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Rugose coral *Cyathophyllum diffusum* sp. n. from the Frasnian deposits of the Holy Cross Mts

ABSTRACT: The rugose coral *Cyathophyllum diffusum* sp. n. from the Upper Frasnian marly limestones of the Holy Cross Mts, Central Poland, is described. The new species has got dispersed trabeculae in the peripheral parts of septa. Distally convex blisters, *i.e.* the intraseptal dissepiments, connect the dispersed trabeculae of a septum. Another type of intraseptal dissepiments is demonstrated in the species *Iowaphyllum mutabile* Tsien, 1977, from the Frasnian limestones of the same region; in this species intraseptal dissepiments disrupt continuity of trabeculae and are the particular type of lonsdaleoid dissepiments.

INTRODUCTION

The rugose coral *Cyathophyllum diffusum* sp. n. is the first described Frasnian species of the genus *Cyathophyllum* Goldfuss, 1826 (*sensu* Birenheide 1963). Preliminary reports on this species were given by the present author in 1976 (M. Sc. thesis; Institute of Geology, University of Warsaw) and in 1978 at the *III*rd Conference of the Polish Paleontologists. All the researches of the Author were scientifically supervised by Professor J. Fedorowski, University of Poznań.

The described collection is stored at the Silesian University at Sosnowiec, Earth Sciences Department. Specimens *J01* — *J18* and *KK1* are the property of the Warsaw University and are only temporarily stored at Sosnowiec. All the other specimens belong to the Silesian University.

Acknowledgements. The Author feels greatly indebted and wishes to express his thanks to many persons for help in long research on the new species. G. Racki, M. Sc., M. Racka, M. Sc. and Professor A. Radwański kindly collected and offered to the Author part of the herein described specimens. Dr R. Birenheide and the Senckenberg Forschungs-Institut in Frankfurt a. M. offered the specimen of *C. spongiosum* for comparative studies. Professor M. Różkowska discussed various substantial aspects of this study. G. Racki, M. Sc. gave the stratigraphical data for the Jaźwica and Wola quarries. Messrs A. Pietura and S. Ulatowski have kindly taken some photos (Pl. 5, Fig. 1a-g; and Pl. 1, Fig. 4; Pl. 6, Figs 1—3 respectively); I. Głuchowska, M. Sc. kindly prepared the drawing (Text-fig. 1).

GENERAL CHARACTERISTICS OF THE MATERIAL

The specimens of *Cyathophyllum diffusum* sp. n. are part of a larger collection of corals and other fossils from the Upper Frasnian marly nodular limestones of the Jaźwica Quarry (complex H_2 of Racki & Zapaśnik 1979), near Bolechowice village, Holy Cross Mts, Central Poland (*see* Text-fig. 1). All the collected coralla are strongly silicified peripherally, to some extent also internally, what results in a general lack of epithecae and obscuring of microstructure. No traces of marked predepositional destruction were discovered.

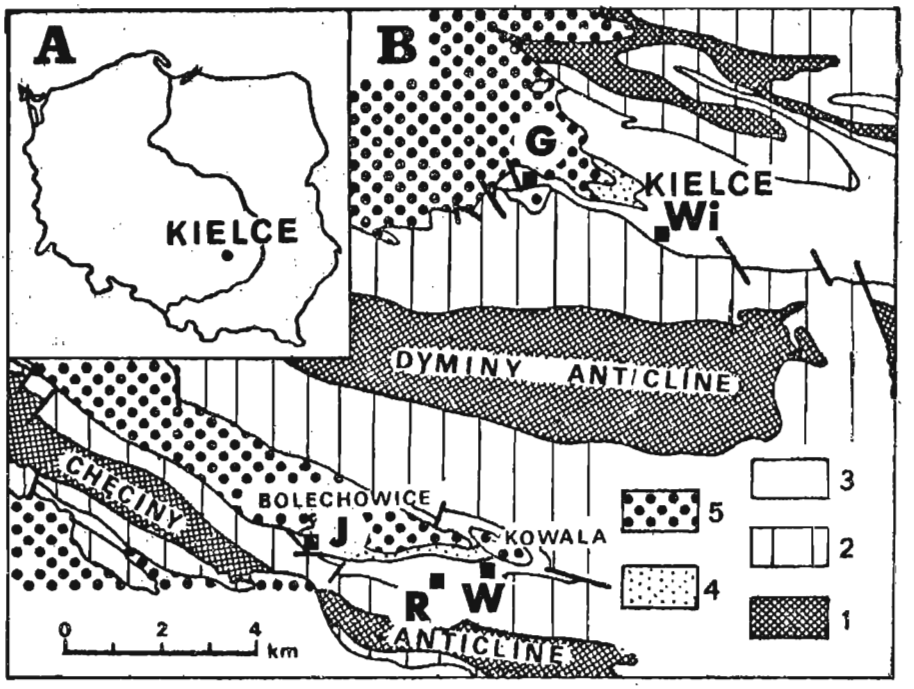

Fig. 1. Location of the outcrops discussed in text, in Poland (**A**), and in the western part of the Holy Cross Mts (**B**); *after* Szulczewski (1971), simplified. *1* Cambrian, Ordovician and Silurian; *2* Lower and Middle Devonian; *3* Upper Devonian; *4* Lower Carboniferous; *5* post-Variscan cover

