

Devonian Phillipsastroid tetracorals of the genus *Rozkowskaella* from the Holy Cross Mountains, Poland

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Abstract: Solitary or weakly colonial Phillipsastroid tetracorals of the Upper Frasnian of Holy Cross Mountains, Poland, with triangular to oval shape of transverse-section and tendency towards reduction of the horseshoe dissepiments, are included here in the genus *Rozkowskaella*, with *Rozkowskaella sandaliformis*, *R. cf. sandaliformis* and *Rozkowskaella sp.*

Key Words: *Rozkowskaella*; Phillipsastroidae; Frasnian; Devonian; Holy Cross Mountains; Poland.

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Résumé : *Tétracoralliaires dévoniens du genre Rozkowskaella (Phillipsastroidae) des Monts Sainte-Croix, Pologne.*- Des tétracoralliaires Phillipsastroidés solitaires ou à peine coloniaux du Frasnien supérieur des Monts Sainte-Croix, en Pologne, avec une forme triangulaire à ovale en section transversale et une tendance à la réduction des dissépiments en fer à cheval, sont placés ici dans le genre *Rozkowskaella*, avec *Rozkowskaella sandaliformis*, *R. cf. sandaliformis* et *Rozkowskaella sp.*

Mots-clefs : *Rozkowskaella* ; Phillipsastroidae ; Frasnien ; Dévonien ; Monts Sainte-Croix ; Pologne.

Жива, мертва ли -
но каждой божьей твари
как знак родства
дарован голос для
общения, пенья:
продления мгновенья,
минуты, дня.

Żywe czy zmarłe,
każde stworzenie marne
na znak wspólnoty
głos ma od Boga dla
brzmienia, znaczenia:
dla przedłużenia mgnienia,
minuty, dnia.

All living creatures,
among their common features,
their kinship clues,
are granted voice for, say,
conversing, singing,
rehearsing and rethinking
a wink, a day.

Иосиф БРОДСКИЙ / Бабочка

Josif BRODSKI / Motyl
tłumaczył Stanisław BARAŃCZAK

Joseph BRODSKY / Butterfly
translated by Alexander GIVENTAL

Introduction

The monotypic Devonian phillipsastroid genus *Trigonella* was introduced by RÓŻKOWSKA in 1980 for the new Frasnian species *Trigonella sandaliformis*. In 1987, WRZOLEK renamed the genus *Rozkowskaella*, due to homonymy of *Trigonella* RÓŻKOWSKA, 1980, with *Trigonella* COSTA, 1778 (a modern bivalve). In 1991, COEN-AUBERT and WRZOLEK revised the original material of RÓŻKOWSKA (1980), together with some newly collected specimens, and introduced *Macgeea* (*Rozkowskaella*) as a new subgenus, considering (after MCLEAN, 1989) the possible synonymy of the latter with *Debnikiella* RÓŻKOWSKA, 1980. The similarity of these genera, if not their identity with *Macgeea* WEBSTER, 1889, was subsequently discussed by MCLEAN (2005, p. 18). The congeneric status of *Rozkowskaella* and *Debnikiella* is rejected in the present paper, due to fragmentary nature of the type material of the latter genus and due to the inaccessibility of its type location for new sampling.

Outcrops and material

The Holy Cross Mountains in central Poland represent an area of gently folded Paleozoic deposits, elevated and exhumed during Cenozoic uplift episodes from beneath their Permo-Mesozoic cover. The Holy Cross Devonian carbonates, deposited in a subtropical shallow marine setting in Euroamerica, have been extensively studied for their fossils; some major recent contributions are listed in a table in Appendix 1.

The present author, during about 40 years of collecting of the Holy Cross Mountains rugose corals, collected, among thousands of other corals, about 20 or so specimens of solitary or rarely colonial, phillipsastroids with anomalous, triangular or oval transverse-cross sections. The first one was collected in 1976, during the course of gathering material for the author's M.Sc. Thesis, and found by Grzegorz RACKI at Góra Łgawa in Bolechowice. It was later offered to Maria RÓŻKOWSKA, who described it in 1980 as a new phillipsastroid genus. Slowly and intermittently additional material came to light

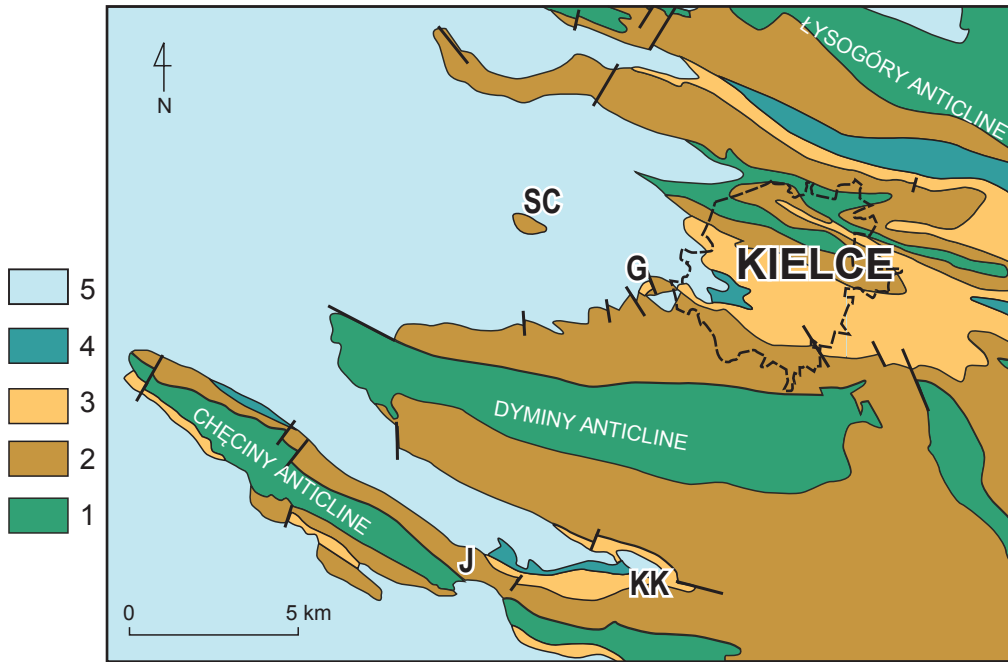
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and was published. This paper is aimed at presenting all of this material and a discussion of some taxonomic questions; included are also some fragmentary specimens, referred to *Rozkowskaella* sp.

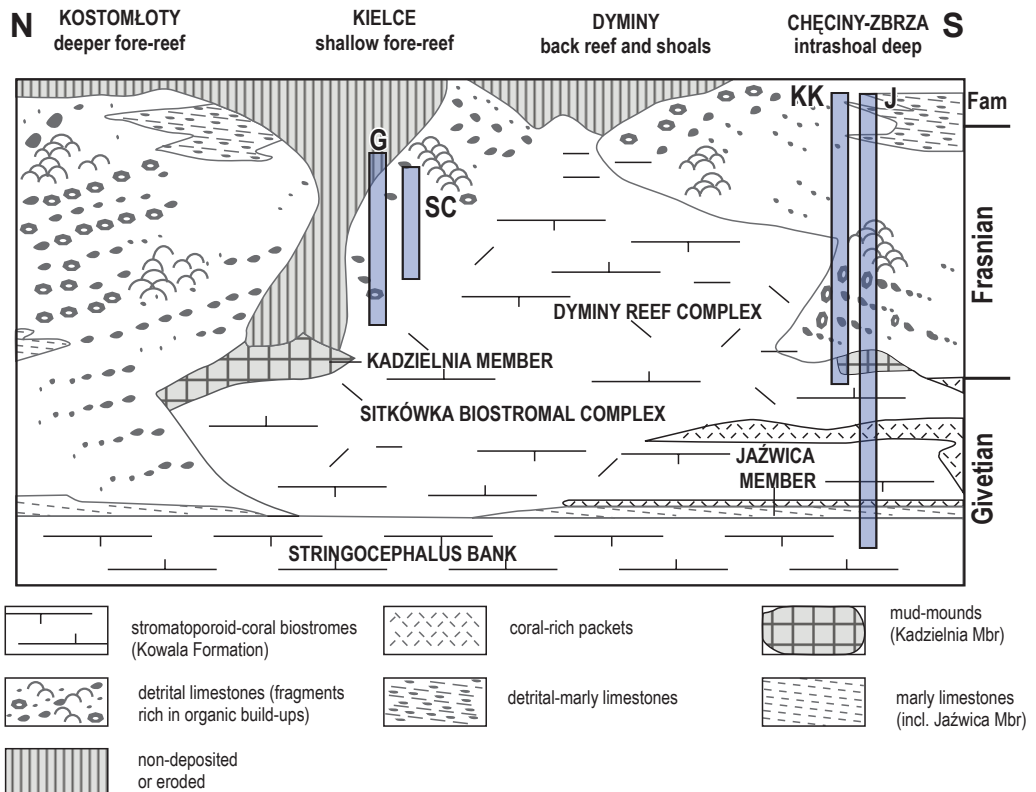
The studied specimens come from the Western - South-Western part of the Holy Cross Mountains (Fig. 1). The rugose corals can be collected here mostly from active quarries, mining the massive biogenic limestones of the Givetian to Frasnian Kowala Limestone Forma-

tion, and their detrital and marly cover deposits (Fig. 2). According to RACKI (1993a), the Holy Cross Devonian carbonate sequence represents here a series of deepening Late Frasnian pulses, at the mobile shelf of southern Euroamerica. *Rozkowskaella* corals are rare and typically form minor admixture in diverse coral associations in these outcrops - briefly presented below in Appendix 2, with lists of the rugosan species / genera.



