POLSKA AKADEMIA NAUK
ZAKŁAD PALEOZOOLOGII

PALAEONTOLOGIA POLONICA

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No. 24 — 1970

AULOPHYLLIDAE (TETRACORALLA) FROM THE UPPER VISÉAN OF SUDETES AND HOLY CROSS MOUNTAINS

(AULOPHYLLIDAE Z GÓRNEGO WIZENU SUDETÓW I GÓR ŚWIĘTOKRZYSKICH)

BY
JERZY FEDOROWSKI

(WITH 52 TEXT-FIGURES AND 23 PLATES)

WARSZAWA 1970

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PALAEONTOLOGIA POLONICA

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ACADÉMIE POLONAISE DES SCIENCES
INSTITUT DE PALÉOZOOLOGIE

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Adres Redakcji — Adresse de la Rédaction
Institut de Paléozoologie
de l'Académie Polonaise des Sciences
Warszawa 22, Al. Żwirki i Wigury No. 93

Printed in Poland

Państwowe Wydawnictwo Naukowe — Warszawa
Nakład 650+90 egz. Ark. wyd. 19,5.
Arkuszy druk. $8^{12}/_{16}$ + 26 wkładek.
Papier rotogr. sat. kl. III 61×86 125 g.
Oddano do składania 11. XI 1969 r.
Podpisano do druku 9. II. 1971 r.
Druk ukończono w marcu 1971 r.

Drukarnia Uniwersytetu Jagiellońskiego w Krakowie
Zam. 905/69

CONTENTS

INTRODUCTION

The Lower Carboniferous formations outcrop on the surface only in the southern part of Poland. Their range, as shown by deep borings, is, however, considerably more extensive and also covers most of the Polish Lowland more or less to the Siedlce-Chojnice line. These deposits occur in a few regional units such as Central Sudetes, Upper Silesia Coalfield, Holy Cross Mountains (Góry Świętokrzyskie), Cracow Region, Lublin Coalfield and Polish Lowland. In regard to facies, all these units form two groups: 1) Cracow Region, with calcareous sedimentation which lasted uninterruptedly from Givetian to the Upper Viséan and 2) the remaining units. In the Lower Carboniferous predominated a terrigenous sedimentation with limestones and calcareous concretions developed locally. Periodically, in each of these units there were conditions favourable to the development of the fauna of corals related to the carbonate sedimentation. Such conditions were the most frequent and common in the Upper Viséan. So far, the presence of tetracorals of that period has not been ascertained only in Northern Poland. Much less frequent than the Viséan are the Tournaisian tetracorals known from a complete profile in Cracow Region and from the Upper Tournaisian of Pomerania. The Namurian tetracorals occur only in marine intercalations in the Upper Silesian Coalfield. No Carboniferous coral faunas younger geologically have been found in Poland. A rapid recession of the sea and the formation of shallow, freshwater deposits with coal beds were started with the Namurian. Beginning with the Westphalian through the end of the Carboniferous, only continental conditions with a predominance of denudation are recorded.

The palaeontological literature concerning with the Carboniferous tetracorals of Poland is very poor. Although the first descriptions of corals from Lower Silesia date back more than 100 years ago (KNUTH, 1869), the next work which dealt with the Carboniferous corals of Upper Silesia appeared only 17 years ago (SCHINDEWOLF, 1952). The Carboniferous Tetracoralla from Lower Silesia were subsequently mentioned and illustrated (without descriptions) in ŻAKOWA's & ŻAK's (1962) and ŻAKOWA's (1966) works. No Carboniferous Tetracoralla from the Holy Cross Mountains and Cracow Region have been so far elaborated palaeontologically. Their presence was mentioned in some works older geologically, but the lack of illustrations and descriptions, along with a very superficial and obsolete manner of determination, preclude the possibility of making use of these works.

In 1959, the present writer started to collect the Carboniferous tetracorals from the area of Southern Poland and, later on, also from deep borings in Polish Lowland. The collection thus accumulated, along with material handed down for elaboration, now include about 10000 specimens. These collection will certainly be enriched in future, since many localities with the fauna of tetracorals, in particular in Cracow Region have not been exploited so far. In 1965, the writer started to elaborate his collection. At first the work was intended as a monograph on all the Carboniferous tetracorals of Poland, but the ampleness and diversity of material induced the present author to publish successively descriptions of particular families or of faunas of particular regions. A description of the Upper Viséan tetracorals from some borings

of the Lublin Coalfield (FEDOROWSKI, 1968) has appeared so far. The present work makes up a description of the family Aulophyllidae from the area of the Sudetes and Holy Cross Mountains. The descriptions of the families Amygdalophyllidae, Cyathopsidae, Bothrophyllidae, Palaeosmilidae, Lithostrotionidae, Lonsdaleidae, Hapsiphyllidae, Polycoeliidae, Cyathaxoniidae, Lindstroemiidae, as well as one or two new families and the Heterocorallia from these regions are now in preparation.

The material dealt with in the present work consists of about 1 500 specimens. It makes up part of the collection of the Carboniferous tetracorals owned by the Geological Institute's Holy Cross Branch in Kielce, collected by Dr. H. ŻAKOWA and made available to the present writer for elaboration as well as part of the collection of the Carboniferous tetracorals owned by the Palaeozoological Institute of the Polish Academy of Sciences, Poznań Laboratory, and which were collected by the present writer.

The systematic part of the work includes two subfamilies and 13 genera (among them, four new ones), 40 species (19 new ones) and 11 subspecies (4 new ones). Three specimens were determined only generically. Systematics was based on the studies of ontogeny of all the species described. In a few cases, the writer succeeded in studying it from the nepionic stage, in the remaining specimens from the neanic stage. In his general considerations, as well as for the determination of stratigraphic horizons in which coral fauna occurred, the writer also made use of his own, unpublished determinations of some species of the remaining families of the Carboniferous tetracorals from the Sudetes and Holy Cross Mountains.

In 1968, granted a Polish Academy of Sciences' fellowship, the writer has stayed for six months in the U. S. S. R. This gave him the possibility of a direct comparison of the collection of the Lower Carboniferous tetracorals of Poland with Soviet collections, in Moscow, Leningrad, Kiev and Donets. In addition, he had the opportunity to study the geological structure of Donets Basin and make direct field observations.

ACKNOWLEDGEMENTS

The present writer's particularly warm and heartfelt thanks are due to Prof. M. RÓŻKOWSKA, Head of the Palaeozoological Laboratory of the Polish Academy of Sciences in Poznań, for many years of work she devoted to introduce him to the problems of morphology and phylogeny of tetracorals, for numerous discussions and for a critical review of the manuscript. The writer also feels indebted to Prof. R. KOZŁOWSKI from the Palaeozoological Institute of the Polish Academy of Sciences in Warsaw and to Prof. Z. KIELAN-JAWOROWSKA, Director of this Institute, for their kind and constructive remarks in the course of preparation of this work for print. A warm gratitude is expressed to Dr. H. ŻAKOWA from the Geological Institute's Holy Cross Branch in Kielce for making available for elaboration a rich collection of tetracorals and for discussing some stratigraphic and sedimentological problems. The writer's thanks are also extended to Dr. T. A. DOBROLJUBOVA and Miss N. V. KABAKOVITSH from the Palaeontological Institute in Moscow and to Dr. N. P. VASSILJUK from the Polytechnical Institute in Donets for making available their collections which enabled comparisons, for introducing him to the most interesting profiles and outcrops from Donets Basin, as well as for many interesting discussions; to Prof. R. B. HECKER from the Palaeontological Institute in Moscow, for bringing into Moscow, for the writer's purposes, part of STUCKENBERG's collection from the University of Kazan.

The photographs were taken by Mr. T. M. TRITT from the Polish Academy of Sciences, Palaeozoological Laboratory in Poznań.

* * *

The following abbreviations have been used in the present work:

Z. Pal. P. — Palaeozoological Institute of the Polish Academy of Sciences, Poznań Branch.
IG. — Museum of the Geological Institute, Holy Cross Branch in Kielce,
C.G.M. — The Tschernyshev's Museum, Leningrad,
n/d — septal index, where „n" designates the number of septa and „d" the diameter of the coral,
ds/dc — ratio of the diameter of the axial structure (ds) to the diameter of the coral (dc),
dd/dc — ratio of the width of the dissepimentarium (dd) to the diameter of the coral (dc).

Palaeozoological Institute
of the Polish Academy of Sciences,
Poznań Branch,
Poznań, April 1969

GENERAL PART

I. DESCRIPTION OF EXPOSURES

A. THE SUDETIC MOUNTAINS

In the most general sense, the outcrops of the Lower Carboniferous in the Sudetes occur in the northern and eastern margins of the Intrasudetic Basin (Text-fig. 1). These are mostly the sediments of the Culm facies, usually shales and greywackes. Several localities with the fauna of brachiopods and pelecypods were found in this area and, at Czerwieńczyce, Sokolec, Jugów and Kamionki, also that of tetracorals. The localities of tetracorals are always marked by the occurrence — among terrigeneous Culm sediments — of marly and calcareous balls and lenses a few to 20 cm in thickness and even to some dozen meters in horizontal extent. A detailed description of the geological structure of the Jugów-Sokolec area and the discussion of previous results of studies were presented by ŻAKOWA (1966) and of the environs of Kamionki — by ŻAKOWA & ŻAK (1962).

Sokolec

The exposure has been located in the field owned by S. APRIASZ, in the upper part of a steep slope, south-west of buildings. Three zigzag ditches were dug 1.5-2.0 m deep and about 10 m in a total length. The following layers with a dip of about 20° to the south (Text-fig. 2) were distinguished in this section. Soil and weathered material, about 30 cm thick.

Layer 1, 25 cm thick. Grey-green, soft greywacke shale, irregular in cleavage and with balls of compact, hard, dark-grey limestones. A poorly preserved fauna, consisting of large (Productidae) and small brachiopods and of crinoid columnels, occurs in shale. In addition to brachiopods, the balls contain many tetracorals such as: *Aulophyllum fungites* (FLEMING), *Clisiophyllum keyserlingi* M'COY, *Caninophyllum archiaci* (M. EDW.-H.), *Dibunophyllum bipartitum bipartitum* (M'COY), *Carcinophyllum vaughani* SALÉE, *Diphyphyllum lateseptatum* M'COY, *Lithostrotion junceum* (FLEMING), *Lithostrotion caespitosum* (MARTIN), *Lithostrotion pauciradiale* M'COY, and *Hexaphyllia marginata* (FLEMING) from Heterocorallia.

Layer 2, 15 cm thick. A grey, compact, hard limestone forming a large lens whose boundaries were not found in the excavation. It contains a rich, redeposited fauna of brachiopods, gastropods and crinoids (stems). Less abundant are pelecypods and tetracorals whose colonies are preserved only fragmentarily. The following species have been found: *Clisiophyllum delicatum*

nanum n. subsp., *Carcinophyllum vaughani* SALÉE, *Lithostrotion caespitosum* (MARTIN), *Lithostrotion pauciradiale* M'COY, *Lithostrotion mccoyanum* M. EDW.-H., and *Hexaphyllia marginata* (FLEMING) from Heterocorallia.

Layer 3, 20 cm thick. Olive-grey, soft, clayey shales with the following very numerous colonial tetracorals preserved in life position: *Lithostrotion mccoyanum* M. EDW.-H., *Lithostro-*

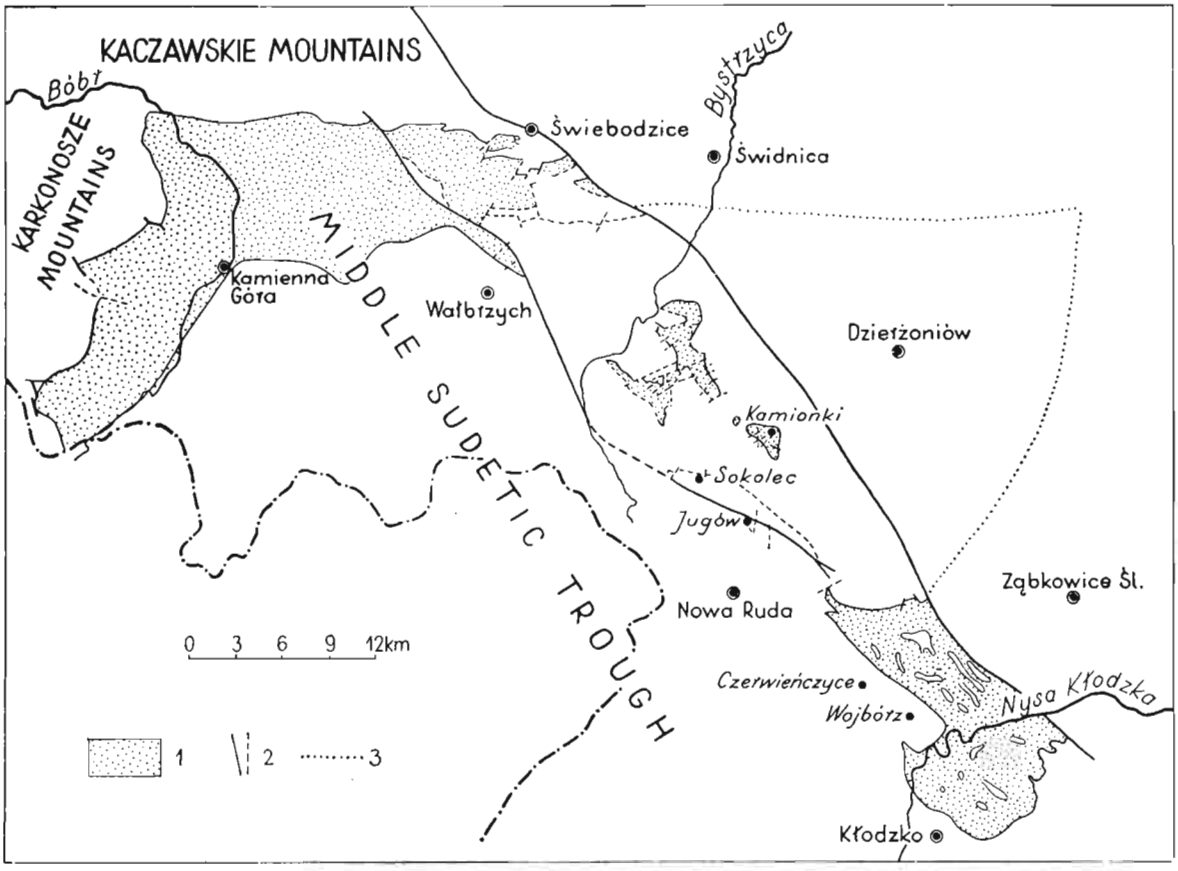

Fig. 1
Map of the occurrence of the Lower Carboniferous in the Mid-Sudetes against the background of tectonic units. Dotted areas designate the Lower Carboniferous sediments (according to ŻAKOWA, 1966, simplified).

tion decipiens (M'COY), *Lithostrotion junceum* (FLEMING), *Lithostrotion pauciradiale* M'COY, as well as few, small spiriferids and productids.

Layer 4, 6 cm thick. Fine-grained, olive-grey, greywacke shale with abundant colonies of *Lithostrotion junceum* and *L. pauciradiale*, preserved in life position.

Layer 5 and lower ones to the bottom of the excavation. Greywackes and greywacke shales, mostly with plant detritus. In some layers, few brachiopods and pelecypods. Tetracorals lacking.

On the basis of brachiopods and goniatites, ŻAKOWA (1966) assigns the Carboniferous sediments of the environs of Jugów and Sokolec to *Goniatites crenistria* (PHILLIPS) zone. The assem-

blage of coral fauna occurring in this layers is characteristic of the coral horizon D_2 of Great Britain. Thus, a concordance is observed in the indications of the fauna of brachiopods, goniatites and tetracorals.

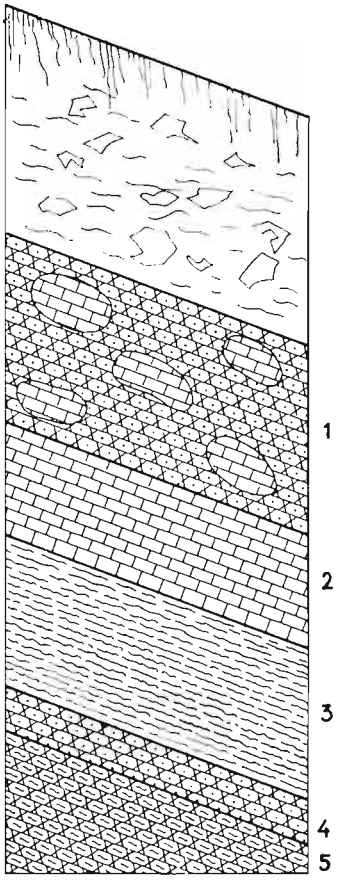

Fig. 2
Lithological profile of the excavation at Sokolec. Description of the layers are given with the discussion of the profile in the text.

Jugów

The writer has dug his exposure close to ŻAKOWA's excavation No. 25 (1966, p. 51). As identical with that, given by ŻAKOWA, the lithology of the layers is not here discussed. Of the family Aulophyllidae only *Dibunophyllum bipartitum bipartitum* were found here. Of the remaining tetracorals, few *Caninophyllum archiaci* and abundantly occurring *Diphyphyllum lateseptatum* and *Lithostrotion caespitosum* were identified. Less abundant and sometimes preserved in fragments only are *Lithostrotion junceum* and *Lithostrotion pauciradiale*. The stratigraphic horizon — the same as in Sokolec, that is, D_2 .

Czerwieńczyce

The Carboniferous is outcropped in this locality east of a village, on the slope of a hill, situated between Czerwieńczyce and Wojbórz. The strike of layers amounts to 290°, and the dip to 50-55° to the north. The section was traced along a dirt road from Czerwieńczyce to Wojbórz

running along a wood to the north-west. A starting point of the section — the youngest conglomerates — is located on the road mentioned above in a place whose azimuth of a church steeple at Czerwieńczyce amounts to 260° and distance from this church to about 600 m along a straight line. The layers described below have been treated summarily, as complexes of layers.

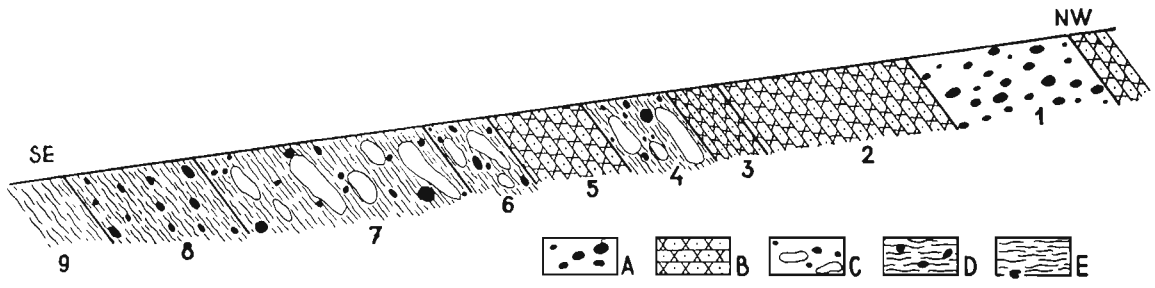

Fig. 3

Lithological profile at Czerwieńczyce: *A* conglomerate, *B* greywackes, *C* clayey-marly shales with calcareous concretions and concentrations of limestones and marls, *D* clayey shales and calcareous concretions, *E* clayey shales, frequently with plant detritus; *1-9* numbers of layers.

Layer 1, about 100 cm thick. Unassorted conglomerates with the largest, flat pebbles reaching 5 cm in length. Gabbro and gneiss pebbles are predominant with limonite coating.

Layer 2, 110 cm thick. Greywackes and greywacke shales, the most coarse-grained near conglomerates, upwards becoming gradually finer and finer. Olive-grey in colour. On cleavage surfaces abundant plant detritus and even larger, carbonized plant remains. No fauna.

Layer 3, 30 cm thick. Fine-grained, grey-olive greywacke. A not very abundant fauna of brachiopods, including *Pugilis* sp. and *Antiquatonia* sp., along with pelecypods and members of crinoid stems. Corals lacking.

Layer 4, 50 cm thick. Dark-brown, clayey-marly shales with fine, very hard calcareous concretions without fauna. In addition to concretions here also occur calcium carbonate concentrations impregnating the shales without any definite boundary. Fauna occurs both in life position and redeposited on the surface of the layers. Of tetracorals the following species were found: *Caninophyllum archiaci*, *Clisiophyllum keyserlingi*, *Dibunophyllum bipartitum bipartitum*, *Lithostrotion junceum* and *L. pauciradiale*. The accompanying fauna contains few *Gigantoproductus* along with relatively numerous, small species of spiriferids and chonetids, few bryozoans (*Fenestella*) and long fragments of stems of crinoids.

Layer 5, 60 cm thick. Olive-grey, middle-grained greywacke. Neither fauna nor flora were found.

Layer 6, 35 cm thick. Dark-brown clayey-marly shales with lenses and concentrations of limestone. Relatively numerous *Gigantoproductus gigantoides*. Of tetracorals, many crushed specimens of *Dibunophyllum bipartitum bipartitum*, *Clisiophyllum keyserlingi*, *Caninophyllum archiaci*, *Lithostrotion junceum* and *L. pauciradiale* were found.

Layer 7, 140 cm thick. Thick, slightly compressed, marly-clayey shales with large lenses and concentrations of limestone and marl (to 110 cm long and to 25 cm thick). In addition to tetracorals, named in layer 6, the following species were found here: *Lithostrotion caespitosum*, *Lithostrotion volkovae*, *Lithostrotion mccoyanum*, *Diphyphyllum lateseptatum*, *Slimoniphyllum slimonianum*, *Dibunophyllum bipartitum koninckі*, *Aulophyllum fungites*, *Koninckophyllum magnificum* and *Heterophyllia grandis*, *Hexaphyllia marginata* from Heterocorallia as well

as few fine specimens of the family Polycoeliidae from Tetracoralla. Of the accompanying fauna, in addition to many *Gigantoproductus gigantoides*, there occur other species of the genus *Gigantoproductus*, as well as *Spirifer* sp., *Leptaenella* sp., *Rhipidomella* sp., *Chonetes* sp. and other brachiopods, pelecypods, ostracods, gastropods and abundant members of crinoid stems.

Layer 8, 80 cm thick. Brown-grey clayey-marly shales with fine calcareous concretions containing small brachiopods, pelecypods, tubes of worms and stems of crinoids. A fauna of tetracorals of the *Cyathaxonia* assemblage, *Fasciculophyllum bowerbanki*, *F. omaliusi*, *Rotiphyllum rushianum*, *Cryptophyllum hibernicum* and other Polycoeliidae and Hapsiphyllidae, not described in detail so far, were also found in this layer.

Layer 9 and further ones clayey shales without fauna or with a scanty fauna of pelecypods and brachiopods, frequently filled with plant detritus. No corals were found.

Coral assemblages of particular layers described differ from each other mostly only quantitatively, which is a result of facial changes. No stratigraphical sequence of fauna was ascertained. The entire assemblage is a typical assemblage of a coral horizon D_2 according to the British nomenclature, based on corals.

B. THE HOLY CROSS MOUNTAINS (GAŁĘZICE)

The Lower Carboniferous has been preserved in the Holy Cross Mountains in the form of small patches (Text-fig. 4), mostly developed in Culm facies. The fauna consisting mostly of brachiopods, pelecypods, trilobites and less frequently of gastropods and cephalopods was

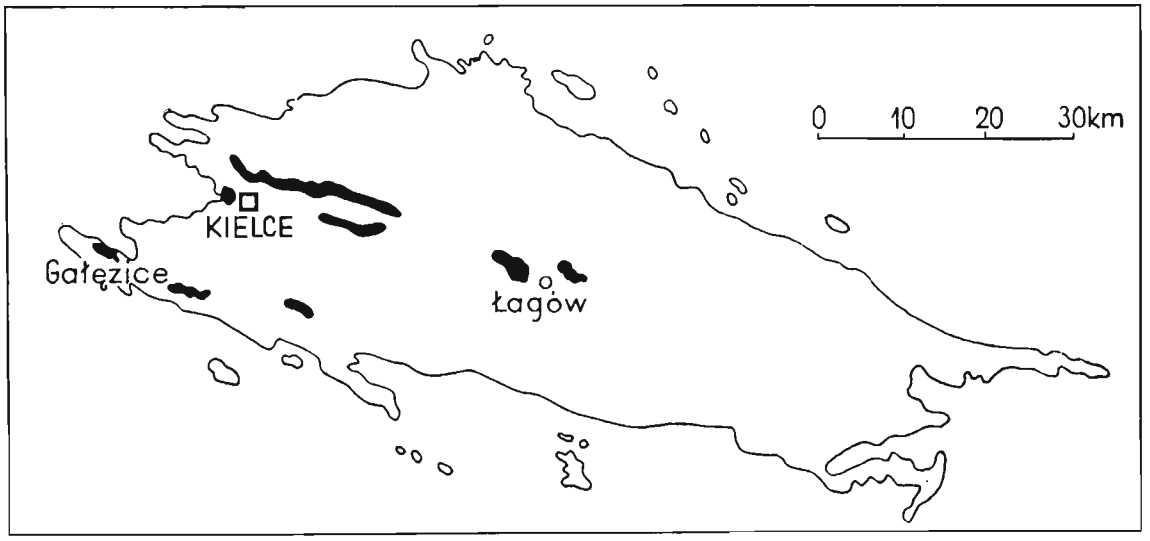

Fig. 4
Outline of the Holy Cross Mountains. The Palaeozoic with the occurrence of the Lower Carboniferous (black areas, slightly magnified); after ŻAKOWA, 1967.

found in these deposits. Tetracorals were found only at Gałęzice in an unique so far discovered outcrop of Carboniferous limestone in the Holy Cross Mountains. CZARNOCKI (1916, 1922, 1948) had found and divided stratigraphically the Carboniferous of Gałęzice syncline. Black

shales with phosphorite concretions were considered by him to be the Tournaisian and overlying organodetritic limestones — to be a complete Viséan including coral horizons C_2-D_3. As to the age of these limestones, a similar standpoint was taken by KWIATKOWSKI (1959) who, in addition, recognized Zechstein limestones of the northern slope of hill Besówka, which he called "changed limestones", for Lower Carboniferous ones (C_2). This view was later corrected by CZARNIECKI *et al.* (1965) who, on the basis of *Horridonia horrida* occurring in them, assigned these limestones to Zechstein. The age D_1-D_2 is ascribed by those authors to the Carboniferous limestone.