J — Jaźwica Quarry; **W** — Wola Quarry; **G** — Grabina Quarry; **Wi** — Wietrznia Quarry; **R** — road cut at Kowala

In the Jaźwica Quarry, the newly described species *Cyathophyllum diffusum* sp. n. is accompanied by *Phillipsastrea ananas* (Goldfuss), *Trigonella sandaliformis* Różkowska, *Frechastraea goldfussi* (M.-Edw. & H.), *F. pentagona* (Goldfuss), *Aristophyllum irenae* Różkowska, *Piceaphyllum pronini* (Soshkina), and *Fedorowskicyathus similis* Różkowska. The other fossil groups are represented by radiolarians, siliceous sponges (*cf.* Rigby, Racki & Wrzołek 1981), tabulate corals, numerous brachiopods (rhynchonellids, atrypids, spiriferids), gastropods, bivalves, sty-

liolinids, nautiloids, goniatites, crinoid columnals, fish fragments, and ?receptaculitids.

All the collections was gathered from loose blocks and its stratigraphical position was established on the basis of conodonts obtained from the rock matrix of some specimens (the holotype including). The details on the Jaźwica section and its stratigraphy are given elsewhere (Racki & Zapaśnik 1979; Rigby, Racki & Wrzołek 1981).

The specimen *KK*1 comes from the Upper Frasnian marls and marly shales of the Wola Quarry near Kowala village (*see* Text-fig. 1). The details on stratigraphy of this section were kindly supplied by G. Racki, M. Sc.

The specimen of *Cyathophyllum spongiosum* (Schulz, 1883) comes from the Eifelian Ahrdorf-Schichten of the Hillesheimer Mulde, Rhenish Slate Mts (locality Niederehe), as indicated by the original label of Dr Birenheide.

The illustrated specimens of *Iowaphyllum mutabile* Tsien, 1977, were collected by the Author from the organogenic and organodetrital limestones occurring in the topmost part (about 4 m) of the Grabina Quarry section (*see* Text-fig. 1). No stratigraphicaly important conodonts were obtained from this part of the Grabina section, but according to the preliminary studies, *I. mutabile* is accompanied by *Frechastraea pentagona* (Goldfuss) and *Pterorrhiza ultima* (Walther), which suggest the Late Frasnian age of these deposits (*Fr*2 of Tsien 1977).

A NEW TERM: INTRASEPTAL DISSEPIMENTS

The new term is here proposed for the distally convex blisters forming part of a septum in rugose corals. The intraseptal dissepiments should be differentiated from the interseptal and most of the lonsdaleoid ones. Two different kinds of intraseptal dissepiments are demonstrated in this paper. In *Cyathophyllum diffusum* sp. n. they were formed later than the trabeculae, and in the longitudinal sections (*see* Pl. 2, Figs 1b, 2; Pl. 4, Fig. 1b–c) the trabeculae are uninterrupted by the blisters. In *Iowaphyllum mutabile* Tsien, 1977, intraseptal dissepiments disrupt the continuity of trabeculae (Pl. 6, Fig. 4). The latter can be seen as granules on the distal surfaces of the blisters (in places of the slow corallite growth, the blisters disappear and trabeculae become continuous). These dissepiments are restricted to a single septum, whereas the typical lonsdaleoid dissepimentum can be traced in several septal and interseptal sectors (as *in* Hill 1956, p. *F*243).

SYSTEMATIC DESCRIPTION

Family **Cyathophyllidae** Dana, 1846

Genus *CYATHOPHYLLUM* Goldfuss, 1826 (*sensu* Birenheide, 1963)

Type species: *Cyathophyllum dianthus* Goldfuss, 1826

Cyathophyllum diffusum sp. n.

(Pl. 1, Figs 1—5; Pl. 2, Figs 1—2; Pl. 3, Figs 1—4; Pl. 4; Pl. 5, Fig. 1; Pl. 6, Figs 1—3)

Holotype: The specimen *J06*, presented in Pl. 1, Fig. 4; Pl. 2, Fig. 1a, b; Pl. 4, Fig. 1b.

Type locality: Jaźwica Quarry, south of Bolechowice village, southern limb of the Gałęzice syncline in the Holy Cross Mts.

Type horizon: Upper Frasnian — *gigas* Zone.

Derivation of the name: Latin *diffusum* — scattered; after diffused trabeculae of the peripheral parts of septa.

Diagnosis: The species with peripheral parts of septa consisting of isolated vertical elements (trabeculae or sets of trabeculae) connected by intraseptal dissepiments. Coralla predominanty solitary. Calyces with broad platforms and with calicinal pits of about 12 mm diameter, without calicinal bosses.

Material: 24 specimens, 40 thin section, 35 peels. All but one specimen from loose blocks of the type locality. The specimen *KK1* comes from the Wola Quarry.

Dimensions and shapes of coralla: given in Table 1.

Table 1

Numerical data and corallite shapes in *Cyathophyllum diffusum* sp. n.

