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SHORT COMMUNICATION

Permian trepostome bryozoans from the Zechstein Main Dolomite (Ca2) of Western Poland and NE Germany

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The trepostome bryozoan *Dyscritella microstoma* Ernst, 2001 is reported for the first time from the Zechstein Main Dolomite (Ca2) of Poland and Germany. This species has been previously recognized in the older fossiliferous Zechstein Limestone (Ca1) of the North Sudetic Basin (Poland) and in the northern part of Germany. The Polish specimens derive from a few boreholes located in the Pomerania region and in the Wolsztyn High, both in the western part of Poland. The German material comes from a borehole on Rügen Island in Northeastern Germany. The present paper deals with the taxonomic description of *D. microstoma* and its distribution in the Main Dolomite deposits.

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Key words: Western Poland, NE Germany, Bryozoa, Zechstein, Main Dolomite (Ca2), taxonomy.

INTRODUCTION

Bryozoans are an important component of the Zechstein Limestone (Ca1) fossil assemblages and they have been reported mainly from the Fore-Sudetic Monocline and the Lower Silesia area since the second half of the 19th century by many German and Polish researchers (Hara, 2001).

Their occurrence in the Wolsztyn High (West Poland) is connected with *in situ* biologically-created carbonate buildups, which show satisfactory reservoir properties (Dyjaczyński *et al*., 2001). Algal-bryozoan carbonate accumulations are common in the Ca1 horizon and they locally attain considerable thicknesses, reaching 100 metres, as a consequence of a complex interplay of sea level fluctuation and tectonic subsidence, being potential traps for gas accumulation (Dyjaczyński *et al*., 2001; Kiersnowski *et al*., 2007).

By contrast, bryozoans are very rare in the second carbonate level of the Zechstein, the Main Dolomite (Ca2). An unnamed bryozoan colony has been recorded and illustrated from the Main Dolomite micritic strata in the shallow shelf plain facies of the Ujazd 1 borehole of the Fore-Sudetic Monocline (Peryt, 1978). A few other records of this fauna are known from the Polish Lowland area (Wagner, 1994) and the Peribaltic Syneclise (Karczewski, 1986). Unconfirmed records of bryozoans were also mentioned by Kerkmann (1969) from the younger parts (Ca2 to Ca3) of Zechstein in Thuringia.

Dyscritella microstoma as described here has been recognized in a few boreholes of Pomerania (NW Poland) and in the Pogorzela High (Fore-Sudetic Monocline). The presence of the bryozoan fauna in thin sections from the Pomerania area is limited to the platform (inner shelf environment) facies such as in the microplatform deposits of Unisław (Unisław IG 2 borehole) and of the Pomeranian Platform (Sławoborze 2 borehole). Furthermore, it has also been recognized in the basinal facies (outer shelf palaeoenvironment setting) of the Czaplinek IG 2 borehole, where the material was transported by wave action or by turbidity currents (Fig. 1).

D. microstoma has also been documented from the Main Dolomite in the northeastern part of Germany (Rügen Island). The age of these deposits is confirmed by a bivalve and ostracod fauna (D. Weyer, pers. comm.).

The currently accepted stratigraphy of the Zechstein deposits in Pogorzela 1 and the Pogorzela 2 boreholes based on 3D seismic data interpretation indicates that, in the most elevated part of

