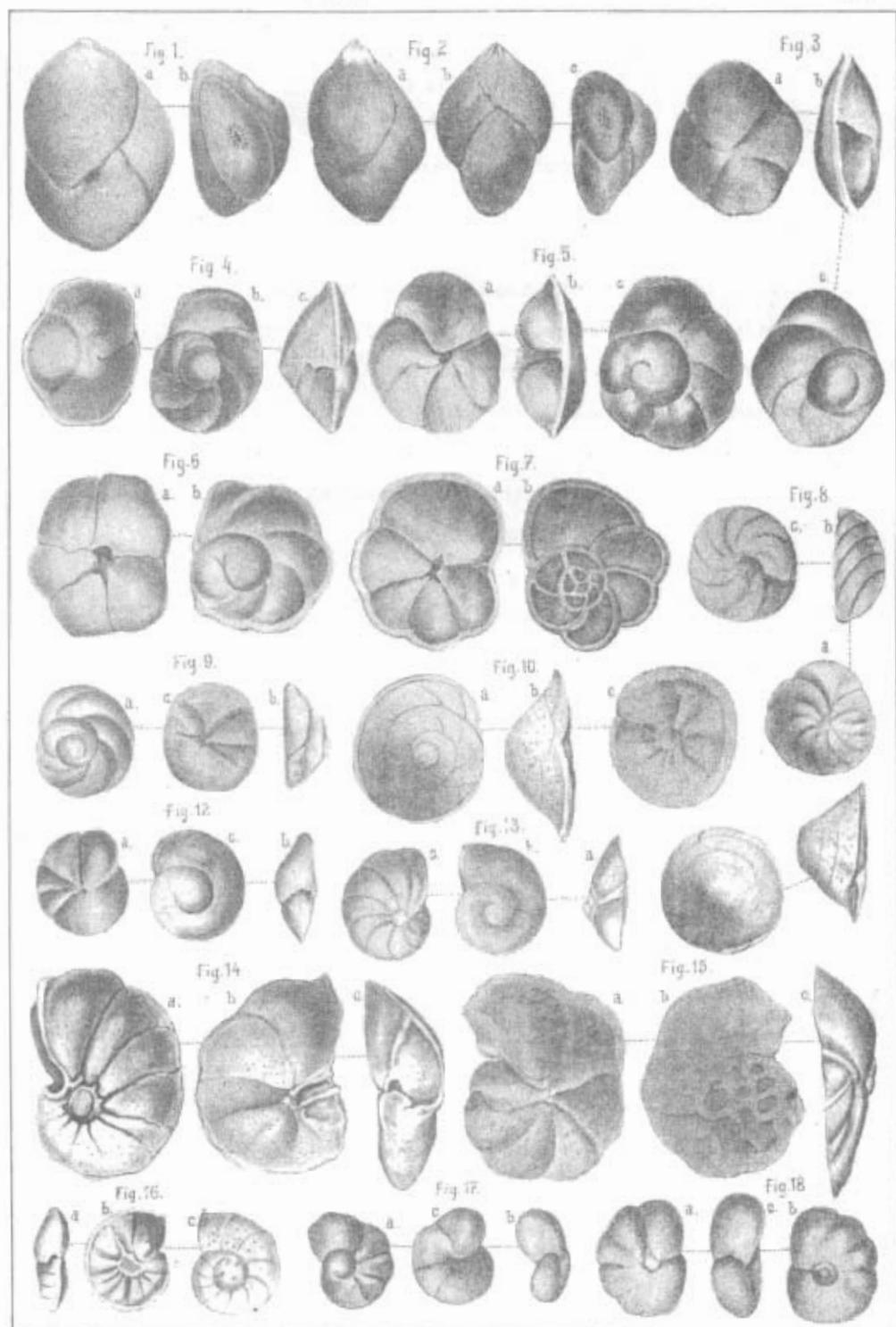
## Plate 2

- 1a,b            *Cristellaria cymboides* d'Orbigny  
2a,b.         *Polymorphina lanceolata* Reuss  
3a,b.         *Cristellaria fragaria* (Gümbel)  
4a-c.         *Valvatina umbilicata* Börnemann  
5a,b.         *Nodosaria longisulcata* n.sp.  
6a,b.         *Nodosaria calomorpha* Reuss  
7.             *Cristellaria* sp. ind.  
8.             *Dentalina obliquata* (Reuss)  
9.             *Dentalina* cf. *soluta* Reuss  
10,11.        *Dentalina* cf. *abnormis* (Reuss)  
12a,b.        *Marginulina ostiata* n.sp.  
13a,b.        *Nodosaria columnaria* n.sp.  
14a,b.        *Robulina arcuato striata* Hantken  
15a,b.        *Robulina rotulata* Lamarck  
16a,b.        *Robulina crassa* d'Orbigny  
17a,b.        *Robulina subangulata* (Reuss)  
18a,b.        *Robulina radiata* Börnemann  
19a,b.        *Robulina cincta* n.sp.  
20a,b.        *Robulina fallax* n.sp.  
21a,b.        *Globulina inflata* Reuss  
22a,b.        *Polymorphina deplanata* (Reuss)  
23a,b.        *Polymorphina obovata* n.sp.  
24a-c.        *Polymorphina humboldti* Börnemann