Specimen number	Height /mm/	Diameter /mm/	Tabularium diameter /mm/	Number of septa	Apical angle /grades/	Corallite shape
J01	?22	24 x 29	10	2 x 30	70	conical
J05	20	50 x 55	11	2 x 32	110	—"—
J06	80	44 x 53	11	2 x 35	110	conical → cylindrical
J07	37	38 x 40	10	2 x 35	60	conical /with rejuvenations/
J10	35	38 x 42	13	2 x 34	60	conical
J11	33	30 x 34	12	2 x 34	70	—"—
J13	42	22 x 28	11	2 x 33	75	conical → cylindrical
J17	30	30 x 32	10	2 x 27	75	conical
J18	30	27 x 30	11	?2 x 30	60	—"—
J31	55	20 x 25	9	2 x 33	60	conical → cylindrical
J32	?18	?50	?11	?2 x 30	?120	fragmentary cone
J33	?25	32 x 34	10	2 x 29	110	conical /with 2 offsets/
J36	?25	52 x 53	10	2 x 32	?	cylindrical /fragment/
J38	57	27 x 30	10	2 x 29	40	conical
J43	?	?38	?12	?2 x 30	?	/matrix embedded, with peripheral rejuvenation/
J44	51	47 x 51	10	2 x 34	120	conical → cylindrical
J45	26	51 x 55	?14	2 x 30	110	conical
J50	?	42 x 50	?12	2 x 32	?	/matrix embedded/
J52	44	53 x 56	?12	2 x 29	110	conical → cylindrical
J53	35	39 x 40	?	2 x 29	60	conical
KK1	23	18	9	2 x 30	70	—"—

NOTE: Destruction of proximal and peripheral parts of most specimens caused probably by silification makes the dimensions approximate

Description. — All but one specimen (Pl. 5, Fig. 1) solitary. One showing a lateral (Pl. 1, Fig. 3) and one several axial rejuvenations (Pl. 6, Fig. 3). Corallites mostly patelloid to turbinate in proximal parts, become cylindrical distally (Pl. 1, Figs 2 and 4, 5). Calyces more or less everted (Pl. 1, Figs 3—5; Pl. 6, Figs 1—2) or with broad, flat platforms (Pl. 2, Fig. 2) or in shape of a flat funnel (Pl. 1, Figs 1—2). Calicinal pits about 12 mm in diameter.

In transverse sections (Pl. 1, Fig. 1; Pl. 3, Figs 1a, 3, 4a; Pl. 4, Figs. 1a; Pl. 5, Fig. 1a; *compare also* Pl. 1, Fig. 1c) septa radially arranged, of two orders. No protosepta distinguishable. The first order septa almost reach the axis. They thin out coming into tabularium, where they twist counterclockwise. The second order

septa almost two times thinner, do not penetrate tabularium. Septa of both orders laminar in the internal part of dissepimentarium and in tabularium. More peripherally they become carinated (in specimens about 20 mm in diameter or more). In still larger specimens (25 mm diameter at least) septa disintegrate peripherally into individual trabeculae (? sets of trabeculae). Tabularium diameter fairly constant, about 11 mm (Table 1). Interseptal dissepiments arranged in regular, concentric pattern, in larger specimens obscured peripherally — due possibly to subhorizontal position of blisters. Intraseptal dissepiments hardly visible. Their flanks(?) are seen as apparent elongated blisters parallel to septal elongation (Pl. 4, Fig. 1a).

In axial longitudinal sections (Pl. 2, Figs 1b, 2; Pl. 3, Figs 1b, 2b, 4b; Pl. 4, Fig. 1b) tabulae incomplete, sagging but convex in the peripheral parts. Interseptal dissepiments blister-like, arranged according to the calyx profile (see above), larger blisters near corallite periphery, smaller ones prevail in the inner part of dissepimentarium. Septa laminar periaxially, peripherally split into individual trabeculae. Tightly arranged intraseptal dissepiments are almost flat, distally slightly concave, and connect the neighboring trabeculae.

In tangential longitudinal sections of large specimens (Pl. 4, Fig. 1c; *compare also* Pl. 1, Figs 1b, 2, 4, 5) trabeculae are loosely arranged and connected by distally convex intraseptal dissepiments. Interseptal ones are distally concave.

ONTOGENY: An attempt was made to execute series of drawings of the proximal part of the specimen J17 but without great success. On the other side in no specimen septal insertion could be identified what suggests early finishing of this process during ontogeny. This phenomenon seems to be correlated to particular development of the peripheral parts of septa. It seems that a lack of new septa with increasing diameter is compensated by complication of both septal structure and calicinal relief.

BLASTOGENY: Peripheral increase was observed in a specimen sectioned and peeled serially. Offsets began as two individuals in the middle part of the everted peripheral platform (Pl. 5, Fig. 1b-1d), got in contact (Pl. 5, Fig. 1d, 1e), and formed a wall between them, probably of ceroid type. In the most distal sections obtainable astreoid relations are seen (Pl. 5, Fig. 1f, 1g). The series suggests gradual fusion of the soft tissues of the buds.

Remarks. — The new species, *Cyathophyllum diffusum* sp. n., resembles *C. spongiosum* (Schulz) from the Eifelian of Eifel (*cf.* Bireheide 1963). In *C. spongiosum*, however, the peripheral trabeculae seem not to lose contact with each other (compare Pl. 4, Fig. 1a and Pl. 4, Fig. 2a). Peripheral parts of septa of *C. spongiosum* resemble these of *Heliophyllum* with type *II* or *III* carinae (*cf.* Sorauf & Oliver 1976). To note is also the absence of intraseptal dissepiments in *C. spongiosum* (compare Pl. 4, Fig. 1b, 1c and Pl. 4, Fig. 2b, 2c) and that septal insertion was not inhibited in the mature stages of ontogeny in this species (*see* Birenheide 1963, Pl. 55, Fig. 39a, 39b).