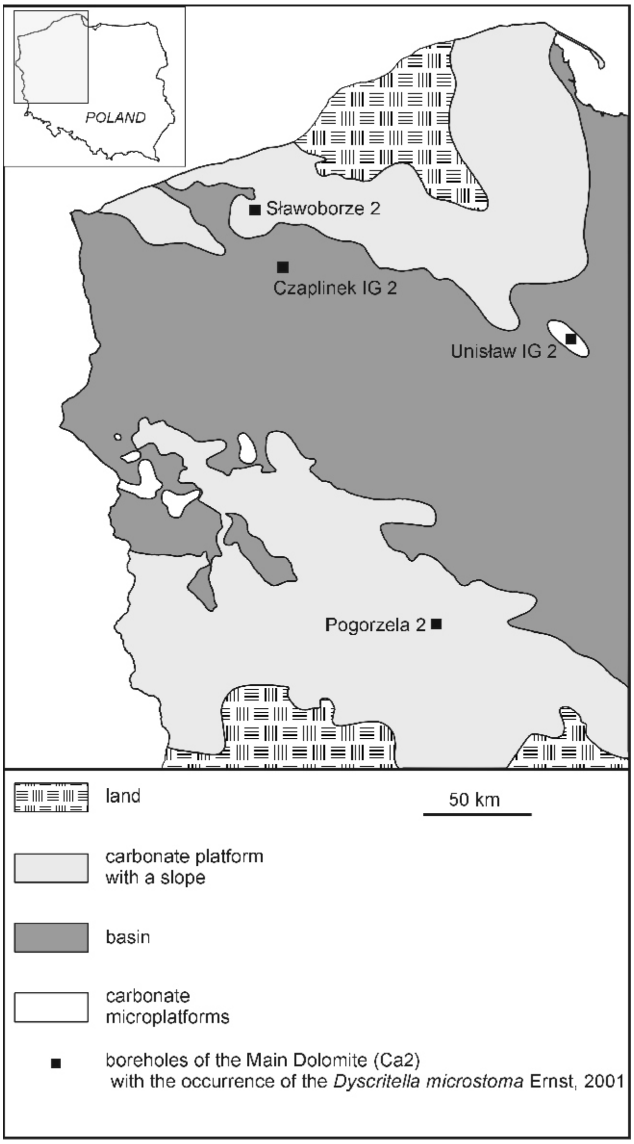

Fig. 1. Fragment of the palaeogeographical map of the Zechstein Main Dolomite of (Ca2) in the western part of Poland (after Wagner 1998, modified)

the Pogorzela High, the Main Dolomite deposits lie directly on the Carboniferous basement (Kwolek and Mikołajewski, 2007).

The primary purpose of this study is to describe *Dyscritella microstoma* taxonomically from the Zechstein Main Dolomite and to discuss its palaeoecology and distribution.

SYSTEMATIC PALAEONTOLOGY

Phylum **Bryozoa** Ehrenberg, 1831
Class **Stenolaemata** Borg, 1926
Order **Trepostomida** Ulrich, 1882
Family Dyscritellidae Dunaeva and Morozova, 1967
Genus *Dyscritella* Girty, 1911
Type-species *Dyscritella robusta* Girty, 1911
Lower Carboniferous, North America

D i a g n o s i s. — Dendroid, massive and encrusting colonies with abundant acanthostyles and exilazooecia. Autozooecia parallel to longitudinal direction of the colony in endozone; gradually bending outwards in exozone. Diaphragms in autozooecia lacking or very rare; lacking in exilazooecia. Exilazooecia circular to angular in cross-section and separated from the autozooecia and from each other by thick walls. Two sizes of acanthostyles may be present: one set large with few per autozooecia, the other set is small with several around each autozooecium. Zooecial walls thin in endozone, rapidly thickening in the exozone.

C o m p a r i s o n. — *Dyscritella* Girty, 1911 differs from the genus *Dyscritellina* Morozova (in Dunaeva and Morozova, 1967) by rare or absent diaphragms and less differentiated acanthostyles.

O c c u r r e n c e. — Devonian to Triassic; worldwide.

Dyscritella microstoma Ernst, 2001
(Figs. 2–3, Tables 1 and 2)

2001 *Dyscritella microstoma* Ernst: 139, pl. 1 figs. 3–5.

M a t e r i a l. — Studied and measured specimens from Germany include 3 complete colonies as well as 11 thin sectioned colonies. Unmeasured material includes about 50 unprepared colonies. Upper Permian (Main Dolomite, Zechstein); Rügen Island, NE Germany, Wiek 101 borehole, depth 989.85–993.35 m and 996.55–1000.0 m (deposited at Bundesanstalt für Geowissenschaften und Rohstoffe [BGR], Berlin).

Studied and measured material from Poland includes two thin sections from Pogorzela 2 borehole, (depth 1743 m), SW Poland, and two thin sections from Unisław IG 2 borehole, (depth 3640.5–3635.5 m), NW Poland. Additional materials studied derived from one thin section from the Czaplinek IG 1 borehole (depth 3204,9 m), Pomerania area, NW Poland, and one thin section from the Sławoborze 2 borehole (depth 3248–3265 m), Pomerania region, NW Poland. All the studied material is from the Main Dolomite; Pogorzela 2 and Sławoborze 2 boreholes are deposited at PGNiG S.A., Warsaw, Zielona Góra branch; Unisław IG 2 and Czaplinek IG 1 boreholes are deposited at the PGNiG S.A., Warsaw, Poland. One thin section used for this study derives from the Zechstein Limestone (Ca1) of the North Sudetic Basin, SW Poland, shown in Figure 2A.

