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The leperditiid-charophyte assemblage from the Givetian of Dębnik, and its stratigraphic value

ABSTRACT: The peculiar ostracode-charophyte assemblage, discovered in the limestone intercalation within the Zbrza Dolostone of the Dębnik anticline, Cracow Upland (southern Poland), is composed of abundant leperditiid ostracodes, *Briartina obtusa* (JONES), *Herrmannina lotzi* (KEGEL), *Herrmannina* sp. and *Briartina* sp., associated with the charophytes *Sycidium volborthi volborthi* KARPINSKY. These fossils indicate an early Givetian age for this part of the carbonate sequence.

INTRODUCTION

The Devonian carbonates exposed near Dębnik in the Cracow Upland, southern Poland (Text-fig. 1*A*—*B*), were a subject of geological studies since over 100 years, but many important problems remain still unsolved (*see* NARKIEWICZ & RACKI 1984). Especially difficult question is an interpretation of the oldest lithostratigraphic unit, *i. e.* the Zbrza Dolostone. General scarcity of fossils, and especially their bad preservation cause that any new paleontological findings should be carefully elaborated in various aspects.

The present contribution contains description of the recently discovered unique ostracode-algal assemblage including for the first time described from Poland the charophyte genus *Sycidium*. This assemblage is analysed from stratigraphic point of view, and the Givetian age is established for the middle part of the Zbrza Dolostone. Paleoenvironmental specifity of the assemblage will be discussed in the future paper.

GEOLOGICAL SETTING

The material studied come from the borehole Dębnik *IG-1* located at the southern limb of the Dębnik anticline (*see* Text-fig. 1*B*—*C*). The

sample was taken at depth 91.0 m from the lower part of the devoid of macrofossils calcareous intercalation (?15 m in thickness) within the middle part of the Zbrza Dolostone (*see* NARKIEWICZ & RACKI 1984). The latter unit is composed of dark, bedded, fine- to medium-crystalline dolomites containing in some layers skeletal relics, chiefly stromatoporoids and brachiopods (*see also* ŁAPTAŚ 1982).

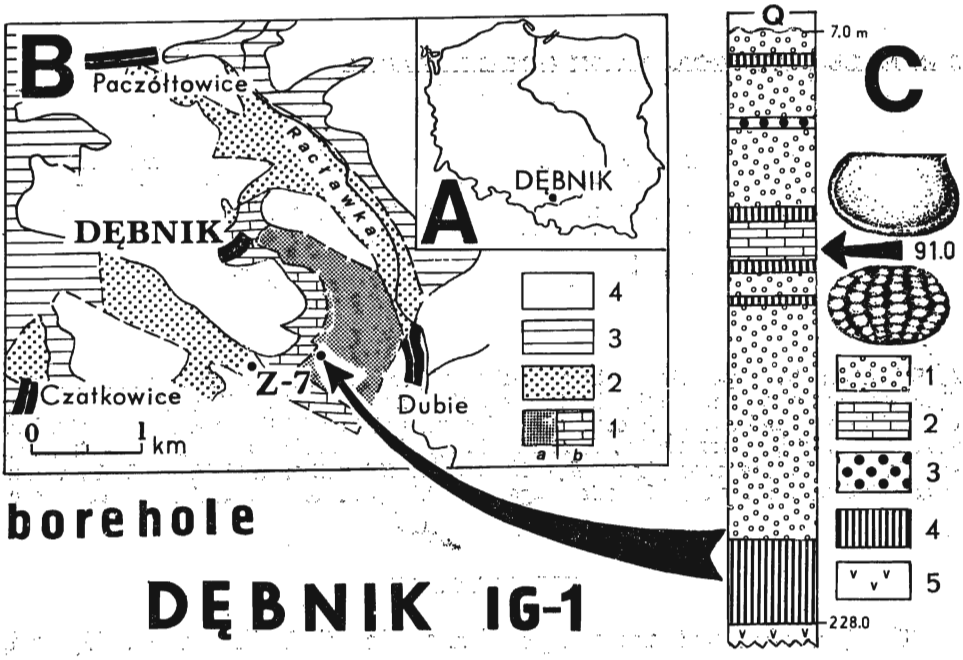


Fig. 1. Location of the sections studied in Poland (**A**) and in the Dębnik area (**B**; *taken from* ŁAPTAŚ 1982, Text-fig. 1, *simplified*)

