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BIFISSURINELLA (BRYOZOA) FROM THE MIDDLE MIOCENE
OF THE CENTRAL PARATETHYS

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Bifissurinella cornifera sp.n. and *Bifissurinella* cf. *triangularis* Poignant et Ubaldo, 1973, are described from the Middle Miocene of the Central Paratethys. New morphological features are reported in the two species which may support the assignment of *Bifissurinella* to the Bryozoa. The generic assignment of the described species is discussed.

Key words: Taxonomy, morphology, Bryozoa (*Bifissurinella*), Middle Miocene, Central Paratethys.

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INTRODUCTION

Two species of *Bifissurinella* occur in the Middle Miocene (Badenian) sediments of Poland and Austria. In their general appearance, they resemble the specimens referred to *Bifissurinella* recorded from the Upper Oligocene-Lower Miocene strata of other sites in Europe. This genus was originally assigned to "incertae sedis" (Poignant and Ubaldo 1973; Andreieff *et al.* 1974) but subsequently included to the Bryozoa (Cheilostomata, Anasca) (Keij 1977). Features not previously observed allow a better understanding of the morphology of this fossil and subcorrobo-

rate its assignment to the Bryozoa. Comparison of *Bifissurinella* (*sensu lato*) with the similar genus *Bicornifera*, gives rise, however, to questions about the validity of the genus *Bifissurinella*.

MATERIAL

In Poland *Bifissurinella* occurs in silty and fine-sandy sediments of the Middle Miocene (Badenian) age, outcropping in the Carpathian Foredeep. It is present in its northern periphery, i.e. on the southern slopes of the Holy Cross Mts. (Mt. Łysa and Śladków Mały localities), as well as in its central part (Raclawice locality).

In the silty sediments from Mt. Łysa (Korytnica basin, see Bałuk and Radwański 1977), *Bifissurinella* is associated with a shallow and warm-water foraminiferal assemblage, which includes species of *Amphistegina*, *Heterostegina*, *Borelis*, *Dendritina*, *Pararotalia* and others. The character of this microfauna suggests that it belongs to the older Badenian (Globigerinoides Ecozone *sensu* Szczuchura 1982). In the sandy sample from Śladków Mały near Chmielnik (see Studencka and Studencki 1980) *Bifissurinella* occurs together with a deeper-water assemblage of a probably regressive or colder environment; there are numerous *Cibicides* and *Elphidium* representatives, but also rare *Pullenia bulloides*, *Gyroidina* sp., *Uvigerina* div.sp., *Hoeglundina scalaris*, *Globigerina prae-bulloides*, *Velapertina* sp., etc. The character of this microfauna, especially the presence of typical Sarmatian species such as *Elphidium reginum*, *E. echinatum* and *Articulina sarmatica*, suggests that it represents the boundary interval between the Badenian and the Sarmatian.

The silty sample from Raclawice near Miechów (see Gonera and Kulka 1979) which contains *Bifissurinella*, represents a more open sea environment than found at the above mentioned localities; here it is associated with a rich and highly diversified assemblage of planktic foraminifera including *Globorotalia* div. sp., *Globoquadrina* sp., *Orbulina* cf. *suturalis* (rare), *Globigerinoides* div. sp. This assemblage is indicative of the lower neritic zone of the open sea. The character of the microfauna suggests an older Badenian age (Globigerinoides Ecozone *sensu* Szczuchura 1982).

Comparative material was available from Austria, from an outcrop at Sooss (south of Baden), in the Vienna Basin. The marly sample contains a similar assemblage of foraminifera and is of the same age as that found at Raclawice.

Summarising the environmental preferences of *Bifissurinella* it appears that it lived in a moderately quiet environment on the shelf, both in its upper and lower part.

REMARKS ON THE SYSTEMATIC POSITION
AND TAXONOMY OF *BIFISSURINELLA* AND SIMILAR FORMS

Bifissurinella was erected by Pognant and Ubaldo (1973) for some Lower Miocene microfossils of France, and referred to as "incertae sedis".

