Rugose corals from the Devonian Kowala Formation of the Holy Cross Mountains

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Rugose corals of the Givetian to Lower Frasnian Kowala limestone Formation in the environs of Chęciny, SW Holy Cross Mts and in its age equivalents in the Silesian-Cracow region of Southern Poland represent five distinct assemblages of restricted time-and-space distribution. Within the *Stringocephalus* Beds the high diversity *Pseudohexagonaria*(?) *laxa* assemblage indicates open-shelf conditions whereas low diversity *Temnophyllum occidentale* assemblage represents restricted conditions. The transgressive Jaźwica Mbr. locally contains diversified and cosmopolitan *Acanthophyllum* sp. n. fauna. Following temporally coral assemblages, i.e. *Disphyllum* (lower Sitkówka and Chęciny Beds) and *Macgeea-Thamnophyllum* (Kadzielnia Mbr, upper Sitkówka Beds) are mostly biostromes of branching corals of low taxonomical diversity typical for restricted relatively setting, rather unfavorable for rugosans. Exceptional are two *Hexagonaria* horizons with common massive colonies. *Diffusolasma* gen. nov., *Sociophyllum severiacum* sp. nov., *Temnophyllum zamkowae* sp. nov. and *Hexagonaria hexagona kowalae* subsp. nov. are proposed as the new taxa.

Key words: Rugosa, Devonian, Holy Cross Mts, Kowala Formation, taxonomy, stratigraphical distribution.

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Introduction

The first extensive study of the Devonian rugose corals of the Holy Cross Mountains was undertaken by Gürich (1896). However, he referred chiefly to corals mostly of shaly facies, of the northern (Łysogóry) region. His collection was destroyed in 1945. His species identifications are still meaningful due to recent resampling in the type localities by subsequent authors. The most significant contribution was given by Maria Różkowska, who published papers on the Frasnian phillipsastreids (1953), offsetting and variability (1960) and Frasnian corals in general (1980). Moenke

(1954) described species of the genus *Hexagonaria* and Różkowska & Fedorowski (1972) the genus *Disphyllum*.

In this paper descriptions are given for corals from the Kowala Formation (Narkiewicz *et al.* 1991, see also Fig. 2) from the environs of Chęciny (Fig. 1) and from its age equivalents in the Silesian-Cracow Upland (Dębnik, Dziewki). Presented are the corals either previously unrecorded from the study area, or those which created some taxonomical difficulties. The remaining species of the Kowala Formation are listed in tables (1 and 2 – genera *Disphyllum* and *Macgeea* + *Thamnophyllum*, respectively).

The stratigraphical and general geological backgrounds have been discussed by Wrzołek (1988) and by Racki (1988, 1993). Data on the WB-12 borehole, drilled ca. 0.5 km to NE of the Devonian outcrop in Dziewki, are taken from Racki *et al.*, (in press). *Disphyllum* in Dębnik (see Tab. 1) occurs in the Givetian of the Main Carmelite quarry (see Baliński 1979: Figs 1, 2). The stratigraphical data for the Holy Cross Mountains are schematically presented in Fig. 2.

The described corals are stored at the Department of Earth Sciences (Silesian University) in Sosnowiec (abbreviated GIUS).

Distribution of coral faunas

Data on the distribution of Devonian tetracorals in the SW Holy Cross Mountains has been already presented by Wrzołek (1988, see also Wrzołek *in* Racki *et al.* 1989), so that only some additional comments, mostly concerning the Kowala Formation assemblages, are given below. Lithological sets are taken from Racki (1993: Fig. 3 and 'Register of localities' therein).

***Pseudohexagonaria*(?) *laxa* assemblage.**– The assemblage occurs in Dziewki (Silesian-Cracow Upland), at Sowie Górki (set B) and Ołowianka (the Holy Cross Mountains). Elsewhere this or a similar assemblage is known from Jurkowice-Budy and Czarnów.

Together 11 species have been identified; cosmopolitan are mostly those of the genera *Cystiphylloides* and ?*Pseudohexagonaria*, also *Temnophyllum latum* Walther 1929 and *Neospongophylloides grandivesiculosus* (Soshkina 1952).

Most of the species are from light-coloured biogenic and biodetrital limestones; specimens of *Sociophyllum severiacum* sp. n. are from dark pelitic and finely detrital limestones.

***Temnophyllum occidentale* assemblage.**– The assemblage occurs in the set A at Góra Zamkowa and in the Jaźwica quarry (set A). The corals are associated there with ramose and massive stromatoporoids, suggesting restricted marine conditions. On the other hand more diversified assemblage of similar species composition is indicated by preliminary investigations at Posłowice (Holy Cross Mountains, northern limb of Gałęzice syncline).

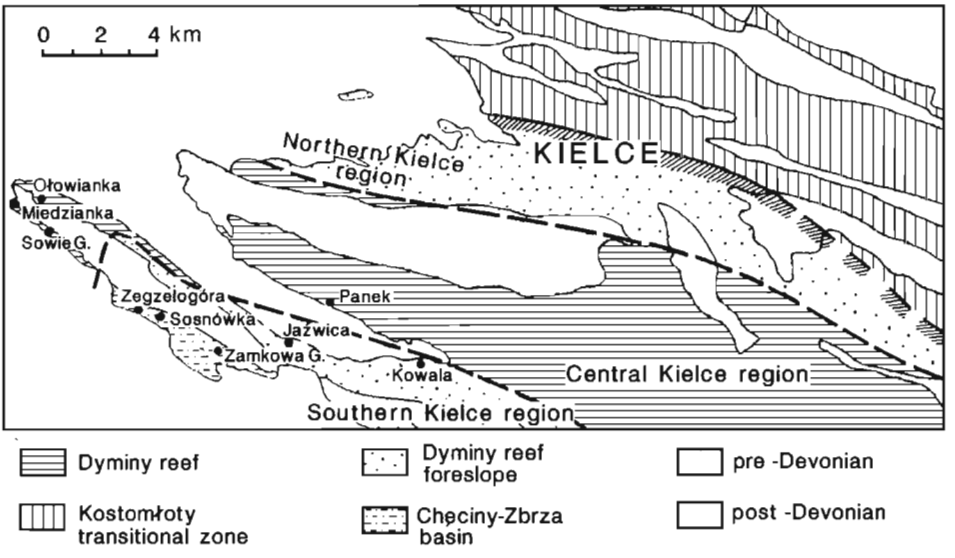

Fig. 1. Location of studied sites of the Kowala Formation in the SW Holy Cross Mts, against early Frasnian paleogeography (after Racki 1993: Fig. 2B); northern edge of the Kielce platform hatchured.

Only 3 species of *Temnophyllum* are recorded in the assemblage. Two of them: *T. occidentale* Hill & Jell 1970 and *T. menyouense* Hill & Jell 1970 are also known from the Givetian and Frasnian of the Canning Basin, Western Australia.

Both the above mentioned assemblages occur within the upper part of the Givetian *Stringocephalus* Beds of the Kowala Formation and in their age-equivalents in the Silesian-Cracow Upland.

***Acanthophyllum* sp. n. assemblage.**– Wrzołek (1988) reported 10 species of this assemblage from the Crinoid-Coral Level of Sowie Górki (set C). Such a high diversity (relatively to the former assemblage) is a result of a transgressive pulse in the Late Givetian.

Only one species [*Cystiphylloides secundum* aff. *schlueteri* (Wedekind 1921)] is described in the present paper. Wrzołek & Wach (in press) illustrate *Spinophyllum longiseptatum* (Lütte 1984). The other corals, including the cosmopolitan ones, typical for the Givetian of Europe are *Grypophyllum denckmanni* Wedekind 1922, *Stringophyllum* cf. *buechelense* (Schlüter 1889) and *Acanthophyllum* sp. nov.

***Disphyllum* + *Hexagonaria davidsoni* assemblage.**– This assemblage, with 10 species includes 7 species of *Disphyllum* (see Tab. 1) and 3 species of *Hexagonaria*. It occurs in the environs of Chęciny (from Zegzelogóra to Kowala), in the lower Sitkówka Beds (Givetian to Frasnian boundary beds), a biostromal part of the Kowala Formation, with numerous banks of *Amphipora* limestones and microbial laminites, suggesting lagoonal conditions. *Disphyllum* in Dębnik occurs in a similar setting. *Hexagonaria* [chiefly *Hexagonaria davidsoni* (Milne-Edwards & Haime

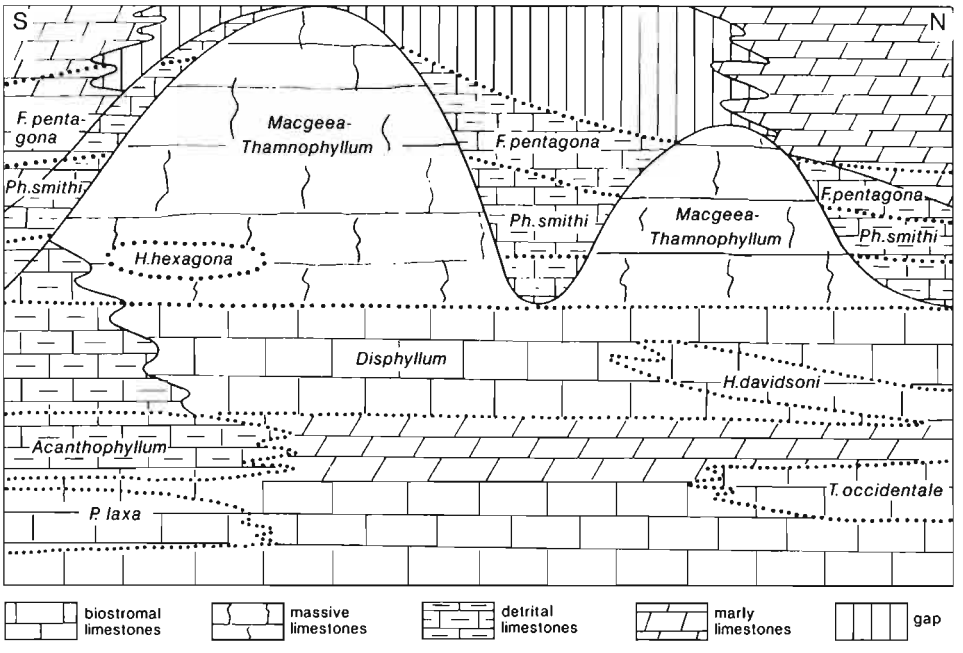

Fig. 2. Spatio-temporal extension of tetracoral zones presented on a schematic section across SW Holy Cross Mts (*after* Wrzołek 1988).

1851)] occurs within one buildup in the lower part of the lower Sitkówka Beds. In the Jaźwica quarry colonies are mostly in growth position, whereas at Zegzelogóra corals are overturned. Some diachronism of the *Hexagonaria davidsoni* horizon within the *Disphyllum* Zone is possible (see Fig. 2).

Disphyllum is locally rock-building in the bottom part of the lower Sitkówka Beds (also in the Chęciny limestone – detrital and biogenic equivalent of the latter); towards the top mostly single colonies or isolated corallites occur, usually embedded in stromatoporoid limestones or laminites (as at Jaźwica, set F).

***Macgeea - Thamnophyllum + Hexagonaria hexagona* assemblage.**– Recorded are 6 species (see Tab. 2 for *Macgeea* and *Thamnophyllum*), representing the upper Sitkówka Beds and Kadzielnia Member of the lower Frasnian.

Both the latter assemblages are of low diversity and are relatively endemic. The opposite is true for the younger Frasnian assemblages, from the detrital and marly deposits overlying the Kowala Formation (Fig. 2): each contains about thirty, mostly cosmopolitan species of phillipsastried and endophyllid tetracorals (Wrzołek 1988). Only three disphyllids from these strata are included in the present paper: *Temnophyllum latum* represented by single corallite found in the detrital limestones of the *Phillipsastraea smithi* Zone of Kowala quarry (set G), *Diffusolasma diffu-*

sum (Wrzołek 1982), relatively common in *Frechastraea pentagona* Zone marly deposits of Jaźwica (set R) and Kowala (set H) quarries, and *Disphyllum* aff. *bonae* Różkowska & Fedorowski 1972 known from a few corallites in detrital limestones of *Ph. smithi* Zone of the Panek quarry.

Taxonomy

Suprageneric classification, diagnoses and terminology follow that of Hill (1981), unless stated otherwise. Distribution data and the coral zonation are from Wrzołek (1988).

The terms 'septal crust' and 'septal crest' are taken from McLean (1976: p. 2). They denote layers of closely packed septal trabeculae on the surface of blisters and vertically fused trabeculae in cystiphyllids, respectively; the term 'intraseptal dissepiments' is from Wrzołek (1982) and pertains to small blisters, confined to free space between loosely packed trabeculae of a septum.

Family Cystiphyllidae Milne-Edwards & Haime 1850
Genus *Cystiphylloides* Chapman 1893

Cystiphylloides secundum secundum (Goldfuss 1826)

Fig. 3A-B.

Remarks.– The specimen, illustrated by Rohart (1988: Pl. 28: 1) shows rather horizontally arranged blisters, i.e. in transverse sections circular sections are common, whereas in the specimens from the Holy Cross Mountains blisters are crescent-shaped at the periphery (Fig. 3A), which reflects their steep inclination (Fig. 3B).

Distribution.– Middle Devonian of Variscan Europe (Birenheide 1978); 4 specimens from Ołowianka and 'middle' Sowie Górki quarry (set B), Givetian, *P. laxa* Zone.

Cystiphylloides secundum cf. *dushanense* (Liao & Birenheide 1984)

Fig. 3C-D.

Description.– Solitary corals with stereoplasmic cones and septal crests, that rarely fuse into incomplete crusts (Fig. 3C). Dissepiments are peripherally steeply inclined towards the axis, adaxially in gradual manner becoming horizontal (Fig. 3D).

Remarks.– The Polish specimens differ from that described in Liao & Birenheide (1984) in having septal crests also in the middle part of the corallites. Possibly this is an effect of multiple rejuvenations. The Eifelian specimens, identified as *Pseudozonophyllum halli* by Różkowska (1954: p. 236, Figs 30-34) from Grzegorzowice have more strongly expressed septal crusts but may represent the same species.

Distribution.– 2 specimens from Dziewki, A-C_1 interval, Givetian, *P. laxa* Zone.