1 Middle Devonian (*a* Zbrza Dolomite, *b* Dębnik Limestone), *2* Upper Devonian, *3* Carboniferous, *4* Mesozoic (Jurassic)

C — Section of the borehole Dębnik *IG-1* (*taken from* NARKIEWICZ & RACKI 1984, Text-fig. 2; *simplified*); arrowed is the sample containing the leperditiid-charophyte assemblage

1 dolosparites, *2* micritic limestones, *3* dolomite breccias, *4* metamorphized deposits, *5* quartz porphyry

The additional observations were made on the limestone relic within strongly metamorphized series (depth 155.3 m) of the borehole Z-7, laying about 600 m from the borehole Dębnik *IG-1*; this pelitic limestone represents most probably a lowermost part of the overlying unit, *i. e.* the Dębnik Limestone (*cf.* NARKIEWICZ & RACKI 1984).

MATERIAL

The collection studied has been obtained after disintegration and washing of crumbable, marly partings of a limestone sample. The specimens are not very well preserved. Ostracodes are represented almost exclusively by singular, fre-

quently fragmented valves attached to rock pieces. Compaction deformations are sometimes evident, also in the charophyte gyrogonites. In the latter the polygonal pattern of enveloping cells is obscured due to strong adherence of the enclosing matrix. Generally, only longitudinal ribs and furrows are visible; however, the reticulate ornamentation is well recognizable on the external casts (Pl. 1, Fig. 6) and in many specimens obtained in thin sections (Pl. 1, Figs 7—9).

The investigated collection is housed at the Silesian University at Sosnowiec (charophytes; Catalogue Number *GIUS 4-403 Db*) and at the Holy Cross Division of the Geological Institute at Kielce (ostracodes; Catalogue Number *IG-OS OI/1-20*).

SYSTEMATIC ACCOUNT OF CHAROPHYTES

LANGER (1976) discussed systematic position of the *Sycidium* group; in regard of pore system and high number of meridional units he proposed the new class Sycidiphyceae with reservation only retained within the Charophyta. Nevertheless, this opinion is not accepted in more recent papers (MUSTAFA 1978, WANG & LU 1980, WANG & *al.* 1980), especially in reason of typical for undoubtful charophytes wall lamination (FEIST & GRAMBAST-FESSARD 1985).

Orientation of the *Sycidium* gyrogonites is taken from PECK & MORALES (1966), *i. e.* the larger opening is considered as an apical pole.

Order **Sycidiales** MADLER, 1952
Family **Sycidiaceae** PECK, 1934
Genus *Sycidium* G. SANDBERGER, 1849
Sycidium volborthi volborthi KARPINSKY, 1906
(Pl. 1 and Pl. 2, Figs 8—9)

1906. *Sycidium Volborthi* sp. n.; KARPINSKY, pp. 369—370, Text-figs 187—189, Pl. 13, Figs 13—20.
1976. *Sycidium volborthi volborthi* KARPINSKY; LANGER, p. 213.

MATERIAL: Above 40 gyrogonites, more or less complete; 1 external mold.

DIMENSIONS (*in* mm): width of the gyrogonite 0.5—0.89, height of the gyrogonite 0.33—0.53, diameter of the basal opening 0.05—?0.10, diameter of apical opening 0.12—0.27 [25 measured specimens].