◀ **Figure 1:** Schematic geological map of the Devonian outcrop in the western part of the Holy Cross Mountains, with marked location of the outcrops with *Rozkowskaella*, described in the present paper (after CZARNOCKI, 1938, simplified and changed): G - Grabina, J - Jaźwica quarry, KK - Kowala quarry, SC - Szczukowskie Góry: 1 - Lower Paleozoic (Cambrian to Silurian); 2 - Lower and Middle Devonian; 3 - Upper Devonian; 4 - Lower Carboniferous; 5 - post-Variscan (Zechstein to Neogene) cover.

▶ **Figure 2:** Stratigraphy of the *Rozkowskaella*-bearing Devonian limestones in the western part of the Holy Cross Mountains (after RACKI, 1993a), along the schematic North-South section; outcrop codes as in Figure 1.



Systematics

Institutional abbreviations – paleontological collections

GIUS - University of Silesia, Department of Earth Sciences, Sosnowiec, Poland;

UAM - Adam Mickiewicz University, Institute of Geology, Poznań, Poland.

Family Phillipsastreidae C.F. ROEMER, 1883

Genus *Rozkowskaella* WRZOŁEK, 1987

[type species *Trigonella sandaliformis* RÓZKOWSKA, 1980]

Diagnosis emended: solitary or colonial (dendroid, with few offsets) phillipsastreids with oval to triangular outline of corallites in transverse sections, with everted calicinal margins and with tendency to reduction of horseshoe dissepiments, particularly so in distal parts of mature corallites.

Synonymy list:

- 1980 *Trigonella* RÓZKOWSKA, p. 24, non *Trigonella* COSTA, 1778, p. 196 (a bivalve);
 ? 1980 *Debnikiella* RÓZKOWSKA, p. 25;
 1987 *Rozkowskaella* WRZOŁEK, p. 277;
 1991 *Macgeea* (*Rozkowskaella*) COEN-AUBERT & WRZOŁEK, p. 10;
 2011 *Rozkowskaella* WRZOŁEK, p. 194.

Remarks: Although *Debnikiella* RÓZKOWSKA, 1980, is a potential senior synonym to *Rozkowskaella* WRZOŁEK, 1987, the latter name is used, in apparent violation to the principle of priority. In fact *Debnikiella* is based on a single fragmentary specimen of *Debnikiella formosa*, reported by RÓZKOWSKA (1980, p. 25-26; Pl. 4, fig. 16) from the Dębik area by Cracow (Silesian-Cracow Upland, Żarnówczany Dół quarry). This location is filled and overgrown, at least since the mid-1970s, and thus unavailable for new sampling. Consequently too little is known of *Debnikiella formosa* to make any taxonomic conclusions plausible, at least at this moment. It is also notable that a single specimen from the Upper Frasnian of Wietrznia, illustrated by RÓZKOWSKA (1980, Pl. 3, fig. 12, a transverse thin section), was also attributed to *Debnikiella formosa* (contrary to her statement at page 25, that the material of the species consists on one specimen), but most probably represents the genus *Macgeea*.

As kindly noted by R. McLEAN in a review of the present paper, some material described below, especially the colony GIUS 388KK 328 (Pls. 2 - 3 - 4 - 5 - 6) is in some aspects similar to material of *Pachyphyllum* from the Frasnian of Western Canada. Indeed, some small colonies of *Pachyphyllum miniaceum* (McLEAN, 1986, Figs. 48.14-48.19, at p. 450) display individual corallites rising 1 cm or slightly more above the massive part of the colony; also

some corallites seem to be oval to subtriangular in transverse section. In contrast to that, colony GIUS 388KK 328 has a distinctly dendroid aspect, and with a markedly triangular shape of the corallites, and therefore appears taxonomically distinct from the Canadian material.

Rozkowskaella sandaliformis (RÓZKOWSKA, 1980)

(Pls. 1 - 2 - 3 - 4 - 5 - 6)

1980 *Trigonella sandaliformis* sp. n.; RÓZKOWSKA, p. 24, Fig. 4; Pl. 2: 6a-c.

ep 1991 *Macgeea* (*Rozkowskaella*) *sandaliformis* (RÓZKOWSKA, 1980); COEN-AUBERT & WRZOŁEK, p. 10, Pl. 1: 6-11, Pl. 2: 1-9; but not Pl. 1: 4, 5 - possibly a *Diffusolasma*.

ep 2011 *Rozkowskaella sandaliformis* (RÓZKOWSKA, 1980); WRZOŁEK, p. 194, Fig. 1:4A, 4B; but not Fig. 1: 1-3 - *Rozkowskaella* cf. *sandaliformis*.

Holotype: UAM Tc 1/13 (Pl. 1, figs. 1a-1b) from the Upper Frasnian of Jaźwica quarry at Góra Łgawa in Bolechowice, SW Holy Cross Mountains, Poland.

Material: seven specimens, all from the Upper Frasnian of the Holy Cross Mountains.

ID	remarks	outcrop details
UAM Tc 1/13	4 peels - holotype	Jaźwica quarry R
GIUS 402J 039	3 slides - topotype	Jaźwica quarry R
GIUS 402J 057	uncut / w offsets - topotype	Jaźwica quarry R
GIUS 402J 139	3 slides - topotype	Jaźwica quarry R
GIUS 365G 027	1 slide T - 40 peels	Grabina C
GIUS 388KK 023	2 slides - 2 peels	Kowala quarry G
GIUS 388KK 328	4 slides - 14 peels	Kowala quarry G

Diagnosis: as for the genus.

Colony growth in GIUS 388KK 328: although offsets are rather common in the material studied, this specimen is notable for the number and size of offsets; illustrated in Pl. 2, fig. 4, and in Pls. 3 - 4 - 5 - 6 is a series of acetate-peels, presenting some details of blastogeny in nine parallel sections, which are cut roughly perpendicularly to the mother corallite;

1) a single, suboval mother corallite (Pl. 2, fig. 4, to the right, seen here in its proximal part) can be seen at the base of this colony; it gives rise to a bundle of offset corallites, cut at odd angles to their axes in a series of eight parallel sections, following the first one;

2) the lower of these (peels 2p and 3p in Pl. 3, figs. 1a-1b respectively) contain the triangular mother corallite and two or three offsets seen laterally to the mother, in longitudinal and obliquely-longitudinal sections; especially nice section is of the upper-left corallite in Pl. 3, fig. 1b, with horseshoe dissepiments present in its proximal, and absent in its distal part;

3) the following peels 4Ap and 4p (Pl. 4,

figs. 1a-1b) display at right a very large lumen of mother corallite almost completely filled by basal parts of offsets, which probably originated at this level, subsequently growing to the sides and downwards of the mother, partly towards distal part of the latter, as seen in the following peels, which are

4) peels 5p and 6p (Pl. 5, figs. 1a-1b) and peels 7p and 8p (Pl. 6, figs. 1a-1b), with transverse sections of distally growing offsets, with distinctly triangular shape; some offsets give rise to their own offsets (upper-right corallite in Pls. 5 - 6, lower-center corallite in Pl. 6); in many places overflowing skeletal tissue can be seen expanding over the older corallite periphery (especially so in the lower-center corallite in Pl. 5, fig. 1b and in Pl. 6).

Remarks: the studied material, and particularly the colony presented above, sheds new light on the possible adaptive significance of triangular corallite shape in *Rozkowskaella*, which has been regarded as an adaptation to life on a soft substrate (COEN-AUBERT & WRZOŁEK, 1991). However, in these sections it is seen to be erect, with distinctly triangular corallites of the colony, thus indicating another adaptive value of this peculiar shape, which probably involved flow regulation in the gastrovascular cavities of polyps of *Rozkowskaella*.

***Rozkowskaella cf. sandaliformis*
(RÓŻKOWSKA, 1980)**

(Pl. 7)

ep 2011 *Rozkowskaella sandaliformis* (RÓŻKOWSKA, 1980); WRZOŁEK, p. 194, fig. 1: 1-3; but not fig. 1: 4 - *Rozkowskaella sandaliformis*.

Material: four specimens, all from the Upper Frasnian of the Kowala quarry in the Holy Cross Mountains.

ID	remarks
GIUS 388KK 022	2 slides
GIUS 388KK 046	2 slides - 10 peels
GIUS 388KK 281	1 slide T
GIUS 388KK 330A	4 slides

Remarks: these fragmentary specimens, with triangular or ovaly-triangular sections, suppressed distal horseshoe dissepiments and with overflowing skeletal tissue (Pl. 7, fig. 4a) most probably belong to *Rozkowskaella sandaliformis*. On the other hand, their dissepimentaria, especially so in GIUS 388KK 330A (Pl. 7, figs. 2b & 4c) suggest some similarity with the poorly known *Debnikiella formosa* RÓŻKOWSKA, 1980, from the Upper Frasnian of Dębnik, near Cracow, southern Poland (see remarks to the genus *Rozkowskaella*, above).

Rozkowskaella sp.