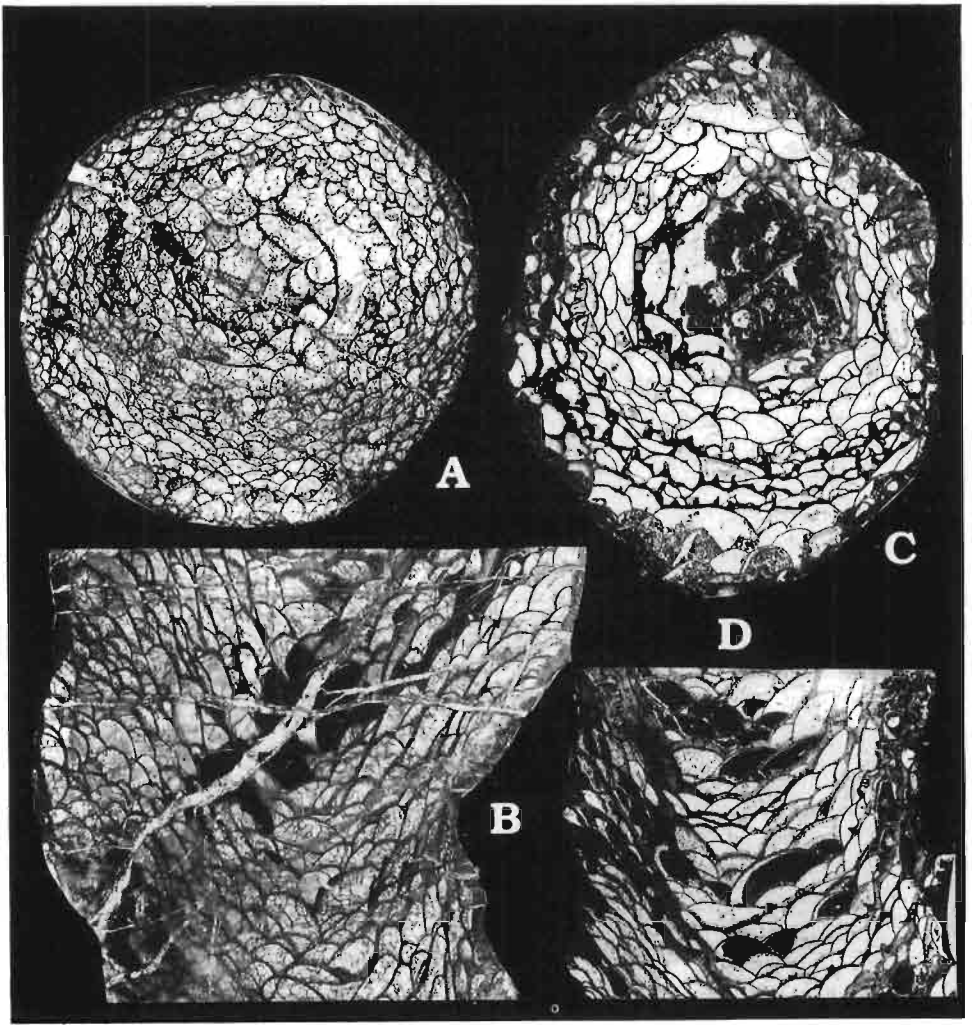

Fig. 3. ❑A, B. *Cystiphylloides secundum secundum* (Goldfuss 1826), transverse and longitudinal section of corallite GIUS 385 OL 11, Ołowianka, *Stringocephalus* beds, Givetian, *P. laxa* Zone. ❑C, D. *C. s.* cf. *dushanense* (Liao & Birenheide 1984), corallite GIUS 358 D 54, Dziewki (interval A-C_1), age equivalents of *Stringocephalus* Beds Givetian, *P. laxa* Zone. All × 2.

Cystiphylloides secundum aff. *schlueteri* (Wedekind 1921)

Fig. 4A-B.

Remarks.– The specimen differs from that of *C. s. schlueteri*, illustrated by Birenheide (1978: Fig. 115a, b) in having 2-3 times larger blisters, although the size and shape of calicinal floor are similar, i.e. the peripheral blisters are more or less horizontal (Fig. 4B, compare with Fig. 4A – circular sections of blisters at the corallite periphery) and are arranged axially in inverse cones (Fig. 4B).

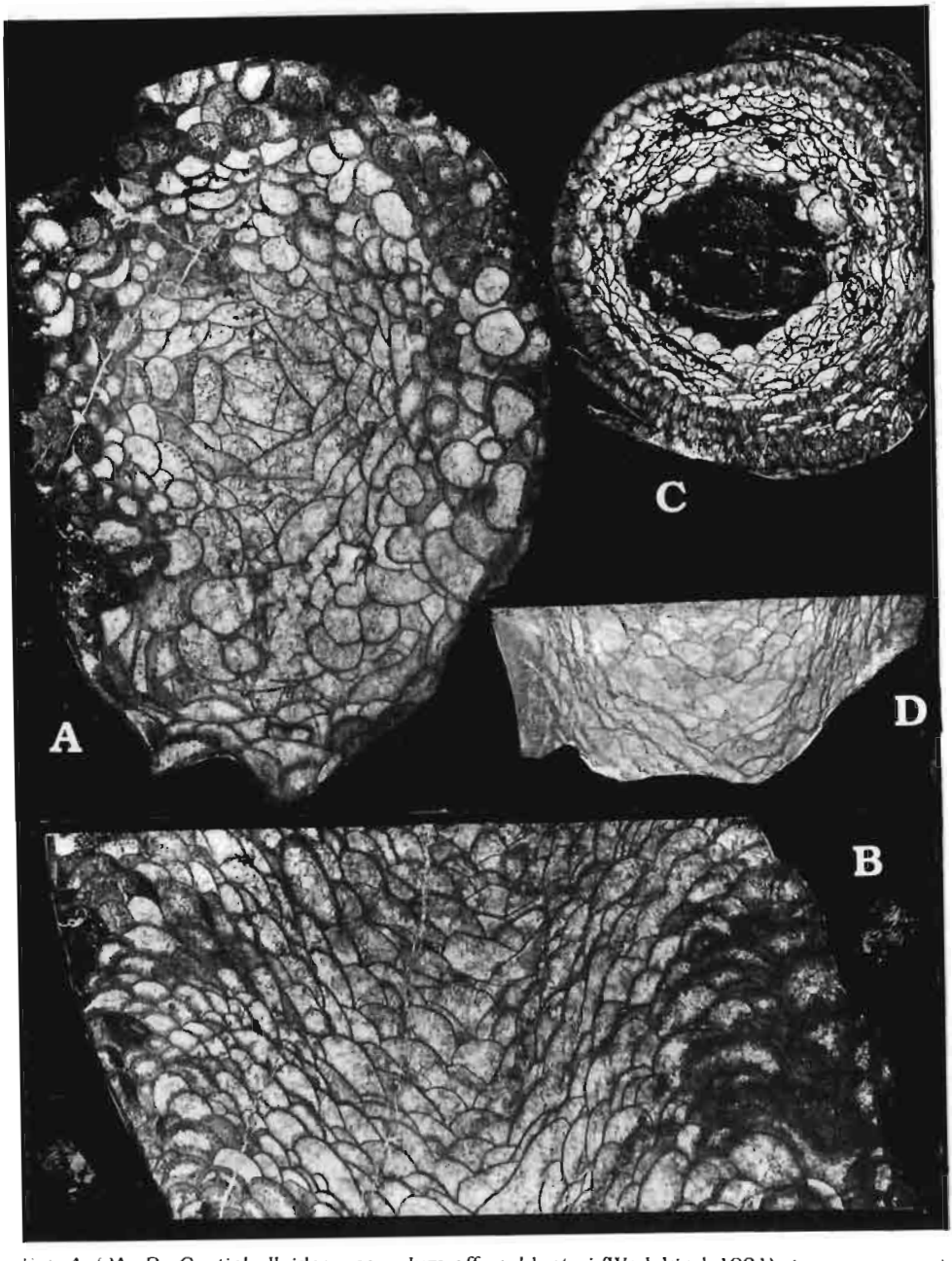

Fig. 4. ❑A, B. *Cystiphylloides secundum* aff. *schlueteri* (Wedekind 1921), transverse and longitudinal section of corallite GIUS 360 SG 17, Sowie Górki (set C), Crinoid-Coral Level, Givetian, *Acanthophyllum* sp. n. zone. ❑C, D. *Cystiphylloides* sp., corallite GIUS 358 D 77, Dziewki (interval A-C_1), age equivalents of *Stringocephalus* Beds, Givetian, *P. laxa* Zone. All × 2.

Distribution.– One fragmentary specimen from the 'middle' Sowie Górki quarry, set C, Givetian, *Acanthophyllum* sp. n. zone.

Cystiphylloides sp.

Fig. 4C-D.

Remarks.– The arrangement of blisters in this specimen is like that of *C. s.* cf. *dushanense*: peripherally steep, adaxially gradually becoming horizontal (Fig. 4D). Notable are transverse sections of septal crusts with prominent, triangular septal segments (Fig. 4C), possibly an effect of multiple rejuvenation and/or intermittent stagnation of growth. On the other hand the similar (?conspecific) specimen from the set VIII of the WB-12 borehole (Wrzołek *in* Racki *et al.* in press) is with thick peripheral theca of septal origin, but without any traces of either rejuvenation or of growth stagnation.

Distribution.– Two specimens from Dziewki, A-C_1 interval, WB-12 borehole, set VIII, Givetian, *P. laxa* Zone.

Family Fasciphyllidae Soshkina 1954

Genus *Fasciphyllum* Schlüter 1885

Remarks.– *Battersbyia* Milne-Edwards & Haime 1851 (type species *B. inaequalis* Milne-Edwards & Haime 1851) probably is a senior synonym of *Fasciphyllum*, but as its type species has been described from a beach pebble, the type horizon and locality will always remain doubtful; the name *Fasciphyllum* is therefore used in the present paper. More comments on these generic names are given by Coen-Aubert (1992).

Fasciphyllum conglomeratum (Schlüter 1881)

Fig. 5A-D.

Dimensions.– From ?8, 19 to 32 septa (of both orders), commonly 26-28 septa; diameter 1.2 to 6.7 mm, most commonly 3.5 to 4.5 mm; sections from 7 samples measured.

Remarks.– The corallites are always overgrown by massive stromatoporoids, which may indicate symbiosis of some sort, especially because: (1) corallites are more or less perpendicular to latilamellae (Fig. 5B), and (2) only species of *Actinostroma*, namely *A. bifarium* Nicholson 1886, *A. expansum* (Hall & Whitfield 1873), and *A. papillosum* (Bargatzky 1881) enter the interaction with *Fasciphyllum*.

The described corallites are either without presepiments (Fig. 5A), with smaller (Fig. 5C) or larger (Fig. 5D) presepiments, totally absent in the corals from Eifel area. It is noteworthy that the Polish material (this concerns also the species presented below) has never yielded specimens with clear indications of branching. Possibly these are solitary corallites, in parallel arrangement, induced by an interaction with stromatoporoids. The illustrated German representatives of the species (Birenheide 1978; Hill 1981), though more densely arranged than in Dziewki, do not provide any evidence for offsetting. Smaller corallites of this species are close to '*Battersbyia*' *inaequalis* Milne-Edwards & Haime 1851 (*sensu* Glinski

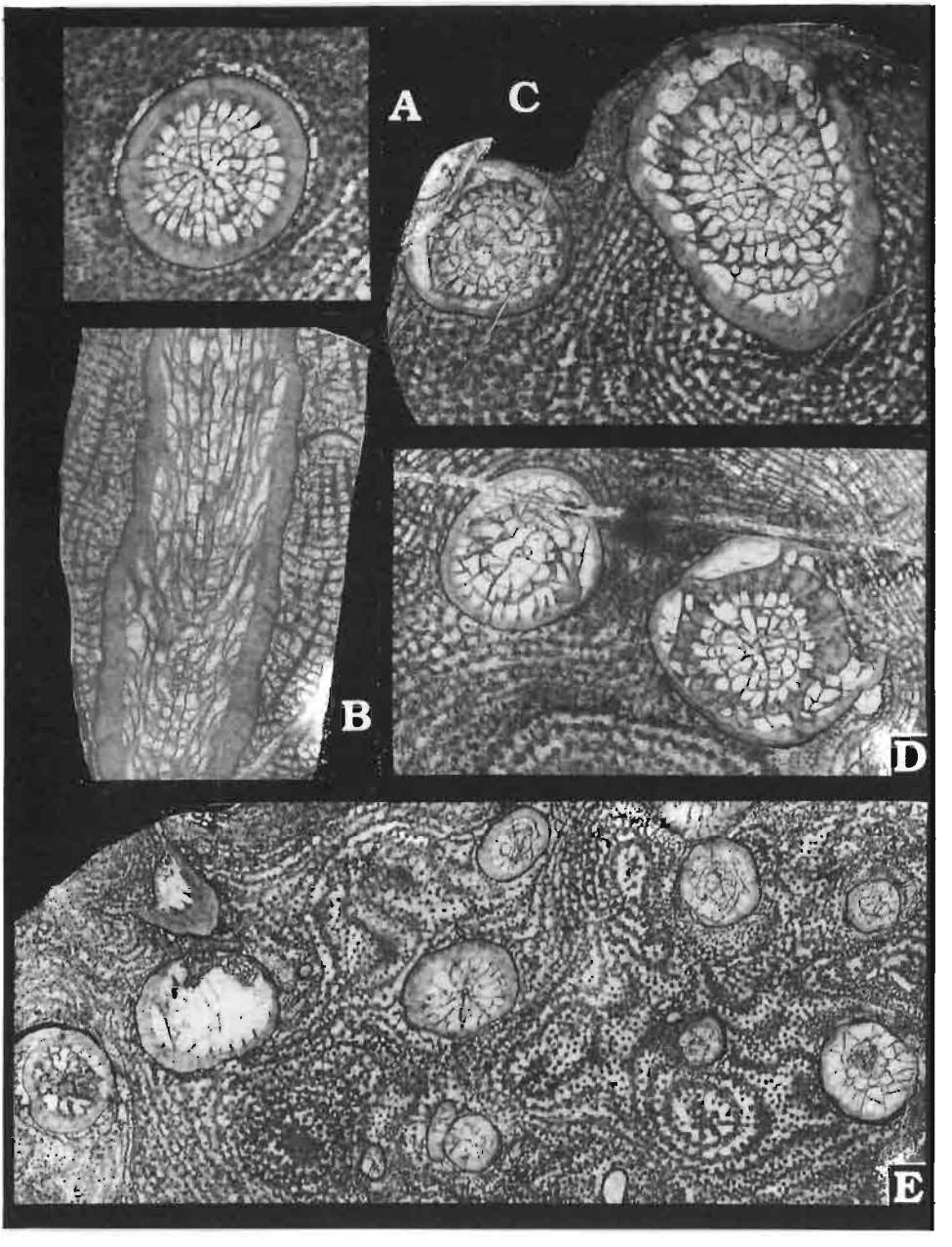

Fig. 5. *Fasciphyllum* corallites intergrown with massive stromatoporoids, Dziewki, set C_2. age-equivalents of *Stringocephalus* Beds, Givetian, *P. laxa* Zone, × 5. ❑A-D. *Fasciphyllum conglomeratum* (Schlüter 1881). A. Specimen GIUS 358 D 93-2. B. Specimen GIUS 358 D 42-2. C. Specimen GIUS 358 D 94-1. D. Specimen GIUS 358 D 94-3. ❑E. *Fasciphyllum* sp.. specimen GIUS 358 D 58.

1957), but the adult ones are distinctly larger than in the former species and with distinct second order septa.

Distribution.– Givetian (Loogh Formation) of the Eifel Area (Birenheide 1978: p. 127); seven samples from Dziewki, set C_2, WB-12 borehole, interval III-VIII, Givetian, *P. laxa* Zone.

Fasciphyllum sp.

Fig. 5E.

Description.– Corallites are 1.3 to 2.7 mm in diameter; septa of both orders (8 to 19 in number) have a tendency towards bilateral arrangement; cardinal(?) septum elongate, reaches axis. The other s1 (1st order septa) ca. 2/3 of the radius long; axial margins of some septa with rhopaloid swellings; s2 (2nd order septa) only locally, ca. 1/4 of the radius long, if present; walls from 0.7 to 0.8 mm thick.

Remarks.– From '*Battersbyia*' *inaequalis* Milne-Edwards & Haime 1851 (*sensu* Glinski 1957; see also Coen-Aubert 1992: Pl. 2: 1, 2) this species differs in presence of s2, from *Fasciphyllum conglomeratum* by smaller size of its corallites.

Distribution.– Two fragmentary ?colonies from Dziewki, set C_2; WB-12 borehole, set VIII, *P. laxa* Zone.

Family Stringophyllidae Wedekind 1922

Genus *Sociophyllum* Birenheide 1962

Sociophyllum severiacum sp. n.

Fig. 6A-G.

Holotype: Colony GIUS 358 D 102 (Fig. 6: A-E).

Type horizon and locality: Dziewki by Siewierz, interval A-C_1, Late Givetian *P. laxa* Zone.