REMARKS: Most diagnostic features of the studied gyrogonites from Dębnik are the oblate shape (*see* Text-fig. 2) and the hexagonal pattern of 18 enveloping cells, that agree well with the specimens of KARPINSKY (1906). The only difference consists in the larger size, and probably more elongated (*see* Pl. 1, Fig. 6) hexagonal plates of the investigated specimens. Furthermore, very thin lime shell (usually 0.05—0.08 mm) seems to be a typical feature of the gyrogonites investigated, but it is rather reflection of difficult conditions of oogonium calcification only. In thin sections from the borehole Z-7 there occur oblate specimens with the thicker lime shell (up to 0.12 mm), possibly also attributable to the nominative subspecies of *Sycidium volborthi* (see discussion below).

Two other oblately-shaped species of *Sycidium* are distinctly different. The first, *Sycidium sipiaense* (WANG & LU) from the Emsian of China, is markedly larger, with both poles strongly truncate and with more pronounced ornamentation (*see* WANG & al. 1980; pp. 9—10, Pl. 1, Figs 1—12). The second, *Sycidium clath-*

ratum PECK from the Carboniferous of the United States, has a smaller number of meridional units (16 instead of 18) and rectangular pattern of pits (*see* PECK & MORALES 1966; p. 311, Pl. 2, Figs 1—4).

AGE and DISTRIBUTION: Middle Devonian, Givetian; the subspecies is widely distributed in the Narovsk Horizon of the East European Platform (SAMOILOVA & PRINADA 1966), in Poland it was found in the Givetian of the Dębnik anticline (Zbrza Dolostone, borehole Dębnik *IG-1*; ? also the bottom part of the Dębnik Limestone in borehole Z-7) and in the eastern Holy Cross Mts (*Stringocephalus burtini* Beds, Jurkowice-Budy Quarry).

SYSTEMATIC ACCOUNT OF OSTRACODES

In the investigated collection (over 170 specimens) it is impossible to study the internal features, although deep muscle scars are visible in the valve sections (Pl. 2, Fig. 10). Therefore, four herein distinguished taxa are based on the shell outline (*cf.* KEGEL 1933), chiefly on the relationship of longitudinal axis to the dorsal margin (parallel in *Briartina*, oblique in *Herrmannina*) and on the ratio of the length of a carapace to its height.

Order **Leperditicopida** SCOTT, 1961
Suborder **Leperditiida** POKORNY, 1953
Family **Leperditiidae** JONES, 1856
Genus *Briartina* KEGEL, 1933
Briartina obtusa (JONES, 1896)
(Pl. 2, Figs 1—3)

non 1900. *Leperditia obtusa* JONES?; LOTZ, p. 204, Pl. 3, Fig. 12a—b [=*Herrmannina lotzi* (KEGEL)].
1933. *Leperditia (Briartina) obtusa* (JONES); KEGEL, pp. 927—928, Text-fig. 14, Pl. 46, Fig. 12 [*other synonymy*].

MATERIAL: Several tens of specimens.

DIMENSIONS (*in* mm): Length of the valve 2.35—3.61, height of the valve 1.44—2.16, ratio of the height to length 0.60—0.64 [9 measurements].

REMARKS: Specimens studied correspond in size and shell outline to the type material from Western Europe.