Remarks on functional morphology. — Hubbard & Pocock (1972) proved that large septal number, complicated septal morphology and calicinal relief point to high sediment rejection potential in scleractinian corals, and the same was suggested for rugose corals. From this point of view, *C. diffusum* sp. n. seems to have been better adapted for sediment rejection than *C. spongiosum*. The skeletal structures of coeval *C. diffusum* sp. n. and *Iowaphyllum mutabile* Tsien, 1977 (plus the morphologically similar species from road cut at Kowala and the Wietrznia Quarry, assigned by Różkowska, 1979, to *Chonophylum*, *Iowaphyllum*, and *Kowalaephyllum*) point to comparable, possibly somewhat lower sediment rejection potential in *I. mutabile*. With similar septal number and dispersed septal structure,

the presence of intraseptal dissepiments of the lonsdaleoid type was connected with temporal smothering of calicinal relief in *I. mutabile*.

Distribution. — As the holotype plus the Upper Frasnian of the Wola Quarry.

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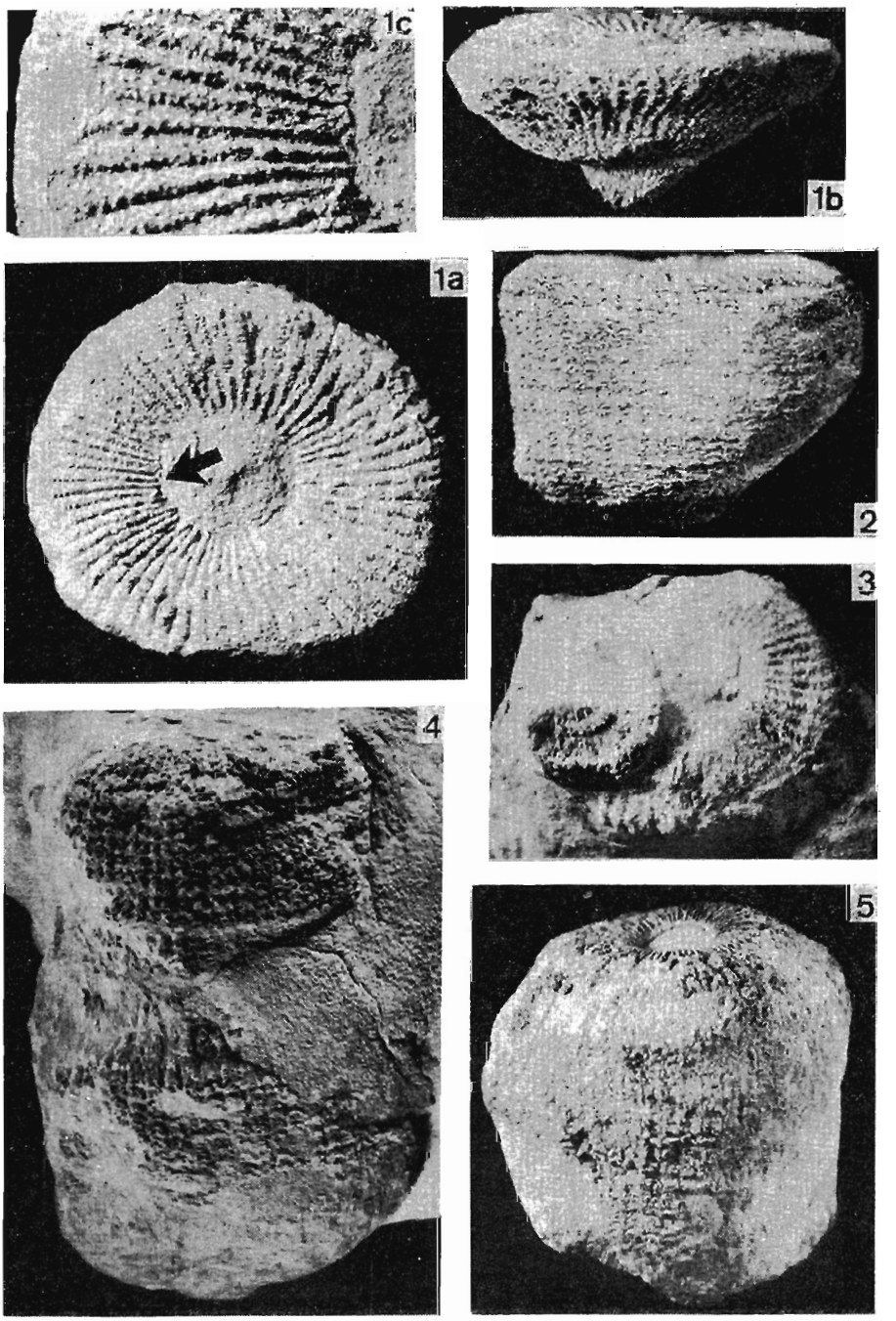
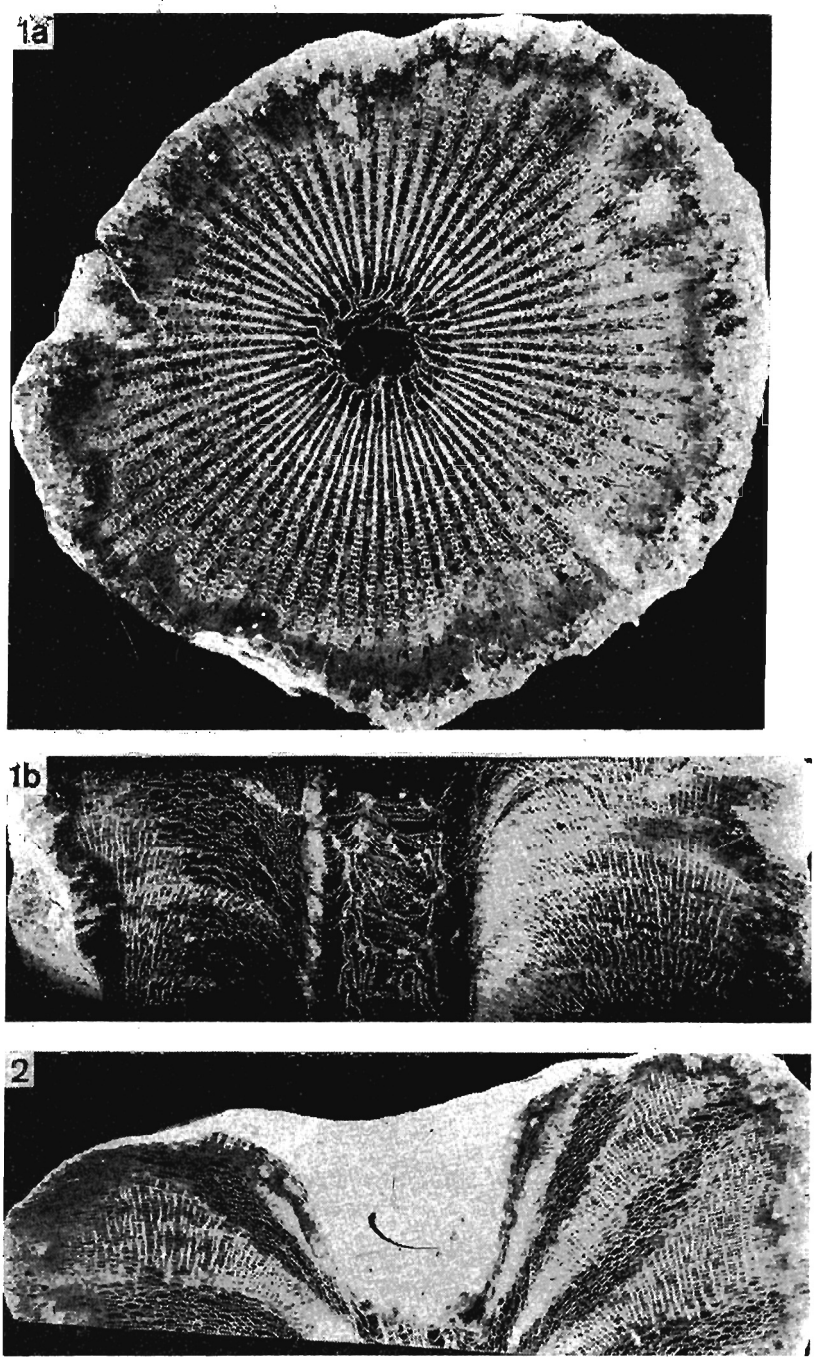
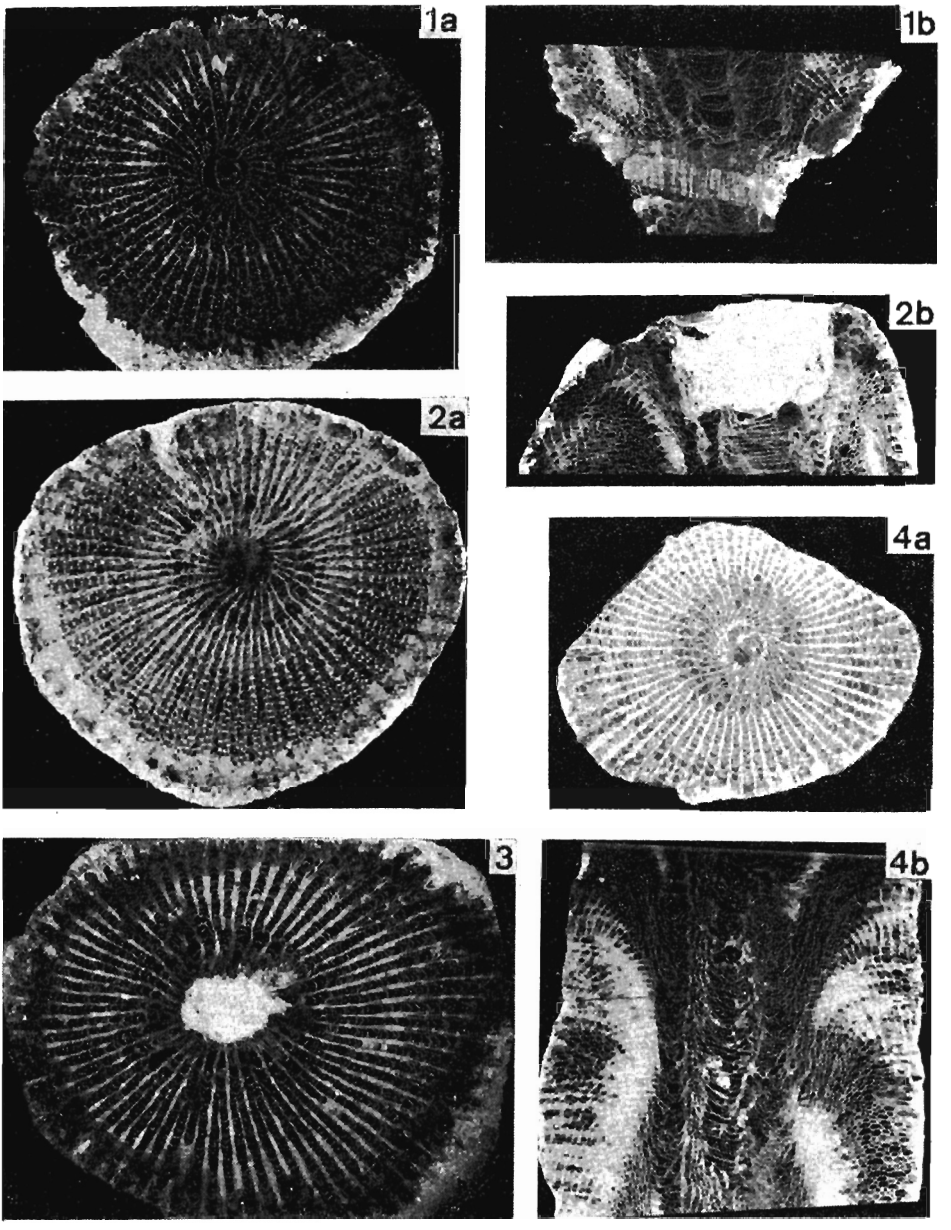