D e s c r i p t i o n. — Encrusting and discoid fungi-shaped colonies. Encrusting colonies up to 4 mm thick, discoid colonies 1.6–2.8 mm in diameter and 1.1–1.2 mm thick in central part. Autozooecial apertures oval to angular (Figs. 2B and 3G, H), 7–9 spaced in 2 mm of colony surface. Diaphragms in autozooecia rare to absent. Walls in endozone 0.01 mm thick, in exozone 0.02–0.04 mm thick and obliquely laminated. Exilazooecia polygonal in cross-section, common to rare, restricted to the late exozone. Acanthostyles abundant, varying significantly in size, originating in the early endozone, with distinct cores, 2–6 surrounding each aperture, often inflecting deeply into the autozooecium (Figs. 2B and 3G, H).

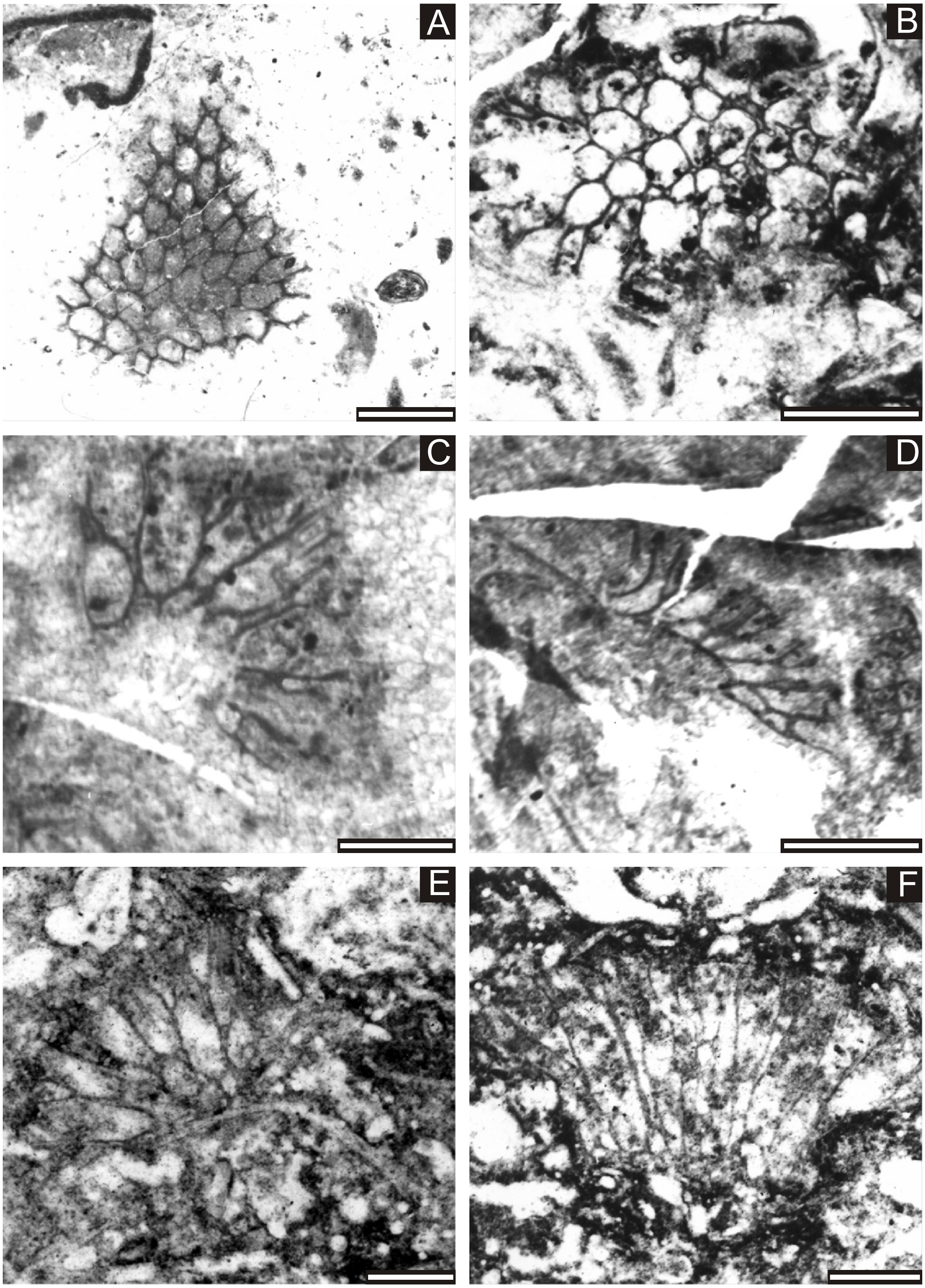

Fig. 2. *Dyscritella microstoma* from the Zechstein Limestone (Ca1) of Poland

A — North Sudetic Basin, tangential section showing part of the colony, scale bar = 1 mm; **B**–**D** — Unisław Platform, SE Pomerania, Unisław IG 2 borehole, 3635.5 m depth: B — tangential section through part of the colony, scale bar = 0.5 mm, C — transverse section through a fragment of colony, scale bar = 1 mm, D — transverse section through part of the colony, scale bar = 1 mm; **E**, **F** — Fore-Sudetic Monocline, Pogorzela 2 borehole, 1743 m dept: E — fragment of colony in transverse section, scale bar = 1 mm, F — longitudinal section through fragment of a colony, scale bar = 1 mm