Derivation of the name: Siewierz, a small town south of Dziewki.

Diagnosis.– Dendroid species of *Sociophyllum* with complete septa, presepiments uncommon, tabularium profile weakly concave to weakly convex.

Material.– 5 samples, about 50 corallites.

Dimensions.– From ?21, 23 to 31 septa; diameter 7 to 11.5 mm; measured 43 corallites in 5 samples.

Description.– Fragments of dendroid colonies, with lateral offsets (Fig. 6D, F) of cylindrical corallites. Septa in radial arrangement, of one order only: straight, wedge-shaped. In the axial region of some corallites isolated trabeculae (see the longitudinal section – Fig. 6G). Presepiments, if present, small (Fig. 6B, F). Dissepiments in 1 to 3 vertical series, may be elongate, steeply inclined towards axis; septa of thick trabeculae, the latter uniformly and strongly inclined towards axis; wall lamellar, with lamellae strongly declined abaxially.

Variability.– In the holotype colony (Fig. 6A-E) the particular corallites display various length of septa, absence or presence of presepiments, various curvature of tabulae or tabellae; similar differences can be observed in the other material of *S. severiacum* sp. n.; moreover the corallites display 1, 2 or 3 series of dissepiments (Fig. 6D, E, G).

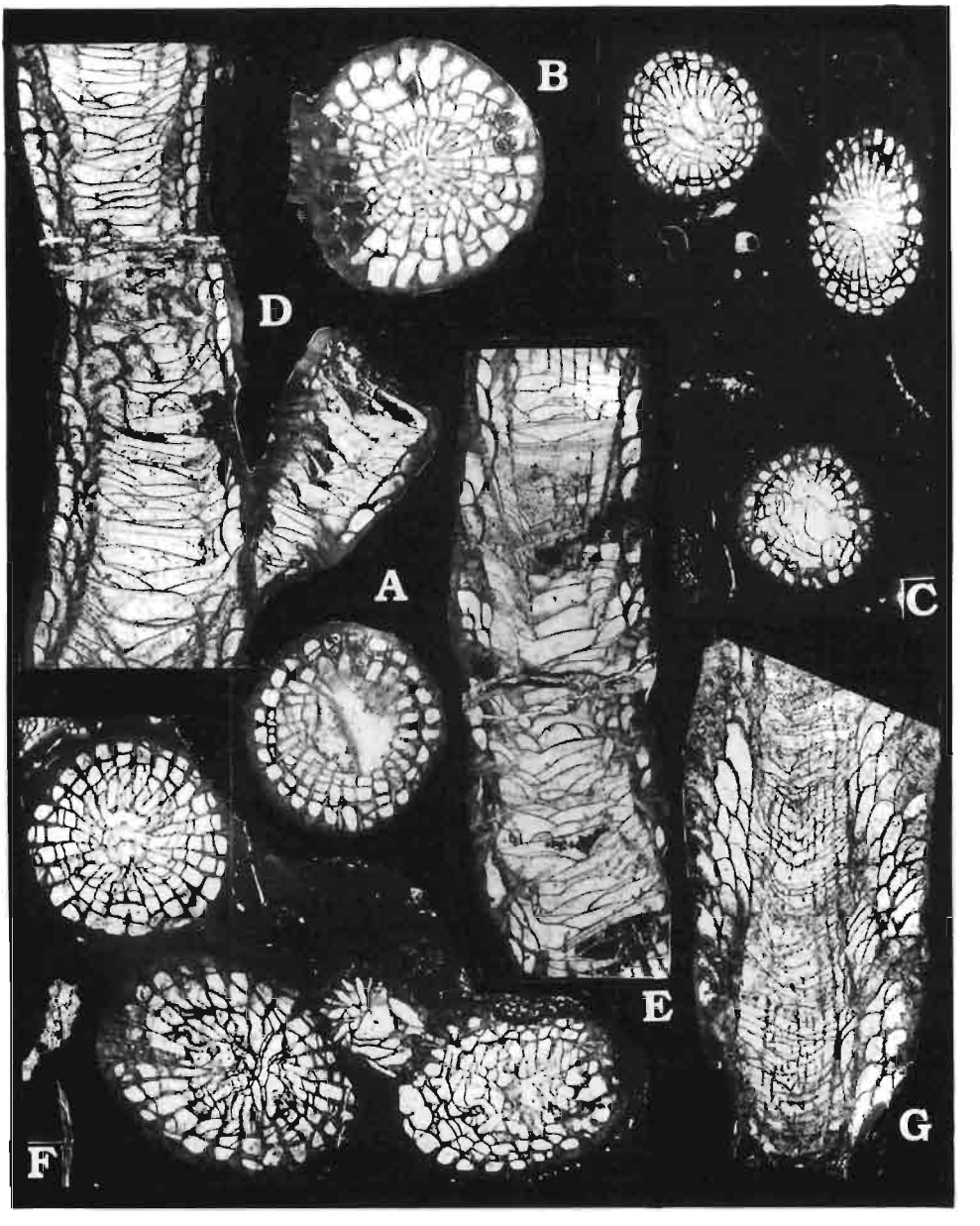

Fig. 6. *Sociophyllum severiacum* sp. n., Dziewki (interval A-C_1), age equivalents of *Stringocephalus* Beds Givetian, *P. laxa* Zone. A-E. Holotype GIUS 358 D 102. F, G. Specimen GIUS 358 D 22; × 3 except for 6C which is × 2.

Remarks.– Other species of the genus *Sociophyllum* (see Birenheide 1962, 1979) have commonly tabulae strongly depressed in axis and display presepiments peripherally; *S. severiacum* sp. n. almost totally lacks presepiments: this feature, although not so strongly expressed, can be also observed in *S. sociale* (Wedekind 1925); on the other hand *S. semiseptatum*

semiseptatum (Schlüter 1881) has relatively flat tabulae or tabellae, but it lacks complete septa, displayed by the new species. *S. semiseptatum aequale* (Birenheide 1962) is a phaceloid to submassive coral with relatively common presepiments, otherwise quite similar to *S. severiacum* sp. n.

Distribution.– Only the type locality.

Genus *Neospongophylloides* Jia *in* Jia *et al.* 1977

Type species: *Tabulophyllum butovi* Bulvanker 1958.

Remarks.– The genus is morphologically close to *Sociophyllum* Birenheide 1962; it differs from the latter by its profile of tabularium (commonly depressed in *Sociophyllum*).

Neospongophylloides grandivesiculosus (Soshkina 1952)

Fig. 7A-G.

Tabulophyllum grandivesiculosum sp. n.; Soshkina 1952: p. 71, Pl. 5: 19.

Tabulophyllum butovi sp. n.; Bulvanker 1958: pp. 171-172, Pl. 52: 2, 3.

non *Smithiphyllum grandivesiculosum* (Soshkina); McLean & Pedder 1987: pp. 155-156; Pl. 5: 6-10.

Material.– Over 40 fragmentary specimens, 60 thin sections.

Dimensions.– From ?28, 32 to 40, even 43 septa; diameter from 10 to 17.5 mm; walls 0.2 to 0.7 mm thick; tabularium diameter from 5.5 to 10 mm or more.

Description.– Mostly fragments of single (?solitary) corallites are present in the collection. One specimen (D27 - Fig. 7G-H) is a submassive (?phaceloid) aggregate (?colony). In transverse sections (Fig. 7A-B, D, G) peripherally presepiments span from two neighbouring septa to half the circumference of a corallite. In the axial part (more than 1/2 of the diameter) septa are radially to bilaterally arranged, of subequal length, almost reaching the axis. Septa may be thickened, chiefly in peripheral parts of tabularium; s2 are commonly lacking, they may ocasionally occur as single short segments sitting on presepiments (Fig. 7G). Blisters occur peripherally, steeply inclined to the axis. The tabularium is mesa-shaped, with peripheral depressions. Axial tabellae typically are flat-topped, periaxial ones concave. Some specimens show slightly concave tabulae (see Fig. 7C – middle part, E, H – upper left).

Remarks.– Specimens studied by previous authors have been interpreted as colonial, whereas the Polish corals, with few exceptions, lack traces of offsetting. The species of McLean & Pedder (1987) is actually a representative of *Smithiphyllum* Birenheide 1962, as it displays short but regularly developed s2.

Distribution.– Late Givetian of Kuznetsk Basin (Soshkina 1952; Bulvanker 1958), Armenia (Sytova & Ulitina 1974) and China (Jia *in* Jia *et al.* 1977); Dziewki, set D, WB-12 borehole, set VIII, Ołowianka quarry: Givetian, *P. laxa* Zone.

Family Disphyllidae Hill 1939

Genus *Disphyllum* de Fromentel 1861

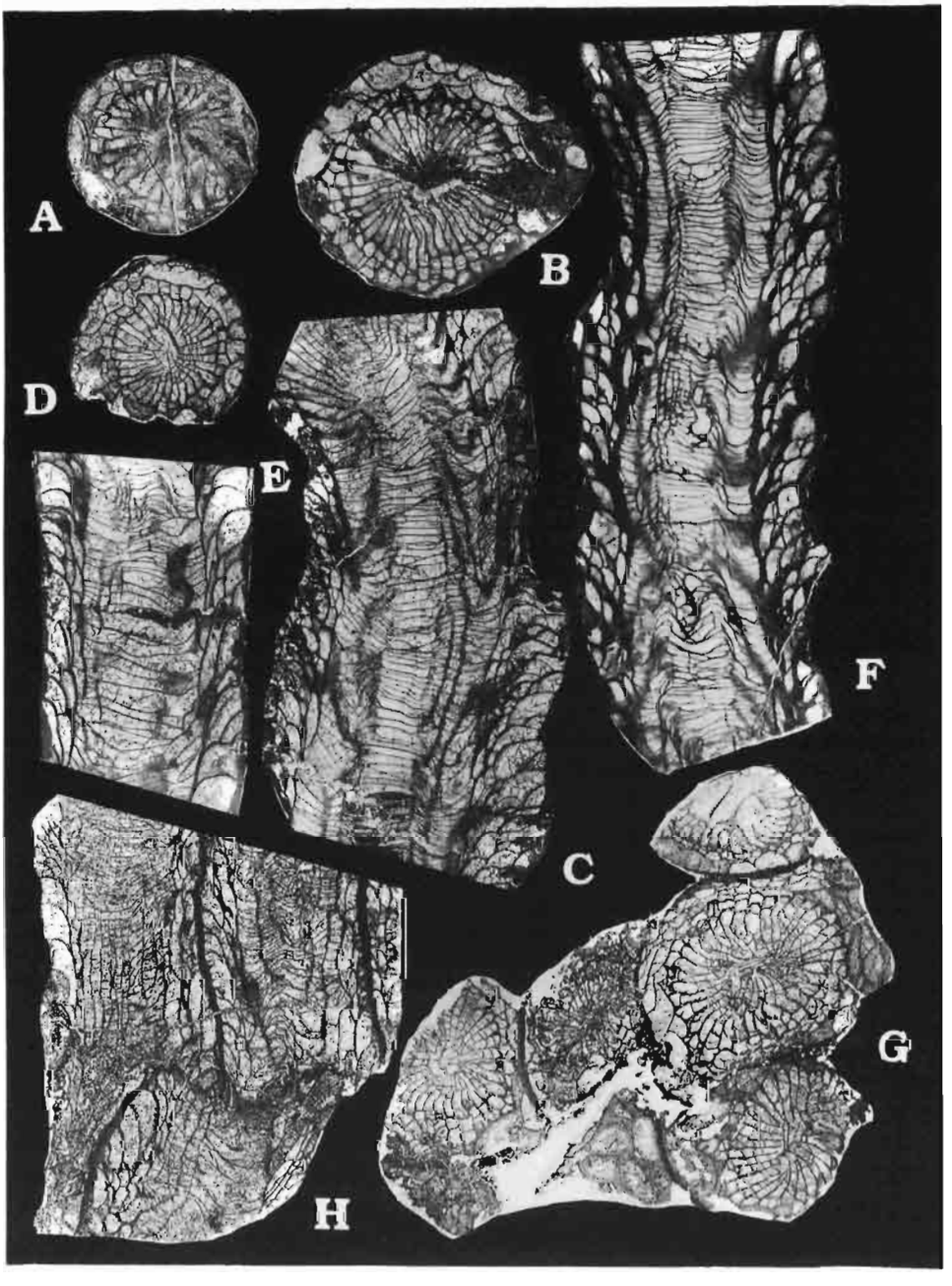

Fig. 7. *Neospongophylloides grandivesiculosus* (Soshkina 1952), Ołowianka (Fig. 7A) and Dziewki, set C_1 (Fig. 7B-H), Givetian, *P. laxa* Zone. A. Specimen GIUS 385 OL 2. B, C. Specimen GIUS 358 D 45. D, E. Specimen GIUS 358 D 31. F. Specimen GIUS 358 D 08. G, H. Specimen GIUS 358 D 27. All × 2.

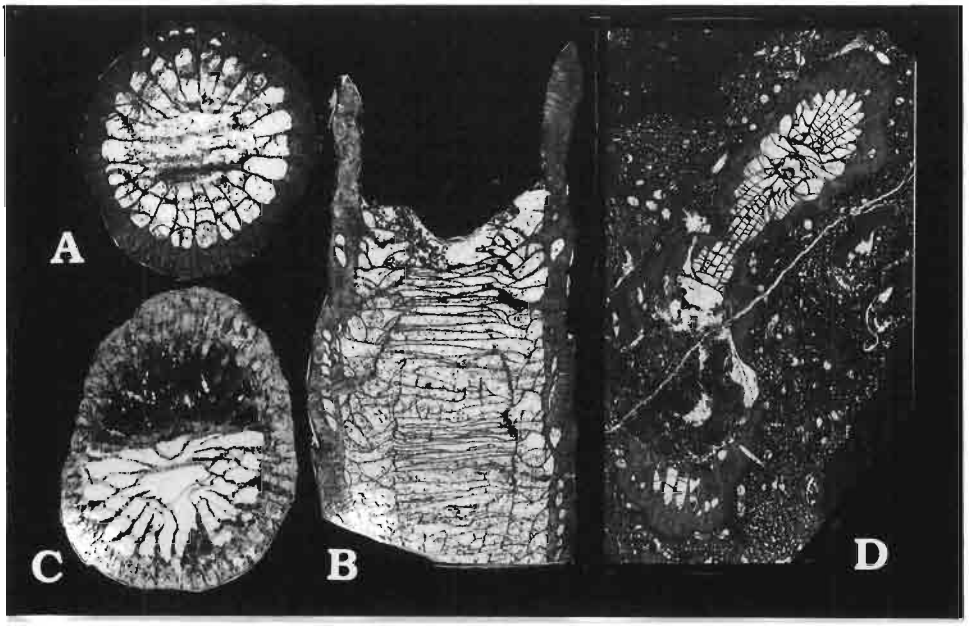

Fig. 8. ❑A-C. *Disphyllum wirbelauense* aff. *bonae* Różkowska & Fedorowski 1972, Panek quarry, set B, detrital limestones, Frasnian, *Ph. smithi* Zone. A, B. Specimen GIUS 384 P 26. C. Specimen 384 P 31-1; × 3. ❑D. *Disphyllum wirbelauense bonae* Różkowska & Fedorowski 1972, Panek quarry (set A), upper Sitkówka Beds, ?Frasnian, *Disphyllum*(?) Zone, GIUS 384 P 38; × 2.

