A C T A P A L A E O N T O L O G I C A P O L O N I C A
Vol. XVII 1972 No. 3

MARIA RÓŻKOWSKA & JERZY FEDOROWSKI

GENUS *DISPHYLLUM* DE FROMENTEL (RUGOSA) IN THE DEVONIAN OF POLAND AND ITS DISTRIBUTION

CONTENTS

Abstract. — 11 species and subspecies of the genus *Disphyllum* de Fromentel are described from the Devonian of Poland, two of them, *D. wirbelauense bonae* and *D. w. regulare*, are new. The geological structure of the *Disphyllum*-bearing localities from the Holy Cross Mts and Sudetes is discussed. The profiles of deep boreholes from Silesian-Cracow anticlinorium and Pomerania are presented. The coral's blastogeny and intraspecific variability are characterized. The septal index and pattern of internal structure are regarded as taxonomical criteria for specific identifications. It was noted that the microstructure is characterized by coarse monacanths distri-

buted horizontally or in the form of half-fans. Distribution of *Disphyllum* in Poland and in the world, the moment of its appearance and its biostratigraphical value are discussed.

INTRODUCTION

The material described herein was collected in years 1946—1971. The first part of the collection was gathered by M. Różkowska in 1946—1952 with the help of Dr. A. Stasińska and with the financial support of the Museum of Earth, Warszawa. At that time, material was collected in Kielce (Kadzielnia and Wietrznia quarries) and its vicinities (Zagórze, Łagów, Ko-

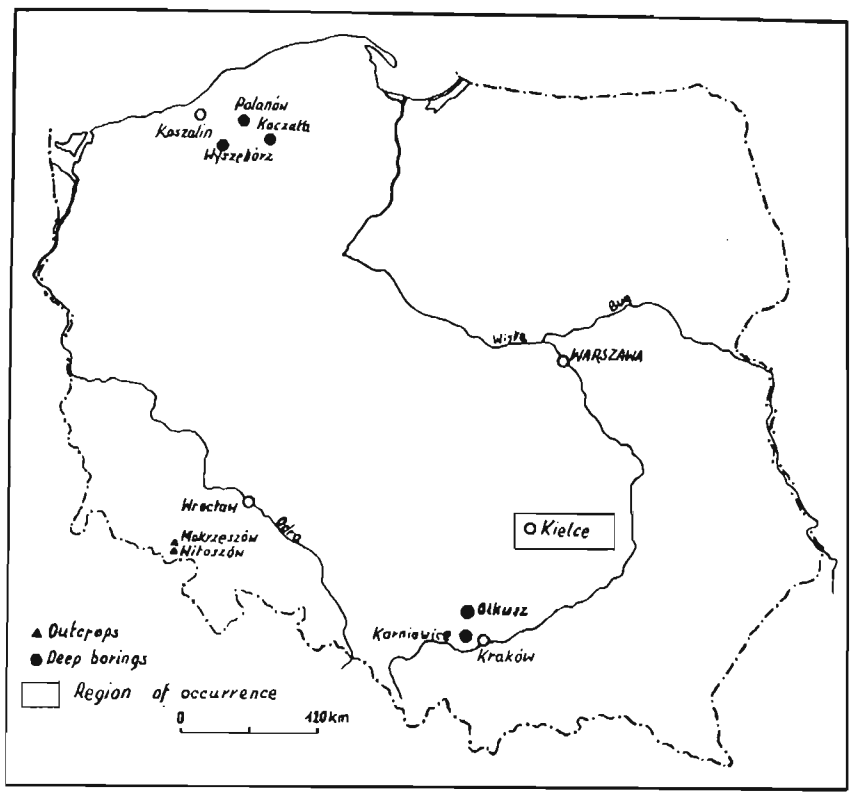


Fig. 1. Sketch map of Poland showing areas wherefrom corals of the genus *Disphyllum* (contoured and numbered), and localities (triangles) and boreholes (solid dots) are reported.

wala, Chęciny and Sitkówka) and in the Sudetes (Mokrzeszów and Witoszów) (Text-fig. 1). In 1968—1971 the collection was supplemented by both authors with material from the Upper Givetian of Chęciny, Sosnówka and Sitkówka. Moreover Dr M. Szulczewski (Institute of Geology, Warsaw

University) supplied some material from the Upper Givetian of Sosnówka, Frasnian of Kowala, Czarnów and Józefka hill (near Górno); and Dr J. Kaźmierczak (Palaeozoological Institute, Polish Academy of Sciences, Warszawa) — of the Upper Givetian of Stokówka near Gałęzice and Sołtysia hill near Radkowice. In the collection, *Disphyllum* from the deep boreholes in the Silesian-Cracow anticlinorium (Karniowice, Olkusz) and Pomerania (Polanów, Wyszebórz, Koczała) is also represented. Conodont zonation on the area of Holy Cross Mts. is accepted after Szulczewski (1971) and that of the borehole Karniowice after Chorowska.

The paper presents an attempt to characterize geographical distribution of the genus *Disphyllum* in Poland and in the world, based on its morphology and microstructure and to evaluate the stratigraphical value of its particular species. Lithology of coral-bearing series is briefly discussed or, where possible, the reader is referred to the published data. In the case of boreholes, only parts of the profile yielding Coelenterata are given here. Lithological profiles of boreholes are based on unpublished reports by L. Szostek, M. Sc., (Boreholes No BB-18, BB-24, BB-26, B-746 in the Olkusz area) and J. Ślósarz (Borehole Karniowice 4) or were elaborated by the junior author (Borehole Polanów and a few boreholes in the Olkusz area). In Wyszebórz and Koczała boreholes the representatives of the genus *Disphyllum* were recorded in a single horizon, to which the present lithological description is confined. All associate faunas, and particularly other representatives of Coelenterata were identified where possible.

The disphylloid corals of Poland were described as early as 1896 by Gürich from the Upper Givetian of Chęciny, under the name of *Fascicularia caespitosa* var. *breviseptata* Frech. On the basis of the topotypes, the senior-author demonstrated a great similarity in structure and n/d value between Gürich's forms and *D. wirbelauense* Pickett. Some differences noted enabled erection of two new subspecies: *D. wirbelauense bonae* n. subsp. and *D. wirbelauense regulare* n. subsp. Both are rock-builders at Zamkowa hill by Chęciny. Other Gürich's (l. c.), forms, identified as *F. caespitosa kadzielniae* Gürich, *F. c. striata* Gürich and *F. c. tenuis* Gürich belong, however, to the genus *Thamnophyllum*.

Sobolev (1904, p. 34) described *Cyathophyllum caespitosum* Goldfuss and *C. c. striata* (Gürich) from crinoidal limestones and *Calceola*-marls of the Givetian of Skały (northern region of the Holy Cross Mts). The corals described by Sobolev (l. c.) presumably belong to *Thamnophyllum germanicum* Scrutton, widely distributed in these rocks; in the rich material collected from this locality, not a single representative of the genus *Disphyllum* was identified by the first co-author.

Czarnocki (1947, p. 243) cited *Megaphyllum pashiense* Soshkina (recte *D. caespitosum pashiense* Soshkina) and *Schlüteria emsti* Wedekind (recte

D. h. kostetskae Soshkina) from the Lower Frasnian of Kadzielnia. Moreover, Czarnocki (l. c.) cited *Disphyllum heterophylloides* (Frech) from the Middle Frasnian of Wietrznia; the latter species should be included in the genus "*Charactophyllum*" Simpson.

Różkowska (1948) published an introductory review of the tetracoral species occurring in the Devonian of the Holy Cross Mts and characterized the microstructure of the genera *Disphyllum* and *Phacellophyllum* (recte *Thamnophyllum*). In her next paper (Różkowska, 1960), the blastogeny in *Disphyllum geinitzi* Lang & Smith was discussed.

From the area of Lower Silesia, Gunia (1962, 1966, 1968) described *D. kostetskae* from the Middle Frasnian conglomerates of Witoszów, and *D. caespitosum pashiense* from the Upper Frasnian limestones of Mokrzeszów.

The co-authors divided the study in the following way: M. Różkowska presented a critical review of previous studies on the genus *Disphyllum* and discussed taxonomy, variability, microstructure and problems of palaeobiogeography and gave systematic descriptions; J. Fedorowski gave descriptions of exposures and borehole profiles, considerations on stratigraphy, discussed blastogeny (presented in descriptions of particular species) and prepared illustrations.

ACKNOWLEDGEMENTS

The authors are deeply indebted to Prof. R. Kozłowski (Palaeozoological Institute, Polish Academy of Sciences, Warsaw) for his comments and constructive criticism during the preparation of the paper. Thanks are due to Dr Dr M. Szulczewski and J. Kaźmierczak for materials supplied and L. Cimaszewski M. Sc. and L. Szostek M. Sc. for core material from boreholes at the areas of Pomerania and Olkusz, respectively. Dr. A. E. H. Pedder (Institute of Sedimentary and Petroleum Geology, Geological Survey, Calgary), Dr. T. C. Scrutton (Department of Geology, University, Newcastle upon Tyne), Dr. P. Semenoff-Tian-Chansky (Muséum d'Histoire Naturelle, Paris) and Prof. H. Flügel (Geologisches Institut, Graz) supplied information on occurrence of *Disphyllum* in particular countries.

The authors thank Dr. W. A. Oliver (U. S. Geological Survey, Washington) for sending his manuscript and fruitful discussion on craspedophylloids and disphylloids and for photocopies of papers on *Disphyllum* of North America. The authors are also indebted to Dr. D. L. Strusz (Bureau of Mineral Resources, Geology and Geophysics, Canberra) for photocopies of papers on *Disphyllum* of Australia and Dr. D. Weyer (Geologisches Institut, Berlin) for discussion of *Fascicularia caespitosa* var. *breviseptata* (Frech).

Photos were made by Miss J. Konieczna; thin-sections and peels by Mrs K. Kobierna and Mrs Z. Walkowiak (all from Laboratory of Palaeozoology, Polish Academy of Sciences, Poznań).

DESCRIPTION OF EXPOSURES AND BOREHOLES

HOLY CROSS MOUNTAINS

The representatives of the genus *Disphyllum* are frequent in the Givetian and Frasnian of SW part of the Kielce region (Text-fig. 2, Table 1). Unfortunately, not all *Disphyllum*-bearing localities are adequately described. However, the present paper mainly deals with paleontological aspects, therefore the descriptions of exposures given below are treated chiefly as informations concerning the occurrence of disphylloid species. The stratigraphy and lithology are treated as briefly as possible.

Givetian

Chęciny. — In an abandoned, small quarry on eastern slopes of Zamkowa hill, grey limestones of a few tens of meters thick with *Spinatrypa* and very numerous colonies of disphylloid corals are exposed. *Disphyllum wir-*

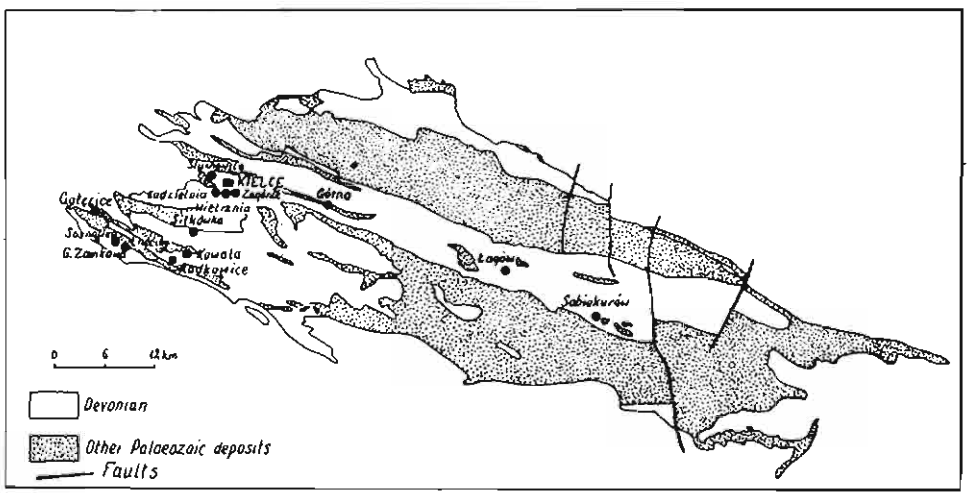


Fig. 2. Sketch map of the Paleozoic of the Holy Cross Mts showing the *Disphyllum*-bearing localities. Outcrops of the Devonian not-dotted.

belauense bonae n. subsp., *D. w. regulare* n. subsp. and *D. geinitzi* were identified. *Tienodictyon zonatum* Yabe & Sugiyama also occurs here, but is much scarcer (Kaźmierczak, personal communication). The limestones are assigned to the uppermost Givetian, and the overlaying cherts may be of the earliest Frasnian age (Pl. I, Figs. 1a, b).

Sosnówka. — A hill situated to S of Chęciny-Polichno road, 2 km from Chęciny. According to Szulczewski (oral communication) and the authors' data, the upper limestone part of the Upper Givetian is exposed here. Grey limestones, similar to those from the Zamkowa hill, gradually pass into cherts. Chert concretions also occur in underlaying limestones which is not the case at the Zamkowa hill. Occurrence of *D. wirbelauense bonae* n. subsp., *D. w. regulare* n. subsp. and *D. geinitzi* in the Upper Givetian rocks was noted. The other faunas are not identified.

Sitkówka (old quarry). — Dark-grey limestones. *Disphyllum geinitzi* is particularly common in rocks exposed in N wall of the quarry (Pl. I, Fig. 3). Colonies are usually broken and upturned and particular branches randomly scattered within the bed. Occasionally these disphyllids are the main component of the rock, being accompanied by numerous branches of *Amphipora ramosa*. Towards the top, the disphyllids decrease in number and Tabulata and particularly *Thamnopora* begin to predominate. Besides the latter, Stromatoporoidea are quite common. The description of Stromatoporoidea, together with geological-ecological discussion of the quarry were given by Kaźmierczak (1972). The faunal assemblage is typical for the Upper Givetian.

Radkowice (Sołtysia hill). — Stratigraphical position, lithological development and faunal assemblage very close to that of Sitkówka. A detailed description of exposures and of Stromatoporoidea faunas is given by Kaźmierczak (l. c.). *Disphyllum* is here represented by its two subspecies, *D. wirbelauense bonae* n. subsp. and *D. w. regulare* n. subsp.

Gałęzice (Stokówka hill). — Hill situated to SE of the village. The Upper Givetian limestones exposed here correspond to those described above in lithology and facial development. The occurrence of *Disphyllum geinitzi* Lang & Smith and *D. wirbelauense bonae* n. subsp. was noted. The assemblage of Stromatoporoidea is here represented by *Actinostroma papillosum* (Bargatzky) and *A. bifarium* Nicholson, according to Kaźmierczak (1972).

All above localities are concentrated in SW part of Kielce region in the Holy Cross Mts (cf. Text-fig. 2). Such limitation of corals of the genus *Disphyllum* in distribution presumably resulted from facial conditions. In this area the genus *Disphyllum* is known to occur exclusively in deposits of the limestone facies and in highly constant faunal assemblages, in association with specifically monotonous assemblages of Tabulata and Stromatoporoidea. In the rest of Kielce region and in Łysogóry region, whence *Disphyllum* till now is unknown, this period is characterized by the predominance of dolomitic facies. At the same time it must be emphasized that no corals of Givetian disphylla are known of the Frasnian limestone facies, very close to that of the Upper Givetian, except for a single occurrence of *D. wirbelauense bonae* n. subsp. at Kowala. There-

Table 1

Distribution of the *Disphyllum* species in the coral bearing localities in Poland

Species and subspecies	Holy Cross Mountains		Silesian-Cracow Anticlinorium		Sudetes		Pomerania	
	Locality	Age	Locality	Age	Locality	Age	Locality	Age
D. wirbelauense wirbelauense Pickett	Sobiekurów	Upper Frasnian						
D. wirbelauense bonae n. subsp.	Chęciny (Castle hill) Sitkówka, Stokówka hill Sosnówka hill, Soltysia hill Kowala railroad cut	Uppermost Givetian L. Polygnathus asymmetricus Zone, L. Frasnian	Olkusz, BJ-24 depth 283— —284 m	Upper Givetian				
D. wirbelauense regulare n. subsp.	Chęciny (Castle hill) Sitkówka, Sosnówka hill Soltysia hill	Uppermost Givetian	Olkusz, BJ-24 depth 283— —284 m	Upper Givetian				
D. geinitzi Lang & Smith	Chęciny (Castle hill) Sitkówka, Sosnówka hill Stokówka hill	Uppermost Givetian						
D. kweihshiense Yoh	Kowala railroad cut	L. Polygnathus asymmetricus Zone, L. Frasnian						
D. hslanghsienense kostetskae (Soshkina)	Wietrznia p. VIII, IX p. I, XI p. V, XVI Kadzielnia p. IX p. V, VI Łagów	L. Polygnathus asymmetricus Zone, L. Frasnian Below Ancyrognathus triangularis Z., L. Frasnian ,, ,, Frasnian	Karniowice 4 depth 293 m	Lower Frasnian Polygnathus asymmetricus Zone	Witoszów	Middle & Lower Frasnian	Polanów depth 1675—1686 m 1734—1737 m 1787—1795 m	Lower Frasnian
D. cylindricum (Soshkina)	Wietrznia p. VIII p. V, XVI Kadzielnia p. VII Łagów	L. Polygnathus asymmetricus Zone, L. Frasnian Below A. triangularis Z., L. Frasnian ,, Frasnian	Karniowice 4 depth: 293— —294,9 m 298—299,4 m Olkusz BB18; BB24; BB26; B743; B746; B570*)	L. Frasnian P. asymmetricus Zone L. Frasnian				
D. caespitosum caespitosum (Goldfuss)	Czarnów Wietrznia p. VIII p. I, XI p. XVI Kadzielnia p. XIII	L. Polygnathus asymmetricus Zone, L. Frasnian ,, Below Ancyrognathus triangularis Zone, L. Frasnian Frasnian	Karnowice 4 Olkusz BB18 depth 319 m Olkusz BB26 depth 209,3 m	L. Frasnian P. asymmetricus Zone L. Frasnian L. Frasnian			Wyszebórz depth 2015— —2021,4 m Koczała 1 depth 2680,0 m	Lower Frasnian Upper Frasnian
D. caespitosum pashiense (Soshkina)	Wietrznia p. VIII p. XVI, XXII Kadzielnia p. IX p. III, VIII Łagów Zagórze	L. Polygnathus asymmetricus Zone, L. Frasnian Below Ancyrognathus triangularis Z., L. Frasnian ,, Frasnian L. Polygnathus asymmetricus Zone, L. Frasnian			Witoszów Mokrzeszów	Middle & Lower Frasnian Upper Frasnian		
D. caespitosum lazutkini (Ivanija)	Wietrznia p. VIII p. I p. XVI, XXII Kadzielnia Zagórze	L. Polygnathus asymmetricus Zone, L. Frasnian Below Ancyrognathus triangularis Z., L. Frasnian Frasnian Ł. Polygnathus asymmetricus Zone, L. Frasnian						

*) Depths see at Occurrence

fore, the present authors suggest *D. w. regulare* n. subsp., *D. geinitzi*, and with some reservation *D. w. bonae* n. subsp. as fossils characteristic for the Upper Givetian of Poland.

Frasnian

Recently, Szulczewski (1971) published a detailed study of the lithology and facial development of the Frasnian and presented conodont zonation and correlation of numerous profiles of this stage over the Holy Cross Mts area. It permitted to the authors a better stratigraphic determination of Frasnian disphyllids.

Czarnów. — Small hill to NE of Śluchowice quarry. The lithological profile and conodont fauna elaborated by Szulczewski (l. c.); other fauna hitherto nonidentified. Occurrence of *Disphyllum caespitosum caespitosum* is limited to the Lower Polygnathus asymmetricus Zone, i. e. to the period of predominance of Kielce facies over this area, which is replaced by Łysogóry facies in the next conodont zone. Presumably this facial change resulted in the lack of *Disphyllum* in the section of Śluchowice, where somewhat younger deposits are exposed.

Kowala railroad cut. — The very detailed profile of this locality is given by Szulczewski (l. c). Occurrence of *Disphyllum kweihsiense* in the life position was noted on the boundary of sets A and B (Szulczewski l. c., Text-fig. 5, Pl. 21, Fig. 2), in deposits assigned to the Lower Polygnathus asymmetricus Zone. Limestones exposed here are of the reef type. Colonies of *Thamnopora boloniensis, Alveolites suborbicularis* and of other Tabulata, *Thamnophyllum kozlowskii* and massive colonies of Stromatoporoidea are the main rock-builders. Occasionally, *Disphyllum wirbelauense bonae* n. subsp. was noted.

Łagów. — The Famennian and Frasnian deposits of Łagów are best exposed along the left bank of Łagiewica river. The last ones are represented by dark, compact thick-bedded limestones, which pass downwards into lumpy limestones with *Leiorhynchus laevis*. In these lumpy limestones not a single colony of *Disphyllum* was found, whereas an abundant occurrence of corals of this genus was noted in the same limestones exposed in a small exposure from the right bank of the river. Here, very numerous *Disphyllum caespitosum pashiense, D. hsianghsienense kostetskae* and *D. cylindricum* are represented. Presumably as in the case of Kadzielnia, the occurrence of *Disphyllum* is of the nest-type, and thus spatially limited. The lack of conodont fauna makes zonation of these rocks difficult. The coral-bearing deposits may be of the Lower or Middle Frasnian age.

Wietrznia. — Although richness and diversity of fauna occurring in this quarry is widely known, no detailed study of deposits exposed here is available. The disphyllids described here were collected over a period of years, and a large number of them was found in parts of the quarry explo-

ited a long time ago. Nevertheless the present authors give an old sketch of the quarry herein (Text-fig. 3), because it is the only possibility for coarse correlation of the specimens with particular horizons.

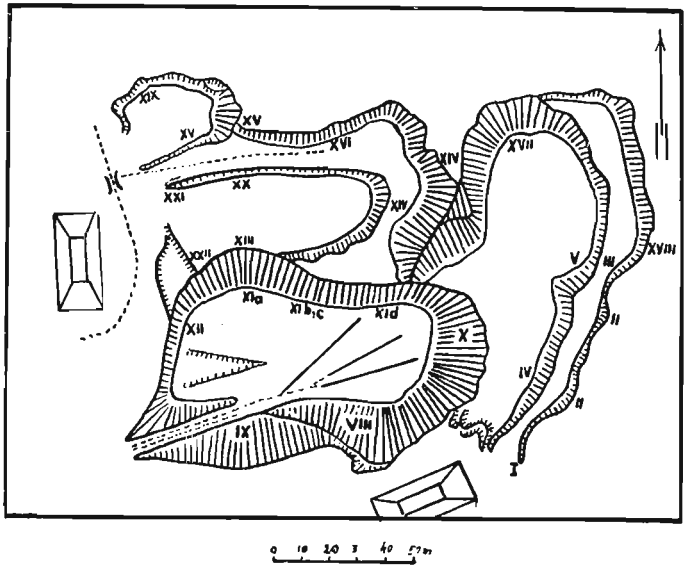


Fig. 3. Sketch of the Wietrznia quarry at Kielce; *Disphyllum*-bearing points marked with solid dots.

From juxtaposition of direct altitude of sampled points, dips of strata (c. 45°N) and lithology it follows that the oldest fauna was found in the points 8 and 9. These points correspond to set A of Szulczewski (l. c.). Point 11 corresponds to set B and points 13, 22 and probably 5 correspond to set C of the above author. According to the conodont zonation by Szulczewski (l. c.), the above points correlate with the Lower or Middle Polygnathus asymmetricus Zone. The possibility is not excluded that the points 5, 13 and 22 already belong to the Middle Frasnian according to the coral-brachiopod stratigraphical subdivision (cf. Czarnocki in Różkowska 1953).

Kadzielnia. — Szulczewski (l. c.) presented a detailed profile of E wall of the quarry. Unfortunately, the specimens described herein were mainly found in the southern and middle parts of the quarry, at the base of the "Geologist Rock", flooded by a pool at present. The specimens were found in biohermal unbedded limestone which makes correlation with conodont-bearing limestones described by Szulczewski basically impossible. According to Różkowska (1953) and more recent data of the authors and Szulczewski (oral communication), the fauna from point 9 belongs to the Lower Frasnian and is older than the Ancyrognathus triangularis Zone, whereas all other points should be assigned to the Middle Frasnian (Text-fig. 4).

Zagórze. — In a series of small quarries situated to S of Kielce-Mójcza road to E of Wietrznia quarry, grained limestones and underlying dolomitic limestones are exposed (Lewandowski MS 1971). In the grained limestones

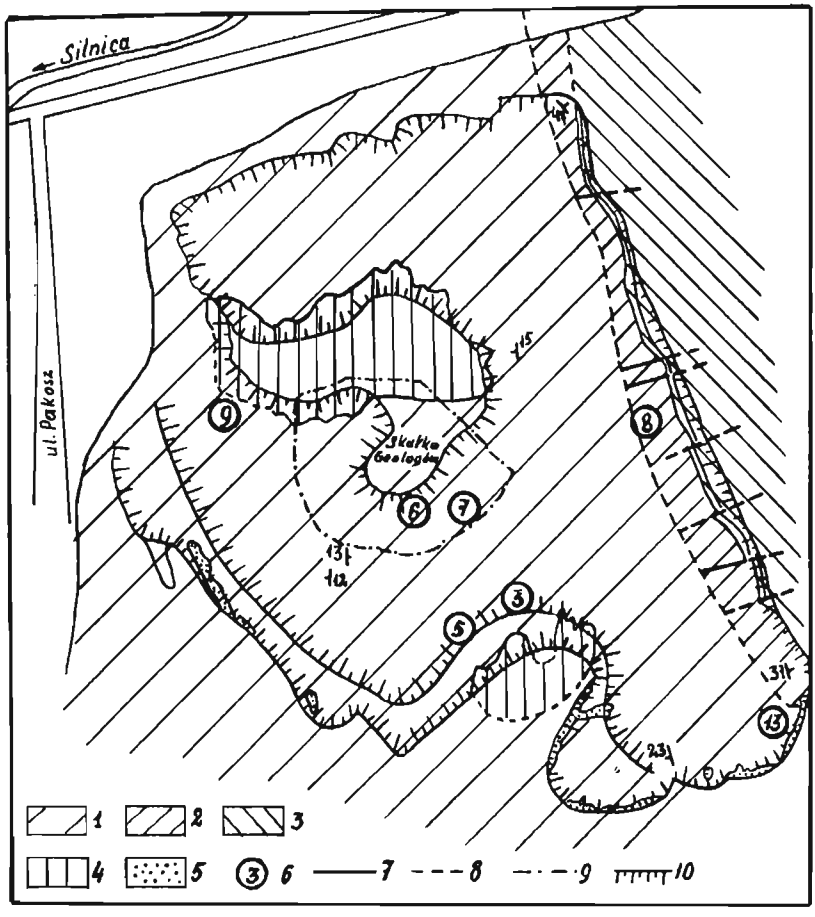


Fig. 4. Sketch of Kadzielnia quarry at Kielce; *Disphyllum*-bearing points marked with solid dots.

Disphyllum caespitosum pashiense and *D. c. lazutkini* were found. This complex is assigned to the Polygnathus asymmetricus Zone.

Sobiekurów. — Small abandoned quarry situated close to Sobiekurów village, 0.5 km to S of Kielce—Opatów road. Very dark, thick-bedded limestones with abundant large colonies of *Alveolites*, up to 40 cm in diameter, from the southern part of the quarry are the oldest rocks exposed here (dip ca. 30°N). Occasionally colonies of *Phillipsastraea* were found. Upwards these limestones pass into lumpy limestones with Stromatoporoidea, numerous *Alveolites*, *Phillipsastraea*, *Disphyllum wirbelauense*, large gastropods and ostracods; close to the top of this series, *Amphi-*

pora begins to predominate. This series is overlayed by similar lumpy limestones but with far less abundant fauna. The fossils are commonly concentrated in well-separated "horizons" in the top parts of particular beds. Such a "horizon" is met in the uppermost part of Sobiekurów profile; here very numerous colonies of *Phillipsastraea*, accompanied by a few Stromatoporoidea and one *Alveolites* colonies were found in life-position. The authors consider the whole limestone series of Sobiekurów as of Upper Frasnian age, mainly on the basis of mass-occurrence of *Phillipsastraea*.

SUDETES

On the area of the Sudetes the corals of the genus *Disphyllum* are known to occur in the Frasnian of the Świebodzice depression at Mokrzeszów and Witoszów (Text-fig. 1, Table 1).

Mokrzeszów. — The quarry at Mokrzeszów, recently described by Gunia (1968), the greater part of which is at present flooded with deep water. Above the water table, alternation of thin-bedded marls and thick- or thin-bedded limestones is observable. Sometimes limestone forms lenses surrounded by marls. Colonies of *Disphyllum caespitosum pashiense* were occasionally found in the limestone. Gunia (l. c.) assigned the series exposed here to the Upper Frasnian on the basis of the occurrence of *Manticoceras intumescens* and *Hypothyridina cuboides*.

Witoszów. — In this section, Gunia (1962, pp. 500—502) described two conglomerate beds separated by shaly-greywacke series with total thickness ca 3 m. For our present purpose the upper conglomerate bed is more interesting as it contains pebbles with Lower and Middle Frasnian fauna; among others, *Disphyllum caespitosum pashiense* and *D. hsianghsienense kostetskae* were identified here.

SILESIAN-CRACOW ANTICLINORIUM

The Olkusz area (Table 1, Text-fig. 1)

Chechło. — Borehole No BB-18 (Text-fig. 5). — The Devonian rocks recorded at the depth of 221 up to 413 m (where drilling was stopped) are represented by alternations of grey, mainly crystalline limestones and dolomites. The occurrence of Coelenterata is limited to two riders. The older one, recorded at the depth 361.8—413 m is characterized by Coelenterata assemblage innumerous in individuals and in species. Individual tetracorals of the genus *Temnophyllum* and weakly branched stromatoporoids of the genera *Amphipora* and *Idiostroma* are represented here. The whole assemblage, indicates relatively deep-water and not particularly favourable life conditions. Occurrence of the genus *Temnophyllum* indicates Upper Givetian-Lower Frasnian age of this rider.