Since 1958, considerable exploratory work — excavations, borings and electro-resistance studies — have been conducted in Gałęzice syncline by ŻAKOWA (1962, 1967, in press). Mostly, on the basis of brachiopods and recently also cephalopods, this author assigns Gałęzice limestones to Goα and Goβ horizons. On the basis of borings between Besówka and Todowa Grząba, she also found that the isolation of the Carboniferous limestone of Besówka is of the tectonic nature.

The author of the present work, dug the excavation described below through the Carboniferous limestone of Besówka about 50 m west of KWIATKOWSKI's (1959) excavation and, in addition, conducted observations in KWIATKOWSKI's and, most of ŻAKOWA's (*op. cit.*) excavations from which comes considerable part of the fauna of corals here described. The sections of these excavations have been described by ŻAKOWA (in press) and, therefore, the present writer would like to mention only that on the Todowa Grząba and Ostrówka limestones are thick-bedded, organogenic and with a dip of layers to the north-east and their slopes, consistent to dip, opposite to those of the Besówka Hill.

The excavation dug by the writer on the south-western slope of the northern top of Besówka Hill was about 20 m long. The beginning of this excavation revealed a contact of black, soft shales with concretions of phosphorite (Tournaisian) and Carboniferous limestone. The excavation was here dug to a depth of more than 2 m and a dip of 35° to the north was ascertained. Down to this depth, limestones were split and formed blocks forced in the surface of shales. Since neither in that place, nor further, up to the end of the profile, no normal surface of layers could be exposed, the writer gave up a graphic presentation of the profile under study. Only five blocks of limestones were here distinguished with the following values (beginning with shales) of thickness: 1.5, 3.5, 3.0, 5.0 and 6.0 m. No complexes of layers distinguished by KWIATKOWSKI (1959) were found by the writer in his excavation. Judging by the situation of Tournaisian and Permian shales, analogous to that on Todowa Grząba Hill the entire Carboniferous limestone of Besówka Hill dips to the north-east at an angle approaching that of the dip of shales (35°). The section runs, therefore, in this place over the heads of layers which do not differ from each other. Maybe, this is only a single, very thick bank of limestone.

Examining the entire lithology of the Carboniferous limestone sediments of Besówka Hill, the following facts may be established: 1) This is an organodetritic limestone composed mostly of the members of crinoid stems, tetracorals and brachiopods. Few gastropods, pelecypods, trilobites, Tabulata corals, fusulines, cephalopods and algae also occur in this locality. These fossils may be broken but they have no signs of wearing. There is a very small amount of chemically precipitated calcium carbonate forming cement, it becomes greater in the upper part of the section. Fine intraclasts of dark limestone rocks are found in the entire section. 2) A colouration with laterite, found both in cement and inside of fossils, is not helpful in conducting a division into particular layers. It occurs in the entire profile in the form of large, irregular spots or streaks. 3) No cyclical sedimentation of the deposit, sometimes observed on Todowa Grząba Hill and which could enable the distinction of layers, was found in this

profile. Fossils are here scattered at random. The amount of fossils, particularly of tetracorals, seems to decrease in the upper part of the profile.

No shales of the uppermost Viséan, known from the north-western part of Gałęzice syncline, occurs on Besówka Hill. As suggested by CZARNIECKI *et al.* (1965), these shales were here completely eroded. This view is in a complete conformity with the writer's opinion. Moreover, he believes that the denudation also destroyed some limestones which is indicated by the occurrence of their fragments in Zechstein conglomerates found by the authors referred to above.

It seems, therefore, that the occurrence of the equivalents of only the oldest layers from Todowa Grząba Hill (Table 1, layers 14-12 of the excavation No. XXI) may be expected on Besówka Hill. The upper part of the Besówka section, in which a decrease in coral fauna is recorded, could correspond to layers 11-9 of Todowa Grząba Hill, which are also poor in tetracorals. The specific composition of this fauna does not give a decisive answer in neither of the two excavations under study. Likewise, no data are available for making a quantitative analysis. The quantity of the representatives of a species in a given layer does not result from its stratigraphic position, but it is proportional to a general number of tetracorals occurring in such a layer. The lack of a stratigraphic sequence of the fauna of corals is one of its most important characters common for all exposures of the Carboniferous limestone in Gałęzice syncline. This uniformity of fauna is, in the writer's opinion, a proof of a short duration of the sedimentation of the Carboniferous limestone. Probably, it lasted only during the period of one geological zone and took place under similar conditions. A decidedly most part of the assemblage consists of short-lived species, limited either to Viséan (when there is no precise determination), or strictly to the Upper Viséan and Lower Namurian. The stratigraphic occurrence of these same species in Western and Eastern Europe and frequently also in Asia, coincides with a considerable accuracy. The assemblage of tetracorals of Gałęzice is identical with the assemblages of the uppermost layers of Viséan and Lower Namurian of Great Britain and the U. S. S. R. (mostly of Donets Basin). The writer considers this assemblage to be typical of the top of D_2 and E_1 in Great Britain, and of the zones $C_1^{\gamma}\ g_2$ to $C_1^{\eta}\ a_3$ in Donets Basin. The writer is conversant with ŻAKOWA's standpoint (1967, in press and oral communication) concerning the position of these limestones which may include horizons Goα and Goβ. Overlying shales have been assigned by this author, on the basis of cephalopods, to the uppermost Viséan. Despite this fact, the present writer maintains his view, based on the studies of Tetracoralla, that these limestones represent the top of the coral horizon D_2. The evolution of tetracorals might take place somewhat more rapidly than that of other groups of animals and, consequently, their assemblages seem to be younger. In addition, the writer believes that CZARNIECKI *et al.* (1965) estimated the age of the Gałęzice limestones (D_1-D_2) as too extensive.

II. ECOLOGY

A. THE SUDETIC MOUNTAINS

Relatively numerous elaborations of the geology of the Mid-Sudetes mostly by Polish geologists allow us to reconstruct, to a certain degree of probability, the configuration of this territory during the Lower Carboniferous. An attempt at such a reconstruction, based on

TABLE 1

FAUNA OF TETRACORALS FROM THE UPPER VISÉAN OF GAŁĘZICE SYNCLINE

Species	Ostrówka																Todowa Grząba																		Besówka					Geographic and stratigraphic distribution
	Excavation VIII Beds						Exposure I Beds				Excavation IX Beds						Excavation XXI Beds																		Author's excavation Complex					
	1	1A	1F	1Ł	1M	2	2	4	5	6a	1	4	5	6	7	8	1	3	4	5	6	7	8	9	10	11	12	13	14	a	b	c	d	e	
Allotropiophyllum cuspidum (THOMSON)																	4			1																		G. Britain, Zone 3, Upper Viséan — Lower Namurian
Arachnolasma sinense (YABE & HAYASAKA)																				1	1				1			1					8	2		China, *Yuanophyllum* Zone, Upper Viséan
A. cylindricum YÜ																	1			7	3	1	2				2	5	1		4	3	8		4	Carnic Alps, Upper Viséan; USSR (Donets Basin), $C_1^{\gamma}a$, highest Viséan; China, *Yuanophyllum* Zone, Upper Viséan; Japan, Upper Viséan
A. subpercrassum (VASSILJUK)																				3	4						3				1	2	1	3		USSR (Donets Basin), $C_1^{\gamma}g$-$C_1^{\alpha}a$, Upper Viséan
A. biseptatum n. sp.																				2	1	1						1				2				USSR (Kazakhstan), Lower Namurian; China, *Yuanophyllum* Zone, Upper Viséan
Aulophyllum fungites (FLEMING)																												3					4		G. Britain, Zone D_1 to Zone 4, Upper Viséan to Lower Namurian; France, Belgium, Turkey — Upper Viséan; N. Africa — Viséan; USSR — Upper Viséan to Lower Namurian
Bifossularia tictensis (TOLMATSCHOFF)		1		1																																USSR (Kuznetsk Basin), Tournaisian — Viséan
Bradyphyllum bellicostatum GRABAU																																	1			China — Middle Carboniferous
Caninia cornucopiae brockleyensis (THOMSON)	1										1																									G. Britain, Zone 3, highest Viséan to Lower Namurian
Caninophyllum archiaci (M.-E. & H.)	3																																3			G. Britain, Zone C_2 to Zone D_2, Viséan
Carcinophyllum delépini SALEÉ															1					3											2					Belgium, France — Viséan
C. septentrionale GORSKY														1			2													2		1				USSR (Novaya Zemla), Upper Viséan
Clisiophyllum keyserlingi M'COY																	1			9	3	2	1	1			1	1			1		2		G. Britain, Zone 2 to Subzone E_2, Upper Viséan to Lower Namurian; Yugoslavia, Turkey, Japan — Viséan
C. parkinsoni n. sp.																				1	1								1							G. Britain, Zone S, Lower Viséan
C. neaversoni n. sp.																				3	1		1								1		3	3	G. Britain, Zone 3, highest Viséan
C. delicatum delicatum SMYTH																	12			2	4									1					G. Britain, Zone S_1, to Zone D_2, Viséan
C. delicatum anastomosum YÜ																	27				1										3	3		2	USSR (Kazakhstan), Lower Namurian; China, Upper Viséan
C. delicatum crassiforme BIKOVA																	3										1			1	1		1		USSR (Kazakhstan), Upper Viséan/Namurian
Cyathaxonia cornu MICHELIN	1																													3	13	12	11	3	G. Britain, Belgium Zone Z_2 to Zone 3, Upper Tournaisian to highest Viséan; N. Africa, Tournaisian; USSR (Ural, Moscow Basin, Donets Basin), Upper Viséan; Poland, Upper Famennian to highest Viséan
Dibunophyllum bipartitum bipartitum M'COY	10	3		2	1	1	1	3	3			1	1	1	3		1	1	2	80	40	3	9		4	1	34	42	7		30	32	39	22	15	G. Britain, Zone D_1 to D_3, Upper Viséan; Belgium, France, Czechoslovakia, N. Africa — Upper Viséan; USSR — Upper Viséan to Lower Namurian
D. bipartitum koninckі (M.-E. & H.)								1							1					18	8	1	1		1		12	9	7		15	3	19	11	2	G. Britain, predominant in Zone 3, Upper Viséan to Lower Namurian; France, Belgium, China, Japan — Upper Viséan; USSR — Upper Viséan to Lower Namurian
D. bipartitum craigianum (THOMSON)						1				1			1							18	6	1	1				2	5	1		6	3	3	2	2	G. Britain, Zone D_2 to Zone 4, Upper Viséan to Lower Namurian; France — Upper Viséan; USSR — Upper Viséan to Lower Namurian
D. lissitzini VASSILJUK																											4									USSR (Donets Basin), C_1^1d, Lower Viséan
D. pseudoturbinatum pseudoturbinatum STUCKENBERG						1								3						17	4	8	2				5	11	5		5	6	3			Belgium, Czechoslovakia, Hungary, N. Africa — Viséan; USSR (Donets Basin, Ural, Novaya Zemla) — Upper Viséan to Lower Namurian
D. percrassum GORSKY																				1	3						1	1			2	3	5			USSR: Novaya Zemla, Upper Viséan to Lower Namurian; Donets Basin, Lower Namurian
Diphyphyllum fasciculatum (FLEMING)																				5	1					1	1				2	2	1			G. Britain, Zone D_2, Upper Viséan; USSR: Moscow Basin, Upper Viséan to Lower Namurian; Kazakhstan, Viséan/Namurian; China — Upper Viséan
D. lateseptatum M'COY																				4	13	1	4				1	6			4				2	G. Britain, Zone, D_2 to E_1 (highest Viséan); USSR: Donets Basin, Lower and Middle Viséan; Moscow Basin, Upper Viséan; Kazakhstan, Viséan/Namurian
Koninckophyllum magnificum THOMSON & NICHOLSON									1	1					1		11			11		7	1					1			3	4	7	1	4	G. Britain, Zone 3 to Zone 4, highest Viséan to Lower Namurian; USSR (Novaya Zemla), Upper Viséan to Lower Namurian
K. interruptum THOMSON & NICHOLSON		1					1						1	1			5			5	1	1	1				2	16	4		1		2	1		G. Britain, Zone 3, highest Viséan to Lower Namurian; Nova Scotia — Upper Viséan; N. Africa — Viséan
K. proprium SIBLY		1															10			20	1		2						1		1		2	2	2	G. Britain, Zone D_2, Upper Viséan
K. meathopense (GARWOOD)																	12			25		1	2			1	1	3	2				1			G. Britain, Zone S, Lower Viséan; Czechoslovakia(?), Tournaisian/Viséan; China(?), Upper Viséan
K. vaughani n. sp.																	3																			G. Britain, Zone D_1, Upper Viséan
Lithostrotion junceum (FLEMING)											2																	3	1		9	5	16	16	14	G. Britain, France, Belgium, Spain, Germany, Czechoslovakia, USSR — Upper Viséan
L. pauciradiale M'COY																							1								5	6	2	2		G. Britain, Zone D_2, Upper Viséan; Czechoslovakia, USSR, China — Viséan
L. mccoyanum M.-E. & H.																				1								1	3			3	1	7	5		G. Britain, Zone D_2, Upper Viséan; USSR: Donets Basin, Lower Namurian, Ural, Viséan; Japan — Upper Viséan
L. decipiens M'COY																															2	2				G. Britain, Zone D_2, Upper Viséan; USSR (Ural), Upper Viséan
L. scoticum HILL																															6	3	15	3	2	G. Britain, Zone S_2-D_1, Viséan; USSR (Moscow Basin), Upper Viséan
L. caespitosum (MARTIN)																															11	12	5	3		G. Britain, Zone D_2, Upper Viséan; France, Belgium — Viséan to Lower Namurian; USSR: Donets Basin, Moscow Basin, Ural, Novaya Zemla—Viséan; Middle Asia — Lower Namurian.
Lonsdaleia cf. *floriformis* (MARTIN)																															13	13	1			G. Britain, Zone D_1 to Zone 3, Upper Viséan to Lower Namurian; USSR (Moscow Basin), highest Viséan
Neokoninckophyllum soshkinae FOMITSHEV																												1	1							USSR (Donets Basin), Westphalian A-C
Palaeosmilia murchisoni M.-E. & H.		7				4	4		1					1			26	1		42	33	3			2		8	104	13		10	7	17	11	7	G. Britain, Zone C_2 to D_2, Viséan; France, Belgium, Germany, Czechoslovakia — Viséan; N. Africa — Upper Viséan; USSR — Upper Viséan; Asia Minor, China — Viséan
Pseudozaphrentoides(?) *juddi* (THOMSON)		1															4			1				4		3					5	8	5	7	5	G. Britain, Zone 1 to Zone 3, Upper Viséan to Lower Namurian; Eurasia — Lower Carboniferous to Lower Permian (after HILL, 1938). Revision wanted
Rylstonia benecompacta HUDSON & PLATT																				2			1				3	1			3	2	4	1		G. Britain, Upper Tournaisian to Viséan; USSR (Kuznetsk Basin), Viséan

literature and her own observations, was undertaken by ŻAKOWA (1966). It is clear from this reconstruction that in the Upper Viséan the area under study was a bay, several km wide and connected with the open sea only through the Moravian-Silesian zone. The existence of such a bay, deeply indenting the land and connected with the open sea in a relatively small area, does not seem certain to the present writer. The water of such a bay, into which rivers discharged themselves, was bound to become fresh after some time. Perhaps, a certain fresh water period occurred during the sedimentation of shales with plants, but it was impossible that it took place during an exuberant development of tetracorals. It seems that during such periods the area, through which this bay was connected with the open sea, was considerably extended.

According to ŻAKOWA (1966), the proximity of the shore, combined with the mobility of the sea bottom, resulted in the diversity and variability of deposits, both vertically and horizontally. Greywackes and clayey shales predominate in this region. Among them, balls, lenses and concentrations of marls and limestones occur in a few localities within a small vertical range. These sediments are compared by ŻAKOWA (*op. cit.*) with what is known as a "facies of interbedding", separated by KHVOROVA (1953) for shallow-neritic, interbedding limestones, shales and sandstones of Moscow Basin. The lithology of the Viséan deposits in the Mid-Sudetes is undoubtedly similar to a "facies of interbedding" of Moscow Basin, although it is more arenaceous and less carbonated. On the other hand, it differs in the composition of the fauna of tetracorals. In the Sudetes, colonial corals are predominant, whereas in Moscow Basin only solitary forms occur in this facies. Nevertheless, the occurrence of sediments, saturated with calcium carbonate, only in the Sudetes may help explain the fact of a mass development of colonial corals in the terrigenous facies. These deposits were bound to form in a place, in which, with a constant influx of the terrigenous material from the land or islands, the conditions were favourable to an easy precipitation of calcium carbonate around the accumulations of organic remains or still living organisms. This was probably a marine region with a normal salinity and a relatively high water temperature at the boundary of the calcareous and terrigenous sedimentation. A normal or even an exuberant life of a fauna with moderate requirements, consisting of pelecypods, brachiopods and other animals, developed in this region which might be sometimes reached by less demanding species of corals which could develop here. The section of Czerwieńczyce, in which the correlation of the taxonomic and quantitative differentiation of tetracorals, depending on the amount of calcareous concentrations contained in shales (layer 7), is marked to the greatest extent, is a very good illustration of this problem.

A close dependence of tetracorals on facial conditions was described in the ecological works on these animals published so far (including HILL, 1938-1941; IVANOVA, 1958; OSIPOVA & BELSKAYA, 1967). The division of fauna into the following assemblages is usually adopted after HILL (*op. cit.*): 1) *Cyathaxonia* Fauna, mostly occurring in clayey-marly shales and characteristic either of deep waters or coastal basins, which are calm but always having a normal salinity; 2) *Caninia-Clisiophyllum* Fauna which mostly occurs in calcareous facies, in shallow waters below the zone of tide and surf; 3) Reef-coral Fauna which mostly occurs in reef limestones, in the zone of whirl or slightly below.

The following regularities in the occurrence of tetracorals were observed in the Sudetes:

1) *Cyathaxonia* Fauna which occurs in an environment normal of it, i.e. in shales in which it is found in life position. Less frequently, corallites are overturned but without traces of transportation. Few, redeposited solitary specimens were also found in limestone balls. Some redeposited corallites were found near larger accumulations of colonial corals.

2) Corals of the assemblage of *Caninia-Clisiophyllum* Fauna take a place intermediate quantitatively among Sudetic tetracorals. In life position, they are scattered in the rock. Their

accumulations are secondary in character and, if such is the case, they are accompanied by fragments of colonies and a detritus of other organic remains. The phenomenon of dwarfishness is sometimes observed in the corals of this assemblage. Particularly numerous are dwarfish specimens of *Dibunophyllum bipartitum bipartitum* occurring in Sokolec. They have all features of normally developed individuals except for the fact that they are 2-3 times smaller. *C. delicatum nanum* n. subsp., the smallest of the subspecies of *Clisiophyllum* known so far, described in the present work, also comes from Sokolec. Most corallites of this subspecies do not exceed 6.5 mm. Normally developed specimens of the other species, for instance *Aulophyllum fungites* and *Clisiophyllum keyserlingi*, as well as colonial corals occur along with the dwarfish forms. Ecological conditions of the Sudetes are non-typical of this fauna.

3) The representatives of Reef-coral Fauna occur in nests mostly *in situ*. Each of such nests consists of very numerous colonies, usually 1-3 species of one genus, less frequently of two genera. Corals of this assemblage are a predominant element, characteristic of the entire fauna of tetracorals in the Sudetes; despite the fact that the conditions they lived under are, according to previous findings, the least favourable to their existence, bushlike colonies of various species of *Lithostrotion* and *Diphyphyllum* predominate quantitatively over the remaining species of this fauna. Besides the last-named, there occur, however, in these same deposits subcerioid and cerioid colonies of *Lithostrotion* and sometimes also a plocoid *Palaeastraea regia*. In contrast to ŻAKOWA's findings (1966), the writer did not ascertain the regionalization of the occurrence of bushlike and massive colonies. This differentiation may be observed sometimes in overlying layers of this same section (Sokolec), now and then in nests, in the same layer (in the remaining localities). No major differentiation of Reef-coral Fauna was also found in particular localities despite their being separated from each other by barren area. The writer cannot, therefore, agree with ŻAKOWA's (*op. cit.*) conclusion, based, among other things, on the occurrence of *Palaeastraea regia*, that the area of Jugów was during that period the nearest to the open sea and formed a slope of an open sea shoal. This conclusion, drawn by analogy to the occurrence of plocoid colonies in Moscow Basin (IVANOVA, 1958), cannot be applied to the territory of the Sudetes, because the facies in which the colonies, described by IVANOVA (*op. cit.*), occurred was completely different. These were organodetritic limestones with no trace of the terrigenous material which was especially emphasized by IVANOVA. On the other hand, in Jugów, the same as in other localities in the Mid-Sudetes, terrigenous sediments occur with only small intercalations of calcareous lenses.

From the similarity of fauna mentioned above and not only of the Reef-coral assemblage, as well as from the similarity of the sediment, another conclusion may be drawn, i.e. that the ecological conditions were similar in all the localities in which this fauna occurred. Likewise a completely free contact was bound to exist between particular part of the basin which enabled the transport of larvae. However, not in all places could they find appropriate conditions for their development, quite opposite — such areas were rather few and spatially confined. In the present writer's opinion, these were shallow places with a constantly changing configuration of the bottom, the same as in the remaining part of the basin. The variability of the sediment is an evidence for this hypothesis. The shore-line probably approached and receded alternately, but during the period of the development of coral fauna it was bound to be relatively distant. In Sokolec, corals developed the nearests the shore or an island and it was in this locality that many colonies were found *in situ* in a greywacke shale without calcareous balls.

On the basis of observations on tetracorals from the Viséan of the Mid-Sudetes, we may rectify some rules of their occurrence and ecological requirements usually adopted by HILL (1938-1941): 1) The assemblages called *Caninia-Clisiophyllum* Fauna and Reef-coral Fauna

sometimes cannot be separated. They may occur in this same facies and in this same area of sea bottom. 2) The boundary of a mass occurrence of the assemblages of tetracorals referred to above should be shifted to the transitional zone between the carbonate and terrigenous sedimentations and even somewhat further within the range of the latter. Of calcareous sandstones, cerioid and plocoid colonies have already been described (FEDOROWSKI, 1965). 3) The following features are characteristic of the transitional zone: a) taxonomic poverty, b) dwarfishness of some species, c) exuberant development of some other species, mostly cosmopolitic. 4) The requirements of Reef-coral fauna are smaller as concerns only the degree of water impurity and speed of forming deposits and not the degree of water salinity.

B. THE HOLY CROSS MOUNTAINS (GAŁĘZICE)

The ecological conclusions presented below make up only part of the problem, particularly interesting in Gałęzice syncline. The writer has based his considerations on his own collections and exposures only from the environs of Besówka Hill. As concerns the remaining area, he had at his disposal the material of corals and a possibility of observation in the excavations dug by ŻAKOWA (1962, 1967). The work by this author containing the results of her observations, made in Gałęzice syncline, is still in press and therefore, the present writer could neither form his view on the conclusions contained in this work, nor present very extensively his own conclusions, based on the observations of these same exposures. A detailed ecological analysis is also delayed by the fact that only part of a rich fauna, not only of Tetracoralla of Gałęzice, has so far been described or at least identified. The studies on this fauna are still being continued by the writer and other palaeontologists.