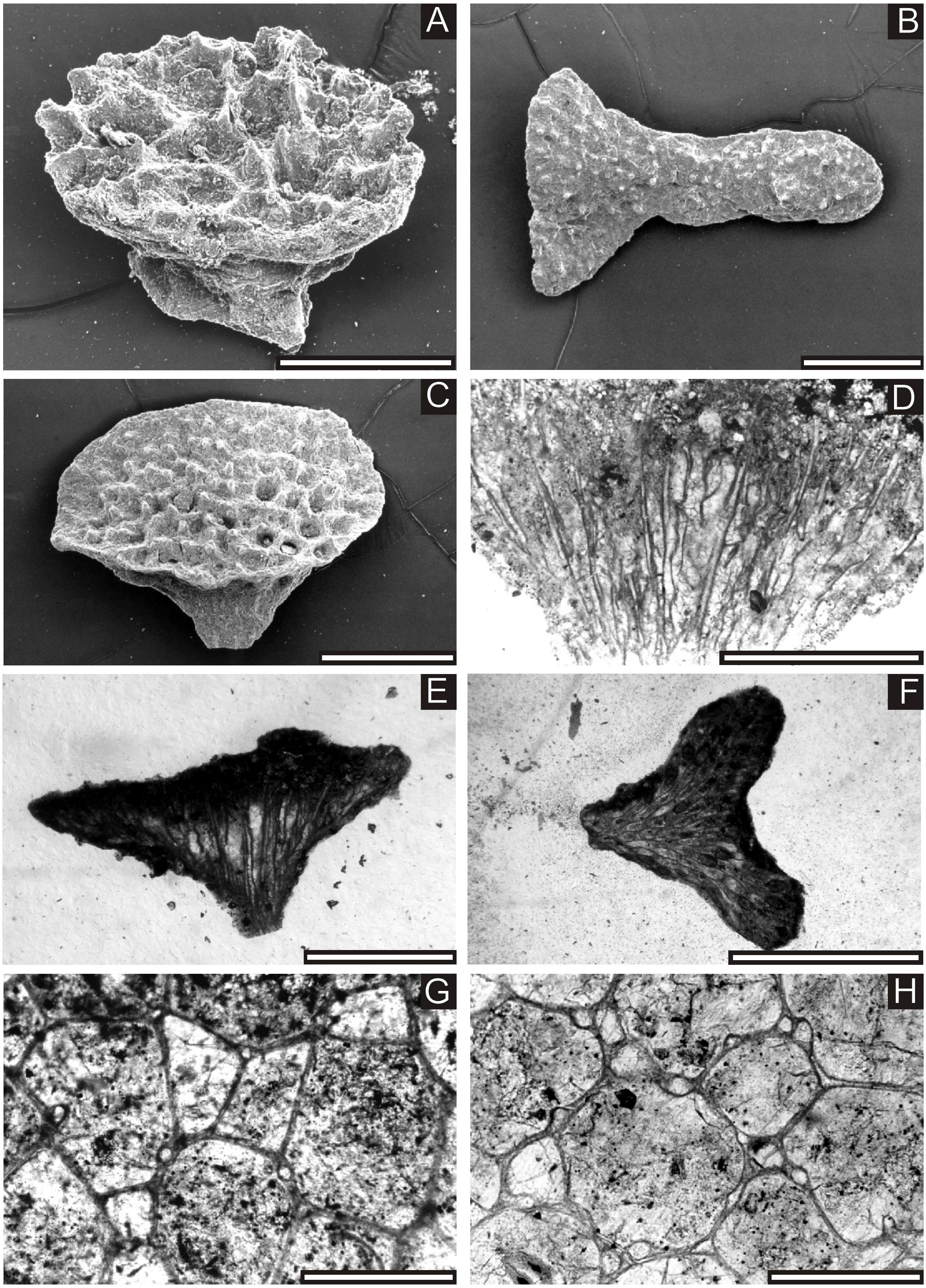

Fig. 3. *Dyscritella microstoma* from the Zechstein Main Dolomite (Ca2), Rügen Island, northeastern Germany, Wiek 101 borehole, depth 989.85–993.35 m (A, B, D–H) and 996.55–1000.0 m (C)

A — discoid colony, SEM, scale bar = 0.5 mm; **B** — encrusting colony, free of substrate, SEM, scale bar = 1 mm; **C** — discoid colony, SEM, scale bar = 1 mm; **D** — longitudinal section of a discoid colony, scale bar = 0.5 mm; **E** — longitudinal section of a discoid colony, scale bar = 1 mm; **F** — deep tangential section of a colony, scale bar = 1 mm; **G** — tangential section of a colony, scale bar = 0.2 mm; **H** — tangential section of the colony, scale bar = 0.2 mm

Table 1

Descriptive statistics of the species *Dyscritella microstoma* Ernst, 2001 (material from the Unisław IG 2 borehole, Poland)

	N	X	SD	CV	MIN	MAX
Aperture width	20	0.19	0.036	19.34	0.12	0.24
Exilazooecia width	12	0.07	0.018	24.89	0.04	0.11
Acanthostyle diameter	20	0.026	0.004	15.02	0.021	0.03
Number of acanthostyles per aperture	20	3.6	1.5	41.61	2.0	6.0

N — number of measurements; X — mean; SD — standard deviation; CV — coefficient of variation; MIN — minimum value; MAX — maximum value

Table 2

Descriptive statistics of the species *Dyscritella microstoma* Ernst, 2001 (material from the Rügen Island, Germany)

	N	X	SD	CV	MIN	MAX
Aperture width	20	0.18	0.036	14.33	0.14	0.23