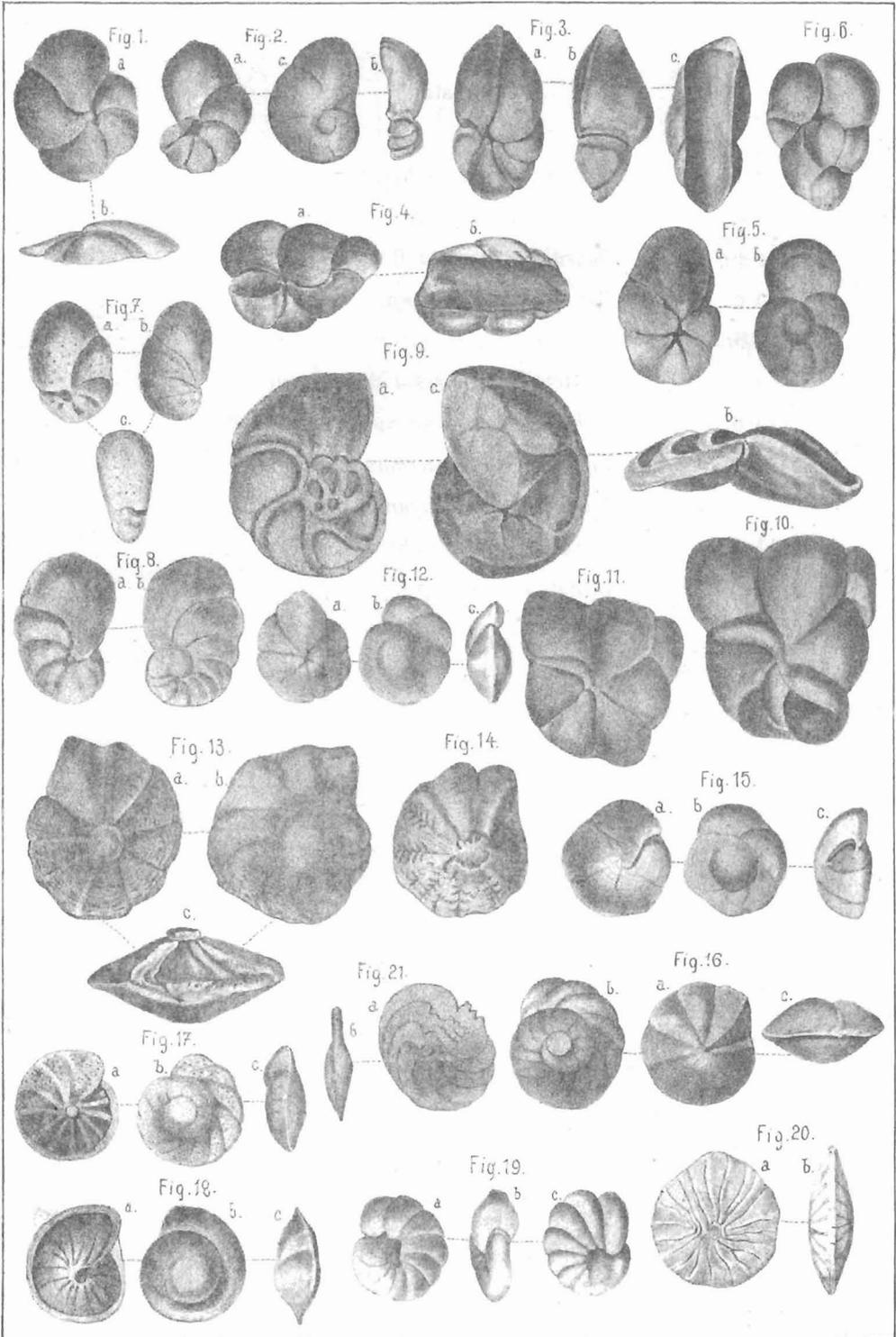
## Plate 3.

- 1a-2c. *Polymorphina deflexa* n.sp.  
3a-7b. *Discorbina pusilla* Uhlig  
8a-c. *Discorbina parisiensis* d'Orbigny  
9a-c. *Discorbina concinna* Brady  
10a-11b. *Discorbina uhligi* n.sp.  
12a-c. *Truncatulina communis* Römer  
13a-c. *Truncatulina tenella* Reuss  
14a-c. *Truncatulina omphalia* n.sp.  
15a-c. *Truncatulina refulgens* Montfort  
16a-c. *Truncatulina lucilla* (Rzehak)  
17a-c. *Truncatulina hantkeni* Rzehak  
18a-c. [not identified]



## Plate 4

- 1a-5b. *Truncatulina rzehaki* n.sp.  
6, 10, 11. *Truncatulina subrefulgens* Rzehak  
7a-c. *Pulvinulina herculea* n.sp.  
8a,b. *Pulvinulina oblonga* Williamson  
9a,b. *Pulvinulina concentrica* Parker and Jones  
12a-c. *Rotalia romeri* Reuss  
13a-14. *Rotalia lithoamnica* Uhlig  
15a-c. *Rotalia grata* Reuss  
16a-c. *Rotalia orbicularis* d'Orbigny  
17a-c. *Rotalia hantkeni* n.sp.  
18a-c. *Rotalia truncana* Gümbel  
19a-c. *Truncatulina livida* n.sp.  
20a,b. *Nummulites boucheri* de la Harpe



## Plate 5

- 1a-f. *Cythere striato reticulata* n.sp.  
2a-e. *Cythere areata* n.sp.  
3a-e. *Bayrdia marginata* Bosquet  
4a-c. *Bayrdia retracta* n.sp.  
5a,b. *Bayrdia acuta* Bosquet  
6a-d. *Cytherella compressa* Bosquet var.  
7a-8. *Lithothamnium nummuliticum* Gmbel  
9. *Lithothamnium racemus* Ascherson  
10. *Lithothamnium suganum* Rothpletz  
11. *Lithothamnium aschersoni* Schwager  
12-13. *Lithothamnium* sp. ?