(Pl. 8)

Material: 9 fragmentary specimens from the mid- and Upper-Frasnian of the Holy Cross Mountains.

ID	remarks	outcrop details	level
GIUS 367SC 35A	3 peels T	Szczukowskie Gorki	mid-Frasnian
GIUS 367SC 77	1 slide T	Szczukowskie Gorki	mid-Frasnian
GIUS 388KK 028B	1 slide LT - 7 peels	Kowala quarry G	Upper Frasnian
GIUS 388KK 069	1 slide T - 4 peels T	Kowala quarry G	Upper Frasnian
GIUS 388KK 146	1 slide T - fragm	Kowala quarry G	Upper Frasnian
GIUS 388KK 242	2 slides	Kowala quarry G	Upper Frasnian
GIUS 388KK 248C	2 sections LT T	Kowala quarry G	Upper Frasnian
GIUS 388KK 316	1 slide T	Kowala quarry G	Upper Frasnian
GIUS 388KK 339B	1 slide L - budding	Kowala quarry G	Upper Frasnian

Remarks:

1) two specimens from the mid-Frasnian of Szczukowskie Górki (Pl. 8, figs. 1-2) are solitary, triangular phillipsastreids, and thus possibly close to *Rozkowskaella sandaliformis*; on the other hand this material is too fragmentary to make a firm statement possible;

2) seven specimens from the Upper Frasnian of the Kowala quarry (Pl. 8, figs. 3-9), are probable representatives of *Rozkowskaella*, but with oval rather than triangular outline to the corallites, or with merely longitudinal sections that do not display a full set of diagnostic characters for this genus.

Conclusions

1) Among the numerous rugosans of the Givetian to Frasnian limestones of the Holy Cross Mountains, Poland, there are some rare solitary to weakly colonial Phillipsastreidae with triangular outline, which are here ascribed to the genus *Rozkowskaella*.

2) Phillipsastroid corals were relatively common and diverse in the Late Frasnian of the Holy Cross subtropical shelf of Euroamerica, and *Rozkowskaella* probably evolved here from its ancestors just prior to end-Frasnian events, which terminated the phylogenetic lineages of so much of the shallow-marine benthos, and among them the Phillipsastreidae.

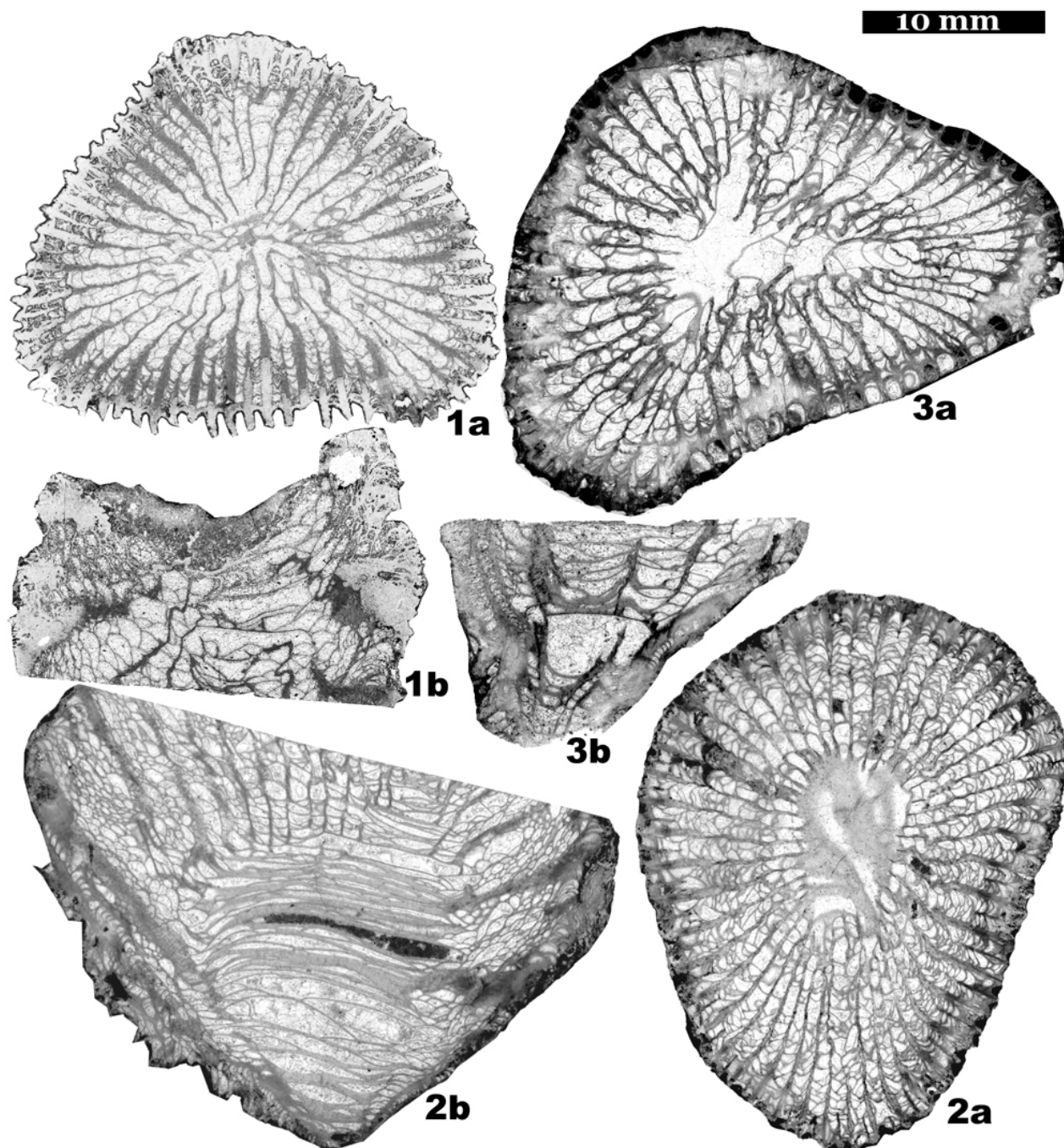


Plate 1: *Rozkowskaella sandaliformis* (RÓZKOWSKA, 1980): corallites from the Upper Frasnian set R of Jaźwica quarry in Bolechowice (topotypical material); 1- UAM Tc 1/13, peels taken from the holotype, 1a transverse, 1b longitudinal section; 2- GIUS 402J 039; 3- GIUS 402J 139, with transverse and longitudinal sections.

3) Triangular outline of corallites is a genetically fixed character in *Rozkowskaella*, probably acquired during an earlier, unknown, phylogeny of the genus, and possibly linked with separation of fluids in gastrovascular cavities of its polyps. As it happens, the presence of flat external corallite surfaces could be a pre-adaptation for some solitary polyps of *Rozkowskaella* for life on a soft bottom, as in the Late Frasnian at the site of present day Jaźwica quarry.