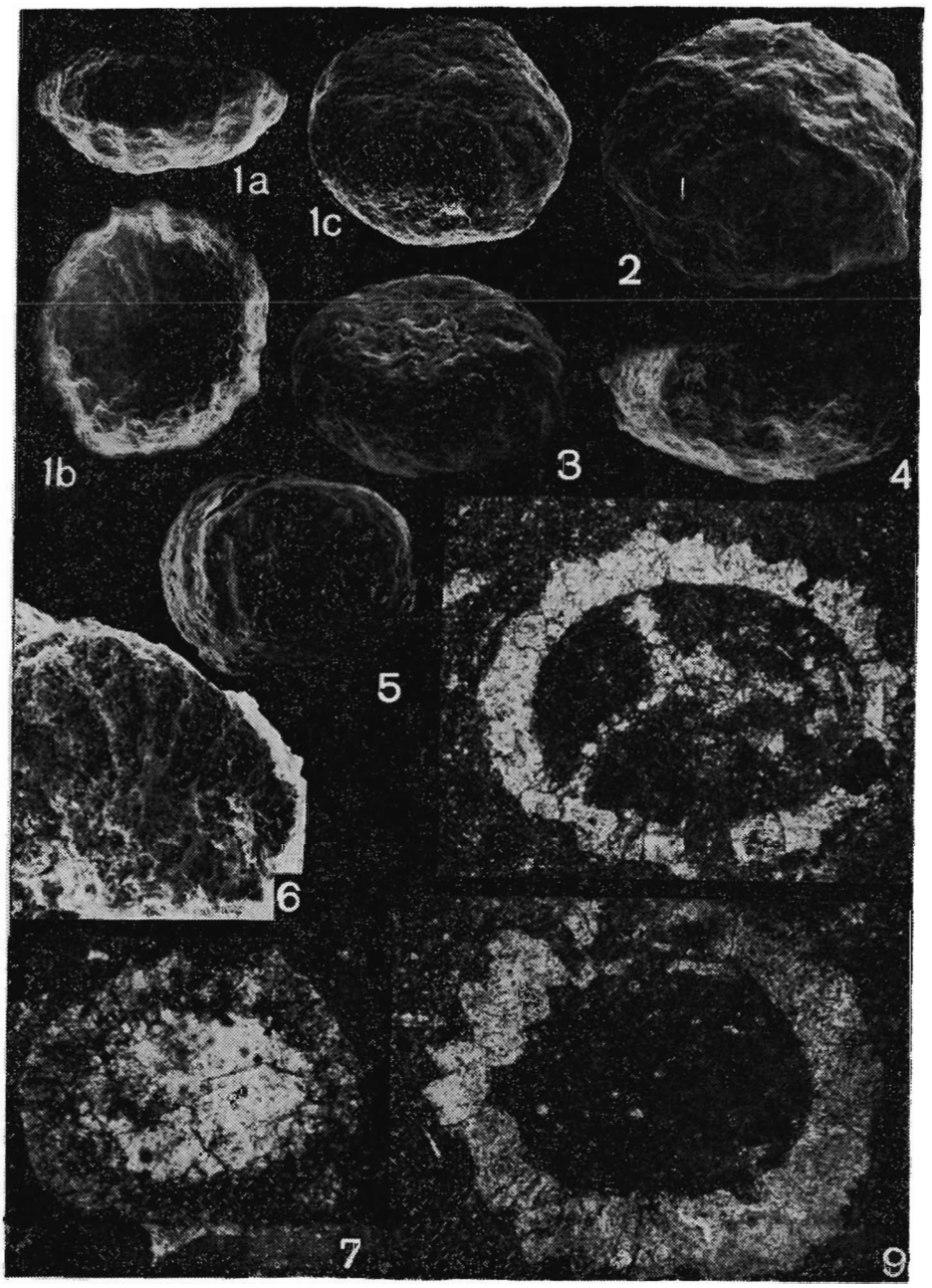
AGE and DISTRIBUTION: Middle Devonian, Givetian of Western Europe (Rhenish Slate Mts, "Massenkalk" of the Giessen area; Ardennes) and Poland (Dębnik anticline, Zbrza Dolostone, borehole Dębnik *IG-1*).

Briartina sp.
(Pl. 2, Fig. 4)

MATERIAL: One valve.

DIMENSIONS (*in* mm): Length of the valve 3.08, height of the valve 2.20, ratio of the height to length 0.71.