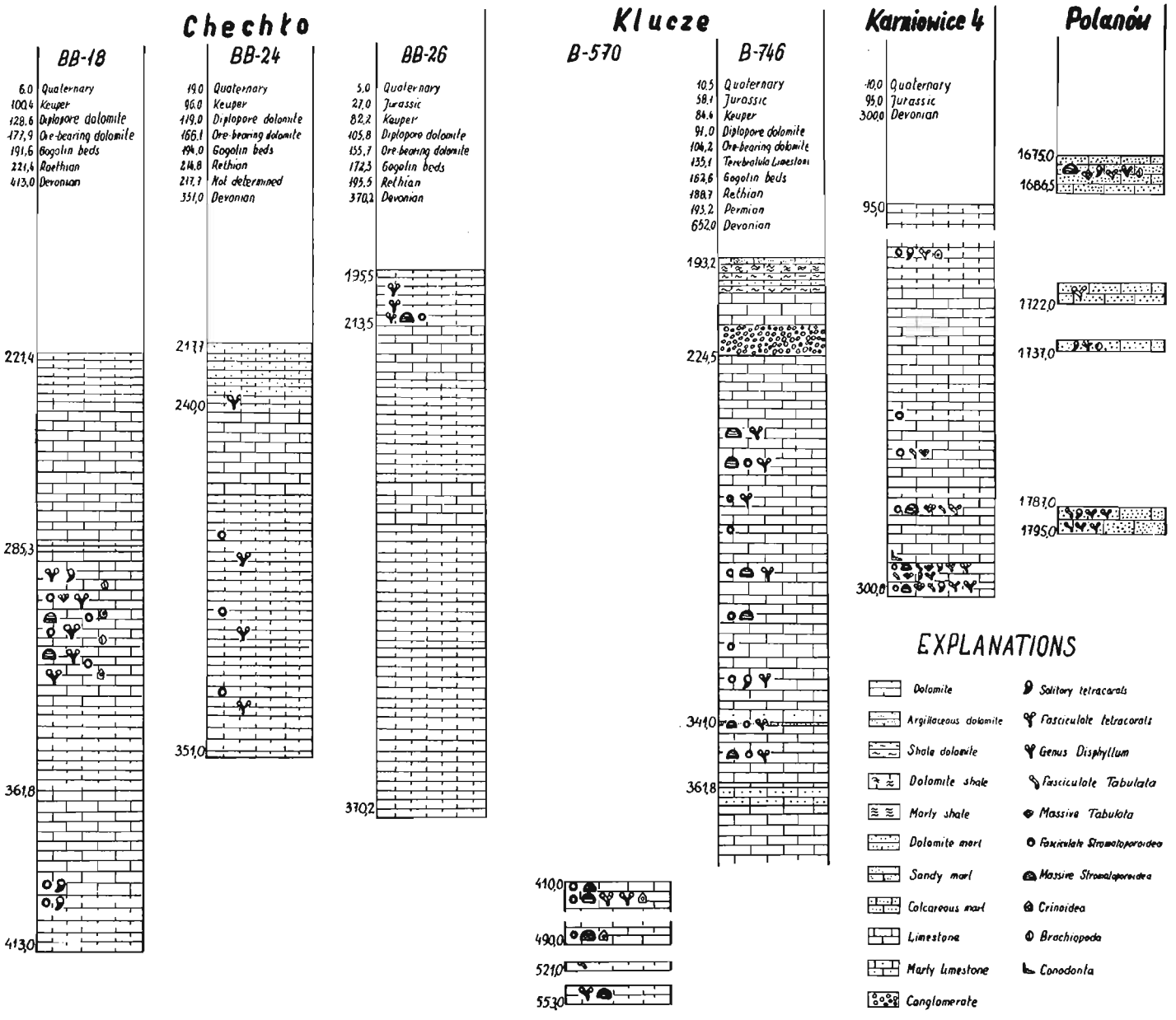


Fig. 5. Borehole profiles. Explanation given in the diagram.

The second rider (depth of 285.6—319 m) is characterized by faunal assemblage far richer in species and more numerous. Here, branchy colonies of Stromatoporoidea and Tetracoralla predominate, whereas massive colonies of Tabulata and Stromatoporoidea are subordinate. *Amphipora* sp., *Clathrodictyon* sp., *Idiostroma* sp., *Stachyodes verticillata, Stachyodes* sp., *Stromatopora* sp., *Alveolites* sp., *Pterorrhiza berdensis* and *Disphyllum cylindricum* were found to occur in the whole interval and *Disphyllum caespitosum caespitosum* at the depth of 319 m. Distribution of fauna is more or less uniform for the whole interval, similarly as the quantity and preservation of the fossils. Particular branches are broken away from colonies and some individuals mechanically damaged. Broken-off branches are randomly scattered. Large fragments of colonies, including *Disphyllum* colonies, obtained in cores seem to indicate periods of predominance of biohermal-type sedimentation.

Borehole No BB-24 (Text-fig. 5). Devonian rocks recorded at depths from 214.8 to 351 m (end of drilling) are represented by alternation of limestones and dolomites which passes into dolomitic marls at the top. Coelenterata, found only in the lowermost part of the profile, are few, poorly preserved, randomly scattered. No larger fragments of colonies were noted. *Amphipora* sp., *Idiostroma* sp. and *Disphyllum cylindricum* were identified.

Borehole No BB-26 (Text-fig. 5). Devonian rocks recorded at the depth of 195.5 m are represented by grey, fine-crystalline dolomites abundant in specimens of *Disphyllum cylindricum, D. caespitosum, Clathrodictyon* sp. and *Idiostroma* sp. The core taken from the depth of 211—212 m consists exclusively of *D. cylindricum,* the arrangement of branches indicates one colony. From 213.5 m downward to 370.2 m in depth (the end of drilling) alternating Devonian limestones and dolomites without Coelenterata were pierced.

Klucze. — Borehole No BB-746 (Text-fig. 5). Devonian rocks recorded at the depths from 188.7 m to 652 m (end of drilling), are strongly differentiated with the predominance of limestones and calcareous marls. Coelenterata were recorded in an interval of 224.5—361.8 m. *Actinostroma clathratum, Actinostroma verrucosum, Actinostroma* sp., *Amphipora rudis, Amphipora* sp., *Athelodictyon* sp., *Clathrodictyon* sp., *Idiostroma roemeri, Idiostroma* sp., *Stachyodes verticillata, Stachyodes* sp., *Syringostroma* sp., *Neostringophyllum* sp. and *Disphyllum cylindricum* were found to occur in the whole mentioned interval.

Sedimentation of coral-bearing deposits presumably proceeded in the near-reef facies. This faunal assemblage inhabited shallow-water area, close to the surf zone, which is indicated by distinct predominance of massive, spherical or encrusting stromatoporoid colonies. Deposition took place presumably at the base of reef, where broken fragments of branchy co-

lonies, large amounts of skeleton fragments and occasionally individual corals were carried. A few small facial changes, characterized by decrease in abundance of fauna and by its flourishing, are marked in this sedimentational cycle. The whole assemblage is characteristic of the Lower Frasnian.

Borehole No B-743. Coelenterata were found here much deeper than in the neighbouring boreholes, at the depth of 602—604 m, in dark-grey dolomites yielding numerous Coelenterata colonies and abundant skeleton fragments. *Actinostroma* sp., *Stachyodus costata* and *Disphyllum cylindricum* were identified.

Borehole No B-570 (Text-fig. 5). Devonian Coelenterata were recorded in the following intervals: 1) at depths of 416—491 m, in grey fine-crystalline limestones with rusty spots and coats around coral branches. *Amphipora rudis, Amphipora* cf. *ramosa, Actinodictyon* sp., *Actinostroma* sp., *Clathrodictyon* sp., *Idiostroma fililaminatum, Idiostroma* sp., *Stachyodes costata, Stachyodes verticillata, Stromatopora* sp., and *Disphyllum cylindricum,* were found at depths of 468 and 469 m; 2) at the depth of 520 m, in light-grey dolomitic limestone, abundant *Thamnopora boloniensis* was noted; 3) at depths of 546—552 m, in dark-grey, fine-grained dolomite, strongly recrystallized specimens of *Actinodictyon* sp. and *Disphyllum cylindricum* were noted. The optimal conditions for the development of corals, i. e. near-reef facies prevailed during the sedimentation of the limestone recorded at the depth of 440—472 m. These limestones are characterized by faunal assemblage richest and most strongly diversified, and with maximal contribution of massive colonies. Coelenterata assemblage indicates the Lower Frasnian age of the whole series.

Golczowice. — Borehole No BJ-24. Tetracorals were recorded at a depth of 235.2—306.5 m, in dark-grey, massive limestone with rusty, or occasionally cherry-red spots. *Zonodigonophyllum* sp., *Disphyllum wirbelauense regulare* n. subsp., *Temnophyllum clavatum, Temnophyllum ornatum* and *Temnophyllum* sp. were identified. The occurrence of *Zonodigonophyllum* together with numerous representatives of *Temnophyllum* indicates the Upper Givetian age of the assemblage. The shallow depth of occurrence of Givetian deposits, which commonly are recorded at much greater depths, presumably results from tectonic disturbances, typical for this area.

Karniowice (Text-fig. 1, Table 1)

Borehole No IG-4 (Text-fig. 5). Devonian rocks were recorded at depths of 95.0—300.0 m (end of drilling). The coral fauna richest in number and species was found in the lowermost part of the profile, at depths 286.7—300.0 m, in light-grey, hard, bituminous limestones. *Amphipora* cf. *ramosa, Clathrodictyon* sp., *Coenites* sp., *Idiostroma* sp., *Stachyodes* sp., *Stromatopora* sp., *Cladopora gracilis, Alveolites* sp., *Thamnopora boloniensis, Tham-*

nopora micropora, "Charactophyllum" heterophyllum, Disphyllum cylindricum, D. hsianghsienense kosteskae, D. caespitosum caespitosum, Pterorrhiza berdensis, Pterorrhiza (Pexiphyllum) ultimum, Thamnophyllum germanicum and *Thamnophyllum unizonatum* were identified. Almost all types of colonies as well as individual corals are represented. Skeletal fragments are the main component of the rock, the contribution of which is much higher than that of limy cement; the fragments are randomly scattered and extremely variable in size; fragments of large colonies predominate. Abundance and taxonomic differentiation of the fauna, as well as its preservation seems to indicate a near-reef environment. The sedimentation presumably took place in talon of reef.

Conodonts found at depth of 291.8 m were identified by M. Chorowska as *Ancyrodella rotundiloba rotundiloba* (Lower-Middle Polygnathus asymmetricus Zone = 2.3—4).

Corals appear for the second time in dark dolomitic limestone at depths of 245—265 m. Branch forms of the genera *Stachyodes, Idiostroma, Alveolites* and *Thamnopora* predominate.

In the uppermost part of the profile, at depths of 144.5—145.6 m, corals were found in dark-grey, fine-crystalline, thick-bedded bituminous dolomites. The predominance of solitary corals is distinct; fragments of branchy colonies are far less numerous. *Coenites clathratus, "Charactophyllum" heterophyllum, Pterorrhiza berdensis, Thamnophyllum unizonatum* were identified. Moreover, crinoidal fragments were noted. Quite strong bituminization of the deposits as well as faunal assemblage seem to indicate deepening of the sea basin and inadequate aeration. Development of coral fauna was also impeded by contemporaneous volcanism, which fact is quite well evidenced.

The occurrence of *Ancyrodelle rotundiloba rotundiloba* as well as species of *Disphyllum* known exclusively from the Frasnian indicate the Lower Frasnian age of this assemblage.

POMERANIA

Borehole Polanów (Text-figs. 1, 5, Table 1) — A series of grey and grey-greenish sandy marls and limestones yields Devonian corals at the following depths:

1675—1686.5 m — *Clathrodictyon* sp., *Alveolites blanki, Pterorrhiza berdensis, Thamnophyllum kozlowskii* and *Disphyllum hsianghsienense kostestkae* in the uppermost part of this complex.

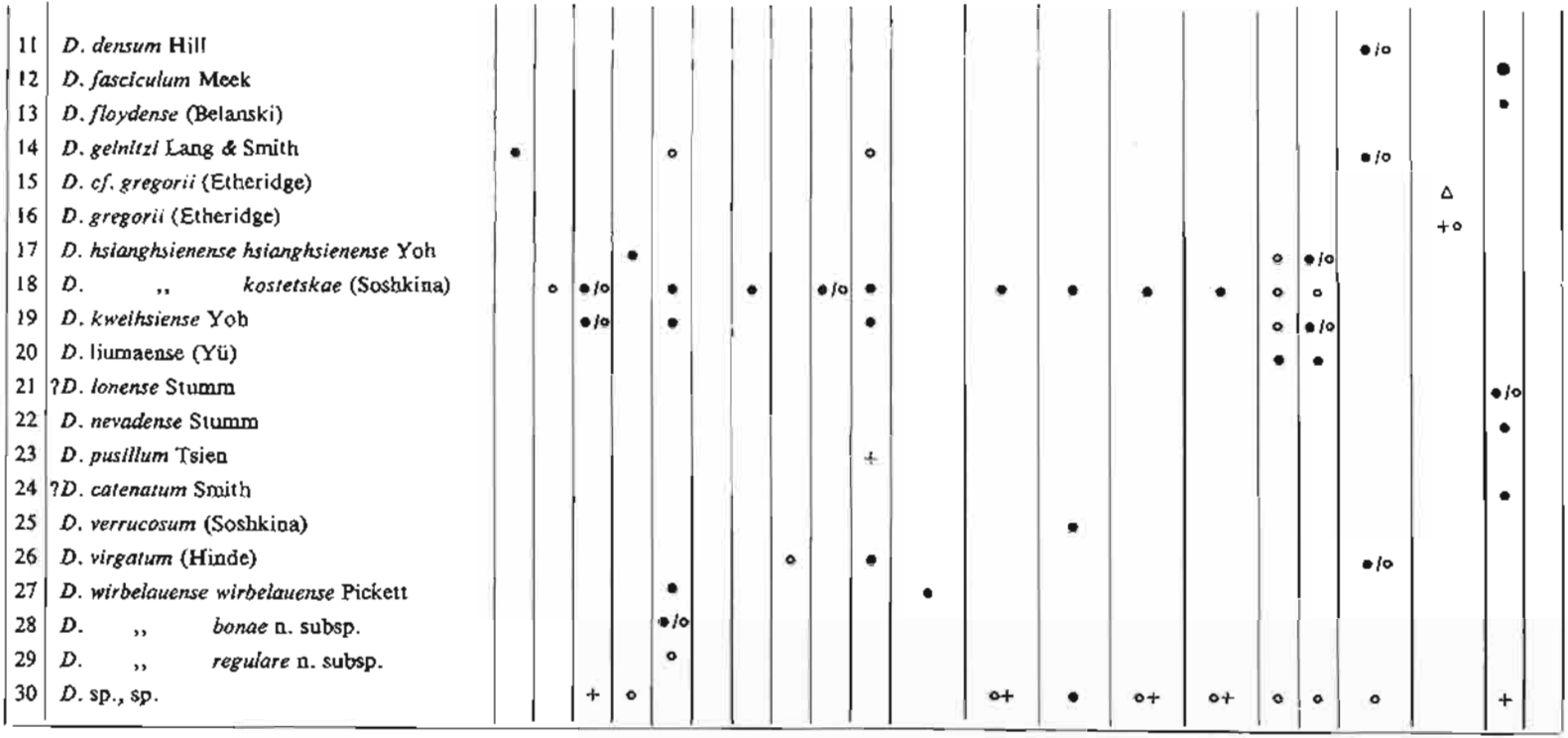
1716—1737 m — *Pterorrhiza supradevonica, Disphyllum hsianghsienense kostestkae.*

1787—1791 m — *Thamnopora boloniensis, Thamophyllum kozlowskii, Pterorrhiza supradevonica* and numerous *Disphyllum hsianghsienense kostestkae.*

Table 2

Palaeogeographic and stratigraphic range of the genus *Disphyllum* de Fromentel

	Species and subspecies	Mediterranean Hercynian Massifs				Central Hercynian Massifs			West Hercynian Massifs				Marine deposits in										
													U.S.S.R.						Australia		America		
		Spain	Austria	N. Africa	S.W. Asia	Poland	Moravia	Harz Mts.	N. France	S. England	Belgium	Rhine region	Ural Mts Tian-shan	Western USSR	Mediterran USSR	Central USSR	N-E USRR	China	West Australia	East Australia	W.N.A.	E.N.A.
1	*D. aequiseptatum* (M.E. & H.)								●/○	●/○	○	○											
2	*D. amoneum* (Padder)																			○			
3	*C. caespitosum caespitosum* (Goldfuss)	●	○	●/○	●	●	○		●/○	●/○	●	●/○	○			○	○	○	●/○				
4	*D.* ,, *pashiense* (Sosbkina)	●				●					●		●/○	●	●	●	○						
5	*D.* ,, *lazutkini* (Ivanija)	●		●/○	●	●					●					●							
6	*D.* ,, *furcatum* Altevogt	●																					
7	*D, compactum* Stumm																				○		
8	*D. couviniense* Tsien										+												
9	*D. curtum* Hill																		○				
10	*D. cylindricum* (Soshkina)				●	●							●		●								



Legend: • Frasnian; ○ Givetian; + Couvinian; △ Lower Devonian.

1791—1955 m — mass occurrence of *Thamnopora boloniensis*; whereas *Thamnophyllum germanicum* and *Disphyllum hsianghsienense kostestkae* are subordinate.

The Coelenterata assemblage listed above seems to be very characteristic, as it comprises the same species as the assemblage of the Polygnathus asymmetricus Zone of the Holy Cross Mts, differing only somewhat in percentage. The Coelenterata assemblage of Polanów is characterized by the mass occurrence of *Thamnopora boloniensis* and the lack or impoverishment of Stromatoporoidea, which, in contrast, distinctly predominate in coral faunas of the southern Poland during the Upper Givetian and particularly Lower Frasnian. The assemblage of Polanów is strongly influenced by the nearby land, which results in large supply of sand into the area of deposition. Stromatoporoids as having higher ecological requirements could not develop. Some species became dwarfish and present decreased size and simplified outline of their colonies (e. g. *Disphyllum hsianghsienense kostetskae*), whereas those with the lowest requirements do flourish. The assemblage is distinctly impoverished but still its particular species are typical for the lower or middle part of the Polygnathus asymmetricus Zone (Lower Frasnian).

Wyszebórz I. — The occurrence of *Disphyllum* is limited to the interval 2019—2021 m in this borehole profile, to which, therefore, the description refers. *Disphyllum*-bearing deposists are developed in the facies of grey-greenish marly limestones. Besides *Disphyllum caespitosum caespitosum*, preserved in the form of broken and crushed branches, small fragments of *Idiostroma* sp. were found. As it is mentioned (Text-fig. 6), *Disphyllum caespitosum caespitosum* is known to occur in Poland exclusively in the Frasnian. The lack of other fauna precludes more detailed age determination.

Koczała I. — As in the case of borehole Wyszebórz I, occurrence of *Disphyllum* is limited to one interval, 2680.1—2686.2 m. The specimens found were identified as *Disphyllum caespitosum caespitosum*, but with restriction, because it was impossible to make longitudinal sections. This form is accompanied by *Phillipsastraea macrommata*, *Pterorrhiza berdensis*, *Tabulophyllum* aff. *gorskyi*, *Temnophyllum* sp., *"Charactophyllum"* sp., *Alveolites* sp., *Thamnopora boloniensis* and *Stromatopora* sp. The presence of *Phillipsastraea macrommata*, according to the authors, establishes the Upper Frasnian age of this series.

CONSIDERATIONS ON STRATIGRAPHY

The cosmopolitan genus *Disphyllum* is known to occur from the Emsian-Couvinian (Strusz, 1961, 1965) to the Upper Frasnian (Table 2) whereas its particular species, still being widely distributed, are known from

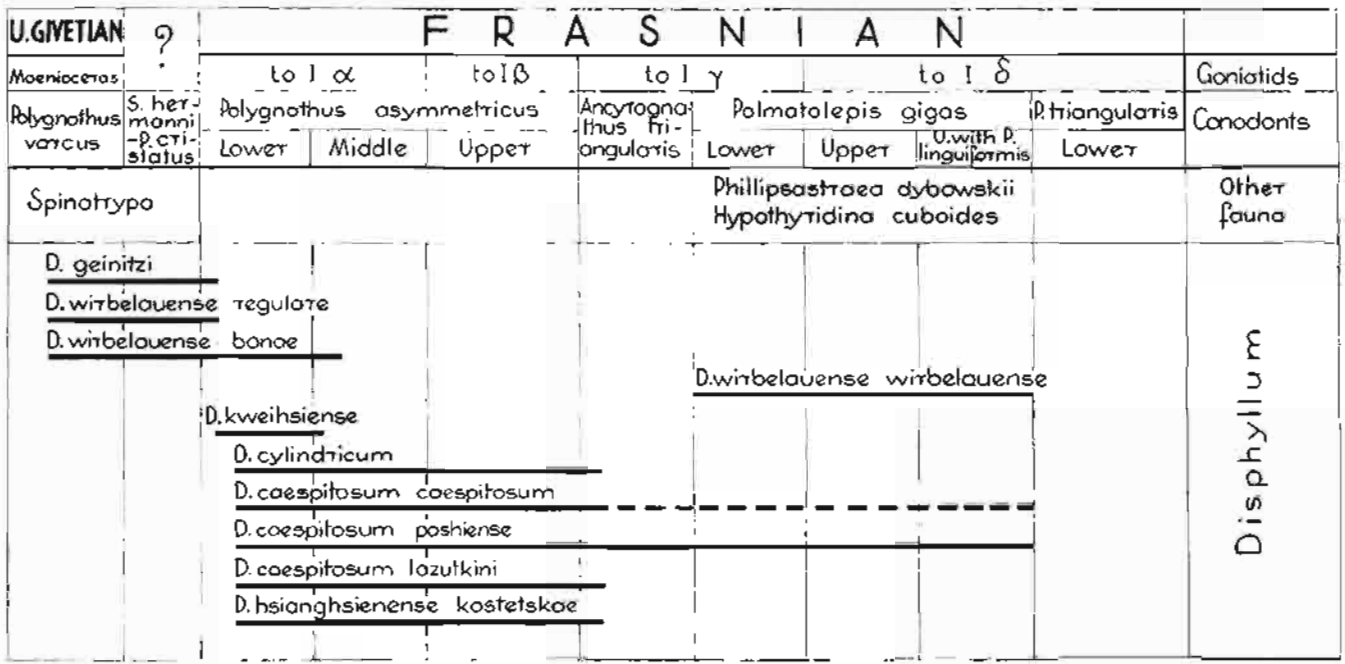


Fig. 6. Stratigraphical distribution of the genus *Disphyllum* in Poland.

narrow time-intervals. Similarly in Poland, the distribution of this genus is wide in the geographical sense (Text-fig. 1) and at the same time stratigraphically limited (Tables 1, 2, Text-fig. 6) Particular species are short-lived and variable depending of facies. However, the latter does not mean that the survival of species is directly related to the duration of facies. On the contrary, the above descriptions of exposures and boreholes show that nevertheless greater facial changes were marked since the Upper Givetian to the Upper Frasnian, species of that genus underwent changes. This confirms the stratigraphical value of these species. The value of them is increased by the fact that they are known to occur in biostromes and bioherms, i. e. in the zoogenic facies, where conodont zonation is not always possible.

The genus *Disphyllum* appeared in Poland probably in the uppermost Givetian. The age determinations of the Devonian limestones at Chęciny, Gałęzice (Stokówka hill), Sitkówka, Radkowice and Sosnówka are not certain, as neither goniatites nor conodonts were found in these localities. The rich Stromatoporoidea and Tabulata assemblages, accompanying *Disphyllum* are typical both for the Upper Givetian and Lower Frasnian. Part of these faunas was recently studied (Stasińska, 1958; Kaźmierczak, 1972) but the problem of their age still remains unsolved. The present authors tentatively accepted the Upper Givetian age of these limestones, which is widely accepted by those studying the Holy Cross Mts area, because disphyllids by themselves are insufficient for revision of this age determination.

Limestones litologically similar to these of the Holy Cross Mts. were recorded by boreholes in the Olkusz area (Borehole No BJ-24, depth of 235—306 m). Only tetracorals (*D. geinitzi* and *D. wirbelauense regulare* a. o.) were identified but relatively rich assemblage of Tabulata and Stromatoporoidea, very close to that of the Holy Cross Mts, was noted. These deposits, as in the above case, are assigned to the Upper Givetian.

The maximal distribution of *Disphyllum* in Poland is marked in the Lower Frasnian, the deposits of which are well-dated with conodont fauna of the Middle and Lower Polygnathus asymmetricus Zone. During this time, *Disphyllum* is the main component of bioherms and biostromes, which are numerous over the whole area of Poland.

In the Upper Polygnathus asymmetricus Zone without any visible change of facies, which remains calcareous, in the Holy Cross Mountains and neighbouring areas the extinction of disphyllids is noticed, whereas other groups of Coelenterata were developing quite exuberantly. No one of Lower and Middle Frasnian disphyllid species and subspecies enters the Upper Frasnian in this region, whereas *D. wirbelauense* wirbelauense appears there for the first time in Poland (at Sobiekurów). From the Upper Frasnian deposits outside the area of the Holy Cross Mts, *D. caespitosum pashiense* was found at Mokrzeszów (Sudetes) and presumed *D. caespitosum*

caespitosum at Koczała (Pomerania). The latter subspecific identification is not certain and it is possible that in Pomerania as in the Sudetes, *Disphyllum* is represented by the same subspecies, *D. caespitosum pashiense*.

PROBLEMS OF PALAEOGRAPHY AND MIGRATION

According to some authors (Hill 1940; Wang 1948; Strusz 1961; see p. 339) representatives of the genus *Disphyllum* appeared as early as the Upper Silurian. In fact, there is a striking resemblance between Silurian genus *Entelophyllum* Wedekind, and the genus *Disphyllum*. However, according to Pedder (1969, p. 253) this similarity undoubtedly results from homeomorphy.

Philip and Pedder (1967) presented a biostratigraphical subdivision of Devonian for eastern Australia based on conodont and tetracoral faunas. The first representative of the genus *Disphyllum* reported by them, *D. cf.*

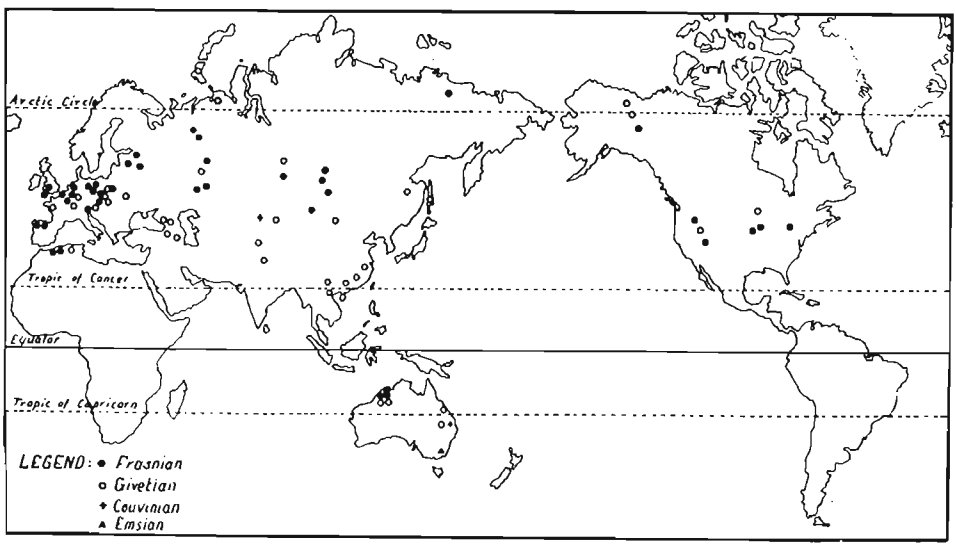


Fig. 7. Distribution of the species of the genus *Disphyllum* in the world.

gregorii, occurs as early as the Counvinian, the Kockeliana Zone, Garra Formation. In turn, Strusz (1965) suggested the possibility that *Disphyllum* appears as early as the Emsian-Couvinian (*D.* sp. aff. *gregorii*). Couvinian disphyllids are known from a few localities in different parts of the world: Belgium (Tsien, 1970), North Africa, Mediterranean and Uralo-Tien-Shan regions (Dubatolov & Spasskij, 1970) (Table 2). In the Givetian, *Disphyllum* is already widely distributed. Some species widespread in the Fras-

nian of Europe are already known in the Givetian of the Far East and Australia. In the Frasnian, disphyllid fauna becomes still more specifically differentiated and numerous. On all continents except for eastern Australia, it is represented by the same or slightly differing species and subspecies. A number of Givetian species continue to occur in the Frasnian, as *D. caespitosum, D. kweihsiense, D. hsianghsienense;* moreover some new subspecies appear: *D. caespitosum lazutkini, D. c. furcatum, D. hsianghsienense kostetskae.* Also some new species appear: *D. cylindricum, D. densum, D. verrucosum, D. magnun* and others (cf. Table 2). The disphyllid fauna of the "West-European" type is distributed all over the world, from western Australia to northern Africa and Spain, up to the coasts of the Arctic Ocean on the north. No faunal provinces may be distinguished for this period, as even disphyllids of the Pacific part of the North America bear a remarkable similarity to those known from the Eurasia (Hill, 1957).

Routes of migration. — The above data, although rather scarce, throw some light on routes of migration of disphyllid faunas. Although the first representatives of the genus *Disphyllum* are known from a few localities in different parts of the world and migration proceeded presumably along all possible sea-ways, the senior author suggests migration from east to west as the principal route. Eastern Australia with its poor Middle Devonian fauna (the Frasnian series are lacking) and the Atlantic part of the North America were presumably isolated from the rest of the continents characterized by the common disphyllid fauna. Both these isolated areas have no disphyllid species in common neither with Eurasia nor the western Australia.

The east-west route of migration is confirmed by the following data: 1) The disphyllid species as *D. hsianghsienense, D. kweihsiense* and *D. caespitosum,* the stratigraphical range of which is limited to the Frasnian in Europe, are known to occur as early as the Givetian in the Far East; the disphyllid fauna reached Spain not before the Frasnian; 2) Beside the main route of migration, presumably some shorter routes were used. One of such seaways was presumably from China in the southern direction to western Australia, which is confirmed by common or similar species found in both these regions; 3) The senior author assumes that *D. wirbelauense,* represented by its two subspecies, *D. w. bonae* n. subsp. and *D. w. regulare* n. subsp., appeared in Poland in the Givetian. From Poland this species migrated west to the Rhineland, whence its type subspecies is known from the Frasnian only; It is as well known in Poland, but only in the Upper Frasnian; 3) The main center of spreading of *Disphyllum* faunas was the Far East, presumably China. From there, the fauna spread west, south and nort-west to Siberia, and probably along the circum-Pacific way to the north-western part of North America.

The above assumptions are based on a critical review of the species of

the genus *Disphyllum* performed by the senior author (see List of disphylloid species and List of not disphylloid species, Tables 4, 5). World-wide distribution of *Disphyllum* is summarized on Text-fig. 7.

CONSIDERATIONS ON VARIABILITY AND TAXONOMY

The morphological variability in the genus *Disphyllum* is great and often it is difficult to decide whether a given structure resulted from adaptation or was genetically conditioned. Tsien (1968, 1970) noted in *Disphyllum* from Dinant and Namur basins of Belgium that structure is highly dependent on environment. The influence of environment is expressed according to Tsien in the calice structure, thickness and length of septa, structure of dissepimentarium and tabularium. It is widely accepted that colony outline also depends on environment. Dendroid colony passing in subcerioid develops in or close to surf zone, phaceloid beneath it, whereas weakly branching, dendroidal colonies develop where there is a supply of terrigenous matter (Polanów). According, to the senior author, although the variability is high, septal index together with structural pattern of skeleton interior may be accepted as constant criteria for specific identifications. The mean value n/d may be calculated on the basis of the graphs of septal number at particular corallite diameters for a given colony. Such graphs obtained for *D. hsianghsienense kostetskae* is given in Text-fig. 21, and for a few other species — in Text-fig. 25. It follows from these graphs that there is a certain number of corallites of two species, having the same number of major septa, e.g. *D. caespitosum* and *D. hsianghsiense kostetskae* occasionally have 24 major septa. It also happens that graphs for two species completely overlap, e.g. the graph for *D. cylindricum* completely falls within the range of the graph for *D. hsianghsienense kostetskae* (Text-fig. 25).

If this is the case then the second feature equally important as the septal index, i.e. structural pattern of corallite interior, is applied to specific identification. The basic structural features of particular species are as follows: 1) univerticilate dissepimentarium and complete, flat tabulae — for the group of *D. wirbelauense* Pickett, 2) poliverticilate dissepimentarium and tabularium consisting of axial and periaxial tabulae; axial tabulae flat, convex — for the group of *D. caespitosum*; 3) poliverticilate dissepimentarium is also found in *D. hsiangsienense*, which species is characterized by incomplete tabulae, narrow axial tabellae with auxiliary tent-shaped plates along their margins; these auxiliary plates result in apparent depression of axial part of corallite.

Subspecies are characterized by dominant septal index identical and similar structural pattern of the interior as that of the nominal subspecies. The differences are confined to some skeletal elements, *D. wirbelauense*

wirbelauense is characterized by short thick septa, whereas attenuation of tabular parts of the septa is typical for its Polish subspecies: in *D.w. bonae* n. subsp. the septa are very thin, straight, and in *D.w. regulare* n. subsp. — filamentous and slightly bent, almost regressive. In *D. caespitosum* group some changes in the pattern of axial tabellae take place: tabellae of the nominal subspecies are flat-convex, in *D.c. pashiense* they are arranged in sets, comprising 5 axial tabellae in extremal cases, in *D.c. lazutkini* they are high-convex, trapezoidal. For the tabellae of the latter type the term "Lazutkini type" is suggested by the senior author.

