

Redescription of the rugose coral *Macgeea (Rozkowskaella) sandaliformis* (ROŻKOWSKA, 1980) from the Upper Frasnian of the Holy Cross Mountains (Poland)

by Marie COEN-AUBERT and Tomasz WRZOLEK

Abstract

The discovery of horseshoe dissepiments at the base of some coralla of *Trigonella sandaliformis* ROŻKOWSKA, 1980, type species of *Rozkowskaella* WRZOLEK, 1987 from the Upper Frasnian of Poland, leads to consider this taxon as a subgenus of *Macgeea* WEBSTER, 1889. Moreover, *Debnikiella* ROŻKOWSKA, 1980, whose type species is *D. formosa* ROŻKOWSKA, 1980 also from the Upper Frasnian of Poland, can probably be placed in synonymy with *Rozkowskaella*. For comparison, a few topotypes of *Pachyphyllum solitarium* HALL & WHITFIELD, 1873, type species of the genus *Macgeea* are described.

Key-words: Rugose corals, Frasnian, Taxonomy, Stratigraphy, Poland.

Résumé

La découverte de dissépiments en fer à cheval à la base de certains polypiers de *Trigonella sandaliformis* ROŻKOWSKA, 1980, espèce-type du genre *Rozkowskaella* WRZOLEK, 1987 provenant du Frasnien supérieur de Pologne, conduit à considérer ce taxon comme un sous-genre de *Macgeea* WEBSTER, 1889. De plus, *Debnikiella* ROŻKOWSKA, 1980, dont l'espèce-type est *D. formosa* ROŻKOWSKA, 1980 également du Frasnien supérieur de Pologne, peut probablement être mis en synonymie avec *Rozkowskaella*. A titre de comparaison, quelques topotypes de *Pachyphyllum solitarium* HALL & WHITFIELD, 1873, espèce-type du genre *Macgeea* sont décrits.

Mots-clefs: Rugueux, Frasnien, Taxinomie, Stratigraphie, Pologne.

Introduction

In 1980, ROŻKOWSKA erected the genus *Trigonella* ROŻKOWSKA, 1980 with *T. sandaliformis* ROŻKOWSKA, 1980 from the late Frasnian of the Holy Cross Mountains in Poland as its type species represented only by its holotype. According to the author, the features characteristic of the new genus are the *Calceola* shape of the corallum, its everted dissepimentarium and the lack of horseshoe dissepiments which clearly distinguishes *Trigonella* from *Pterorrhiza* EHRENBERG, 1834. In 1987, WRZOLEK renamed the genus *Rozkowskaella* WRZOLEK, 1987 because the name *Trigonella* DA COSTA, 1778 was preoccupied by a bivalve (*vide* SHERBORN). In 1989, MCLEAN suggested that *Rozkowskaella* should be placed

in synonymy with *Debnikiella* ROŻKOWSKA, 1980 whose type species is *D. formosa* ROŻKOWSKA, 1980 from the Upper Frasnian of the Silesia-Cracow Upland, Poland; however, the type material of this taxon is very fragmentary.

New specimens of *Rozkowskaella sandaliformis* collected by the junior author, in the Holy Cross Mountains and mostly from the type locality are here described and illustrated so that the name *Rozkowskaella* is now preferred to *Debnikiella*. Moreover, the discovery of horseshoe dissepiments at the base of some well-preserved coralla of *Rozkowskaella sandaliformis* leads us to consider *Rozkowskaella* as a subgenus of *Macgeea* WEBSTER, 1889 which is a probable junior synonym of *Pterorrhiza*. The latter genus is not used because its type material is inadequately known.

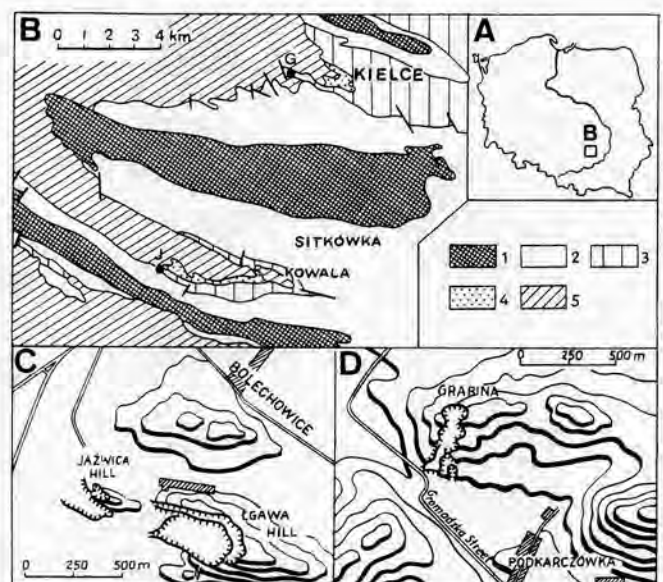


Fig. 1. - Location of Jazwica and Grabina quarries in Poland (A); in the Holy Cross Mountains (B, after SZULCZEWSKI, 1971; G = Grabina, J = Jazwica, 1 = Cambrian, Ordovician and Silurian, 2 = Lower and Middle Devonian, 3 = Upper Devonian, 4 = Lower Carboniferous, 5 = Permian and Mesozoic); in the Łgawa (C) and Grabina (D) hills.

Most of the material is stored at the Laboratory of Palaeontology and Stratigraphy from the Silesian University of Sosnowiec, Poland (GIUS); one specimen is from the collections of the Institut royal des Sciences naturelles de Belgique at Brussels, Belgium (IRScNB).

Geological setting

All specimens of *Macgeea (Rozkowskaella) sandaliformis* have been collected from loose material found in Jaźwica and Grabina quarries, in the Holy Cross Mountains (Fig. 1). However, the state of preservation and the lithology of the matrix allow the specimens to be assigned precisely to particular lithological units (Fig. 2). The list of rugose corals from the two exposures (Table 1) is based on data from WRZOLEK (1988), but

some specific determinations were discussed with the senior author.

Jaźwica quarries (GIUS 402)

The active quarries at Łgawa Hill are some 500 metres south of Bolechowice village. The Devonian deposits form part of the northern limb of the Chęciny anticline which is also the southern limb of the Gałęzice-Bolechowice syncline. The quarries have been described in detail by RACKI & ZAPASNIK (1979) and RACKI (1981).