Remarks.– Birenheide (e.g. 1978: pp. 90-91) put the emphasis on the subcerioid nature of the holotype colony of *D. caespitosum*, the type species of the genus, and ascribed this species to *Columnaria* Goldfuss 1829. In his opinion also phaceloid and dendroid species can be included into *Columnaria* (e.g. also the species ascribed to *Disphyllum* by Różkowska & Fedorowski 1972). However, *Columnaria* (type species *C. sulcata* Goldfuss; see Birenheide 1978: Pl. 12: 4) and *Disphyllum* can be distinguished as separate genera. The former is cerioid and its dissepiments are so scarce, that they are often not in contact with each other. *Disphyllum* is dendroid, phaceloid to subcerioid, commonly with more numerous dissepiments. Even if only one series is present, it forms a continuous zone at the corallite periphery.

Disphyllum wirbelauense aff. *bonae* Różkowska & Fedorowski 1972

Fig. 8A-C.

Remarks.– Two fragmentarily preserved specimens have been found in surprisingly high stratigraphical position (when compared with the other Holy Cross Mountains material) in the Panek quarry (set B, *Ph. smithi* Zone, see also Tab. 1). Possibly it is a subspecies of *D. wirbelauense* related to *D. w. bonae*, characterized by a more complex tabularium (Fig. 8B).

Tab. 1. Number of colonies of *Disphyllum* collected in the Holy Cross Mts in the Kowala Formation and in the Silesian-Cracow area.

		Disphyllum caespitosum Goldfuss 1826	*Disphyllum cylindricum* (Soshkina 1939)	*Disphyllum geinitzi* Lang & Smith 1935	*Disphyllum kweihsiense* Yoh 1937	*Disphyllum wirbelauense wirbelauense* Pickett 1967	*Disphyllum w. bonae* Różkowska & Fedorowski 1972	*Disphyllum w. regulare* Różkowska & Fedorowski 1972
Dębnik						2		
Jaźwica	D		3				4	
	E		1				1	
	F-G					1	2	2
	H		1			2	2	
	I		3				3	
Kowala quarry	A				2			
Panek	A						1	
	B						aff.3	
Sosnówka	A					1	4	1
	B					1	2	
	C					1		
Góra Zamkowa	C		1					
	E						2	
	F						1	
	G					1	3	
Zegzelogóra	?			2				
	A	1						
	B						3	

Besides the axial, more or less flat tabellae, the periaxial ones are bulbous, intermediate in shape and position to the dissepiments. The transverse sections (Fig. 8A, C) are more or less like in typical *D. w. bonae*. For comparative purposes the typically preserved *D. w. bonae* from the lower part of the Panek section, *?Disphyllum* Zone, Frasnian, is illustrated (Fig. 8D).

Genus *Temnophyllum* Walther 1929

Remarks.– The illustrated specimens of *T. latum* Walther 1929, the type species of *Temnophyllum*, present relatively broad and continuous peripheral septotheca (Hill 1981: Fig. 196: 6), but species with corallites devoid of septotheca and even with partly reduced second order septa, displaced by herring-bone dissepimentarium have also been included into the genus (e.g. Liao & Birenheide 1985, but see Liao & Birenheide 1989). This is followed also in the present paper, but *Temnophyllum* should be split into several separate genera (or subgenera). A step in this direction is the

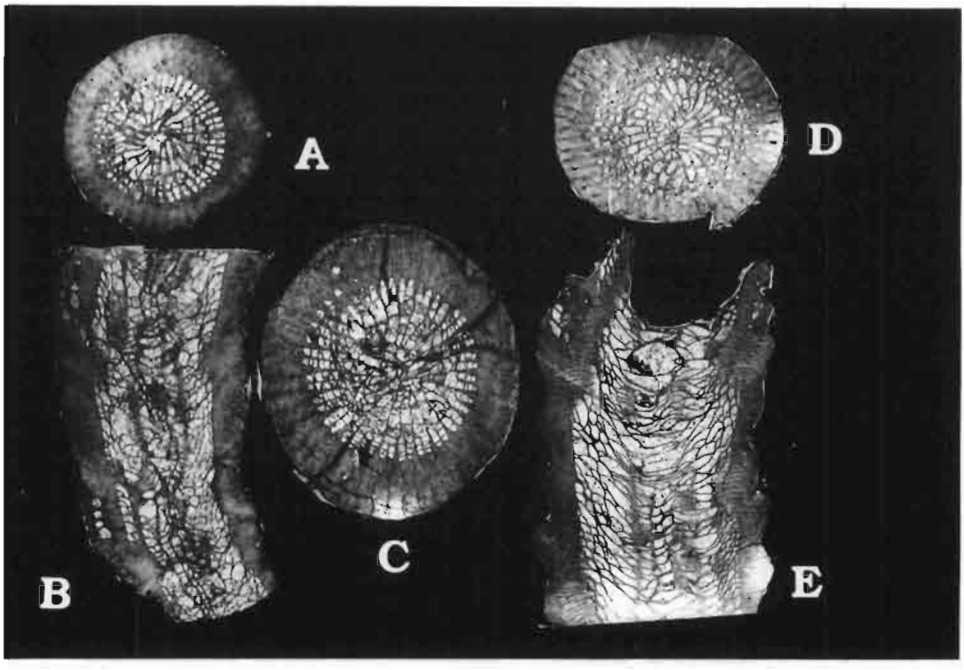

Fig. 9. *Temnophyllum latum* Walther 1929. ❑A-C. Dziewki (set C_2), age-equivalents of *Stringocephalus* Beds, Givetian, *P. laxa* Zone. A, B. Specimen GIUS 358 D 39 in transverse and longitudinal section. C. Specimen GIUS 358 D 23. ❑D, E. Kowala (set G), Frasnian detrital limestones, *Ph. smithi* Zone, specimen GIUS 388 KK 41. All × 2.

assignment of *Temnophyllum*-like corals with carinate septa to *Spinophyllum* Wedekind 1922 (including *Truncicarinulum* Yü & Kuang 1982; see Wrzołek & Wach in press).

Temnophyllum latum Walther 1929

Fig. 9A-E.

Dimensions.– 22 to 28 s1; diameter from 12 to 17 mm; thickness of septotheca 1.5 to 3.5 mm; measured 20 specimens.

Remarks.– The corallites D 23 (Fig. 9C) and D 51 are distinctly larger from the other (Fig. 9A-B), but they are still close to the largest specimens of the species, recorded from Germany (Birenheide 1978: p. 86). The range of variability for the German specimens regarding diameter is from 12 to 16 mm, thickness of septotheca ca. 1.5 mm, maximum 3 mm, mean s1 number is 28. The average specimens (as in Fig. 9A-B) are morphologically and numerically close to German corals.

To note is the presence of a single corallite of the species in the high Frasnian of the Kowala quarry (see Fig. 9D-E).

Distribution.– Givetian Schwelmer Kalk of Sauerland (Birenheide 1978: p. 86); 29 corallites from the Givetian *P. laxa* Zone of Dziewki (set C_2), WB-12 borehole (set VIII), and of the Ołowianka quarry; late Frasnian *Ph. smithi* Zone of the Kowala quarry, set G.

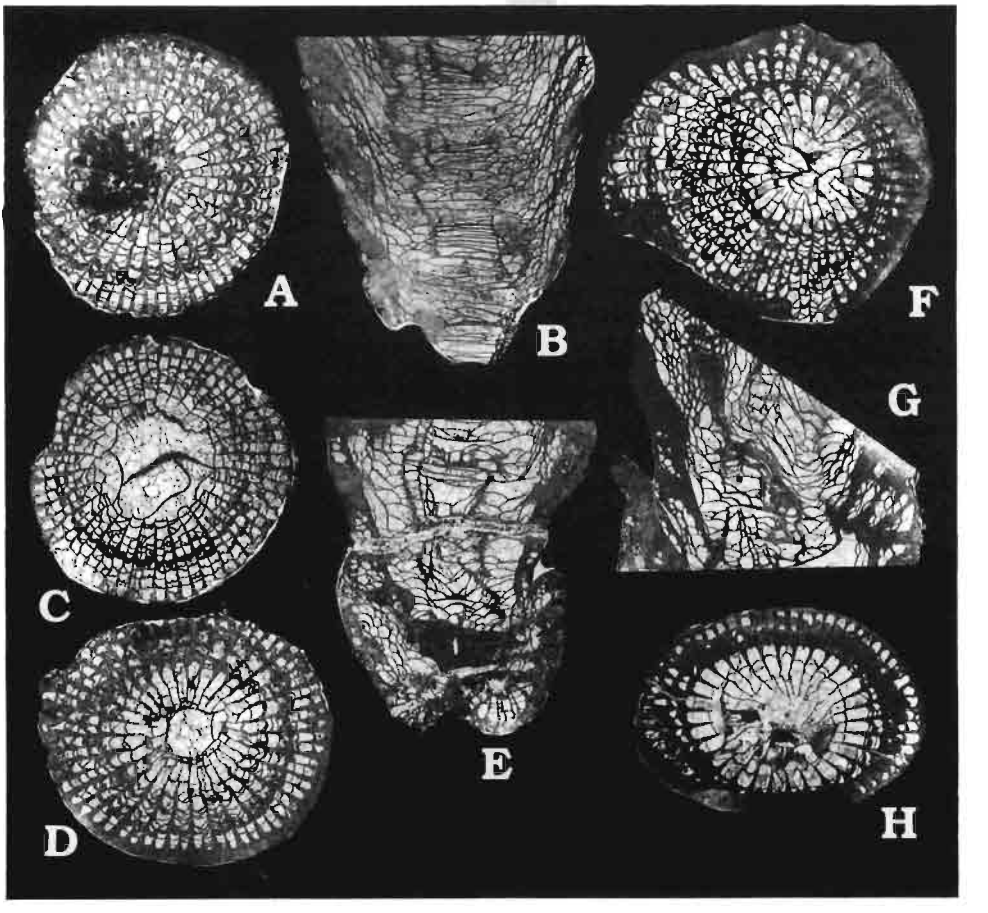

Fig. 10. *Temnophyllum occidentale* Hill & Jell 1970, *Stringocephalus* Beds, Givetian, *T. occidentale* Zone. ❑A-B. Góra Zamkowa (set A), specimen GIUS 392 Z 25. ❑C-H. Jaźwica (set A). C. Specimen GIUS 402 JS 08. D, E. Specimen GIUS 402 JS 02. F-H. Specimen GIUS 402 JS 19. All × 2.

Temnophyllum occidentale Hill & Jell 1970

Fig. 10A-H.

Dimensions.– 24 to 31 s1; diameter from 11 to 21.5, usually 17-18 mm; length of s1 5 to 9 mm; length of s2 from 1 to 6, usually 3 to 4 mm; measured 18 corallites.

Remarks.– The species is very variable: generally it is characterized by the absence of septotheca, though it is present in some sections (Fig. 10H cf. Fig. 10F, another section of the same corallite). Septa are thicker (Fig. 10D), moderately thick (Fig. 10A), or thin (Fig. 10C); the first order septa reach almost the axis, may be more (Fig. 10C) or less (Fig. 10D) withdrawn. The herring-bone arrangement of dissepiments either absent (Fig. 10C, H) or present in part of a section (Fig. 10A, D, F); the development of this pattern is connected with some shortening of the second order septa.

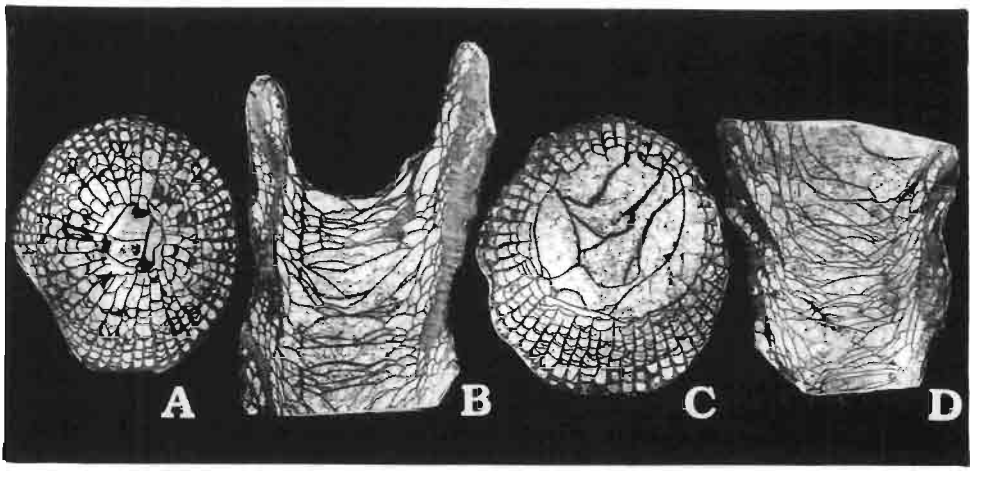

Fig. 11. *Temnophyllum menyouense* Hill & Jell 1970, *Stringocephalus* Beds, Givetian, *T. occidentale* Zone. ❑A. Góra Zamkowa (set A), specimen GIUS 392 Z 28. ❑B-D. Jaźwica (set A). B. Specimen GIUS 402 JS 89. C, D. Specimen GIUS 402 JS 05. All × 2.

The corallites commonly display expansions and contractions; dissepiments are steeply arranged, towards the axis they gradually pass into a zone of bulbous periaxial tabellae. Axial tabellae are more or less flat; septal trabeculae (monacanths) parallel and steeply inclined.

The Australian specimens of the species have dissepimentarium more sharply separated from the tabularium. *T. turbinatum* Hill has some septa more clearly thickened and second order septa never so strongly reduced. Specimens of the species recorded by Różkowska in the Holy Cross Mountains display spindle-shaped septa (in transverse sections) and lack the herring-bone dissepimental pattern (Różkowska 1980). *T. menyouense* has thinner septa and concave axial tabellae.

Distribution.– Late Givetian of Australia (Hill & Jell 1970); 20 corallites from Góra Zamkowa at Chęciny, western quarry, set A and Jaźwica quarry, set A, Givetian, *T. occidentale* Zone.

Temnophyllum menyouense Hill & Jell 1970

Fig. 11A-D.

Dimensions.– 28 to 29 s1; diameter 13 to 15 mm; length of s1 from 3 to 6 mm; of s2 ca. 2 mm; measured 3 corallites.

Remarks.– The specimens of Różkowska (1980) have somewhat thicker septa. One of my specimens (Fig. 11C-D) has septa strongly withdrawn from the axis (compare with Fig. 11A), so that its first order septa are almost equal in length to its second order septa. Slightly depressed tabularium is notable, with axial tabellae larger and concave, the periaxial ones bulbous, similar in shape to dissepiments.

Distribution.– Givetian and Frasnian of the Canning Basin, Australia (Hill & Jell 1970); early Frasnian of the environs of Kielce and Kowala (Różkowska 1980); 3 corallites from Zamkowa, western quarry (set A) and Jaźwica quarry (set A), Givetian, *T. occidentale* Zone.