Exilazooecia width	20	0.06	0.02	35.08	0.02	0.10
Acanthostyle diameter	20	0.03	0.01	24.56	0.02	0.04
Number of acanthostyles per aperture	23	3.6	1.40	38.47	2.0	7.0

Explanations as in Table 1

Comparison. — *Dyscritella microstoma* Ernst, 2001 differs from *D. tubulosa* Morozova, 1970 (Upper Permian, Zechstein of Lithuania) by having smaller autozooecial apertures, thinner walls as well as smaller and more abundant acanthostyles.

Occurrence. — *Dyscritella microstoma* Ernst, 2001 was originally described from the Zechstein Limestone (Ca1) of Germany. The material investigated comes from the Main Dolomite (Ca2) Zechstein of Rügen Island, NE Germany, and from Pogorzela 2 borehole, Fore-Sudetic Monocline, West Poland, and the Unisław IG 2 borehole, Pomerania, NW Poland, as well as from the Zechstein Limestone (Ca1) of the North Sudetic Basin, SW Poland.

DISCUSSION AND CONCLUSIONS

Although the Zechstein bryozoans show low morphological and taxonomical diversity, mostly caused by a significant fluctuation in the temperature and salinity regime of the Permian basin (Ross, 1995), they play an important role as frame-building organisms in the Zechstein Limestones (Ca1). By contrast, the bryozoan fauna in the Zechstein Main Dolomite (Ca2) is very rare and usually fragmentarily preserved (Fig. 2B–F), and its significance is much smaller than in the Zechstein Limestone (Ca1).