M. (R.) sandaliformis is present in unit R which consists of reddish and grey nodular limestones with shaly intercalations and brachiopod coquinas. The conodonts from this unit are assigned to the *Palmatolepis gigas* Zone and the diverse assemblage of rugose corals belongs to the late Frasnian *Frechastrea pentagona* Oppel Zone which was introduced by WRZOLEK (1988). According to

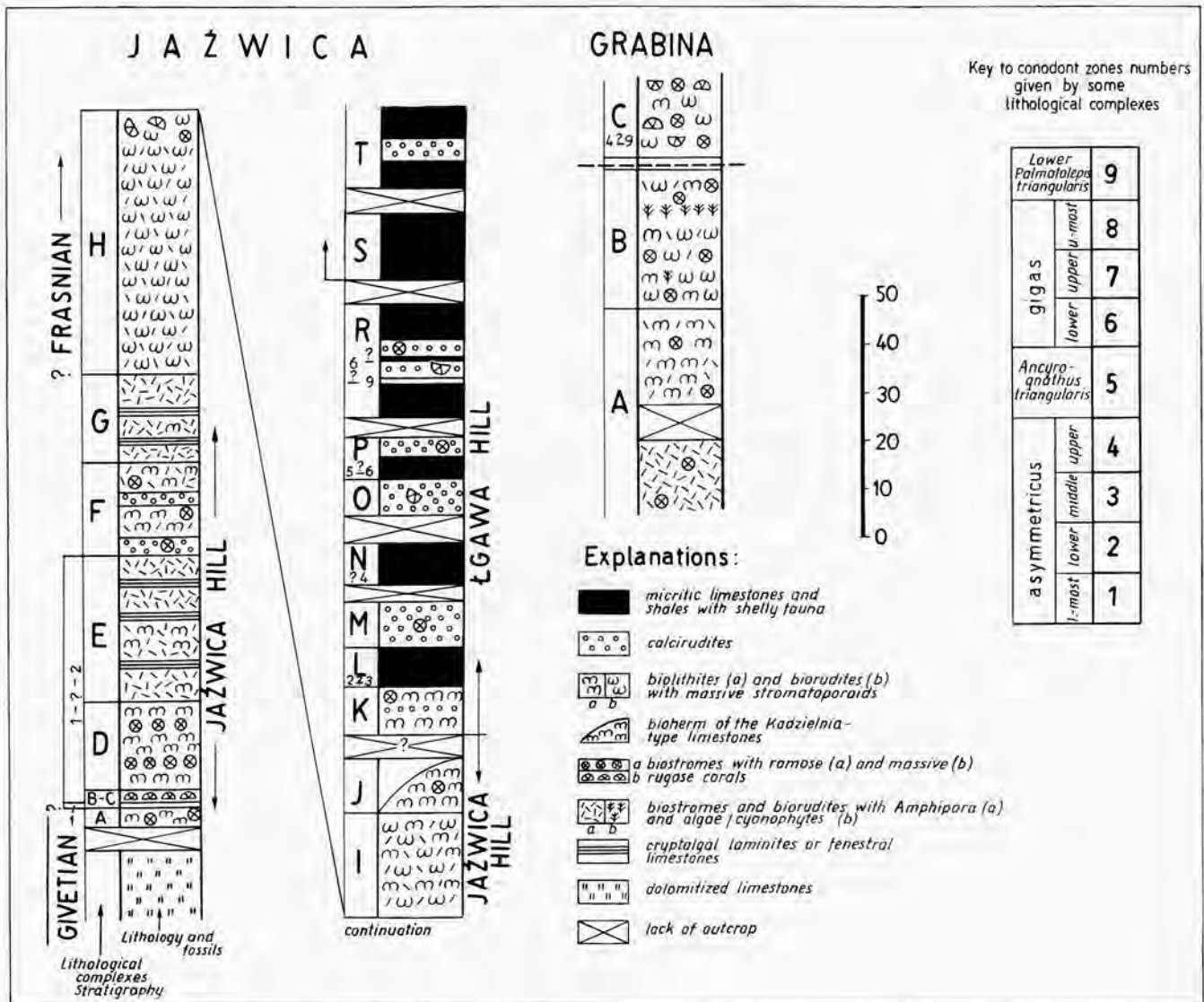


Fig. 2. – Lithology, palaeontology and stratigraphy of Jaźwica and Grabina quarries in the Holy Cross Mountains; the data on conodonts are from RACKI (1981 and unpublished).

Table 1.

Distribution of rugose corals in Jazwica and Grabina quarries, Holy Cross Mountains. The number of specimens assigned to each species is noted; the crosses (+) indicate specimens listed by ROŻKOWSKA (1980).

	JAZWICA QUARRY Lithological units						GRABINA QUARRY Lithological units		
	A	C	D-G	H-J	L-P	R	A	B	C
<i>Hankaxis mirabilis</i> (ROŻKOWSKA, 1980)						1			
<i>H. insignis</i> COEN-AUBERT, 1982									5
<i>Hankaxis</i> n. sp.									1
<i>Tabulophyllum densum</i> ROŻKOWSKA, 1980								4	
<i>T. priscum</i> (MÜNSTER, 1841) <i>sensu</i> (ROŻKOWSKA 1980)									1
<i>T. simile</i> (ROŻKOWSKA, 1980)					1	+			2
<i>Disphyllum wirbelauense</i> PICKETT, 1967		2	2	2					
<i>D. wirbelauense bonae</i> ROŻKOWSKA & FEDOROWSKI, 1972			7	5					
<i>D. cylindricum</i> (SOSHKINA, 1939)			4	4					
<i>Disphyllum</i> sp.							1		
? <i>Aristophyllum irenae</i> ROŻKOWSKA, 1980						+		1	
<i>Temnophyllum</i> aff. <i>latum</i> WALTHER, 1929			1						
<i>T. occidentale</i> HILL & JELL, 1970	16								
<i>Temnophyllum</i> n. sp.	4								
<i>Spinophyllum diffusum</i> (WRZOŁEK, 1982)						41			
<i>S. aff. diffusum</i> (WRZOŁEK, 1982)						5			
<i>Spinophyllum</i> sp.								7	
<i>Picaephyllum pronini</i> (SOSHKINA, 1951)								1	
<i>Hexagonaria</i> aff. <i>hexagona</i> (GOLDFUSS, 1826)			8						
<i>H. davidsoni</i> (MILNE-EDWARDS & HAIME, 1851)		15							
<i>Phillipsatrea lacunosa</i> (GÜRICH, 1896)									1
<i>P. ananas</i> (GOLDFUSS, 1826)						1			
<i>P. aff. roemeri</i> (DE VERNEUIL & HAIME, 1850)				1		1			2
<i>P. conili</i> TSIEN, 1978						1			2
<i>P. veserensis</i> COEN-AUBERT, 1974									1
<i>P. cf. rozkowskiae</i> SCRUTTON, 1968						2			
<i>P. ibergense</i> (ROEMER, 1855)									
<i>Frechastraea pentagona</i> (GOLDFUSS, 1826)						6			
<i>F. pentagona minima</i> (ROŻKOWSKA, 1953)						6			3
<i>F. goldfussi</i> (DE VERNEUIL & HAIME, 1850)						1			
<i>F. micrommata</i> (ROEMER, 1852)						2			1
<i>F. cf. sanctacrucensis</i> (ROŻKOWSKA, 1953)						2			
<i>Macgeea (Macgeea) multizonata</i> (REED, 1922)				1	4				5
<i>M. (M.) berdensis</i> SOSHKINA, 1939					1				
<i>M. (M.)</i> sp.							2	1	
<i>M. (Rozkowskaella) sandaliformis</i> (ROŻKOWSKA, 1980)						5			1
<i>Pexiphyllum ultimum</i> WALTHER, 1929 <i>sensu</i> ROŻKOWSKA, 1953									23
<i>Thamnophyllum kozłowski</i> (ROŻKOWSKA, 1953)					1				