D. hsianghsienense kostetskae is characterized by auxiliary tent-shaped plates along tabella margins. Occasionally these plates may be semicircular in outline which results in cystiphylloid shape of corallite in longitudinal section. Although both *D. hsianghsienense kostetskae* and *D. cylindricum* have the same number of dominant major septa, 22, the specific rank of the name cylindricum proposed by Soshkina (1939) is regarded as valid in view of the existing differences in structural pattern of the interior. In contrast to the apparent depression of axial part of tabularium in *D.h. kostetskae*, the tabulae in *D. cylindricum* are flat and often complete.

Comparison of morphological features of particular species of the genus *Disphyllum* from Poland is given in Table 3.

BLASTOGENY

It was found that the representatives of the genus *Disphyllum* studied reproduced by lateral budding only. Two out of four types of lateral budding related to the width of dissepimentarium, distinguished by Jull (1965), were noted, i.e.: type II — specimens with narrow dissepimentarium, in which whole septa and dissepimenta of the budding sector undergo changes during the budding, and type III — specimens with wide dissepimentarium, in which only peripheral structures of the budding sector undergo changes. The above changes, according to the junior author, are not important for systematics, because they appear independently in different species and also in different genera from various epochs. They were stated in the present paper in Devonian corals. Previously Jull (*l.c.*) found them in Lower Carboniferous and Fedorowski (1965) in Lower Permian ones.

The budding, conversely than in the majority of the genera studied in this respect, may be regarded merely as one of the secondary diagnostic features for the genus *Disphyllum*. It seems, however, that it is occasionally diagnostic for particular species of this genus.

All species and supspecies studied may be divided into two groups: 1) *Disphyllum geinitzi*, 2) all other species. These groups differ in: a) bud of *D. geinitzi* inherits from parents corallite only peripheral parts of septa,

Table 3

Comparison of features of the *Disphyllum* species in Poland

Species and subspecies	Shape of corallum	n/d	Dominant n/d	Number of dissepiment ranges	Number of tabulae per 5 mm of the height	Periaxial tabellae	Tabulae	Stereozone
1. *D. wirbelauense wirbelauense* Pickett	subphaceloid	23—25/8.5—9.6	—	1	10	rare plates	complete, rhomboidal	continuous
2. *D. wirbelauense bonae* n. subsp.	dendroid	20—24/4—9	22/8	1	10—16	rare plates	complete, flat and convex	non continuous
3. *D. wirbelauense regulare* n. subsp.	phaceloid	18—27/4—14	23/8—9	1	7—15	lacking	complete, flat	continuous
4. *D. geinitzi* Lang & Smith	phaceloid	20—27/13	24—9	1—2	4—8	rare vesiculate	mostly complete	lacking
5. *D. kweihsiense* Yoh	subcerioid	18—21/8—10	20/8	1—3	16—29	vesiculate concave	incomplete, „lazutkini" type of tabellae	non continuous
6. *D. hsianghsienense kosterskae* (Soshkina)	subcerioid	18—26/6—15	22/9—10	2—5	3—6	vesiculate	incomplete, tabellae with cape-like accessory plates	non continuous
7. *D. cylindricum* (Soshkina)	dendroid	19—26/6—13	22/8	1—3	6—12	rare, vesiculate	often complete, flat	continuous, rarely incontinuous
8. *D. caespitosum caespitosum* (Goldfuss)	phaceloid	19—30/6—16	25/10—11	1—4	3—11	vesiculate	incomplete, flat or convex	lacking
9. *D. caespitosum pashiense* (Soshkina)	subphaceloid	21—29/8—16	25/11—12	1—5	9—11	vesiculate	incomplete, systems of convex tabellae	lacking
10. *D. caespitosum lazutkini* (Ivanija)	—	25—27/6—12	25/11	1—3	14—17	concave	incomplete tabellae of the „lazutkini" type	lacking

a fact which was also stressed by Różkowska (1960), whereas in all other species it inherits also inner parts of septa; b) bud of *D. geinitzi* is separated by fragmentary epitheca and not septotheca as in the case of all other species. The fact that the bud inherits peripheral parts of septa from parent corallite is common for both these groups.

The above differences are described in more detail in discussion on budding of particular species and may constitute the basis for determining the relationships within this genus. It seems that although *D. geinitzi* is known from the same time-interval as *D.w. bonae* n. subsp. and *D. w. regulare* n. subsp., and often even from the same locality, it is closely related neither to these nor to other Polish species of *Disphyllum*. Presumably *D. geinitzi* represents a side-branch, with an obscured affinity. At the same time it may be assumed that, although there are a distinct differences in morphology, both *D. wirbelauense bonae* n.subsp. and *D.w. regulare* n.subsp. are very close to Frasnian species of *Disphyllum* with wide dissepimentarium. This affinity is confirmed by two important features in common for both these groups, i.e. inheritance of peripheral and middle parts of septa of parent corallite by bud; and 2) separation of bud from parent corallite primarily by septotheca forming a distinct, permanent wall. Epitheca originated not before descendant corallite developed all primary specific features.

MICROSTRUCTURE

The microstructure of the genus *Disphyllum* has not hitherto been studied in detail. Some observations were given by Strusz (1965), Pickett (1967), Jell (1965) and Sorauf (1971). Here, the senior author presents her observations based on Polish material. The microstructure was studied in thin-sections in transmitted light, under binocular with 25-fold magnification.

Disphyllum belongs to the most primitive representatives of the superfamily Philipsastraeiceae. Its completely laminar septa are devoid carinae but covered with knobs sporadically distributed over their lateral surfaces. Trabeculae are monacanths almost vertically orientated (with up to 30° deviation) close to calice margin. Downwards, near the proximal end of corallite, trabeculae are almost horizontally orientated (with an angle with the vertical ca. 70—80°). Thus the whole set of trabeculae forms almost a half-fan in longitudinal section of septa (Strusz 1965, p. 524). In the material studied, such a half-fan is distinct in the specimen of *D. caespitosum lazutkini* (Pl. III, Fig. 3; Pl. XI, Fig. 10). Monacanths closely adjoin one another being separated by a dark line; their subaxial ends result in dentate appearance of septa margin (Pl. XI, Fig. 3). Monacanths measured in longitudinal section are variable in width, rang-

ing from 0.2 mm in *D. geinitzi* and *D. wirbelauense bonae* n. subsp. to 0.3 mm in *D. caespitosum lazutkini* and *D. kweihsiense*. Trabeculae are formed of sclerodermites with dark calcification center and calcite fibrils orientated towards sides and axis of corallite (Pl. XI, Figs. 3, 9). The number of monacanths is increased by fission (*D.c. lazutkini* in Pl. XI, Fig. 9). Besides trabecular structure, lamellar structure which results from basal secretion according to Schouppé & Stacul (1966) is marked in lateral parts of septum. This may be noted in the specimen of *D.c. lazutkini* figured in Pl. XI, Fig. 9: in the lower part of the specimen's septum, arcuate monacanths arranged in half-fan may be observed; in the upper part of the septum, they are obscured by coat with lamellar structure. Similar coat was found on the lateral surface of septum in *D. caespitosum* (Pl. XI, Figs. 5, 6). In the transversal section it may be noted that the wall consists of two layers closely adjoining one another; narrow dark epitheca (0.1 mm thick in *D. geinitzi*, 0.06 mm thick in *D.h. kostetskae*) and lamellar-fibrous wall (0.3 mm thick in *D.c. caespitosum*, 1.2 mm thick in *D. wirbelauense regulare*). In the lamellar-fibrous wall, sharp ends of lanceolate septa are set. When such a sharp end reaches epitheca, a septal groove is formed (e.g. in *D.c. caespitosum*); this relationship is confirmed by the lack of septal grooves in the cases when sharp septal ends do not reach epitheca (e.g. in *D. hsianghsienense kostetskae*). Septa may penetrate the wall slightly (*D. cylindricum*; Pl. XI, Fig. 8) or deeply (Pl. XI, Fig. 10). In the case of *D. wirbelauense regulare* n. subsp. peripheral parts of septa are so widened that they are contiguous and form septotheca (Pl. XI, Fig. 1); they are spindle-shaped in outline and the lamellar wall squeezes in between thick ends of septa in the form of wedge-like projections. In all other corallites studied, except for *D. cylindricum*, septa are isolated from one another. In *D. cylindricum*, where dissepimentarium is univerticilate, septotheca originates in some places.

Septa of the genus *Disphyllum* are commonly cuneate, i.e. widened in the peripheral part and narrower toward the axis. This widening is caused by sclerodermite fibrils elongated towards the sides (*B. cylindricum*; Pl. XI, Fig. 8). The septa are usually bicuneate, because they become thickened for the second time when passing through the thick-walled periaxial circle of dissepiments (Pl. XI, Fig. 8). Inner wall results from accumulation of sclerenchyme on septa and dissepiments; thus an apparent inner septotheca is formed. In *D. caespitosum lazutkini* (Pl. XI, Fig. 10) and *D. wirbelauense regulare* n. subsp. in the transverse section, a dark or light trabecular line and fibrils spreading to the sides may be noted in septum axis (Pl. XI, Fig. 1). Septa are directed straight to the axis; occasionally they are bent or lapped round the axis.

Lateral septal margins of numerous Polish representatives of this genus are covered with knobs. The knobs are weekly developed when septa are

Table 4

LIST OF DISPHYLLOID SPECIES

No	Species	Author	Locality	Age
		Great Britain		
1	*Cyathophyllum caespitosum Goldfuss*, 1826	M. Edw.-H., 1851, p. 384 1853, p. 229	Torquay, Newton, Plymouth	Devonian
	Disphyllum goldfussi (Geinitz, 1846) = *D. caespitosum* (Goldfuss)	Lang&Smith, 1935, p. 568	N. Devon	Frasnian/ Givetian
2	*Cyathophyllum aequiseptatum* M. Edw.-H., 1851	M. Edw.-H., 1851, p. 389 1853, p. 232	Ilfracombe Devonshire	Devonian
	Disphyllum aequiseptatum (M. Edw.-H., 1851)	Lang&Smith, 1935, p. 571	Sommerset N. Devon	Frasnian/ Givetian
3	*D. caespitosum* var. = *D. hsianghsienense kostetskae* (Soshkina, 1941)	Middleton 1959, p. 152	Devonshire	Frasnian
		France		
1	*Disphyllum goldfussi* (Geinitz, 1846) = *D. caespitosum* (Goldfuss, 1826)	Lang&Smith 1935, p. 569	Boulonnais Pas de Calais	Frasnian/ Givetian
		Belgium		
1	*Disphyllum goldfussi* (Geinitz, 1846) = *D. caespitosum* (Goldfuss, 1826)	Tsien 1970, p. 164	Gerpinne	Frasnian F2d
2	*D. aequiseptatum* (M. Edw.-H., 1851)	*ibid.*, p. 168	Mont d'Haurs	Givetian Gid
3	*D. virgatum* (Hinde, 1880)	*ibid.*, p. 166	Couvin	Frasnian Flc
4	*D. geinitzi* Lang&Smith, 1935	*ibid.*, p. 167	Séloignes	Givetian Gib
5	*D. crassiseptatum* Tsien, 1970 = *D. kweihsiense* Yoh, 1937	*ibid.*, p. 175	Senzeille	Frasnian, F2g, i
6	*D. gradatum* Tries, 1970 = *D. cylindricum* (Soshkina, 1969)	*ibid.*, p. 178	Rochefort	Frasnian F2d
7	*D. kostetskae* (Soshkina, 1949) = *D. hsianghsienense kostetskae* (Soshkina, 1949)	*ibid.*, p. 170	Gerpinne	Frasnian F2h
8	*D. hilli* Tsien, 1970 = *D. caespitosum lazutkini* (Ivanija, 1953)	*ibid.*, p. 174	Arche	Frasnian F2c
9	*D. couviniense* Tsien, 1969	Tsien, 1969 p. 56	Couvin	Couvinian Co2b
10	*D. pusillum* Tsien, 1969	*ibid.*, p. 56	,,	Couvinian Co2d
11	*D. virgatum simplex* Tsien, 1970	Tsien, 1970 p. 167	Hotton	Frasnian F1c
12	*Disphyllum* sp. 1 = *D. wirbelauense* n. subsp.	*ibid.*, p. 179	Sautour	Frasnian F2i

cont. table 4

No	Species	Author	Locality	Age
		Rhine Region		
1	*Cyathophyllum caespitosum* Goldfuss, 1826	Goldfuss, 1826, p. 60	Bergisch Gladbach, Bensberg	Frasnian/ Givetian
		Birenheide 1969, p. 38	,,	,,
	Disphyllum goldfussi (Geinitz 1846) = *D. caespitosum* (Goldfuss, 1826)	Lang&Smith 1935, p. 568	,,	,,
2	*Disphyllum wirbelauense* Pickett, 1967	Pickett, 1967, p. 47	Wirbelau/Lahn	L. Frasnian to I
		Harz Mountains		
1	*Cyathophyllum caespitosum* Goldfuss, 1826 = *D. hsianghsienense kostestkae* (Soshkina, 1949)	Roemer 1855 p. 29 Frech 1885, (partim)	Rübeland, Grund	Frasnian
		Moravia		
1	*Schlüteria emsti* Wedekind, 1922 = *D. caespitosum* (Goldfuss, 1826)	Kettnerova 1932, p. 52	Čelechovice	Givetian
		Austria		
1	*D. caespitosum* (Goldfuss, 1826) = *D. hsianghsienense kostestkae* (Soshkina, 1949)	Flügel, 1956 p. 7	Mühlbacher Kogel, Graz	,,
		Spain		
1	*Cyathophyllum caespitosum* Goldfuss = *D. caespitosum* (Goldfuss, 1826)	Baroois, 1882 p. 518	Asturia Candas	U. Frasnian
2	*D. geinitzi* Lang & Smith, 1935	Altevogt, 1963 p. 570	Pineres Asturia	Frasnian
3	*D. caespitosum cylindricum* (Soshkina, 1939) = *D. caespitosum pashiense* (Soshkina, 1939)	*ibid.*, p. 23	,,	,,
4	*D. lazutkini* (Ivanija, 1953) = *D. caespitosum lazutkini* (Ivanija, 1953)	*ibid.*, p. 20	Candas Asturia	,,
5	*D. caespitosum furcatum* Altevogt, 1963	*ibid.*, p. 21	,,	,,
6	*D. rugosum magnum* Altevogt, 1963 = = *D. magnum* Altevogt, 1963	*ibid.*, p. 19	Playa de Carranques Asturia	U. Frasnian
		North Africa		
1	*D. caespitosum breviseptatum* (Frech, 1886) = *D. caespitosum* (Goldfuss, 1826)	Semenoff-Tian-Chansky, 1961 p. 296)	Chénoua Algeria	Frasnian/ Givetian
2	*Disphyllum* sp. = *D. kweihsiense* Yoh, 1937	*ibid.*, p. 297	,, ,,	,,
3	*Disphyllum caespitosum* (Goldfuss, 1826) = *D. caespitosum lazutkini* (Ivanija, 1953)	*ibid.*, p. 294	,, ,,	,,

cont. table 4

No	Species	Author	Locality	Age
		USSR		
1	*Cyatophyllum caespitosum* Goldfuss, 1826 partim = *D. caespitosum* (Goldfuss, 1826)	Peetz, 1901 p. 203	Ural, Kuz-Bass	Frasnian/ Givetian
		Lebedev 1902, p. 70	Kuz-Bass	,,
	D. emsti Wedekind, 1922 = *D. caespitosum* (Goldfuss, 1826)	Kaplan 1959, p. 21	Bajanaul	Givetian
2	*Megaphyllum pashiense* Soshkina, 1939 = *M. katavense* Soshkina, 1939 = *D. caespitosum pashiense* (Soshkina, 1939)	Soshkina, 1939 p. 14	Ural	Frasnian
		Degtiarev 1951, p. 9	,,	,,
		Soshkina, 1952 p. 105	Timan Armenia	,,
	Megaphyllum pashiense Soshkina, 1939 = *D. caespitosum pashiense* (Soshkina, 1939)	Ivanija, 1953 p. 31		
		Bulvanker 1958, p. 187	Kuz-Bass	,,
		Ermakowa 1960, p. 6	Russka Platforma	,, ,,
		Besprozvannych 1964, p. 75	Kolyvan, Tomsk	Givetian
	Disphyllum pashiense (Soshkina, 1939) = *D. caespitosum pashiense* Soshkina, 1939)	Ivanija, 1965 p. 208	Kuz-Bass	Frasnian
3	*Megaphyllum cylindricum* Soshkina, 1939 = *D. cylindricum* (Soshkina, 1939)	Soshkina, 1939 p. 16	Ural	,,
	Schlüteria emsti Wedekind, 1922 = = *D. cylindricum* (Soshkina, 1939)	Spasskij, 1955 p. 136	,,	,,
4	*Schlüteria emsti* Wedekind, 1922 = = *D. hsiangsienense kostestkae* (Soshkina, 1949)	Soshkina, 1939 p. 29	,,	,,
	Schlüteria kostestkae Soshkina, 1949 = *D. hsiansgsienense kostestkae* (Soshkina, 1949)	Soshkina, 1949 p. 148	,,	,,
		Soshkina, 1952 p. 100	Armenia, Timan Russka Platforma	,,
		Ermakova, 1960 p. 7	Russka Platforma, Timan	,,
5	*Schluteria verrucosa* Soshkina, 1952 = *D. verrucosum* (Soshkina, 1952)	Soshkina, 1952 p. 100	Russka Platforma	,,
		Ermakova, 1960 p. 7	,, ,,	,,
6	*Schluteria lazutkini* Ivanija, 1953 = = *S. typica* Ivanija, 1953 = *S. striata* Ivanija, 1953 = *D. caespitosum lazutkini* (Ivanija, 1953)	Ivanija, 1953 p. 26	Kuz-Bass, Altai-Sajan	Frasnian
		Bulvanker, 1958 p. 129	Kuz-Bass	,,
	D. lazutkini (Ivanija, 1953) = *D. caespitosum lazutkini* (Ivanija, 1953)	Ivanija, 1965 p. 211	Kuz-Bass, Altai-Sajan	,,

cont. table 4

No	Species	Author	Locality	Age
	Asia (U.S.S.R excluded)			
1	*Cyathophyllum ceaspitosum* Goldfuss, 1826 = *D. hianghsienense* Yoh, 1937	Penecke, 1904 p. 146	Hadshin Anti-taurus	,,
2	*C.* (*Thamnophyllum*) sp. = *D. cylindricum* (Soshkina, 1939)	Reed, 1922 p. 14	Chitral	,,
3	*C.* (*Fasciculatia*) *caespitosa* var. *breviseptata* (Frech, 1855) = *D. hsianghsienense* kostetskae (Soshkina, 1949)	Yabe & Hayasaka, 1920 pl. VIII, Fig. 7	Shechuan, S. China	Givetian
	D. goldfussi (Geinitz, 1846) = *D. hsianghsienense kostetskae* (Soshkina, 1949)	Ma, 1937, p. 10	,, ,,	,,
4	*D. liumaense* Yii, 1947	Yü, 1947	Kwangsi, China	Frasnian
5	*D. varium kweihsiense* Yoh, 1937 = *D. kweihsiense* Yoh, 1937	Yoh, 1937 p. 61	,, ,,	Givetian
6	*D. goldfussi hsianghsiense* Yoh, 1937 = *D. hsianghsienense* Yoh, 1937	*ibid.*, p. 63	,, ,,	,,
	West Australia			
1	*Cyathophyllum depressum* Hinde, 1890 = *D. depressum* (Hinde, 1890)	Hinde, 1890 p. 195	West-Kimberleys	Devonian
	D. depressum (Hinde, 1890)	Hill, 1954 p. 7	,,	Givetian
2	*D. goldfussi* (Geinitz, 1846) = *D. caespitosum* (Goldfuss, 1826)	*ibid.*, p. 7	,,	Frasnian/ Givetian
3	*Cyathophyllum virgatum* Hinde, 1890 = *D. virgatum* (Hinde, 1890)	Hinde, 1890 p. 194	,,	Devonian
	D. virgatum (Hinde, 1890)	Hill, 1954 p. 7	,,	Frasnian/ Givetian
4	*D. virgatum variabile* Hill, 1954 = *D. hsiangsienense* Yoh, 1937	*ibid.*, p. 7	Carnarvon Basin	Givetian
5	*D. virgatum densum* Hill, 1954 = *D. densum*, Hill, 1954	*ibid.*, p. 7	West Kimberleys	,,
6	*D. curtum* Hill, 1954	*ibid.*, p. 7	,,	,,
	East Australia			
1	*Campophyllum gregorii* Etheridge 1892 = *D. gregorii* (Etheridge, 1892)	Etheridge, 1892, p. 60	Queensland	Givetian
2	*D. cf. gregorii* (Etheridge, 1892)	Hill, 1942 p. 151 Strusz 1965 p. 537	Garra Formation N.S.W.	Couvinian
3	*D. goldfussi* (Geinitz, 1846) = *D. caespitosum* (Goldfuss, 1826)	Hill 1954, p. 108	Waratah Bay Victoria	Givetian
4	*Amaraphyllum amoenum* Pedder, 1969 = *D. amaonum* (Pedder, 1969)	Pedder, 1969 p. 252	Timor Limestone N.S.W.	,,

cont. table 4

No	Species	Author	Locality	Age
		North America		
1	*Disphyllum fasciculum* Meek, 1877 = = *D. fasciculum* (Meek, 1877)	Meek, 1877	Nevada	Frasnian (Pedder in litt.)
2	*Cylindrophyllum floydense* Belanski, 1928 = *D. floydense* (Belansky, 1928)	Belansky, 1928	Iova	Frasnian (Oliver in litt.)
3	*D. lonense* Stumm, 1938	Stumm, 1938 p. 481	Nevada	Frasnian/ Givetian
4	?*D. nevadense* Stumm, 1939	Stumm, 1939 p. 63	Nevada	Frasnian (Pedder in litt.)
5	?*D. catenatum* Smith, 1945	Smith, 1945 p. 21	Mackenzie River Region	Frasnian
6	*D. compactus* Ehlers & Stumm, 1949	Ehlers & Stumm, 1949 p. 22	Traverse Group Michigan	Givetian (Cylindrophyllum Oliver in litt.)

Table 5

LIST OF NOT DISPHYLLOID SPECIES

No.	Species	Author	Locality Age	Remarks
		Great Britain		
1	*Disphyllum* (*Phacellophyllum*) *caespitosum* (Goldfuss, 1826)	Tailor 1950 p. 186	Plymouth Givetian	= *Thamnophyllum*
2	*Disphyllum* sp. aff. *caespitosum* (Goldfuss, 1826)	Scrutton 1965, p. 104	Hudleigh Givetian	carinated septa
3	*Disphyllum goldfussi* (Geinitz, 1846)	British Palaeozoic fossils 1964 Pl. 32, Fig. 5	South-Devon ?Givetian	herringbone dissepiments
4	*Disphyllum* sp.	Middleton 1959, p. 152	Devonshire Frasnian	minor septa reduced
5	*Disphyllum* sp. *A*	Fagerstrom 1961, p. 14	,,	*Acinophyllum mclareni* Oliver (pers. comm.)
6	*Disphyllum* sp. *B*	*ibid.*, p. 14	,,	*Cylindrophyllum* Oliver (pers. comm.)
		France		
1	*Cyathophyllum* (*Disphyllum*) *goldfussi* (Geinitz, 1846)	Le Maître 1937, p. 108	La Ville Dé d'Ardin Givetian	solitary coral Semenoff-Tian-Chansky (pers. com.)
2	*Cyathophyllum* (*Disphyllum*) *virgatum* (Hinde, 1890)	*ibid.*, p. 107	,,	,, ,,

cont. table 5

No	Species	Author	Locality Age	Remarks
		Belgium		
1	*Disphyllum fasciculare* (Soshkina, 1939)	Tsien, 1970, p. 171	Sautour F2i	carinated
2	*Disphyllum grabaui* Tsien, 1970	*ibid.*, p. 170	Arche F2d	herringbone dissepiments
3	*Disphyllum* sp. 2	*ibid.*, p. 179	Frasnian F2c	carinated
		North Africa		
1	*Disphyllum rugosum* (Wedekind, 1922)	Semenoff-Tien-Chansky 1961, p. 295	Chénoua Algeria Frasnian/ Givetian	carinated
		U.S.R.R.		
1	*Disphyllum caespitosum* (Soshkina, 1939)	Ivanija 1965, p. 209	Kuz-Bass Frasnian	three-order septa = *Pseudostringo-phyllum* Soshkina, 1939
		Asia (U.S.R.R. excluded)		
1	*Disphyllum* cf. *goldfussi* (Geinitz, 1846)	Wang, 1948, p. 7	Yunnan Givetian	carinated
2	*D. caespitosum emsti* (Wedekind, 1922)	Flugel, 1961, p. 382	Feke Anti-taurus Givetian	minor septa contratingent
3	*D. liumaense* Yü, 1947	Fontaine, 1961, p. 96	Bac Son Givetian	herringbone dissepiments
4	*Disphyllum* sp.	*ibid.*, p. 97	,,	carinated
5	*D. siluriense* Wang, 1948	Wang, 1948 p. 7	Yunnan Givetian	nomen nudum
6	*D. caespitosum tricyclicum* Schouppé, 1965	Schouppé, 1965, p. 22	Chitral Frasnian	three-order septa
		East Australia		
1	*Disphyllum robustum* (Etheridge, 1898)	Hill, 1942 p. 150	Tamworth District N.S.W. Couvinian	lateral processes = *Synaptophyllum* Simpson, 1900
2	*D. gemmiforme* (Etheridge, 1899)	Hill, 1940 p. 259	Murrum-bidgee N.S.W. Givetian	*Zelolasma* Pedder, 1963
3	*D. arundinaceum* (Lonsdale, 1845)	Hill, 1937 p. 147	N.S.W. Devonian	lateral processes = *Synaptophyllum* Simpson, 1900
4	*D. sp. aff. floydense* (Belanski, 1928)	Strusz, 1961 p. 339	N.S.W. Ludlow	rhabdacanthine trabeculae
5	*D. praecox* Hill, 1940	Hill, 1940 p. 398	Yass Bowning District Silurian	,, ,,

cont. table 5

No	Species	Author	Locality Age	Remarks
6	*D. mesa* Hill, 1942	Hill, 1942 p. 185	Wellington District Koblencian	horse shor dissepiments = = *Thamnophyllum* Penecke
7	*D. angulare* Hill, 1950	Hill, 1950 p. 141	Buchan District Victoria Givetian	*Chalcidophyllum* Pedder, 1963
8	*D. spelaeanum* Hill, 1950	*ibid.*, p. 141	Couvinian	fan-shaped trabeculae
9	*D. incongruum* Philip, 1960	Philip, 1960 p. 179	Coopers Creek Formation Victoria	axial structure
10	*D. cognatus* Philip, 1962	*ibid.*, p. 177	,,	carinated
		West Australia		
1	*Disphyllum intertextus* Hill, 1954	Hill, 1954 p. 22	West Kimberleys U. Pillara Limestone Frasnian	septa interfingering axially
		North America		
1	*Disphyllum goldfussi* (Geinitz, 1846)	Lenz, 1961 p. 501	Ramparts Limestone Givetian	*Temophyllum* Walther, 1928
2	*D. disjunctus* (Whiteaves, 1891)	Warren & Stelck, 1956	Peace River Region Givetian	*Dendrostella* Glinski (Oliver in litt.)
3	*D. callavaense* Bransen, 1924	Stumm 1935 Cart 130	Callaway Limestone Givetian	minor septa lacking
4	*D. occidens* Stumm, 1938	Stumm, 1938 p. 480	Nevada Givetian	cyathophylloid
5	*D. colemanense* (Warren, 1938)	Stumm, 1955 Cart 132	Calvinaria Albertus Zone Frasnian	thamnophylloid
6	*D. nevadense* Stumm, 1939	*ibid.*, Cart 147	Nevada Frasnian	*Cylindrophyllum* Simpson, 1960 (Oliver in litt.)
7	*D.* (*Synaptophyllum*) *camselli* Smith, 1945	Smith, 1946 p. 23	Mackenzie River Frasnian	carinated
8	*D. dyeri* Cranswick & Fritz, 1958	Cranswick & Fritz, 1958	Kwataboakagan Couvinian	not disphylloid (Pedder in litt.)
9	*D. salicis* McLaren, 1964	McLaren, 1964 p. 7	Mackenzie District Givetian	herringbone dissepiments
10	*D. synaptophylloides*	Stumm, 1965	Jeffersville Givetian	peripheral offsets (Oliver in litt.)

thin (Pl. XI, Fig. 10), and prominent when septa are thick (Pl. XI, Fig. 8); they were not found in the case of *D. wirbelauense regulare* n. subsp. (Pl. XI, Fig. 1), characterized by short septa. These knobs result from translocation of sclerodermites from axial line to the sides of septa. The senior author does not regard the knobs as carinae and shares Jell's (1969, p. 53) viewpoint that carinae develop in the presence of rhipidacanths, i.e. complex trabeculae, common in the family Phillipsastraeidae, similar to yeard-arm carinae of *Heliophyllum* (Smith 1945, p. 5). There is one more type, zig-zag carinae (Lang 1925, p. 429) which arises when single trabeculae do not adjoin one another in a regular way but are set in alternate line. Such permanent structures, regular in occurrence, are of taxonomical importance. However, knobs in *Disphyllum* occur sporadically and are randomly distributed; thus they cannot be considered a diagnostic feature. In the case of *Schlüteria rugosa* Wedekind, 1922, carinae are weakly projecting but regularly spaced and distinct in transversal section. According to the senior author, *S. rugosa* does not belong to the genus *Disphyllum*.

SYSTEMATIC DESCRIPTION

Order **Rugosa**
Suborder **Streptelasmatina** Wedekind, 1927
Superfamily **Phillipsastraeicae** Roemer, 1883
Family **Disphyllidae** Hill, 1939
Genus *Disphyllum* de Fromentel, 1861
(Type species: *Cyathophyllum caespitosum* Goldfuss, 1826)

Synonyms:

1826. *Cyathophyllum*; G. A. Goldfuss, Petrefacta.., p. 54, partim.
1846. *Cladocora*; H. B. Geinitz, Grundriss.., p. 569.
1873. *Cyathophyllum*; W. N. Dybowski, Monographie.., p. 416, partim.
1893. *Cannophyllum*; E. J. Chapman, On the corals..., p. 39.
1896. *Fascicularia*; G. Gürich, Das Palaeozoicum..., p. 167, partim.
1922. *Schlüteria*; R. Wedekind, Beiträge zur Kenntniss..., p. 3, partim.
1939. *Megaphyllum*; E. D. Soshkina, Verchnedevonskie korally..., p. 14, 16.
1971. *Amaraphyllum*; A. E. H. Pedder, An interim..., p. 252.
non 1922. *Pseudostringophyllum*; E. D. Soshkina, Verchnedevonskie..., p. 36.
non 1941. *Ceratinella*; E. D. Soshkina, p. 36.