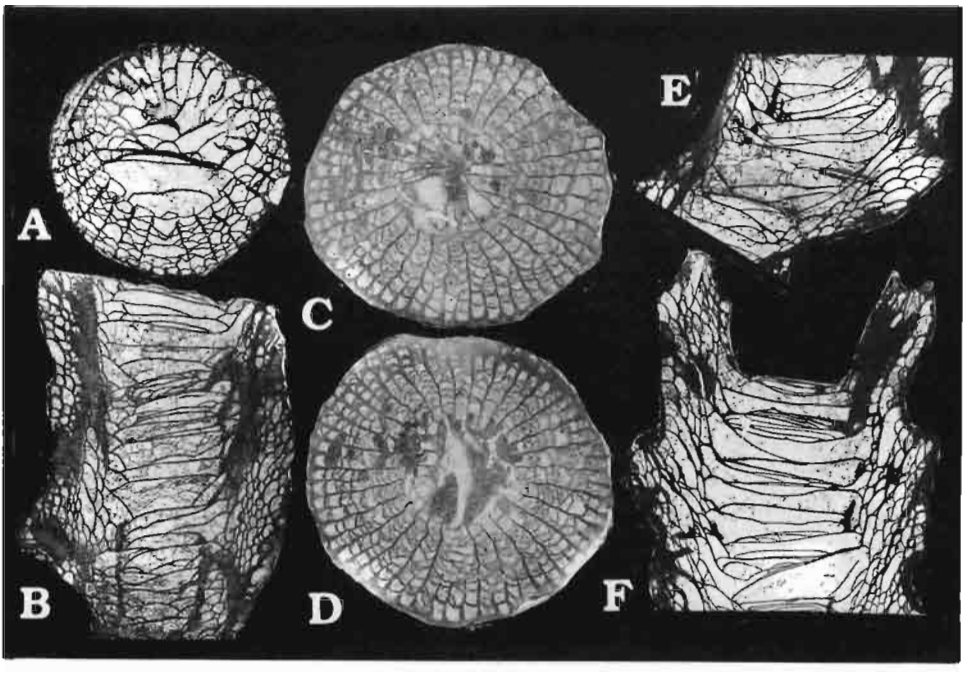

Fig. 12. *Temnophyllum zamkowae* sp. n., *Stringocephalus* Beds, Givetian, *T. occidentale* Zone. ❑A-D. Jaźwica (set A). A, B. Holotype GIUS 402 JS 03. C, D. Specimen GIUS 402 JS 09. ❑E-F. Góra Zamkowa (set A). E. Specimen GIUS 392 Z 02. F. Specimen GIUS 392 Z 01. All × 2.

Temnophyllum zamkowae sp. n.

Fig. 12A-F.

Holotype: Specimen GIUS 402 JS 03 (Fig. 12A, B).

Type horizon and locality: Jaźwica quarry, set A, *T. occidentale* Zone, Late Givetian.

Derivation of the name: from Góra Zamkowa (Castle Hill) at Chęciny.

Diagnosis.– *Temnophyllum* without septotheca, with thin s1, ca. 2/3 of the corallite radius long; cardinal(?) septum commonly short; very short s2, replaced by dissepiments in herring-bone arrangement; tabularium profile plano-concave, locally complete tabulae.

Material.– 14 corallites.

Dimensions.– 25 to 32 s1; diameter from 9.5 to 17, up to 19 mm; length of s1 3.5 to 7 mm; of s2 1.5 to 2.5 mm; measured 13 specimens.

Description.– Corallites are ceratoid (straight – Fig. 12B, or curved – Fig. 12E) to subcylindrical (Fig. 12F).

Septa are in radial arrangement, commonly with cardinal(?) septum shortened (Fig. 12A, D, but not in Fig. 12C, both the latter sections of the same specimen). The s1 are ca. 2/3 of the radius long, rarely even to the axis (Fig. 12C); s2 with a tendency to shortening, replaced by dissepiments in herring-bone arrangement.

The ratio of dissepimentarium to tabularium width is close to 1:2:1; peripherally 4-5 series of steeply inclined dissepiments, some of them are

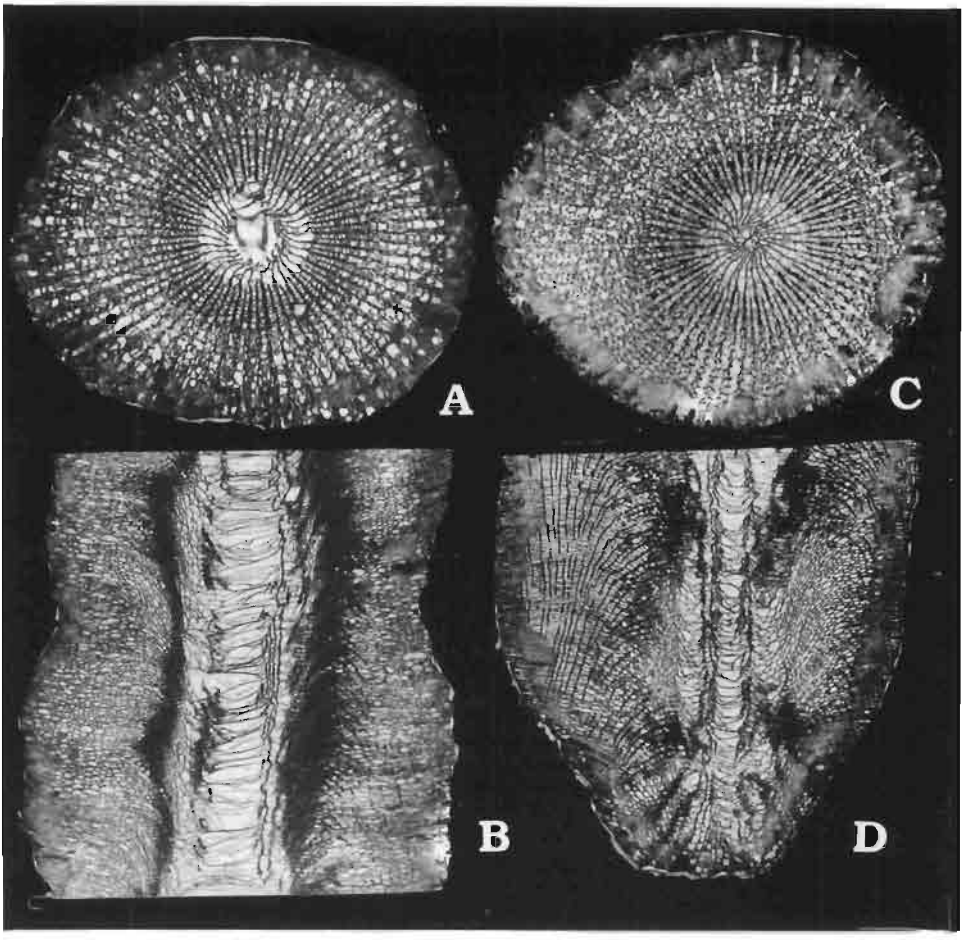

Fig. 13. *Diffusolasma diffusum* (Wrzołek 1982). Jaźwica (set R), marly limestones, Frasnian, *F. pentagona* Zone. A, B. Specimen GIUS 402 J 122. C, D. Specimen GIUS 402 J 123. All × 1.5.

relatively very large (e.g. Fig. 12F – to the left); periaxial tabellae convex, bulbous; the axial ones flat to slightly concave; broadly concave tabulae are also quite common.

Remarks.– *T. menyouense* is a similar species, with thicker septa; its s2, however, are longer and complete, tabulae less common. On the other hand some specimens are morphologically intermediate between the two species, with septa intermediate in length and thickness. Specimens of *T. zamkowae* sp. n. with longer s2 are similar to *T. occidentale*, but lack the thickened septa of the latter species.

Distribution.– Góra Zamkowa, western quarry, set A, Jaźwica quarry, set A, both Givetian, *T. occidentale* Zone.

Genus *Diffusolasma* gen. nov.

Type species: *Cyathophyllum diffusum* Wrzołek 1982.

Diagnosis.– Corallites large (commonly more than 35 mm in diameter), solitary; peripheral parts of the septa composed of isolated septal trabeculae, connected by non-naotic intraseptal dissepiments; trabeculae in broad fans, with charactophylloid flexure (Pedder 1972) adaxially.

Remarks.– From *Cyathophyllum* Goldfuss 1829 *sensu* Birenheide (1963) the new genus differs in thickened middle segments of septa (see Wrzołek 1982: compare Pl. 5: 1a, 2a); from *Ceciliaphyllum* McLean 1982 in different development of adaxial margins of s2; in the latter genus they are of isolated spine-like segments (see McLean 1982).

Spinophyllum Wedekind 1922, with smaller corallites than these of the new genus and with less complicated structure of the peripheral parts of septa is possible ancestor of *Diffusolasma* gen. nov. *Spinophyllum* resembles in these respects the juvenile corallites of *Diffusolasma* (e.g. Wrzołek 1982: Pl. 3: 4).

Species assigned: Only the type species.

Diffusolasma diffusum (Wrzołek 1982)

Fig. 13A-D.

Cyathophyllum diffusum sp. n.; Wrzołek 1982: p. 169, Pls 1-6.

Remarks.– Corallites of similar size show various shape: conical (Fig. 13C, D) or subcylindrical (Fig. 13A, B), also various degree of dispersion of septal elements can be observed (Fig. 13A, C).

Distribution.– Kowala quarry, set H, Jaźwica quarry, set R – type locality (Wrzołek 1982), Miedzianka, set ?E, Frasnian, *F. pentagona* Zone.

Genus *Hexagonaria* Gürich 1896

Hexagonaria hexagona kowalae subsp. n.

Figs 14A-C, 15A-C.

Holotype: Specimen GIUS 388 KK 6 (Fig. 14A-C).

Type horizon and locality: Kowala quarry, set A, lower Frasnian, *Macgeea-Thamnophyllum* Zone.

Derivation of the name: From the type locality.

Diagnosis.– *Hexagonaria hexagona* with septa weakly or moderately carinate in peripheral parts of corallites.

Material.– Fragments of 11 colonies.

Dimensions.– 18 to 24 s1; diameter from 9.5 to 16, most commonly 11-12 mm; tabularium diameter 4 to 6.5 mm; length of s1 – from 4.5 to 8 mm; of s2 – 2 to 5 mm; measured 39 corallites of 11 colonies.

Description.– Colonies are cerioid, with straight inter-corallite walls. Occasionally isolated cylindrical corallites occur in peripheral parts of a colony; their skeletal elements are thickened, with stronger development of carinae (Fig. 14C).

Septa are wedge-shaped, with peripheral parts composed of more or less expanded trabeculae (compare Fig. 15A and B). In the axial part (ca. 1/3 of the corallite diameter) only the s1, continue almost to the axis, where they are somewhat vortically curved (Fig. 14A, C), and/or slightly withdrawn from the very axis (Fig. 15B). Arrangement of the dissepiments

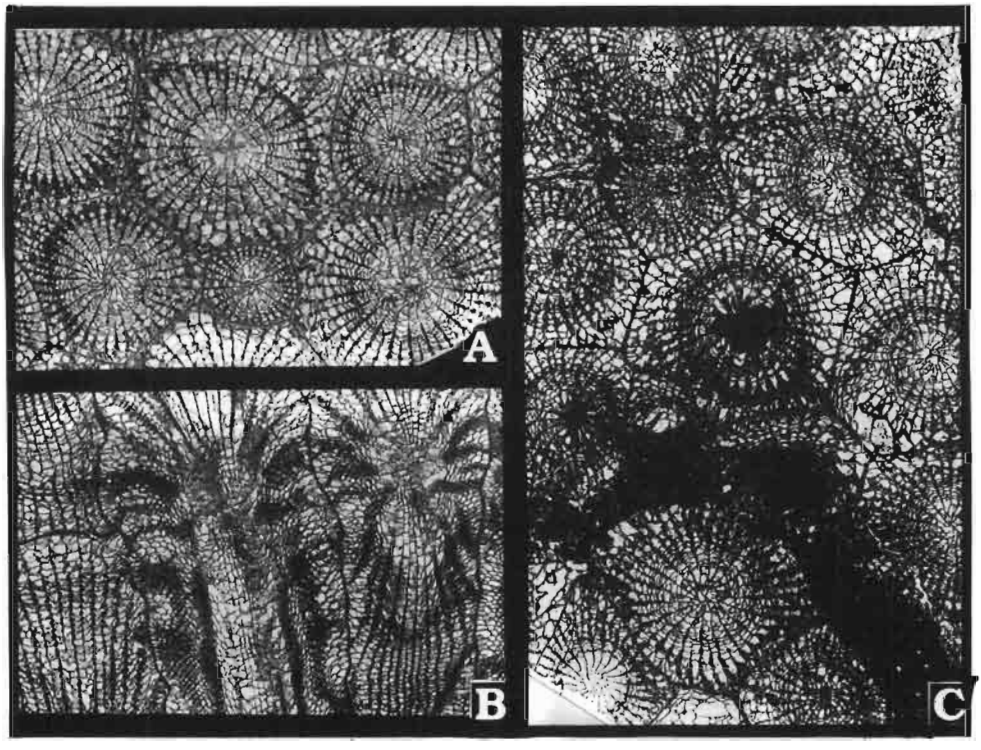

Fig. 14. *Hexagonaria hexagona kowalae* subsp. n., Kowala (set A), upper Sitkówka Beds. Frasnian, *Macgeea-Thamnophyllum* Zone. A-C. Holotype GIUS 388 KK 6 ; × 2.

in the inner dissepimentarium is of herring-bone, rarely of concentric type (Fig. 15A).

Peripheral dissepimentarium consists of 4-5 vertical series of dissepiments. By inter-corallite walls dissepiments may be horizontal (Fig. 14B) or even everted; mostly they are slightly inclined to the axis. Towards the latter there occur 2-3 series of smaller and steeply arranged dissepiments. The dissepimentarium/tabularium boundary is obscured by vesiculous peripheral tabellae. The axial tabellae are either slightly concave (Fig. 15C) or flat-topped (Fig. 14B). Septal trabeculae (monacanths) form broad half-fans; peripherally they are inclined 30-60 degrees to the corallite wall, adaxially arranged more or less horizontally (Fig. 14B).

Remarks.– The new subspecies differs from *Hexagonaria hexagona hexagona* (Goldfuss 1826) [see Pickett 1967: p. 59, Pl. 4: 15, =?*Hexagonaria sedgwicki* (Milne-Edwards & Haime 1851), recorded by Moenke (1954) from the Late Givetian of Wietrznia, Holy Cross Mountains] in a not so strong dispersion of the peripheral trabeculae. Distinction of a new subspecies is supported by temporal, geographical and subtle morphological isolation of the corals from Kowala.

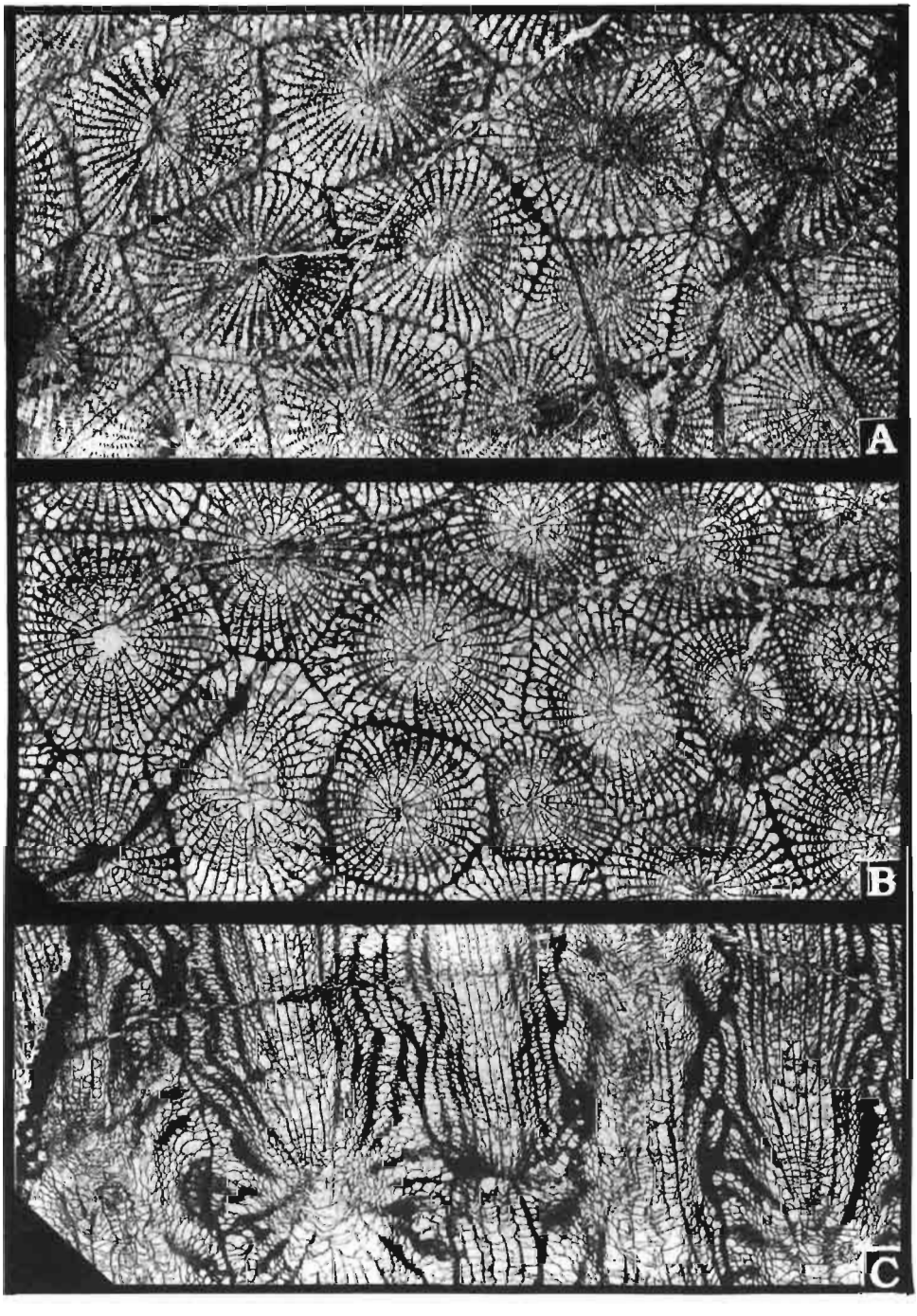

Fig. 15. *Hexagonaria hexagona kowalae* subsp. n., Kowala (set A), upper Sitkówka Beds, Frasnian, *Macgeea-Thamnophyllum* Zone. A. Colony GIUS 388 KK 85. B, C. Colony GIUS 388 KK 84. All × 2.