COEN-AUBERT (1982), several of the rugose corals recorded from unit R in Jazwica occur also in the Upper Frasnian of Belgium.

Grabina quarry (GIUS 365)

The abandoned quarry at Grabina hill, in the Kadzielnia range, lies 1 kilometre to the west of Karczówka monas-

tery in Kielce. The Devonian deposits dip to the north, towards the axis of the Kielce syncline.

In this exposure, *Macgeea (Rozkowskaella) sandaliformis* is recorded from unit C which consists of organogenic and organodetrital limestones with massive stromatoporoids, massive and solitary rugose corals, brachiopods, trilobites, fishes and conodonts. Correlation using

conodonts is imprecise, but suggests the Upper *Polygnatus asymmetricus* – Lower *Palmatolepis triangularis* interval (RACKI, personal communication). The rugose corals again indicate the *Frechastraea pentagona* Oppel Zone.

Systematic Palaeontology

Family PHILLIPSASTREIDAE ROEMER, 1883

Genus *Macgeea* WEBSTER, 1889

- = ?*Pterorrhiza* EHRENBERG, 1834
- = *Pexiphyllum* WALTHER, 1929
- = *Trigonella* ROŻKOWSKA, 1980 non *Trigonella* DA COSTA, 1778 (a bivalve)
- = ?*Debnikiella* ROŻKOWSKA, 1980
- = *Rozkowskaella* WRZOLEK, 1987

Type species

By subsequent designation of FENTON & FENTON (1924, p. 54), *Pachyphyllum solitarium* HALL & WHITFIELD, 1873.

DIAGNOSIS

Conical to cylindrical solitary rugose corals with a deep calice. Epitheca not quite extending to the rim of the calice so that the peripheral edges of the septa are exposed distally. Septa of both orders, non-carinate or sometimes faintly carinate, more or less long and dilated in the dissepimentarium. Dissepimentarium with one outer row of flat dissepiments, inside this a row of horseshoe dissepiments and then a few inner rows of globose dissepiments. Symmetrical fans of rhipidacanth centred over horseshoe dissepiments. Broad tabularium with incomplete or compound tabulae.

DISCUSSION

By subsequent designation of LANG, SMITH & THOMAS (1940), the type species of *Pterorrhiza* EHRENBERG, 1834 is *Cyathophyllum marginatum* GOLDFUSS, 1826 from the Givetian or early Frasnian of the Bergisches Land in Germany. The syntypes of this species have been illustrated by PICKETT (1967) and its lectotype has been chosen and sectioned by BIRENHEIDE (1969a, 1978) and refigured by HILL (1981). It should be noted, however, that the internal structure of the lectotype is not well known. Indeed, this specimen has never been sectioned longitudinally and according to BIRENHEIDE (personal communication), it is impossible to do so because the corallum is too short and its calice too deep. Moreover, the transverse section of the lectotype, with its septa strongly dilated and nearly in lateral contact in the tabularium, clearly belongs to a juvenile stage; indeed, it has the same look as the immature form of *Macgeea* (*Macgeea*) *ponderosa* STUMM, 1960 from the Frasnian of New York State, USA figured recently by SORAUF (1987, fig. 7.5). A similar ontogenetic development has been des-

cribed by FEDOROWSKI (1968) in *M. (M.) densa* (FEDOROWSKI, 1968) from the Lower Givetian of the Holy Cross Mountains, Poland.

The type material of *Pterorrhiza marginata* therefore shows serious deficiencies and its description is inadequate. Furthermore, as noted by PEDDER (1969), it is impossible to interpret *Pterorrhiza* on new topotype material of *P. marginata* because the precise type stratum and locality are unknown. Although *Pterorrhiza* may be a senior synonym of *Macgeea*, it is suggested that the genus cannot now be used. It is hoped that the proposed selection by SORAUF (personal communication) of a neotype for *Macgeea solitaria* will clarify the definition of the genus *Macgeea* (see BIRENHEIDE, 1969b). The difficulties over the use of *Pterorrhiza* have been discussed recently by SORAUF (1988) and MCLEAN (1989).

Subgenus *Macgeea* (*Macgeea*) WEBSTER, 1889

- = ?*Pterorrhiza* EHRENBERG, 1834
- = *Pexiphyllum* WALTHER, 1929

Type species

As for the genus *Macgeea*.

DIAGNOSIS

Horseshoe dissepiments persisting in the late ontogenetic stages. Other features as for the genus.

Macgeea (*Macgeea*) *solitaria*

(HALL & WHITFIELD, 1873)

(Plate 1, Figures 1-3)

- * 1873 *Pachyphyllum solitarium* n. sp. – HALL & WHITFIELD, p. 232, pl. 9, fig. 6-8;
- 1889 *Macgeea solitaria*, H. and W. – WEBSTER, p. 711;
- 1924 *Macgeea solitaria* (Hall and Whitfield) – FENTON & FENTON, p. 54, pl. 9, fig. 7-10;
- v 1935 *Macgeea solitaria* (Hall and Whitfield) – LANG & SMITH, fig. 10, 11, pl. 37, fig. 1-3;
- 1945 *Macgeea solitaria* (Hall and Whitfield) – SMITH, pl. 24, fig. 1;
- 1946 *Macgeea solitaria* (Hall and Whitfield) – STAINBROOK, pl. 57, fig. 16, pl. 60, fig. 11, 14;
- v 1949 *Macgeea* (*Macgeea*) *solitaria* (Hall and Whitfield) – VON SCHOUPPE, p. 159, pl. 11, fig. 49, 50, pl. 14, fig. 81-85;
- non 1951 *Macgeea* cf. *solitaria* Hall & Whitfield – TAYLOR, p. 189, pl. 3, fig. 1;
- non 1951 *Macgeea solitaria* (Hall et Whitfield) – SOSHKI-NA, p. 82, fig. 34, pl. 14, fig. 5-9;
- non 1952 *Macgeea solitaria* Hall et Whitfield – SOSHKI-NA, p. 84, pl. 19, fig. 66;
- v 1956 *Macgeea solitaria* (Hall-W.) – HILL, fig. 192, 2;
- v 1958 *Macgeea* (*Macgeea*) *solitaria* (Hall & Whitf.) – VON SCHOUPPE, fig. 1, 2;
- non 1960 *Macgeea solitaria* (Hall et Whitfield), 1872 – SPASSKY, p. 44, pl. 19, fig. 1-5;