On the basis of the writer's observations the following may be stated:

1) Corals of the assemblage *Caninia-Clisiophyllum* are decidedly predominant quantitatively and taxonomically in Gałęzice. The Reef-coral Fauna occurring together with them is differentiated taxonomically but usually not very abundant. Bushlike colonies of *Lithostrotion* and *Diphyphyllum*, particularly numerous in the inferior part of the profile od Todowa Grząba, predominate in the last-named fauna. Subcerioid and cerioid colonies are not numerous. Plocoid colonies (only *Palaeastraea regia*) occur only occasionally.

2) Relatively abundant representatives of *Cyathaxonia* Fauna occur together with the representatives of the two former faunas. These are many specimens of *Cyathaxonia cornu*, *Rotiphyllum* sp., *Allotropiophyllum* sp. from Tetracoralla, and *Hexaphyllia* from Heterocorallia, etc. Fragments of fine — usually 1-3 mm in diameter and to 2 cm long — *Hexaphyllia* are most frequently found in the calices of large solitary tetracorals.

3) The entire fauna is redeposited. Even very large colonies of bushlike species of *Lithostrotion*, reaching more than 50 cm in height and about 1 m in diameter, are overthrown and probably displaced. These large colonies are observed only in the oldest layers on Todowa Grząba Hill and, here and there, at Ostrówka. Only small colonies of these same species were found at Besówka Hill.

4) No traces of the segregation of fauna can be found at Besówka Hill. Solitary corallites, colonies and the accompanying fauna are scattered at random both vertically and horizontally, regardless of size. Particularly abundant here are well-preserved columnals of crinoid stems. An only difference observed is a gradual impoverishment of the fauna of tetracorals occurring in the upper part of the profile.

5) The state of preservation of the inner structure of corallites is excellent. Frequently, individuals are, however, incomplete, with broken-off proximal ends, sometimes broken in halves or crushed in fragments. Very numerous are broken-off fragments of bushlike colonies. Broken-off fragments of subcerioid and plocoid colonies are also found sometimes. On the other hand, no traces of rounding have ever been found. There are corallites with inner structure partially damaged mechanically but which continued their development, cicatrizing the damaged place. The detritus of animal remains, the same as in the surrounding sediment, occurs in these places.

6) A taxonomic wealth, a great number of taxons, a large quantity of which are new among tetracorals and, at the same time, an occurrence of species previously described from very distant regions, attracts one's attention even in the present, incomplete determinations. About 100 species of tetracorals have been determined by the present writer in detail or only preliminarily. This number may, however, be expected to increase at least by one third. Some species are met with in hundreds of specimens.

Fragmentary stems of crinoids, here and there representing the main component of limestone, are predominant among the accompanying fauna. Besides tetracorals, brachiopods are a component the second in regard to their number. Both big *Gigantoproductus* and relatively small *Eomarginifera*, *Antiquatonia*, *Athyris*, etc. (KWIATKOWSKI, 1959) occur among them. The remaining group of animals are represented in a much more modest number. Gastropods (GROMCZAKIEWICZ, 1967 and in press) are mostly represented by the superfamily Pleurotomariacea and the family Platyceratidae, as well as by other species of other families with large and fine individuals. Pelecypods few and so far not described, of bryozoans — *Fenestella*, of trilobites — *Liobolina apodemata* OSMÓLSKA (OSMÓLSKA, 1962), and large foraminifers *Millerella*. Green algae are also found by GROMCZAKIEWICZ (*op. cit.*). The same discrepancies as among corals are observed in the accompanying fauna. In addition to massive forms with thick skeletons, resistant to the effects of waving and normally met with either in the zone of surf or in an environment with a variable, mobile regime, there occur delicate, thin-skeletal forms, inhabitants of calm areas of the sea. The composition of fauna in particular layers does not seem to change to a major degree. Some groups occur sometimes in larger accumulations such as, for instance, a mass accumulation of members of crinoid stems found on Besówka.

Lithological changes also do not seem to be very significant. The sediment in the entire section continues to be an organodetritic limestone, although a bituminization occurs in particular layers with a variable degree of intensity or the quantity of organic remains increases or decreases as compared with the amount of limestone of chemical origin. Thus, both fauna and sediment allow one to present the reconstruction of ecological conditions as a total, without analyzing particular layers in which they probably were not subject to major fluctuations. The fact of the occurrence of fauna as a reworked deposit undoubtedly makes the reconstruction of particulars more difficult, primarily establishing ecological niches which, judging by the taxonomic and structural differentiation of fauna, were bound to be diversiform. At the same time, it is, however, clear from the observation of the state of preservation of fauna and from the complete lack of the traces of rounding that the distance of the transportation of the material was not long and, therefore, the reconstruction of a general habitat is quite possible.

The great number and taxonomic differentiation, together with a normal and even particularly intensive development of skeletons of tetracorals, on the observation of which the conclusions were mostly based, allow one to consider the conditions of the environment to be very favourable. Corals might find them either on a more or less immobile shelf, or in a basin with a gradually depressing bottom. In such a basin, bioherms a few, several scores or even hundred of meters in size are formed, surrounded by shales as, for instance, in the Devonian

of the Ardennes (LECOMPTE, 1962, 1967). The core of the bioherms consists of corals or stromatoporoids forming massive colonies. In Gałęzice, there are no non-interbedded and naturally succeeding each other accumulations of fauna with a predominance of massive corals. Instead, solitary corallites predominate in this locality and massive colonies are few and small. The part of the syncline in which bedding is indistinct or, maybe, does not occur at all (Besówka), is composed of limestone which is of the nature of a random heap of the remains of fauna with a predominance of crinoid stems. Thus, during the period of the formation of the Carboniferous limestone, Gałęzice syncline was not a basin with a depressing bottom and does not contain bioherms. Probably, it was part of a shelf on which bedded, calcareous sediments with a small thickness and of the nature of biostromes (LECOMPTE, *op. cit.*) predominated. A comparison of ecological conditions of this shelf may be best made in reference to Moscow Basin, in which the facies of the Carboniferous limestone was common over almost entire Carboniferous. In addition, that is the region in which the most numerous observations were made in the ecology of tetracorals of that period (DOBROLJUBOVA, 1935, 1937, 1948; DOBROLJUBOVA & KABAKOVITSH, 1948) and a general ecological elaboration was prepared with consideration to corals (IVANOVA, 1949, 1958; OSIPOVA & BELSKAJA, 1967). In that region, tetracorals occur in the following three of the facies, separated by IVANOVA (*op. cit.*): 1) the open sea (neretic) facies of shallows and their slopes and with the related facies of the island littoral; 2) the facies of near-shore shallows with a variable regime ("fatsya pereslayvanya" — "facies of interbedding"); 3) the facies of a relatively deep sea with normal physico-chemical conditions. In Moscow Basin, a separate fauna of corals, brachiopods and other animals is related with each of these facies and each is also marked by a different type of sediment.

The type of sediment in Gałęzice, i.e. an organodetritic limestone, corresponds to the open sea facies from Moscow Basin, of which the most characteristic are large (up to 1.8 m long), flat, massive, cerioid and plocoid colonies. In Gałęzice, colonies of these types are very few and small, reaching only a few to several scores of centimetres. The predominance of corals of the assemblage *Caninia-Clisiophyllum*, found at Gałęzice, suggest a similarity to the facies of near-shore shallows to which, on the other hand, the type of sediment does not correspond. In addition, at Gałęzice, there simultaneously occur numerous bushlike colonies characteristic of calm island littorals and many representatives of *Cyathaxonia* Fauna, inhabitants of calm near-shore basins. It is clear, therefore, that in the Carboniferous limestone of Gałęzice, representatives of all coral biotopes, strongly separated from each other in Moscow Basin, may be found next to each other. At the same time, the least numerous here are massive colonies, to which the type of sediment corresponds to the greatest extent.

On the basis of the observations and comparisons presented above the present writer has reached a conclusion that the sedimentation of the Carboniferous limestone in Gałęzice syncline took place in a zone corresponding to the facies transitional from island littoral to open-sea shoals. That was probably a shallow area (the presence of green algae), excellently aerated and with a normal salinity (the abundance of strongly developed fauna). It was separated from the open sea by a sort of an underwater elevation on which massive colonies of tetracorals were probably developing. The smaller of them or their fragments might be thrown by waves outside this elevation and to the inner zone. This zone was, therefore, neither completely calm nor uniform. Calm areas in which crinoid meadows could develop (probabtely in the environs of Besówka) and particularly well screened places in which the fauna of small *Hexaphyllia* and thin-shelled gastropods and brachiopods developed, were bound to exist in this zone. At the same time, the places with strong water movement were certainly situated nearly which is indicated by a mechanical damage of corals which was done at their life time. The great

Gigantoproductus probably also lived in such places together with large solitary tetracorals and with colonies.

The entire basin was certainly exposed during some periods to a more general and stronger activity of rough waters which attacked ecological niches, carried away and mixed together the fauna that lived in the basin. During such disturbances, fauna was subject to mechanical damage of different types and sometimes was strongly crumbled giving material of which the organodetritic limestone was formed. The period of the activity of rough waters was not probably very long since it did not lead to the rounding of skeletons, which could take place during a long-lasting transportation. Masses of broken skeletons of crinoids together with representatives of other animals either living among them or drifting with water were deposited near crinoid meadows. Soft parts of animals, even only partly torn away from the skeletons and heaps of algae, might settle in other poorly aerated places where later spots of bitumins were formed. Even the great bushlike colonies could not resist the activity of these waters and were thrown over. During some periods, a general calmness probably took place in the basin and then chemical limestones were more abundantly deposited as, for instance, in the younger part of the section on Besówka Hil.l

III. PALAEOGEOGRAPHY

The distribution of facies on the territory of Poland in the Carboniferous was elaborated in detail by BOJKOWSKI (1960) and, recently, by ŻAKOWA (1968). Tetracorals do not seem to introduce anything new in this respect. In the writer's opinion, much more important seems to be the examination of their occurrence as a link which connects the Carboniferous coral faunas of Western and Eastern Europe. An analysis of such type has not so far been made because the Carboniferous corals from the territory of Poland were almost unstudied.

All species and genera, so far described and determined in Poland, may be diveded into the following groups: 1) New taxons which will be omitted from consideration; 2) Cosmopolitic species and genera; 3) West-European species and genera; 4) East-European and Asian species and genera. The most numerous (21 species) is group 2 to which not only actually cosmopolitic species have been assigned, but also those which at the same time occur in groups 3 and 4, which are almost equal in number of species (10 and 11). Great Britain is a region particularly related faunally; more than 2/3 of all species are in common with this area. An equally related fauna probably occurs in the French-Belgian Dinant Basin very similarly developed to the British Avon (VAUGHAN, 1915). Unfortunately, this fauna is still incompletely described. Facies mostly unfavourable to the development of tetracorals occur between the French-Belgian Coalfield and Poland in the area of Germany and Czechoslovakia. A lack or a poor knowledge of fauna in this territory may also be a result of an insufficient recognition. Corals are mentioned from the Upper Viséan of North-Western Germany (PAUL, 1937, 1938) and Czechoslovakia (HERITSCH, 1935; ZUKALOVA, 1961, 1965). Calcareous-clayey sediments of the neritic facies, containing corals not described so far, have been recently bored in North-Western Poland. It is clear from the occurrence of tetracorals discussed above that there certainly existed a direct connection with Great Britain by two ways: the southern one through the Sudetic Mountains, Moravia and Thuringia (*Lithostrotion junceum* was described by WEISSERMEL from this region in 1935) and the northern one through the North Atlantic continental shelf.

A direct connection of the Upper Viséan seas of Poland with Eastern Europe has also been found on the basis of previous geological and palaeontological studies. According to BOJKOWSKI (1960), a direct connection may be traced through both Lublin Coalfield and the Sub-Carpathian Region. ŻAKOWA draws this connection only through Lublin Coalfield. This problem may be solved only by borings since the Lower Carboniferous does not occur anywhere in this region on the surface. The fauna of corals, much the same as other groups of marine animals, described so far, are indicative of a direct and completely free connection between the sedimentative basin of the Holy Cross Mountains and Donets Basin. In addition to 17 species of tetracorals in common shown in Table 1, common species assigned to a new genus whose description has not yet been published by the writer and, therefore, omitted from consideration, occur in both basins. It is only in these two basins that the genera *Nervophyllum* (three new species at Gałęzice) and *Neokoninckophyllum* are known so far. Judging by a review of the remaining fauna of tetracorals from Gałęzice still unpublished, the number of species in common is actually greater. Many species in common with Poland, particularly of the genera *Lithostrotion*, *Diphyphyllum*, *Dibunophyllum*, *Palaeosmilia*, etc. occur in more distant areas of the U. S. S. R. as Moscow Basin, Novaya Zemla and Kazakhstan. Closely related seems to be the fauna of tetracorals from Ural as may be concluded from STUCKENBERG'S specimens reviewed by the present writer.

VOJNOVSKY-KRIEGER and VASSILJUK (1961) attract attention to the occurrence, in the Upper Viséan sediments of Donets Basin, of a Far-Eastern, Japanese and Chinese faunas of corals and to a close relationship of the fauna of corals of Novaya Zemla and Ural to that of the West-European province. The data presented by the writer in Table 1 fully confirm this observation and extend it by further species in common in East-European areas and Poland, as well as allow one to find a closer relationship with the areas of Eastern and Central Asia and Kazakhstan.

The spreading Viséan transgression demolished the barriers which separated former zoogeographical provinces. The number of endemic species or those limited to small areas was during that period insignificant as compared to their total number. A decisive majority of genera were cosmopolitic. Uncomparably more numerous than in any of the remaining stages of the Carboniferous are also cosmopolitic species and, in addition, not only the long- but also short-lived ones. In this connection, the separation of zoogeographical provinces for tetracorals (among other authors, HILL, 1948, 1957; VOJNOVSKY-KRIEGER & VASSILJUK, 1961) is not possible during this period since there are no assemblages of fauna separate for particular regions. The province of *Dibunophyllum* covering (HILL, 1948) Europe and part of the eastern coast of the U. S. A. is a good example in this respect. Even a superficial analysis of the components of this fauna and the fauna of other provinces, for instance, *Kueichouphyllum*, indicates that only some of them are different and a fundamental majority of the genera and many species are in common. Thus, it is not the separation but disappearance of zoogeographical provinces that is a feature characteristic of the Viséan faunas of corals.

This spreading of the Viséan transgression and mixing of the faunas of corals does not preclude the possibility of the existence of specific assemblages of species in different areas of seas which, in view of the community of genera, does not, however, deserve the name of zoogeographical provinces. The formation of such assemblages results, in the present writer's opinion, not from the separation of particular basins but from the variability of facies as well as from various directions of migration, different rate of evolution of particular species, longer life of their larval stages and different resistance to unfavourable conditions of the environment. Open seas, even deep ones, are not an obstacle for the spreading of corals, provided that appropriate

current are in these seas and even widely spaced islands which in a way provide stop places in which they may develop even if ecological conditions are difficult in them. Such a stop place might be, for instance, the area of the Mid-Sudetic Mountains. The larvae of some Recent hexacorals live for 30 days and may be transported for long distances. In all likelihood we may assume that equally longlived were the larvae of some species of tetracorals. If, in addition, the individuals of such a species could develop and produce their progeniture under not very favourable ecological conditions, nothing stood in the way of the cosmopolitic spreading of a species during the existence of widely open seas. On the other hand, in the case of a brevity of larval period or a low ecological tolerance, there were formed endemic species or those limited to small areas which assembled into groups characteristic of these areas. Most genera of tetracorals which occurred in Viséan included relatively numerous species at least part of which might migrate to distant regions. These species, even evolving gradually during their migration, extended the geografical range of the genus over great areas.

The areas, in which the development of new species and genera took place, are numerous, e.g. *Caninophyllum patulum* (MICHELIN) appears, according to VOLKOVA (1941), earlier in Kazakhstan than in Western Europe, and *Neokoninckophyllum tanaicum* FOMITSHEV and *Neokoninckophyllum soshkinae* FOMITSHEV were found by the present writer in older sediments in the Holy Cross Mountains than those found by FOMITSHEV in Donets Basin. Since their occurrence mostly coincides in the geological age in most cases, it is difficult, however, to establish with a complete certainty in which area a given species appeared first. This is an evidence of both the speed and the many-sided possibilities of the spreading of the fauna of corals in Viséan and, therefore, once again — of the existence of excellent connections between particular sedimentation basins. In the Upper Viséan, the area of Poland was situated at the contact point of two facies, that of the Carboniferous limestone and that of Culm, but points which favoured the development of corals were, however, few in this area. The most favourable conditions probably predominated on the shoals of Gałęzice syncline, where the faunas of corals migrating from the east met and mixed with those from the west. This is the area in which the western boundary of the occurrence of most Asian and East-European species of *Arachnolasma*, *Dibunophyllum*, *Clisiophyllum*, *Bradyphyllum*, etc. should be traced. On the other hand, east of Gałęzice syncline, some species of *Allotropiophyllum*, *Caninia*, *Caninophyllum* and *Koninckophyllum* are unknown so far. These species are, however, less numerous from which it might result that the main mass of the fauna of corals migrated from the east to the west. Many new species and genera, some of which may turn out to be endemic ones, also developed in the area of Gałęzice syncline.

SYSTEMATIC PART

Family AULOPHYLLIDAE DYBOWSKI, 1873

Subfamilies assigned: Aulophyllinae DYBOWSKI, 1873; Clisiophyllinae NICHOLSON & THOMSON, 1883.

Stratigraphic and geographic range: Lower Carboniferous to Lower Permian; Eurasia, North Africa, North America, Australia.

Diagnosis. — Solitary corals or, less frequently, phaceloid colonies; dissepimentarium strongly developed; axial structure or columella occurring at least at the beginning of ontogeny; in the ephebic stage it may disappear; columella biseptal; cardinal fossula open; counter-cardinal fossula may also occur.

Remarks. — In the writer's opinion, only those genera should be assigned to this family which have the columella formed by the connection of the cardinal and counter septa and without any participation of septal lamellae. Lamellae may reach and contact columella, but they are not its organic component. All genera with the compound columella consisting of columella, lamellae and tabellae, etc. should, therefore, be excluded from this family. The capability of budding and forming colonies is an important diagnostic character, but usually of a not higher than generic rank. This is the reason why assigning colonial genera, e.g. *Corwenia*, to the Aulophyllidae is considered by the present writer to be correct. In his opinion, the range of the family Aulophyllidae should, therefore, be limited only to those genera which were assigned by HILL (1956) to the subfamily Aulophyllinae. On the other hand, here should be assigned most representatives of the family Neokoninckophyllidae FOMITSHEV and Lophophyllidae GRABAU sensu DOBROLJUBOVA and KABAKOVITSH (1962).

Subfamily AULOPHYLLINAE DYBOWSKI, 1873

Genera assigned: *Aulophyllum* M.-EDW. & H., 1850, *Auloclisia* LEWIS, 1927, *Berkhia* GORSKY, 1951, *Slimoniphyllum* KATO & MITCHELL, 1962, *Zakowia* n. gen.

Stratigraphic and geographic range: Lower Carboniferous; Eurasia, North Africa.

Diagnosis. — Columella occurs in the Aulophyllinae only in the youngest stages of ontogeny.

Remarks. — Genera assigned to this subfamily may be divided into the following two groups: 1) with axial structure composed mostly of septal lamellae, i.e. *Aulophyllum*, *Berkhia*, *Zakowia* and 2) with axial structure composed mostly of tabellae, i.e. *Auloclisia* and *Slimoniphyllum*.

Genus **AULOPHYLLUM** M.-EDWARDS & HAIME, 1850

(Type species: *Clisiophyllum prolapsum* M'COY, 1849)

Synonyms:

Fungites URE, 1793,
Turbinolia FLEMING, 1828,
Clisiophyllum M'COY, 1849, partim,
Cyclophyllum DUNCAN & THOMSON, 1867,
Permia STUCKENBERG, 1895,
?*Setamainella* MINATO, 1943.

Species assigned: *Turbinolia fungites* FLEMING, 1828, *Permia iwanowi* STUCKENBERG, 1895, ?*Setamainella hayasakai* MINATO, 1955.

Stratigraphic and geographic range: Viséan to Lower Namurian; Europe, North Africa, Novaya Zemla, ?Japan.

Diagnosis — See HILL, 1938-1941, p. 82.

Remarks. — This genus was thoroughly studied by SMITH (1913) and, therefore, the present writer will confine himself to a few remarks only on the congenerity of *Aulophyllum* M.-EDW. & HAIME, 1850 and *Permia* STUCKENBERG, 1895. Discussing the geographical distribution of *Aulophyllum*, HILL (1938-1941, p. 83), who was the first to mention this problem, said: "The Russian species were placed by STUCKENBERG (1895, 1904) in *Cyclophyllum* and possibly also in *Permia* (1895, p. 186, Pl. 3, Fig. 6e)". A similar opinion, based on facts concerning several specimens, was expressed during a discussion by N. V. KABAKOVITSH from the Palaeontological Institute in Moscow, where the present writer studied in 1968. At that occasion he had also the opportunity to examine the entire material available and which was identified by STUCKENBERG as *Permia iwanowi* n. sp. (housed in the Kazan University Museum). In this material, two poorly preserved microscopic slides are most likely to correspond to STUCKENBERG's (1895, Pl. 3, Figs. 6b and 6e) illustrations. The rest of the specimens, illustrated by this author, are missing. The saved corallites have characters typical of *Aulophyllum*, i.e. a regular, narrow dissepimentarium, major and minor septa and an axial structure separated by a tabular wall which, in weathered specimens (in KABAKOVITSH's collection), forms a sort of an aulos. It is, however, clearly visible in STUCKENBERG's microscopic slides that the axial structure consists of lamellae and tabellae, the same as in *Aulophyllum*. A lamellar axial structure may be also found in STUCKENBERG's (*l.c.*, Pl. 3, Figs. 6c and 6d) illustrations. Debatable are only Figs. 6f and 6g in which, with relatively large dimensions, neither dissepimentarium nor lamellae have been drawn in an axial structure surrounded by a thick wall. The possibility occurs that these specimens were not conspecific with the rest of them assigned by STUCKENBERG to *Permia iwanowi* and corresponded to the characters ascribed by HUDSON (1943) to the genus *Permia*. However, taking into account the fact that these were precisely the corallites which got lost and the remaining ones are only typical *Aulophyllum*, it is necessary to consider the genus *Permia* as a younger synonym of *Aulophyllum*. The present writer, the same as HILL (1956, p. F286), has assigned the genus *Setamainella* MINATO, 1943 to *Aulophyllum* with a reservation. A univocal solution of the problem of its taxonomic assignment is, however, prevented by insufficient studies and illustrations.

Aulophyllum fungites (FLEMING, 1828)

(Text-fig. 5 *A-C*; Pl. I, Figs. 1-5)

1793. *Fungites* URE; D. URE, The history..., p. 327, Pl. 20, Fig. 6.
1828. *Turbinolia fungites* FLEMING; J. FLEMING, A history..., p. 510.
1895. *Cyclophyllum Falki* STUCKENBERG; A. STUCKENBERG, Korally i mšanki..., p. 100, Pl. 5, Fig. 7; Pl. 17, Fig. 7.

1904. *C. Thomsoni* STUCKENBERG, Korally i mšanki..., p. 47, Pl. 5, Fig. 6*a-e*.
1904. *C. Zitteli* STUCKENBERG; A. STUCKENBERG, *Ibid.*, p. 48, Pl. 5, Fig. 9*a, b*; Pl. 9, Fig. 3*a b*.
1904. *C. mstensis* STUCKENBERG; A. STUCKENBERG, *Ibid.*, p. 49, Pl. 9, Fig. 5*a-d*.
1911. *C.* nr. *pachyendothecum* THOM. in text, *Aulophyllum* sp. in plate; A. VAUGHAN, in: S. SMITH, The faunal..., p. 633, Pl. 1, Fig. 5.
1913. *Aulophyllum fungites* EDWARDS & HAIME (sic); A. SALÉE, Le groupe..., Pl. 4 (1), Figs. 2, 3 (Figs. only).
1913. *A. fungites* (FLEMING); S. SMITH, On the genus..., p. 51, Pls. 5-9 (*cum synon.*).
1917. *A. fungites* FLEMING; E. J. GARWOOD, The faunal..., Pl. 17, Fig. 5 (Fig. only).
1923. *Cyclophyllum Thomsoni* STUCKENBERG; A. J. PERNA, Korally..., p. 27.
1923. *C. mstensis* STUCKENBERG; A. J. PERNA, *Ibid.*, p. 28, Pl. 3, Fig. 5.
1929. *Aulophyllum fungites* FLEMING; F. DAGUIN, Étude..., p. 26, Pl. 4, Fig. 4.
1929. *A. fungites* mut. *cambriense* S. SMITH; E. NEAVERSON, Faunal horizons..., p. 126, Pl. 5, Fig. 23.
1930. *A. fungites* (FLEMING); S. SMITH & W. D. LANG, Descriptions..., p. 187.
1935. *A. fungites* FLEMING; N. MENCHIKOFF & T. Y. HSU, Les polypiers..., p. 248, Pl. 10, Fig. 6*a-e*.
1938-1941. *A. fungites* (FLEMING); D. HILL, A monograph..., p. 83, Pl. 3, Figs. 8-10 (*cum Scottish synon.*).
1958. *A. fungites* (FLEMING); C. ÜNSALANER-KIRAGLI, Lower Carboniferous..., p. 54, Pl. 2, Fig. 1*a, b*.
1960. *A. fungites* FLEMING; N. P. VASSILJUK, Nižnekamennougolnye..., p. 155, Pl. 40, Fig. 1 *a-c*.
1964. *A. fungites* FLEMING; N. P. VASSILJUK, Korally zon..., p. 77, Pl. 4, Figs. 8, 9.
1966. *A. fungites* (FLEMING); H. ŻAKOWA, Poziom Goniatites...., p. 123 (Tab. 10), Pl. 22, Figs. 4*a, b*, 5*a, b*.