Species assigned: Cyathophyllum caespitosum Goldfuss, 1826; *Cladocora goldfussi* Geinitz, 1846; *Cyathophyllum aequiseptatum* M. Edw.-H., 1853; *Diphyphyllum fasciculum* Meek, 1877 (according to Pedder); *Cyathophyllum virgatum* Hinde, 1890; *Campophyllum gregorii* Etheridge, 1899; *Diphyphyllum robustum* Etheridge, 1899; *Schlüteria emsti* Wedekind, 1922; *Cylindrophyllum floydense* Belanski, 1928; *Disphyllum geinitzi* Lang & Smith, 1935; *D. varium kweihsiense* Yoh, 1937; *D. goldfussi hsianghsienense* Yoh, 1937; *D. lonense* Stumm, 1938; *D. nevadense* Stumm, 1939 (according to Pedder); *Megaphyllum pashiense* Soshkina, 1939; *M. katavense* Soshkina, 1939; *M. cylindricum* Soshkina, 1939; *Disphyllum compactum* Ehlers & Stumm, 1940

(according to Pedder); *Schlüteria kostetskae* Soshkina, 1949; *S. verrucosa* Soshkina, 1952; *S. lazutkini* Ivanija, 1953; *S. striata* Ivanija, 1953; *S. typica* Ivanija, 1953; *Disphyllum virgatum densum* Hill, 1954; *D. virgatum variabile* Hill, 1954; *D. curtum* Hill, 1954; *D. caespitosum cylindricum* Altevogt, 1963; *D. rugosum magnum* Altevogt, 1963; *D. caespitosum furcatum* Altevogt, 1963; *D. synaptophylloides* Stumm, 1965; *D. wirbelauense* Pickett, 1967; *D. pusillum* Tsien, 1967; *D. couvinense* Tsien, 1969; *D. crassiseptatum* Tsien, 1970; *D. grabaui* Tsien, 1970; *D. gradatum* Tsien, 1970; *Amaraphyllum amoenum* Pedder, 1971 *D. wirbelauense bonae* n.subsp.; *D. w. regulare* n.subsp..

According to the senior author all species attributed to the genus *Disphyllum*, which are not listed above, do not belong to this genus (see also List of not disphylloid species pp..., Table 5).

New diagnosis. — Dendroid, phaceloid and subcerioid corals with epitheca; no solitary corals; budding intracalicinal; septa of two orders: major septa not reaching the axis, minor septa shorter; all septa complete with smooth margins, feebly knobbed (no yard-arm and zig-zag carinae); dissepimentarium narrow to wide; dissepiments uniform (horse-shoe, lonsdaloid and herringbone dissepiments lacking); no axial structure; tabularium uni-bi or triserial; septa with coarse monacanths, parallel and horizontal or forming half-fans.

Disphyllum wirbelauense Pickett, 1967

1967. *Disphyllum wirbelauense* Pickett; J. Pickett, Untersuchungen..., p. 47, Text-fig. 12, Pl. 6, Fig. 25a, b.

Revised diagnosis. — A *Disphyllum* with septal index 22—27/7—14, with short septa, 1 circle of dissepiments and commonly with stereozone; tabulae continuous, convex or flat.

Remarks. — Pickett has described this species from the Frasnian of Rhineland. In Poland, the nominative subspecies is also known from the Frasnian, whereas new subspecies, *D. w. bonae* n. subsp. and *D. w. regulare* n. subsp., are more common in the Givetian. The subspecies differ from one another in the length and thickness of septa, *D. geinitzi* is very similar to *D. wirbelauense* in narrow dissepimentarium and short septa, differing in distinctly thinner skeletal elements, almost complete lack of sclerenchyme accumulation and occurrence of two irregular verticils of dissepiments.

Occurrence. — Poland: Holy Cross Mts, Givetian-Frasnian. Germany: Rhineland, Frasnian.

Disphyllum wirbelauense wirbelauense Pickett, 1967

(Pl. II, Fig. 6; Text-fig. 8a, b)

1967. *Disphyllum wirbelauense* Pickett; J. Pickett, Untersuchungen..., p. 47, Text-fig. 12, Pl. 6, Fig. 25a, b.

Diagnosis. — A *Disphyllum wirbelauense* with septal index 23—25/8.5—9.6; major septa thick, straight, short (sI < 1/2r); stereozone predominates.

Material. — Two fragments of single corallites; 2 thin-sections.

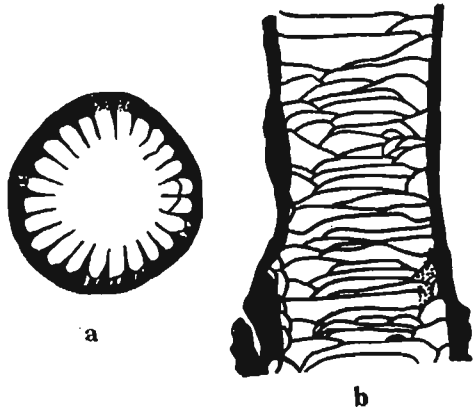


Fig. 8. *Disphyllum wirbelauense wirbelauense* Pickett (No. Z. Pal. P. Tc-5/12), Sobiekurów, Upper Frasnian: a — transverse section, b — longitudinal section; ×3.

Description. — Transversal section. Stereozone peripheral, narrow, with dissepiments occasionally visible; lanceolate ends of septa set in sterozone; major septa short; minor septa do not project outside stereozone.

Longitudinal section. — Stereozone narrow, adjoined by continuous tabulae rhomboidal in outline; accessory plates placed above axial parts of tabulae. In places, sets of accessory plates over a single continuous tabula may be formed; then tabula is accompanied by periaxial tabulae.

Remarks. — Specimens from Sobiekurów are very close to those from Wirbelau described by Pickett (1967), differing in somewhat thinner septa.

Occurrence. — Poland: Holy Cross Mts, Sobiekurów near Opatów, Upper Frasnian, the Phillipsastrea dybowskii Zone. Germany: Rhineland, Lower Frasnian.

Disphyllum wirbelauense bonae n. subsp.

(Pl. II, Figs. 1—5, Text-figs. 9—12)

Holotypus: Specimen No Z. Pal. P. Tc. 5/1, figured in Pl. II, Fig. 1.

Locus typicus: Chęciny, Holy Cross Mts.

Stratum typicum: Upper Givetian.

Derivatio nominis: After Queen Bona, who had the castle on Góra Zamkowa (Zamkowa hill) at Chęciny built.

Diagnosis. — A *Disphyllum wirbelauense* with septal index 20—24/4—9 and dominant number of major septa equalling 22; major septa thin,

straight, long (sl > 1/2r); inner wall continuous; tabulae complete, arranged in sets with accessory plates.

Material. — Approximately 30 limestone blocks with corallite fragments and ca. 100 separate corallites; 31 thin-sections and 10 peels.

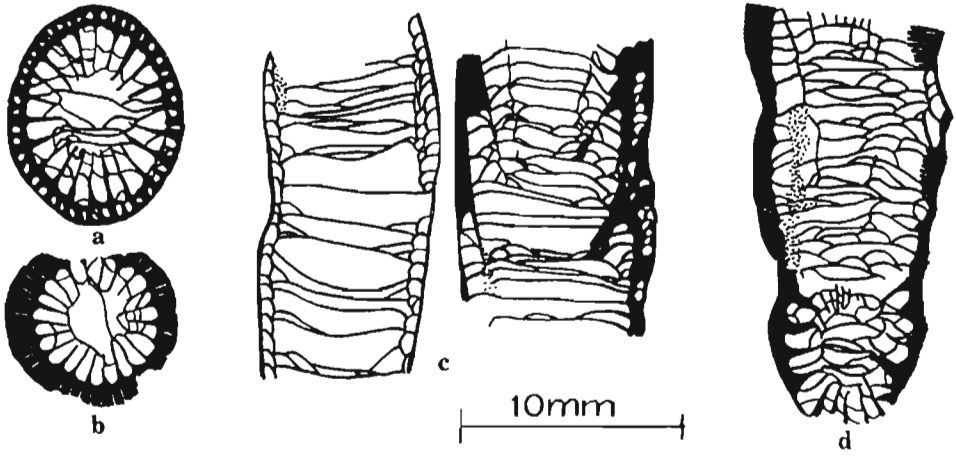


Fig. 9. *Disphyllum wirbelauense bonae* n.subsp.: a — transverse section of corallite with one row of dissepiments, b — coral with thick stereozone, c — longitudinal section with one range of dissepiments (No. Z. Pal. P. Tc-5/10); d — longitudinal section of corallite with stereozone (No. Z. Pal. P. Tc-5/13). All specimens from Chęciny near Kielce, Uppermost Givetian.

Description. — Corallites subcylindrical, up to 55 mm long and covered with smooth epitheca. Calice deep, with sharp margin, steep walls and flat bottom. Buds set at an angle of 60—80°.

Transversal section. — Corallite circular in cross-section, with external wall 0.4 mm thick. Inner wall similar in thickness, and formed of ends of septa peripherally widened and periaxial walls of dissepiments, covered by thick layer of sclerenchyme. Major septa long, thin over tabularium area. Minor septa do not enter tabularium area.

Longitudinal section. — One row of spherical dissepiments almost vertically arranged between thickened external and internal walls. Trabeculae almost horizontally orientated (set at an angle to the vertical ca. 80°), 0.15 mm thick. Tabulae continuous, bent downwards at the margins and with numerous accessory plates. Along 5 mm section 15 tabulae with their accessory plates were counted.

Blastogeny. — *D. wirbelauense bonae* n. subsp. is characterized by a narrow dissepimentarium, thus budding proceeds in the whole dissepimentarium and nearly the whole septa in budding sector are influenced by changes. Formation of septal apparatus is, therefore, very similar to that of *D. caespitosum* (cf. below), although there are differences in the width of dissepimentarium.

The hystero-nepionic stage begins with deformation of the septal apparatus within the budding sector. In the specimen figured in Text-fig. 10, initially only two major septa and minor septum situated between the former, are influenced by changes; in the minor septum these changes are expressed by its elongation. The narrow and shallow budding sector (Text-

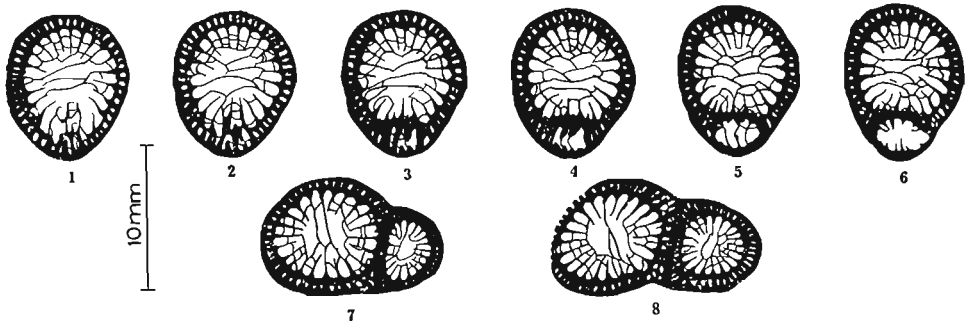


Fig. 10. *Disphyllum wirbelauense bonae* n.subsp. (No. Z. Pal. Tc-5/); Chęciny near Kielce, uppermost Givetian. Sections of successive blastogenic stages.

fig. $10_{1,2}$) in which the tabularium of bud is not yet differentiated, gradually extends sideways involving successive septa of parent corallite. The increment of bud convexity is accompanied by subdivision of succesive septa of budding sector into thick peripheral and inner sections. Thin, periaxial sections of septa of parent corallite are not subjected to extensive

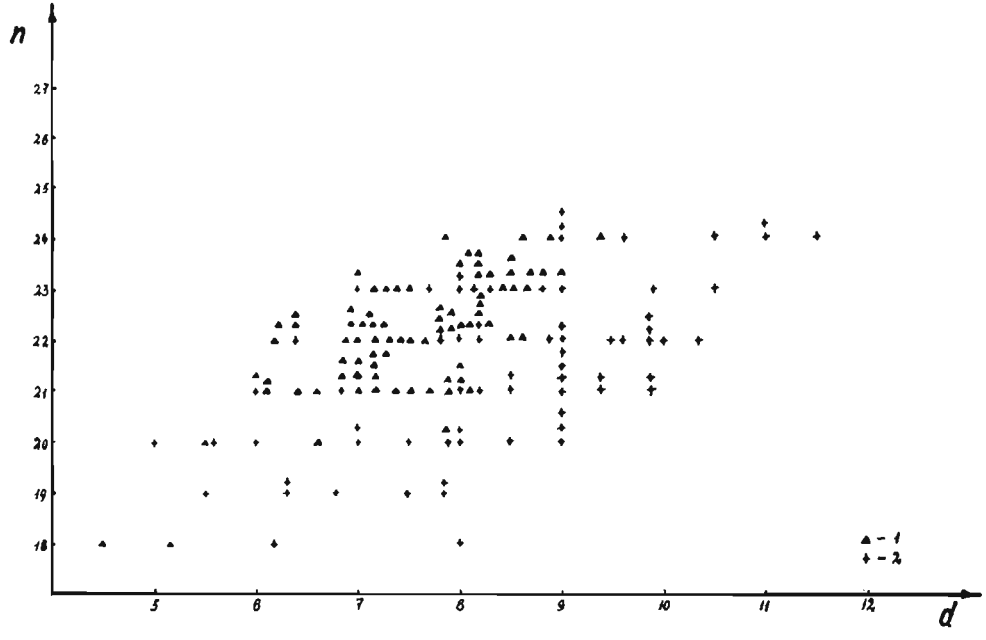


Fig. 11. *Disphyllum wirbelauense* group. Scatter diagram of number of major septa versus corallite diameter. 1 — *D. w. bonae* n.subsp., 2 — *D. w. regulare* n.subsp.

changes during this process and the free axial field of parent corallite remains almost unchanged during blastogeny. Inner sections of septa, which are common for parent corallite and bud, undergo shortening in the bud and thickening at the boundary between both individuals. The latter results in formation of septotheca (Text-fig. 10_{4-6}).

Increment of septa is more rapid in bud than in parent corallite and proceeds along the whole bud periphery including bud- and parent-corallite boundary. This inequality in septum increment results in differences between bud and parent corallite septothecas in density and number of elements. In the case of the former septotheca, major and minor septa appear simultaneously. Moreover, radial septal pattern precludes identification of major protoseptum.

In this species, as in the case of *D. caespitosum*, moment of transition from hystero-nepionic to hystero-neanic stage is difficult to determine. Skeletal parts of both individuals are soon completely separated by the septotheca, whereas soft parts are still connected. Moreover, morphology of young corallite is very close to that of the ephebic stage still before formation of epitheca (Text-fig. $10_{7,8}$). Final separation presumably ends

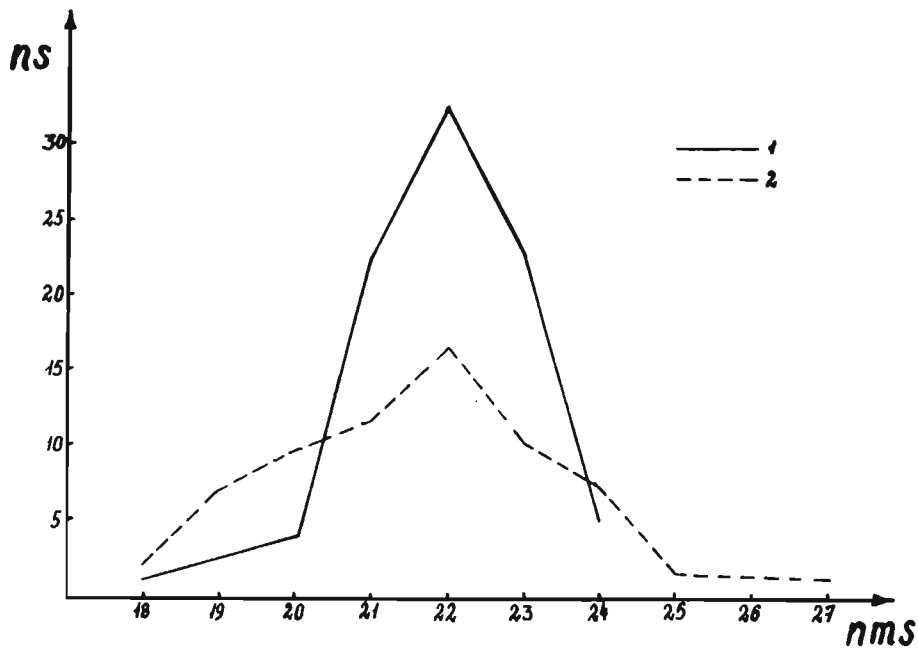


Fig. 12. *Disphyllum wirbelauense* group. Frequency curve of number of major septa. 1 — *D. w. bonae* n.subsp., 2 — *D. w. regulare* n.subsp.

the hystero-neanic development in this species, which is indicated by the fact that then the young corallite is morphologically fully developed and only somewhat smaller than the parent corallite.

Variability is very high and expressed in differences in wall thickness, length of major septa and tabula arrangement. External and internal walls are commonly separated by one series of thick dissepiments. Stereozone is continuous in places; then tabulae are incomplete and with vesiculate accessory plates. Such tabularium is cystiphylloid in appearance in the longitudinal section. This might be interpreted in terms of occurrence of different species unless distinct transitional forms were not found even in a single corallite.

Pickett (1967, p. 47) considered "short, thickened septa" as feature diagnostic for *D. wirbelauense*. Givetian disphyllids of the rich Chęciny material, although very variable in regard to other features, are characterized by long, thin, invariable septa. Septa so developed are regarded by the senior author as a feature diagnostic for a few subspecies, for *D. w. bonae* n. subsp. and *D. w. regulare* n. subsp.

Occurrence. — Poland: Holy Cross Mts, South region (Chęciny, Stokówka, Sitkówka, Sołtysia Góra near Radkowice), Upper Givetian, Kowala, Lower Frasnian, the Polygnathus asymmetricus Zone; Silesian-Cracow anticlinorium, borehole Olkusz BJ 24, depth 283—284 m, Givetian.

Disphyllum wirbelauense regulare n. subsp.

(Pl. III, Figs. 10—15, Pl. XI, Figs. 1, 2; Text-figs. 11—13)

Holotypus: Specimen No Z. Pal. P. Tc. 5/31, figured in Pl. III, Figs. 10 and 12.
Locus typicus: Borehole Olkusz BJ 24, depth 283 m.
Stratum typicum: Givetian.
Derivatio nominis: Lat. *regulare* — after a regular tabularium.

Diagnosis. — A *Disphyllum wirbelauense* with septal index 18—27/4—14; major septa short, thin, bent; stereozone wide, continuous; tabulae complete, crowded, regularly horizontally orientated.

Material. — About 20 limestone blocks yielding corallite fragments and ca. 110 single corallites; 32 thin-sections and 43 peels.

Description. — Corallites subcylindrical, slightly bent, up to 58 mm long. Buds rare, set at almost a right angle to the parent corallite. Surface covered with thin, smooth epitheca. Septal grooves fine. In specimen with calice weathered out, short, lamellar major septa with beaded periaxial margin are observed. Minor septa enter calice high, close to its distal margin. Calice 8 mm deep; which almost equals corallite diameter.

Transverse section. — Corallite circular, occasionally somewhat ovate in cross-section. Thickness of epitheca and wall, measured between ends of septa, equals 1.4 mm. Septotheca formed of spindle-shaped septa of both lengths. Stereozone obscures single dissepiment verticil. Major septa enter tabularium becoming thread-like and somewhat bent; commonly shorter than 1/2r; dominant major septa are 23 in number. Minor septa do not penetrate stereozone.

Longitudinal section. — Massive, wide stereozone developed at periphery; stereozone is occasionally penetrated by somewhat elongated, inflated dissepiments. Tabularium uniserial; tabulae horizontally orientated,

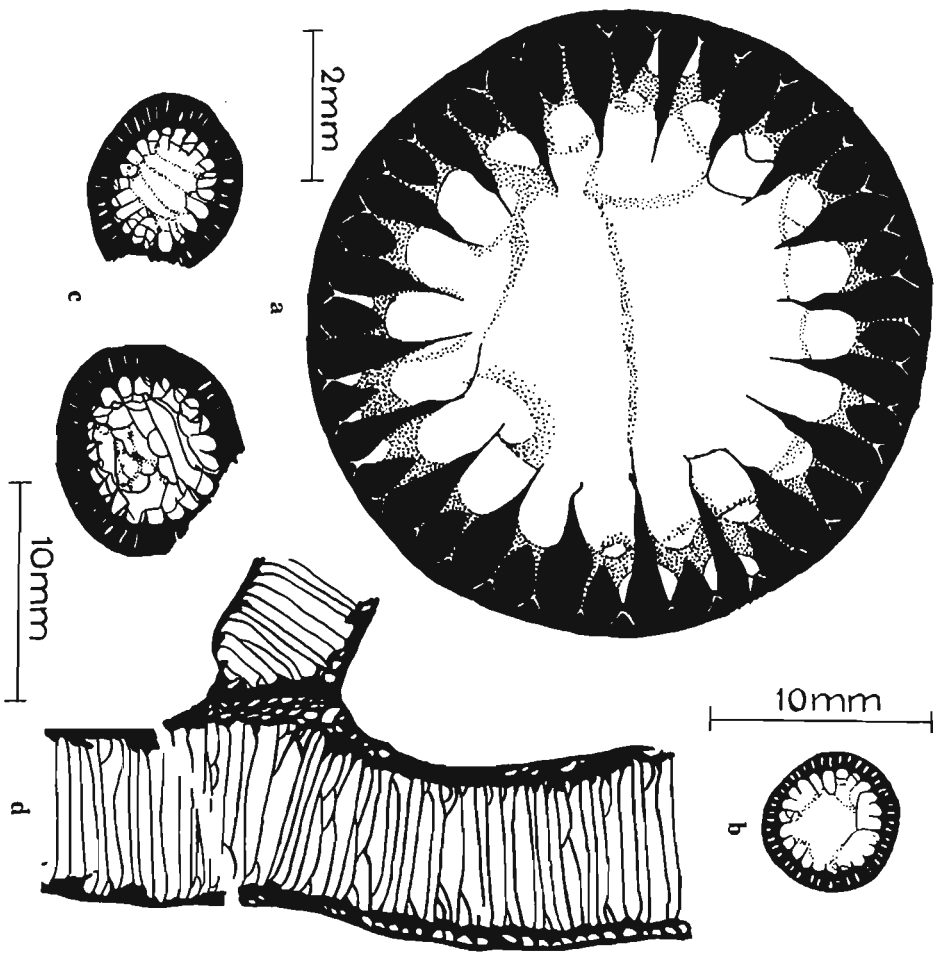


Fig. 13. *Disphyllum wirbelauense regulare* n.subsp.: a — transverse section shown spindle-shaped septa in septotheca and threadly-thin major septa in tabularium (No. Z. Pal. P. Tc-5/31), Olkusz, boring BJ-24; b — transverse section, (No. Tc-5/29), Olkusz, boring BJ-24; c — transverse section (No. Te-5/30), Chęciny; d — longitudinal section (No. Tc-5/26), Olkusz, boring BJ-24; all specimens from Uppermost Givetian.

crowded (5 to 15 tabulae along 5 mm section); tabula margins, close to periphery, locally covered with inflated vesiculate accessory plates.

Variability moderately high. Major septa very short, hardly visible in tabularium to somewhat longer, straight. Stereozone usually compact, but in places open, somewhat similar to that of *D. w. bonae* n. subsp.

Remarks. — *D. w. regulare* n. subsp. differs from *D. w. bonae* n. subsp. in thin, short, bent septa and regular tabularium.

Occurrence. — Poland: Holy Cross Mts (Chęciny, Sitkówka, Sołtysia Góra at Radkowice, Sosnówka) and Silesian-Cracow anticlinorium (borehole Olkusz BJ 24, depth of 283—284 m), Givetian.

Disphyllum geinitzi Lang & Smith, 1935

(Pl. IV, Figs. 1—4, Pl. V, Figs. 6, 7; Text-figs. 14—16)

1826. *Cyathophyllum caespitosum* Goldfuss; G. A. Goldfuss, Petrefacta..., p. 60, Pl. XIX, Fig. 2d.
1935. *Disphyllum geinitzi* Lang & Smith; Cyathophyllum..., p. 570, 571, Figs. 25, 26, Pl. 36, Figs. 1—3.
1960. *Disphyllum geinitzi* Lang & Smith; M. Różkowska, Blastogeny..., p. 7—14, Figs. 1—8.

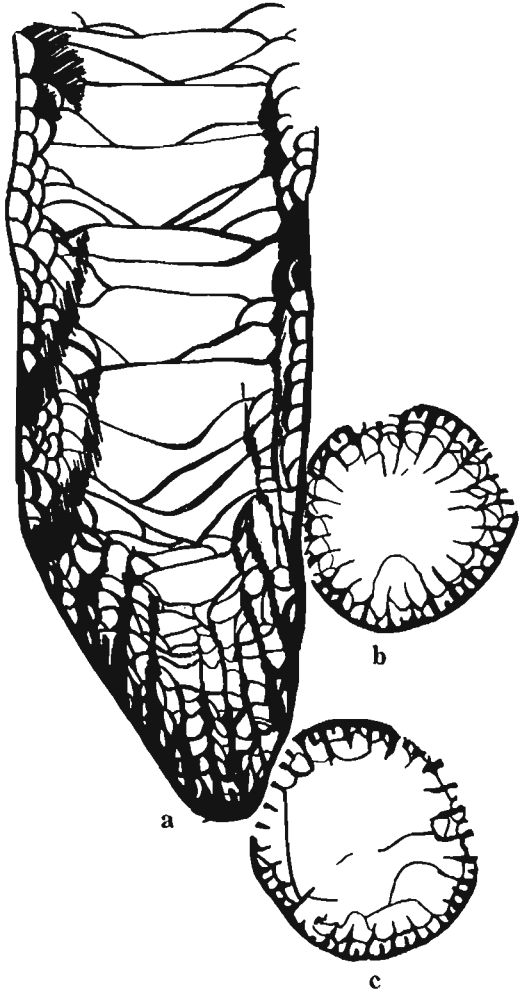


Fig. 14. *Disphyllum geinitzi* Lang & Smith (No. Z. Pal. P. Tc-5/41), Sitkówka, Uppermost Givetian: a — longitudinal section, b, c — transverse sections; ×3.

1963. *Disphyllum geinitzi* Lang & Smith; G. Altevogt, Die oberdevonischen..., p. 25, 26, Pl. 3, Figs. 9a—c.
1969. *Disphyllum geinitzi* Lang & Smith; R. Birenheide, Typen..., p. 40, Pl. 3, Fig. 8, Pl. 4, Fig. 13.
1970. *Disphyllum geinitzi* Lang & Smith; H. H. Tsien, Espèces..., p. 167, 168, Figs. 7A, B.

Diagnosis. — See Lang & Smith (1935, p. 570).

Material. — Twelve fragments of colony and approximately 80 corallite fragments; 27 thin-sections and peels.

Description. — Phaceloid colony with corallites closely spaced, and often adjoining laterally one another. Corallites circular to ovate in cross-section. Epitheca smooth, except for transversal ridge-like swellings and fine, densely spaced growth-rings. Calice deep, with steep walls, flat bottom and sharp margin.

Transverse section. — Corallite reaching up to 13 mm in diameter. Dark, thin epitheca covering thin wall, 0.1 mm thick. Peripheral ends of septa, lanceolate, sharpened, embedded in wall. Major septa 20 to 27 in number; 9 mm diameter, and 24 dominant major septa were found. All elements thin; sclerenchyme almost completely lacking on walls, dissepiments and septa. Major septa leave free space, 5—6 mm in diameter at the axis in corallite at 9 mm diameter. Minor septa do not penetrate periaxial dissepimental wall, and often do not even reach it. Major to minor septum length ratio, sI/sII, most often equals ca. 3.3.

Longitudinal section. — One row of larger dissepiments, convex toward the axis, periodically accompanied by row of smaller dissepiments, more steeply inclined. Tabulae commonly continuous, with accessory plates.

Variability moderately low. Major septa generally short. Tabularium is the most variable feature; tabulae continuous or discontinuous, flat, convex or sagging. Accessory plates flat, wide, occasionally short, vesiculate.

Blastogeny. — Some development stages of this species were studied by Różkowska (1960). In the present paper, the complete course of the blastogeny, studied in serial thin-sections, is presented by the junior author. Blastogeny of two corallites budding from the same parent corallite is given in Text-fig. 15. First descendant corallite (Text-fig. 15_{1-8}) slowly develops and particular growth stages are well marked. Growth of the second descendant (Text-fig. 15_{7-8}) was accelerated, i.e. modification of septal apparatus of parent corallite in the budding sector, construction of bud septa and section of epitheca separating both descendant and parent corallites proceeded along ca. 1.5 mm section. The description of blastogeny, given below, is based on observations of the former slowly developing corallite.

Hystero-nepionic stage. — Budding sector initially becomes very sligh-

tly swelled, that it is hard to notice on the corallite surface. At the same time, internal structure of this sector undergoes complete modification. Budding starts with strong thickening and deformation of 2—3 septa. This is followed by separation of the thickened parts of septa from remaining, peripheral parts, which sometimes do not extend from the external wall of corallite (Text-fig. $15_{1,2}$). Cardinal septum of bud is the only one protoseptum which may be distinguished in the blastogeny of this species with a high probability. It originates from minor septum of parent corallite, situated between two thickened major septa of the budding sector. During first part of bud development (Text-fig. 15_{1-3}) it is elongated, but before the end of hystero-nepionic stage became shortened and situated between two elongated metasepta (Text-fig. $15_{7,8}$). It does not distinguish in the ephebic stage.

The thickened septa from budding sector in parent corallite play a double role from the beginning of the budding process. They are not only radial

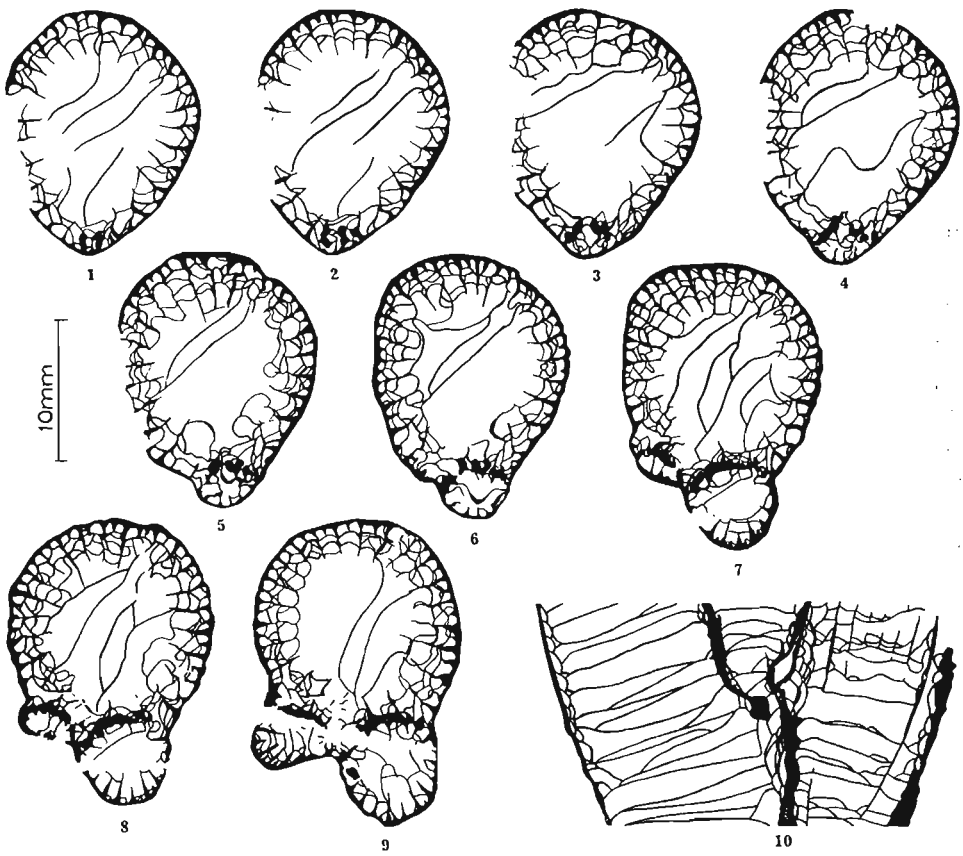


Fig. 15. *Disphyllum geinitzi* Lang & Smith (No. Z. Pal. P. Tc-5/33), Sołtysia Hill, Uppermost Givetian; 1-9 — sections of successive blastogenic stages, 10 — longitudinal section by the budding part of corallite, shown the new epitheca joined with the thickened medial part of atvo septum.

element of skeleton of parent corallite. Inceptions of three new, primary septa of bud exactly on these thickened septa were secreted (Text-fig. 15_1). These neo-septa initially are devoid of widened triangular base, typical of this species, but are carina-like swellings on atavo-septa of parent corallite. Such form of mentioned septa is preserved through the whole nepionic stage and septa, when adjoined by dissepiments or tabellae are difficult to distinguish. Thickened atavo-septa of parent corallite are subjected to various modifications and changes in shape but their position in corallite essentially remains the same and they form skeleton for the part of calice in common for parent corallite and bud.