According to the generic diagnosis of *Bifissurinella*, emended by Keij (1977), this genus is characterized (among others) by "Small proximal zooecium with a circular frontal opening, the two following zooecia with long, narrow, frontal openings bordered by a low rim". Specimens from Poland and Austria externally are almost identical with those so far assigned to *Bifissurinella*, they have, however, more complicated and more varied morphology of their frontal parts than that described by Keij (1977). It is evident that Keij had at his disposal poorly preserved material, without primary structures, which was admitted by him. He (1977) referred *Bifissurinella* to the Bryozoa (Cheilostomata, Anaëca) erecting a new family Bicorniferidae, mostly on the basis of the connections occurring between chambers and on the basis of lateral rootlet pores and of terminal pores reminding the pores in articulated cheilostomatous Bryozoa; these terminal pores were observed mostly in *Bicornifera*, a genus close to *Bifissurinella*.

According to Keij (1977: 230) "... tricamerate tests of *Bifissurinella* are either the calcified, terminal segments arising from a non-calcified, stolonate system or arise as single colonies with a rootlet system. The smaller terminal chambers may be compared with kenozoecia of Bryozoa, and the two much bigger ones with autozoecia". Keij confirmed, however, that the silt-like character of the frontal apertures, observed in *Bicornifera* as well as in *Bifissurinella* are uncommon in Bryozoa and noted that none of the two genera has structures comparable with bryozoan ovicells, avicularia or vibracula.

The interpretation of the morphological structures, observed in *Bifissurinella* (especially in specimens here described), is not easy. Since there is, however, distinct polymorphism of chambers, and moreover, these chambers possess numerous openings diversified in shape and cryptocyst-like structures, it seems that there are no more obstacles left to refer this genus to the Bryozoa.

The regular of the tube-like proximal end of specimens (zoarium) referred to *Bifissurinella* (p. 4: 1a, 1b) suggests that it is either the basal part of the entire colony or the terminal part of a segment (internode) with which it was articulated with another segment.

According to its general morphology, *Bifissurinella* resembles *Bicornifera*, a genus described as a problematicum from the Oligocene of Austria (Lindenberg 1965). This similarity was also noted by Pognant

and Ubaldo (1973), as well as by Keij (1977), who included both forms into the *Bicornifera-Bifissurinella* group.

According to Keij (*l.c.*) *Bifissurinella* differs from *Bicornifera* by: representing terminal segments or individual colonies instead of an articulated zoarium (as ascribed to *Bicornifera*); being tricamerate in contrast to generally quadricamerate; having a pronounced carina (unknown in *Bicornifera*). According to this author, there is, however, a transitional taxon between the two genera, i.e. tricamerate *Bicornifera lagaaiji*, the distal opening or pore field of which suggests that it represents an internode of an articulated zoarium.

Since in *Bicornifera* from the Oligocene of North America (described as problematicum by Haman *et al.* 1981) the distal part of the test appears to be nonporous and the proximal part is suggested to be non perforated as well, and because the carina is not a stable feature of *Bifissurinella* (see Keij 1977 and the present paper) it is difficult to distinguish *Bicornifera* from *Bifissurinella*. The large variation in other morphological details, observed by different authors (Keij 1977; Haman *et al.* 1981; present paper), further adds to the doubt whether both genera warrant a separate systematic status.

Bifissurinella (Late Oligocene-Middle Miocene) seems to represent a more integrated colony, with more individualised chambers (zooecia) than found in *Bicornifera* (Paleocene-Oligocene), especially in the Paleocene representatives of that latter genus. But specimens referred to *Bicornifera* also change in time, tending towards a more integrated colony, so that some of the Oligocene species (e.g. *B. lagaaiji* or *B. alpina*, the type species of *Bicornifera*!) are hardly distinguishable in this respect from those of *Bifissurinella*.

Bifissurinella appears to belong to the same phyletic stock as *Voorthuyseniella* Szczecura, 1969, which is known from the Early Eocene to Recent and generally considered as a problematicum, while Keij (1977) suggested its affiliation with the Bryozoa.

SYSTEMATIC PALAEOLOGY

Genus *Bifissurinella* Pognant *et* Ubaldo, 1973, emend. Keij, 1977

Type species: *Bifissurinella triangularis* Pognant *et* Ubaldo, 1973.

Stratigraphic range: Late Oligocene-Middle Miocene.

Geographic distribution: SW France, NW Italy, F.R.G., Austria, S Poland.