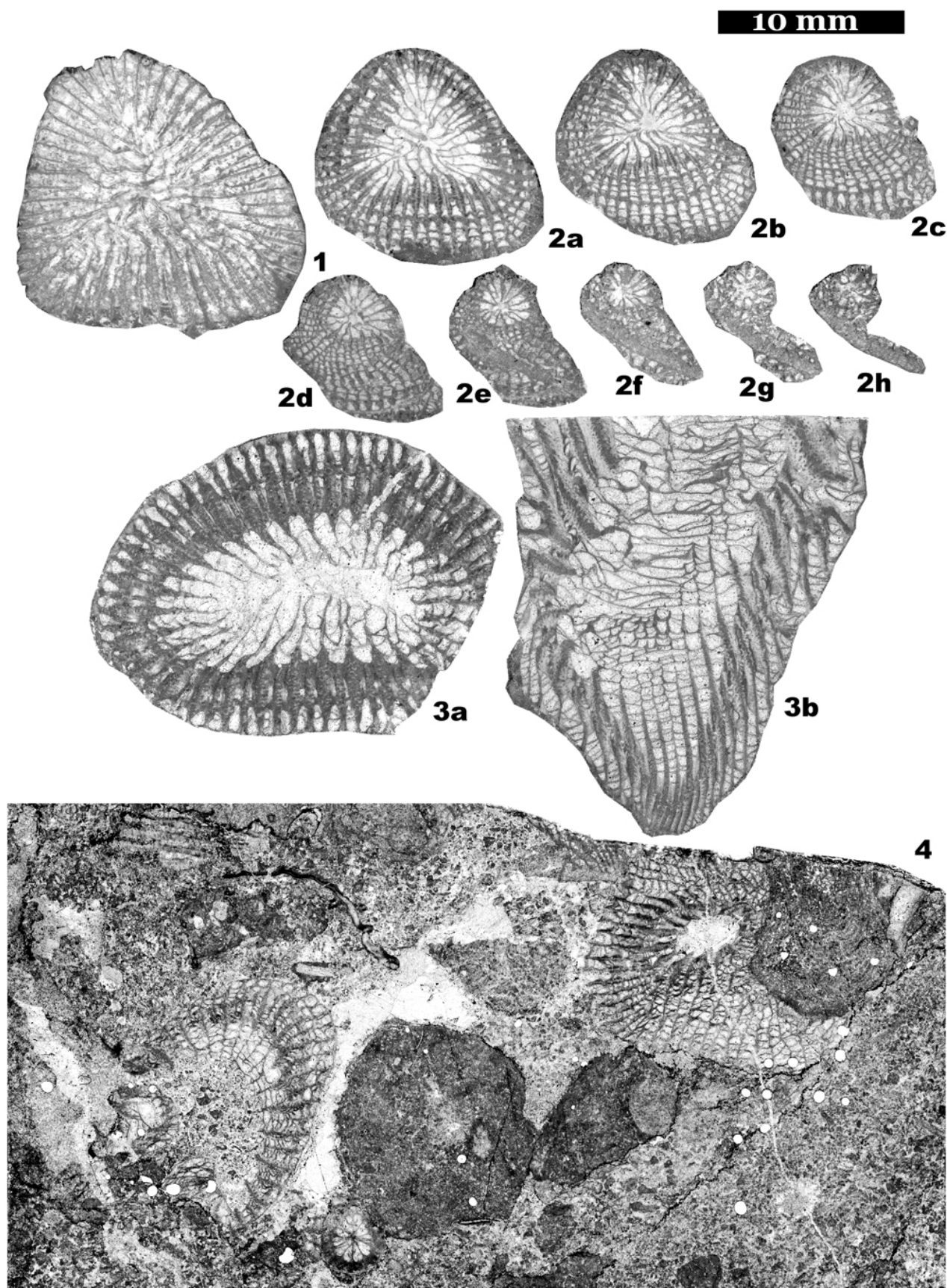
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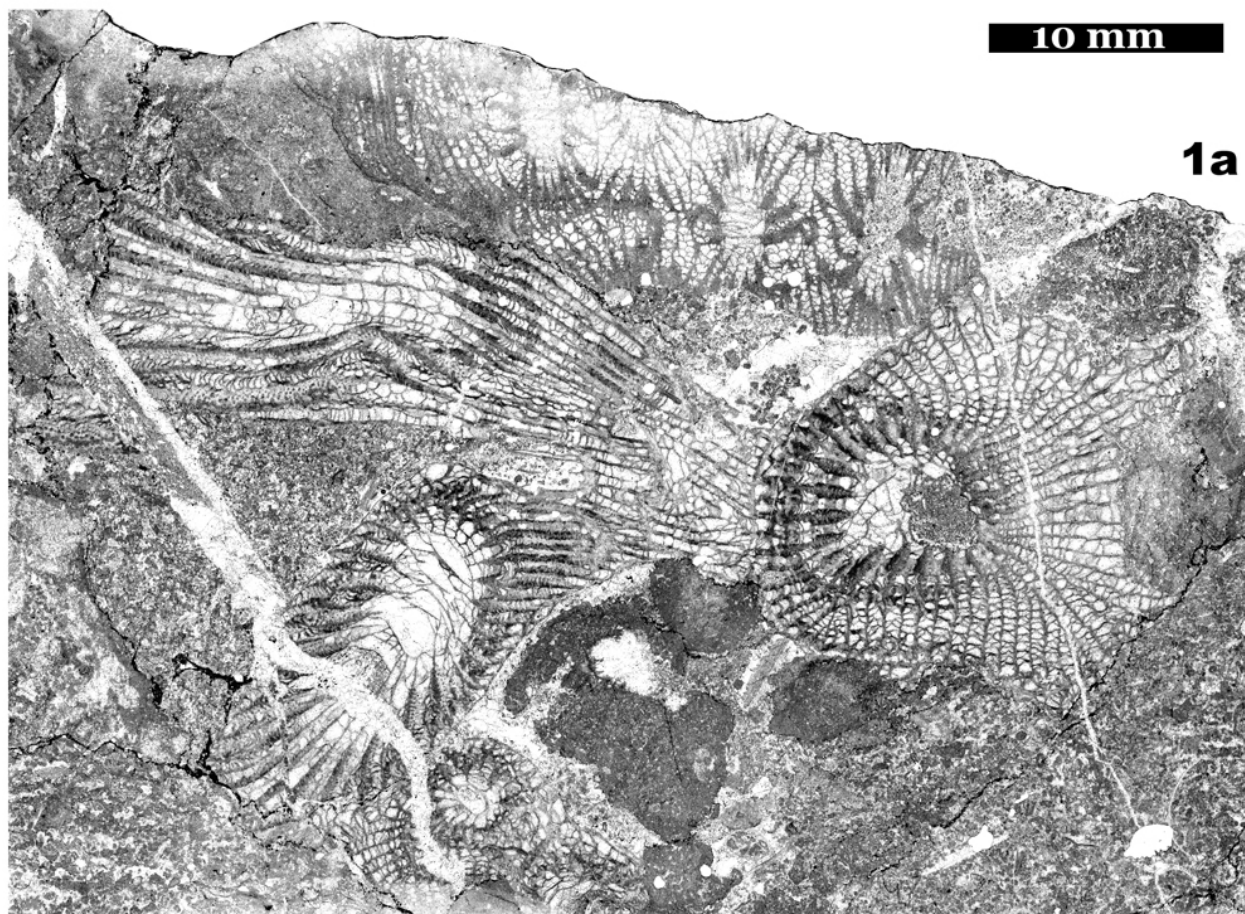
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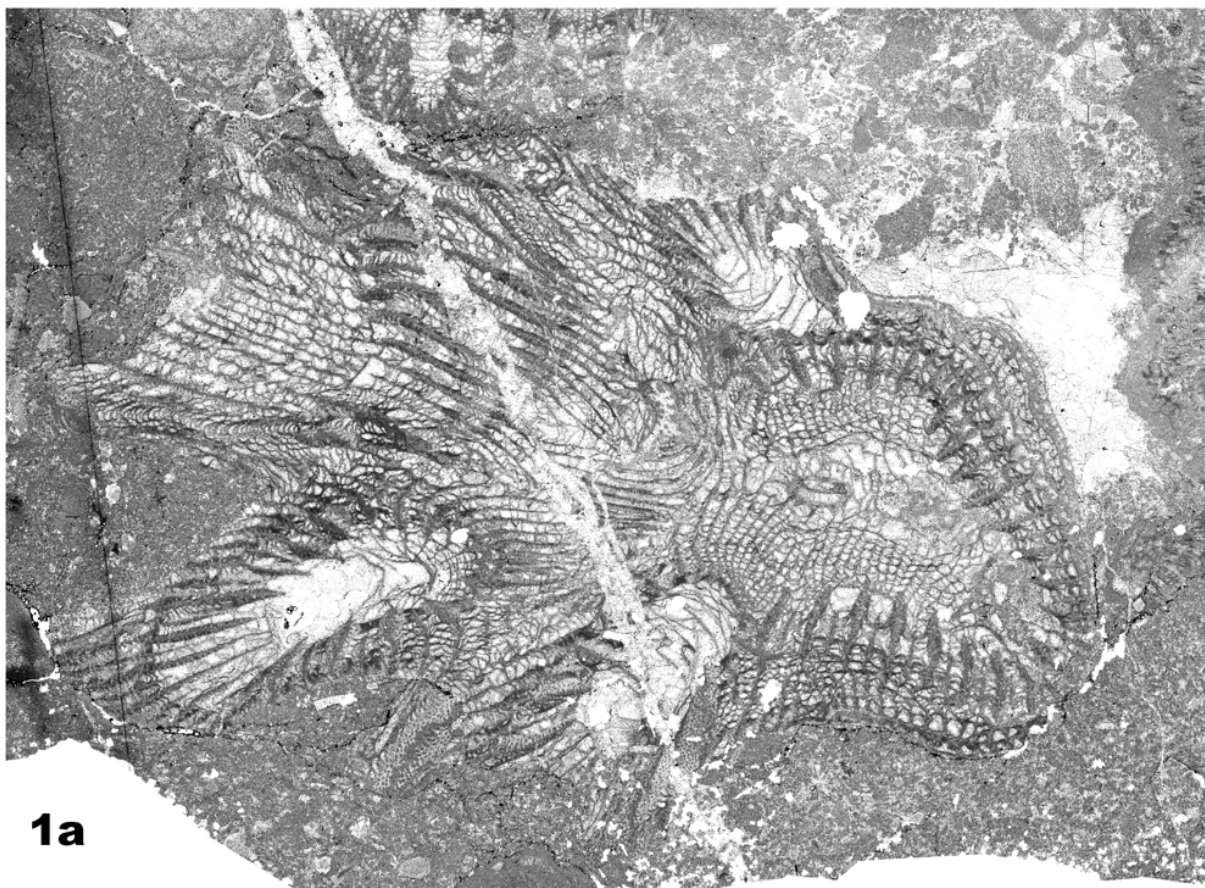


◀ **Plate 2:** *Rozkowskaella sandaliformis* (RÓŻKOWSKA, 1980) from the Upper Frasnian: 1-2- GIUS 365G 027 from Grabina quarry: 1- transverse section, slide; 2a-h- peels, taken from a series of 40, to illustrate some details of ontogeny: 2a- peel 01, 2b- peel 10, 2c- peel 16, 2d- peel 22, 2e- peel 26, 2f- peel 30, 2g- peel 34, 2h- peel 36; 3a, 3b- GIUS 388KK 023 from the Kowala quarry, two peels; 4- GIUS 388KK 328, a colony from the latter location, 1st of a series of nine peels, illustrating blastogeny; note transverse section of a metriophyllid tetracoral.