Material. — About 10 solitary corals without proximal ends and mostly without calices. Most of them with an abraded or weathered surface.

Dimensions (in mm):

Specimen	Septal index n/d
Z. Pal. P. Tc-4/	
387	54 : 25
465	60 : 24
465	62 : 27
3167	43 : 23
2673	39 : 15
IG. OS-70/	
2451	68 : 25
2665	56 : 23
2759	52 : 20
2759	60 : 27

Diagnosis. — As for the genus.

Remarks. — A few mutations have been distinguished by SMITH (1913) who described this species in detail. Since some of them may occur one after another in one and the same specimen, it is impossible to separate these mutations without many sections of various ontogenetic stages of one and the same corallite. The present writer, whose material was insufficiently preserved to carry out such studies, confined himself only to the separation of the species and a few remarks.

The following characters are noteworthy in the Polish material:

1) A considerable variability of the number of septa with only insignificant changes in dimensions.

2) A variable but, at the same time, small width of dissepimentarium. Particularly narrow is the dissepimentarium of the specimen I.G. No. OS-70/2759 (Pl. I, Figs. 2a,*b*) which, with a diameter of 27 mm, is less than 2 mm wide.

3) The axial structure of most specimens is separated by a stereoplasmatic wall, sometimes 1 mm thick. It is developed on peripheral parts of axial tabellae. Septal lamellae are mostly embedded in it identically as septa in epitheca, but they may also pierce it through.

4) The morphology of the axial structure is mostly similar to that of the *redesdalense* and *pachyendothecum* mutations distinguished by SMITH (1913). However, there are also speci-

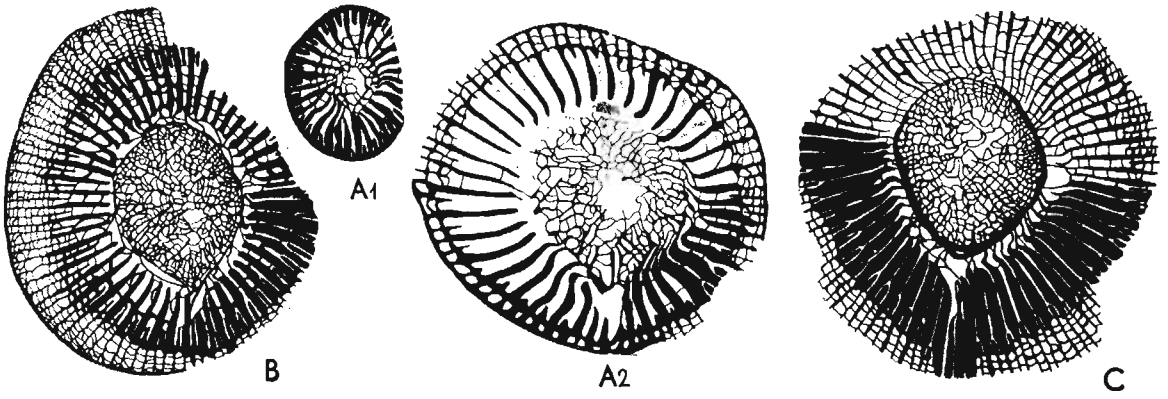

Fig. 5

Aulophyllum fungites (FLEMING): A_1 transverse section of the neanic stage, A_2 transverse section of the early-ephebic stage, non-typical axial structure, ×3 (Z. Pal. P. Tc-4/2673), Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); *B* transverse section of the ephebic stage, ×2 (Z. Pal. P. Tc-4/387), Czerwieńczyce, Sudetes, Upper Viséan, D_2; *C* transverse section of the ephebic stage, ×2 (IG. OS-70/2451), Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

mens which have not their counterparts in the mutations separated so far. In the present writer's opinion, the separation of further types of morphological structure is purposeless. It seems more correct to consider the arrangement of lamellae as random and not being subject to any regularity. One of the specimens available to the writer (Text-fig. 5 $A_{1,2}$) and which particularly deviates in this respect from the holotype may be a new subspecies, not separated so far.

5) The length of minor septa not always equals 1/2 of that of major septa as mentioned in diagnosis. This length seems to be correlated with the width of dissepimentarium and directly proportional to it. Axial ends of minor septa in all specimens enter tabularium to more or less the same depth.

All species of the genus *Cyclophyllum* erected by STUCKENBERG (1895, 1904) have been included in the synonymy of this species. The conspecificity of these species has been established by the writer on the basis of STUCKENBERG's original material. Of the species and subspecies, described by PERNA (1923) only *Cyclophyllum mstensis* was illustrated. Of PERNA's specimens only one slide identified as *Cyclophyllum thomsoni* STUCKENBERG is preserved, the rest of the material is missing. The descriptions, as well as the drawings and slides of those two species correspond to the diagnosis of *A. fungites* and therefore they have been included in its synonymy. The rest of the species whose verification is impossible have not been taken into account.

Occurrence. — Great Britain, Upper Viséan, D_1 to Zone 4; U. S. S. R., Viséan to Lower Namurian; North Africa, Viséan; Turkey, Upper Viséan; France and Belgium, Upper Viséan; Poland (the Sudetes and Holy Cross Mts.), Upper Viséan, D_2.

Genus **SLIMONIPHYLLUM** KATO & MITCHELL, 1961

(Type species: *Rhodophyllum slimonianum* THOMSON, 1874)

1961. *Slimoniphyllum*; M. KATO & M. MITCHELL, *Slimoniphyllum...*, p. 280 (*cum synon.*).

Species assigned: *Slimoniphyllum slimonianum* (THOMSON), *S. quadrifossulum* n. sp.
Stratigraphic and geographic range: Upper Viséan; Europe.

Diagnosis. — See KATO & MITCHELL, 1961, p. 281.

Slimoniphyllum slimonianum (THOMSON, 1874)

(Text-fig. 6$A_{1\text{-}10}$; Pl. I, Fig. 9; Pl. XIII, Figs. 12*a*, *b*)

1874. *Rhodophyllum slimonianum* THOMSON; J. THOMSON, Descriptions..., p. 558, Pl. 20, Fig. 2.
1961. *Slimoniphyllum slimonianum* (THOMSON); M. KATO & M. MITCHELL, *Slimoniphyllum...*, p. 281, Pls. 35, 36 (*cum synon.*).

Material. — Two solitary corals without proximal ends, one with internal structure damaged in the course of fossilization and having calice, the other excellently preserved, without calice.

Dimensions (in mm): Specimen Z. Pal. P. Tc-4/3166, with septal index of successive sections: 30:23, 40:40, 42:41.

Diagnosis. — A *Slimoniphyllum* with a well developed axial structure, fossulae only near cardinal septum and counter septum; major septa in tabularium dilated and usually vesicular.

Remarks. — Ontogeny, examined from a diameter of 6 × 7 mm and with 20 septa, displays certain differences, as compared with British specimens, primarily in columella which is stronger and longer and which, in the Polish specimen, disappears completely only at a diameter of about 24 mm and with 28 × 2 septa. Columella and few (2-3 on each side) lamellae form a loose axial structure separated, during most part of ontogeny, by a stereoplasmatic wall. This structure does not occur in British specimens which have a more or less strongly developed wall separating the axial part of the corallite. The shortening, in the younger part of the neanic stage, of only cardinal septum and counter septum, as well as the arrangement of septa are identical in the Polish and British specimens. The early-ephebic stage in Polish specimens differs from that of British ones in more swollen major and longer minor septa, but is similar to it in identically regular dissepiments and complex axial structure which is already devoid of columella. The ephebic stage is very similar, both morphologically and in its measurable characters to the specimens with a well-developed axial structure which were illustrated by KATO & MITCHELL (1961, Pls. 35 and 36 and Text-fig. 9). Dissepimentarium more regular in Polish specimens and their almost complete lack of vesicular septa are the main differences.

Occurrence. — Great Britain, D_2 to subzone P_2 and Coral Zone 3, Upper Viséan; Poland (the Sudetes), Upper Viséan, D_2.

Slimoniphyllum quadrifossulum n. sp.

(Text-figs. 7$A_{1,2}$; Pl. I, Figs. 8*a*, *b*)

Holotype: Specimen IG. OS-70/2462.
Type horizon: Upper Viséan, D_2 (top).
Type locality: Holy Cross Mountains, Gałęzice.
Derivation of the name: *quadrifossulum* — having four fossulae.

Material. — A fragmentary corallite without proximal part and calice.

Diagnosis. — A *Slimoniphyllum* 30 mm in diameter and with 41 × 2 septa; counterfossula less prominent than cardinal fossula and alar fossulae; major septa strongly dilated

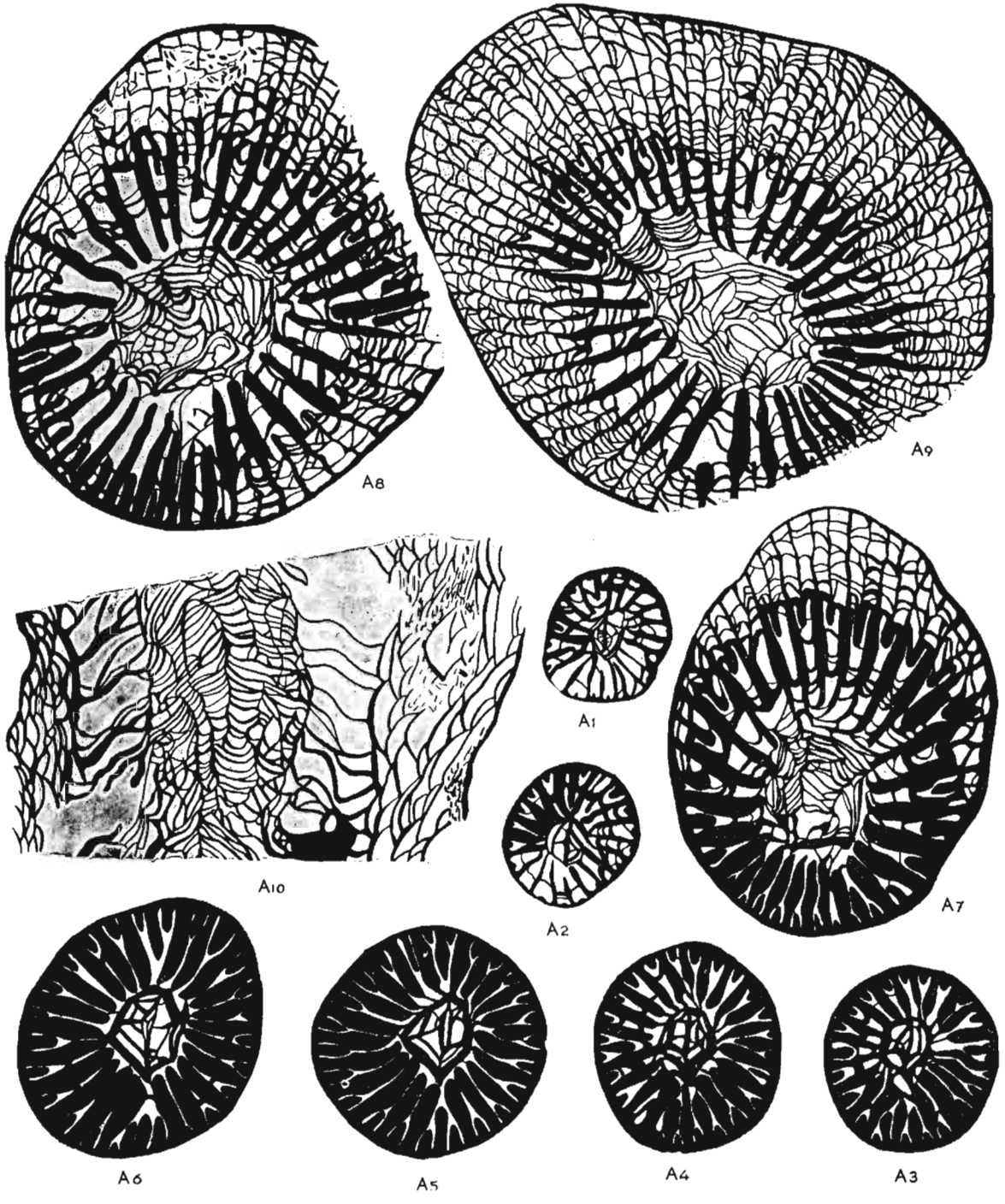

Fig. 6

Slimoniphyllum slimonianum (THOMSON): A_{1-6} transverse sections of the neanic stage, × 3; A_{7-8} transverse sections of the early-ephebic stage, × 2; A_9 transverse section of the ephebic stage, × 2; A_{10} longitudinal section, × 2 (Z. Pal. P. Tc-4/3166). Czerwieńczyce, Sudetes, Upper Viséan, D_2.

in dissepimentarium, non-vesicular and rhomboidally arranged; weak, mostly tabellar, axial structure.

Description. — *Transverse section* (Text-fig. 7A_1; Pl. I, Fig. 8*a*): Cardinal fossula very deeply penetrating dissepimentarium. Cardinal septum slightly thinner than two major septa adjoining it in fossula and shorter than the width of dissepimentarium. Alar septa normally developed, the last septa in counter quadrants shortened and contained in alar fossulae. Counter septum very slightly shortened, counter fossula underdeveloped. Major septa rhomboidally arranged, apices of the rhomb marking the fossulae. Major septa, in addition to those mentio-

Fig. 7
Slimoniphyllum quadrifossulum n. sp.: A_1 transverse section, × 2; A_2 longitudinal section, holotype × 2 (IG. OS-70/2462). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

ned above, shortened, are of equal length, rollerlike, very thick in tabularium and thin in dissepimentarium. Septal lamellae very thin, connected with septa, interlaced and mixed with flat axial tabellae, forming together a very loose and simple axial structure devoid of columella. Minor septa thinner in dissepimentarium than major septa. They enter tabularium where their ends become thicker. Dissepimentarium fairly wide, dissepiments rectangular and convex with their convexity turned to the periphery.

Longitudinal section (Text-fig. 7A_2; Pl. I, Fig. 8*b*): Tabularium wide, loose. Tabulae long, irregular, flat, slightly convex or concave and, only near the sections of septal lamellae, elevated. Axial part of tabularium does not differ from peripheral part. Axial structure non developed.

Remarks. — Since the characters of the single specimen here described, markedly deviate from the diagnosis of the only species known so far, i.e. *S. slimonianum*, it has been given a new specific name. These characters are: 1) axial structure poorly developed in transverse section and lacking in longitudinal section; 2) uncommonly strong swelling of major septa in tabularium; 3) lack of septa of the vesicular type; 4) excellent development of cardinal fossula and alar fossulae but relatively poor of counter fossula, 5) considerably greater number of septa with a given diameter of the corallite.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **ZAKOWIA** n. gen.

(Type species: *Zakowia sanctaecrucensis* n. sp.)

Species assigned: *Zakowia sanctaecrucensis* n. sp., *Z. parva* n. sp. and *Zakowia* sp.
Stratigraphic and geographic range: Poland (Holy Cross Mountains); Upper Viséan, D_2 (top).
Derivation of the name: *Zakowia* — named in honour of Dr. HALINA ŻAKOWA (Geological Institute, Kielce Branch, Poland).

Diagnosis. — Solitary corals with a strongly developed dissepimentarium, septa continuous, major and minor; cardinal septum usually shortened; cardinal fossula open, may be inconspicuous; axial structure formed only by septal lamellae and few axial tabellae; the role of columella is played by an elongated cardinal septum or by its lamella which does not exceed the middle of the axial structure, this lamella may be inconspicuous; tabellae raised in a domelike manner, forming, together with sections of lamellae, an irregular, not separated axial structure.

Remarks. — *Berkhia* GORSKY, 1951, which, in its ephebic stage, has an axial structure consisting of lamellae and tabellae only, is the nearest morphologically to the genus *Zakowia*. *Zakowia* sp., in which the lamella of the cardinal septum cannot be distinguished at all, is most similar to this genus. The rest of the species of the genus *Zakowia* differ from *Berkhia* in the conspicuousness of this lamella, at least in some of the sections, and primarily in different earlier ontogenetic stages. The development of *Zakowia* is very specific (cf. description of *Z. sanctaecrucensis* n. sp.), whereas in *Berkhia* GORSKY, 1951 the late-neanic stage is rather similar to the corresponding stage of the subfamily Clisiophyllinae.

Zakowia also displays a certain similarity to the genus *Nervophyllum* VASSILJUK, 1959, in particular to *N. superius* n. sp. This genus has a columella which may disappear and which is also related to cardinal septum. This is, however, a typical columella which pierces the entire axial structure. Younger ontogenetic stages in *Nervophyllum* are clisiophylloid and different than those in *Zakowia*. In the ontogeny of *Zakowia*, a certain similarity is observed to that of *Aulophyllum* (SMITH, 1913, Pl. 5, Figs. 1-3), in which cardinal septum is also predominant and counter septum as if fused to it only. In *Zakowia*, in contradistinction to *Aulophyllum*, the axial structure remains loose, irregular, with many lamellae connected with septa and, seen in longitudinal section, not individualized. The most similar to the axial structure of *Aulophyllum* is that of *Zakowia* sp. On the basis of the similarity in ontogeny mentioned above, as well as its axial structure devoid of columella in ephebic stage, *Zakowia* n. gen. has been assigned by the present writer to the subfamily Aulophyllinae. The possibility cannot be, however, precluded that a study of a full ontogeny of this genus will make up a basis for raising it to the rank of family.

Zakowia sanctaecrucensis n. sp.

(Text-fig. 8$A_{1,2}$,$B_{1,2}$; Pl. II, Fig. 1; Pl. XIII, Figs. 4*a*, *b*, 5*a*, *b*)

Holotype: Specimen I. G. OS-70/366 (Pl. II, Fig. 1; Pl. XIII, Fig. 5*a*).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *sanctaecrucensis* — after Holy Cross Mountains.

Material. — Five solitary corals, one of them with calice and two with partly preserved proximal ends.

Dimensions (in mm):

IG. OS-70/	Index of septa n/d
52	47 : 18×18
366	53 : 26×23
2716	46 : 21×21

Diagnosis. — A *Zakowia* which, with a diameter of 23×26 mm, has 53×2 septa; cardinal fossula conspicuous, cardinal septum shortened; axial structure wide, few septal lamellae frequently connected with septa; lamella of cardinal septum entering cardinal fossula.

Description. — *Transverse section* (Text-fig. 8 A_2,B_1; Pl. II, Fig. 1; Pl. XIII, Figs. 4*b*, 5*a*): Major septa continuous, thickened in a rollerlike manner in tabularium and somewhat more strongly in cardinal quadrants. Cardinal septum shortened and thinner than neighbouring major septa. Cardinal fossula open, slightly merged in dissepimentarium. Minor septa thin, its length being correlated to the width of dissepimentarium. In a narrow dissepimentarium

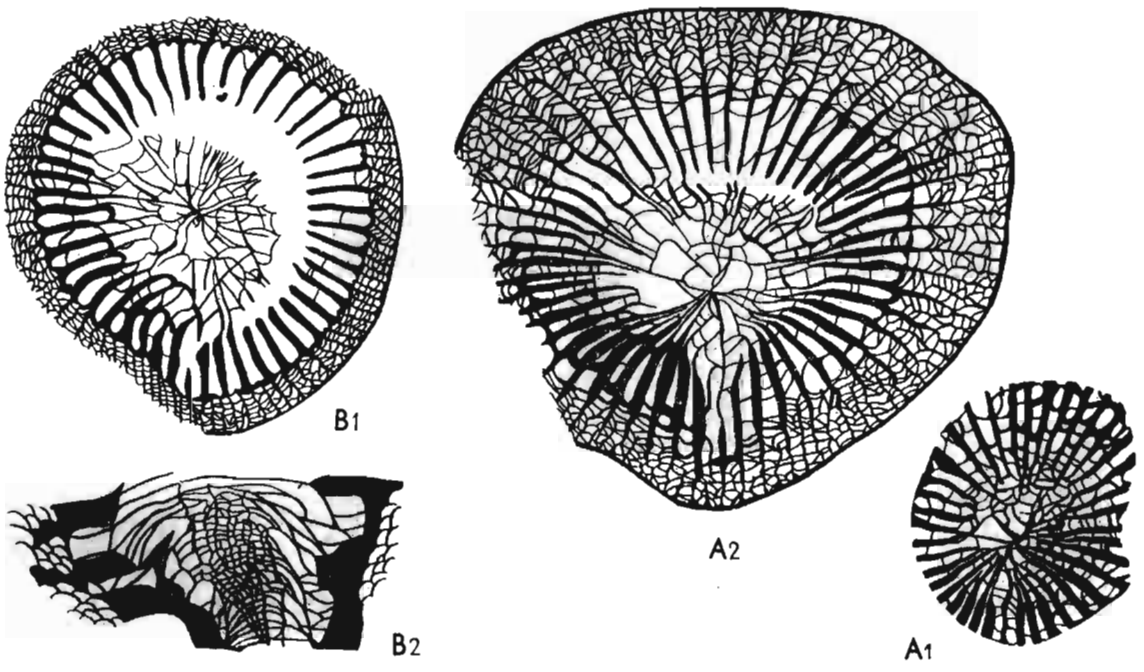

Fig. 8

Zakowia sanctaecrucensis n. sp.: A_1 transverse section of the neanic stage, × 3; A_2 transverse section of the ephebic stage, holotype, × 3 (IG. OS-70/366); B_1 transverse section at the base of calice, × 3; B_2 longitudinal section, × 3 (IG. OS-70/52). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

they reach an inner wall, in a wider their length equals 1/2 to 3/4 of its width. Axial structure consisting of thin, twisted lamellae varying in length and arranged radially. Only few of them reach the middle of the corallite, the rest — also arranged centripetally — are shortened. Sometimes lamellae of neighbouring septa are situated near and parallel to each other which gives

the impression of a longitudinal elevation. Lamella of cardinal septum, particularly strongly developed in the holotype, enters cardinal fossula. Few tabellae of axial structure do not affect its construction. The width of dissepimentarium reaches slightly more than 1/4 of the diameter of the corallite (holotype), in paratypes being even smaller. Dissepiments of the herringbone and pseudo-herringbone type are predominant, rectangular dissepiments few (e.g. in holotype). In some cases, e.g., in paratype IG. OS-70/52, rectangular dissepiments are predominant.

Longitudinal section (Text-fig. 8B_2; Pl. XIII, Fig. 4*a*): Dissepiments small and convex, the internal series slightly thickened. Tabularium wide. Peripheral tabellae flat, horizontal or slightly raised to the axis. Axial tabellae more vesicular, elevated in a domelike manner, the most densely distributed in the axial part. Neither columella nor axial rod are observed, instead there occur sections of septal lamellae which, however, do not affect to any considerable extent the arrangement and shape of tabellae. Radial and basal elements of the axial part of the corallite (as stated above) are connected with each other rather slightly in contrast to a decisive majority of the representatives of the family Aulophyllidae.

Ontogeny. — The youngest stage, in whose section the writer succeeded, was 11 × 13 mm in diameter and had 40 major septa. This is a late neanic stage. Judging by the fragmentary epitheca preserved, minor septa and dissepimentarium are not yet developed. Major septa considerably varying in length, the thickest on the periphery and becoming gradually thinner and thinner towards the inside of the corallite. Some septa, including cardinal septum, are distinguished by their length. They join each other axially. Septal lamellae not yet separated. It is difficult to state which of the septa of counter quadrants is a counter septum. Concluding by the number of septa on each side of the cardinal septum, it may be assumed that it is already in this stage that the counter septum is not elongated towards the axis of the corallite and does not join the cardinal septum. The unequality of the development of particular quadrants cannot be, however, precluded and one of the septa reaching the axis of corallite may actually be a counter septum.

Remarks. — The ontogenetic stage described above essentially differs from respective stages of the subfamily Clisiophyllinae corresponding to it ontogenetically. A certain, although slight similarity, to the development of *Aulophyllum fungites*, mentioned above, may be found. Similarities and differences which occur between the type and the remaining species are given below with the descriptions of these species.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Zakowia parva n. sp.