- v, p.p. 1967 *Pterorrhiza solitaria* (Hall and Whitfield 1872) – PICKETT, p. 65, fig. 18, pl. 5, fig. 19, 20 (non pl. 5, fig. 21);
- v, non 1969 *Macgeea solitaria* (Hall et Whitfield), 1873 – TSIEN, p. 70, pl. 48, fig. 7, 8, 16;
- non 1977 *Macgeea solitaria* (Hall et Whitfield) – SPASKY, pl. 24, fig. 3;
- non 1981 *Macgeea solitaria* (Hall et Whitfield, 1872) – TSYGANKO, p. 131, pl. 58, fig. 1, 2.

Neotype

As the type material of *Pachyphyllum solitarium* is missing according to BIRENHEIDE (1969b) and SORAUF (1988), a neotype shall soon be selected by SORAUF (personal communication) from the collections of the US National Museum of Natural History, in Washington DC, USA. The type locality is Hackberry Grove near Rockford, Cerro Gordo County, Iowa, USA and the type horizon is the Cerro Gordo Member of the Lime Creek Formation, Upper Frasnian.

Material and localities

Three topotypes have been investigated. The first one is specimen R19.620 and thin section R28.994 (Pl. 1, Figs. 1-3) stored in the British Museum (Natural History) at London, Great Britain and figured by LANG & SMITH (1935, pl. 37, fig. 1, 2). The two other revised topotypes are specimens SMF 18.864 and SMF 18.867 stored in the Forschungsinstitut Senckenberg at Frankfurt am Main, Germany and illustrated by PICKETT (1967, fig. 18, pl. 5, fig. 19, 20). The third corallum assigned by PICKETT (1967, pl. 5, fig. 21) to *Macgeea (Macgeea) solitaria* is probably a juvenile *Charactophyllum nanum* (HALL & WHITFIELD, 1873).

Geographic and stratigraphic occurrence

The species is known with certainty only from the Upper Frasnian of Iowa, USA.

DIAGNOSIS

A species of *Macgeea (Macgeea)* with 60 to 70 septa at a diameter of 13,5 to 18 mm. Septa slightly dilated in the dissepimentarium. Inner dissepiments poorly developed.

DESCRIPTION

The topotypes investigated are small trochoid coralla with a deep calice and the epitheca not quite extending to its rim so that the peripheral edges of the septa are exposed.

The wall is locally preserved. The septa are non-carinate and dilated in the dissepimentarium. A dark median line, occasionally with small ramifications, is clearly recognizable in the collar of horseshoe dissepiments which is often coated with stereome on both the internal and external flanks. There are few inner dissepiments. The septa become thinner in the tabularium or, more usually, after their entry into it where they bear a few spinose or knobby carinae or have some stereoplasmic thickenings. The major septa are shortened, leaving a

space in the centre of the tabularium; their axial ends may be forked, flexuous or discontinuous. The minor septa traverse all or nearly all the dissepimentarium; they can also project a little into the tabularium where they may be contratingent.

The dissepimentarium consists of:

- one peripheral row of flat dissepiments sometimes concave or intersecting laterally;
 - one row of horseshoe dissepiments with narrow symmetrical fans of rhipidacanth centred over them;
 - one or two rows of inner inclined dissepiments which only appear in the upper part of the corallum.
- Very locally, one row of external inclined dissepiments is also present between the flat and the horseshoe dissepiments.

The tabulae, sometimes thickened with stereoplasma, are mostly compound with broad flat-topped tabellae. Septa possibly with some stereoplasmic thickenings are seen in the tabularium, at the base of the corallum.

There are 62 to 64 septa. The two transverse sections of the corallum figured by LANG & SMITH (1935) are elliptical with measurements of 13,5 or 14,5 x 18 mm. The width of the tabularium ranges from 9 to 10,5 mm.

DISCUSSION

The main qualitative characters of *Macgeea (Macgeea) solitaria* are the slight dilatation of the septa in the dissepimentarium and the poor development of the inner dissepiments. These features also occur in two species found in the Frasnian of the USA, namely *M. (M.) thomasi* STAINBROOK, 1946 from the Independence Shale of Iowa and *M. (M.) ponderosa* from the Chemung facies of the West Falls Group in New York State. According to STAINBROOK (1946, p. 423), the first taxon is separated from *M. (M.) solitaria* by its smaller size whereas the second one, recently revised by SORAUF (1987), has much larger corallites with more septa. By the length and the thickness of the septa, *M. (M.) solitaria* is related to Belgian Frasnian species of *Macgeea (Macgeea)* such as *M. (M.) multizonata* (REED, 1922), *M. (M.) rozkowskiae* COEN-AUBERT, 1982 and *M. (M.) gallica gallica* LANG & SMITH, 1935 redescribed by COEN-AUBERT (1982); however, it is readily distinguished from them by narrower corallites and very few inner dissepiments. The third specimen described by PICKETT (1967, pl. 5, fig. 21) as *M. (M.) solitaria* has no horseshoe dissepiments and its septa are dilated throughout their length, leaving an open space in the centre of the tabularium so that it is probably a juvenile *Charactophyllum nanum*.

Until now, *M. (M.) solitaria* has not been confirmed from outside North America. Indeed, the Couvinian coralla of Belgium described by TSIEN (1969) and the Givetian specimen of South-West England studied by TAYLOR (1951) are too fragmentary to allow a precise comparison whereas the records from the Frasnian of the U.S.S.R. do not belong to the species. The material of the Ural Mountains figured by SOSHKINA (1951, 1952) differs from it by having septa strongly dilated in the

dissepimentarium and even in lateral contact at the periphery. The specimens of TSYGANKO (1981) from the same area show septa dilated a long way into the tabularium and the coralla of the Rudnyí Altay illustrated by SPASSKY (1960) have much fewer septa than the topotypes of *M. (M.) solitaria*.