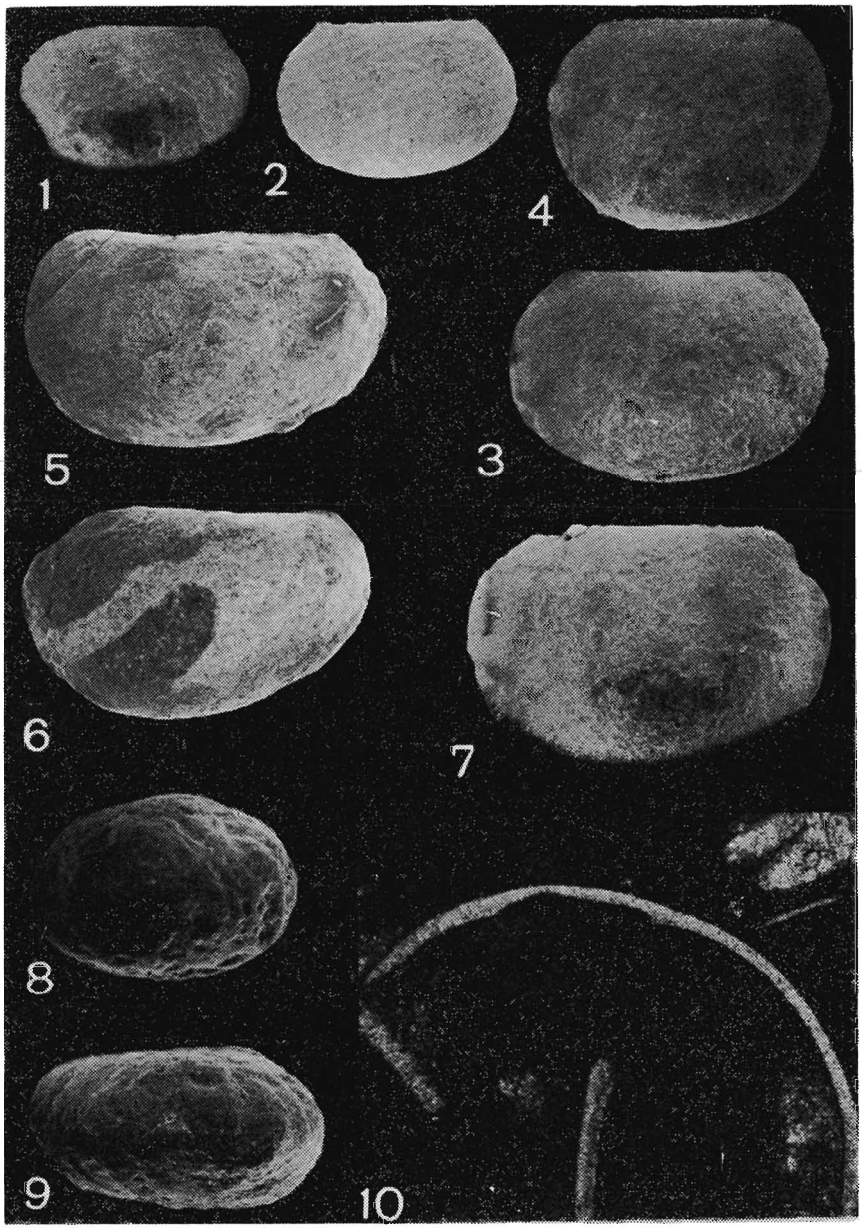
REMARKS: One specimen probably represents another species of the *Briartina*, close to *B. obtusa* (JONES), but characterized by the shorter hinge margin and the height to length ratio somewhat higher and resulting in a less slender shape of the carapace.



Givetian charophytes from the Dębnik anticline (1-7 — borehole Dębnik *IG-1*, 8-9 — borehole *Z*-7)

1-6 — *Sycidium volborthi volborthi* KARPINSKY: gyrogonites in lateral (1a, 4-5), oblique-apical (1b, 3) and basal (1c, 2) views, all × 50; 6 — apical (?) fragment of the external cast showing ornamentation consisting of alternating hexagonal pits, × 75

7-9 — Gyrogonites in thin sections; note the presence of reticulate pattern on the internal surface of lime shell (9), diagnostic (*see* KARPINSKY 1906) of *Sycidium*; × 120



Givetian leperditiid ostracodes and charophytes from the Dębnik anticline (borehole Dębnik *IG-1*)

1-3 — *Briartina obtusa* (JONES): three valves in lateral views; × 12
4 — *Briartina* sp.: valve in lateral view; × 12
5-6 — *Herrmannina lotzi* (KEGEL): two valves in lateral views; × 12
7 — *Herrmannina* sp.: valve in lateral view; × 12
8-9 — *Sycidium volborthi volborthi* KARPINSKY: two gynogonites in lateral views; × 50
10 — Leperditiid valve in thin section, to show deep muscle scars; × 70

AGE and DISTRIBUTION: Middle Devonian, Givetian, Poland (Dębnik anticline, Zbrza Dolostone, borehole Dębnik *IG-1*).