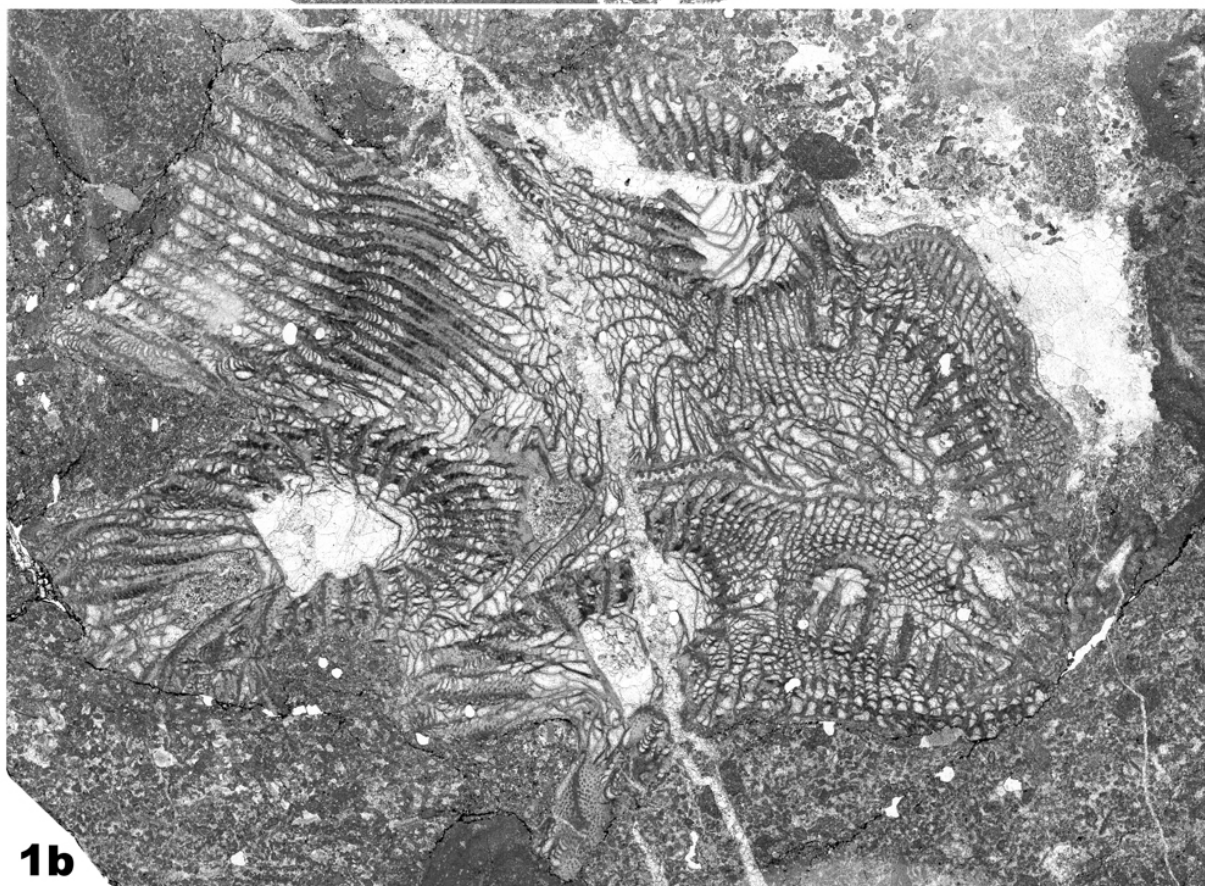


◀ **Plate 3:** *Rozkowskaella sandaliformis* (RÓŹKOWSKA, 1980) from the Upper Frasnian of the Kowala quarry, GIUS 388KK 328: 1a, 1b- peels 2p and 3p of a blastogenetic series of nine peels: lateral offsets growing at high angle to large triangular mother corallite; note longitudinal section of a massive phillipsastroid rugosan.

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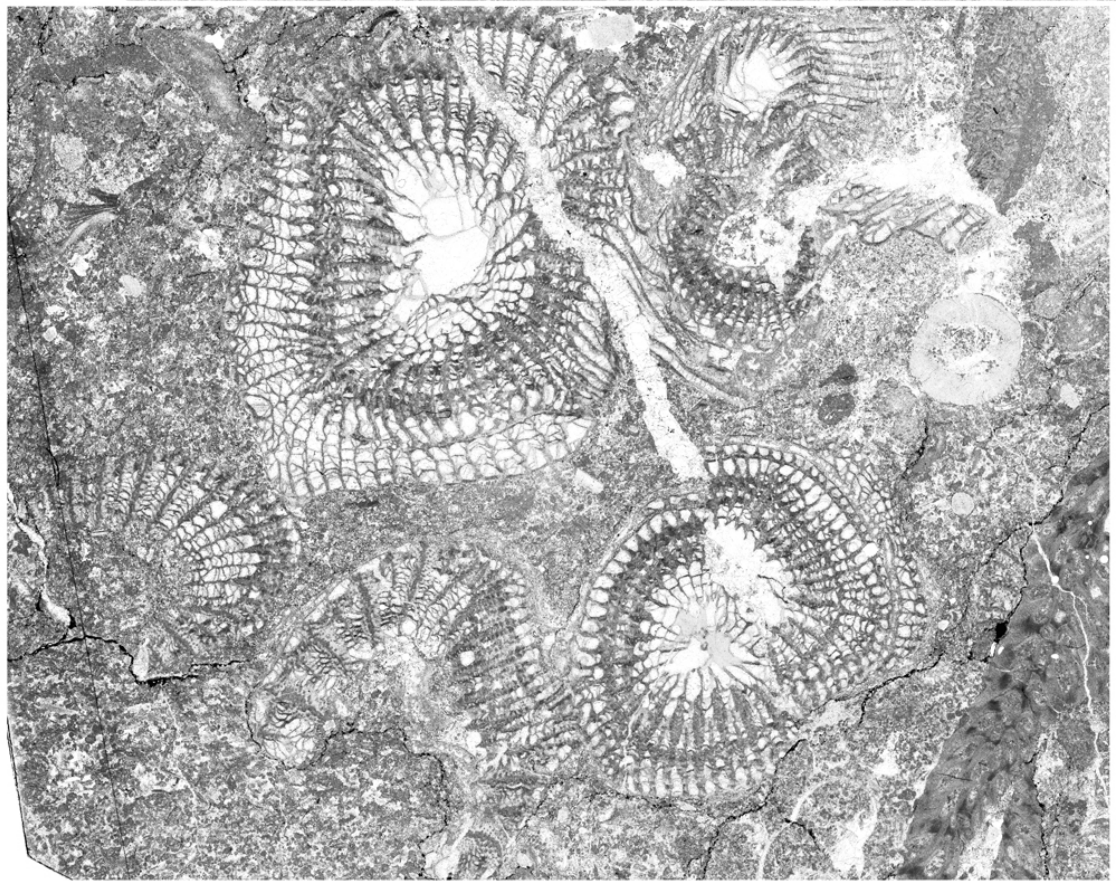
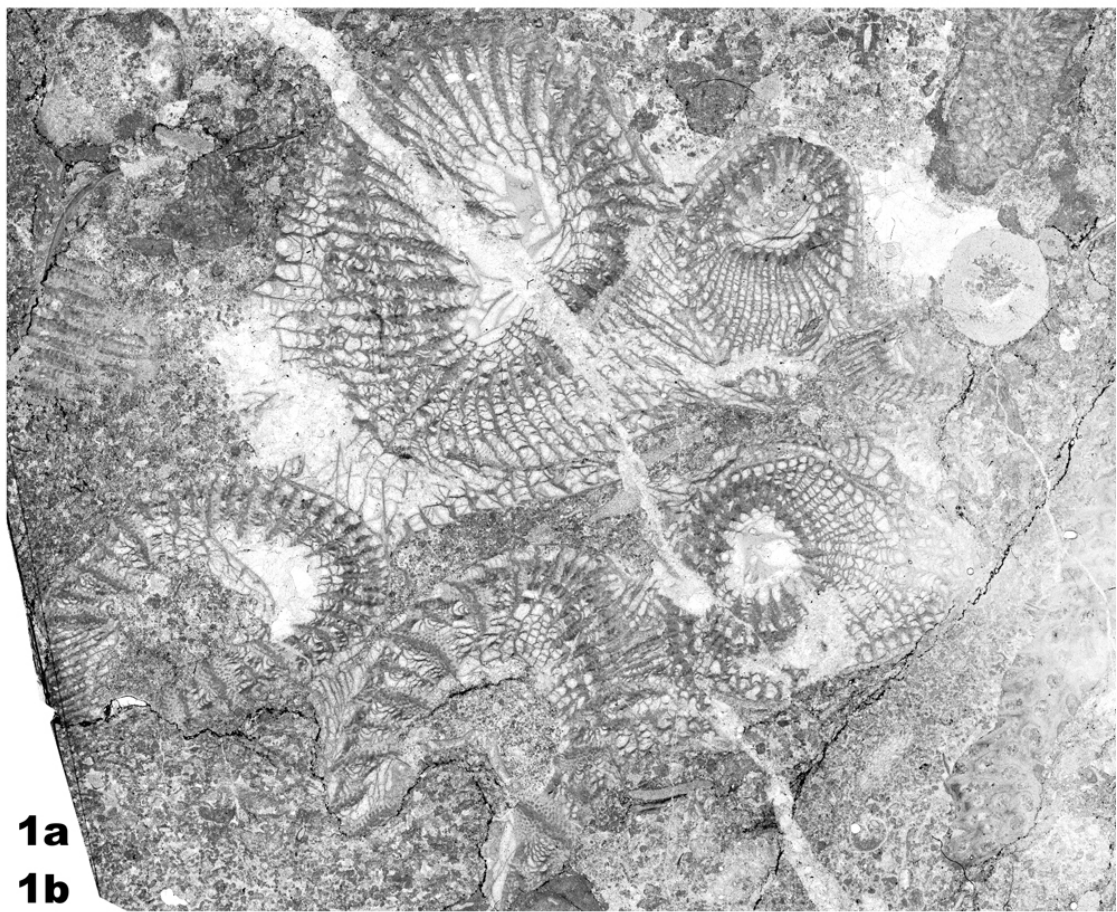
1a