Subgenus *Macgeea (Rozkowskaella)* WRZOLEK, 1987

= *Trigonella* ROŻKOWSKA, 1980 non *Trigonella* DA COSTA, 1778 (a bivalve)
 = ?*Debnikiella* ROŻKOWSKA, 1980
 = *Rozkowskaella* WRZOLEK, 1987

Type species

Trigonella sandaliformis ROŻKOWSKA, 1980

DIAGNOSIS

Horseshoe dissepiments disappearing during the ontogeny with simultaneous development of numerous globose dissepiments in the inner part of the dissepimentarium.

Macgeea (Rozkowskaella) sandaliformis
 (ROŻKOWSKA, 1980)

(Plate 1, Figures 4-11, Plate 2, Figures 1-9)

v *1980 *Trigonella sandaliformis* sp. n. – ROŻKOWSKA, p. 24, fig. 4, pl. 2, fig. 6.

Holotype

Fig. 4 and pl. 2, fig. 6 in ROŻKOWSKA (1980). Specimen TcI/13 stored in the Department of Geology, MICKIEWICZ'S University of Poznań, Poland. From Jaźwica quarry at Łgawa Hill, south of Bolechowice village, Holy Cross Mountains, Poland. Lithological unit R, late Frasnian.

Remark

To avoid any further confusion, we must note that ROŻKOWSKA (1980, p. 51, fig. 24) recorded the locality for the holotype erroneously as Kowala II = road cut

Kowala; on page 24 only, the type locality is noted correctly as Jaźwica quarry.

Material and localities

Six specimens with 9 thin sections and 45 peels mainly collected by the junior author.

Jaźwica quarry: TcI/13 (holotype collected by RACKI), J39, J57, J139 and J141.

Grabina quarry: G27.

Geographic and stratigraphic occurrence

The species is known only from the Upper Frasnian of the Holy Cross Mountains, Poland.

DIAGNOSIS

A species of *Macgeea (Rozkowskaella)* with a triangular cross section and 68 to 90 septa in sections measuring 2 x 3,6 cm. Major septa often dilated throughout their length and more or less withdrawn from the axis of the corallum. Minor septa variable in length.

DESCRIPTION

The material consists of conical solitary rugose corals with a triangular cross section. The length of the corallum often measures 3,5 cm, but varies between 2 and 3,5 cm. The specimens from Jaźwica are weathered and silicified peripherally, but the wall is preserved locally in two of them. Specimen J57 (Pl. 2, Fig. 9) is divided into two axial offsets; two smaller and adjacent peripheral buds appear in one of them. The specimen from Grabina is embedded in matrix and proximally broken.

The earliest ontogenetic stages were studied in specimen G27:

- in the most proximal sections (Pl. 1, Fig. 11), the septa are dilated in the dissepimentarium and become thinner after entry into the tabularium;
- in the following sections (Pl. 1, Fig. 10), the septa remain thin in the tabularium, but their thickness increases in the dissepimentarium so that they become spindle-shaped;
- in the most distal sections (Pl. 1, Fig. 9), the septa are somewhat less dilated in the tabularium than in the dissepimentarium.

Table 2.

Dimensions of *Macgeea (Rozkowskaella) sandaliformis* (ROŻKOWSKA, 1980)

Specimen	Number of septa	Corallum diameter in mm	Tabularium diameter in mm	Corallum length in mm	Remarks
TcI/13	68-74	21 x 27	12-19	35	holotype
J39	90	22 x 30	9-16	35	non sectioned, with offsets
J57	74	19 x 23	?	20	
J139	80-82	20 x 36	11-15	35	
J141	68	23 x 33	9,8-11,5	35	
G27	64	15 x 17	8-8,5	?	only transverse sections

In adult specimens, the septa are often dilated throughout their length. Sometimes however, they become thinner in the tabularium or only at their axial ends and sometimes they are thicker in the inner or in the outer part of the dissepimentarium. The septa are generally non-carinate, but in some sections, a few spinose carinae are present or a dark median line with small ramifications is seen.

In the holotype and specimen G27, the major septa extend close to the corallite axis. In the other coralla, there is an open space in the centre of the tabularium, usually wide, but occasionally smaller. The axial ends of the major septa may be either curved or forked or bear spinose carinae or may even be rhopaloid. An open fossula, marked by the reduction of the cardinal septum, can be seen in one corner of some corallites; in specimen J39 (Pl. 1, Figs. 6, 7), there is an isolated fragment of septum at the border of the dissepimentarium and the tabularium, in continuity with the cardinal septum. The minor septa traverse all or nearly all the dissepimentarium in specimens G27 and J141 and to a lesser extent in the holotype; they very rarely project a short distance into the tabularium. In the other specimens, they are often reduced and restricted to the outer part of the dissepimentarium or to the ring of the horseshoe dissepiments; sometimes also, they are represented beyond them by rare isolated fragments or spines (Pl. 2, Figs. 3, 4).

Horseshoe dissepiments are locally recognizable in the cross sections of coralla J139 and G27; they are occasionally bordered by a double ring of stereoplasmic thickening. In specimen J139 (Pl. 2, Fig. 3), the horseshoe dissepiments are separated from the tabularium by numerous rows of inner dissepiments. By contrast, in specimen G27 (Pl. 1, Fig. 10), they are seen at the border of the tabularium; the dissepimentarium is broad along the flattened side of this corallite whereas it is narrow and nearly restricted to horseshoe dissepiments along the two other sides.

In longitudinal section, the dissepimentarium consists at the base of the corallum (Pl. 2, Figs. 5, 6) of:

- one peripheral row of broad flat dissepiments which may intersect laterally or pass to several rows of globose dissepiments forming a talon;
- one row of horseshoe dissepiments often bordered by a double ring of stereoplasmic thickening; sometimes, there is a narrow symmetrical fan of fine trabeculae centred over them;
- locally one or two rows of inner globose dissepiments.

In the upper part of the corallum (Pl. 1, Fig. 8), the horseshoe dissepiments become very irregular and pass gradually to peneckielloid or arched dissepiments. Meanwhile, the inner globose and inclined dissepiments become more numerous, forming up to 13 rows and are covered by rhipidacanth.

The tabulae are incomplete and intersect laterally; their axial parts may be concave, horizontal or more often flat-topped. Sometimes the tabulae are thickened with stereoplasma or a discontinuous columella appears at the base of the corallum (Pl. 2, Fig. 5).

In the adult stages, 68 to 90 septa are present, but there are only 64 septa or less in the young ones. The section of the corallum measures 2 x 3,6 cm in the mature specimens and less than 1,5 cm in the young ones. The width of the tabularium ranges commonly from 9 to 16 cm and more generally from 8 to 19 cm.