Neo-epitheca and wall separating bud and parent corallite always originate in the central, common part of calice and never closer to calice margin. Microstructure of the new wall indicates its formation in an infolding of oral disc entering calice interior. Secondary calice fibres and fibrils of dark epithecal matter are radially arranged in the initial part of the wall. The wall separating parent corallite and bud consists of three layers, observable even at small magnification: of dark line (epitheca) and two pseudothecas. Higher magnification shows that the dark matter of epitheca is formed both on the parent corallite and bud sides, which indicates the occurrence of two epithecas. This is particularly distinct in places where these individuals become detached. There, a new wall commonly originates along a few sections, and thereafter gradually unites and widens towards the calice.

It follows that the young corallite is connected with the parent one along a few channels for a long time. The connection of new wall and thickened septum of parent corallite was found in one of the serial longitudinal sections (Text-fig. 15_{10}).

Septa increase very slowly. Before formation of first sections of wall separating both individuals, bud secretes only major septa. Minor septa initially appear among a few major septa close to cardinal septum and old part of epitheca in bud. First dissepiments connecting major septa with axial ends of minor septa appear almost simultaneously with the latter. Although epitheca is still discontinuous, this stage (Text-fig. 15_{7-9}) may be regarded as neanic, because all main structural elements of species have already appeared.

Further development of the young corallite leads to complete separation from the parent one with epitheca and to detachment, often at a great angle. The further growth of the young corallite, increment of its septa and widening of dissepimentarium are very slow till the end of its ontogenetic development.

Remarks. — The structure of the species discussed well corresponds to diagnosis given by Lang & Smith (1935, p. 570). However, at Sitkówka where this species as well as *D. wirbelauense bonae* n.subsp. and

D. w. regulare n.subsp. are quite frequent, specific identification of damaged, somewhat weathered specimens is often inequivocal, because the latter subspecies are also characterized by one verticil of dissepiments and complete tabulae. *D. geinitzi* differs from these subspecies primarily in

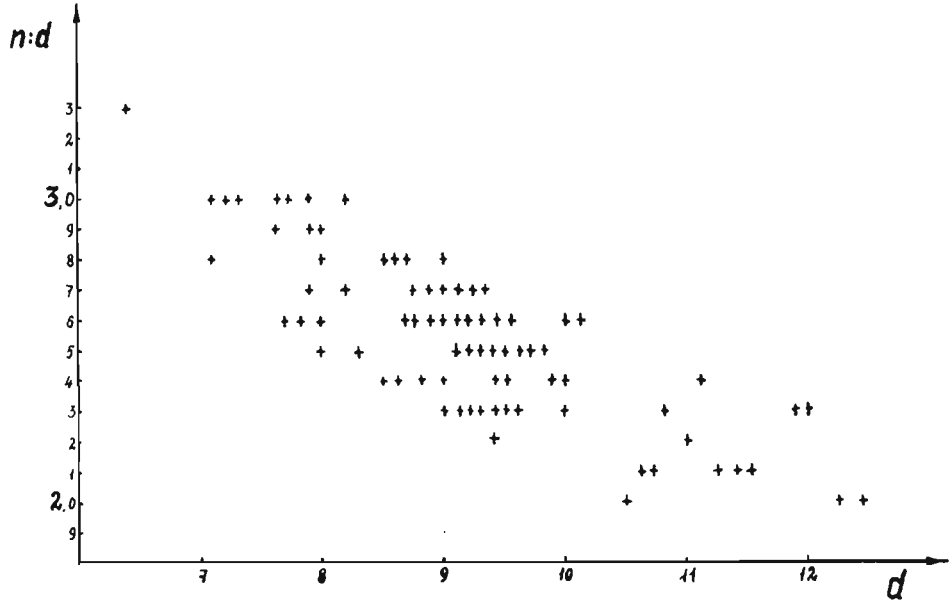


Fig. 16. *Disphyllum geinitzi* Lang & Smith. Scatter diagram of septal index (n/d) x corallite diameter.

almost complete lack of sclerenchyme accumulation on skeletal elements and larger diameter attained. All skeletal elements of *D. geinitzi* are thin, particularly dissepiments arranged in one or two series.

Altevogt (1963, p. 25) described this species from the Frasnian of Spain. His specimens, like those from Sitkówka, have 24 major septa at 8.5 mm diameter. The Spanish specimens somewhat differ, however, from Polish in the internal structure, densely-spaced vesiculate tabulae (Altevogt, 1963; Pl. 3, Fig. 9c) and wider dissepimentarium, consisting occasionally of 4 series of disseptiments.

Occurrence. — Poland: Holy Cross Mts (Sitkówka, Chęciny, Sosnówka, Stokówka), Givetian. Germany: Rhineland (Bensberg), Givetian. Belgium: Givetian. Spain, Asturia: Lower Frasnian.

Disphyllum kweihsiense Yoh, 1937

(Pl. V, Figs. 1—5; Text-figs. 17, 25)

1937. *Disphyllum varium* var. *kweihsiense* Yoh; S. S. Yoh, Die Korallen..., p. 61—63, Pl. VII, Figs. 7a, b.

1961. *Disphyllum* sp.; P. Semenoff-Tian-Chansky, J. Lafuste & M. Durand Delga, Madréporaires..., p. 297, Pl. II, Figs. 1, 2.
1970. *Disphyllum crassiseptatum* Tsien; H. H. Tsien, Espèces..., p. 175—176, Figs. 10a—d.

Diagnosis. — See Tsien (1970, p. 176).

Material. — Twenty fragments comprising ca. 60 corallites; 11 thin-sections and 11 peels.

Dimensions (in mm):

Septal index	No of dissepiment ranges	No of tabulae along 5 mm section
21/9	—	—
18/8	2—3	—
19/8	—	—
18/6.5	—	—
20/8	3	—
20/9	2—3	—
20/10	2—3	—
—	—	16
—	—	19
—	—	29

Description. — Subphaceloid colony with corallites adjoining one another. Such colony in life-position was figured by Szulczewski (1971, Pl. 21, Fig. 2).

Transverse section. — Epitheca and wall 0.4 mm thick. Thickened peripheral ends of septa with somewhat knobby margins, fixed in the wall. Knobby swells are also marked on septa when they pass among dissepiments. Major septa long; free field at the axis reaches only 1 to 3 mm in diameter. Minor septa attain 1/2 to 1/3 of length of major septa and commonly penetrate periaxial dissepiments verticil. Major septa innumerous, almost always 20 in number; only in one case out of 29 surveyed, number of major septa was 21. Corallite diameter is also small; only in one case out of 39 surveyed it equals 10.5 mm. Dissepimentarium consists of 1 to 4 dissepiment verticils, concave toward corallite axis.

Longitudinal section. — Dissepiments variable in size, horizontal along the periphery, inclined towards the axis. Tabularium biseriate, periaxial tabulae concave or flat, inclined to the axis. Axial zone consists of tabulae of the "lazutkini" type, with axial surface inflatted and margins bent downwards; semicircular accessory plates fixed at bend. Axial tabelae densely-spaced and joined in systems.

Variability is generally quite high. The structures of axial and periaxial tabularium are most variable here. Axial tabellae may be loosely or densely spaced; in the latter case they are thread-like. Thickness and

length of major and minor septa are also variable. Septa are knobbed in places, particularly within dissepimentarium area; knobs occasionally have carina-like appearance. Dissepimentarium usually wide; occasionally narrow dissepimentarium with 1 to 2 dissepiment verticils was found.

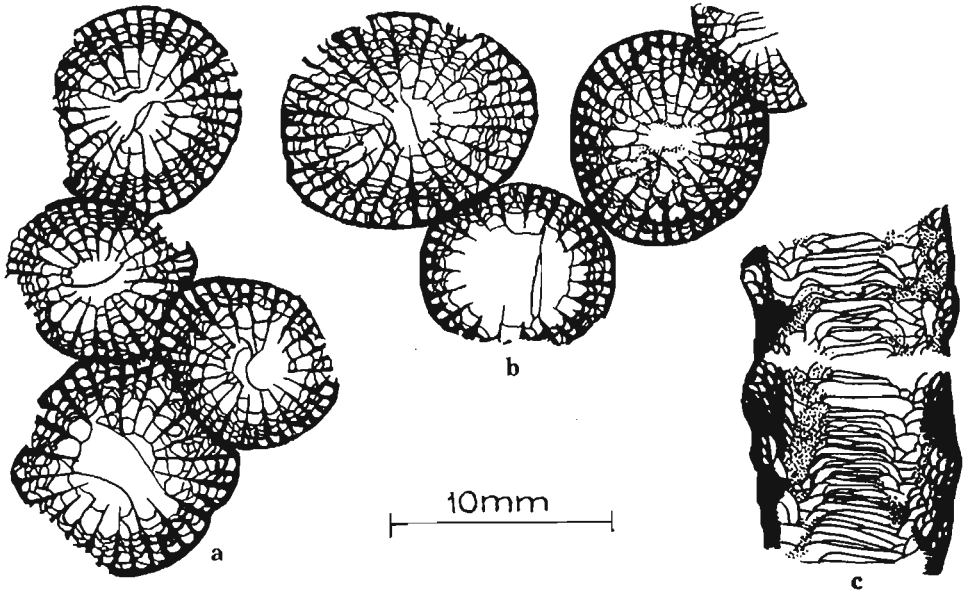


Fig. 17. *Disphyllum kweihsiense* Yoh: a — transverse section (No. Z. Pal. P. Tc-5/37); b — transverse section (No. Tc-5/36); c — longitudinal section, trapezoid axial tabellae connected in systems (No. Tc-5/40). All specimens from Kowala, Lower Polygnathus asymmetricus Zone.

Remarks. — *D. kweihsiense* belongs to pauciseptal disphyllids with multiseriate dissepimentarium and attaining small diameter. Similarly small size is attained by Canadian species *D. catenatum* Smith (1945, Pl. 11, Figs. 9—12), which perhaps differs from typical representatives of this genus in trabeculae locally arranged in symmetrical fans (Smith l. c., Pl. 11, Fig. 10b). Belgian specimens of *D. crassiseptatum* Tsien, 1970 (= *D. kweihsiense*) are characterized by tabularium of the "lazutkini" type and similar septal index, n/d = 21/8; small differences in structure, which according to the senior author fall into the limits of intra-specific variability include narrow dissepimentarium composed of 1—2 dissepiment verticils thick wall, minor septa very short and major septa very long in these Belgian forms.

The Polish specimens are transitional between Chinese and Belgian. Stereozone poorly developed and somewhat longer septa of II-nd order are the features in common with the Chinese material, whereas structure of tabularium of Polish material is typical for the Belgian ones.

Occurrence. — Poland: Holy Cross Mts (Kowala) boundary of sets A and B, Lower Frasnian, Polygnathus asymmetricus Zone (cf. Szulczewski, 1970). Belgium: F2d, g, i, Frasnian. China: South Kwangi Province, Givetian.

Disphyllum hsianghsienense Yoh, 1937

1937. *Disphyllum goldfussi* var. *hsianghsienense* Yoh; S. S. Yoh, Die Korallenfauna..., p. 63, Pl. 8, Figs. 1a, b.

Diagnosis. — Dendroid, phaceloid and subceroid colonies; septal index 18—26/6—15; inner wall distinct; narrow axial tabellae with accessory plates along margins; tabularium depressed at the axis.

Remarks. — This species is known from the Stringocephalus burtini Zone in China; in Europe it is widely distributed in the Frasnian. It has often been confused with *D. caespitosum*, from which it differs in lower value of n/d index and tabularium depressed in the axial part.

Occurrence. — Eurasia, North Africa: Givetian — Frasnian.

Disphyllum hsianghsienense kostetskae (Soshkina, 1939)

(Pl. II, Figs. 7, 8; Pl. VI, Figs. 3—5; Pl. VIII, Figs. 1—10; Pl. IX, Figs. 1—17; Pl. XI, Figs. 3—7; Text-figs. 18—21, 25)

1850. *Cyathophyllum caespitosum* Goldfuss; F. A. Roemer, Beiträge..., pp. 29.
1920. *Cyathophyllum (Fasciculatia) caespitosum* Goldfus var. *breviseptata* Frech; H. Yabe & I. Hayasaka, Paleontology, Pl. 8, Fig. 7.
1937. *Disphyllum goldfussi* Geinitz; T. Y. Ma, On the seasonal..., p. 10, Pl. 1, Figs. 1a—d.
1949. *Schlüteria kostetskae* Soshkina; E. D. Soshkina, Devonskie..., pp. 148, 149, Pl. 56.
1954. *Schlüteria kostetskae* Soshkina; E. D. Soshkina, Devonskie..., p. 45 (cum synon.).
1959. *Disphyllum caespitosum* (Goldfuss) var; G. V. Middleton, Devonian..., p. 152, Figs. 3a-g.
1962. *Disphyllum kostetskae* (Soshkina); T. Gunia, Nowe wyniki..., p. 172, Figs. 1, 2.
1970. *Disphyllum kostetskae* Soshkina; H. H. Tsien, Espèces..., p. 170, Figs. 11, 12.

Diagnosis. — A *Disphyllum hsianghsienense* with phaceloid to subcerioid colonies; septal index 18—26/6—15, dominant 22/9—10; tabularium triseriate; axial tabellae with tent-like accessory plates.

Material. — One large subspheroid corallum and ca. 40 fragments of colonies; 112 thin-sections.

Description. — Hemispherical corallum having a circumference of ca. 30 cm, with corallites short, bent, irregularly polygonal to ovate or, occasionally, circular in cross-section. Corallum outline becomes cerioid in places where corallites adjoining one another have dissepiments widened on one side and where budding is particularly intense. Specimens of Łagów presumably represent fragments of phaceloid colonies, which is in-

dicated by corallites undeformed in transversal section. Calice deep, with steep walls; however, calice bottom depressed in axial part and not flat as in other representatives of *Disphyllum*.

Transverse section. — Thin epitheca usually adjoined by wall up to 0.6 mm thick. Sharpened ends of septa set in wall. Accumulation of sclerenchyme on periaxial dissepiment series and septa results in formation of inner wall, occasionally adjoining external wall; in the latter case a wide

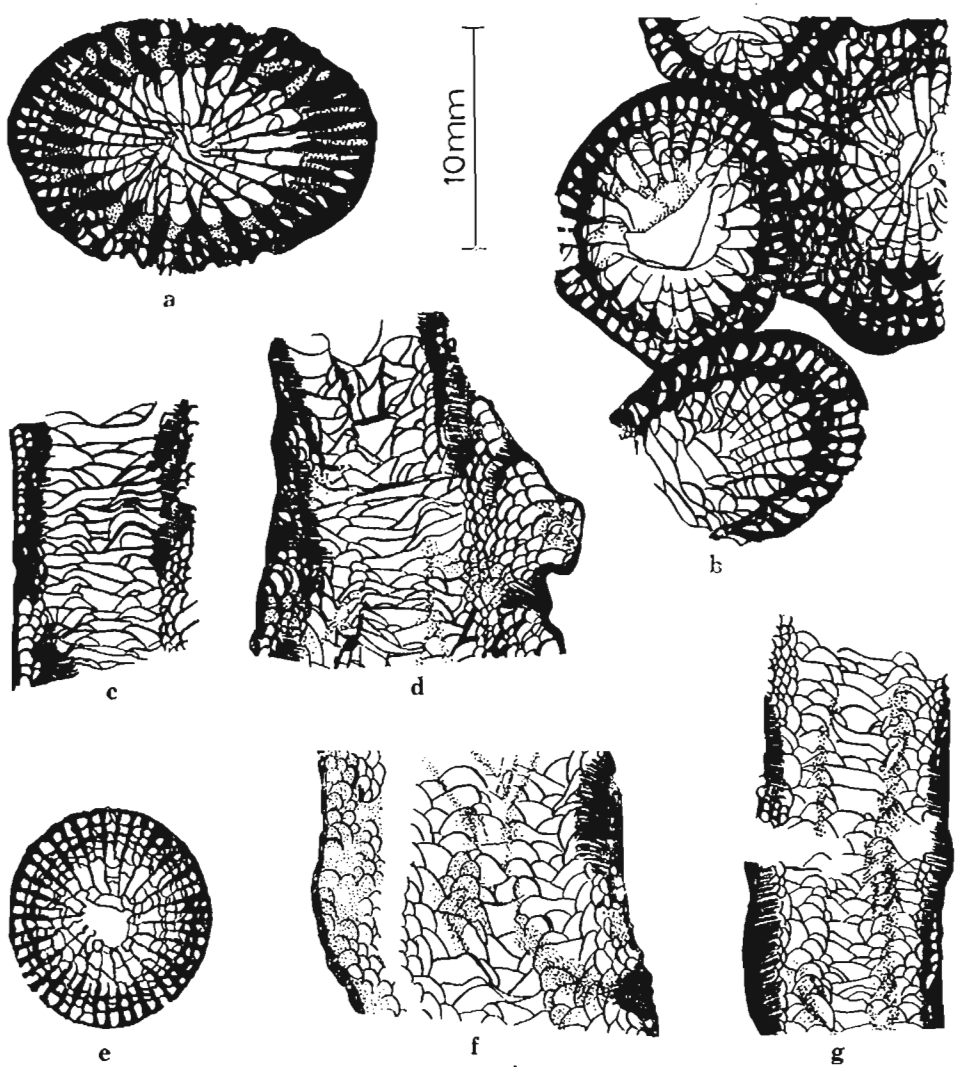


Fig. 18. *Disphyllum hsianghsienense kostetsake* (Soshkina): a — transverse section of the corallite with thick skeleton structure (No. Z. Pal. P. Tc-5/79); b — transverse section of the group of thick skeleton corallites (No. Tc-5/73); c — longitudinal section (No. Tc-5/96); d — longitudinal section (No. Tc-5/97). All specimens from Wietrznia quarry, point No. VIII; e — transverse section (No. Tc-5/85); f — longitudinal section, shown cystiphylloid structure, (No. Tc-5/93); g — longitudinal section (No. Tc-5/91). All specimens from Polanów, Lower Frasnian.

stereozone originates. Major septa bicuneate, becoming thread-like within tabularium. Free field attaining 0.6—5.0 mm in diameter. Minor septa short, not penetrating inner dissepiment series.

Longitudinal section. — Peripheral dissepiments large, hemispherical, horizontally orientated; towards the axis, dissepiments progressively decrease in size and are more and more steeply inclined. Periaxial tabellae vesiculate and orientated transversally to axis; axial tabellae narrow, flat, usually sagging and apparently located in depression formed by tent-like accessory plates fixed on their margins. This results in "wavy" structure of tabularium, which fact was described by Soshkina (1939, p. 29).

Variability distinctly high. Three types presumably environmentally dependant (Tsien 1970, p. 163) may be distinguished. First ecotype is represented by subcerioid coralla from Wietrznia (Pl. IX); which is characterized by thick skeletal elements, stereozone commonly developed and short minor septa. Similar ecotype of the species *D. goldfussi* (= *D. h. kostetskae*) was figured by Tsien (l.c., Fig. 2). Other ecotype is represented by subcerioid colony figured in Pl. II, Fig. 7 of the present paper. But all its skeletal elements are thin, major septa long, and almost reaching axis, minor septa occasionally long (sI/sII = 3—2), inner wall lacking. This ecotype is similar to *D. caespitosum* figured by Tsien (l.c., Fig. 3) differing in smaller number of septa and tabularium concave in axial part. Corals from Łagów represent transition between the above types; colony from Łagów, phaceloid in outline, with regular inner structure, densely spaced, is most similar to those figured by Soshkina (1939, 1949). Tent-like plates are distinct.

Blastogeny. — Budding lateral, involving merely peripheral part of parent corallite, only comparable with IIIrd type of Jull (1965). Periaxial

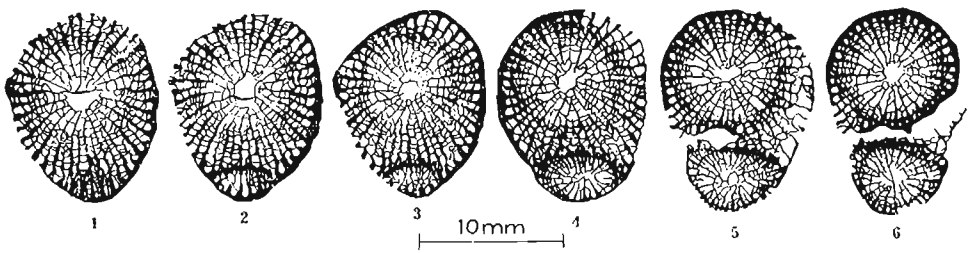


Fig. 19. *Disphyllum hsianghsienense kostetskae* (Soshkina), specimen No. Tc-5/85, Polanów, Lower Frasnian. Transverse section by the successive blastogenic stages.

parts of septa, not subjected to modification in the course of blastogeny, will not be discussed here. Under the term of inner parts of septa, sections of septa situated between parent corallite and bud are meant.

1. Hystero-nepionic stage (Text-fig. 19_{1-4}) begins with slight swelling of major and minor septa in the budding sector, close to external wall.

These septa become very soon constricted and, occasionally, divided into peripheral and inner sections. Thus it may be supposed that paragastral and oral cavities of the bud are formed very early in the blastogeny. Inner sections of septa after separation from peripheral ones subjected to strong swelling along the bud-parent corallite boundary, which results in formation of septotheca (Text-fig. 19_2) in such early stage of blastogeny. Increment of new septa of the bud is commonly very quick and proceeds along its whole periphery (Text-fig. 19_{3-5}).

Cardinal and counter protosepta originate through subdivision of external part of the same major septum of parent corallite. Cardinal protoseptum remains close to atavo-epitheca and is long, almost to the end of the neanic stage, connected with counter-septum, developing on the side of parent corallite. In this species, counter-lateral protosepta may be

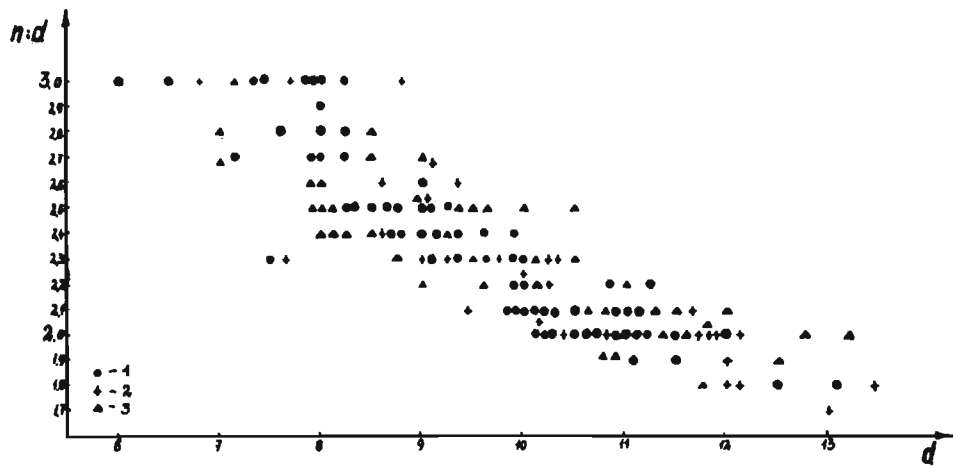


Fig. 20. *Disphyllum hsianghsienense kostetskae* (Soshkina), Scatter diagram of septal index (n/d) x corallite diameter. 1 — corallum from Wietrznia quarry, 2 — from Łagów, 3 — from Polanów.

identified with great probability as neighbouring with counter septum. Also alar septa are distinct in the arrangement of metasepta in some thin-sections (Text-fig. 19_{3-4}).

2. Hystero-neanic stage is not clearly marked. Although bud is quite early isolated with septotheca, it may be supposed that the soft parts of both individuals were still connected. This is indicated by epitheca still undeveloped and some skeletal elements in common. It seems that the mode of corallite detachment found here (Text-fig. 19_{5-6}) has not been hitherto described. At the end of nepionic stage, septa of parent corallite are subjected to some modification within the sector around bud (Text-fig. 19_{4-5}) which is followed by their disruption and shortening as well as by constriction of dissepimentarium in this part of corallite. This may be interpreted by the phenomenon of detachment of soft parts

(Text-fig. 19_{5-6}), connected with cast off of parts of septa and dissepiments from the budding sector by the parent corallite. In result the parent corallite becomes in some sort rejuvenated and remarkably decreases in size. Skeletal elements cast off by the parent corallite and supposedly soft parts covering them are included by the descendant corallite which is indicated by the fact that they are not separated from it with epitheca. These tissues are supposedly gradually resorbed by the young individual, which quite rapidly extends its epitheca over the whole periphery. In this stage (non-illustrated in the figure) the young individual exhibits morphology typical

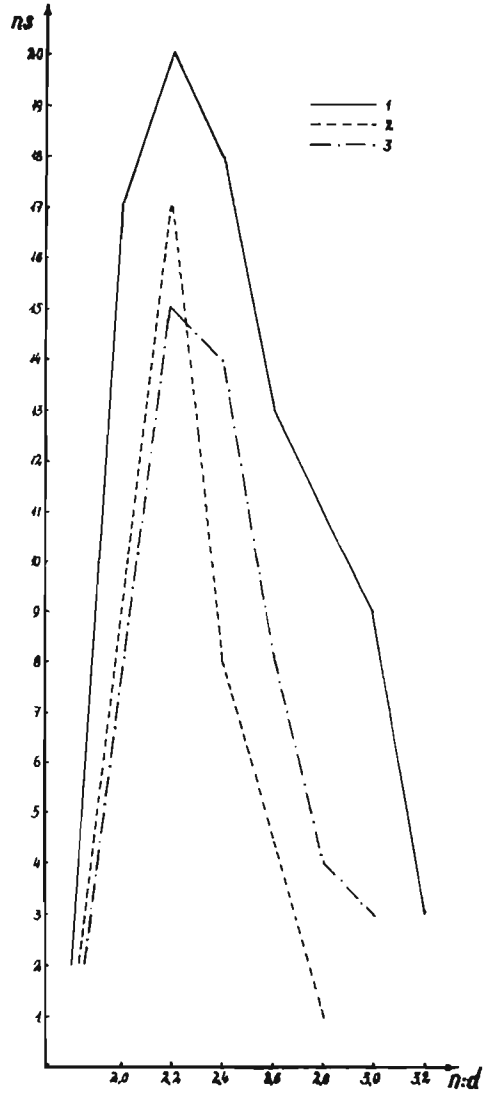


Fig. 21. *Disphyllum hsianghsienense kostetskae* (Soshkina). Frequency curve of septal index (n/d), 1 — corallite from Wietrznia quarry, 2 — from Łagów, 3 — Polanów.

for this species, differing from mature forms only in distinctly smaller size.

It should be stressed that the mode of corallite detachment described above is not of diagnostic value. Such detachment was only found in undeveloped colonies from Polanów. Interpretation in terms of ecotype seems more justified. Well-developed colonies of this subspecies, found in the Holy Crosss Mts, are characterized by normal mode of corallite detachment, which was described in the present paper on the example of *D. caespitosum*.

Remarks. — In the case of some specimens, particularly when the dominant number of major septa reaches 24 or 25, it is difficult to state whether they belong to *D. caespitosum* or *D. hsianghsienense kostetskae*. As it follows from the Text-fig. 25, such numbers of dominant major septa are attained occasionally by the largest forms assigned to *D. hsianghsienense kostetskae*. In such a case the structure if tabularium, which is flat-convex in *D. caespitosum* and concave in the axial part in *D. h. kostetskae* is regarded as a decisive feature.

Occurrence. — Poland: Holy Cross Mts, South Region, Kielce (Kadzielnia quarry, points V, VI, IX; Wietrznia quarry, points I, V, VIII, IX, XI, XVI), the Polygnathus asymmetricus Zone; Łagów, Lower or Middle Frasnian; Silesian-Cracow anticlinorium, borehole Karniowice 4, depth 293 m, the Polygnathus asymmetricus Zone; Sudety Mts, Witoszów, Lower and Middle Frasnian; Pomerania, Polanów, depths given in Text-fig. 6. Germany: Harz Mts, Iberg Lst., Frasnian. England: South Devonshire, Frasnian/Givetian. Belgium: F2h. USSR: Ural Mts, Armenia, Russian Platform, Timan Mts, Altai-Sajan, Frasnian. China: Shechuan Prov., Kwangsi prov., Middle Devonian.

Disphyllum caespitosum (Goldfuss, 1826)

1826. *Cyathophyllum caespitosum* Goldfuss; A. Goldfuss, Petrefacta..., p. 60, Pl. 19, Fig. 2b.

Diagnosis. — Multiseptal *Disphyllum* with septal index 18—30/6—16, dominant 25/11 in all subspecies; dissepimentarium consisting of 2 to 7 dissepiment series; tabularium biserial, tabulae horizontally orientated, occasionally convex.

Remarks. — The palaeogeographical distribution of *Disphyllum caespitosum* is very wide, from W Australia through Eurasia to N Africa, whereas stratigraphical range of this species mostly includes the Frasnian; some specimens were also reported from the Givetian.

The variability is high and comprises changes in colony outline, length and thickness of septa and structure of tabularium. However, features listed in diagnosis of this species are essentially constant. On the basis of the

latter, the senior author allocated beside the nominative subspecies, two other subspecies, *Megaphyllum pashiense* Soshkina (= *D. caespitosum pashiense* (Soshkina)) and *Schlüteria lazutkini* Ivanija (= *D. caespitosum lazutkini* (Ivanija)), hitherto considered as a separate species.

In illustrations given by previous authors for *D. caespitosum* (Lebedev, 1901, Pl. 2; Lang & Smith, 1935, p. 569; Birenheide, 1969, p. 38; Tsien, 1970, Figs. 3, 4) septa of corallites are long, thin, commonly wavy. However, Lang & Smith (l.c., p. 569) found that septa of Ist order, thin within the tabularium area, rapidly thicken towards periphery. Tsien figured (Tsien l. c., Fig. 2, left side) specimen of *D. goldfussi* with thin, long septa, which was found in suitable environment, and other specimen with short, thick septa, found in insuitable environment. Such dependance on facies is also manifested by the *D. caespitosum* from the Devonian of Poland. Both these ecotypes were identified in the material collected.

Disphyllum caespitosum caespitosum (Goldfuss, 1826)

(Pl. II, Fig. 9; Pl. VI, Figs. 1, 2, 6, 7; Text-figs. 22—25)

1826. *Cyathophyllum caespitosum* Goldfuss; G. A. Goldfuss, Petrefacta..., p. 60, Pl. 19, Fig. 2b.

1882. *Cyathophyllum caespitosum* Goldfuss; Ch. Barrois, Recherches..., p. 204, Pl. 8, Figs. 3a—c.

(?) 1887. *Cyathophyllum caespitosum* Goldfuss; K. A. Penecke, Über die Fauna..., p. 273.

1902. *Cyathophyllum caespitosum* Goldfuss; N. I. Lebedev, Rol korallov..., p. 70, Pl. 2, Figs. 18, 19, 20

1912. *Cyathophyllum* cf. *caespitosum* Goldfuss; H. Mansuy, Paléontologie, p. 57, Pl. 10, Figs. 5a, b.

1935. *Disphyllum goldfussi* Lang & Smith; W. D. Lang & S. Smith, *Cyathophyllum caespitosum*..., p. 544, Figs. 2, 3 (cum synonymy partim).

1954. *Disphyllum goldfussi* (Geinitz); D. Hill, Coral faunas..., p. 18, 19, Pl. 2, Figs. 11, 12, 28.

1961. *Disphyllum caespitosum breviseptatum* (Frech); P. Semenoff, Tian-Chansky, Lafuste J. & M. Delga-Durand, Madréporaires..., p. 296, Figs. 6—8.