The occurrence of the bryozoan fauna in the basal facies of a unique carbonate horizon, directly overlying the Carboniferous rocks, was a strong argument to suggest that it was the Zechstein Limestone (Ca1). The recent stratigraphical interpretation of the Zechstein deposits of the Pogorzela High, in the light of 3D seismic data, suggests that PZ1 (cyclothem Werra) strata are absent in the close vicinity of the Pogorzela High and the Carboniferous basement is directly overlain by rocks of the Main Dolomite (Ca2). Probably, initial stages of the Zechstein transgression did not reach the most elevated part of the High (Kwolek and Mikołajewski, 2007). The rock sequence shows that the most elevated part of the Pogorzela High was an island during the Zechstein transgression (Kwolek and Mikołajewski, 2007; Kiersnowski *et al*., 2007). A similar sequence was found in the Koszalin–Chojnice Zone where the Zechstein transgression did not flood all basement highs. These highs formed islands surrounded by algal and algal-bryozoan barriers, having several tens of metres in thickness and separating the lagoonal-littoral part of the basin from the open sea (Wagner, 1987; Kwolek and Mikołajewski, 2007).

The new material of *D. microstoma* described here reveals two different colony forms: encrusting and fungi-shaped (Figs. 2–3). Among the Polish material from the Main Dolomite (Ca2) bryozoans encrust shells (Fig. 2C, E) as well as soft, decayed substrates such as algae (Fig. 2D). In this environment, the colonies were apparently provided with enough hard substrate such as skeletal fragments, and they were not affected by a high sedimentation rate. Moreover, the bryozoan colonies in their small sizes and very low diversity may suggest that they lived in a shallow-water, low-energy, tidal, sub-tidal or lagoonal water environment.

By contrast, the material from the Wiek 101 borehole (Rügen Island) represents predominantly fungi-shaped colonies (Fig. 3A, C, D–E), presumably resulting from a scarcity of hard substrates and possibly a higher rate of sedimentation.

Colonies of *D. microstoma* are similar to horn-shaped colonies of the trepostome bryozoan *Dianulites petropolitanus* from the Ordovician of the Baltic region (Modzalevskaya, 1955; Taylor and Wilson, 1999). The basal (lateral) part of such colonies is built by an epitheca. Another variation of such a colony form comprises tongue-shaped prolongations (Fig. 3B, F). Taylor and Wilson (1999) suggested that such colonies lived as inverted cones semi-infaunally in soft sediments with their living tissues confined to the exposed upper surface. Furthermore, such colonies would indicate a high rate of sedimentation (see also Spjeldnaes, 1996). Similarly, the discoid colonies of *Dyscritella microstoma* may indicate a shallow, quiet environment with soft substrates and moderately high sedimentation rates.

Comparative material of *D. microstoma* (Fig. 2A) from the Zechstein Limestone (Ca1), exhibits only an encrusting growth habit (Hara, 1998).

D. microstoma, undoubtedly, demonstrates the intraspecific plasticity of the colonial form, depending on the type of substrate and other parameters such as sedimentation rate. The difference in the colony shape certainly reflects different environments at these localities.

The accompanying fauna within the studied sequences of the Zechstein Main Dolomite (Ca2) is mostly dominated by mytiloid molluscs such as *Liebea squamosa* (Sowerby), myophorids *Schizodus obscurus* (Sowerby) and *Schizodus schlotheimi* (Geinitz), which is fairly common. Microfossils, especially uniserial foraminifers, are quite common, as well as microbialite fragments, whereas ostracods are rare. The mollusc fauna is an important indicator of a warm, highly saline and shallow-water environment (Karczewski, 1986).

To sum up, the occurrence of the rare bryozoan fauna, combined with factors such as the morphology of the colonial form and the character of the accompanying fauna clearly suggest that the bryozoans of the Zechstein Main Dolomite (Ca2) were deposited in a shallow-water, low-energy environment, with a progressive increase of the salinity.

Dyscritella microstoma indicates the palaeogeographic links within the German and Polish Zechstein Basin. A comparable species, *D. tubulosa* Morozova, 1970, is also restricted to the Zechstein Basin. Both these species, however, are related to *D. incrustata* Morozova, 1970, from the Kazanian Stage of the East European Platform

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