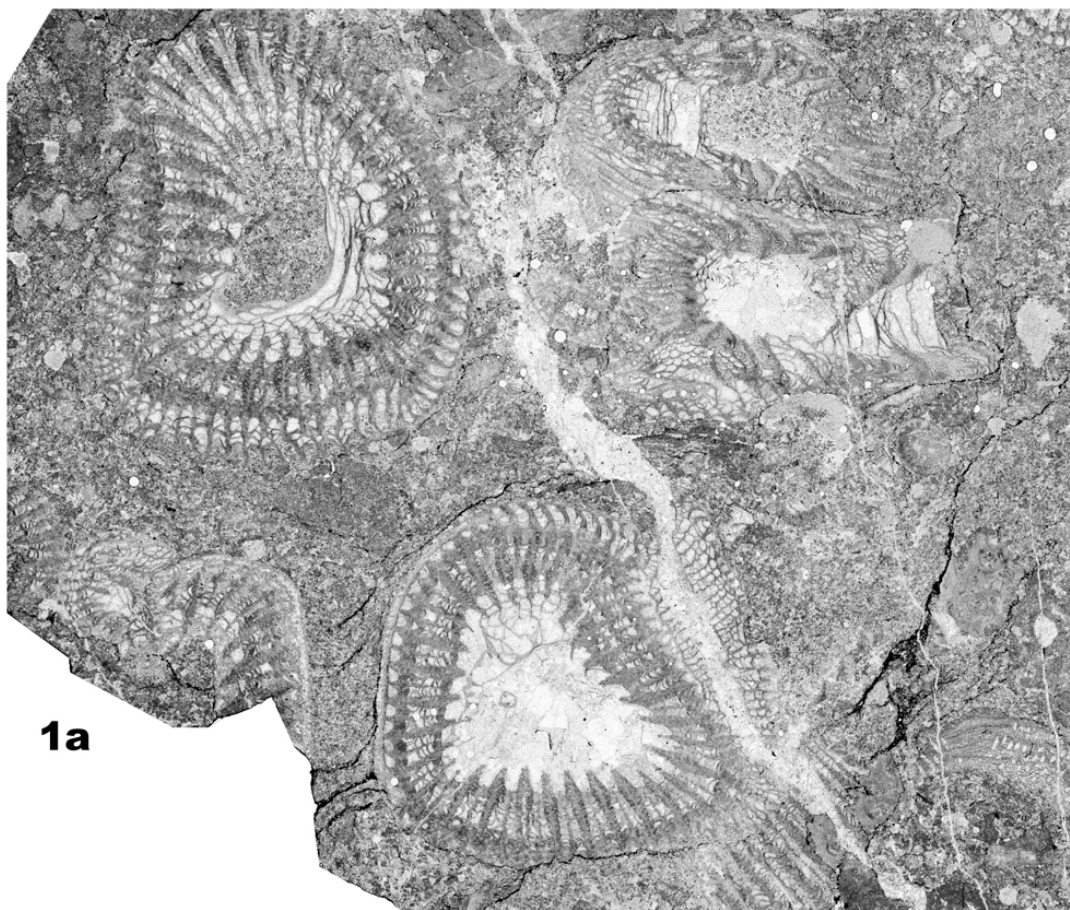
1b

◀ **Plate 4:** *Rozkowskaella sandaliformis* (RÓŹKOWSKA, 1980) from the Upper Frasnian of the Kowala quarry, GIUS 388KK 328: 1a, 1b- peels 4Ap and 4p of a blastogenetic series of nine peels: parricidal offsets arising from the large triangular mother corallite.

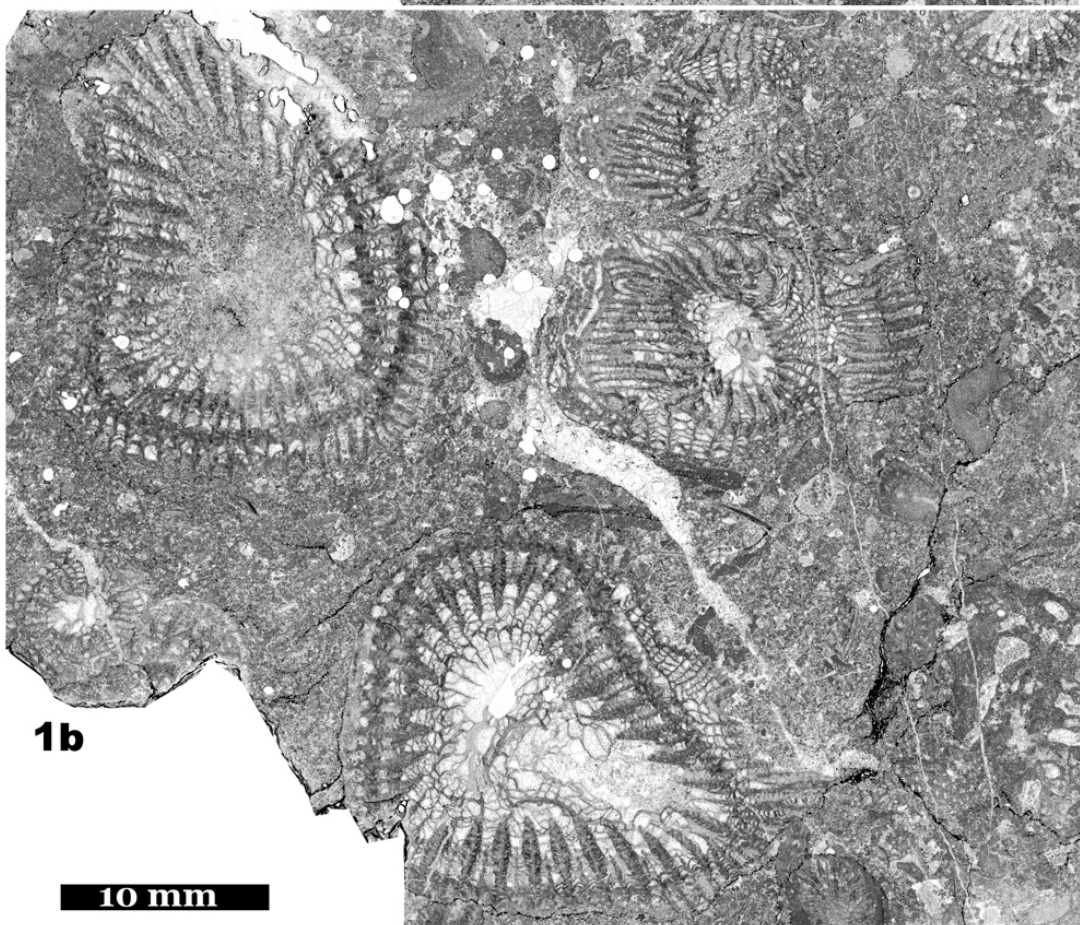
10 mm



◀ **Plate 5:** *Rozkowskaella sandaliformis* (RÓŻKOWSKA, 1980) from the Upper Frasnian of the Kowala quarry, GIUS 388KK 328: 1a, 1b- peels 5p and 6p of a blastogenetic series of nine peels: parricidal offsets increase their size and become obviously triangular in shape; in 1b the upper-right offset probably forms a longitudinal fission.



1a



1b

10 mm

◀ **Plate 6:** *Rozkowskaella sandaliformis* (RÓŹKOWSKA, 1980) from the Upper Frasnian of the Kowala quarry, GIUS 388KK 328: 1a, 1b- peels 7p and 8p, the last peels of a blastogenetic series of nine: further increase of size of the parricidal offsets; the lower one develops either rejuvenation or axial offsets.