Genus *Herrmannina* KEGEL, 1933

Herrmannina lotzi (KEGEL, 1933)

(Pl. 2, Figs 5—6)

1900. *Leperditia obtusa* JONES?; LOTZ, p. 204, Pl. 3, Fig. 12a—b.
1933. *Leperditia (Herrmannella) lotzi* sp. n.; KEGEL, pp. 917—918, Text-fig. 7, Pl. 46, Fig. 10.

MATERIAL: Several tens of specimens.

DIMENSIONS (*in* mm): Length of the valve 3.11—4.06, height of the valve 1.94—2.42, ratio of the height to length 0.58—0.63 [6 measurements].

REMARKS: The specimens from Dębnik agree well with the holotype of *H. lotzi* (see KEGEL 1933, Text-fig. 7). Some other illustrated German representatives of this species display a strong truncation of the shell posterodorsal border, but this feature was not observed in the material studied.

AGE and DISTRIBUTION: Middle Devonian, Givetian (?also topmost Eifelian) of the Rhenish Slate Mts (lower Honsel Beds, "Massenkalk" of the Giessen area), Givetian of the Dębnik anticline (Zbrza Dolostone, Borehole Dębnik *IG-1*).

Herrmannina sp.

(Pl. 2, Fig. 7)

MATERIAL: Five valves.

DIMENSIONS (*in* mm): Length of the valve 2.24—3.91, height of the valve 1.56—2.62, ratio of the height to length 0.67—0.69 [4 measurements].

REMARKS: The specimens discussed resemble *H. lotzi* (KEGEL), but they are distinguished by the more massive shell shape and higher ratio of the shell height to length.

AGE and DISTRIBUTION: Middle Devonian, Givetian, Poland (Dębnik anticline, Zbrza Dolostone, borehole Dębnik *IG-1*).

STRATIGRAPHIC ASPECT OF *Sycidium volborthi* KARPINSKY

LANGER (1976, p. 213) established an Eifelian subspecies *Sycidium volborthi eifelicum* differing from the Givetian nominative subspecies primarily by the more spheroidal shape of gyrogonite. This subdivision was questioned by MUSTAFA (1978) because of poorly known variability within the type KARPINSKY's material.

Analysis of the biometrical data of LANGER (1976, Diagram 1) and (MUSTAFA 1978) shows that among Eifelian specimens of *S. volborthi* the suboblate shapes predominate, 50.3 and 66.3 per cent respectively, but the oblate spheroidal gyrogonites occur too (*see* Text-fig. 2). It is also true for the undescribed material from the Eifelian of the Holy Cross Mts (*see* MALEC 1982). On the other side, most of the KARPINSKY's specimens and all the Polish material studied from the Givetian strata are typically oblately shaped. This differentiation is statistically

supported by the KOLMOGOROV-SMIRNOV test in spite of relative scarcity of the Russian and Polish data.