1964. *Schlüteria emsti* Wedekind; N. I. Besprozvannych, Korally Rugosa..., p. 71, Pl. 6, Fig. 1.

1969. *Disphyllum emsti* (Wedekind); A. A. Kaplan, Četyrechlučevye..., Pl. 1, Figs. 5, 6.

1969. *Cyathophyllum caespitosum* Goldfuss; R. Birenheide, Typen..., p. 38, Pl. 2, Figs. 7, 7a, Pl. 15, Fig. 14.

1970. *Disphyllum goldfussi* (Geinitz); H. H. Tsien, Espèces..., p. 164—166, Fig. 2 (gauche), Figs. 3, 4 (cum synon.).

non 1850. *Cyathophyllum caespitosum* Goldfuss; F. A. Roemer, Beiträge..., p. 29,

non 1904. *Cyathophyllum caespitosum* Goldfuss; K. A. Penecke, Das Sammelergebnis..., p. 46, Pl. 4, Figs. 2a, 3a, b, Pl. 5, Fig. 1.

non 1920. *Disphyllum goldfussi* Geinitz; H. Yabe, I. Hayasaka, Paleontology..., Pl. 8, Fig. 7.

non 1937. *Disphyllum goldfussi* Geinitz; T. Y. Ma, On the seasonal..., Pl. I, Figs. 1a—d.

non 1937. *Cyathophyllum goldfussi* Geinitz; M. Lemaître, Étude..., p. 108, Pl. 8, Figs. 8, 9.
non 1959. *Disphyllum caespitosum* var.; G. V. Middleton, Devonian..., p. 152, Figs. 3a—e.
non 1964. *Disphyllum goldfussi* Geinitz; Atlas..., Pl. 31, Fig. 5.
non 1969. *D. sp. aff. D. caespitosum* Goldfuss; C. T. Scrutton, Corals..., p. 104.
non 1950. *D. (Phacellophyllum) caespitosum* (Goldfuss); P. W. Taylor, The Plymouth Limestone..., p. 186, Pl. 3, Figs. 3a, b.

Diagnosis. — A *Disphyllum caespitosum* with septal index 18—30/6—16, dominant 25/10—11; tabularium flat.

Material. — One large phaceloid colony and ca. 13 fragments; 40 thin-sections and peels with transverse and longitudinal sections.

Description. — Corallites parallely arranged in phaceloid colonies. Epitheca longitudinally striated and feebly wrinkled by transversal irre-

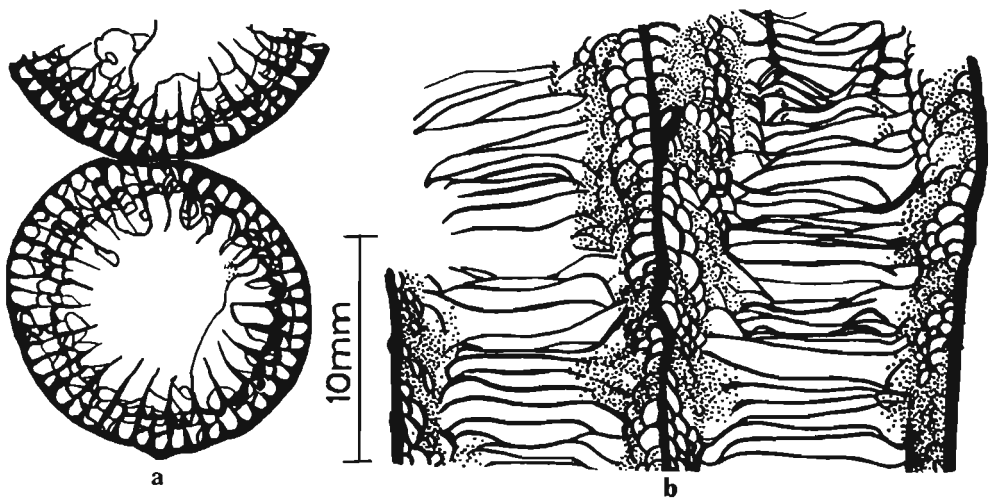


Fig. 22. *Disphyllum caespitosum caespitosum* (Goldfuss): a — transverse section shown very short major septa (No. Z. Pal. P. Tc-5/48); b — longitudinal section (No. Tc-5/47). Both specimens from Wietrznia quarry, point VIII, Lower Polygnathus asymmetricus Zone.

gularities of growth. Calices deep, with sharp edges, steep walls and flat bottom.

Transverse section. — Corallites circular in cross-section. When dissepimentarium widened or corallites adjoin one another, cross-section becomes irregularly polygonal. Epitheca and adjoining wall thin, 0.2 mm thick. Septa long, thin, becoming slightly thicker towards periphery. Periaxial dissepiment verticil coarser and forming discontinuous inner wall. Axial field free of septa attaining 2.5 mm in diameter when septa well-preserved. Minor septa occasionally break through dissepimentarium. Peripheral ends of septa sometimes knobbed.

Longitudinal section. — Dissepimentarium consisting of 2—6 series of dissepiments varying in size. Tabularium biserial with flat axial part. Accessory tabular plates parallely orientated, flat, sometimes vesiculate. Periaxial part consisting of vesicular or plate-like plates, set obliquely to the axis. Axial tabellae numbering 5—11 per 5 mm section.

Variability wide. — A large phaceloid colony from Wietrznia (point VIII) is characterized by thin skeletal elements, and untypical septa, short and loosely spaced; however, this may result from destruction during re-

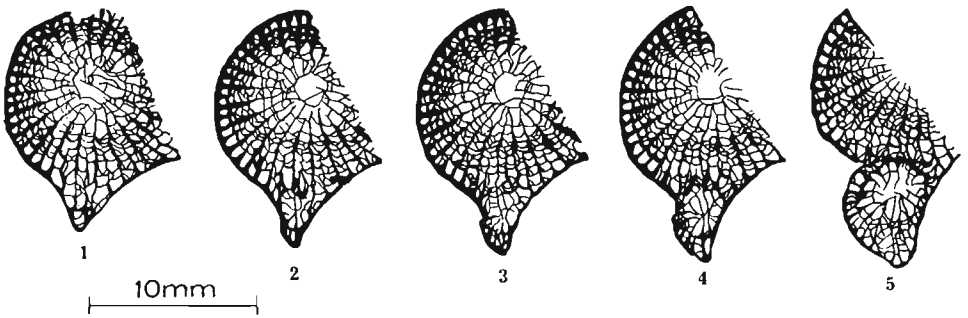


Fig. 23. *Disphyllum caespitosum caespitosum* (Goldfuss) (No. Z. Pal. P. Tc-5/48), Wietrznia quarry, point VIII, Lower Polygnathus asymmetricus Zone. Transverse sections of the successive blastogenic stages.

crystallization. Dissepimentarium width and dissepiment size are variable. Axial tabellae commonly flat, but somewhat convex or concave were also found. Other corallum (Pl. II, Fig. 9) is characterized by long, thickened, somewhat wavy septa and wide dissepimentarium.

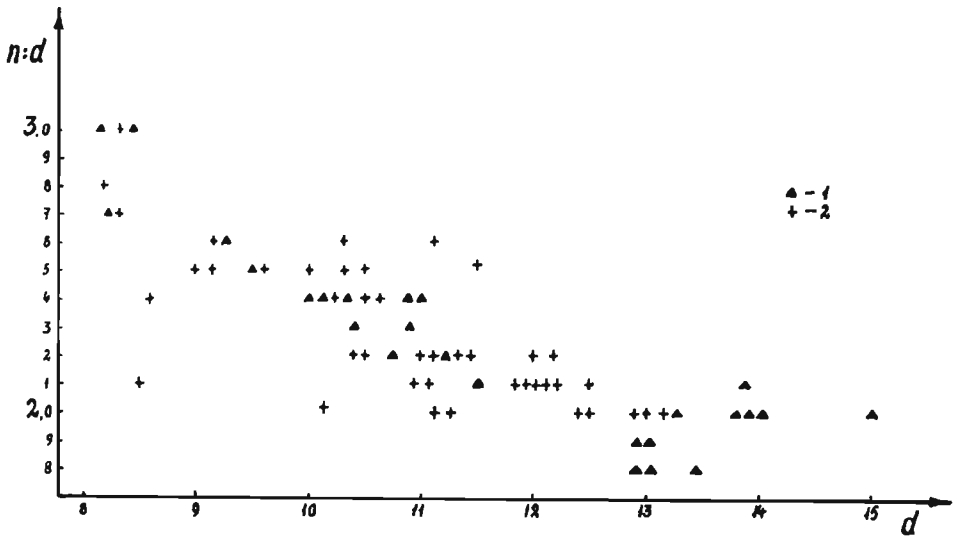


Fig. 24. *Disphyllum caespitosum* group. Scatter diagram of septal index (n/d)× corallite diameter. 1 — *D. c. caespitosum* (Goldfuss) from Wietrznia quarry, 2 — *D. c. pashiense* (Soshkina) from Zagórze.

Blastogeny. — Budding involves only most peripheral part of corallite and does not influence the structure of its axial part nor axial parts of its septa. Thus terms used below concern only remaining parts of septa, which directly participate in the budding.

Budding begins with formation of a very distinct swell, in which only peripheral parts of 2—3 septa of parent corallite undergo thickening (Text-fig. 23_1). Subdivision into peripheral and inner sections of septa gradually proceeds. Septa may undergo constriction only in a part of bud, where its calice develops. Thickening of inner septa of parent corallite at

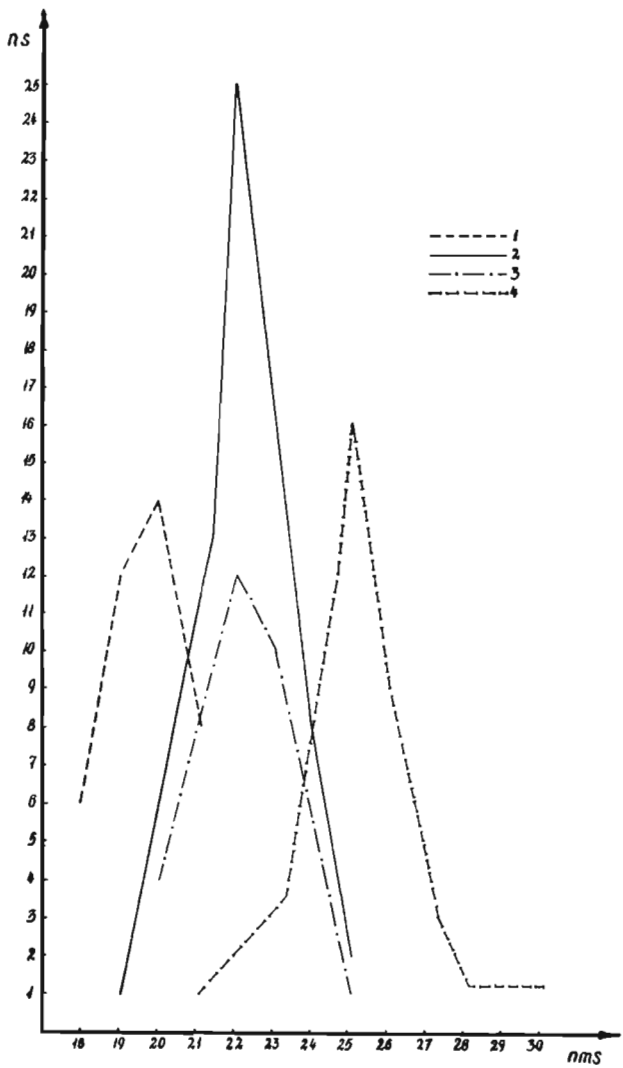


Fig. 25. Frequency curves of number of major septa in *D. cylindricum* (Soshkina) (3), *D. hsianghsienense kostetskae* (Soshkina) (2), *D. kweihsiense* Yoh (1) and *D. caespitosum* (Goldfuss) group (4).

the boundary with bud was not found in the phase of development (Text-fig. $23_{2,3}$). This is the period in which mainly peripheral parts of bud develop rapidly. Numerous neo-septa originate in the neighbourhood of atavo-epitheca. Among these, cardinal septum, which originates from peripheral part of one of parent corallite septum is easy to identify as it is longer than other neo-septa.

Septotheca is formed in late stage of blastogeny and is poorly developed (Text-fig. $23_{4,5}$). It should be stressed that bud neo-septa do not develop in the section adjoining parent corallite even after formation of first fragments of septotheca. Therefore main quadrants of bud are developing distinctly quicker than the opposite ones. This is the main difference in blastogeny of *D. caespitosum* and *D. hsianghsienense kostetskae*.

Separation of bud from parent corallite with epitheca proceeds through constriction of corallites along the line of septotheca. Both individuals form epitheca on their parts of septotheca and separate in this way. This is a very slow process and only its initial phase is illustrated in Fig. 23_5.

Remarks. — The nominative subspecies of *D. caespitosum* seems to be rare both in Poland and in the world. *Disphyllum hsianghsienense kostetskae*, which was assigned to *D. caespitosum* since 1850 (cf. Roemer), seems to be much more abundant.

Occurrence. — Poland: Holy Cross Mts, South region, Kielce (Kadzielnia quarry, point VIII, Wietrznia quarry, points I, VIII, XI, XIV), Frasnian, the Polygnathus asymmetricus Zone; North region, Czarnów, bed 7, lower Polygnathus asymmetricus Zone (to I α) (cf. Szulczewski, l. c.); Pomerania, borehole Koczała 1, depth 2680.0 m, Wyszebórz 1, depth 2015—2021.4 m; Silesian-Cracow anticlinorium: borehole Karniowice 4, depth 298—299.4 m, Olkusz BB18, depth 319 m, Olkusz BB26, depth 209.3 m, Frasnian. Germany: Rhineland (Bensberg), Frasnian/Givetian. Belgium: F2c, d. England: North Devon, Torquay, Plymouth, Givetian-Frasnian. France: Boulonnais, Frasnian/Givetian. Spain, Candas, Frasnian. Austria, E Alps, Givetian(?). USSR: Ural Mts, Kolyvan-Tom, Bajanaul, Frasnian/Givetian. China: Yunnan, Givetian. W. Australia: U. Pillara Limestone, Frasnian/Givetian. Africa: Algeria, Frasnian/Givetian.

Disphyllum caespitosum lazutkini (Ivanija, 1953)

(Pl. III, Figs. 1—9; Pl. XI, Figs. 9, 10; Text-fig. 26)

1953. *Schlüteria lazutkini* Ivanija; V. A. Ivanija, K izučeniju..., p. 29, 30, Pl. 5, Figs. 21, 22; *S. typica* Ivanija, p. 28, Figs. 28, 29; Pl. 3, Figs. 13—17; Pl. 4, Fig. 18; *S. striata* Ivanija, p. 26, 27, Pl. 2, Fig. 10; Pl. 3, Figs. 11, 12.

1958. *Schlüteria lazutkini* (Ivanija); E. Z. Bulvanker, Devonskie..., p. 129, 130, Pl. 50, Fig. 5; Pl. 52, Figs. 1a, b.

1961. *Disphyllum caespitosum* (Goldfuss); P. Semenoff-Tian-Chansky, J. Lafuste & M. Durand Delga, Madréporaires...., p. 294—296, Text-pl. I, Figs. 2—5.

1963. *Disphyllum lazutkini* (Ivanija); G. Altevogt, Die oberdevonischen..., p. 20, Pl. 1, Figs. 4, 4a, 4b.
1965. *Disphyllum lazutkini* Ivanija; V. A. Ivanija, Devonskie..., p. 211, 212, Pl. 97, Figs. 411, 412.
1970. *Disphyllum hilli* Tsien; H. H. Tsien, Especes..., p. 174, Text-figs. 16—18.

Diagnosis. — A *Disphyllum caespitosum* with septal index 25—27, and dominant index equalling 25/11; axial tabulae trapezoidal, of the "lazutkini" type.

Material. — A few limestone blocks with corallite fragments. Ten transverse and longitudinal thin-sections were made.

Z.Pal. Tc. 5	n/d	Dissepiment ranges	sI/sII lengths mm	Number of axial tabellae in 5 mm section
27	25/6	1—2	6/2	14
21	25/11	2—3	3/1.5	—
22	26/10.5	2—3	4/2	17

Description. — Corallites circular to subcircular in cross-section, straight or somewhat arcuate.

Transverse section. — Epitheca and external wall attaining 0.6 mm in thickness at the corner between peripheral ends of septa. Septa thickened

Fig. 26. *Disphyllum caespitosum lazutkini* (Ivanija): a — transverse section (No. Z. Pal. P. Tc-5/22); b, c — longitudinal sections (No. Tc-5/23 — 24). All specimens from Wietrznia quarry, point XXII, Middle Frasnian, ×3.

at the periphery, becoming thin in tabularium. Minor septa sometimes pierce thick inner wall. Axial field free of septum attaining 3—4 mm in diameter. Characteristic numerical data are listed in the table below:

Longitudinal section. — Calice deep with bottom somewhat convex, rised above axial tabellae; periaxial tabellae distinctly concave; axial tabellae trapezoidal, rising above furrow-like periaxial tabularium, with upper surface flattened and margins strongly bent downwards; when axial tabellae regular, tabularium similar to that of *Amplecocarinia*. Vesiculate accessory plates fixed at bends of axial tabellae.

Remarks. — The above subspecies is allocated into the group of subspecies of multiseptal *D. caespitosum* on the basis of the dominant number of major septa equalling 25 and flat-convex tabularium. It differs from other subspecies, *D. c. pashiense* and the nominative *D. c. caespitosum* in trapezoidal axial tabellae. Polish specimens are innumerous and incomplete, therefore the range of variability cannot be evaluated.

Occurrence. — Poland: Holy Cross Mts, South region, Kielce (Kadzielnia quarry, point VI, Wietrznia quarry, points I, VIII, XVI, XXII), Zagórze, the Polygnathus asymmetricus Zone. USSR: Kuzbas, Frasnian. Belgium: F2c, d. Africa: Chénoua, Frasnian.

Disphyllum caespitosum pashiense (Soshkina, 1939)
(Pl. VII, Figs. 1—11, 12—17; Text-figs. 24, 27)

1939. *Megaphyllum pashiense* Soshkina; E. D. Soshkina, Verchnedevonskie..., p. 14, 15, Pl. 1, Figs. 1—4; Pl. 12, Figs. 99, 100; Pl. 14, Figs. 114—118; *M. katavense* Soshkina, Pl. 1, Figs. 5—7.
1952. *Megaphyllum pashiense* Soshkina; E. D. Soshkina, Opredelitel..., p. 105, Pl. 46.
1955. *Schlüteria emsti* Wedekind; N. Ya. Spasskij, Korally..., p. 136, Pl. 24, Figs. 1a, b.
1958. *Megaphyllum pashiense* Soshkina; E. D. Bulvanker, Devonskie..., p. 187, 188, Pl. 57, Figs. 1a, b.
1962. *Disphyllum kostetskae* (Soshkina); T. Gunia, Fauna otoczaków..., p. 503, Pl. 46, Figs. 4, 5 only.
1963. *Disphyllum caespitosum cylindricum* (Soshkina); G. Altevogt, Die oberdevonischen..., p. 23, 24, Pl. 2, Figs. 6a, b.
1965. *Disphyllum pashiense* (Soshkina); V. A. Ivanija, Devonskie..., p. 208 (cum synonymy).
1968. *Disphyllum* cf. *pashiense* (Soshkina); T. Gunia, Fauna..., p. 151, Pl. V, Fig. 6.
non 1951. *Megaphyllum pashiense* Soshkina; E. D. Soshkina, Pozdnodevonskie..., p. 109.

Diagnosis. — A *Disphyllum caespitosum* with septal index 21—29/8—16 and dominant index 25/11—12; axial tabellae flat or convex, arranged in sets.

Material. — Approximately 40 limestone blocks with corallites and 7 single corallites; 33 thin-sections.

Description. — Phaceloid colonies; calice deep, with steep walls.

Transverse section. — Skeletal elements thick; minor septa short, slightly entering tabularium. Major/minor septum ratio equalling 5/2. Inner wall continuous. Axial field free of septa attaining 3.5—5.0 mm in diameter.

Longitudinal section. — Dissepimentarium wide, consisting of 3—7 series of dissepiments varying in size. Periaxial tabellae vesiculate or

platelike, axial tabellae broad occupying 8 mm in corallite 12 mm in diameter, inflatted and arranged in 2—5 tabella sets. Number of tabellae in along 5 mm section equals 9 to 11. Vesiculate accessory plates may be fixed along axis and margins of tabellae.

Variability wide. Major septa vary in length resulting in changes of diameter of septum-free axial field. Tabularium is most variable here, because axial tabellae are wide or narrow depending on specimen. Tabulae

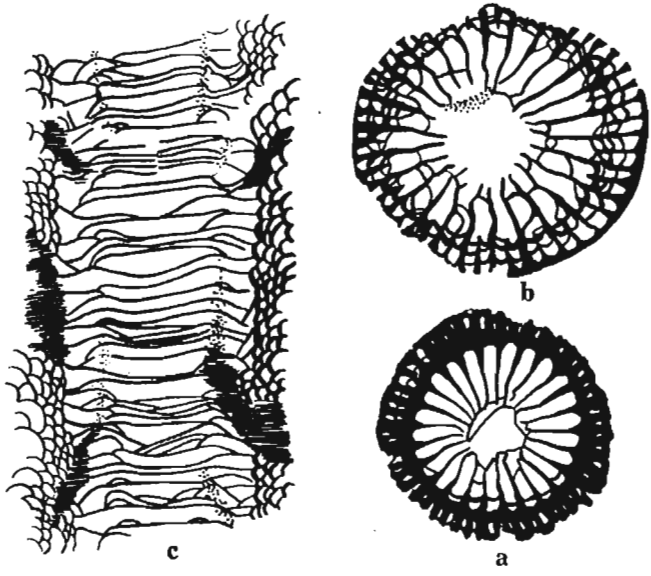


Fig. 27. *Disphyllum caespitosum pashiense* (Soshkina): a, b — transverse sections (No. Z. Pal. P. Tc-5/54 — 53); c — longitudinal section (No. Tc-5/56). All specimens from Zagórze, Lower Polygnathus asymmetricus Zone, ×3.

systems are densely- or loosely-spaced. Axial tabellae are commonly convex, often flat, or, occasionally, slightly concave.

Remarks. — According to the senior author, *Megaphyllum pashiense* Soshkina, 1951, is not included in the synonymy of the present species as its septal index equals 21 according to Soshkina. Coral described and figured by Gunia (1968) as *D.* cf. *pashiense* is very close to that figured in Pl. VII, Fig. 13 of the present paper and therefore it is included in the synonymy.

Disphyllum cylindricum (Soshkina) similarly as *D. c. pashiense* is characterized by (horizontal-convex) tabulae arranged in sets, but differs from the latter in smaller number of major septa, 22 at the average in comparison with 25 in the latter. Therefore, the specimen identified as *D. caespitosum cylindricum* by Altevogt (1963, Pl. 2, Figs. 6a, b) is assigned to *D. c. pashiense*.

Occurrence. — Poland: Holy Cross Mts, South region, Kielce (Wietrznia quarry, points VIII, XXII), the Polygnathus asymmetricus Zone; Kadziel-

nia quarry, points III, VIII, IX, below the Ancyrognathus triangularis Zone (tol γ); Zagórze, Łagów, Lower Frasnian; Sudety Mts, Witoszów, Mokrzeszów, Frasnian. USSR: Ural Mts, Timan Mts, Kuzbas, Saian Altaj, Armenia, Lower Frasnian/Upper Givetian. Spain: Asturia, Frasnian. Asia: Pakistan (fide Altevogt, 1963), Frasnian.

Disphyllum cylindricum (Soshkina, 1939)

(Pl. X, Figs. 1—12; Pl. XI, Fig. 8; Text-figs. 25, 28)

1939. *Megaphyllum cylindricum* (Soshkina); E. D. Soshkina, Verchnedevonskie..., p. 16, Pl. 1. Figs. 8, 9.

1951. *Megaphyllum pashiense* Soshkina; E. D. Soshkina, Poznodevonskie..., p. 109. 110, Pl. XXI, XXIV.

non 1963. *Disphyllum caespitosum cylindricum* (Soshkina); G. Altevogt, Die oberdevonische..., p. 23, 24, Pl. 2, Figs. 6.

Diagnosis. — A *Disphyllum* with short minor septa, wide tabularium; tabularium commonly composed of complete tabulae arranged in sets. Septal index 19—26/6—13, dominant index 22/8.

Material. — Approximately 45 limestone blocks with corallite fragments randomly scattered; the longest corallite attains 45 mm in length and 11 mm in diameter at distal end; 34 thin-sections and 4 peels.

Description. — Corallites are subcylindrical in cross-section, and in places adjoin one another.

Transverse section. — Corallites circular to ovate in cross-section; epitheca and external wall 0.3 mm thick; inner wall 0.5 mm thick. Major septa cuneate, sometimes bi-cuneate, long but do not reach the axis. Minor septa short, not penetrating inner wall, attaining a half to a quarter of major septum length.

Longitudinal section. — Dissepimentarium, consisting of 1—3 dissepiment series, obscured by thick accumulation of sclerenchyme on septa and dissepiments. Axial tabellae flat-convex, arranged in sets and with vesiculate accessory plates. Tabularium occupying 6.7 mm at 8.2 mm diameter. Tabulae 6—12 in number along 5 mm section.

Variability high. External and inner wall separated or connected; in the latter case a continuous stereozone originates. Occasionally inner wall is thin and discontinuous, then major septa are cuneate, thickened only at periphery. Septum-free axial field commonly very narrow, occasionally wide. Minor septa short, particularly when stereozone is developed; in some corallites minor septa are so shortened that attain denticle-like appearance in transverse section. Periaxial tabellae occasionally lacking, variable in width. Axial tabellae commonly complete and reach dissepimentarium; often biserial tabularium may be found.

Remarks. — Quantitative features of the above species are identical with those of *D. h. kostetskae*; also dominant number of major septa is the same, 22. However, the internal structure is quite different, differing from that of *D. h. kostetskae* in flat-convex tabulae arranged in sets and often continuous, the lack of accessory plates along margins of axial tabellae which result in furrow-like appearance of the axial part of the latter subspecies.

The senior author does not consider *Megaphyllum cylindricum* Soshkina (1951, pp. 109—110) with septal index 21/11 as a synonym of the

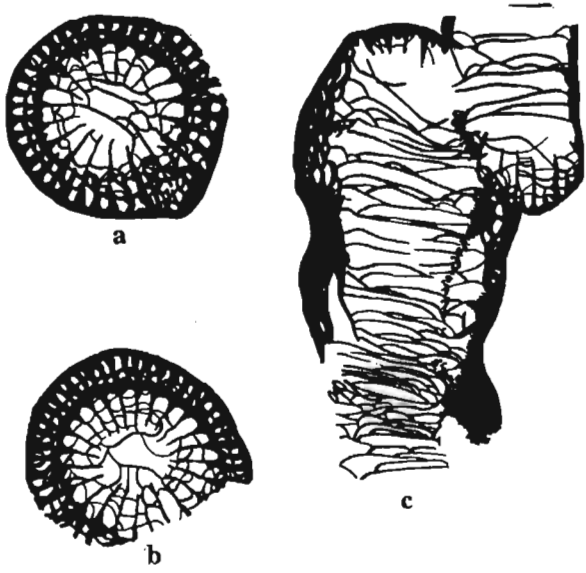


Fig. 28. *Disphyllum cylindricum* (Soshkina): a, b — transverse section (No. Z. Pal. P. Tc-5/105), Olkusz, boring BB-18, depth 312,5 m; c — longitudinal section (No. Tc-5/109), Olkusz, boring BB-18, depth 306,8 m. Lower Frasnian, ×3.

species *M. pashiense* because of minor number of septa and considers both these species, *D. cylindricum* and *D. c. pashiense*, as convergent forms. Identifications may be doubtful when a number of specimens is small or in extremal cases.

According to the senior author Altevogt (1963, p. 23) incorrectly assigned Spanish coral with n/d = 26/12 to *D. caespitosum cylindricum*, because its index as well as other features better correspond to the diagnosis of *D. caespitosum* pashiense.

Occurrence. — Poland: Holy Cross Mts, Kielce (Kadzielnia quarry, pt. VIIa, Wietrznia quarry, pts. V, VIII, XVI), the Polygnathus asymmetricus Zone; Łagów, Lower or Middle Frasnian; Silesian-Cracow anticlinorium, boreholes Olkusz BB 18, depth 302—317, B 746, depth 253—343 m, B 570, depth 468—546 m, BB 24, depths 239—329 m, BB 26, depths 202—212 m, and B 743, depths 602—604 m, Frasnian, borehole; Karniowice 4, depths

293—299.4, the Polygnathus asymmetricus Zone. USSR: Ural Mts, Upper Givetian-Lower Frasnian.

Palaeozoological Institute
of the Polish Academy of Science
Poznań Branch
Poznań, ul. Mielżyńskiego 27/29
December, 1971

REFERENCES

ALTEVOGT, G. 1963. Die oberdevonischen rugosen Korallen von der asturischen Küste (Cabe Penas, Nordspanien). — *N. Jb. Geol. Paläont., Abh.*, **117**, 9-38, Stuttgart.

— 1967. Devonian tetracorals from Spain and their relation to North American species. In: D. H. Oswald (ed.), *Int. Symp. Devon. System*, **2**, 755-769, Calgary.

BARROIS, Ch. 1882. Recherches sur les terrains anciens des Asturies et de Galice. — *Mém. Soc. Géol. Nord.*, **2**, 1, 1-630, Lille.

BESPROZVANNYCH, N. I. 1964. Korally Rugosa srednodevonskich otloženij Kolyvan-Tomskoj skladčatoj zony (Ob-Zajanaskaja Oblast). Silurijskie i devonskie korally aziatickoj časti SSSR. *A. N. SSSR, Sibir. Otd. Inst. Geol. Geofiz.*, 50-79, Moskva.

BIRENHEIDE, R. 1969. Typen mittel- und oberdevonischer Rugosa aus der Sammlung Goldfuss. — *Senckenberg. Lethaea*, **50**, 37-55, Frankfurt a. M.

BOJKOVA, K. A. 1954. Nekotorye vidy korallov Rugosa i Tabulata iz otloženij verchnego devona Russkoj platformy. — *Sborn. Vsesoj. geol.-razv. neft. Inst., Paleont.*, **1**, 44-51, Leningrad.

BRITISH PALAEOZOIC FOSSILS. 1964. British Museum (Natural History), 1-208, London.

BULVANKER, E. Z. 1941. Rugosa Glavnogo devonskogo polja. — *Fauna Gl. devon. polja*, **1**, 133-137. Moskva.

— 1958. Devonskie četyrechlučevye korally okrain Kuzneckogo bassejna. — *Trudy Vses. Geol. Inst.*, **1**, 1-212, Leningrad.

CHAPMAN, E. J. 1893. On the corals and coralliform types of Paleozoic strata. — *Trans. Roy. Soc. Canada*, **39**, 4, 39-48, Ottawa.

CRANSWICK, J. S. & Fritz, M. A. 1958. Coral fauna of the Upper Abitibi River Limestone. — *Proc. Geol. Assoc. Canada*, **10**, 37-70, Ottawa.

CZARNOCKI, J. 1947. Przewodnik XX Zjazdu Polskiego Towarzystwa Geologicznego. W Górach Świętokrzyskich w r. 1947. — *Roczn. P. T. Geol.*, **17**, Warszawa.

DEGTIAREV, D. D. 1951. Fauna korallov izvestnjakov, vključajuščich pašijskuju tolšču w čusovskom rajonie. — *Ural. Gos. Univ. im. A. M. Gorkogo*, 1-40, Sverdlovsk.

DEMBIŃSKA-RÓŻKOWSKA, M. 1948. Korale dewońskie Gór Świętokrzyskich. — *Wiad. Muzeum Ziemi*, **4**, 178-220, Warszawa.