Cyathophyllum diffusum sp. n.: **1** — specimen J45 (*1a* distal, *1b* side view, *1c* fragment arrowed in Fig. *1a*); **2** — specimen J52, side view; **3** — specimen J43, distal view with peripheral rejuvenation; **4** — specimen J06 (holotype), side view; **5** — specimen J44, side view

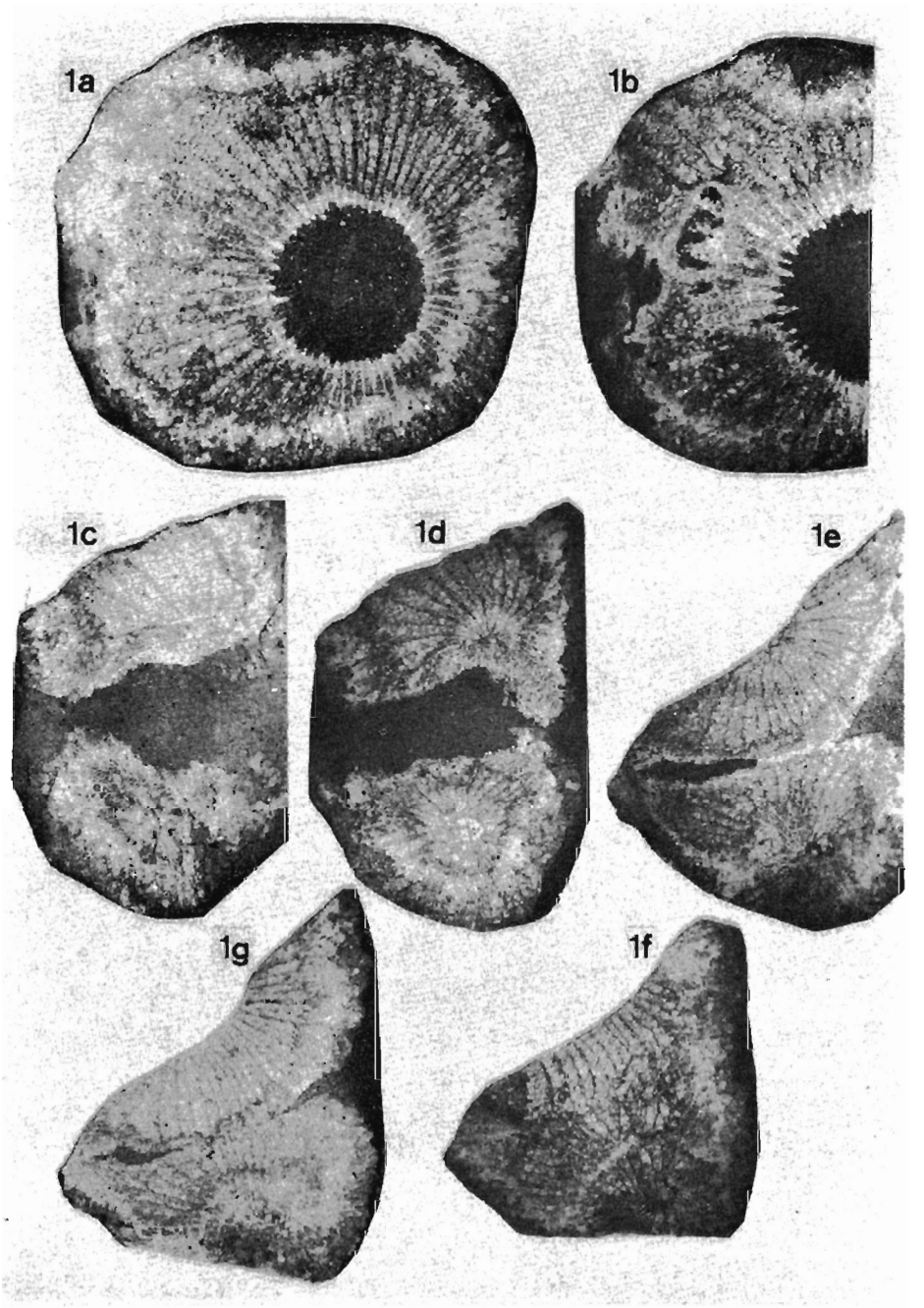
All figures of natural size, except of Fig. 1c taken × 2.5