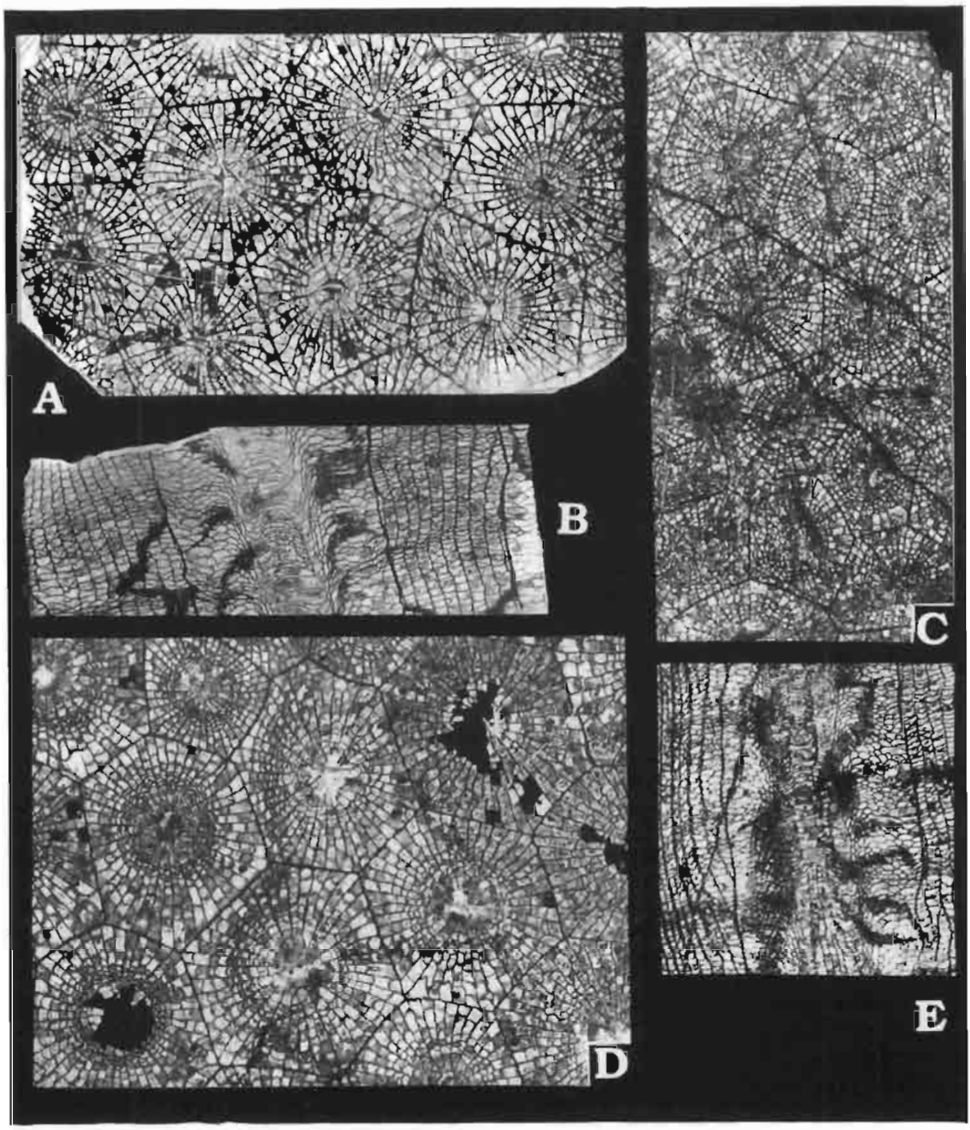

Fig. 16. *Hexagonaria davidsoni* (Milne-Edwards & Haime 1851), Chęciny limestones, Givetian, *Disphyllum* Zone. A, B. Colony GIUS 393 ZG 2, Zegzelogóra (set B). C. Colony GIUS 391 SS 7, Sosnówka (set B). D. Colony GIUS 393 ZG 33 same locality. E. Colony GIUS 393ZG 24-44-2, same locality. All × 2.

Distribution.– Kowala quarry (set A), Jaźwica (set H): Frasnian, *Macgeea-Thamnophyllum* Zone.

Hexagonaria davidsoni (Milne-Edwards & Haime 1851)

Figs 16A-E, 17A-B, 18A-D.

Hexagonaria davidsoni (Milne-Edwards & Haime); Moenke 1954: pp. 468-470, Pl. 2: 7-9.

Hexagonaria davidsoni (Milne-Edwards & Haime); Rohart & Semenoff-Tian-Chansky 1981: pp. 4-12, Figs 1-3, Pls 1: 1, 2, 4, 2: 1-5, 3: 1, 2.

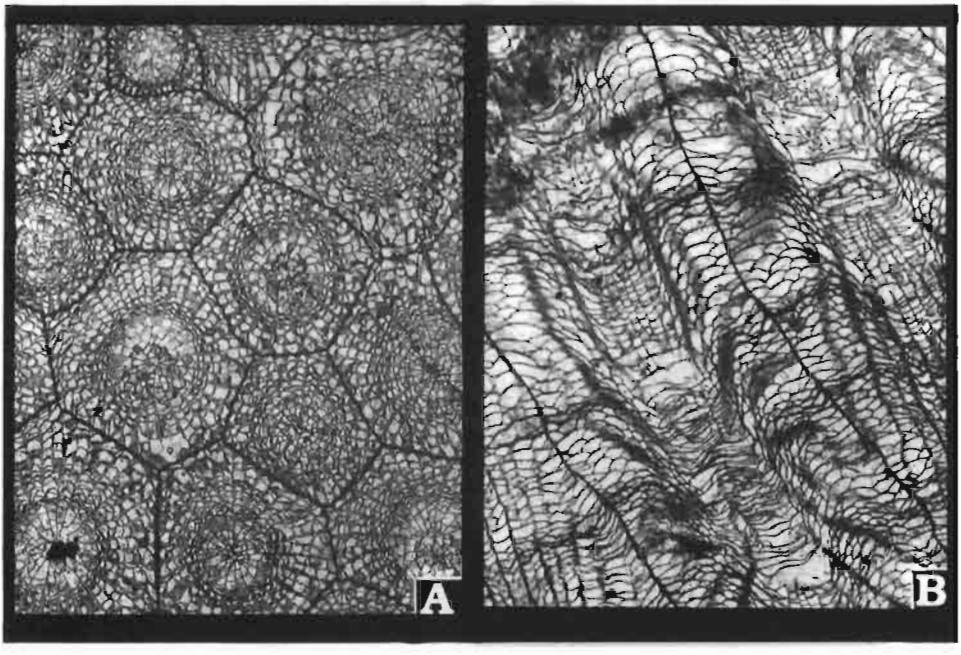

Fig. 17. *Hexagonaria davidsoni* (Milne-Edwards & Haime 1851), Givetian, *Disphyllum* Zone. A. Colony GIUS 402 JS 94, Jaźwica (set C) lower Sitkówka Beds, × 2. B. Colony GIUS 393 ZG 24-53-1, Zegzelogóra (set B) Chęciny limestones, × 3.

Dimensions.– 18 to 24, commonly 20-21 s1; corallite diameter from 9 to 14, commonly 10-12 mm; tabularium diameter 3.5 to 6 mm, usually 4.5 to 5 mm; 190 corallites of 36 colonies measured.

Description.– Cerioid colonies, lenticular in shape, their height up to 20 cm, diameter up to ca. 45 cm.

Septa slightly spindle-shaped in transverse sections, thickened in the internal part of dissepimentarium. The first order septa almost to the axis, commonly slightly twisted in tabularium; s2 ca. 2/3 of the corallite radius long. Dissepiments in concentrical arrangement, some herring-bone patterns may be seen in spaces adjoining adaxially the second order septa (Fig. 16A). Trabeculae are arranged in broad half-fans (Fig. 16E), peripherally more or less parallel to corallite wall, adaxially strongly inclined, approximately perpendicular to corallite axis.

Peripherally there are 4 to 5, sometimes even more vertical series of dissepiments (Figs 16B, E, 17B). They are slightly elongate and somewhat inclined adaxially. Tabularium is of concave, to weakly convex profile. Axial tabellae form flat-topped domes, peripheral tabellae are concave.

Some specimens from Sosnówka and Zegzelogóra (e.g. Fig. 17B) display alternating levels of smaller and larger dissepiments.

Remarks.– The type material of the species (see Rohart & Semenoff -Tian-Chansky 1981) shows non-thickened septa. My colonies show at

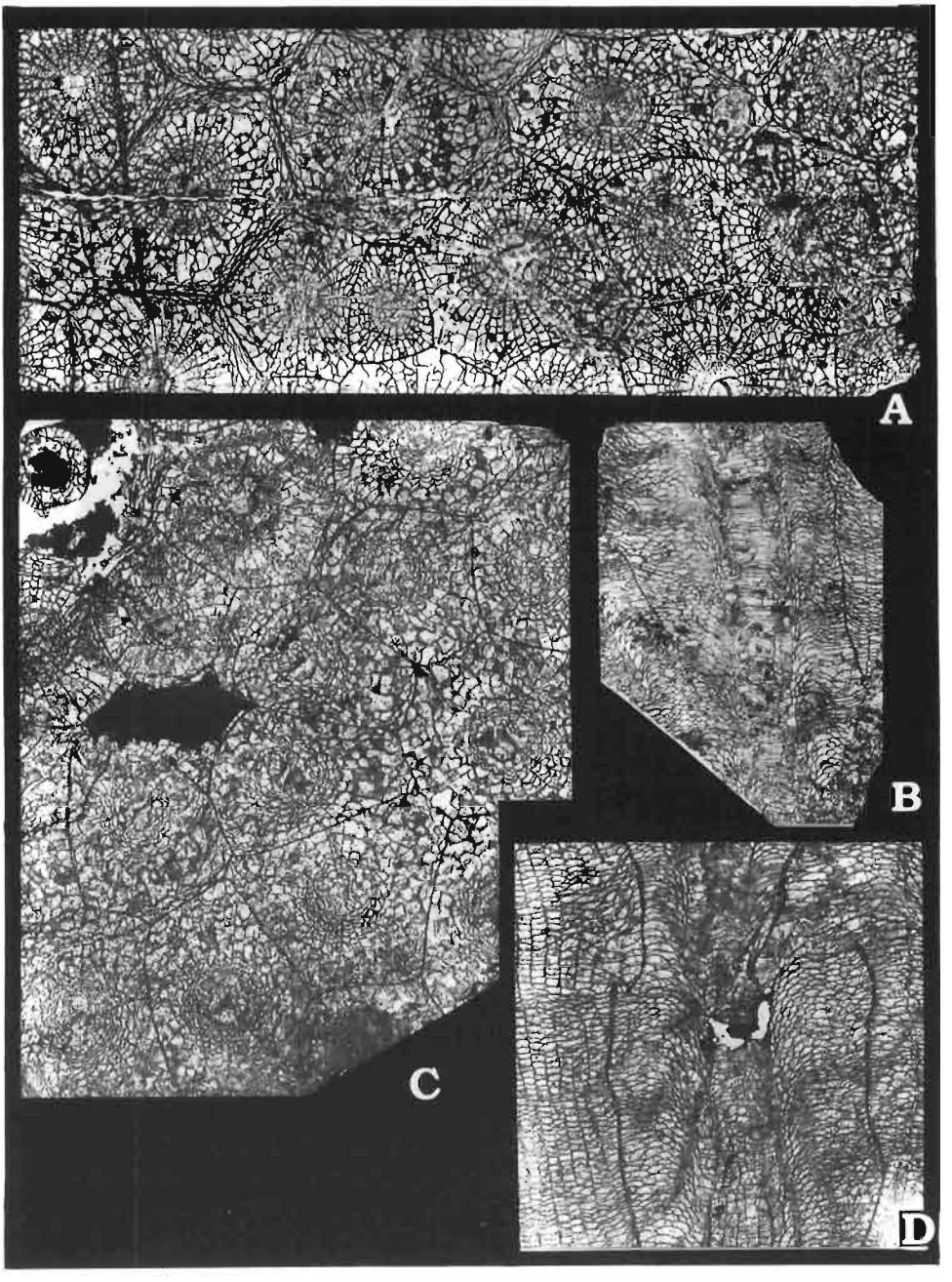

Fig. 18. *Hexagonaria* cf. *davidsoni* (Milne-Edwards & Haime 1851), Zegzelogóra, Chęciny limestones, Givetian, *Disphyllum* Zone. A, B. Colony GIUS 393 ZG 7, the first morphotype. C, D. Colony GIUS 393 ZG 11, the second morphotype. All × 2.