DUBATOLOV, W. N. & SPASSKIJ, N. J. 1970. Korally osnovnych paleobiogeografičeskich provincij devona. Zakonomernosti rasprostranenija paleozojskich korallov SSSR. — *Inst. Geol. A. N. Est. SSR*, Moskva.

EDWARDS, H. M. & HAIME, J. 1851. Monographie des Polypiers fossils des terrains Paléozoïques. — *Arch. Mus. Hist. Nat. Paris*, 1-502, Paris.

— 1853. A Monograph of the British fossil corals. 4: Corals from the Devonian formation. — *Palaeont. Soc. Mon.*, 212-244, London.

EHLERS, G. M. & STUMM, E. C. 1949. Corals of the Devonian Traverse Group of Michigan. 2: Cylindrophyllum, Depasophyllum, Disphyllum, Eridophyllum, and Synaptophyllum. — *Cont. Mus. Paleont. Univ. Michigan*, **8**, 3, 21-41, Ann Arbor.

ERMAKOVA, K. A. 1960. Korally devona Russkoj platformy i Timana. 1-14, Moskva.

ETHERIDGE, R. 1899. On the corals of the Tamworth District, chiefly from the Moore Creek and Woolmol Limestones. — *Rec. Geol. Survey N. S. Wales*, **6**, 151-183, Sidney.

— 1902. Additions to the Middle Devonian and Carboniferous corals in the Australian Museum. — *Rec. Austral. Museum*, **4**, 253-262, Sidney.

FAGERSTROM, J. A. 1961. The fauna of the Middle Devonian Formosa Reef Limestone of southwestern Ontario. — *J. Paleont.*, **35**, X, 1-45, Tulsa.

FEDOROWSKI, J. 1965. Lower Permian Tetracoralla of Hornsund, Vestspitsbergen. (Wyniki badań geologicznych Polskich wypraw Spitsbergeńskich). — *Stud. Geol. Pol.*, **17**, 3-173, Warszawa.

— 1967. The Lower Permian Tetracoralla and Tabulata from Treskelodden, Vestspitsbergen. — *Skirft. Norsk. Polarint.*, **142**, 1-44, Osol.

FENTON, C. L. & FENTON, M. A. 1924. The stratigraphy and fauna of the Hackberry stage of the Upper Devonian. — *Contr. Mus. Geol. Univ. Michigan*, **1**, 1-260, Michigan.

FLÜGEL, H. 1956. Die Sandsteinfazies des Mitteldevons von Graz. — *Anz. Österr. Akad. Wiss. (Math.-naturw. Kl.)*, **93**, 45-57, Wien.

— 1961. Stromatoporen und Korallen aus dem Mitteldevon von Feke (Antitaurus). — *Senckenberg. Lethaea*, **42**, 377-409, Frankfurt.

— & Schimunek, K. 1960. Revision der aus dem Mitteldevon von Graz beschreibenen Arten der Gattung Hexagonaria Gürich (Rugosa). — *N. Jb. Geol. Paläont., Abh.*, **111**, 1, 1-29, Stuttgart.

FONTAINE, H. 1961. Les Madréporaires Paléozoïques du Viet-Nam, du Laos et du Cambodge. — *Arch. Géol. Viet-Nam*, 5, 1-276, Saigon.

FRECH, F. 1885. Die Korallenfauna des Oberdevons in Deutschland. — *Ztschr. Deutsch. Geol. Ges.*, **37**, 21-130, Berlin.

— 1886. Die Cyathophylliden und Zaphrentiden des Deutschen Mitteldevon. — *Palaeont. Abh.*, **3**, 3, 1-119, Berlin.

GOLDFUSS, G. A. 1826-1833. Petrefacta Germaniae, **1**. 1-76; 1826, 77-164; 1829, 165-240, 1831, 241-251, Düsseldorf.

GRÄFF, W. 1958. Kritische Bemerkungen zu den als "Cyathophyllum" vermiculare aus dem Grazer Mitteldevon beschriebenen Korallen. — *Mitt. naturw. Ver. Steiermark*, **88**, 79-103, Graz.

GUNIA, T. 1964. Fauna otoczaków a zagadnienie wieku zlepieńców Witoszowa (Dolny Śląsk). — *Roczn. P. T. Geol.*, **32**, 4, 493-523, Kraków.

— 1966. Nowe wyniki badań nad stratygrafią i paleogeografią górnego Dewonu depresji Świebodzic. — Z geologii Ziem Zachodnich z okazji XX-lecia polskich badań geologicznych, 160-183, Wrocław.

— 1968. Fauna, stratygrafia i warunki sedymentacji górnego dewonu Depresji Świebodzic. — *Geol. Sudetica*, **4**, 115-220, Warszawa.

GÜRICH, G. 1896. Das Palaeozoicum im Polnischen Mittelgebirge. — *Verh. Russ.-Kais. Min. Ges.*, **2**, 32, 1-539, St. Petersburg.

HAMADA, T. 1960. Middle Palaeozoic Formations in China and Korea. I: Korea and Northeast China. — *Jap. J. Geol. Geogr.*, **31**, 165-183, Tokyo.

HILL, D. 1936. Upper Devonian corals from Western Australia. — *J. Roy. Soc. West. Australia*, **22**, 25-38, Brisbane.

— 1937. Type specimens of Paleozoic corals from New South Wales in W. B. Clarks

first collection, and in the Strzelecki collection. — *Geol. Mag.*, **74**, 4, 145-153, London.

— 1941. The Lower Middle Devonian rugose corals of the Murrumbidge and Goodradigbee rivers, N. S. Wales. — *J. Proc. Roy. Soc. N. S.* Wales, **74**, 247-276, Sydney.

— 1942a. The Devonian rugose corals of the Tamworth District. N. S. Wales. — *Ibidem*, **76**, 142-146.

— 1942b. Middle Devonian rugose corals from the Wellington District. — *Ibidem*, **76**, 182-189.

— 1942c. — The Middle Devonian rugose corals of Queensland. 3: Burdekin Downs, Fanning r., and Reid Gap, N. Queensland. — *Proc. Roy. Soc. Queensland*, **53**, 4, 229-268, Brisbane.

— 1950. Middle Devonian corals from the Buchan District, Victoria. — *Ibidem*, **62**, 2, N. Ser., 137-164.

— 1954a. Devonian corals from Waratah Bay, Victoria. — *Proc. Roy. Soc. Victoria*, **66**, N. Ser., 105-118, Brisbane.

— 1954b. Coral faunas from the Silurian of N. S. Wales and the Devonian of W. Australia. — *Bull. Commonw. Austral., Dept. Nat. Devel. Geol. Geophys.*, **23**, 1-51, Canberra.

HINDE, G. J. 1890. Notes on the palaeontology of Western Australia. 2: Corals and Polyzoa. — *Geol. Mag.*, **3**, 7, 194-204, London.

IVANIJA, V. A. 1953. Materialy k izučeniju nižnefranskogo kompleksa korallov Rugosa Kuzbassa. — *Trudy Tomsk. Gosud. Univ. im. V. Kujbiševa*, **124**, 19-50, Tomsk.

— 1965. Devonskie korally Rugosa Sajano-Altajskoj gornoj oblasti. — *Tom. Gos. Univ. im. V. Kujbiševa*, 5-398, Tomsk.

JELL, J. 1969. Septal microstructure and classification of the Philipsastraeidae. — In: Campbell (ed.), Stratigraphy and Paleontology, 50-73, Canberra.

JULL, R. K. 1965. Corallum increase in Lithostrotion. — Palaeontology, **8**, 204-225, London.

KAPLAN, A. A. 1969. Četyrechlučevye korally živetskich otloženij Bajanaula Čingiza i Predčingiza. — *Izv. Vyssich Učebn. Zaved.*, **1**, 19-29, Leningrad.

KAŹMIERCZAK, K. 1971. Morphogenesis and systematic of the Devonian Stromatoporoidea from the Holy Cross Mountains, Poland (Morfogeneza i systematyka dewońskich Stromotoporoidea z Gór Świętokrzyskich). — *Palaeont. Pol.*, **26**, 3-150, Warszawa.

KETTNEROVÁ, M. 1932. Paleontologicke studie z čelechovickeho devonu 4: Rugosa. — *Trav. Inst. Geol. Paläont. Univ. Charles*, 1-97, Praha.

KOZŁOWSKI, S. 1962. Wycieczka II E. Przewodnik XXXV Zjazdu P. T. Geol. Kielce. 16-19, Warszawa.

LAMBE, M. L. 1900. A revision of the genera and species of Canadian Paleozoic corals: The Madreporaria Perforata and the Alcyonaria. — *Cont. Canad. Poleont. Geol. Survey Canada*, **4**, 1-96, Ottawa.

LANG, W. D. & SMITH, S. 1935. Cyathophyllum caespitosum Goldfuss and other Devonian corals considered in a revision of that species. — *Quart. J. Geol. Soc.*, **91**, 538-590, London.

— , — , THOMAS, H. D. 1940. Index of Palaeozoic coral genera. 1-231, London.

LEBEDEV, N. I. 1902. Rol' korallow v devonskich otloženijach Rossii. — *Trudy Geol. Kom.*, **17**, 2, 1-137, St. Petersburg.

LECOMPTE, M. 1968. La Belgique et le Nord de la France. In: D. H. Oswald (ed.), *Int. Symp. Devon. System*, **2**, 15-52, Calgary.

— 1970. Die Riffe im Devon der Ardennen und ihre Bildungsbedingungen. — *Geol. et Palaeont.*, **4**, 25-71, Marburg.

LE MAÎTRE, M. 1934. Étude sur la faune des calcaires dévoniens du Bassin d'Ancenis. — *Mém. Soc. Géol. Nord.*, **12**, 1-267, Lille.

— 1937. Étude sur la faune corallienne des calcaires Givétiens de la Ville-Dé-d'Ardin (Deux Sèvres). — *Bull. Soc. Géol. France*, **5**, 7, 105-128, Paris.

— 1947. Contribution à l'étude du Dévonien du Tafilalet. 2: Le récif coralligène de Ouihalane. — *Notes Serv. Géol. Maroc*, **67**, 1-112, Lille.

LENZ, A. 1961. Devonian rugose corals of the Lower Valley, northwest territories. In: Geology of the Arctic, **1**, 500-514, Toronto.

LEWANDOWSKI, M. 1971. Stratygrafia górnego dewonu okolicy Zagórza i Wietrzni na podstawie konodontów. — *Unpublished Reports Inst. Geol. U. W.*, Warszawa.

MA, T.Y.H. 1937. On the seasonal growth in Palaeozoic tetracorals and the climate during the Devonian period. — *Palaeont, Sinica*, B, **2**, 3, 1-50, Nanking.

MAŁKOWSKI, H. 1971. Stratygrafia górnego dewonu okolic Górna na podstawie konodontów. — *Unpublished Reports. Inst. Geol. U. W.*, Warszawa.

MANSUY, H. 1912. Paléontologie, II Partie. In: J. Deprat & H. Mansuy, Étude Géologique du Yun-nan Oriental. — *Mém. Serv. Géol. Indochine*, **1**, 2, 1-146, Hanoi-Haipong.

MCLAREN, D. J. & NORRIS, A. W., 1964, Fauna of the Devonian Horn Plateau formation, District of Mackenzie. — *Bull. Geol. Surv. Canada*, **114**, 1-74, Ottawa.

— , — , & CUMMING, L. M., 1970. Biochronology. 11: Devonian faunas. In: R. W. J. Douglas (ed.), Geology and economic minerals of Canada. — *Bull. Geol. Surv.*, Calgary.

MEEK, F. B. 1877. United States Geological Exploration of the fortieth parallel. 1: Palaeontology. 29-31, Washington.

MIDDLETON, G. V. 1959. Devonian tetracorals from South Devonshire, England. — *J. Paleont.*, **32**, 139-160, Tulsa.

OLIVER, W. A. JR. 1967. Succession of rugose coral faunas in the Lower and Middle Devonian of east N. America. In: D. H. Oswald (ed.), *Int. Symp. Devon. System*, **2**, 733-744, Calgary.

PEDDER, A. E. H. 1963. Two new genera of Devonian tetracorals from Australia. — *Proc. Linn. Soc. N. S. Wales*, **88**, 364-367, Sydney.

— , JACKSON, J. H. & ELLENOR, D. W. 1969. An interim account of the Middle Devonian Timor Limestone of Nort-Eastern New South Wales. — *Ibidem*, **94**, 3, 242-272, Melbourne.

PEETZ, H. V. 1901. Beiträge zur Kenntnis der Fauna as den devonischen Schichten am Rande des Steinkohlen-Bassins von Kusneck (West-Sibirien). 1-393, St. Petersburg.

PENECKE, K. A. V. 1887. Über die Fauna und das Alter einiger paläozoischer Korallenriffe der Ostalpen. — *Ztschr. deutch. geol. Ges.*, **39**, 267-276, Berlin.

— 1904. Das Sammelergebnis Dr. Franz Schaffers aus dem Oberdevon von Hadschin im Antitaurus. — *Jb. geol. Reichsanst.* **53**, 140-152.

PHILIP, G. M. 1962. The paleontology and stratigraphy of the Siluro-Devonian sediments of the Tyers area, Gippsland, Victoria. — *Proc. Roy. Soc. Victoria*, **75**, 2, 123-246, Melbourne.

— & PEDDER, A. E. H. 1964. A re-assessment of the age of the Middle Devonian of South-eastern Australia. — *Nature*, **202**, 1323-1324, St. Albans.

— & — 1967. Stratigraphical correlation of the principal Devonian Limestone sequences of Eastern Australia. In: D. H. Oswald (ed.), *Int. Symp. Devon. System*, **2**, 1025-1041, Calgary.

PICKETT, J. 1967. Untersuchungen zur Familie Phillipsastraeidae (Zoantharia Rugosa). — *Senckenberg. Lethaea*, **48**, 1-89, Frankfurt a. M.

REED, F. R. C. 1922. Devonian fossils from Chitraland the Pamirs. — *Palaeont. Indica*, N. ser., **6**, 1-134, Calcutta.

ROEMER, F. A. 1855. Beiträge zur geologischen Kenntnis des nordwestlichen Harzgebirges. — *Palaeontographica*, **3**, 1, 1-52, Stuttgart.

RÓŻKOWSKA, M. 1960. Blastogeny and individual variation in tetracoral colonies from the Devonian of Poland (Blastogeneza i zmienność osobnicza w koloniach Tetracoralla z dewonu Polski). — *Acta Palaeont. Pol.*, **5**, 1, 3-64, Warszawa.

SCHLÜTER, C. 1881. Über einige Anthozoen des Devon. — *Verh. naturhist. Ver. Rheinl.*, **38**, 189-232, Bonn.

— 1889. Anthozoen des rheinischen Mitteldevon. — *Abh. Geol. Spezialk. Preussen*, **8**, 4, 259-465, Berlin.

SCHOUPPÉ, A. v. 1965. Die mittel — bis oberdevonische Korallenfauna von Kuragh (Chitral). — Ital. Exp. to the Karakorum (K^2) and Hindu Kush. Prof. Ardito Desio leader. Leiden.

— & STACUL. P. 1966. Morphogenese und Bau das Skelettes der Pterocorallia. — *Palaeontographica, Suppl.*, **11**, 1-186, Stuttgart.

SCRUTTON, C. T. 1969. Corals and stromatoporoids from the Chudleigh Limestone. — *Proc. Ussher. Soc.*, **2**, 102-106, Redruth.

SEMENOFF-TIAN-CHANSKY, P. 1961. Madréporaires paléozoïques. In: P. Semenoff, J. Lafuste & Durand-Delga, Madréporaires du Dévonien du Chénoua (Algérie). — *Bull. Soc. Géol. France*, **7**, III 292-313, Paris.

SLOSS, L. L. 1939. Devonian rugose corals from the Traverse beds of Michigan. — *J. Paleont.*, **13**, 52-73, Tulsa.

SMITH, S. 1945. Upper Devonian corals of the Mackenzie River Region Canada. — *Spec. Pap. Géol. Soc. Amer.*, **59**, 1-126, New York.

SOBOLEV, D. 1904. Devonskie otloženija profilja Grzegorzewice-Skały-Włochy. — *Izv. Varš. Polit. Inst.*, 1-107, Varšava.

SORAUF, J. E. 1970. Microstructure in the exoskeleton of some Rugosa (Coelenterata). — *J. Paleont.*, **45**, 1, 23-32, Tulsa.

SOSHKINA, E. D. 1939. Verchnedevonskie korally Rugosa Urala. — *Trudy Paleont. Inst. Akad. Nauk SSSR*, **6**, 4, 1-112, Moskva-Leningrad.

— 1941. Sistematika srednedevonskich Rugosa Urala. — *Ibidem*, **10**, 4, 1-53.

— 1949. Devonskie korally Rugosa Urala. — *Ibidem*, **15**, 4, 1-160.

— 1951. Pozdnedevonskie korally Rugosa, ich sistematika i evoljucija. — *Ibidem*, **34**, 1-122.

— 1952. Opredetitel' devonskich četyrechlučevwych korallov. — *Ibidem*, **39**, 1-127.

— 1954. Devonskie četyrechlučevye korally Russkoj platformy. — *Ibidem*, **52**, 1-74.

SPASSKIJ, N. J. 1955. Korally Rugosa i ich značenie dla stratigrafii srednego devona zapadnogo sklona Urala. — *Trudy Vsesoj. Nauč.-Issled. Geol. Razv. Inst.*, **90**, 92-169, Leningrad.

— 1967. Značenie devonskich četyrechlučevych korallov dla paleobiogeografičeskogo rajonirovanija SSSR. — *Trudy Vsesoj. Paleont. Obšč.*, **9**, 49-55, Moskva.

STRUSZ, D. L. 1961. Lower Palaeozoic corals from New South Wales. — *Palaeontology*, **4**, 334-361, London.

— 1965. Disphyllidae and Phacellophyllidae from the Devonian Garra Formation of New South Wales. — *Ibidem*, **8**, 518-571.

STUMM, E. C. 1938. Upper Middle Devonian Rugose Corals of the Nevada Limestone. — *J. Paleont.*, **12**, 478-485, Tulsa.

— 1940. Upper Devonian rugose corals of the Nevada Limestone. — *Ibidem*, **14**, 57-67.

— 1949. Corals of the Traverse group of Michigan. 2: Cylindrophyllum, Depasophyllum, Disphyllum, Eridophyllum, and Synaptophyllum. — *Contr. Mus. Paleont. Univ. Michigan*, **8**, 3, 21-41, Ann Arbor.

— 1968. The corals of the Middle Devonian Temile Creek Dolomite of Northwestern Ohio. — *Ibidem*, **22**, 37-44.

SZULCZEWSKI, M. 1971. Upper Devonian conodonts, stratigraphy and facial development in the Holy Cross Mountains (Konodonty, stratygrafia i rozwój facjalny górnego dewonu Gór Świętkorzyskich). — *Acta Geol. Pol.*, **21**, 1, 1-129, Warszawa.

TAYLOR, P. W. 1951. The Devonian tetracorals of the Plymouth Limestone. — *Trans. Roy. Geol. Soc. Cornwall*, **18**, 161-214, Penzance.

TSIEN, H. H. 1969. Contribution à l'étude des Rugosa du Couvinien dans la région de Couvin. — *Mém. Inst. Géol. Univ. Louvain*, **25**, 1-174, Louvain.

— 1970. Espèces du genre Disphyllum (Rugosa) dans le Dévonien moyen et le Fransnien de la Belgique. — *Ann. Soc. géol. Belgique*, **93**, 160-182, Bruxelles.

WANG, H. C. 1948a. Middle Devonian rugose corals of eastern Yunnan. — *Contr. Geol. Inst. Univ. Peking*, **33**, 1-45, Peking.

— 1948b. Some Middle rugose corals from Tushan and Tuyun, Kueichow. — *Nat. Peking Univ. fiftieth Anniv. Pap. geol. ser.*, 105-113, Peking.

WARREN, P. S. 1928. The Palaeozoic of the Crowsnest Pass, Alberta. — *Mem. Trans. Roy. Soc. Canada*, **3**, 22, 4, 109-119, Ottawa.

WEDEKIND, R. 1922. Zur Kenntnis der Stringophyllen des oberen Mitteldevon. — *Sitz. Ber. Ges. Bef. Naturw.*, **14**, 1-93, Marburg.

YABE, H. & HAYASAKA, J. 1920. Palaeontology of Southern China. — Geogr. Res. China, 1911-1916, *Rept. Tokyo Geogr. Soc.*, 1-221, Tokyo.

— 1920. Atlas of fossils. — Geogr. Res. China, 1911-1916, *Rept. Tokyo Geogr. Soc.*, Tokyo.

YOH, S. S. 1937. Die Korallenfauna des Mitteldevons aus der Provinz Kwangsi, Südchina. — *Palaeontographica*, **87**, 45-76, Stuttgart.

YÜ, C. C. 1947. Some Devonian fossils from Kweilin and other localities in Kwangsi. — *Bull. geol. Soc. China*, **27**, 123-140, Nanking.

MARIA RÓŻKOWSKA & JERZY FEDOROWSKI

RODZAJ *DISPHYLLUM* DE FROMENTEL (RUGOSA) W DEWONIE POLSKI I JEGO ROZPRZESTRZENIENIE

Streszczenie

Opisano z Polski 6 gatunków i 4 podgatunki rodzaju *Disphyllum*, w tym dwa podgatunki jako nowe: *D. wirbelauense regulare* n. subsp. z górnego żywetu i *D. w. bonae* n. sp. z górnego żywetu i najniższego franu.

Ustalono nowe diagnozy podgatunków i gatunków i wyodrębniono cechy istotnie ważne diagnostycznie od drugorzędnych, biorąc pod uwagę nadzwyczaj szeroką

zmienność wewnątrzgatunkową i zależność pokroju kolonii od środowiska. Opisano mikrostrukturę i pączkowanie. Przedyskutowano znaczenie stratygraficzne gatunków tego rodzaju, rozprzestrzenienie geograficzne, przypuszczalne kierunki migracji, a na załączonych tabelach podano krytyczny przegląd gatunków *Disphyllum* występujących na świecie oraz gatunków opisanych jako *Disphyllum*, a w rzeczywistości nie należących do tego rodzaju.

Cechy istotne diagnostycznie. — Stwierdzono dużą zmienność wewnątrzgatunkową w pokroju kolonii, w grubości i długości septów oraz w budowie dissepimentarium i tabularium. Cechami ważnymi diagnostycznie są: dla gatunku — średnia wartość n/d[1] oraz architektura wnętrza koralita; dla podgatunku — drugorzędne cechy strukturalne przy identycznym n/d[1] i podobnej budowie wewnętrznej.

Mikrostruktura. — Przedstawiciele rodzaju *Disphyllum* cechują się trabekularną budową septów. Trabekule są monakantami szerokości 0,2-0,3 mm, ułożonymi horyzontalnie lub półwachlarzowato. (Pl. XI, Fig. 10). Sekrecja bazalna jest lamellarna (Pl. XI, Figs. 5, 6, 9). Ściana jest dwustrefowa, złożona z cienkiej, ciemnej epiteki (0,06-0,1 mm) i grubszej ściany zewnętrznej o budowie lamellarno-włóknistej. Trójkątne podstawy septów wnikają głęboko w tę ścianę. Powierzchnie boczne septów są gładkie, bez karin, tylko miejscami, sporadycznie, występują drobne guzki.

Pączkowanie. — Stwierdzono, że pączkowanie jest wyłącznie lateralne, w dissepimentarium. Nie jest ono w tym wypadku cechą diagnostyczną dla rodzaju, może jednak być nią dla niektórych gatunków.

Znaczenie stratygraficzne. — Rodzaj *Disphyllum* pojawił się w Polsce w najwyższym żywecie, najbujniej rozwinął się w dolnym franie i wymarł całkowicie przed końcem franu. Stwierdzono, że *D. geinitzi* i *D. wirbelauense regulare* n. subsp. charakteryzują wyższą część górnego żywetu, *D. kweihsiense* występuje tylko w najniższym franie, a *D. wirbelauense wirbelauense* tylko w górnym franie. Pozostałe gatunki i podgatunki (z wyjątkiem *D. wirbelauense bonae* n. subsp.) najczęściej występują w dolnym, rzadziej w środkowym franie. Tylko *D. caespitosum pashiense* i być może *D. c. caespitosum* wchodzą w Sudetach i na Pomorzu do górnego franu.

Rozprzestrzenienie geograficzne i migracja. — Najstarsze disfylla opisano z zigenu Australii. Ich pozycja stratygraficzna jest dyskusyjna. Dobrze datowane są natomiast disfylla w kuwinie Australii (Kockeliana Zone), Uralu i Tiań-Szania, Północnej Afryki i Belgii. W żywecie *Disphyllum* ma już szerokie rozprzestrzenienie: od Australii i Chin do Ameryki Północnej. Najbujniejszy rozwój rodzaju przypada na fran. Szczególnie pospolite są gatunki, o tzw. „charaterze zachodnio-europejskim". Granice prowincji zoogeograficznych ulegają zupełnemu zatarciu. Centrum migracji były prawdopodobnie Chiny. Stąd gatunki *Disphyllum* wędrowały na zachód, do Europy na E do Ameryki oraz krótszymi szlakami: na S do Australii i na NW do Syberii.

[1] Stosunek liczby septów (n) do średnicy koralita (d).

МАРИЯ РУЖКОВСКА & ЕЖИ ФЕДОРОВСКИ

РОД *DISPHYLLUM* DE FROMENTEL (RUGOSA) ИЗ ДЕВОНА ПОЛЬШИ И ЕГО РАСПРОСТРАНЕНИЕ

Резюме

Описано из территории Польши 6 видов и 4 подвида рода *Disphyllum*, в том числе два новых подвида: *D. wirbelauense regulare* n. subsp. из верхнего живета и *D.w.bonae* n. subsp. из верхнего живета и низов франа.

Установлены новые диагнозы подвидов и видов, а также определены существенно важные диагностические признаки в отличие от второстепенных, учитывая чрезвычайно богатое внутривидовое разнообразие и зависимость форм колоний от окружающей среды. Дано описание микроструктуры и почкования. Рассмотрено стратиграфическое значение видов этого рода, их географическое распространение, предполагаемые пути миграции, а в приложенных списках представлен критический обзор видов *Disphyllum*, распространенных на земном шаре, а также видов, относимых к *Disphyllum*, но в действительности не относящихся к этому роду.

Важные диагностические признаки. Констатируется большая внутривидовая изменчивость форм колоний, толщины и длины септ и строения диссепиментариума и табуляриума. К важным диагностическим признакам относятся: для вида — средняя величина n/d[1] и внутренняя архитектура кораллита, для подвида — второстепенные структурные признаки при одинаковых n/d[1] и сходном внутреннем строении.

Микроструктура. Представители рода *Disphyllum* характеризуются трабекулярным строением септ. Трабекулы представлены монакантами шириной 0,2—0,3 мм, расположенными горизонтально или полувеерообразно (табп. XI, фиг. 10). Базальная секреция ламеллярная (табл. XI, фиг. 5, 6, 9). Стенка двухзональная, состоит из тонкой, темной эпитеки (0,06—0,1 мм) и более толстой внешней стенки с ламеллярно-волокнистым строением. Треугольные основания септ на большую глубину входят в эту стенку. Боковые поверхности септ гладкие, без карин, лишь местами наблюдаются мелкие бугорки.

Почкование. Наблюдалось единственно латеральное почкование в диссепиментариум. В данном случае оно не является диагностическим признаком рода, однако может играть такую роль по отношению к некоторым видам. Некоторое упрощение колонии и специфическое отделение молодого кораллита, которые наблюдались в местонахождении Полянув на Поморье, обусловлены экологическими условиями. Почкование у описанных видов происходит по двум, несколько отличающимся схемам (1 — *D.geinitzi*, 2 — остальные виды), что свидетельствует о филогенетическом отличии *D. geinitzi*.

Стратиграфическое значение. Род *Disphyllum* появился на территории Польши

[1] отношение числа септ (n) к диаметру кораллита (d)

в конце живетского века, наиболее обильно развивался в раннефранское время и полностью исчез перед концом франского века. Констатировано, что *D.geinitzi* и *D.wirbelauense regulare* n. subsp. характеризуют верхний интервал верхнего живета, *D. kweihsiense* распространен единственно в низах франского яруса, а *D.wirbelauense wirbelauense* только в верхнем фране. Остальные виды и подвиды (за исключением *D.wirbelauense bonae* n. subsp.) приурочены, как правило, к нижнему, реже к среднему франу. Только лишь *D.caespitosu mpashiense* и, возможно, *D.c.caespitosum* в Судетах и на Поморье проходят в верхний фран.

Географическое распространение и миграция. Наиболее древние представители рода *Disphyllum* известны с зигенского яруса Австралии, однако их стратиграфическая позиция спорная. Достоверной датировкой характеризуются представители *Disphyllum* кювина Австралии (Kockeliana Zone), Урала и Тянь-Шаня, Северной Африки и Бельгии. В живетском ярусе этот род пользуется уже широким распространением: с Австралии и Китая по Северную Америку. Самое бурное развитие этого рода приходится на франский ярус. В то время наибольшее распространенние получили так называемые „западноевропейские виды". Границы зоогеографических провинций подверглись полному затушеванию. Центр миграции находился, по-вероятности, в Китае. Из этого центра виды *Disphyllum* мигрировали на запад в Европу и на северо-восток в Америку и более коротким путем: на юг — в Австралию и на северо-запад — в Сибирь.

Explanation of plates

Plate I

Fig. 1. Quarry situated on the Zamkowa hill at Chęciny near Kielce: a — uppermost Givetian limestones, b — uppermost Givetian or lowermost Frasnian cherts.
Fig. 2. Eastern wall of the Wietrznia quarry at Kielce; Lower and Middle Frasnian limestones.
Fig. 3. Northern wall of old quarry at Sitkówka, close to railroad station; limestones with *Disphyllum geinitzi* Lang & Smith as an almost single rock-builder.

Plate II

All figures ×2

Disphyllum wirbelauense bonae n.subsp.

Fig. 1. Transverse section (No. Z. Pal. Tc-5/1), holotype.
Fig. 2. Longitudinal section (No. Tc-5/2)
Fig. 3. Longitudinal section (No. Tc-5/10)

Fig. 4. Transverse section (No. Tc-5/11)
Fig. 5. Transverse and longitudinal sections (No. Tc-5/13), All specimens from Chęciny, Uppermost Givetian.

Disphyllum wirbelauense wirbelauense Pickett

Fig. 6. Transverse and longitudinal sections (No. Tc-5/12), Sobiekurów, Upper Frasnian.

Disphyllum hsianghsienense kostetskae (Soshkina)

Fig. 7. Transverse section (No Tc-5/14) Wietrznia quarry, point V, Middle Frasnian.
Fig. 8. Longitudinal section, the same specimen.

Disphyllum caespitosum caespitosum (Goldfuss)

Fig. 9. Transverse section (No. Tc-5/15), Wietrznia, point VIII, Lower Frasnian, Polygnathus asymmetricus Zone.

Plate III

All figures ×2

Disphyllum caespitosum lazutkini (Ivanija)

Fig. 1. Transverse and longitudinal sections (No. Z. Pal. P. Tc-5/17), Kadzielnia, point VI.
Gig. 2. Transverse section (No. Tc-5/27), Wietrznia, point XXII.
Fig. 3. Longitudinal section (No. Tc-5/18), Wietrznia, point XXII.
Fig. 4. Longitudinal section (No. Tc-5/19), Wietrznia, point VIII.
Fig. 5. Longitudinal section (No. Tc-5/20), Wietrznia, point XVI.
Fig. 6. Transverse section (No. Tc-5/21), Wietrznia, point XVI.
Fig. 7. Transverse section (No. Tc-5/22), Wietrznia, point XXII.
Fig. 8. Longitudinal section (No. Tc-5/23), Wietrznia, point XXII.
Fig. 9. Longitudinal section (No. Tc-5/24), Zagórze.

Disphyllum wirbelauense regulare n.subsp.