(Text-fig. 9*A-C*; Pl. I, Figs. 6, 7; Pl. XIII, Figs. 1-3)

Holotype: Specimen IG. OS-70/3125 (Pl. I, Fig. 7; Pl. XIII, Fig. 2).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: *parva* — Lat. *parvus* = small; after a narrow axial structure.

Material. — Five fragmentary, solitary corals without calices and proximal ends. Dimensions (in mm):

IG. OS-70/	Index of septa n/d
2713	44 : 20×18
3125	47 : 24 : 19
3140	44 : 18×16

Diagnosis. — A *Zakowia* which, with a diameter of about 20 mm, has 44×2 to 47×2 septa; axial structure narrow, most septal lamellae reaching the axis of corallite, occurring abundantly and connected with septa; cardinal fossula strongly developed, cardinal septum shortened; lateral cystose dissepiments may also occur.

Description. — *Transverse section* (Text-figs. 9*A*-C_1; Pl. I, Fig. 7; Pl. XIII, Figs. 1-3): Major septa continuous, in tabularium thickened in a rollerlike manner, straight. Cardinal septum and, mostly, one pair of adjoining major septa are shortened. Cardinal fossula open, merged in dissepimentarium slightly or not at all. Counter septum and alar septa not distinguished, the remaining major septa varying in length. Minor septa thin, shortened, penetrating only about a half of the width of dissepimentarium. Axial structure composed of septal lamellae which sometimes are thickened and frequently connected with septa. Most of them reach the axis of corallite. Lamella of cardinal septum may slightly enter cardinal fossula, but is short and indistinguishable from the remaining septal lamellae. Axial tabellae do not take part in the construction of axial structure. They are more clearly visible only in an oblique section (holotype). Dissepimentarium of the following two types: 1) strongly developed lateral cystose and pseudo-herringbone dissepiments (holotype), and 2) without lateral cystose dissepiments, but above minor septa there are herringbone, and between minor and major septa pseudo-herringbone and rectangular dissepiments (paratypes).

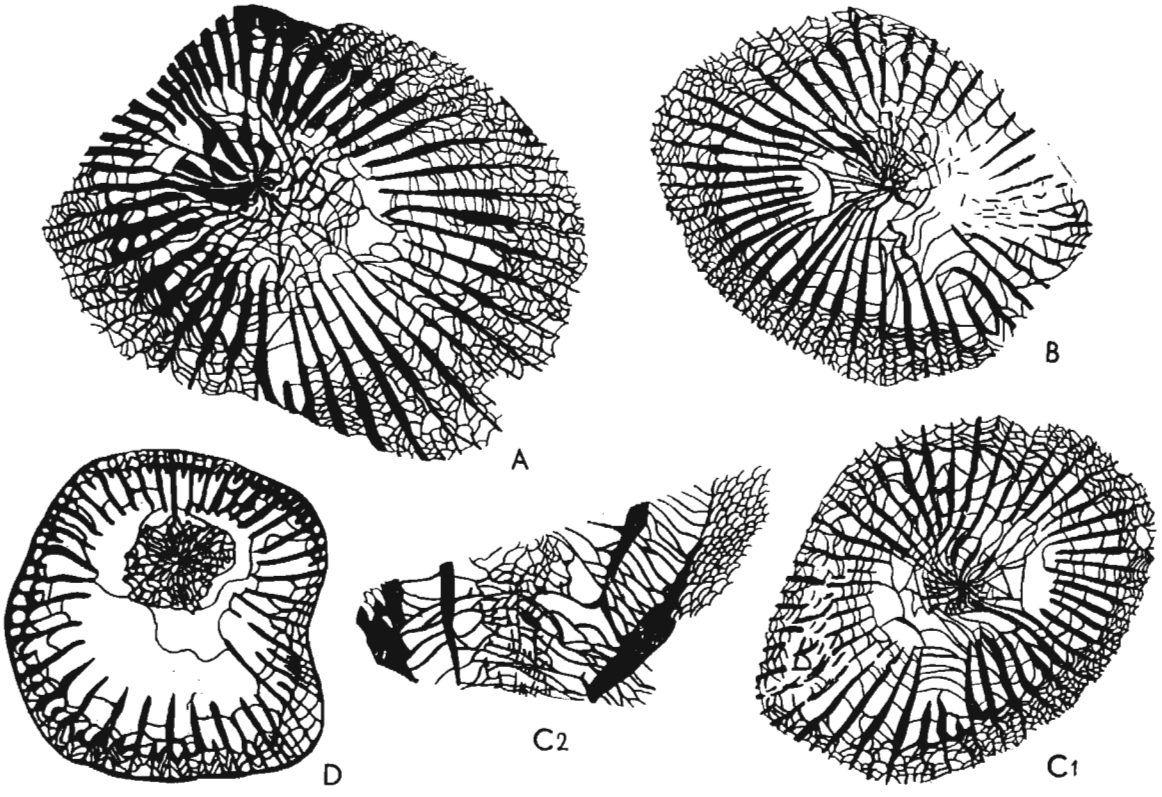

Fig. 9

Zakowia parva n. sp.: *A* transverse section of the ephebic stage, holotype (IG. OS-70/3125); *B* transverse section of the ephebic stage (IG. OS-70/2713); C_1 transverse section of the ephebic stage, C_2 longitudinal section (IG. OS-70/3140); *D Zakowia* sp.: transverse section near the base of calice (IG. OS-70/448). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 3.

Longitudinal section (Text-fig. 9 C_2, Pl. I, Fig. 6): Dissepiments small, more or less uniform, arranged almost vertically, their inner row thickened. Tabularium wide, composed of tabulae raised in a domelike manner and to a more or less equal extent over the entire width. In the peripheral part tabellae inosculating. In the axial part, sections of septal lamellae are mounted on tabulae and tabellae. Their effect on the structure of tabellae is, in this part of corallite, only very slight, but, condensing it, they form a sort of an axial structure of the type which is similar to that in *Bothrophyllum*.

Remarks. — The species here described differs from the type species primarily in the composition of the axial structure and tabularium as seen in longitudinal section. Slightly smaller dimensions and number of septa are only secondary characters.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Zakowia sp.

(Text-fig. 9 *D*; Pl. XIII, Fig. 6)

Description. — A fragmentary specimen (IG. OS-70/448) of which only the ephebic stage and calice are preserved. Near the edge of calice the diameter amounts to 25 mm, below calice — to 16 mm, number of septa 40 × 2. Major septa continuous, in tabularium thickened in a rollerlike manner, minor septa extending across the dissepimental zone and up into the tabularium with thickened ends. Cardinal fossula and cardinal septum inconspicuous. Dissepimentarium narrow, dissepiments of the pseudo-herringbone type and — when only one verticil occurs — rectangular. Axial structure without traces of columella and composed of twisted, centripetally arranged septal lamellae and few axial tabellae. Axial region free of septa and wide, axial structure situated excentrically. No longitudinal section has been made.

Remarks. — The specimen described differs from the type species in the excentric situation of the axial structure, its multilamellar compact composition, considerably shorter major septa having a wide, free axial region and a very narrow dissepimentarium. *Zakowia* sp. displays a certain similarity to *Aulophyllum* M.-EDW. & HAIME, 1850, in particular to *Berkhia* GORSKY, 1951. This mostly concerns its axial structure. Since only one specimen is available, it is impossible to make a comparison and determine exactly its generic assignment.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Subfamily CLISIOPHYLLINAE NICHOLSON & THOMSON, 1883

Genera assigned: *Clisiophyllum* M'COY, 1849, *Dibunophyllum* THOMSON & NICHOLSON, 1876, *Koninckophyllum* THOMSON & NICHOLSON, 1876, *Arachnolasma* GRABAU, 1922, *Corwenia* SMITH & RYDER, 1926, *Symplectophyllum* HILL, 1934, *Carniaphyllum* HERITSCH, 1936, *Neokoninckophyllum* FOMITSHEV, 1939, *Amandophyllum* HERITSCH, 1941, *Sestrophyllum* FOMITSHEV, 1953, *Nervophyllum* VASSILJUK, 1959, *Biphyllum* n. gen., *Koninckinaotum* n. gen., *Mira* n. gen.

Stratigraphic and geographic range: Lower Carboniferous to Lower Permian; Eurasia, North Africa, North America, Australia.

Diagnosis. — Aulophyllidae which during ontogeny pass through the koninckophylloid and dibunophylloid stages; columella and axial structure may completely disappear in the ephebic stage.

Remarks. — Most authors consider this subfamily to be a synonym of the subfamily Aulophyllinae. After his studies on the ontogeny of many genera, assigned in the present work to both these subfamilies, the writer found considerable differences occurring between them. The manner of setting up the axial structure is different in these subfamilies. All genera of the subfamily Clisiophyllinae, examined by the writer, have in the neanic stage a strong, frequently thickened columella, connected with cardinal and counter septa. With growth, a few lamellae or axial ends of septa also appear. These lamellae may join columella but they do not enter its structure as is the case in the family Amygdalophyllidae GRABAU in CHI, 1935. A further development takes place variously and depending on the genus. The ontogenetic stages described above do not occur in the Aulophyllinae. Axial structure is separated very early. In *Aulophyllum*, the counter septum fuses with the cardinal septum only at the beginning of the development; later on, a sort of a cyatotheca is formed with septal lamellae inside of it. A similar cyatotheca is formed in *Auloclisia* and *Slimoniphyllum* in which, however, columella occurs in axial structure for a longer period. A specific development has been found by the writer in *Zakowia* n. gen. in which columella is hardly distinguishable. A young stage of the genus *Berkhia* GORSKY (1951, Pl. 18, Fig. 2*a*) with a sort of a thin columella is most closely related to the Clisiophyllinae. Columella and axial structure may completely disappear in the Clisiophyllinae in which caninioid stages then occur. In some cases, only columella may disappear and a new structure which then is formed as, for instance, in *Dibunophyllum bipartitum craigianum* (THOMSON) and *Nervophyllum superius* n. sp., is very similar to the axial structure of the Aulophyllinae. The similarity of the youngest ontogenetic stages and a trend to the reduction of columella show how close is the relationship of both these subfamilies.

Genus **CLISIOPHYLLUM** M'COY, 1849

(Type species: *Clisiophyllum keyserlingi* M'COY, 1849)

Synonyms:
Clisaxophyllum GRABAU in YÜ, 1933,
Carcinophyllum THOMSON & NICHOLSON, 1876 sensu GORSKY, 1932,
Auloclisia LEWIS, 1927 sensu YÜ, 1933, partim,
Auloclisia LEWIS, 1927 sensu CHI, 1935,
Auloclisia LEWIS, 1927 sensu GORSKY, 1938,
Carcinophyllum THOMSON & NICHOLSON, 1876 sensu ILINA, 1939,
Auloclisia LEWIS, 1927 sensu MINATO, 1942,
Diebunophyllum THOMSON & NICHOLSON, 1876 sensu SAKAGUCHI & YAMAGIWA, 1958,
Noclisiophyllum WU, 1964,
non *Clisiophyllum* M'COY, 1849 sensu TRAUTSCHOLD, 1874 (which is probably *Cyathoclisia*),
non *Clisiophyllum* M'COY, 1849 sensu STUCKENBERG 1895 (*C. coniseptum*, *C. squamosum*, *C. gracile* and *C. krasnopolski* are probably *Cyathoclisia*; *C. cinctum*, *C. uralense* are missing),
non *Clisiophyllum* M'COY, 1849 sensu DELÉPINE, 1930 (which is probably *Cyathoclisia*),
non *Clisiophyllum* M'COY, 1849 sensu HERITSCH, 1936 (which is *Amandophyllum* HERITSCH, 1941),
non *Clisiophyllum* M'COY, 1849 sensu VOLKOVA, 1941 (which is probably *Cyathoclisia*),
non *Clisiophyllum*(?) M'COY, 1849 sensu LANGENHEIM & TISCHLER, 1960 (probably *Spirophyllum* n. gen.),
non *Clisiophyllum* M'COY, 1849 sensu KANMERA, 1961 (dendroid form).

Species assigned: *Clisiophyllum keyserlingi* M'COY, 1849, *C. omaliusi* HAIME, 1855, ?*C. tumulus* SALTER, 1855, *C. kayseri* FRECH, 1885, *C. eichwaldi* STUCKENBERG, 1904, *C. curkeense* VAUGHAN, 1905, *C. ingletonense* VAUGHAN, 1911, *C. multiseptatum* GARWOOD, 1913, *C. dublinense* SMYTH, 1915, *C. nodai* YABE & HAYASAKA, 1920, *C. multilamellatum* PERNA, 1923, *C. ofukensis* OZAWA, 1925, *Clisiophyllum* sp. PARKINSON, 1926 (= *C. parkinsoni* n. sp.), *C. delicatum* SMYTH 1926, *C. yengtzeense* YOH, 1929, *C. rigidum* LEWIS, 1930, *C. nemistioides* LEWIS, 1930, *Clisiophyllum* sp. LEWIS, 1930

(= *C. vacuum* n. sp.), *C. wangi* YÜ, 1933, *Clisaxophyllum triangulatum* YÜ, 1933, *C. grossinum* YÜ, 1933, *Auloclisia multiplexum* YÜ, 1933, *A. densum* YÜ, 1933, *A. circulare* YÜ, 1933, *A. tentatum* YÜ, 1933, *Clisiophyllum parvulum* VOJNOVSKY-KRIEGER, 1934, *C. intortum* VOJNOVSKY-KRIEGER, 1934, *C. hunanense* YÜ, 1937, *Auloclisia petrenkoi* GORSKY, 1938, *A. pauciseptatum* GORSKY, 1938, *Neoclisiophyllum xianxiangense* WU, 1964, *N. minor* WU, 1964, *?Auloclisia chaoi* WU, 1964, *Clisiophyllum crassiseptatum* WU, 1964, *C. laxum* WU, 1964, *C. simplex* WU, 1964, *C. (?)cyathoclisiaeforme* BIKOVA, 1966, *Clisaxophyllum simonovi* BIKOVA, 1966, *Dibunophyllum omorii* SAKAGUCHI & YAMAGIWA, 1958, *Clisiophyllum neaversoni* n. sp., *C. monoseptatum* n. sp.

Some of these species are probably synonyms, but this cannot be ascertained without a revision of the original material.

Stratigraphic and geographic range: Lower Carboniferous to Lower Namurian, ?Lower Permian; Eurasia, North Africa, ?North America.

Revised diagnosis. — Solitary corals; cardinal septum usually shortened; cardinal fossula open, with parallel walls; in transverse section axial structure variously individualized, sometimes up to the occurrence of a stereoplasmatic wall; columella short; lamellae arranged radially or twisted spirally; in longitudinal section axial structure markedly individualized; axial tabellae arranged in a domelike or tentlike manner.

Remarks. — The genus *Clisiophyllum* belongs to the most common and frequently described Carboniferous tetracorals. It was most accurately analysed by SALÉE (1913) and HILL (1938-1941). Like closely related genera *Dibunophyllum*, *Arachnolasma* and *Koninckophyllum*, this genus is very variable, difficult to determine univocally and consequently, differently interpreted. Particularly important are the following two trends in interpreting it: 1) a broad concept in which the species of the type of both *C. keyserlingi* and, e.g. *C. multiplexum* are covered by the common generic name and 2) a narrow concept, i.e. a division into two genera or at least subgenera. This duality was initiated by GRABAU (1927, MS) who introduced the name of *Clisaxophyllum*. This name, together with an extensive justification, was published by YÜ (1933). The invalidity of this name has recently been proved by WU (1964) and KATO (1966) who, however, are followers of the narrow concept of this genus. The name of *Clisaxophyllum* is replaced by WU (*op. cit.*) by *Neoclisiophyllum*, which is assumed by KATO (*op. cit.*) as a subgeneric name. *C. yengtzeense* YOH, 1929 is considered to be a type species of this genus (or subgenus).

Certain forms, e.g. *C. multiplexum* or *C. delicatum crassiformae* and in particular the specimens of this subspecies available to the writer considerably differ from the type species of the genus *Clisiophyllum*, i.e. *C. keyserlingi*. In their individualized axial structure, which may be even separated by a stereoplasmatic wall, they have very many radially arranged lamellae. Likewise, in longitudinal section, their axial structure is very well individualized and the arrangement of tabellae is different than that in *C. keyserlingi*; that is, they are arranged much more densely and steeply. The species (and subspecies) with so different characters are, however, related by several transitional forms with typically developed species of *Clisiophyllum* and even *Dibunophyllum*. Such an array was observed by the writer in his collection consisting of about 100 specimens of the *Neoclisiophyllum* type. Since no assemblages of features could be found characteristic only of a given group of corallites and not occurring in others, the writer assigned these specimens to the common species *C. delicatum* SMYTH. The series of subspecies referred to above, have not whorled lamellae („nucleate *Clisiophylla*") and a considerable reduction of their lamellae makes them similar to *Dibunophyllum* rather than to *C. keyserlingi*. In the writer's collection, there are, however, certain species which may fill this gap. These are: *C. monoseptatum* n. sp. and *C. vacuum* n. sp. which may be placed on the boundary between „nucleate *Clisiophylla*" (VAUGHAN'S terminology, 1911) and *C. keyserlingi*. A species *C. yengtzeense* YOH, considered by WU as typical of the genus *Neoclisiophyllum*, should, in

the writer's opinion, be assigned to this same group of species with transitional characters. The differences between this species and *C. keyserlingi* are, as compared with characters in common, very slight and of not higher than specific rank. As mentioned above, in the group of genera including *Clisiophyllum* the individual variability and at the same time, the taxonomic differentiation, are great. There are many species on the boundary of different genera and the assignment of such species is of necessity subjective. Perhaps, if another type species, differing from *C. keyserlingi* to a sufficiently great extent was chosen for *Neoclisiophyllum*, this genus might be accepted. It is, however, the writer's view that the introduction of a new taxon, even as a subgenus is neither necessary nor appropriate. Species which could be assigned to it are incomparably less numerous than those, which would be unclassifiable as corresponding to a possible diagnosis of both *Neoclisiophyllum* (even in its modified form) and *Clisiophyllum*. The existence of "nucleate *Clisiophylla*" may be indicative of definite development trends occurring among *Clisiophylla*. These trends are not, however, crystallized to such an extent as to enable the assignment of "nucleate *Clisiophylla*" to a higher taxonomic rank.

The descriptions species contain only those data which are not given in Table 2.

Clisiophyllum keyserlingi M'Coy, 1849

(Text-figs. 10*A*, *B*; Pl. XIII, Figs. 10*a*, *b*, 11)

1849. *Clisiophyllum keyserlingi* M'Coy; F. M'Coy, On some..., p. 2.
1851. *C. keyserlingi* M'Coy; F. M'Coy, A Synopsis..., p. 94, Pl. 3*C*, Figs. 4, 4*a*.
1872. *C. keyserlingi* M'Coy; L. de Koninck, Nouvelles recherches..., p. 41, Pl. 3, Fig. 3.
1937. *C. keyserlingi* M'Coy; C. C. Yü, The Fenginian..., Pl. 4, Fig. 3*a-g* (Fig. only).
1938-1941. *C. keyserlingi* M'Coy; D. Hill, A monograph..., p. 60, Pl. 1, Figs. 1-14 (*cum synon.*).
1957. *C.* aff. *m'coyanum* Thomson; M. Minato & M. Kato, Two Carboniferous..., p. 139, Text-fig. *A*.
1957. *C. keyserlingi* M'Coy; V. Kostic-Podgorska, Koralska fauna..., p. 56, Pl. 2, Figs. 1-6; Pl. 3, Figs. 1-3.
1958. *C. keyserlingi* M'Coy; V. Kostic-Podgorska, Fauna..., p. 40, Pl. 20, Figs. 1-6; Pl. 21, Figs. 1-3.
1958. *C. keyserlingi* M'Coy; C. Ünsalaner-Kiragli, Lower Carboniferous..., p. 56, Pl. 11, Fig. 4*a*, *b*.
non 1964. *C. keyserlingi* M'Coy; N. P. Vassiljuk, Korally zon..., p. 78, Pl. 5, Fig. 1.

Material. — More than 20 incomplete, mostly damaged solitary corallites without calices and proximal ends. Those from the Sudetes were crushed during fossilization.

Revised diagnosis. — A *Clisiophyllum* about 30 mm in diameter and with 56×2 septa. Axial structure loose, regular, occupying about a half of the diameter of the corallite; lamellae whorled around a short columella and on the whole free; axial tabellae domelike.

Remarks. — This species was revised in detail by Hill (1938-1941) on the basis of original British specimens. Its range, by this author, seems to be somewhat too extensive and some of the specimens (e.g., *l.c.*, Pl. 1, Figs. 8, 13) exceed it. However, the individual variability of this species is in fact very extensive. There are some species as, for instance, *C. crassiseptatum* Wu or *C. keyserlingi* sensu Vassiljuk (non M'Coy) which have certain characters in common with *C. keyserlingi* M'Coy but their axial structure is composed of axial ends of septa and not of separated septal lamellae. In the present writer's opinion, the separation of septal lamellae is a result of essential morphological changes in the corallite and therefore this character is sufficiently important to be a basis for separating species. For this reason, neither the species and subspecies described by Wu (1964) nor Vassiljuk's (1964) specimens described as *C. keyserlingi* have been included in the synonymy.

TABLE 2

Morphologically-comparative table of *Clisiophyllum* M'Coy

Species	Cardinal septum	Cardinal fossula	Length of minor septa	n/d	ds/dc	dd/dc	Number of septal lamellae	Separation of axial structure	Axial part of septa	Axial lamellae	Remarks
Clisiophyllum keyserlingi M'Coy	short, thin	present	long	56 : 30	1/2	to 1/3	half the number of major septa	only in longitudinal section	septal lamellae	twisted	
C. parkinsoni n. sp.	short, thin	present	long	42 : 25	1/2	>1/4	few	in both sections	septa continuous	twisted	
C. delicatum Smyth (sensu lato)	slightly shortened	present or absent	long or slightly shortened	23 : 5 to 50 : 25	1/4 to 1/6	1/3 to 1/2	few or numerous	in both sections	septal lamellae	radial	„nucleate *Clisiophylla*"
C. neaversoni n. sp.	short, thin	present	short	60 : 35	1/3	>1/3	8-10 of both sides	only in longitudinal section	septa continuous, rarely lamellae	twisted	
C. vacuum n. sp.	short, thin	present	discontinuous	41 : 26	>1/3	<1/3	numerous	non separated	septal lamellae	twisted	
C. monoseptatum n. sp.	slightly shortened, thin	present	short, partly reduced	43 : 24	1/4	1/2	9-12 of both sides	non separated	septal lamellae	twisted	
Clisiophyllum sp.	short. thin	present	long	38 : 15	1/4	1/4	numerous	stereoplasmatic separation	septal lamellae	radial	

Polish specimens more or less correspond in their measurable characters to the holotype, but also display the following morphological differences: 1) columella may be long, thin and S-shaped; 2) lamellae thin and, as in the holotype, spirally arranged, may be, however, much more frequently connected with septa; 3) major septa much more thickened, minor septa longer

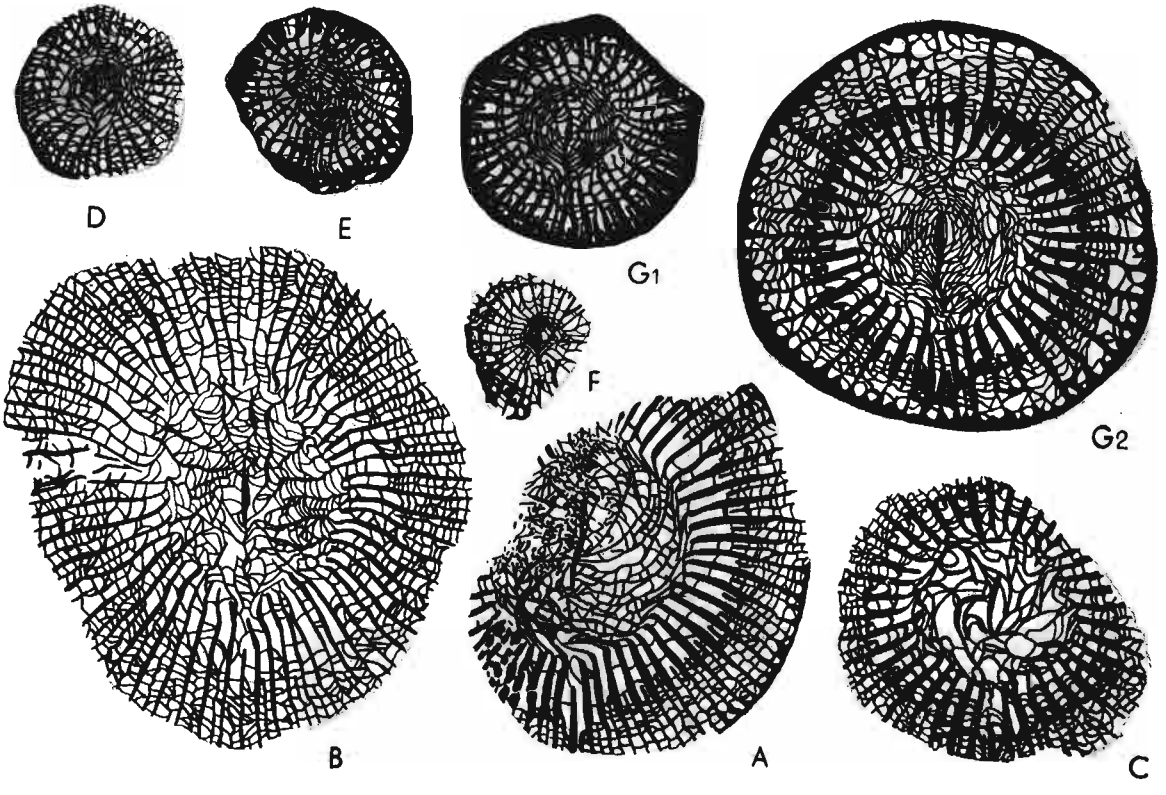

Fig. 10

A, B Clisiophyllum keyserlingi M'Coy: *A* transverse section of the ephebic stage (Z. Pal. P. Tc-4/273), Sokolec, Sudetes, Upper Viséan, D_2; *B* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2662). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

C Clisiophyllum parkinsoni n. sp.: transverse section of the ephebic stage, holotype (IG. OS-70/582), the same locality and horizon.