These results could be partly influenced by the state of gyrogonite preservation (*e. g.* internal casts in case of LANGER's collection, unrecognizable compactional deformations in Dębnik specimens), but seem to confirm, from the stratigraphical point of view, distinction of subspecies within *Sycidium volborthi*. Morever, the high intrapopulation shape variability of the Eifelian subspecies raises a possibility that it is

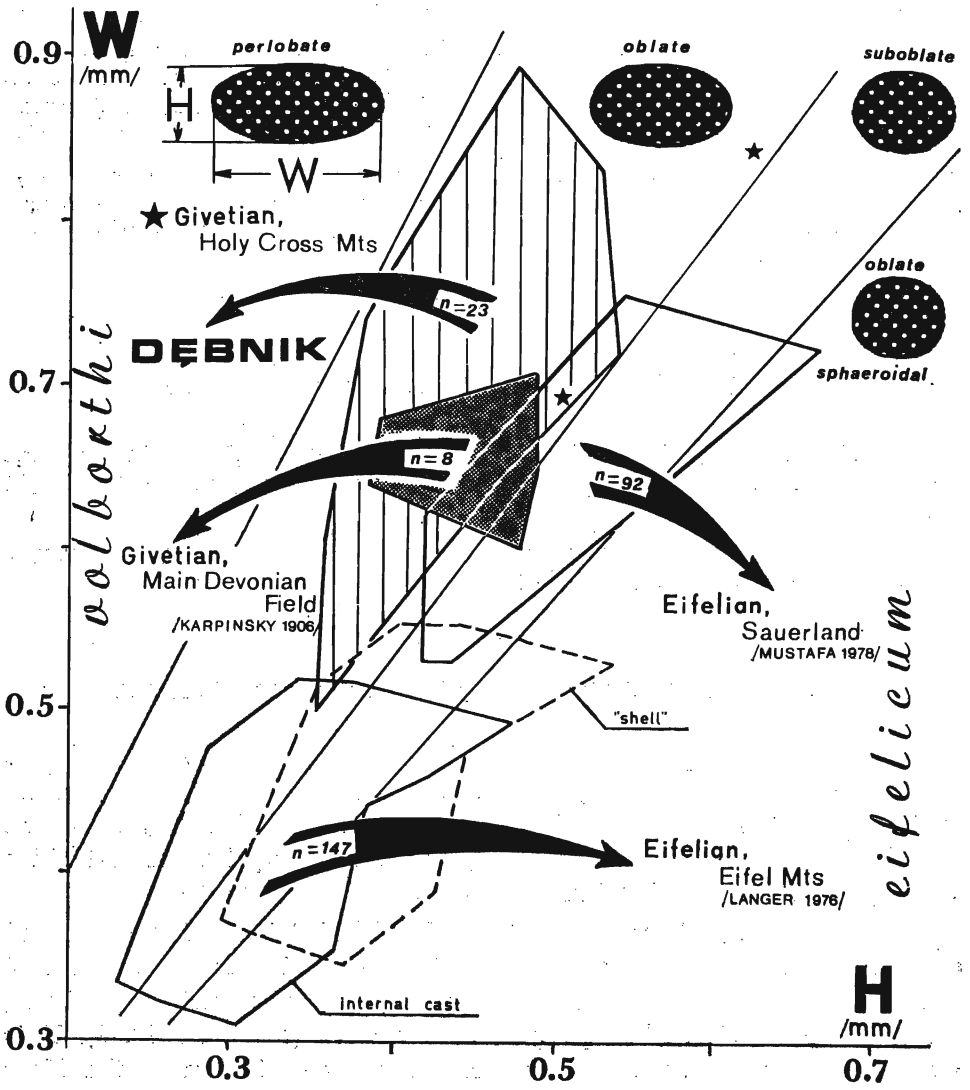


Fig. 2. Variabilities of the gyrogonite shape (terminology *after* HORN, *vide* PECK & MORALES 1966) of *Sycidium volborthi* KARPINSKY from different sites known in the literature (partly *after*: MUSTAFA 1978, Text-fig. 1); note a differentiation of the Eifelian and Givetian subspecies

an ancestor for both the Givetian *S. volborthi volborthi* KARPINSKY and *S. panderi* KARPINSKY (1906, pp. 367—369, Text-figs 181—186; Pl. 13, Figs 1—12, 29—34; Pl. 14, Figs 9—10), characterized already by definite shapes of gyrogonite, *i. e.* oblate and spheroidal respectively.