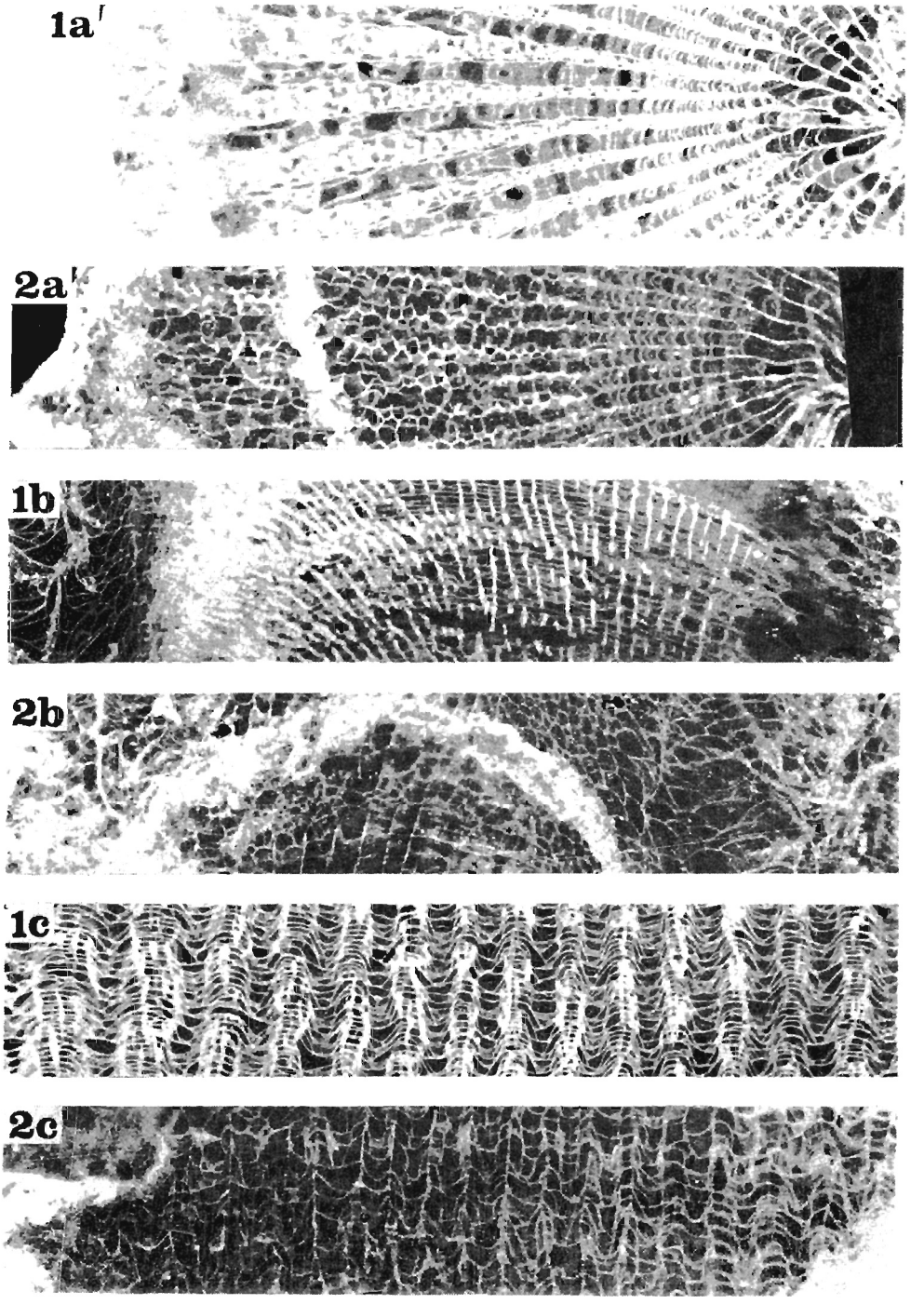
Cyathophyllum diffusum sp. n.: **1** — specimen J06 (holotype; *1a* transverse, *1b* longitudinal section); **2** — specimen J36, longitudinal section; all figures taken × 2



Cyathophyllum diffusum sp. n.: **1** — specimen J01 (*1a* transverse, *1b* longitudinal section); **2** — specimen J38 (*2a* transverse, *2b* longitudinal section); **3** — J11, transverse section; **4** — specimen J31 (*4a* transverse, *4b* longitudinal section); all figures taken × 2