Diagnosis (modified after Keij 1977).—Calcareous, uniserial, terminal, tricamerate segments. Small proximal zooecium followed by two larger ones that have frontal pores and horn-like protuberances. Bilamellar walls separating zooecia perforated by simple septula. Lateral wall with pronounced carina or smooth.

Bifissurinella cornifera sp.n.

(pl. 9: 1; pl. 10: 1—3; pl. 11: 1; pl. 12: 1—4)

Holotype: ZPAL V.XIII/1.*Type horizon*: Middle Miocene (Badenian).*Type locality*: Mt. Łysa (Korytnica Bay), central Poland.*Derivation of the name*: Lat. *cornifera* — horned.*Diagnosis*.— *Bifissurinella* with horn-like protuberances on second and sometimes also on third zoecium. Carina, if present, parallel and close to the dorsal side.*Material*.— Six specimens.

Dimensions (in mm) (without horns):

	ZPAL V.XIII/1	V.XIII/2	V.XIII/3
length	0.68	0.56	0.56
height	0.40	0.40	0.32
width	0.32	0.36	0.28

Description.— Zoarium triangular in lateral view, consisting of three tightly joined zoecia of unequal size and shape. The small and rather narrow proximal zoecium is followed by two larger, laterally inflated ones. Distinct, weakly incised sutures between zoecia are seen in transparent specimens. The proximal end is prolonged (in well preserved specimens) by a thin-walled, tube-like rim (pl. 10: 2; pl. 12: 1a, 1b), adjoining and contacting by distinct hollow the first zoecium (pl. 11: 1c; pl. 12: 2c).

The first zoecium is supported frontally by a somewhat concave cover (shield) reminiscent of a cryptocyst, which is bordered by a more or less distinct rim and pierced by one or more openings (pl. 10: 1, 3d); plates partly covering the openings may be present (pl. 10: 3a, 3d). The second zoecium possesses a round or horseshoe-shaped, rather large orifice, partly covered by finely furrowed, deepening inwards shield (cryptocyst-like structure) which is externally distinctly rimmed. The distally prolonged frontal face of this second zoecium together with the orifice rim form a horn-like protuberance. A small and round pore occurs proximally to the orifice, whereas a row of small and round pores occurs in the distal part of the orifice (pl. 9: 1a; pl. 10: 1). The frontal face of the third zoecium, with (or without) the horn-like protuberance, has a round and rather small main orifice and a row of small pores (pl. 9: 1b, 1c, 1f; pl. 11: 1b; pl. 12: 2b). The surface of the zoarium is smooth, sometimes glossy, or finely furrowed. The carina, if present, is generally better developed on the terminal zoecium and runs parallel and close to the dorsal side; it is present in specimens with a flattened dorsal side (pl. 10: 2).

Variability concerns mostly the general shape and size of the specimens and the development of the horn-like protuberances (there may be one or two of them). The rounded or flattened dorsal side of the zoarium may be caused by the shape of substrate to which it was attached. The variation in shape and size of the orifices at the frontal faces of the zoecia is probably a preservational artefact. The proximal end of the specimens may also be differently preserved; generally it is short and broken-off.

Remarks.— In comparison with the most similar species *Bifissurinella triangularis* Poignant et Ubaldo, 1973. *Bifissurinella cornifera* sp.n. differs by one or two distinct horn-like protuberances and a carina, if present, that is close to the dorsal side. The horn-like protuberances lack in *B. triangularis*.

Occurrence.—Poland, Carpathian Foredeep, Mt. Łysa and Raclawice localities, and Austria, Vienna Basin, Soos locality—Middle Miocene (Badenian).

Bifissurinella cf. *triangularis* Poignant et Ubaldo, 1973
(pl. 11: 2)

Material.—One specimen.

Dimensions (in mm):

	ZPAL V.XIII/4
width	0.56
length	0.60
height	0.32

Remarks.—From the specimens referred to *Bifissurinella triangularis*, by Poignant and Ubaldo (1973) and Keij (1977), the Polish one differs in having a short horn-like protuberance in the distal part of the second zoecium.

Occurrence.—Poland, Carpathian Foredeep, Ślasków Mały locality—Middle Miocene, passage layer between Badenian and Sarmatian.