DISCUSSION

The ontogeny of *Macgeea (Rozkowskaella) sandaliformis* shows several unusual features. Firstly, in the early stages, its dissepimentarium is similar to that of species of *Macgeea (Macgeea)*, but it becomes different in the adult stages; indeed, the horseshoe dissepiments are then present rarely whereas the inner inclined dissepiments become very abundant. Secondly, the dilatation of the septa is restricted to the dissepimentarium in the immature stages, but extends throughout their length in the mature forms; normally, the septa of rugose corals grow thinner during the ontogeny, especially in the tabularium where they become very slender. Thirdly, the septa of both orders are long and well developed in the young stages, but become shorter in the adult ones: the shortening of the major septa leaves a wide open space in the centre of the corallites whereas the minor septa do not cross the full width of the dissepimentarium. The axial withdrawal of major septa is frequently seen during the ontogeny of many Devonian rugose corals, but the minor ones usually grow longer in the dissepimentarium as the corallum develops.

At the specific level, it is interesting to compare *M. (R.) sandaliformis* with some large sized species of *Macgeea (Macgeea)* such as *M. (M.) gallica gigantea* BRICE & ROHART, 1974 from the middle part of the Frasnian of Belgium and France and *M. (M.) telopea* CRICKMAY, 1962 from the Middle Frasnian of the Northwest Territories in Canada. However in *M. (M.) gallica gigantea*, the horseshoe dissepiments are well developed even in the late stages of the ontogeny, the inner dissepiments are reduced to 7-8 rows and the septa of both orders are long and remain thinner in the tabularium. Similar features characterize *M. (M.) telopea* which also differs from *M. (R.) sandaliformis* in having slender septa in the dissepimentarium.

The most striking feature of *M. (R.) sandaliformis* is the triangular transverse section of its corallum. It probably reflects an ecological adaptation to a particular habitat and recalls the shape of *Calceola sandalina* (LINNÉ, 1771) whence the specific name was derived by ROŹKOWSKA (1980). It shall be noted however that the cross section of *Macgeea (Macgeea) solitaria* figured by HALL & WHITFIELD (1873, pl. 9, fig. 7) is nearly triangular.

A triangular transverse section occurs also in the genus *Bighornia* DUNCAN, 1957 with *B. parva* DUNCAN, 1957 from the Upper Ordovician of Wyoming, USA, as type species. The general appearance of this taxon in the cross sections figured by DUNCAN (1957) and HILL (1981) looks similar to that of *Macgeea (Rozkowskaella) sandaliformis*, but *Bighornia parva* has a columella, a well-

defined cardinal fossula, lacks dissepiments and is consequently assigned to the family Streptelasmataceae NICHOLSON, 1889. In this family, several species of the genera *Grewingia* DYBOWSKI, 1873 and *Deiracorallium* NELSON, 1963, also from the Upper Ordovician of North America and described among others by NELSON (1981) and ELIAS (1981, 1982), are weakly triangular in cross sections whereas the genus *Lobocorallium* NELSON, 1963 from the same area is typically trilobate. According to ELIAS (1984), the development of rugose corals with non-circular transverse sections may have improved their stability on soft substrata and prevents them from being overturned and killed. However, as this rare feature is restricted to a few Ordovician genera in only one zoogeographic province, genetic control is possible. On the other hand, there is great variability in the external shape of *Grewingia*, *Deiracorallium*, *Lobocorallium* and *Bighornia*: from weakly triangular, through slightly trilobate to strongly and persistently angular or even subcalceoloid. Therefore, as ELIAS (1982, p. 64) noted, the significance of external form as a diagnostic generic character is questionable.

Macgeea (Rozkowskaella) formosa
(ROŹKOWSKA, 1980)

v, *1980 *Debnikiella formosa* sp. n. – ROŹKOWSKA, p. 25, fig. 5, pl. 3, fig. 12, pl. 4, fig. 16.

Holotype

Fig. 5 and pl. 4, fig. 16 in ROŹKOWSKA (1980). Specimen TcI/15 stored in the Department of Geology, MICKIEWICZ's University of Poznań, Poland. From Żarnówczany Dół, abandoned quarry near Dębnik village, Silesia-Cracow Upland, Poland. Upper Frasnian.

Material and localities

Two specimens with 3 thin sections. In addition to the holotype, ROŹKOWSKA (1980, pl. 3, fig. 12) assigned another specimen (TcI/16) from Wietrznia in the Holy Cross Mountains, Poland, to the species.

Geographic and stratigraphic occurrence

The species is known only from the Upper Frasnian of the Silesia-Cracow Upland and the Holy Cross Mountains in Poland.

DIAGNOSIS

A species of *Macgeea (Rozkowskaella)* with 66 to 68 septa at a diameter of 22 to 30 mm. Major septa dilated in the dissepimentarium and becoming thinner in the tabularium. Minor septa traversing the full width of the dissepimentarium.

DESCRIPTION

According to ROŹKOWSKA (1980), the holotype is a sub-cylindrical corallum; from this specimen, there remain a fragmentary transverse section and an incomplete longi-

tudinal section. The other corallum TcI/16 from the Holy Cross Mountains is represented only by a cross section.

The wall is locally preserved. The septa are non-carinate and dilated in the dissepimentarium. In the holotype, they become thinner in the tabularium, but in the other specimen, they thin a little way after entering the tabularium. The major septa are usually shortened and there is an extensive open space in the centre of the tabularium where their axial ends may be discontinuous or rhopaloid; however, a few major septa reach the axis of the corallum. The minor septa traverse the full width of the wide dissepimentarium. In the transverse section of specimen TcI/16, horseshoe dissepiments are locally recognizable and are bordered by a double ring of stereoplasmic thickening.

On the only preserved side of the holotype, the dissepimentarium consists of:

- a peripheral row of flat dissepiments sometimes intersecting laterally;
- some external dissepiments inclined towards the wall and some strongly arched dissepiments with narrow symmetrical fans of trabeculae;
- numerous inner rows of inclined dissepiments.

The tabulae are vesiculate and intersecting laterally.

In specimen TcI/16, 68 septa are present. The diameter of the corallum ranges from 22,5 to 30,5 mm and the width of the tabularium varies between 12,5 and 14,5 mm.

DISCUSSION

In addition to the holotype, ROŹKOWSKA (1980, p. 26) referred, with some doubt, another corallum from the Holy Cross Mountains, to *Macgeea (Rozkowskaella) formosa*. However, according to ROŹKOWSKA (1980), this specimen may belong also to *Debnikiella* sp. In any case, the material assigned to *Macgeea (Rozkowskaella) formosa* is too fragmentary to precise the variability of the species and according to the junior author, it is impossible to collect new topotypes in Dębnik, at present.