Fig. 10. Longitudinal section (No. Tc-5/25), Olkusz BJ 24 depth 283 m.
Fig. 11. Longitudinal section (No. Tc-5/26), Olkusz BJ 24 depth 283 m.
Fig. 12. Transverse section (No. Tc-5/31), Olkusz BJ 24, depth 283 m.
Fig. 13. Transverse section (No. Tc-5/30), Olkusz BJ 24, depth 283 m.
Fig. 14. Transverse section (No. Tc-5/29), Olkusz BJ 24, depth 283.
Fig. 15. Transverse section (No. Tc-5/30), Chęciny.
Figs. 1—9 Middle and Lower Frasnian, Figs. 10—15 Givetian.

Plate IV

All figures ×2

Disphyllum geinitzi Lang & Smith

Fig. 1. Longitudinal and transverse sections (No. Z. Pal. P. Tc-5/41) Sitkówka, Uppermost Givetian.
Fig. 2. Transverse section (No. Tc-5/31) Sitkówka, Uppermost Givetian.
Fig. 3. Transverse section (No. Tc-5/32, Sitkówka, Uppermost Givetian.
Fig. 4. Longitudinal section (No. Tc-5/33), Sołtysia Hill, Uppermost Givetian.

Plate V

All figures ×2

Disphyllum kweihsiense Yoh

Fig. 1. Transverse section (No. Z. Pal. P. Tc-5/36).
Fig. 2. Transverse section (No. Tc-5/37).
Fig. 3. Longitudinal sections (No. Tc-5/38).
Fig. 4. Transverse section (No. Tc-5/39).
Fig. 5. Longitudinal sections (No. Tc-5/40).
All specimens from Kowala, Lower Polygnathus asymmetricus Zone.

Disphyllum geinitzi Lang & Smith

Fig. 6. Transverse section (No. Tc-5/34).
Fig. 7. Transverse and longitudinal sections (No. Tc-5/35).
All specimens from Sitkówka, Uppermost Givetian.

Plate VI

All figures ×2

Disphyllum caespitosum caespitosum (Goldfuss)

Fig. 1. Longitudinal section (No. Z. Pal. Tc-5/46).
Fig. 2. Longitudinal section (No. Tc-5/42).
Fig. 6. Longitudinal section (No. Tc-5/47).
Fig. 7. Transverse section (No. Tc-5/48).
All specimens from Wietrznia quarry, point VIII, Lower Polygnathus asymmetricus Zone, Lower Frasnian.

Disphyllum hsianghsienense kostetskae (Soshkina)

Fig. 3. Transverse section (No. Tc-5/43).
Fig. 4. Longitudinal section (No. Tc-5/44). Both specimens from Mokrzeszów (Sudetes), Upper Frasnian.
Fig. 5. Longitudinal section (No. Tc-5/45), Polanów, Lower Frasnian.

Plate VII

All figures ×2

Disphyllum caespitosum pashiense (Soshkina)

Fig. 1. Transverse section (No. Z. Pal. P. Tc-5/52), Zagórze.
Fig. 2. Transverse section (No. Tc-5/51), Zagórze.
Fig. 3. Transverse section (No. Tc-5/53), Zagórze.
Fig. 4. Transverse section (No. Tc-5/54), Zagórze.
Fig. 5. Transverse section (No. Tc-5/55), Zagórze.
Fig. 6. Longitudinal section (No. Tc-5/56), Zagórze.
Fig. 7. Longitudinal section (No. Tc-5/57), Zagórze.
Fig. 8. Longitudinal section (No. Tc-5/58), Kadzielnia, point IX.
Fig. 9. Longitudinal section (No. Tc-5/58a), Kadzielnia, point IX.
Fig. 10. Longitudinal section (No. Tc-5/59), Łagów.
Fig. 11. Longitudinal section (No. Tc-5/60), Kadzielnia, point IX.

Fig. 12. Longitudinal section (No. Tc-5/61), Zagórze.
Fig. 13. Longitudinal section (No. Tc-5/62), Kadzielnia, point III.
Fig. 14. Longitudinal section (No. Tc-5/63), Kadzielnia, point III.
Fig. 15. Longitudinal section (No. Tc-5/64), Kadzielnia, point VIII.
Fig. 16. Longitudinal section (No. Tc-5/65), Kadzielnia, point IX.
Fig. 17. Longitudinal section (No. Tc-5/66), Kadzielnia, point IX.
All specimens — Frasnian.

Plate VIII

All figures ×2

Disphyllum hsianghsiense kostestkae (Soshkina)

Fig. 1. Transverse section (No. Z. Pal. P. Tc-5/70), Wietrznia, point VIII.
Fig. 2. Transverse and longitudinal sections (No. Tc-5/71), Łagów.
Fig. 3. Transverse section (No. Tc-5/72), Wietrznia, point IX.
Fig. 4. Transverse section (No. Tc-5/73), Wietrznia, point VIII.
Fig. 5. Longitudinal section (No. Tc-5/74), Kadzielnia, point V.
Fig. 6. Longitudinal section (No. Tc-5/75), Wietrznia, point IX.
Fig. 7. Transverse section (No. Tc-5/76), Łagów.
Fig. 8. Transverse section (No. Tc-5/77), Kadzielnia, point V.
Fig. 9. Transverse section (No. Tc-5/78), Łagów.
Fig. 10. Transverse section (No. Tc-5/79), Wietrznia, point VIII.
All Figs. — Frasnian, Figs. 1, 4, 10 — Lower Frasnian (Pol. asymmetricus Zone). Sections from one corallum.

Plate IX

All figures ×2

Disphyllum hsianghsienense kostetskae (Soshkina)

Fig. 1. Transverse section (No. Z. Pal. P. Tc-5/83), Polanów 2, depth 1791 m.
Fig. 2. Transverse section (No. Tc-5/84), Polanów 2, depth 1791 m.
Fig. 3. Transverse section (No. Tc-5/85), Polanów 2, depth 1791 m, (holotype).
Fig. 4. Transverse section (No. Tc-5/86), Polanów 2, depth 1781 m.
Fig. 5. Longitudinal section (No. Tc-5/87), Polanów 2, depth 1787 m.
Fig. 6. Longitudinal section (No. Tc-5/88), Polanów 2, depth 1675 m.
Fig. 7. Longitudinal section (No. Tc-5/89), Polanów 2, depth 1787 m.
Fig. 8. Longitudinal section (No. Tc-5/90), Polanów 2, depth 1791 m.
Fig. 9. Longitudinal section (No. Tc-5/91), Polanów 2, depth 1787 m.
Fig. 10. Longitudinal section (No. Tc-5/85), Polanów 2, depth 1791 m, (holotype).
Fig. 11. Longitudinal section (No. Tc-5/93), Polanów 2, depth 1681 m.
Fig. 12. Longitudinal section (No. Tc-5/94), Wietrznia be V.
Fig. 13. Longitudinal section (No. Tc-5/95), Łagów.
Fig. 14. Longitudinal section (No. Tc-5/96), Wietrznia, bed VIII.
Fig. 15. Longitudinal section (No. Tc-5/97), Wietrznia, bed VIII.
Fig. 16. Longitudinal section (No. Tc-5/98), Wietrznia, bed VIII.
Fig. 17. Longitudinal section (No. Tc-5/99), Łagów.
All figs. — Frasnian, Figs. 14—16 — Lower Frasnian (Pol. asymmetricus Zone), from one corallum.

Plate X

All figures ×2

Disphyllum cylindricum (Soshkina)

Fig. 1. Transverse section (No. Z. Pal. P. Tc-5/102), Olkusz BB18, 317,2 m.
Fig. 2. Transverse section (No. Tc-5/103), Olkusz B 570, depth 469.0 m.
Fig. 3. Transverse sections (No. Tc-5/104), Wietrznia, bed V.
Fig. 4. Transverse section (No. 5/105), Olkusz BB18, depth 312,5 m.
Fig. 5. Transverse and longitudinal sections (No. Tc-5/106), Łagów.
Fig. 6. Transverse section (No. Tc-5/107), Olkusz B746, depth 341,5 m.
Fig. 7. Transverse section (No. Tc-5/108), Karniowice.
Fig. 8. Transverse section (No. Tc-5/109), Olkusz BB18, depth 306,8 m.
Fig. 9. Longitudinal section (No. Tc-5/110), Olkusz BB18, depth 302,8 m.
Fig. 10. Longitudinal section (No. Tc-5/111), Olkusz BB18, depth 306,8 m.
Fig. 11. Longitudinal section (No. Tc-5/112), Olkusz BB18, depth 302,8 m.
Fig. 12. Longitudinal sections (No. Tc-5/113), Olkusz B746) depth 341,5 m.

All figs. — Frasnian.

Plate XI

Disphyllum wirbelauense regulare n.subsp.

Fig. 1. Transverse section (No. Z. Pal. P. Tc-5/25), Holotype, Olkusz B24, depth 283 m. Givetian. Transverse section showing spindle-shaped short septa with a median line representing the trace of axes of monacanths, fibres diverge from the trabecular axes at a low angle. ×20.
Fig. 2. Longitudinal section (No. Z. Pal. P. Tc-5/114), Stokówka, Givetian. The section parallel to the length of the septum showing short horizontal monacanths; ×20.

Disphyllum hsianghsienense kostetskae (Soshkina)

Fig. 3. Longitudinal section (No. Z. Pal. P. Tc-5/115), Wietrznia bed VIII, Lower Frasnian, Pol. asymmetricus Zone. The section parallel to the legnth of the septum showing short horizontal monacanths with a median line representing the trace of axes of sclerodermites; fibres diverge from the sclerodermitic centres. ×20.
Fig. 4. Longitudinal section No. Z. Pal. Tc-5/116), Łagów, Frasnian. Median longitudinal section showing short horizontal trabeculae with an angle of ° to the vertical. ×20.
Fig. 5. Longitudinal section (No. Z. Pal. P. Tc-5/117), Łagów, Frasnian. Tangential section of septum showing lamellar sclerenchyme on septal flanks arranged in rows parallel to the growth lines of the septum. ×20.
Fig. 6. The same tangential section ×50.
Fig. 7. Longitudinal section No. Z. Pal. P. Tc-5/118), Polanów, Frasnian. Section parallel to the length of the septum showing short trabeculae with a low angle (°) to the vertical ×20.

Disphyllum cylindricum (Soshkina)

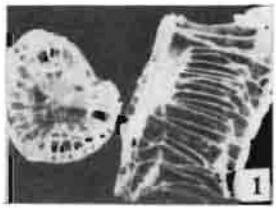
Fig. 8. Transverse section (No. Z. Pal. P. Tc-5/119), Olkusz, depth 312,5, Frasnian. Corallite with thick knobbed septa, with median line representing the traces of axes of monacanths fibres diverging from them; ×20.

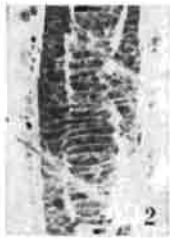
Disphyllum caespitosum lazutkini (Ivanija)

Fig. 9. Longitudinal section (No. Z. Pal. Tc-5/120), Wietrznia point XXII, Frasnian. Tangential section of septum showing arched trabeculae with sclerodermites in the lower part and lamellar sclerenchym in the upper part of the septum. ×20.

Disphyllum caespitosum lazutkini (Ivanija)

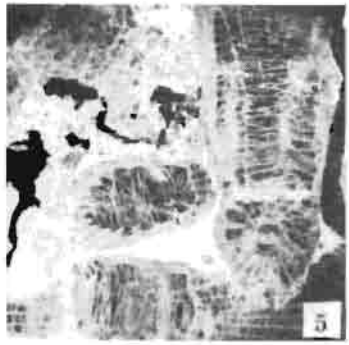
Fig. 10. Transverse section (No. Z. Pal. P. Tc-5/121), Kadzielnia point VI, Frasnian. Section of a corallite with thin knobbed septa having traces of median lines with traces of sclerodermites. ×20.

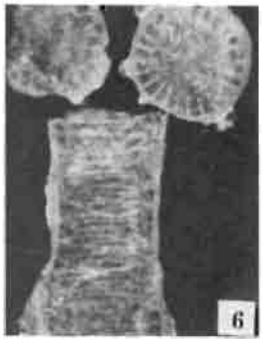

1

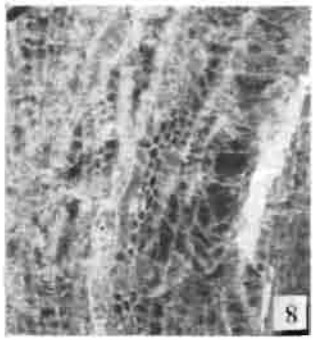

2

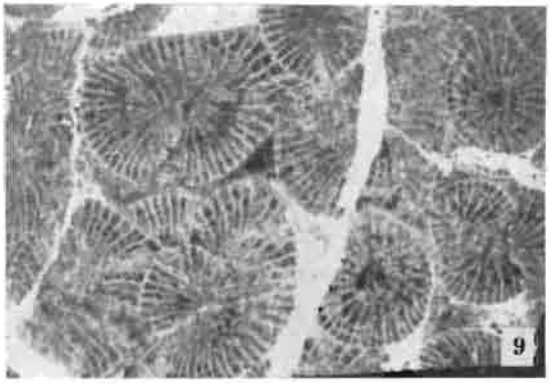

3

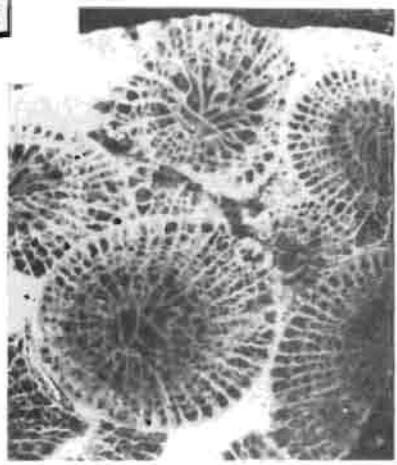

4


5


6


8


9




1


2

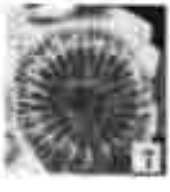

3


4


6


8


12


7


14

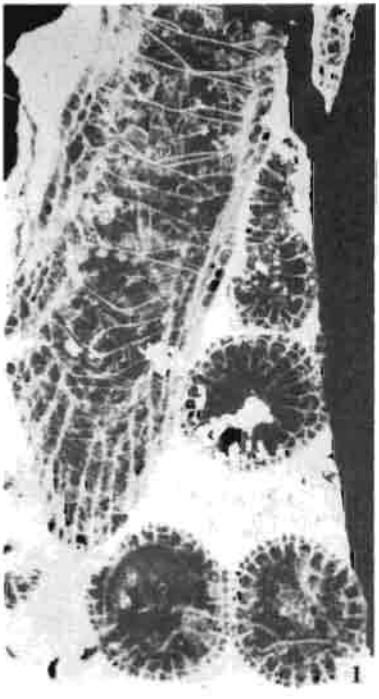

13

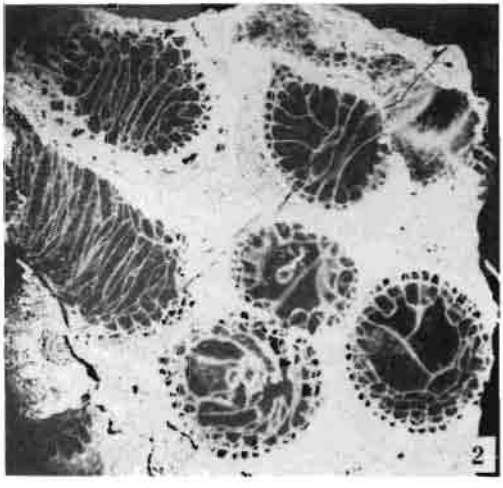

9

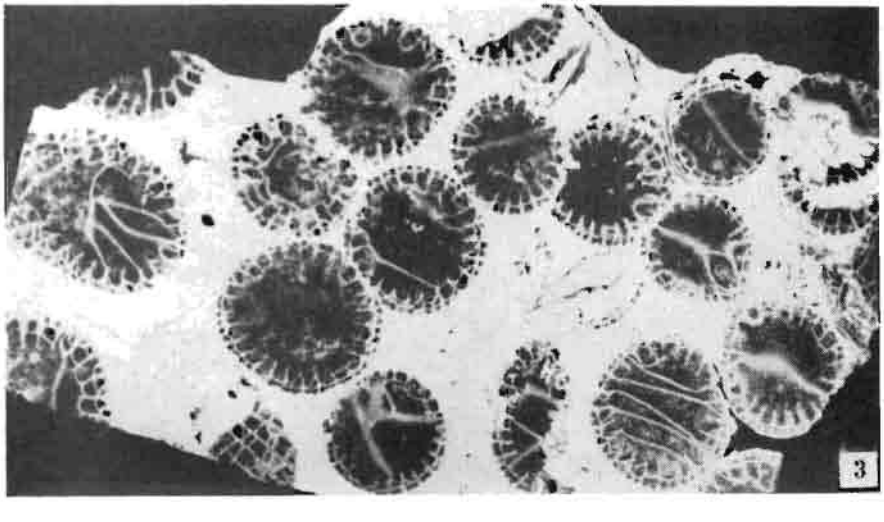

11

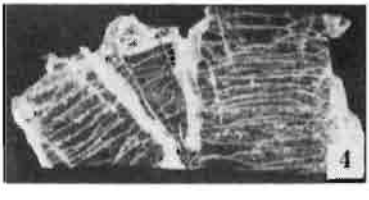

10

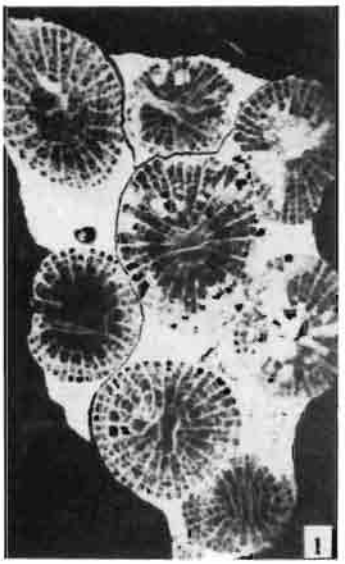

15

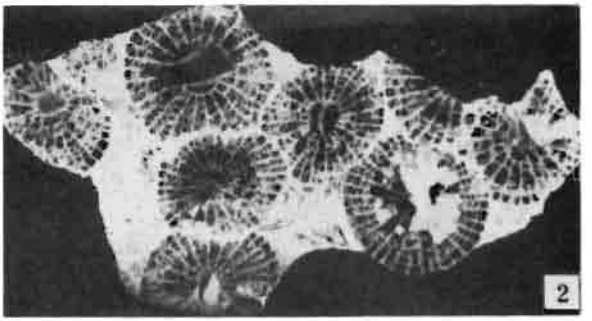

1

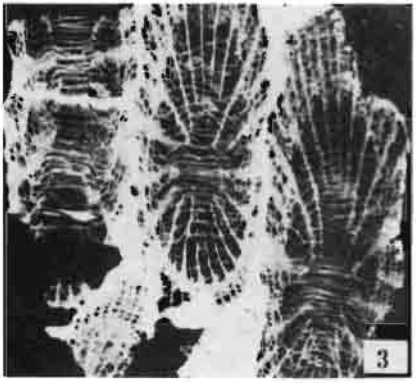

2

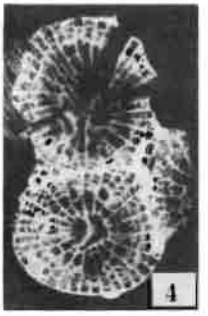

3

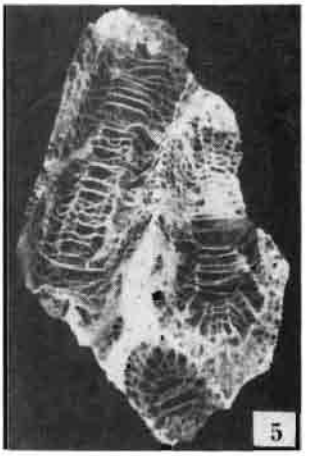

4

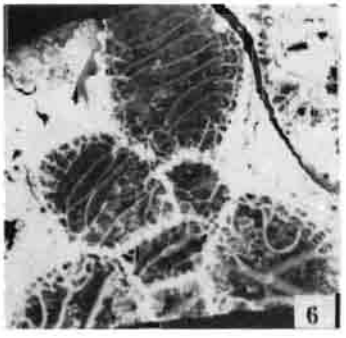

1

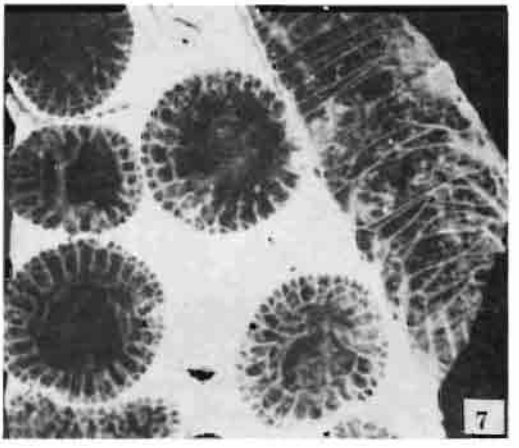

2

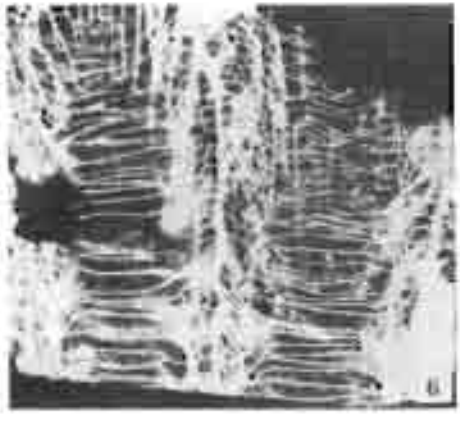

3

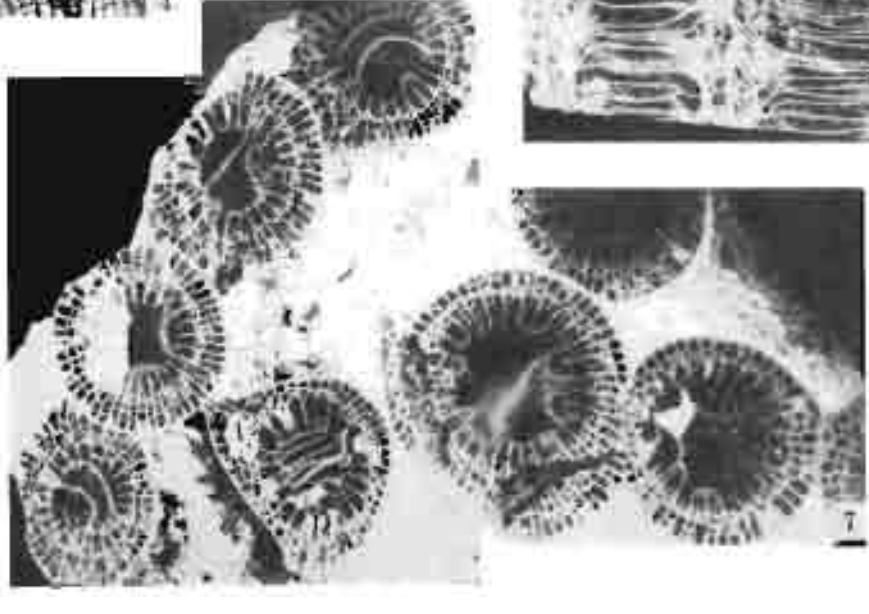

4


5

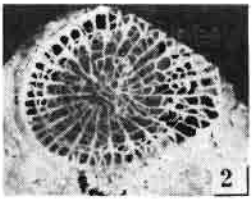

6

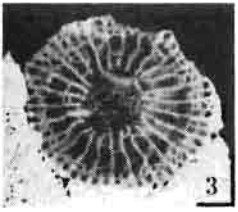

7

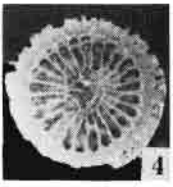


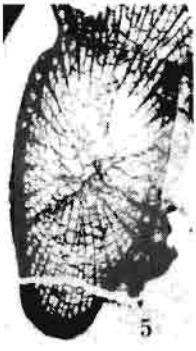


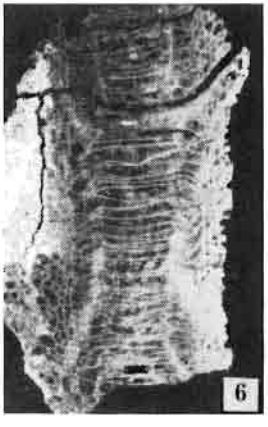

1

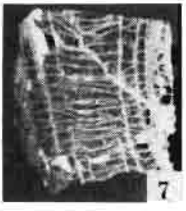

2

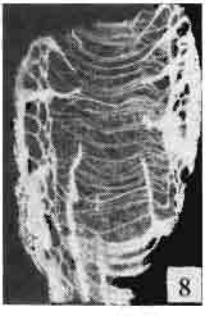

3


4

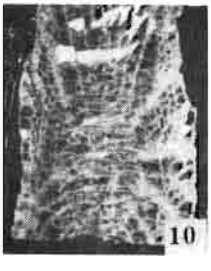

5

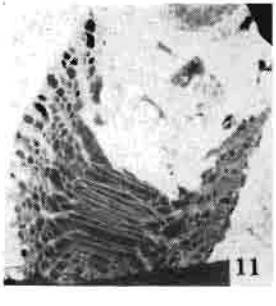

6

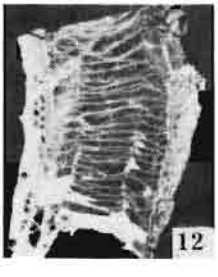

7


8

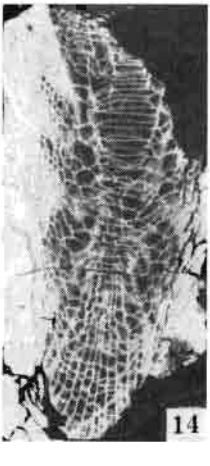

9

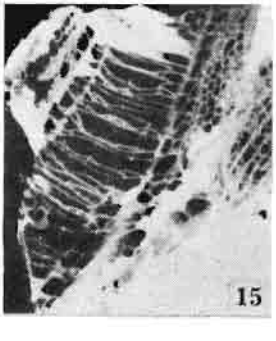

10

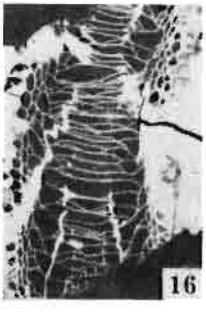

11

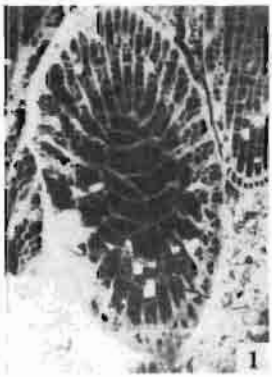

12


13

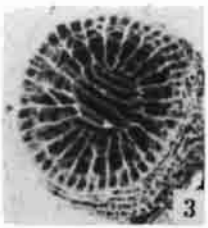

14

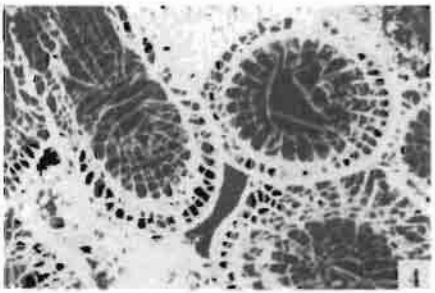

15


16

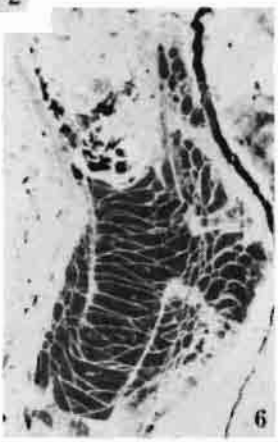

1

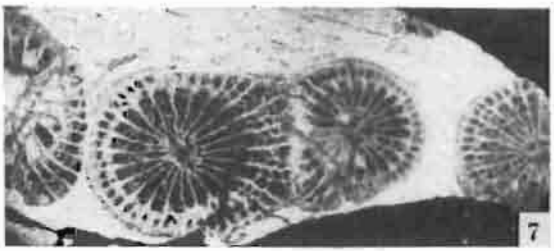

2

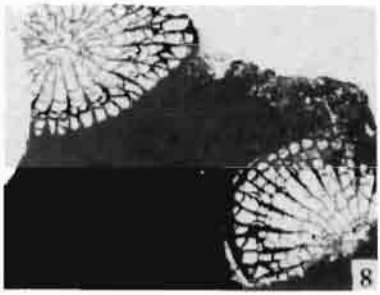

3

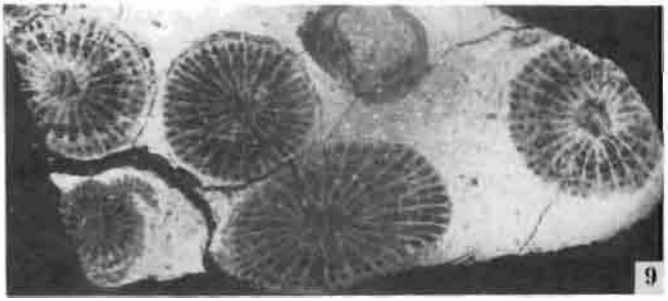

4


5


6


7


8


9


10


1


2


3


4


5


6


7


8


10


11


9


12

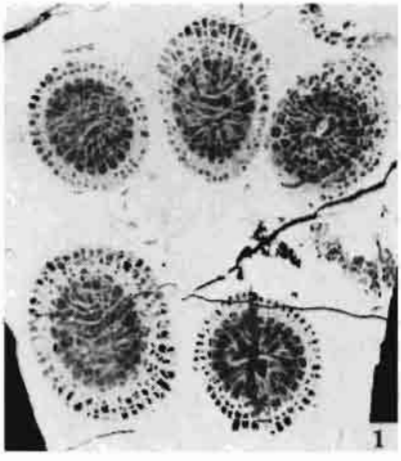

13


17

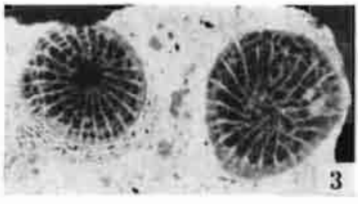

14


15


16

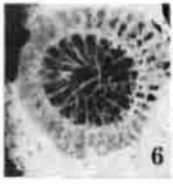

1


2


3

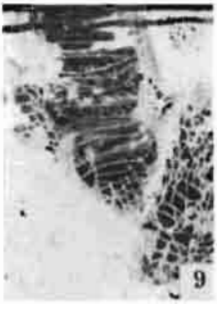

4


5


6


7

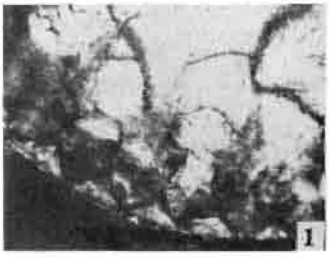

8


9

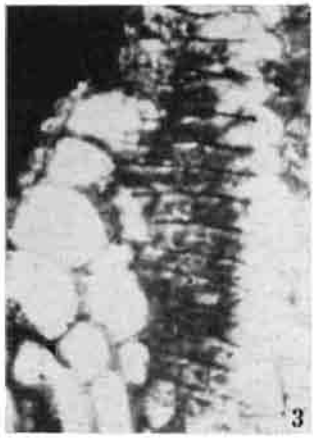

10


11


12


1


2


3

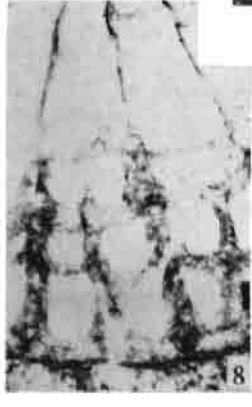

4


5


6


10


7


8


9