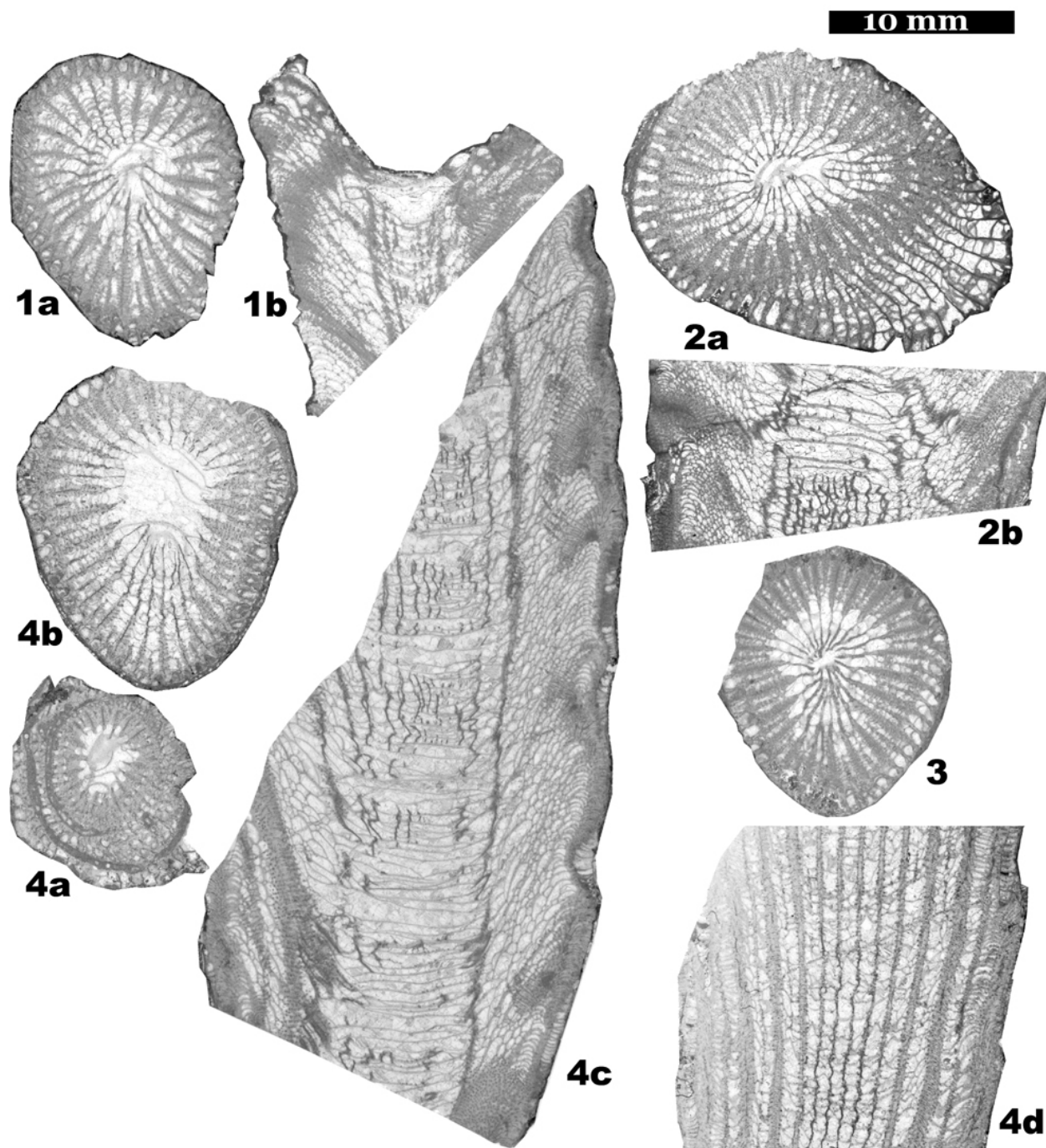


Plate 7: *Rozkowskaella* cf. *sandaliformis* (RÓZKOWSKA, 1980) from the Upper Frasnian of the Kowala quarry: 1a, 1b- GIUS 388KK 022: small rounded-triangular corallite with deeply conical calice and with weakly developed septal eversion; 2a, 2b- GIUS 388KK 046, solitary, with thickened septa and peripheral expansion; no horseshoe dissepiments in longitudinal section; 3- GIUS 388KK 281: rounded-triangular transverse section; 4a-4d- GIUS 388KK 330A, fragmentary corallite with subtriangular traverse cross-section, traces of skeletal overflow in juvenile transverse section and with relatively frequent horseshoe dissepiments, peripheral series of subhorizontal dissepiments, and depressed axial tabellae in longitudinal axial section.

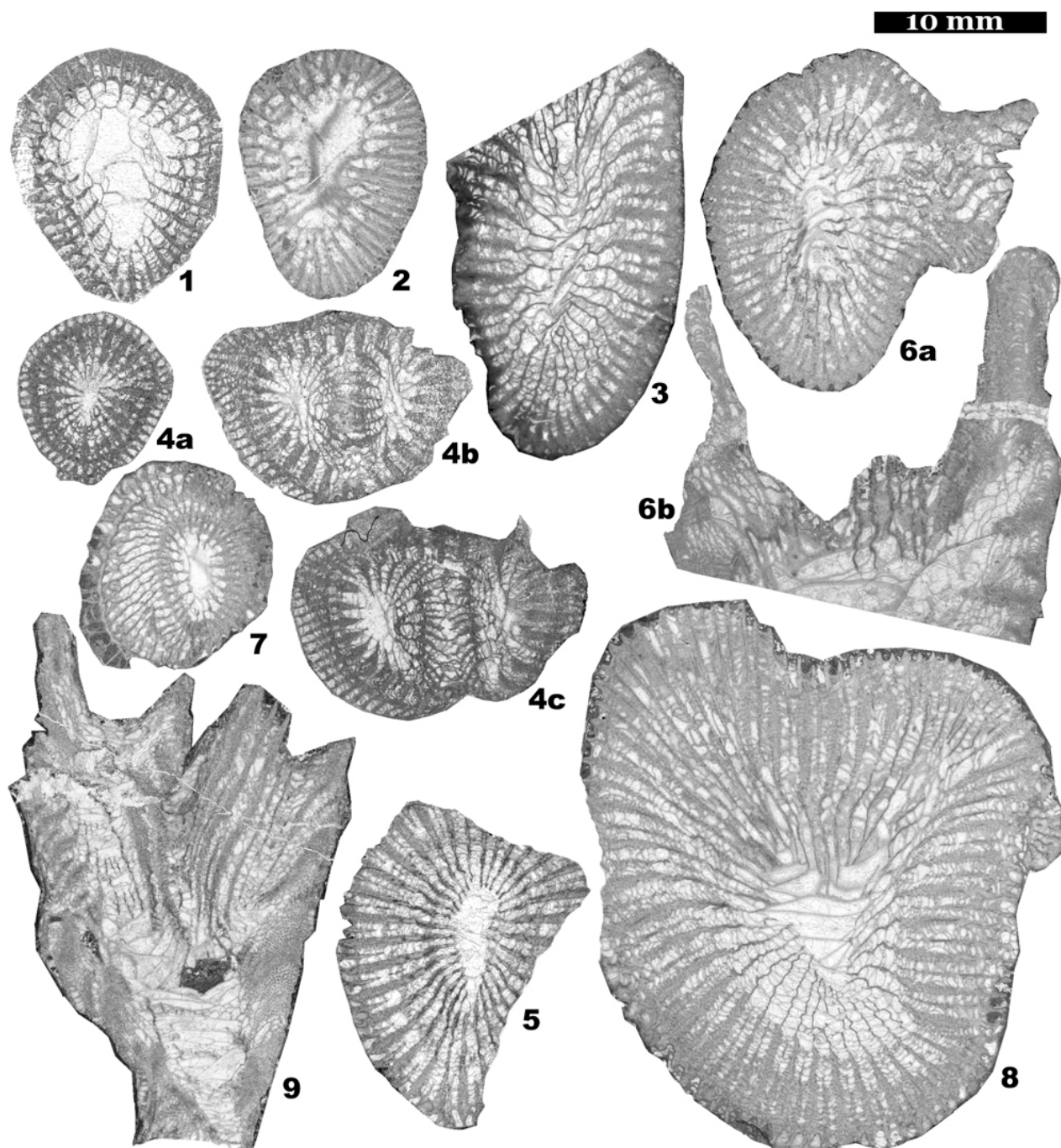


Plate 8: *Rozkowskaella* sp., fragmentary and/or dubious material: 1-2- GIUS 367SC 35A and SC 77: two corallites from the mid-Frasnian of Szczukowskie Górki quarry, with oval to triangular transverse sections - slide (SC 77) and peel (SC 35A); 3-9 - corallites from the Upper Frasnian detrital complex (set G) of the Kowala quarry: 3- GIUS 388KK 028B, oblique section of an oval (?) corallite with horseshoe dissepiments; 4a-4c- GIUS 388KK 069, three peels of rounded-triangular corallite with two axial parricidal offsets; 5- GIUS 388KK 146, fragment of an oval transverse section; 6a, 6b- GIUS 388KK 242, transverse and longitudinal calicinal section of an oval corallite with traces of a lateral offset; 7- GIUS 388KK 248C, oval small corallite with expanded peripheral part and overflowing skeletal tissue at part of its periphery; 8- GIUS 388KK 316, transverse-oblique section of a very large, subtriangular (?) corallite; 9- GIUS 388KK 339B, longitudinal section of a corallite with talon at its base and two axial parricidal offsets visible in its distal part.