Though the base of the coralla is not preserved, the dissepimentarium of the adult specimens of *M. (R.) formosa* is similar to that of *M. (R.) sandaliformis* in having numerous rows of inner globose dissepiments and more or less specialized ones at the locus of the horseshoe dissepiments. These features confirm the probable sub-generic affinities of these two taxa. At the specific level, the former is easily distinguished from the latter by the lack of triangular transverse section, by having fewer septa for coralla of nearly the same dimensions and by the thinning of the septa in the tabularium.

Conclusions

Macgeea (Rozkowskaella) sandaliformis, type species of *Rozkowskaella*, is now represented by six specimens, five of them coming from the type locality whereas the mate-

rial of *M. (R.) formosa*, type species of *Debnikiella* remains very fragmentary. We agree with McLEAN (1989) that *Rozkowskaella* and *Debnikiella* are likely to be synonyms, but contrary to this author, we prefer to retain the first name rather than the second one. Indeed, after revising several specimens of *Macgeea (Rozkowskaella) sandaliformis*, this species is now defined with great precision and the structure of its dissepimentarium during ontogeny is clearly understood. On the other hand, the dissepimentarium of *M. (R.) formosa* is known only on one side from the one longitudinal section of a adult specimen available at present.

We agree also with McLEAN (1989) that the calceoloid shape of *M. (R.) sandaliformis*, very important at the specific level, is not of generic or subgeneric significance; this character probably depends on ecological factors. In fact, *M. (R.) sandaliformis* is closely related to *Macgeea* in its early ontogeny, especially the dissepimentarium which consists of flat, horseshoe and a few inner dissepiments. However, the adult coralla of *Macgeea (Rozkowskaella) sandaliformis* differ from *Macgeea* by the

gradual disappearing of the horseshoe dissepiments and the development of numerous inner ones. Because of this evolution, we consider that *Macgeea (Rozkowskaella)* is a subgenus of *Macgeea*.

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Marie COEN-AUBERT
Département de Paléontologie
Section des Invertébrés fossiles
Institut royal des Sciences
naturelles de Belgique
rue Vautier 29
B-1040 Bruxelles
Belgique

Tomasz WRZOŁEK
Uniwersytet Śląski
Katedra Paleontologii i
Stratygrafii
ul. Mielczarskiego 60
PL 41-200 Sosnowiec
Pologne

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PLATE I

Macgeea (Macgeea) solitaria (HALL & WHITFIELD, 1873)

- Figs. 1, 2, 3. – Specimen R19.620 and thin section R28.994 stored in the British Museum (Natural History), London, Great Britain. Topotype figured by LANG & SMITH (1935, pl. 37, fig. 1, 2). Figs. 1, 2: transverse sections x 3; fig. 3: longitudinal section x 5.

Macgeea (Rozkowskaella) sandaliformis (ROŹKOWSKA, 1980)

- Figs. 4, 5. – IRScNB a3047. Specimen 402 J141. Transverse and longitudinal sections x 3.
Figs. 6, 7, 8. – Specimen GIUS 402 J39. Figs. 6, 7: transverse sections x 3 and x 5; fig. 8: longitudinal section x 3.
Figs. 9, 10, 11. – Specimen GIUS 365 G27. Transverse sections x 3. Fig. 9: thin section; figs. 10, 11: peels 1 and 14.

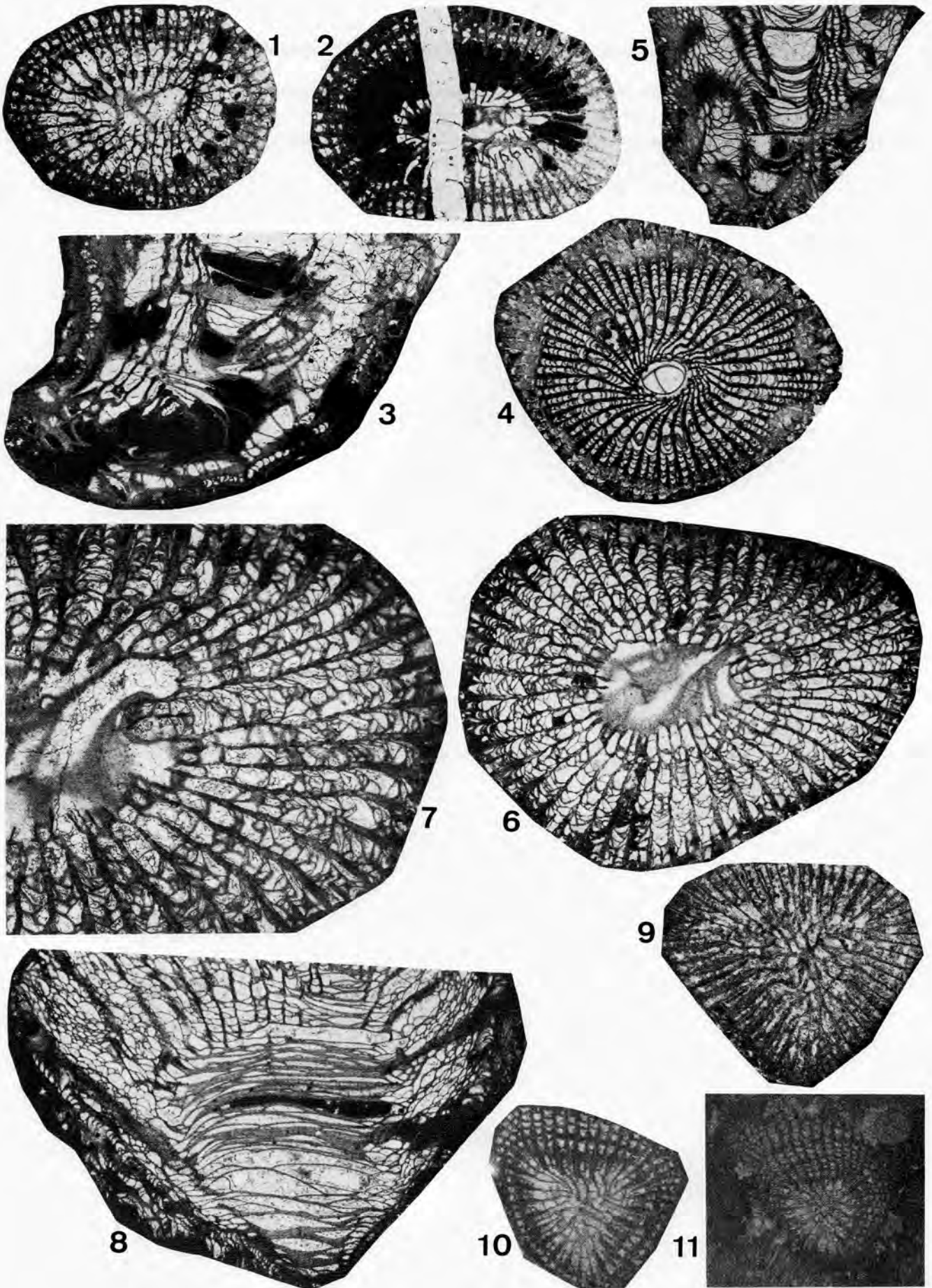
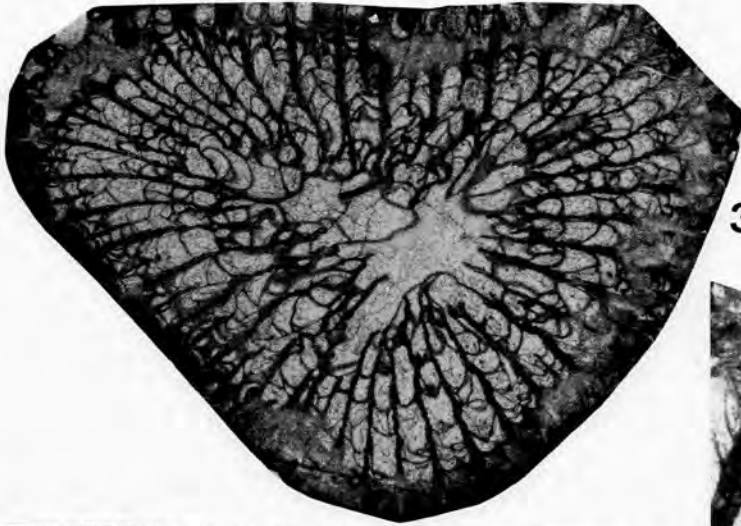