D-G Clisiophyllum vacuum n. sp.: *D* transverse section of the juvenile corallite (IG. OS-70/3361); *E* as above (IG. OS-70/3360); *F* as above (IG. OS-70/3366); G_1 holotype, transverse section of the neanic stage, G_2 transverse section of the ephebic stage (IG. OS-70/3356). The same locality and horizon.

All × 2

and dissepimentarium wider than those in the holotype; 4) in a few specimens, minor septa do not penetrate tabularium.

Occurrence. — Great Britain, bottom of Zone 2 (D_2) probably to Zone 4 (E_2), according to Hill (1938-1941); Yugoslavia, Viséan; Turkey, Viséan; Japan (Onimaru series or Nagaiwa series), Viséan; Poland (Sudetes, Holy Cross Mts.), Upper Viséan, D_2.

Clisiophyllum parkinsoni n. sp.

(Text-fig. 10*C*; Pl. II, Figs. 2, 3)

1926. *Clisiophyllum* sp. *Rhodophyllum* type PARKINSON; D. PARKINSON, The faunal..., p. 229, Pl. 13, Fig. 1*a-c*.

Holotype: Specimen IG. OS-70/582 (Pl. II, Fig. 2).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: *parkinsoni* — named in honour of Dr. D. PARKINSON.

Material. — Four fragmentary, solitary corals without calices and proximal ends. Dimensions (in mm):

IG. OS-70/	Index of septa n/d
582	42 : 23
1306	40 : 20
2147	38 : 20

Diagnosis. — A *Clisiophyllum* to 25 mm in diameter and with 42 × 2 septa. Axial structure loose, consisting of a few convolute septal lamellae and irregular tabellae, columella thin, short, dissepimentarium narrow, dissepiments rectangular.

Description. — *Transverse section* (Text-fig. 10*C*; Pl. II, Figs. 2, 3): Major septa thickened to the greatest extent within inner wall, in cardinal quadrants slightly more so that in counter quadrants. Axial ends of septa very thin, on the boundary of axial structure bent at a large, sometimes right angle. Some of them interlace each other. Axial structure consists on a thin, short, straight or bent columella and few spirally coiled and irregular septal lamellae which, overlapping equally few axial tabellae and interlacing with them, form an axial structure of the clisiophylloid type, which is very simplified and contains few structural elements. Cardinal fossula merged in dissepimentarium. Cardinal septum, in the lower part thickened in a wedgelike manner, may extend to form a thin, twisted lamella which reaches as far as axial structure. Minor septa thinner than major and reaching only the inner wall or slightly entering it. Dissepiments rectangular, convex, their convexity being turned to the periphery. Inner row, more thickened in cardinal quadrants, forms an inner wall.

Remarks. — The species described can be only partially included in the diagnosis of the genus given by HILL (1938-1941) who states that, among other features, the number of septal lamellae approximately corresponds to a half of this number of major septa. In the case of our species, this number is considerably smaller. Despite of this fact the axial structure is of the indubitably clisiophylloid type and markedly differs from those of both *Auloclisia* LEWIS, 1927 (the occurrence of columella) and *Dibunophyllum* THOMSON & NICHOLSON, 1876 (spirally coiled septa, short columella). Polish and British specimens have the same dimensions, number of septa, diameter of axial structure, width of dissepimentarium and length of major and minor septa. Polish specimens differ from British mostly in less numerous septal lamellae and a more clearly visible columella. Although PARKINSON (1926, p. 229) maintains that the British specimens are devoid of columella, the present writer is of the opinion that it may be discerned in both transverse and longitudinal sections given by PARKINSON (*l.c.*, Pl. 13, Figs. 1*a-c*).

Occurrence. — Great Britain, Lower Viséan, Zone S; Poland (Holy Cross Mts.), Upper Viséan, D_2 (top).

Clisiophyllum delicatum SMYTH, 1926

Subspecies assigned: *Clisiophyllum delicatum delicatum* SMYTH, 1926, *Carcinophyllum delicatum reticulatum* GORSKY, 1932, *Clisaxophyllum delicatum anastomosum* YÜ, 1933, *C. delicatum vesiculosum* (YÜ, 1933), *C. delicatum sapaltjubensae* VASSILJUK, 1960, *C. delicatum crassiformae* BIKOVA, 1966, *Clisiophyllum delicatum columnatum* n. subsp., *C. delicatum nanum* n. subsp.

Diagnosis. — A *Clisiophyllum* to 25 mm in diameter and with 52×2 septa. Axial structure of the „nucleate" type, clearly marked in both transverse and longitudinal sections.

Remarks. — All previously described subspecies, assigned in the present work to *C. delicatum* SMYTH, were considered independent taxonomic units. In the writer's opinion, they are so similar morphologically that their taxonomic rank should be lowered. Differences between particular subspecies are shown in Table 3. The descriptions of the species contain only those data which are not included in this table.

Clisiophyllum delicatum delicatum SMYTH, 1926

(Text-figs. 11*A-G*, 17; Pl. II, Figs. 4-8; Pl. XIII, Figs. 7-9)

1926. *Clisiophyllum delicatum* SMYTH; L. B. SMYTH, A contribution..., p. 150, Pl. 4, Fig. 5*a*, *b*.
1929. *C.* cf. *delicatum* SMYTH; E. NEAVERSON, Faunal horizons..., Pl. 4, Fig. 16 (Fig. only).
1930. *C.* cf. *delicatum* SMYTH; H. P. LEWIS, The Avonian..., p. 271, Pl. 21, Fig. 3*a*, b.

Material. — More than 20 solitary corals, some of them with calices and proximal ends. The range of variability of measurable characters is shown in Text-fig. 17.

Diagnosis. — A *Clisiophyllum delicatum* to 20 mm in diameter and with 41×2 septa. Axial structure consisting of a short columella and relatively few septal lamellae, minor septa reaching the inner verticil of dissepiments or shortened.

Description. — *Transverse section* (Text-figs. 11A_1,$B_{1,2}$,C_1,$D_{1,2}$,*E-G*; Pl. II, Figs. 4-8; Pl. XIII, Fig. 7): Major septa long, terminating near axial structure, minor septa thinner than major. Columella thin, frequently piercing the entire structure and extending towards cardinal septum. Septal lamellae thin, sometimes discontinuous, mostly not connected with columella. Dissepiments rectangular. Herringbone dissepiments occur in the places in which minor septa are shortened.

Longitudinal section (Text-figs. 11A_2, C_2, D_3; Pl. XIII, Figs. 8, 9): Dissepiments convex, arranged steeply. Inner row vertical, slightly thickened. Tabellae variously arranged and bent, halfway their length happen to be either convex or concave; usually, they are slightly raised towards the axial structure. Axial structure conspicuous. Columella thin, slightly wavy; axial tabellae steeply raised, finer and considerably more densely arranged than the tabellae in the marginal part of the corallite.

Individual variability. — Variability is observed: 1) in the length and thickness of columella which may be clearly thickened and penetrate the entire axial structure or be thin and wavy; 2) in the number of septal lamellae varying between 1/3 and 2/3 of the number of septa; 3) in the ratio of the width of axial structure to the diameter of the corallite; 4) in the length of minor septa which varies between about 1/2 to a full width of dissepimentarium; 5) in the length of major septa which may reach axial structure or be withdrawn from it for a relatively long distance. These changes are not correlated with each other, do not display any trend and, therefore, may be considered as a random individual variability only. Some specimens

TABLE 3

Morphologically-comparative table of *Clisiophyllum delicatum* SMYTH

Subspecies	Cardinal septum	Cardinal fossula	Length of major septa	Thickness of major septa	Length of minor septa	Number of septal lamellae	n/d	ds/dc	dd/dc	Longitudinal section		Stereoplasmatic wall
										axial structure	tabularium	
Clisiophyllum delicatum delicatum SMYTH	shortened	present, not merged in dissepimentarium	long	thin	= dissepimentarium or shortened	few	41 : 20	1/4-1/6	<1/3	vesicular tabellae	continuous, rare vesicular tabellae	absent
C. delicatum anastomosum YÜ	shortened	present, not merged in dissepimentarium	long	slightly thickened	into tabularium	2/3—4/5 number of major septa	40 : 22	~1/3	<1/3	vesicular tabellae	continuous and flat tabellae	absent
C. delicatum crassiforme BIKOVA	shortened	present, slightly merged in dissepimentarium	long	thickened of 1/2 dissepimentarium	into tabularium	≈ number of major septa	50 : 25	~1/3	~1/2	flat, closely packed tabellae	continuous and flat tabellae	present
C. delicatum columnatum n. sp.	shortened	present, not merged in dissepimentarium	long	thickened of 1/2 disepimentarium	into tabularium	few	44 : 22	~1/3	~1/3	flat, closely packed tabellae	continuous and rare tabellae	partly
C. delicatum nanum n. sp.	long	not developed	long	slightly thickened in tabularium	into tabularium	few	32 : 8.5	<1/3	~1/4	vesicular, long, steep tabellae	continuous and rare tabellae	absent

such as, for instance, IG. OS-70/2844 (Text-fig. 11*E*) overrun the variability limit discussed and may be placed on the boundary of subspecies, in this case, of *C. delicatum crassiforme*.

Remsarks. — Polish specimens differ from British ones primarily in a less regular axial structure. The photographs of only two specimens are published by the British authors who

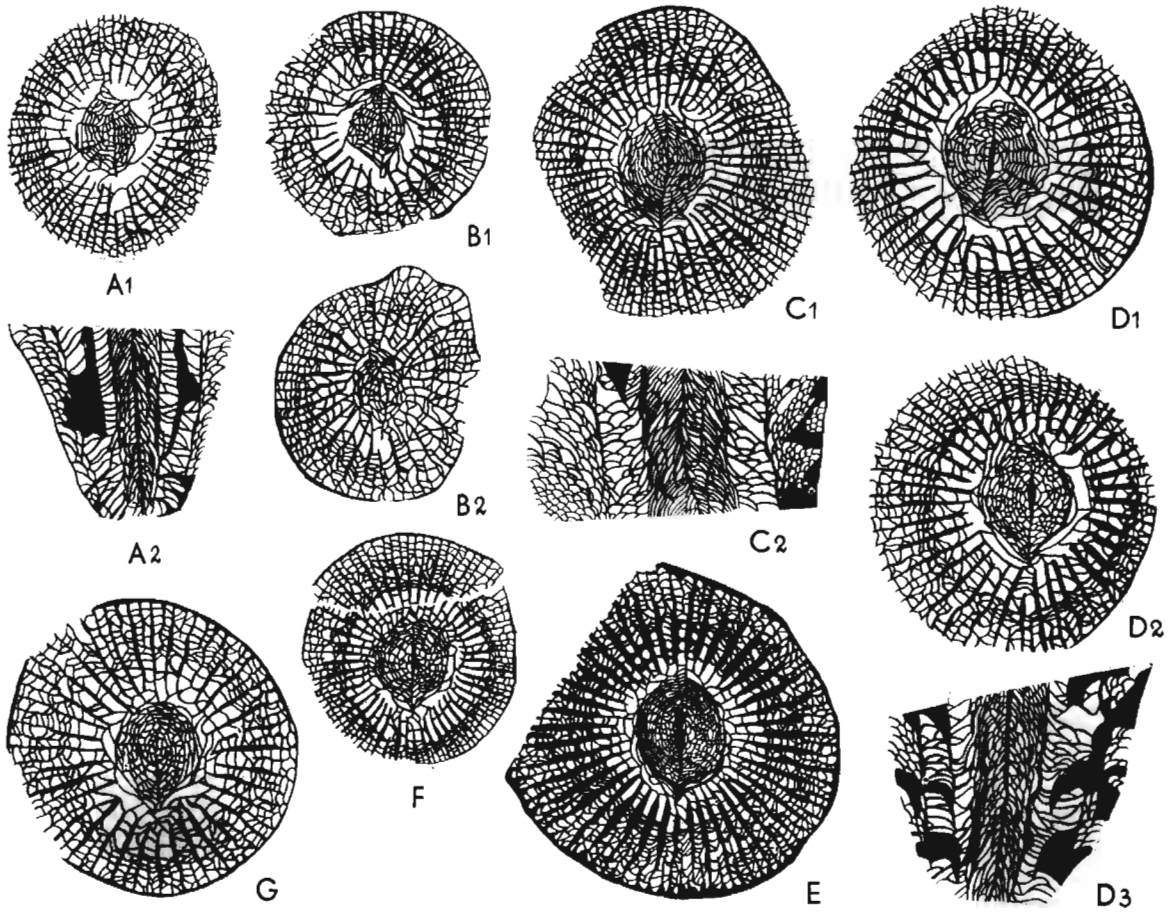

Fig. 11

Clisiophyllum delicatum delicatum SMYTH: A_1 transverse section of the ephebic stage (IG. OS-70/1158), A_2 longitudinal section; $B_{1,2}$ transverse sections of the ephebic stage (IG. OS-70/1219); C_1 transverse section of the ephebic stage (IG. OS-70/699), C_2 longitudinal section; $D_{1,2}$ transverse sections of the ephebic stage, D_3 longitudinal section (IG. OS-70/1155); *E* specimen of the axial structure similar to *C. delicatum crassiformae*, transverse section of the ephebic stage (IG. OS-70/2844); *F* transverse section of the ephebic stage (IG. OS-70/895); *G* transverse section of the ephebic stage (IG. OS-70/931). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

do not discuss variability and consequently we do not know whether or not this regularity is actually a stable character. The specimens, worked out by the present writer, display — as mentioned above — a great individual variability, as well as a differentiation in the structure, in ontogeny, e.g. longitudinal sections of young parts of corallites differ from the illustrations of British specimens in long, mostly complete marginal tabellae, whereas the sections made higher up have a tabularium almost identically vesicular as that in the British specimens.

Occurrence. — Great Britain, Viséan, S_1-D_2; Poland (Holy Cross Mts.), Upper Viséan, D_2 (top).

Clisiophyllum delicatum anastomosum (YÜ, 1933)

(Text-figs. 12*A*, *D*, 17; Pl. II, Figs. 9, 12)

1933. *Clisaxophyllum yengtzeense* YOH; C. C. YÜ, Lower Carboniferous..., p. 107, partim; Pl. 22, Fig. 3*a-e*; Pl. 23, Fig. 7*a-d*.
1933. *C. anastomosum* YÜ; C. C. YÜ, *Ibid.*, p. 110, Pl. 22, Fig. 2*a-d*.
1937. *Clisiophyllum yengtzeense* YOH; C. C. YÜ, The Fenginian..., p. 24, Pl. 5, Figs. 2, 3.
1966. *Clisaxophyllum yengtzeense sapaltjubensiformis* BIKOVA; M. S. BIKOVA, Nižnekamennougolnye..., p. 51, Pl. 3, Figs. 9, 10.

Material. — Forty solitary corallites, many of them with calices and almost complete proximal ends. The range of variability of measurable characters is shown in Text-fig. 17.

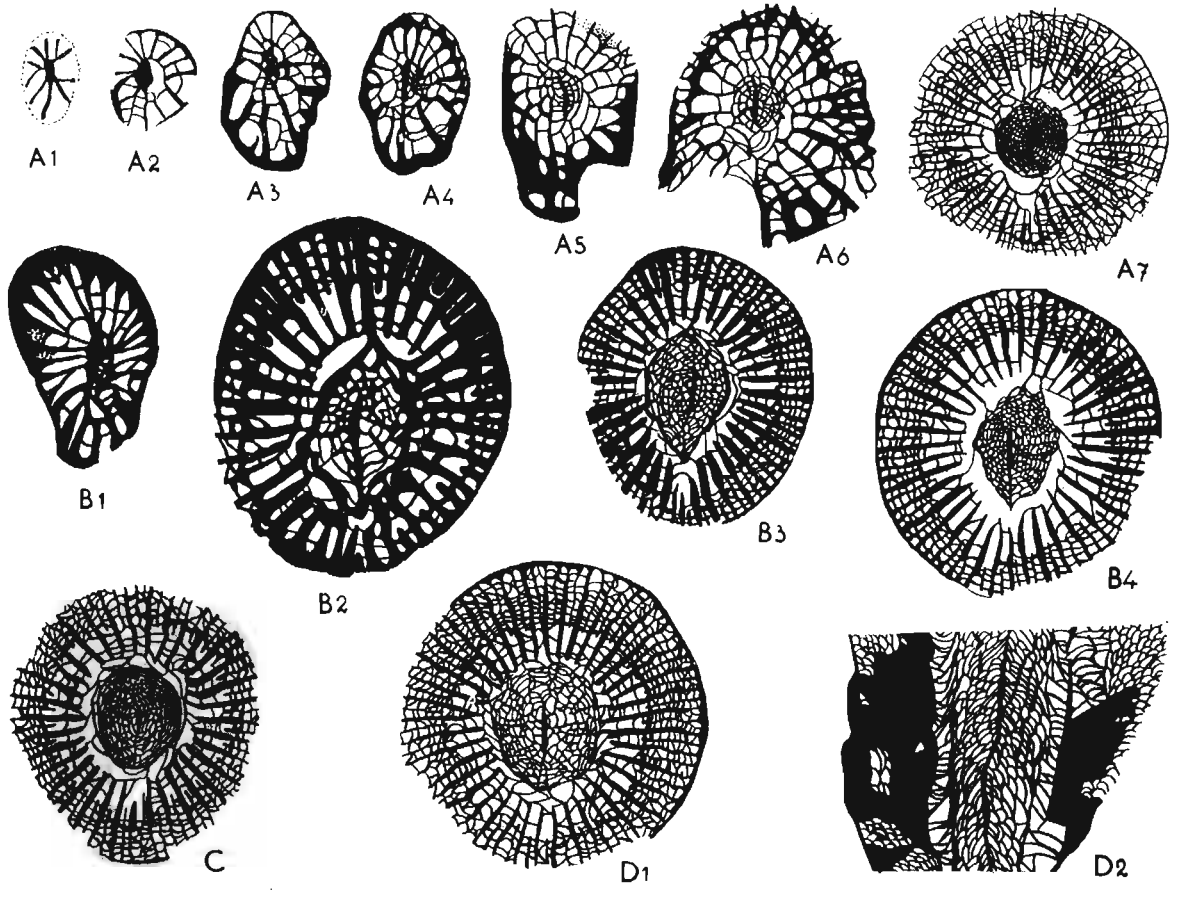

Fig. 12

Clisiophyllum delicatum anastomosum (YÜ): A_{1-6} successive transverse sections from the early- to late-neanic stage, × 5; A_7 transverse section of the ephebic stage, × 2 (IG. OS-70/1058); $B_{1,2}$ transverse sections of the neanic stage, 5×; B_3 transverse section of the early-ephebic stage, × 2; B_4 transverse section of the ephebic stage, × 2 (IG. OS-70/1224); *C* transverse section of the ephebic stage, × 2 (IG. OS-70/970); D_1 transverse section of the ephebic stage, × 2; D_2 longitudinal section, × 2 (IG. OS-70/113). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

Diagnosis. — *A Clisiophyllum delicatum* with a diameter of corallites reaching 22 mm and with 40×2 septa; axial structure occupying about 1/3 of the diameter of a corallite; columella thickened, rollerlike; the number of septal lamellae equalling 2/3 to 4/5 of that of septa;

minor septa entering tabularium; dissepimentarium narrower than 1/3 of the diameter of a corallite, regular.

Individual variability. — 1) Axial structure. Its diameter in relation to that of corallite varies from 3:15 to 5:12 mm. Columella penetrates mostly 2/3 of axial structure from the side of cardinal septum. Septal lamellae in axial structure may be long, almost straight and mostly stretching from the margin of the structure to columella or — in the peripheral part of the structure — straighter and, towards its inside, more and more twisted and fusing with axial tabellae. Axial tabellae flat, more densely arranged on the periphery of axial structure, as seen in transverse section, towards its inside become more and more irregular. A certain zonality in this arrangement of tabellae may be distinguished in some individuals, whereas one of the types of such arrangement, mostly vesicular tabellae, predominates in other individuals. Deposits of stereoplasma occur on marginal tabellae of axial structure of a few corallites. 2) The remaining differences are less important both for being of smaller scale and of minor diagnostic significance. The width of dissepimentarium varies between a width of 3-4 verticils to about 1/3 of the width of a corallite. Narrow-dissepimental individuals predominate. The structure of dissepimentarium is mostly differentiated, more densely arranged and flatter dissepiments occurring near the inner wall and widely spaced ones near epitheca. Many individuals have, however, a dissepimentarium which is uniform over its entire width. Rectangular dissepiments are the predominant type, occasionally irregular or lateral cystose dissepiments are also observed

Remarks. — Specimens with a conspicuous axial structure, whose lamellae are not spirally twisted, have been assigned by the writer to the subspecies here discussed. Due to this assignment, it includes most specimens illustrated by YÜ (1933) and named *Clisaxophyllum yengtzeense* YOH. These specimens clearly differ from both the holotype chosen by YOH (1929) and the first specimen of this species illustrated by YÜ (1933, Pl. 21, Figs. 6 a-d), but, in the writer's opinion, are in conformity with the description of *C. anastomosum* YÜ. No major differences may be also observed between *C. anastomosum* and *C. yengtzeense sapaltjubensiformae* BIKOVA. A slightly wider dissepimentarium and a somewhat wider axial structure having more numerous lamellae are not a sufficient basis to distinguish even a subspecies. Apart from their individual variability, Polish specimens differ from the holotype and Chinese specimens: 1) in a stronger development of columella which frequently intersects most part of axial structure and extends in the form of a thin lamella towards cardinal septum; its axial part happens to be swollen in a manner never encountered in Asian specimens; 2) in shorter major septa, which results in a better individualization of axial structure; 3) in a slightly smaller number of septa with the same diameter; 4) in looser, more vesicular and not so steeply arranged tabellae in axial structure in the longitudinal section.

Occurrence. — China, Upper Viséan; USSR (Kazakhstan), Namurian C_1ndl; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Clisiophyllum delicatum crassiforme (BIKOVA, 1966)

(Text-figs. 13 *D*, *E*; Pl. II, Fig. 13; Pl. XIV, Figs. 1-3)

1966. *Clisaxophyllum* (?) *crassiformis* BIKOVA; M. S. BIKOVA, Nižnekamennougolnye..., p. 54, Pl. 3, Figs. 3, 4 partim

Material. — Seven solitary corallites devoid of proximal ends and calices.

Dimensions (in mm):

Specimen	Index of septa n/d
IG. OS-70/1223	41 : 20×20
IG. OS-70/2110	49 : 24×24
Z. Pal. P. Tc-4/2927	43 : 23×21

Diagnosis. — A *Clisiophyllum delicatum* to 25 mm in diameter and with 50×2 septa. Axial structure at least partly separated by stereoplasma, densely lamellar and with a thickened columella; dissepimentarium occupies about 1/2 of the width of corallite; minor septa usually entering tabularium.