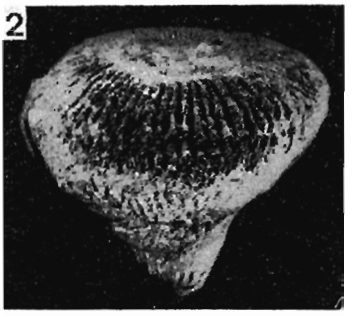


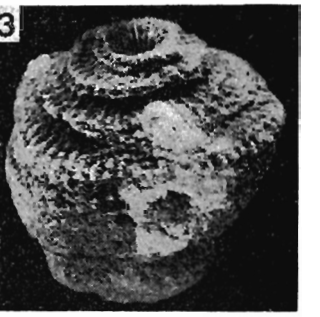
Cyathophyllum diffusum sp. n., specimen J33 (in parentheses are cumulative distances from section 1a, taken in *mm*): **1a** — section through calice and below offsets (0.0); **1b** — proximal part of the upper left-hand offset (1.3); **1c** — two individual offsets (3.9); **1d** — offsets get in contact (5.7); **1e** — cerioid(?) wall between offsets (9.4); **1f** — wall disintegrates (11.3); **1g** — astreoid contact of primarly independent offsets (11.8); all figures taken × 2

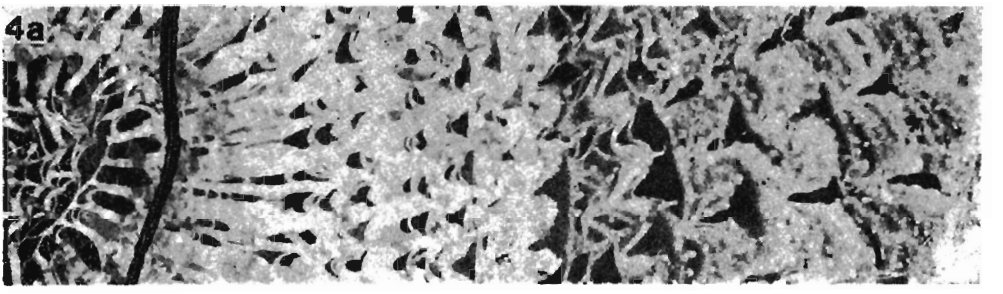


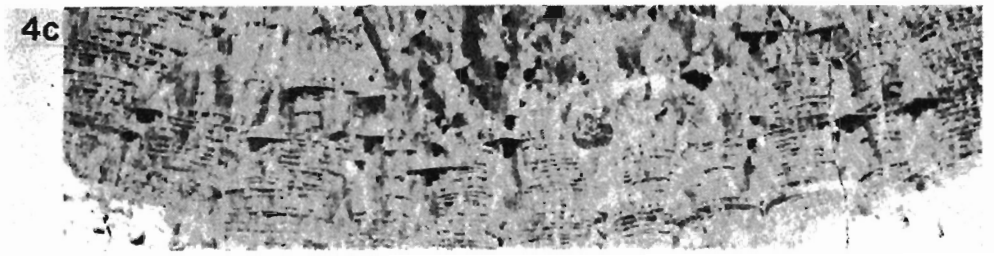
1 — *Cyathophyllum diffusum* sp. n.: *1a* and *1c* specimen J36 (*1a* fragment of transverse section, *1c* fragment of longitudinal tangential section); *1b* specimen J06 (holotype), fragment of longitudinal axial section, axis to the left

2 — *Cyathophyllum spongiosum* (Schulz, 1883), specimen E01: *2a* fragment of transverse section, *2b* fragment of longitudinal axial section, axis to the right, *2c* fragment of longitudinal tangential section; all figures taken × 4









Cyathophyllum diffusum sp. n.: **1** — specimen J18, side view; **2** — specimen J10, side view; **3** — specimen J07, side view; all figures of natural size
Iowaphyllum mutabile Tsien, 1977: **4a** — specimen G02-01, fragment of transverse section; **4b**, **4c** — specimen G02-04 (*4b* fragment of longitudinal axial section, axis to the left; *4c* fragment of longitudinal tangential, slightly oblique section); all figures taken × 4

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KORALOWIEC CZTEROPROMIENNY *CYATHOPHYLLUM DIFFUSUM* SP. N. Z FRANU JAŹWICY

(Streszczenie)

Przedmiotem pracy jest opis nowego gatunku koralowca czteropromiennego *Cyathophyllum diffusum* sp. n. z osadów górnego franu odsłoniętych w kamieniołomie Jaźwica w Górach Świętokrzyskich (*patrz* fig. 1, tab. 1 oraz pl. 1—6). Cechami diagnostycznymi nowego gatunku jest obecność rozproszonych trabekul peryferycznych części septów (pl. 2, fig. 1—2, fig. pl. 3, fig. 2a; pl. 4, fig. 1a, 1b), oraz występowanie dissepimentów intraseptalnych (nowy termin), które są pęcherzami wypukłymi w kierunku dystalnym, leżącymi między trabekulami poszczególnych septów (najwyraźniej widoczne pl. 4, fig. 1b, 1c; por. pl. 1, fig. 2). Zwrócono uwagę na inny typ dissepimentów intraseptalnych występujący u gatunku *Iowaphyllum mutabile* Tsien, 1977: w tych częściach koralita, gdzie są one rozwinięte, dissepimenta intraseptalne przerywają ciągłość trabekul, a te ostatnie przybierają postać niskich wyrostków na dystalnych powierzchniach dissepimentów intraseptalnych (pl. 6, fig. 4a-4c). Wskazano prawdopodobne znaczenie funkcjonalne przedstawionych cech (tj. rozproszenia trabekul i rozwoju dissepimentów intraseptalnych). Jak dowodzą Hubbard i Pocock (1972) skomplikowane struktury kielicha występują u koralowców o podwyższonej zdolności do odrzucania osadu.