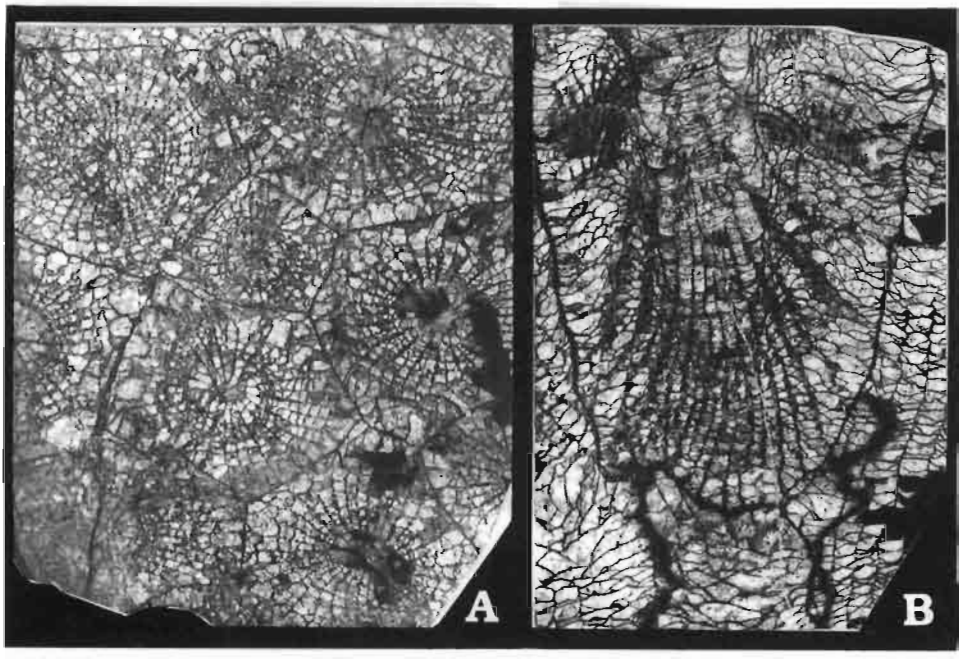

Fig. 19. *Hexagonaria mirabilis* Moenke 1954, Zamkowa (set C), Chęciny limestones, Givetian, *Disphyllum* Zone, colony GIUS 392 Z 12. A - × 2, B - × 3.

least slight thickening (Fig. 17A). Of note are also differences in corallite size between the colonies (compare Fig. 16A, C-D).

With some reservations, as *Hexagonaria* cf. *davidsoni*, ascribed to this species are the two morphotypes, recorded from Sosnówka and Zegzelogóra. One of them (Fig. 18A-B) shows mince presepiments, developed as a narrow and continuous zone, especially in larger corallites (Fig. 18A). The presepiments are more steeply inclined, than the dissepiments closer to axis (Fig. 18B). The measured 17 corallites from two colonies have from 18 to 23 s1; corallite diameter is from 9 to 15.5 mm; tabularium diameter from 3.5 to 5 mm.

The other morphotype, represented so far by a single colony, differs from the former by thinner septa, commonly withdrawn from the corallite periphery (Fig. 18C); the longitudinal section (Fig. 18D) is more or less the same as in the other morphotype. Corallites of this colony have from 17 to 20 s1; their diameters are from 8.5 to 12 mm; tabularium diameter from 3.5 to 4 mm (measured 12 corallites).

Distribution.– Ferques, France, de la Parisienne Member of the Ferques Formation, Late *M. asymmetrica* Zone (type locality – Rohart 1988); Belgian Ardennes, early *A. triangularis* ('F2i') Zone (Coen-Aubert 1982); 38 colonies from the Holy Cross Mountains: Jaźwica quarry (set C), Góra Zamkowa, western quarry (set C), Sosnówka (set B), Zegzelogóra, Givetian, *Disphyllum* Zone, *Hexagonaria davidsoni* biohorizon.

Hexagonaria mirabilis Moenke 1954

Fig. 19A-B.

Dimensions.– 18 to 20 s1; corallite diameter from 13 to 15 mm; tabularium diameter 5 mm; measured 5 corallites of 1 colony.

Remarks.– The small peripheral presepiments (Fig. 19A-B) make the specimen different from the type material (Moenke 1954: Pl. 2: 3, 4), but they have been observed also in some Belgian specimens (Coen-Aubert 1980: Pl. 1: 1) with slightly bigger corallites and carination weakly expressed. Some similarities with the described above *Hexagonaria davidsoni* is to be noted: the latter taxon is characterized by thinner and only weakly carinate septa; similar are overall large corallites and peripheral small presepiments. The latter feature is typical of the genus *Wapitiphyllum* (type species *W. vallatum*; see McLean & Pedder 1984), with underdeveloped or absent s2.

Distribution.– 'Middle' Frasnian of Wietrznia (point 13 of Moenke 1954), possibly *Macgeea-Thamnophyllum* Zone; Frasnian 'F2d' to 'F2g', but also 'F2h' and 'F2i' levels of Belgium (Coen-Aubert 1980); one colony from Góra Zamkowa, western quarry, set C: Givetian, *Disphyllum* Zone.

Hexagonaria sanctacrucensis Moenke 1954

Fig. 20A-C.

Emended diagnosis.– *Hexagonaria* with small corallites; septa spindle-shaped in transverse sections, strongly to moderately carinate peripherally. Peripheral dissepiments everted; septal trabeculae in half fans or in weakly divergent fans.

Dimensions.– 17 to 23 s1; diameter 7 to 11 mm; tabularium diameter 3.5 to 4.5 mm; 85 corallites of 10 colonies measured.

Description.– Some of the septa are peripherally slightly carinate (Fig. 20A, C); s1 gradually thinning towards the axis; axially about 1.5 to 2 mm without septa; s2 do not enter tabularium. Dissepiments are arranged in concentric pattern, concave towards axis in the internal part of the dissepimentarium, in the opposite direction peripherally.

Peripherally 4 to 6 rows of everted dissepiments occur. Internally there are 1 to 3 vertical series of smaller blisters, steeply inclined towards the axis. Tabularium is with peripheral concave and axial flat-topped tabellae. Septal trabeculae (ca. 0.2 to 0.25 mm thick) are arranged in broad fans. Peripherally they are subparallel to each other and approximately parallel to the inter-corallite wall; internally strongly inclined towards axis.

Remarks.– The species is very close to pseudocerioid (?)*Hexagonaria phillipsastraeiformis* Moenke 1954, especially regarding carination of inter-corallite wall (Moenke 1954: Pl. 1: 7). *Hexagonaria buxutiensis* Tsien 1977 is similar to it in transverse sections, but longitudinal sections (Sorauf 1967: Fig. 4: 1c, d but not Fig. 4: 1a-b, *fide* Tsien 1977) are quite different, and do not show any peripheral eversion of the dissepimentarium.

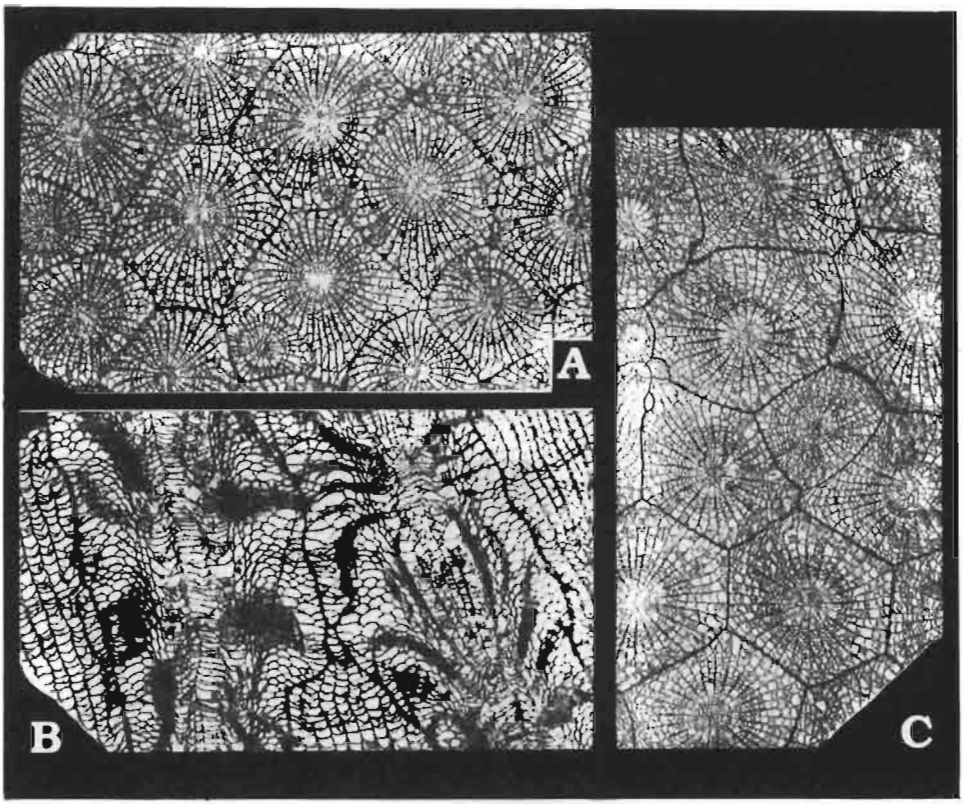

Fig. 20. *Hexagonaria sanctacrucensis* Moenke 1954, Zegzelogóra (set B), Chęciny limestones. Givetian, *Disphyllum* Zone. A, B. Specimen GIUS 393 ZG 24-44-6. C. Specimen GIUS 393 ZG 24-60-3. All × 3.

Distribution.– Wietrznia, point 1 of Moenke (1954: pp. 446-449) probably corresponding to set B of Szulczewski (1971), earliest to early *M. asymmetrica* uncertainty interval (Racki & Bultynck in preparation); tetracorals, listed by Moenke (1954) indicate the *Macgeea-Thamnophyllum* Zone (Frasnian; see Wrzołek 1988); 12 colonies from Sosnówka, set B and Zegzelogóra, Givetian, *Disphyllum* Zone.

Genus *Pseudohexagonaria* Krämer 1982

Type species: *Hexagonaria philomena* Glinski 1955.

Remarks.– The species presented below are only provisionally assigned to the genus, as they invariably display very short second order septa (ca. 1/2 mm long). It also seems inappropriate to ascribe them to *Wapitiphyllum*, that is characterized by a continuous zone of presepiments (see McLean & Pedder 1984), or to *Disphyllia* (*sensu* Yü & Birenheide 1987), characterized by thin septa built of very fine trabeculae. Coen-Aubert & Lütte (1990) include into *Pseudohexagonaria* species with short second order septa, except for the holotypes of *Hexagonaria philomena* Glinski 1955 and *Hexagonaria parallaxa* Glinski 1955.

Pseudohexagonaria(?) *laxa* (Gürich 1896)

Figs 21A-B, 22A-C.

Emended diagnosis.– *Pseudohexagonaria*(?) with very short second order septa, rather flat tabulae and uncommon tabellae. Tabularium/dissepimentarium boundary is sharp.

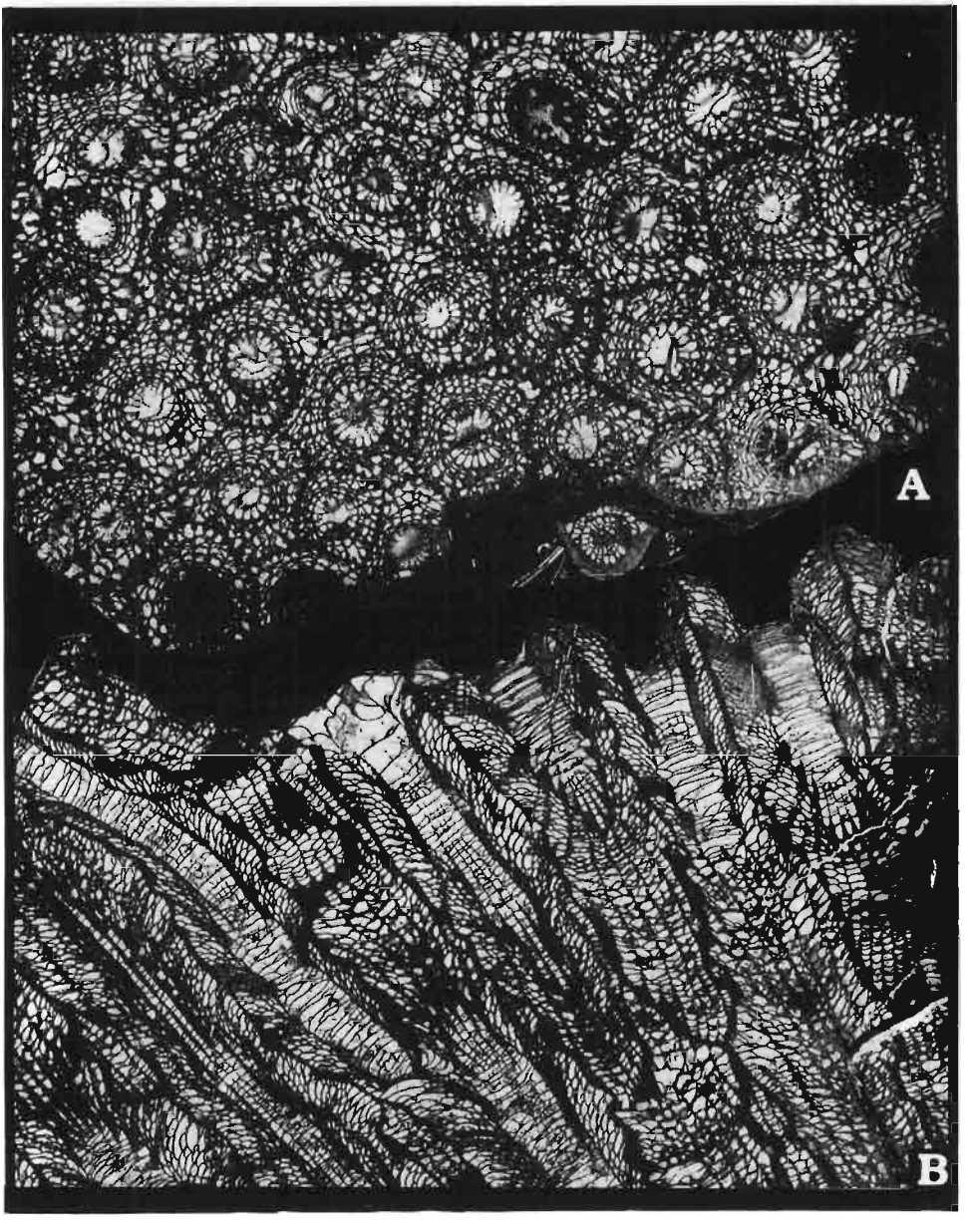

Fig. 21. *Pseudohexagonaria*(?) *laxa* (Gürich 1896), Dziewki (set C_2), age equivalents of *Stringocephalus* Beds, Givetian, *P. laxa* Zone, GIUS 358 D 86 in transverse (A) and longitudinal (B) section; × 2.