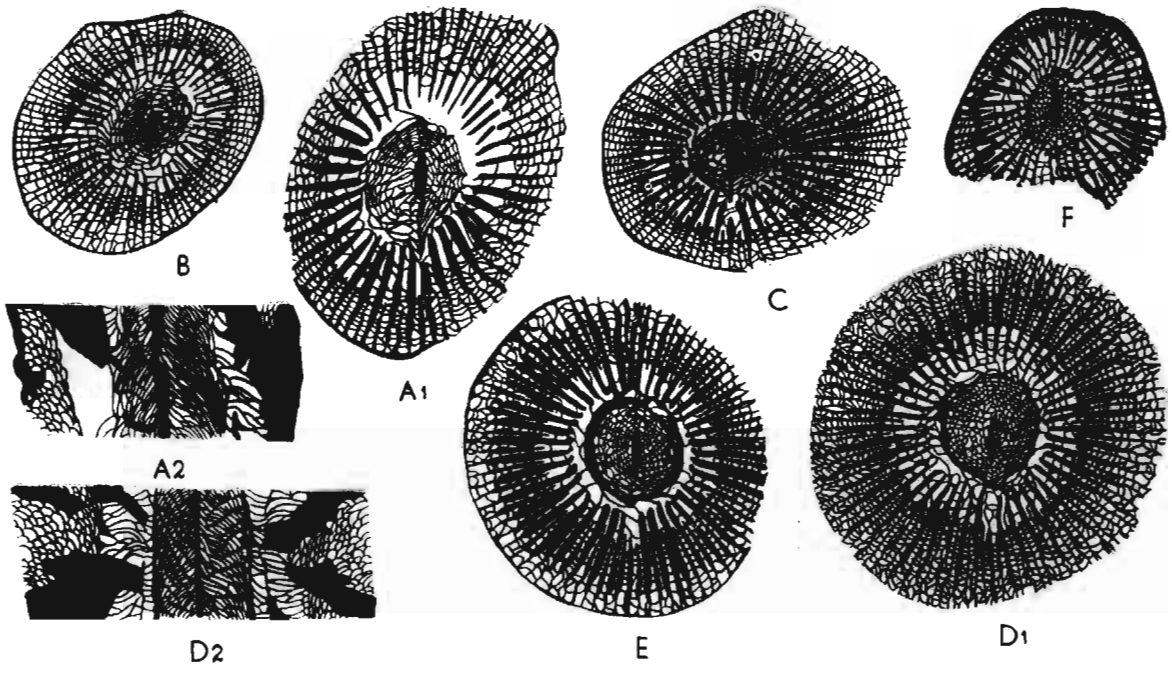

Fig. 13

Clisiophyllum delicatum columnatum n. subsp.: A_1 transverse section of the ephebic stage, A_2 longitudinal section, holotype (Z. Pal. P. Tc-4/2064); *B* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2884); *C* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2664).

D, *E Clisiophyllum delicatum crassiforme* (BIKOVA): D_1 transverse section of the ephebic stage, D_2 longitudinal section (IG. OS-70/2210); *E* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2927). *F Clisiophyllum* sp., transverse section of the ephebic stage (Z. Pal. P. Tc-4/2254).

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

Remarks. — The Polish specimens are considered by the writer to be conspecific only with BIKOVA's holotype (1966, Pl. 3, Figs. 3 and 4). They differ from the holotype in a slightly more conspicuous axial structure having a thicker stereoplasmatic wall and longer minor septa which penetrate tabularium to a larger depth. Predominant are characters in common, i.e. nearly the same diameters and number of septa, wide dissepimentarium occupying about 1/2 of the width of corallite, development of irregular, freguently lateral cystose dissepiments and a strongly developed, multilamellar axial structure with a long, thick columella. The dissimilarity of

longitudinal sections may result from an inaccurate orientation of the specimen from Kazakhstan sectioned quite obliquely. It has a more vesicular tabularium.

Occurrence. — USSR (Kazakhstan), Upper Viséan — Lower Namurian; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Clisiophyllum delicatum columnatum n. subsp.

(Text-figs. 13*A-C*, 17; Pl. II, Figs. 14, 15; Pl. XIV, Fig. 4)

Holotype: Specimen Z. Pal. P. Tc-4/2064 (Pl. II, Fig. 15; Pl. XIV, Fig. 4).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *columnatum* — after a very thick columella.

Material. — Nineteen solitary corallites, some of them with younger ontogenetic stages preserved. Measurable characters shown in a diagram in Text-fig. 17.

Diagnosis. — A *Clisiophyllum delicatum* to 22 mm in diameter and with 44×2 septa; lamellae few; columella axially very strongly thickened; minor septa entering tabularium; tabellae in axial structure very densely arranged.

Description. — *Transverse section* (Text-figs. 13A_1,*B*,*C*; Pl. II, Figs. 14, 15; Pl. XIV, Fig. 4): Epitheca to 0.5 mm thick, without a longitudinal ribbing. Major septa the thickest at the boundary of tabularium; minor septa thinner than major septa; columella elongated, in the form of a thin lamella, towards cardinal fossula, axially strongly thickened. Septal lamellae straight, not divided into radial sections. Dissepimentarium consisting of 3-7 verticils of rectangular dissepiments, slightly convex towards the periphery.

Longitudinal section (Text-fig. 13A_2): Dissepiments small, convex, almost equal in size, steeply arranged, near the inner wall vertical. Tabularium with an excellently separated axial structure. Columella thick.

Individual variability. — Corallites differ from each other in the thickness of columella, number of septal lamellae in axial structure, length and thickness of major and minor septa, as well as in the width of axial structure in relation to the diameter of a corallite.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Clisiophyllum delicatum nanum n. subsp.

(Text-figs. 14*A-E*, 17; Pl. II, Figs. 16, 17)

Holotype: Specimen Z. Pal. P. Tc-4/406 (Pl. II, Fig. 16).
Type locality: Sudetes, Sokolec.
Type horizon: Upper Viséan, D_2.
Derivation of the name: *nanum* — Lat. *nanus* = fine, small.

Material. — More than 40 solitary corallites, many of them with almost completely preserved proximal ends. Measurable characters shown in a diagram (Text-fig. 17).

Diagnosis. — A *Clisiophyllum delicatum* with corallites 5-8.5 mm in diameter and (23 to 32) ×2 septa; axial structure regular with a thickened columella; septal lamellae arranged radially; dissepiments rectangular, occurring in the form of 2-3 verticils; minor septa entering tabularium.

Description. — *Transverse section* (Text-figs. 14A_1, $_2$, C_1, D, E; Pl. II, Figs. 16, 17): Epitheca thin, without longitudinal ribbing, septal bases thickened. Major septa mostly do not reach axial structure. One or a few septa may occasionally join septal lamellae. Counter septum usually elongate, the remaining major septa equal in length. Columella extends in the form of thin lamellae to the margins of the structure, thickened in the axial part of corallite. The number of septal lamellae is correlated with the width of axial structure and depends on the ontogenetic stage. In mature corallites this number amounts to 8-9 on each side of columella. Tabellae,

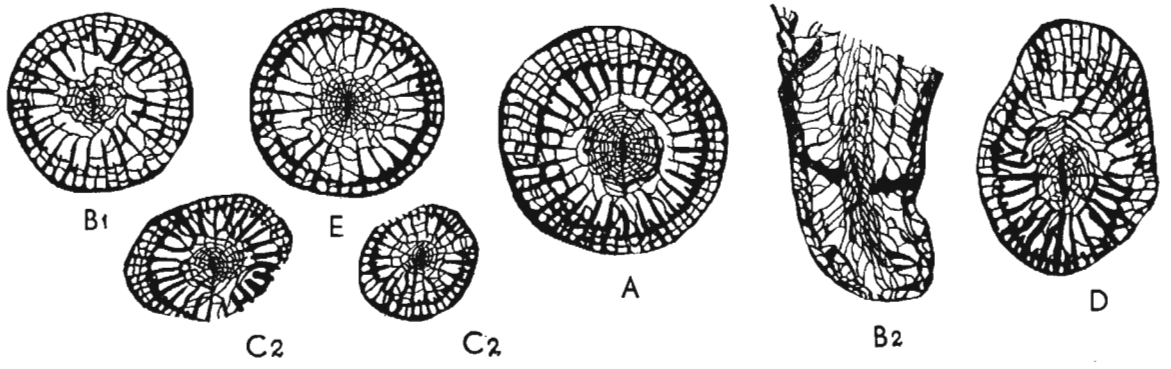

Fig. 14

Clisiophyllum delicatum nanum n. subsp.: *A* transverse section of the ephebic stage, holotype (Z. Pal. P. Tc-4/406); B_1 transverse section of the ephebic stage, B_2 longitudinal section (Z. Pal. P. Tc-4/71); C_1 transverse section of the ephebic stage, C_2 transverse section of the late-neanic stage (Z. Pal. P. Tc-4/400); *D* transverse section of the ephebic stage (Z. Pal. P. Tc-4/125). Sokolec, Sudetes, Upper Viséan, D_2.

E transverse section of the ephebic stage (IG. OS-70/3264), Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top). All × 5

occurring between lamellae, are small, arranged regularly and densely; small deposits of stereoplasma may occur on the marginal tabella. Dissepimentarium consists of 2-3 verticils of rectangular dissepiments which are slightly convex towards the periphery. Inner wall thickened.

Longitudinal section (Text-fig. 14B_2): Dissepiments arranged obliquely in 2-3 rows, the inner one having thickened walls. Axial structure conspicuous, without stereoplasmatic swellings on its margin.

Individual variability. — This subspecies is marked by accurately correlated septal index (diagram in Text-fig. 17), in which it differs from the remaining subspecies. Despite a great number of specimens it is also difficult to find any considerable morphological deviations. They occur only in the ratio of the width of axial structure to the diameter of corallite which varies from 1/4 to slightly more than 1/3 and in the number of septal lamellae in the structure. This variability is, however, exceptionally small as compared with other subspecies.

Remarks. — The subspecies described is marked by the smallest dimensions of all representatives of *Clisiophyllum* known so far. The most similar in this respect is *C. minor* (WU) from the Upper Viséan of China which, however, considerably differs in the composition of axial structure having folded lamellae and in the abortion of minor septa.

Of the subspecies of *Clisiophyllum delicatum* SMYTH, 1926 (as understood by the present writer), the most closely related is *C. delicatum reticulatum* (GORSKY, 1932) included by the last author to *Carcinophyllum*. Specimens from Donets Basin, not differing from GORSKY's specimens

even in subspecific characters, were described by VASSILJUK (1964) under this same specific name but as a species of *Clisiophyllum*. The present writer accepts the synonymy of both names and lowers the rank of this taxon to subspecies. The morphology and measurable characters of *C. delicatum nanum* n. subsp. deviate from those of the type subspecies to a greater extent than in other subspecies and it may well be that this is an independent taxonomic unit.

Occurrence. — Poland (the Sudetes, Sokolec); Upper Viséan, D_2.

Clisiophyllum neaversoni n. sp.

(Text-figs. 15*A-D*; Pl. III, Figs. 1-4; Pl. XIV, Figs. 5, 6)

1929. *Clisiophyllum* cf. *conoseptum* KEYSERLING; E. NEAVERSON, Faunal horizons..., p. 128, Pl. 4, Fig. 15.

Holotype: Specimen Z. Pal. P. Tc-4/2808 (Pl. III, Fig. 3).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: *neaversoni* — named in honour of Dr. E. NEAVERSON.

Material. — More than 20 incomplete solitary corallites without proximal ends and calices. Dimensions (in mm):

Specimen	Index of septa n/d
IG. OS-70/	
1450	54 : 24×24
1981	51 : 33×31
2976	48 : 27×23
3384	55 : 25×25
Z. Pal. P. Tc-4/	
2373	60 : 35×31
2808	60 : 34×30

Diagnosis. — A *Clisiophyllum* with corallites to 35 mm in diameter and having 60×2 septa; major septa, 1/3 of the width of dissepimentarium, thickened; they may enter axial structure; minor septa strongly shortened; axial structure occupying 1/3 or less of the diameter of corallite; lamellae few, running towards the ends of a listlike columella; tabellae in axial structure arranged in a domelike manner.

Description. — *Transverse section* (Text-figs. 15A_1,$B_{1,2}$,C,D_5; Pl. III, Figs. 1-3; Pl. XIV, Figs. 5*a*, 6): Epitheca thin, without longitudinal ribbing. Septal bases thickened. Major septa, in the peripheral part of dissepimentarium, thin, wavy and even twisted. Axial ends of all major septa bent in one direction. Septal lamellae directed, on each side of columella, towards one of its ends, which despite the fact that lamellae are on the whole straight, gives the impression as if the structure was whorled. Tabellae, in the structure, are few and regularly stretched between lamellae, being more densely arranged on the periphery. Dissepiments, larger and more irregular on the periphery, towards tabularium become finer and flatter, rectangular or of the herringbone type.

Longitudinal section (Text-fig. 15A_2; Pl. III, Fig. 4; Pl. XIV, Fig. 5*b*): Dissepiments convex in the marginal part of corallite larger and more flatly arranged, towards tabularium diminishing and more and more steeply arranged, near inner wall — vertical. Periaxial tabellae

mildly ascending to axial structure, usually S-shaped, less frequently vesicular. Axial structure conspicuous, composed of fine tabellae arranged in a domelike manner and near the margin of the structure vertical. Columella twisted, variable in thickness.

Ontogeny. — The youngest stage examined, already neanic, has a zaphrentoid structure. Cardinal fossula strongly developed; cardinal septum long, connected through columella with

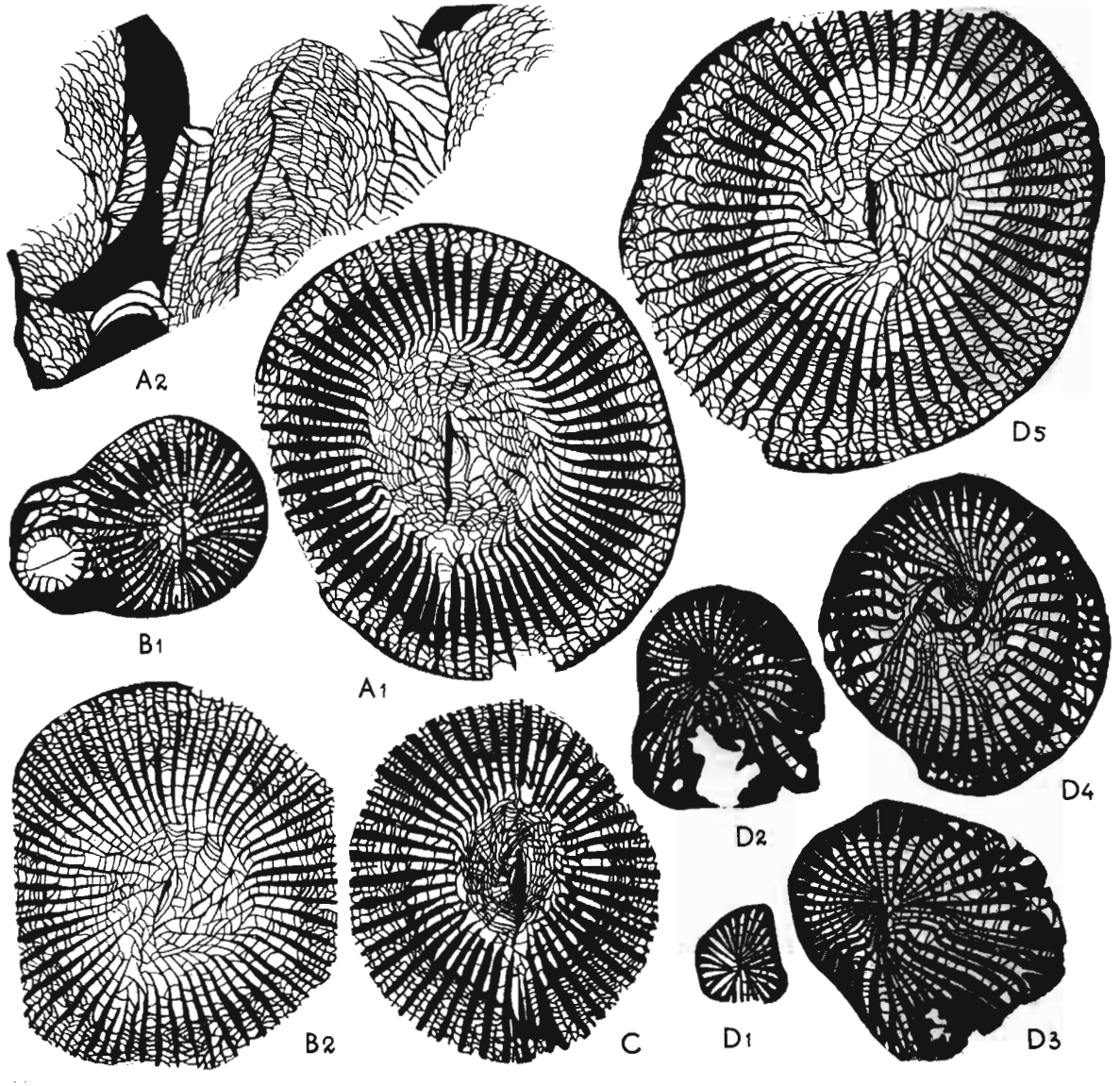

Fig. 15

Clisiophyllum neaversoni n. sp.: A_1 transverse section of the ephebic stage, A_2 longitudinal section, holotype (Z. Pal. P. Tc-4/2808); B_1 transverse section of the late-neanic, overgrowned *Nalivkinella* sp., B_2 transverse section of the ephebic stage (IG. OS-70/345); *C* transverse section of the ephebic stage (IG. OS-70/1983); D_{1-4} successive transverse sections from the early- to the late-neanic stage, D_5 transverse section of the ephebic stage (IG. OS-70/1981). Gałęzice, Holy Cross Mts.. Upper Viséan, D_2 (top); all × 2.

counter septum. Counter lateral septa parallel to counter septum, alar septa long, reaching columella. Acceleration of the growth of septa in counter quadrants (Text-fig. 15 D_1). A further development of the neanic stage of the corallite illustrated is slightly deformed. A strong development of columella, continuously connected at least with counter septum is a character predominating in successive sections. Minor septa appear relatively late together with dissepimentarium (Text-fig. 15 D_3) and from the beginning are abortive. Columella, at first straight, bends at the end of the neanic stage, septa or already broken-off lamellae take the position directed towards the ends of columella in a manner typical of the species.

Individual variability. — It is considerable and concerns all structural elements. The ratio of the number of septa to the diameter of corallite is only to a small extent related to the ontogenetic age of the corallite. The composition of axial structure varies in details from individual to individual, the main differences being a greater (specimen Z. Pal. P. Tc-4/2808; Text-fig. 15 A_1) or smaller (specimen IG. OS-70/1981; Text-fig. 15 D_5) number of septal lamellae and a ratio of the width of the structure to the diameter of corallite which varies from less than 1:4 to slightly more than 1:3. The number of septa connected with lamellae is variable. Minor septa, on the whole very short, in specimen OS-70/345 (Text-fig. 15 B_1) penetrate almost through the entire dissepimentarium. This specimen also differs in lamellae which are not separated from septa and perhaps it should be separated from this species. Variable is also the width of dissepimentarium in relation to tabularium. This character has been observed by the writer in sections which corresponded to each other ontogenetically and which had no contractions and thickenings. It was found that in some individuals it varied between 1/3 and almost 1/2 of the diameter of corallites.

Remarks. — It might well be that the range of the individual variability of this species was set too extensively, particularly so in the case of the composition of axial structure and the ratio of its width to the diameter of corallite. The number of the specimens available was, however, too small so as to enable the statement whether the differences between particular specimens were permanent or constituted individual characters only. Taking into account a great ontogenetic variability recorded in the entire genus *Clisiophyllum*, the writer accepted the last-named alternative. Of all known species, *C. keyserlingi* M'Coy, 1849 is most closely related to *C. neaversoni* n. sp. Minor septa, strongly shortened in *C. neaversoni* n. sp., narrow axial structure, wider dissepimentarium and less numerous septal lamellae are principal differences. Specimens displaying similar characters, e.g. the lectotype of *C. geinitzianum* Thomson with short minor septa, illustrated by Hill (1938-1941), are, however, met with within the range of individual variability of both species. The introduction of *C. geinitzianum* Thomson to the synonymy of *C. keyserlingi* seems to the present writer to be debatable.

Occurrence. — Great Britain (Clwyd), Upper Viséan, D_3; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Clisiophyllum vacuum n. sp.

(Text-figs. 10 *D-G*; Pl. III, Fig. 5; Pl. XIV, Figs. 7 *a-c*)

1930. *Clisiophyllum* sp. Lewis; H. P. Lewis, The Avonian..., p. 269, Pl. 22, Fig. 9 *a, b*.

Holotype: Specimen IG. OS-70/3356 (Pl. III, Fig. 5; Pl. XIV, Fig. 7).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: *vacuum* — Lat. *vacuus* = empty; after its incomplete minor septa.

Material. — Four solitary corallites, of which only the holotype reaches the ephebic stage, the rest of them being juvenile individuals. Proximal ends lacking.

Dimensions (in mm):

IG. OS-70/	Index of septa n/d
3356	41 : 26×25
3359	33 : 13×12
3360	32 : 13×11
3365	33 : 16×14

Diagnosis. — A *Clisiophyllum* whose corallites reach 26 mm in diameter and have 41×2 septa; number of lamellae and tabellae in axial structure increasing in ontogeny; minor septa discontinuous, only periepithecal and tabular sections remaining.

Descriptions. — *Transverse section* (Text-figs. 10 *D-G*; Pl. III, Fig. 5; Pl. XIV, Figs. 7*b,c*): Outer wall thick, composed of a thin epitheca and several times thicker septotheca. Major septa continuous, in tabularium thickened, reaching axial structure. Minor septa divided into thick peripheral sections and somewhat less thickened tabular sections. They also penetrate a few internal dissepiments and sometimes may be divided into radial segments. Axial structure dense. Columella swollen in a rollerlike manner in axial part, extends in the form of a thin lamella towards cardinal septum and, in younger stages, joins it. Septal lamellae not whorled, directed, on either side, towards the same end of columella, short and thin. Frequently, they are disposed parallel to tabellae and consequently tabellae seem to be the main component of axial structure. Dissepiments mostly of the herringbone type, occasionally irregular.

Remarks. — In the ontogenetic development, studied only fragmentarily, the development of axial structure seems to be the most important. In younger stages, this is a typical dibunophylloid structure (Text-fig. 10*G*). With growth, lamellae become more and more numerous, thinner and disposed spirally almost parallel to tabellae from which frequently they are difficult to distinguish. The rate of development is variable and some of the specimens reach certain features of maturity when still being small (Text-fig. 10*E*). The species described differs from typical representatives of *Clisiophyllum* in the development of minor septa and septotheca. These characters make up a sort of transition to the genus *Carcinophyllum* in which they are fully developed. Since the present writer has not succeeded in studying the ontogeny of this species, he does not feel entitled to decide, whether the morphology of *C. vacuum* n. sp. is the result of relationship or convergence with *Carcinophyllum*. The British specimen, described by LEWIS (1930) and considered by the present writer to be conspecific with Polish specimens, is a juvenile form. Its dimensions and number of septa are much the same as those of juvenile Polish specimens to which it also corresponds morphologically. The development of minor septa is, in the present writer's opinion, the most important concordant character.

Occurrence. — Great Britain (Isle of Man), Upper Viséan, top of D_1; Poland (Holy Cross Mts.), Upper Viséan, D_2 (top).

Clisiophyllum monoseptatum n. sp.

(Text-fig. 16A_{1-4}, Pl. XIV, Figs. 8*a-d*)

Holotype: Specimen IG. OS-70/885 (Pl. XIV, Fig. 8).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *monoseptatum* — only major septa well developed.

Material. — Two solitary corallites. Holotype with a partly preserved calice. Paratype preserved as a fragment of neanic stage.

Diagnosis. — A *Clisiophyllum* 24 mm in diameter and with 43 major septa most of them fused with lamellae; minor septa shortened up to a complete disappearance; axial structure occupying 1/4 of the diameter of corallite, inconspicuous.

Description. — *Transverse section* (Text-figs. 16$A_{1\text{-}3}$; Pl. XIV, Figs. 8*a-c*): Epitheca thin, devoid of longitudinal ribbing. Major septa with thickened bases, on the periphery thin. Their axial ends are bent and fused with lamellae, only some of them hardly reach the margin of axial structure but, if such is the case, there are no lamellae corresponding to them. With the onto-

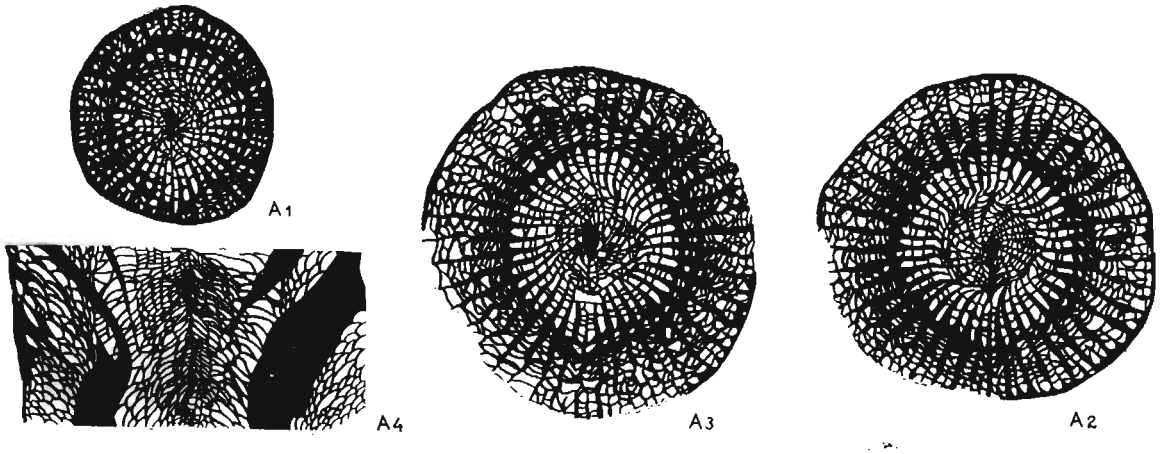

Fig. 16

Clisiophyllum monoseptatum n. sp.: A_1 transverse section of the late-neanic stage, A_2 transverse section of the early-ephebic stage. A_3 transverse section of the late-ephebic stage, A_4 longitudinal section, holotype (IG. OS-70/885). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

genetic development, minor septa are more and more shortened. Cardinal septum remains, connected with columella for a long time. Columella variable in thickness, penetrating 2/3 of axial structure as viewed from the side of cardinal septum. Septal lamellae run towards the central part of columella and some of them fuse with it. Tabellae more or less densely but uniformly distributed in the entire axial structure. Some of them may be slightly thickened on the periphery. Dissepiments small, mostly of the herringbone type, except on the periphery where larger, irregular dissepiments occur and near the internal wall where small, flat, rectangular dissepiments are observed in fragments of corallite.