PLATE 2

Macgeea (Rozkowskaella) sandaliformis (ROŹKOWSKA, 1980)

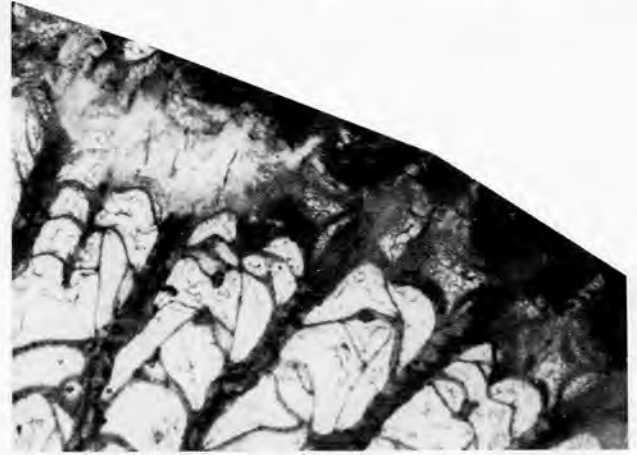
- Figs. 1, 2, 3, 4, 5, 6. – Specimen GIUS 402 J139. Figs. 1, 2: external views, natural size; figs. 3, 4: transverse sections x 3 and x 10; figs. 5, 6: longitudinal sections x 3 and x 15.
- Figs. 7, 8. – Holotype. Specimen Tc1/13 stored at the Department of Geology, MICKIEWICZ's University of Poznań, Poland. Transverse and longitudinal sections of peels x 4.
- Fig. 9. – Specimen GIUS 402 J57. External view, natural size.



3



1



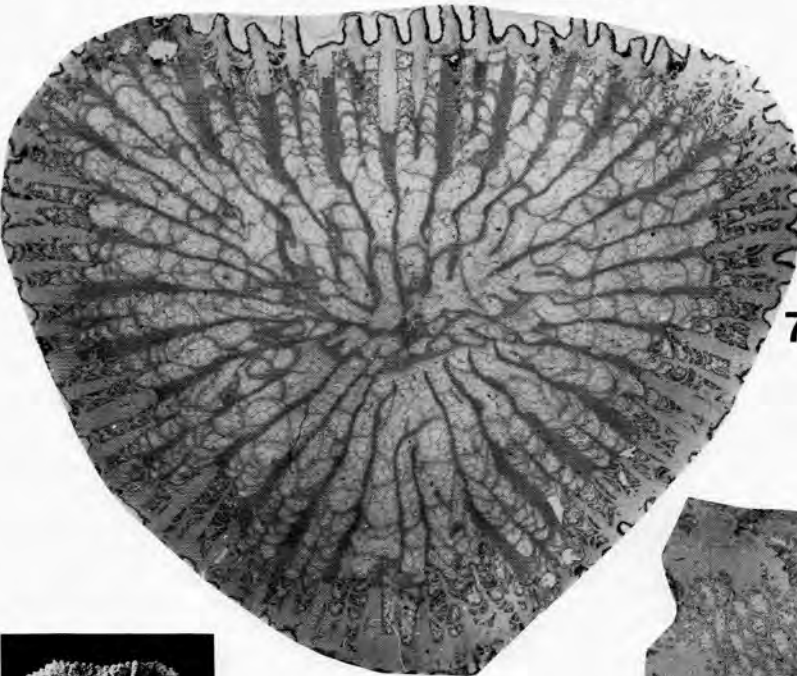
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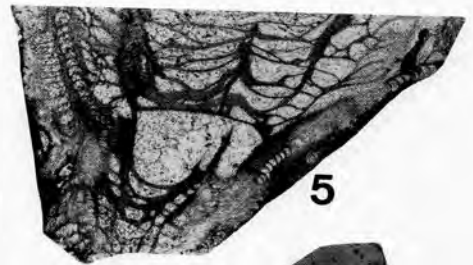
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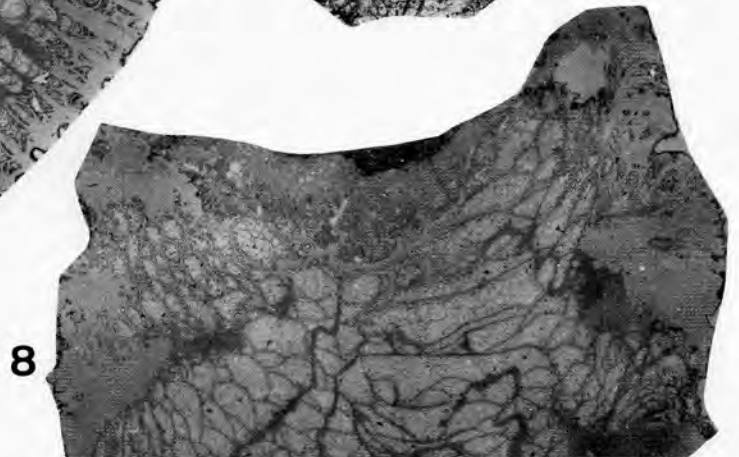
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8