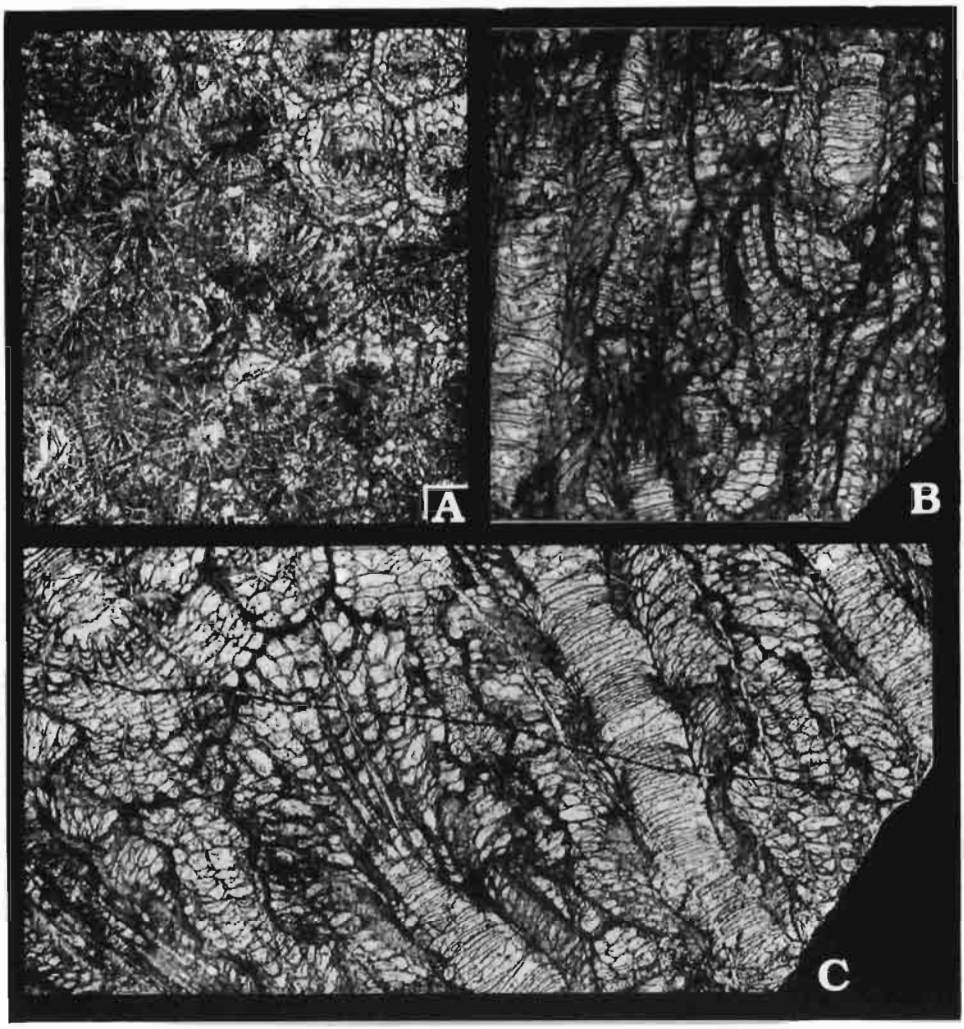

Fig. 22. ❑A, B *Pseudohexagonaria(?) laxa* (Gürich 1896). Colony GIUS 385 OL 4, Ołowianka, *Stringocephalus* Beds, Givetian, *P. laxa* Zone; A - × 2, B - × 3. ❑C. *Pseudohexagonaria(?)* cf. *laxa* (Gürich 1896). Colony GIUS 385 OL 5, same locality; × 3.

Dimensions.– 16 to 20 s1; diameter 5 to 10 mm; tabularium diameter 2.0 to 2.5 mm; diameter of axial space without septa from 1.5 to 3.5 mm; measured 75 corallites of 10 colonies.

Description.– The s1 are 2/3 to 3/4 of the length of the corallite radius, commonly thickened, with coarse, knobby projections; sometimes interrupted by presepiments (Figs 21A, 22A). Isolated corallites (e.g. Fig. 21A – at the bottom) show peripheral septotheca. The s2 are developed mostly as short (ca. 1/2 mm long) projections at inter-corallite walls, rarely as isolated segments on second order presepiments. Dissepimental arrangement is locally in herring-bone, locally in concentric pattern.

Calices are bell-shaped, with flat bottoms (Fig. 21B). Dissepiments occur in 3 to 4 or more vertical series; they are inclined at an angle of about 45 degrees towards the axis. Tabulae are more or less flat, tabellae are uncommon. Trabeculae are parallel, at the angle of ca. 60 degrees in respect to inter – corallite wall (see also Różkowska 1960: p. 14).

Remarks.– The material is identical with the colony illustrated by Różkowska (1960). Colonies of *Pseudohexagonaria*(?) cf. *laxa* (Fig. 22C) from Dziewki (set C_2), WB-12 borehole (set VIII), and Ołowianka (all *P. laxa* Zone) show slightly but broadly everted profile of dissepimentarium and, correspondingly, trabeculae in half-fans, not in parallel arrangement, as typical. Transverse sections of these colonies are quite similar to the typical morphotype. Dimensions of *Pseudohexagonaria* (?) cf. *laxa* are: 6 to 22 s1; tabularium diameter from 3.5 to 6 mm; diameter of axial space devoid of septa from 2 to 4 mm. 30 corallites of 5 colonies were measured.

The specimens from Dziewki (e.g. Fig. 21A-B) are generally much better preserved, when compared with strongly recrystallized specimens from Ołowianka (Fig. 22A-B).

Distribution.– Newly collected 10 colonies from Dziewki, set C_2, Middle *P. varcus* to *S. hermanni* - *P. cristatus* uncertainty interval (presumably the type locality; the type material of Gürich (1896) probably was destroyed during World War II, as it is missing from the collections of the Wrocław University); Ołowianka, Givetian, *P. laxa* Zone.

Pseudohexagonaria(?) cf. *vesiculosa* (Coen-Aubert 1980)

Fig. 23A-B.

Dimensions.– 18 to 20 s1; diameter 8 to 10 mm; tabularium diameter 3.5-4 mm; length of s1 3-4 mm; of s2 0.5-1 mm; measured 10 corallites of 1 colony.

Remarks.– From the colonies illustrated by Coen-Aubert (1980: Pls 10: 5, 12: 3-5), this specimen differs by more complete development of the s1 (Fig. 23A), sharp tabularium/dissepimentarium boundary, complete tabulae (Fig. 23B) and coarse (?)trabeculae in half-fans.

Distribution.– One colony from Dziewki, set D, Givetian, *P. laxa* Zone.

Pseudohexagonaria(?) sp.

Fig. 23C-D.

Dimensions.– from 15 to 19 s1; corallite diameter from 6 to 9 mm; tabularium diameter 3.8-5.7 mm; length of s1 from 2 to 4 mm; length of s2 from 0.5 mm; measured 10 corallites of 2 colonies.

Remarks.– Corallites are smaller, than in *P.*(?) *laxa*; s1 are long, attaining ca. 3/4 of the corallite radius (Fig. 23D). Notable is narrow dissepimentarium (2-3, rarely more vertical series of dissepiments – Fig. 23C) and tabularium/dissepimentarium boundary obscured by periaxial tabellae. Also a lack of complete tabulae in tabularium is characteristic for these specimens, otherwise quite similar to *P.*(?) *laxa*.

Distribution.– Two colonies from the 'middle' Sowie Górki quarry, set B, Givetian, *P. laxa* Zone.

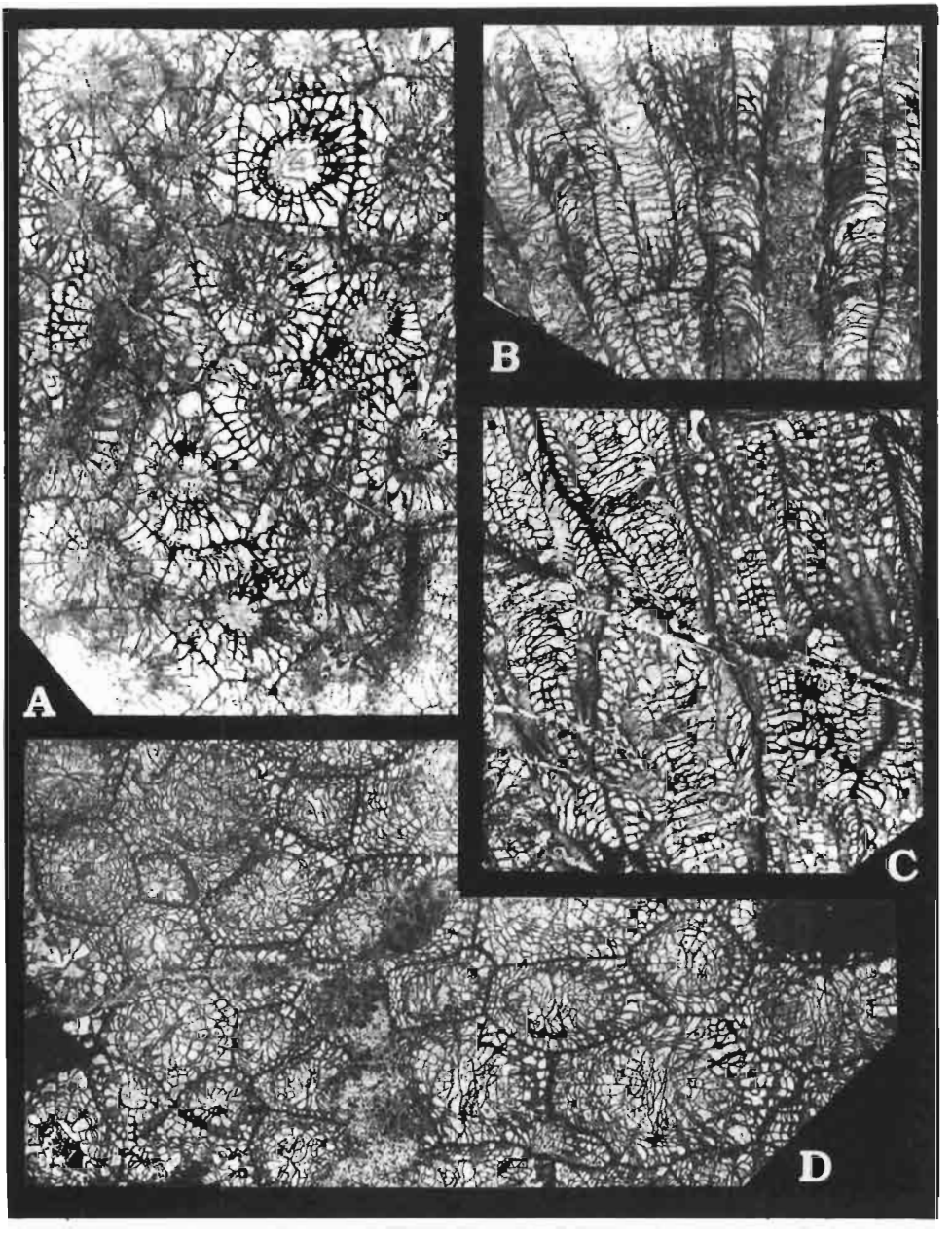

Fig. 23. ⊿A, B. *Pseudohexagonaria* (?) cf. *vesiculosa* (Coen-Aubert 1980), Dziewki (set C_2), age equivalents of *Stringocephalus* Beds, Givetian, *P. laxa* Zone; colony GIUS 358 D 101; × 2. □C, D. *Pseudohexagonaria*(?) sp., Sowie Górki (set B), *Stringocephalus* Beds, Givetian, *P. laxa* Zone. C. Colony GIUS 360 SG 66, × 3. D. Colony GIUS 360 SG 69, × 2.

Family Phillipsastreidae Roemer 1883

Genus *Macgeea* Webster 1889

Tab. 2. Number of specimens of *Macgeea* and *Thamnophyllum* collected in the Holy Cross Mts in the Kowala Formation.

		Macgeea (Macgeea) multizonata (Reed 1922)	*Macgeea (Macgeea) berdensis* Soshkina 1939	*Thamnophyllum kozlowskii* (Różkowska 1953)	*Thamnophyllum cf. kozlowskii* (Różkowska 1953)	*Thamnophyllum monozonatum* (Soshkina 1939)
Jaźwica	H	1				
	L-P	4	1	1		
Kadzielnia	A					1
Kowala railroad cutting	A-C	10	2	25	10	
Sitkówka quarry	C	3		10	9	
Sosnówka	C				1	
Zegzelogóra	?				1	
	B			1		

Remarks.– Only data on the corals collected by the present author from the Kowala Formation are given in the Tab. 2. Illustrations and descriptions of these species can be found in Różkowska (1953, 1980). More comments on taxonomy and nomenclature of these taxa are in the paper by Coen-Aubert & Wrzołek (1991), additional data on stratigraphical and geographical distribution are given in Wrzołek (1988).

Conclusions

(1) Tetracorals of the Kowala Formation represent a sequence of five assemblages, allowing for recognition of five local coral Zones.

(2) The assemblages are of low diversity: from 3 species (*Temnophyllum occidentale* assemblage) to 11 species (*Pseudohexagonaria*(?) *laxa* assemblage).

(3) The endemic corals (*i.e.* species occurring either exclusively in the study area or also in one other area of the Devonian European Region) dominate in the Kowala Formation. They are the only corals in the bulk of its rock volume and belong to the *Disphyllum* assemblage (corresponding roughly to lower Sitkówka beds and Chęciny Beds) and the *Macgeea-Thamnophyllum* assemblage (upper Sitkówka Beds). Generally tetracorals are not a very common element in these strata, indicating habitats rather unfavorable for corals in the main body of the Kowala Formation, and representing rather restricted-marine conditions.

(4) The cosmopolitan assemblages, though they occur in quantitatively unimportant rock volume, are also the most diversified ones. They are

Pseudohexagonaria(?) *laxa* and *Acanthophyllum* sp. n. assemblages, representing the initial colonisation phase and the transgressive pulse of the Jaźwica Member (T-R II b cycle of Johnson *et al.* 1985), respectively. Corals, associated with these events suggest relatively open-marine conditions. The T-R II c cycle of the early Frasnian, though did not bring open-marine conditions and cosmopolitan corals to the study area, is connected with replacement of *Disphyllum* by the *Macgeea-Thamnophyllum* assemblage.

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Streszczenie

Koralowce czteropromienne z żywecko-frańskiej formacji wapieni z Kowali SE części Gór Świętokrzyskich (Fig. 1) układają się w następstwo pięciu charakterystycznych zespołów, wyznaczających lokalne zony biostratygraficzne.

Dwie najniższe z nich stwierdzono w obrębie warstw stringocefalowych żywetu. Pierwsza, Zona *Pseudohexagonaria*(?) *laxa*, zawiera stosunkowo zróżnicowany zespół gatunków, wiele z nich występuje również poza obszarem świętokrzyskim (w tym w wapieniach z Dziewek obszaru Śląsko-Krakowskiego), co wskazuje na „otwarty" charakter morza stringocefalo-

wego. Kolejny zespół, *Temnophyllum occidentale*, jest znacznie słabiej zróżnicowany taksonomicznie; także wskaźniki facjalne sugerują relatywnie „zamknięty" charakter zbiornika tej doby.

Górnożywecki zespół *Acanthophyllum* sp. n. występuje jedynie lokalnie w obrębie ogniwa wapienia mikrytowego z Jaźwicy (dokładniej: w poziomie liliowcowo-koralowcowym Sowich Górek), lecz jego silne zróżnicowanie gatunkowe oraz kosmopolityczny charakter koralowców są typowe dla pulsu transgresywnego (cykl T-R IIb Johnsona *et. al.* 1985, patrz Racki 1993).

Kolejne zespoły, *Disphyllum* (dolne warstwy sitkówczańskie i wapienie chęcińskie; także wapienie łomu karmelickiego w Dębniku) oraz *Macgeea-Thamnophyllum* (Ogniwo z Kadzielni, górne warstwy sitkówczańskie) ponownie charakteryzują się zubożeniem gatunkowym. Choć Rugosa pojawiają się tu niekiedy masowo, to jednak jako nieliczne gatunki, a także jako podrzędny ilościowo składnik kompleksów skalnych, w których występują. Świadczy to o relatywnie „zamkniętym" typie późnożywecko-wczesnofrańskiego zbiornika SE części Gór Świętokrzyskich. Z drugiej strony słabym echem wczesnofrańskiego cyklu T-R IIc jest zapewne zastąpienie zespołu *Disphyllum* przez *Macgeea-Thamnophyllum*.

Nowe taksony, zaproponowane w niniejszej pracy to: *Diffusolasma* gen. nov., gatunek typowy *Cyathophyllum diffusum* Wrzołek 1982, duży osobniczy disfyllid, pochodzący zapewne od *Spinophyllum* i wykazujący homeomorfię do niektórych osobniczych *Cyathophyllum* (*sensu* Birenheide 1963); *Sociophyllum severiacum* sp. nov., z nadzwyczaj rzadkimi presepimentami i wklęsłym do płaskiego profilem tabularium; *Temnophyllum zamkowae* sp. nov., bez grubej septoteki, z septum głównym(?) zazwyczaj skróconym i z bardzo krótkimi septami drugiego rzędu; *Hexagonaria hexagona kowalae* subsp. nov., z karinacją septów słabiej zaznaczoną niż u podgatunku nominalnego.