CHRONOSTRATIGRAPHIC IMPLICATIONS

The age of the thick (over 260 m) unit of the Zbrza Dolostone was a matter of significant controversies (*see* NARKIEWICZ & RACKI 1984, pp. 528—529). Assignment of its highest part to the Givetian has recently been firmly established after finding of the guide fossil, *Stringocephalus burtini* DEFRANCE (*see* ŁAPTAŚ 1982). Nevertheless, the stage attribution of the remaining portion of this unit is still disputable due to a lack of determinable fossils.

The chronostratigraphic value of the charophyte and ostracodes described above is not well acknowledged, but yet it throws some light on the position of the Eifelian/Givetian boundary within the dolomite sequence. The known ranges of all three determined species indicate still the Givetian age of the middle part of the Zbrza Dolostone. Furthermore, even a more precise chronostratigraphic conclusion seems to be possible for the following reasons:

(*i*). The charophyte *Sycidium volborthi volborthi* bearing Narovsk Horizon is considered as a lower, but not lowermost, part of the Givetian (*see* SAMOILOVA & PRINADA 1966). However, it must be noted that *Stringocephalus* was not found below the Upper Narovsk Subhorizon [*see* Mosolovsk Beds *in*: ZANINA & LICHAREV 1975], and the Eifelian/Givetian boundary is difficult to proper biostratigraphic recognition in the sections of the East European Platform (*see also* RZHONSNITSKAYA 1986).

(*ii*). In the Holy Cross Mts these charophytes are rare elements in the undescribed *Trochiliscus*-dominated association at the Jurkowice-Budy Quarry certainly within the *Stringocephalus* range-zone, i. e. ensensis to hermanni-cristatus Zones in the conodont terms (JOHNSON & *al.* 1982, 1985; STRUVE 1982). It is also true for the leperditiid-rich micrite facies in the Holy Cross Mts.

(*iii*). Both identified species of the leperditiid ostracodes were previously reported from the "untere Stringocephalen-Stufe" (*see* KEGEL 1933). According to the current subdivision of the Rhenish Middle Devonian restriction to an early Givetian strata is very probable in the case of *Briartina obtusa* (JONES), known only from the "Massenkalk"-facies (*see* LOTZ 1900).

(*iv*). KREBS (1974, p. 189) distinguished the *Leperditia*-micrite facies typical of the Givetian shelf lagoon of Central Europe; it is notable, that such limestones are best examplified in the Lower Givetian Spickberg Beds of the Eifel region (*see also* STRUVE 1963, BECKER 1971). Similar age have equivalents of the *Leperditia*-rich facies known from Belgium (Hotton Formation; PEL 1975) and Canada (Sulphur Point Formation; KREBS 1974, p. 189).

Summarizing, the middle part of the Zbrza Dolostone is thought to represent the lower Givetian. Interval of the ensensis to the lower part of

the varcus Zone can be presumed according to the recent stratigraphic schemes (*see* ZIEGLER 1979, STRUVE 1982, JOHNSON & *al.* 1985).

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ZESPÓŁ MAŁŻORACZKOWO-RAMIENICOWY Z ŻYWETU DĘBNIKA I JEGO ZNACZENIE STRATYGRAFICZNE

(Streszczenie)

Specyficzny zespół małżoraczkowo-ramienicowy został stwierdzony w wapiennej wkładce w środkowej części środkowodewońskich dolomitów ze Zbrzy okolic Dębnika (*patrz* fig. 1—2 oraz pl. 1—2). Zdominowany jest on przez duże małżoraczki z rzędu Leperditicopida, reprezentowane przez cztery taksony: *Briartina obtusa* (JONES), *Herrmannina lotzi* (KEGEL), *Herrmannina* sp. oraz *Briartina* sp. Towarzyszą im jedynie ramienice *Sycidium volborthi volborthi* KARPINSKY. Przedyskutowano różne aspekty stratygraficzne tych mało znanych skamieniałości, co umożliwiło określenie wieku badanej części sekwencji węglanowej Dębnika na wczesny żywet.