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BIFISSURINELLA (BRYOZOA) ZE ŚRODKOWEGO MIOCENU
PARATETYDY CENTRALNEJ

Streszczenie

W pracy opisano *Bifissurinella cornifera* sp.n. i *Bifissurinella* cf. *triangularis* Poignant et Ubaldo, 1973, ze środkowego miocenu (badenu) Polski, z zapadliska przedkarpacciego. *B. cornifera* sp.n. znaleziono także w materiałach porównawczych z badenu Basenu Wiedeńskiego. Nieznane dotąd u tej grupy mikroskamieniałości szczegóły budowy stwierdzone w opisanym w pracy materiale, pozwoliły potwierdzić stanowisko Keija (1977), że reprezentują one mszywioly (Cheilostomata); inni badacze tej grupy mikroskamieniałości uznają je za problematyki. W pracy przedyskutowano przynależność rodzajową opisanych gatunków.

EXPLANATION OF PLATES 9—12

Plate 9

1. *Bifissurinella cornifera* sp.n.: ZPAL V.XIII/1, holotype; a frontal view of second zoecium showing proximal opening (*op*), distal openings (*od*) and main orifice, $\times 180$; b terminal part of the horn-like protuberance of third zoecium, seen from above, showing row of distal openings, $\times 570$; c frontal view of third zoecium showing distal openings arranged in a row, $\times 210$; d general, somewhat oblique frontal view of specimen, $\times 110$; e general, lateral view of specimen, $\times 110$; f proximal part of frontal face of third zoecium, seen from above, showing weakly differentiated openings, arranged in a row, $\times 570$.

Badenian, Mt. Łysa (Korytnica basin), Carpathian Foredeep, Poland.

Plate 10

1—3. *Bifissurinella cornifera* sp.n.: 1—ZPAL V.XIII/1, holotype, frontal view of first and second zoecium, $\times 120$; 2—ZPAL V.XIII/5, general somewhat oblique view of specimen with broken horn-like protuberance of first zoecium, showing flattened dorsal side and carina, $\times 100$; 3—ZPAL V.XIII/2, a somewhat oblique frontal view of specimen showing its proximal part, $\times 100$; b oblique frontal view of third zoecium, $\times 215$; c general lateral view of specimen, $\times 100$; d oblique frontal view of first zoecium showing apertures partly covered by lids, $\times 350$.

1, 3 Badenian, Mt. Lysa (Korytnica basin), Carpathian Foredeep, Poland;
2 Badenian, Sooss near Baden (Vienna Basin), Austria.

Plate 11

1. *Bifissurinella cornifera* sp.n.: ZPAL V.XIII/3. a lateral view of specimen, $\times 120$; b frontal view of third zoecium showing round orifice and small distal openings, $\times 370$; c frontal view of proximal part of specimen showing pore (p) in proximal end, and horseshoe-shaped orifice of second zoecium, $\times 150$.

2. *Bifissurinella* cf. *triangularis* Poignant et Ubaldo: ZPAL V.XIII/4, a oblique, frontal view of distal part of specimen, showing secondary slit-like opening of third zoecium, $\times 150$; b lateral view of specimen, $\times 100$; c frontal view of first and second zoecium showing row of more or less elongated openings in second zoecium, $\times 150$.

1 Badenian, Raclawice near Miechów, Carpathian Foredeep, Poland; 2 passage layer between Badenian and Sarmatian, Ślasków Mały near Chmielnik, Carpathian Foredeep, Poland.

Plate 12

1—3. *Bifissurinella cornifera* sp.n.: 1—ZPAL V.XIII/5, a lateral view of specimen with broken horn-like protuberance of second zoecium, $\times 210$; b somewhat oblique, frontal view of proximal end showing its regular edge, $\times 450$; 2—ZPAL V.XIII/6, a somewhat oblique, lateral view of specimen with twisted horn-like protuberance of second zoecium and damaged proximal end, $\times 120$; b somewhat oblique, frontal view of third zoecium showing its round orifice and distal openings, $\times 190$; c damaged proximal end pierced by pore (p), $\times 300$; 3—ZPAL V.XIII/7, lateral view of specimen with broken horn-like protuberance of second zoecium, $\times 120$.

1—3 Badenian, Sooss near Baden (Vienna basin), Austria.