Appendix 1

Devonian fossil groups described from outcrops listed in the present study of *Rozkowskaella*, western Holy Cross Mountains, Poland.

fossil groups	references	Grabina	Jaźwica quarry	Kowala	Szczukowskie G.
forams and problematica	RACKI & SOBOŃ-PODGÓRSKA, 1993		•		•
Stromatoporoidea	KAŹMIERCZAK, 1971	•	•	•	•
Tabulata	NOWIŃSKI, 1993	•	•	•	•
	ZAPALSKI, 2012	•	•	•	•
Rugosa	RÓŹKOWSKA, 1980		•	•	
	WRZOŁEK, 1993		•	•	
	WRZOŁEK & WACH, 1993	•			•
Brachiopoda	RACKI, 1993b		•	•	
	RACKI & SOBOŃ-PODGÓRSKA, 1993	•	•	•	•
Ostracoda	MALEC & RACKI, 1993		•	•	•
Trilobita	CHLUPAČ, 1993	•	•		•
Gastropoda	KRAWCZYŃSKI, 2002	•	•	•	•
Tentaculita	HAJŁASZ, 1993		•	•	
Crinoidea	GŁUCHOWSKI, 1993	•	•	•	•
Pisces	LISZKOWSKI & RACKI, 1993		•	•	

Appendix 2

The Holy Cross locations, which yielded *Rozkowskaella* and *Rozkowskaella*-like corals, with lists of their described tetracoral species, and lists of undescribed genera; numbers in square brackets refer to number of identified specimens.

Grabina: (Fig. 1 : G) hill with abandoned quarry, about 1 km to the west of Karczówka Hill in Kielce; Devonian strata dip gently to the north and form part of the southern limb of the Kielce syncline here:

1) thickly-bedded stromatoporoid mid-Frasnian (?) biogenic limestones of the Kowala Fm, of lagoonal origin, form a major part of the Devonian sequence here, with scarce rugose corals [~10], among them there are *Disphyllum* sp. [2], *Hexagonaria* sp. [1], *Macgeea* or *Thamnophyllum* sp. [8];

2) they are overlain by massive biogenic limestones of the Kowala Fm, locally with rock-forming *Renalcis* and stromatoporoids, forming an organic buildup at this site; the rugose corals are rare [~20] also in this interval and contain disphyllids *S. aiense liujingense* [3 - WRZOŁEK & WACH, 1993] and *Marisastrum* sp. [1] and endophyllids *Tabulophyllum* sp. [8];

3) at the top of the sequence, there are to be seen a few meters of detrital-biogenic limestones, with an abundant and diverse benthic fauna indicating a fore-reef, open-

marine setting; rugose corals, with common Upper Frasnian taxa, are extremely numerous here [~200]; so far *Rozkowskaella sandaliformis* [1] has been illustrated by COEN-AUBERT and WRZOŁEK (1991), and *Smithicyathus lacunosus* / cf. *lacunosus* [9] by WRZOŁEK (2007); along with other common rugosans, there are endophyllids *Hankaxis* sp. [24] and *Tabulophyllum* sp. [11], phillipsastreids *Baculophyllum* [>20], various species of *Frechastraea* [50], *Phillipsastrea* [62] and a *Scruttonia* sp. [1];

4) pelitic to finely-detrital limestones have been collected locally in the central part of Grabina quarry, possibly from infilling of a neptunian dyke at this site; the age of its infilling must be, at least partly, Famennian, as indicated by the presence of a heterocoral *Oligophylloides pachythecus* in one sample.

Jaźwica quarry: (Fig. 1 : J) large active quarry at Łgawa Hill in Bolechowice, exploiting Devonian dolomites and limestones; an important reference section for the southern facies belt of the Holy Cross Devonian (RACKI, 1993a); some rugose corals were described or listed by RÓŹKOWSKA (1980), WRZOŁEK (1982, 1993 - mostly from the Kowala Fm) and COEN-AUBERT and WRZOŁEK (1991); notable, there are also abundant siliceous sponges (RIGBY *et al.*, 2001) in the marly Upper Frasnian - point 5 below:

1) marly limestones of the Jaźwica Member / Kowala Formation, Upper Givetian in age, a few

meters thick, represent an intra-shoal deep setting; their rugosans have been described by WRZOLEK (1993): *Temnophyllum occidentale* [13], *T. menyouenese* [2], *Temnophyllum zamkowae* [2] and *Temnophyllum* sp. [4];

2) the successive unit, consisting of biogenic stromatoporoid-coral limestones of the Kowala Fm, is a hundred or so meters thick, and originated in a shallow lagoon; the rugose corals are here usually dispersed, with notable exception for the *Hexagonaria davidsoni* biostrome at its base, and some *Disphyllum* banks in the lower part of the interval; its disphyllid rugose corals have been listed and/or illustrated by WRZOLEK (1993): *Disphyllum cylindricum* [4], *Disphyllum wirbelauense* [8], *Disphyllum* sp. [3], *Hexagonaria davidsoni* [37], *Temnophyllum* cf. *latum* [1], *T. occidentale* [1] and *Temnophyllum* sp [1];

3) massive to biohermal limestones of the Kadzielnia Member / Kowala Formation, representing a mud-mound, with a major contribution of stromatoporoids and corals, with disphyllids and a phillipsastreid listed and/or illustrated by WRZOLEK (1993): *Disphyllum cylindricum* [2], *D. wirbelauense* [1], *Disphyllum* sp. [7], *Hexagonaria kowalae* [7], *Temnophyllum* cf. [1] and *Macgeea* sp. [2];

4) detrital limestones of the mid-Frasnian, cap the Kowala Fm in the central, poorly accessible part of the Jaźwica quarry and yielded about 10 coralla of *Disphyllum* sp. [1], *Macgeea* spp. [5] and *Phillipsastrea* spp. [4];

5) marly limestones, Upper Frasnian in age, yielded in the years 1970-1980 an abundant silicified benthic fauna, naturally weathered out at the top of the Łgawa Hill; since that time however, the site has been used as a waste-dump for the Jaźwica quarry, and thus it was inaccessible for study; the illustrated corals are *Aristophyllum irenae*, *Piceaphyllum pronini*, *Tabulophyllum simile* by RÓŻKOWSKA (1980), *Diffusolasma diffusum* by WRZOLEK (1982, 1993) and *Rozkowskaella sandaliformis* by COEN-AUBERT and WRZOLEK (1991); among hundreds of other rugosans few were sectioned and include a single corallite of the endophyllid *Hankaxis* sp. and a few colonial phillipsastreids with *Frechastraea* spp. [7] and *Phillipsastrea* spp. [10].

Kowala quarry: (Fig. 1 : KK) a large active and still expanding quarry (as in 2014), directly to the south of Kowala village, exploiting the Givetian to Famennian carbonates for the cement factory at Nowiny; Devonian strata form part of the southern limb of Gałęzice-Bolechowice syncline here, and dip ca 30° to the north:

1) biogenic limestones of the Kowala Formation, including the biohermal Kadzielnia Member, are the major interval exploited in this

quarry, and are thus poorly accessible; they contain abundant shallow-marine to lagoonal fossils, possibly of the Lower Frasnian, with stromatoporoids dominating; among the rugose corals there are *Disphyllum kweihsiense* [2], listed by WRZOLEK (1993, p. 231), *Hexagonaria kowalae* [44], described by the latter (with numerous colonies from subsequent sampling), and *Thamnophyllum* sp. [2];

2) detrital limestones cap the biogenic Kowala Formation, their mid-Frasnian part contains *Spinophyllum* sp. [1], *Temnophyllum* sp. [1], and *Phillipsastrea* sp. [2];

3) upper part of the detrital limestones (Kowala set G of RACKI, 1993a) contains abundant and diverse Upper Frasnian benthic fossils, indicating an open-marine, fore-reef setting; among almost 400 sectioned corals of this interval described were so far *Smithicyathus lacunosus* [16], and *S.* cf. *lubliniensis* [1] WRZOLEK (2007); the other corals include endophyllids *Hankaxis* spp. [11], *Tabulophyllum* spp. [~80], and *Tarphyphyllum* spp. [~30], phillipsastreids *Frechastraea* spp. [~60], *Macgeea* spp. [11], *Phillipsastrea* spp. [~130], and cf. *Thamnophyllum* [1];

4) the deeper-offshore, marly sedimentation started in the Upper(most) Frasnian and continued well into Famennian; these marls and shales, with a total thickness of about 150m, contain in their lowermost part (few meters thick) the siliceous sponges (RIGBY *et al.*, 2001), and the rugose corals of the Upper Frasnian with disphyllid *Diffusolasma* sp. [2], and endophyllid *Tabulophyllum* sp. [2];

5) a major part of the marly-shaly sequence of the Kowala quarry is Famennian to Tournaisian in age, and contains two (or possibly three) horizons with corals (see BERKOWSKI, 2002, p. 46); about 50 specimens collected here by the present author, are in the course of investigation by Błażej BERKOWSKI; to note is presence of a heterocoral *Oligophylloides* sp. [1] in the mid-Famennian part of this interval.

Szczukowskie Górki: (Fig. 1 : SC) an active quarry in Szczukowskie Górki village, about 1 km to the west of Grabina; biogenic limestones of the Kowala Formation contain mid-Frasnian rugose corals, with *Spinophyllum aiense liujingense* illustrated by WRZOLEK and WACH (1993), and with disphyllids cf. *Hexagonaria* [9], *Kuangxiastraea* sp. [6], endophyllids *Tabulophyllum* spp. [7], and phillipsastreids: *Rozkowskaella* sp. [2], *Macgeea* sp. [4], cf. *Peneckiella* [1], cf. *Phillipsastrea* [6], and *Thamnophyllum* sp. [4].