Longitudinal section (Text-fig. 16A_4; Pl. XIV, Fig. 8*d*): Dissepiments plano-convex, varying in size, arranged semicircularly and, near the internal wall, vertically. Tabellae vesicular, oblique in relation to a thin columella, axial ones smaller than those on the periphery of the corallite.

Remarks. — In the writer's opinion, only two of the species described so far may be compared with *C. monoseptatum* n. sp. These are *C. densilamellatum* PERNA and *C. neaversoni* n. sp., both having shortened minor septa. *C. monoseptatum* n. sp. differs from *C. densilamellatum* in axial structure, quite different in longitudinal and transverse section and from *C. neaversoni* n. sp. — in measurable characters, a narrower axial structure, connected with major septa and inconspicuous in longitudinal section and in a poor development of cardinal fossula.

Occurrence. — Poland (Holy Cross Mountains, Gałęzice); Upper Viséan, D_2 (top).

Clisiophyllum sp.

(Text-fig. 13*F*)

Material. — One specimen (Z. Pal. P. Tc-4/2254) 15 mm in diameter and with 38×2 septa.

Description. — Epitheca thick. Septa continuous. Major septa thickened in inner wall, reaching axial structure and mostly fused with septal lamellae. A band of stereoplasmatic swellings, which forms a boundary of axial structure, runs on the boundary between lamellae

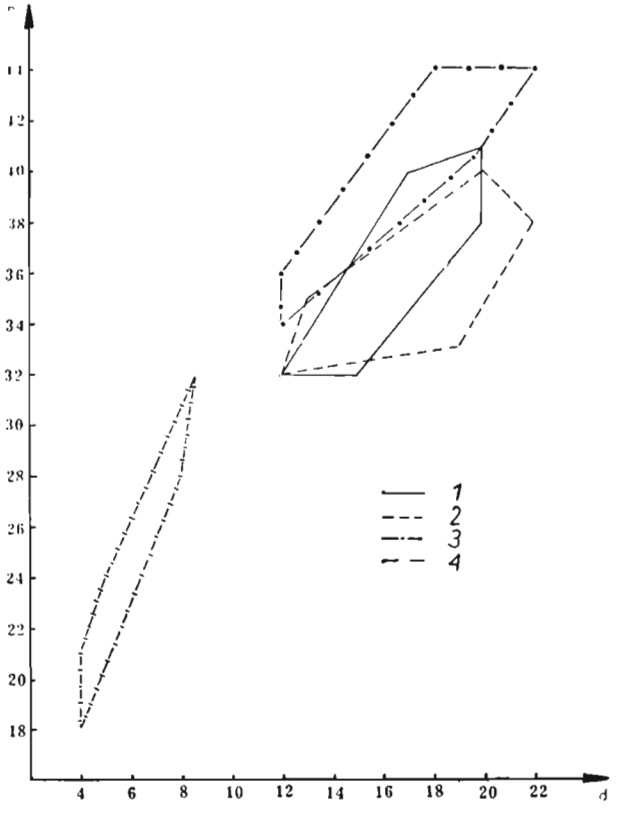

Fig. 17

Septal index (n/d) for some subspecies of *Clisiophyllum delicatum* SMYTH. Points corresponding extreme specimens are united by lines. 1 — *C. delicatum delicatum* SMYTH, 2 — *C. delicatum anastomosum* YÜ, 3 — *C. delicatum columnatum* n. subsp., 4 — *C. delicatum nanum* n. subsp.

and axial ends of septa. Axial structure composed of a thick rollerlike columella, radially arranged septal lamellae whose number is almost equal to that of septa, and densely disposed axial tabellae. Minor septa penetrate tabularium but are not thickened in it.

Remarks. — The development of axial structure corresponds to the type of "nucleate *Clisiophylla*", whereas the manner of separating it from septa is quite specific and, so far as the present writer knows, has not been described in the representatives of *Clisiophyllum*.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **DIBUNOPHYLLUM** THOMSON & NICHOLSON, 1876

(Type species: *Dibunophyllum muirheadi* THOMSON & NICHOLSON, 1876)

Synonyms:
Staurophyllum GORSKY, 1951, p. 79,
Neokoninckophyllum FOMITSHEV, 1939 sensu NATIONS, 1963, p. 1262,
Hunanoclisia WU, 1964, p. 48,
non *Dibunophyllum* THOMSON & NICHOLSON, 1876 sensu GERTH, 1921,
non *Dibunophyllum* THOMSON & NICHOLSON, 1876 sensu DOBROLJUBOVA, 1937,
non *Dibunophyllum* THOMSON & NICHOLSON, 1876 sensu FELSER, 1937,
non *Dibunophyllum* THOMSON & NICHOLSON, 1876 sensu MOORE & JEFFORDS, 1945,
non *Dibunophyllum* THOMSON & NICHOLSON, 1876 sensu JEFFORDS, 1948,
non *Dibunophyllum* THOMSON & NICHOLSON, 1876 sensu SAKAGUCHI & YAMAGIWA, 1958.

Species assigned: *Clisiophyllum bipartitum* M'COY, 1849, *Rhodophyllum carezi* BARROIS, 1882, *Dibunophyllum praecursor* FRECH, 1885, *D. murchisoni* STUCKENBERG, 1895, *D. pallasi* STUCKENBERG, 1895, *D. vermiculare* STUCKENBERG, 1895, *D. pseudoturbinatum* STUCKENBERG, 1904, *D. barboti* STUCKENBERG, 1904, *D. vaughani* GARWOOD & GOODYEAR, 1924, ?*D. yüi* CHI, 1931, ?*D. nontabulatum* HUANG, 1932, *D. kankouense* YÜ, 1933, *D. tingi* YÜ, 1933, *D. shangchainense* YÜ, 1933, *D. reticuliforme* YÜ, 1933, *D. lambii* BELL, 1929, ?*D. valeriae* NEWELL, 1935, *D. linnense* HILL, 1939, *D. yüi* HERITSCH, 1939, non CHI, 1931, *D. percrassum* GORSKY, 1951, *D. miloradowitschi* GORSKY, 1951, *D. gangamophylloide* GORSKY, 1951, *Staurophyllum thomsoni* GORSKY, 1951, *S. ambiguum* GORSKY, 1951, *Dibunophyllum asiaticum* MINATO, 1955, *D. lissitzini* VASSILJUK, 1960, *D. fomitshevi* VASSILJUK, 1960, *D. dobroljubovae* VASSILJUK, 1960, *D. lonsdaleoides* VASSILJUK, 1960, *D. finale* VASSILJUK, 1960, *Hunanoclisia sinense* WU, 1964, *H. reticuliforme* WU, 1964, *H. flexilis* WU, 1964, *Dibunophyllum xiangxiangense* WU, 1964, *D. stereoseptatum* WU, 1964, *D. simplex* WU, 1964, *D. reductum* n. sp. Some of these species are probably synonyms, but this cannot be ascertained without a revision of the original material.

Stratigraphic and geographic range: Lower Carboniferous to Lower Permian (?); Eurasia, North Africa, North America, Spitsbergen.

Diagnosis. — See HILL, 1938-1941, p. 65.

Remarks. — This almost cosmopolitic genus, described many times, continues to be one of the most controversial Carboniferous tetracorals. This results from a considerable individual variability, from many rapidly evolving phyletic branches which lead to, among other phenomena, the disappearance of axial structure and from a close relationship or maybe convergence with other genera, in particular with *Clisiophyllum*, *Arachnolasma* and *Amandophyllum*. The boundaries between genera are not clearly outlined and there does not in principle exist such a morphological character which could not be found in the genera mentioned above. Even the most characteristic species, i.e. *D. bipartitum* has three subspecies whose extreme specimens so strongly differ from each other that, was is not for all possible transitional forms, they could be assigned to separate genera, which as a matter of fact took place more than once. The genera mentioned above, the same in fact as most genera of the subfamily Clisiophyllinae, have a very similar ontogeny and frequently it is impossible to distinguish young stages. As far as it can be judged by previous studies, the microstructure is also identical. Under such circumstances a strict assignment of extreme species of a genus is very difficult and to a considerable extent subjective. These genera might be canceled and only one of them, i.e. *Clisiophyllum*, which has a priority, be acknowledged. Since most Carboniferous solitary tetracorals, having dissepimentarium and axial structure, would suddenly be placed within one genus and a few species, as the range of species would of necessity be extended, such an approach to the problem would considerably simplify the determination. The natural character of such systematics seems to the present writer to be unlikely because here we have to do with one of the group of corals the most numerously represented in the Carboniferous with tens of thousands of specimens described so far and which occur over a vast geographical range. With such

TABLE 4

Morphologically-comparative table of *Dibunophyllum* THOMSON & NICHOLSON

Species	Cardinal septum	Cardinal fossula	Length of major septa	Thickness of major septa	Length of minor septa	Number of septal lamellae	Axial structure	Dissepimentarium	n/d	ds/dc	dd/dc	Longitudinal section	
												axial structure	tabularium
Dibunophyllum bipartitum M'COY (sensu lato)	shortened, thin	open, slightly merged in dissepimentarium	long	various; more in tabularium	short	5-12 of both sides	various; median plate present or absent	without lonsdaleoid vesicles	63 : 40	~1/3	~1/3	separated, various	more commonly vesicular
D. pseudoturbinatum STUCKENBERG (s. lato)	shortened, thin	open, slightly merged in dissepimentarium	long	various; thickened of 1/2 dissepimentarium	long, into tabularium	5-12 of both sides	various; median plate present or absent	without lonsdaleoid vesicles	52 : 38	~1/3	~1/3	separated, various	more commonly vesicular
D. lonsdaleioides VASSILJUK	thin, long	open, slightly merged in dissepimentarium	long	slightly in tabularium	short, partly reduced	8 of both sides	median plate short	big peripheral lonsdaleoid vesicles	34 : 22	~1/3	~1/3		
D. lissitzini VASSILJUK	thin, long	open, slightly merged in dissepimentarium	long	thickened of 1/3 dissepimentarium	long, into tabularium	4-7 of both sides	various; median plate thin, long	small peripheral lonsdaleoid vesicles	46 : 29	~1/6	~1/2	separated, irregular	tabellae long, vesicular
D. percrassum GORSKY	thin, short	open, merged in dissepimentarium	long	thickened of 1/3 dissepimentarium	short, partly reduced	4-7 of both sides	regular; median plate thick	without londsaleoid vesicles	52 : 30	1/4 to 1/5	>1/3	separated, vesicular	vesicular
D. reductum n. sp.	thin, short	open, not merged in dissepimentarium	long	only in the inner wall	short, partly reduced	2-4 of both sides	without median plate	without lonsdaleoid vesicles	49 : 25	~1/5	1/3	non separated, vesicular	vesicular

great quantities, a particularly extensive range of individual variability and a wide geographical distribution, taxonomic changes were bound to take place and did take place, much the same as in Recent reefs in which many species of the same genus live close to each other. Although tracing an accurate boundary between these related genera is at present impossible in practice, the present writer assumes the actuality of their existence.

A new genus of *Hunanoclisia* has been recently introduced by WU (1964) who briefly discusses its similarities to and differences from *Nervophyllum*, *Aspidiophyllum* and *Dibunophyllum*. If the genus *Nervophyllum* is, in the present writer's opinion, actually distinct, the other two — *Aspidiophyllum* and *Dibunophyllum* — whose synonymy was proved by HILL (1938-1941), include in their diagnosis also the characters of *Hunanoclisia*. Some specimens with a particularly narrow axial structure may presumably belong to *Arachnolasma*.

MINATO and KATO (1957) suggest that the genus *Rhodophyllum* THOMSON, 1874, which was included by HILL (1938—1941) in the synonymy of *Dibunophyllum*, should be reestablished. Their suggestion is based mostly on the manner of disposing lamellae in axial structure. If the conspecificity of such a varying axial structure as that in *D. bipartitum bipartitum* and *D. bipartitum craigianum* is, however, accepted, the position of lamellae can be hardly raised to the rank of a generic character. The present writer completely agrees with HILL (*l.c.*), the more so that this author based her revision on THOMSON's original material and that she also included *Rhodophyllum* in the synonymy of *Dibunophyllum*.

Dibunophyllum bipartitum (M'COY, 1849)

Subspecies assigned: *Clisiophyllum bipartitum bipartitum* M'COY, 1849, *C. bipartitum koninckі* M.-E & H., 1851, *Rhodophyllum bipartitum craigianum* THOMSON, 1874.

Diagnosis. — See HILL, 1938-1941, p. 67.

Remarks. — This species was revised by HILL (*l.c.*) who, in the present writer's opinion, quite correctly assigned to it many genera and species described mostly in THOMSON's works. Three subspecies, which also occur in Poland, are distinguished by HILL in this species. *D. turbinatum* M'COY is also accepted as a real species by DOBROLJUBOVA (oral communication), VASSILJUK (1960, 1964) and others. According to DOBROLJUBOVA's oral communication and her manuscript, which the present author had the opportunity to read, she assumes that the specimens, in which no variability occurs in axial structure or those in which such a variability is irregular and does not directly lead to *D. bipartitum*, should be assigned to *D. turbinatum*. In practice, she starts the development series of the species *D. bipartitum* with *D. bipartitum koninckі* with the omission of its first member, i.e. the nominal subspecies which is marked by the very regularity of axial structure or only slight changes in it. DOBROLJUBOVA's reasoning is based on the following three facts: 1) The specimen in which columella was starting to bend was chosen by HILL as a lectotype. However, as emphasized by HILL (*l.c.*), she chose it only for the species *sensu lato*. 2) The specimens identified by M'COY as *Clisiophyllum turbinatum* and described once more by SMITH (1916), did not display any changes in axial structure. 3) The specimens identified by M'COY as *Clisiophyllum bipartitum* turned out to be so poorly preserved that HILL could not make up her mind to choose a lectotype from them and, therefore, the name of *D. turbinatum* should, according to DOBROLJUBOVA, be accepted as better founded. The first of the specimens, illustrated by M'COY (1851, Pl. 3C, Fig. 6) and grounded and drawn by HILL (*l.c.*, Text-fig. A), has a co-

lumella which, however, does not differ from that of *D. turbinatum* and consequently the assignment of these specimens to different species would be groundless. In view of the facts that *C. bipartitum* was the first name published and that it was generally accepted, HILL resolved to maintain this name as a specific name and giving *C. turbinatum* M'COY as synonym, although the specimens of this "species" turned out to be better preserved. The present writer had the opportunity to get acquainted with the specimens assigned by DOBROLJUBOVA to *D. turbinatum* and to find that they slightly differed from those he owned and which were illustrated by HILL (*l.c.*) primarily in a very loose dissepimentarium having dissepiments increasing towards the periphery. Perhaps, the Soviet specimens do not as a matter of fact belong to *D. bipartitum*. It is doubtful, however, if the name of *D. turbinatum* (M'COY) could be maintained for them. Despite its variability and multiformity, a detailed description of this species and its subspecies seems to the present writer to be superfluous since it was already given in HILL's work (*l.c.*). The writer has confined himself to the presentation of the individual variability of the Polish specimens observed in particular subspecies.

Dibunophyllum bipartitum bipartitum (M'COY, 1849)

(Text-figs. 18*A-E*, 21; Pl. III, Figs. 6-9; Pl. IV, Figs. 1-3; Pl. XV, Figs. 1-4)

1849. *Clisiophyllum bipartitum* M'COY; F. M'COY, On some..., p. 2.
1851. *C. bipartitum* M'COY; F. M'COY, A synopsis..., pp. 93, 96, Pl. 3*C*, Figs. 6, 6*a*.
1872. *C. turbinatum* M'COY; L. DE KONINCK, Nouvelles recherches..., pp. 39, Pl. 3, Fig. 2.
1904. *Dibunophyllum turbinatum* M'COY; A. STUCKENBERG, Korally i mšanki..., p. 54, Pl. 5, Fig. 3*a, b*.
1923. *D. turbinatum* M'COY; A. J. PERNA, Korally..., p. 31, Pl. 3, Fig. 8.
1935. *D. yüi* CHI; F. HERITSCH, Rugose Korallen..., p. 148, Text-figs. 13-15.
1935. *D. mülleri* HERITSCH; F. HERITSCH, *Ibid.*, p. 149 (partim, Text-fig. 16 only).
1935. *D. muirheadi* THOMSON & NICHOLSON; N. MENCHIKOFF & T. Y. HSU, Les polypiers..., p. 245, Pl. 10, Fig. 3.
1935. *D.* cf. *derbiense* SIBLY; N. MENCHIKOFF & T. Y. HSU, *Ibid.*, p. 246, Pl. 10, Fig. 4.
1935. *Dibunophyllum* sp.; N. MENCHIKOFF & T. Y. HSU, *Ibid.*, p. 246, Pl. 10, Fig. 5.
1938-1941. *D. bipartitum bipartitum* (M'COY); D. HILL, A monograph..., p. 72, Pl. 1, Figs. 15-19, 21; Pl. 2, Figs. 1-6 (*cum synon.*).
1960. *D. turbinatum* M'COY; N. P. VASSILJUK, Nižnekamennougolnye... p. 132, Pl. 32, Figs. 1-1*e*; Pl. 33, Figs. 1-11; Pl. 34, Figs. 1-1*c*.
1962. *D. vaughani* SALÉE; C. C. YÜ, I. D. LIN & Y. N. FAN, Rugosa..., p. 22, Pl. 3, Fig. 1*a, b*.
1964. *D. turbinatum* M'COY; N. P. VASSILJUK, Korally zon.., p. 73, Pl. 3, Fig. 8.
non 1957. *D. bipartitum bipartitum* M'COY; V. KOSTIČ-PODGORSKA, Koralska fauna..., p. 57, Pl. 4, Figs. 1-4.
non 1958. *D. bipartitum bipartitum* M'COY; V. KOSTIČ-PODGORSKA, Fauna..., p. 42, Pl. 22, Figs. 1-4.

Material. — More than 600 solitary corallites including more than 100 from the Sudetes. Specimens varying in size and state of preservation, some of them having preserved calices and almost complete proximal ends. Dimensions are given in a diagram shown in Text-fig. 21.

Diagnosis. — See HILL, 1938-1941, p. 72.

Remarks. — Polish specimens belong to rather small or middle-sized representatives of the subspecies with morphological characters clearly marked and with a considerable individual variability. In most specimens, axial structure occupies about 1/3 of the diameter of the corallite, columella is strongly developed and slightly thickened; a few septal lamellae reach columella on both its sides. Major septa in tabularium are conspicuous but not excessively thickened. Minor septa short, dissepimentarium of the herringbone type. Less numerous corallites display the following modifications: a strong swelling of major septa in tabularium, strong swelling of columella, occurrence of many septal lamellae and elongation of minor septa.

The last-named character does not occur in all septa in a given section, they also do not reach a larger length than 2/3 of that of dissepimentarium. No correlation is observed between these changes and between them and the diameter of corallite and number of septa. In addition to

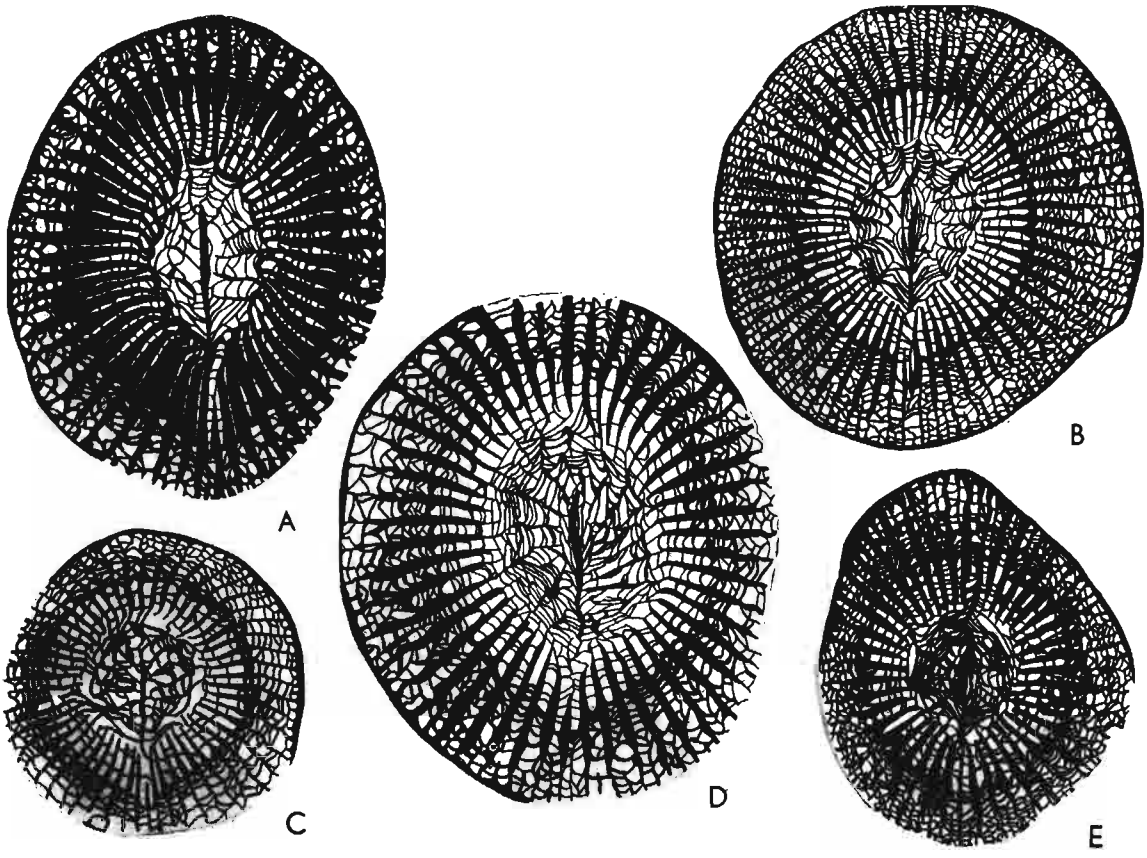

Fig. 18

Dibunophyllum bipartitum bipartitum (M'Coy): *A* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2057); *B* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2315); *C* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2827); *D* transverse section of the ephebic stage (Z. Pal. P. Tc-2873); *E* transverse section of the ephebic stage (IG. OS-70/170). Galęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

these random modifications, a definite change is observed in axial structure which tends to be similar to that of *D. bipartitum koninckí*, which is expressed in shortening and bending of columella and septal lamellae. Since the specimens of a certain group display all characters typical of transitional forms, this group may be assigned to both subspecies alike.

Occurrence. — Great Britain, Belgium, Czechoslovakia, North Africa, China, Poland — Upper Viséan; USSR — Upper Viséan to Lower Namurian.

Dibunophyllum bipartitum koninckí (M.-Edw. & Haime, 1851)

(Text-figs. 19*A-D*, 21; Pl. IV, Figs. 4-8; Pl. V, Figs. 1-3; Pl. XV, Figs. 5, 6)

1851. *Clisiophyllum koninckí* M. Edwards & Haime; H. M.-Edwards & J. Haime, Monographie..., p. 410.

1938-1941. *Dibunophyllum bipartitum koninckí* (M.-Edw. & Haime); D. Hill, A Monograph..., p. 75, Pl. 1, Fig. 20; Pl. 2, Figs. 7-13 (*cum synon.*).

1959. *D.* cf. *bipartitum koninckí* (EDWARDS & HAIME); M. KATO, On some..., p. 39, Text-fig. 7.
1964. *D. bipartitum koninckí* (E. & H.); N. P. VASSILJUK, Korally zon..., p. 74, Pl. 4, Figs. 2, 3.
1964. *D. bipartitum* M'COY; W. S. WU, Lower Carboniferous..., p. 52, Pl. 10, Figs. 13-16 (Chinese only).

Material. — About 160 specimens, including 10 from the Sudetes and the rest from the Holy Cross Mts. Some corallites with preserved calices and almost complete proximal ends. Measurable characters shown in a diagram in Text-fig. 21.

Diagnosis. — See HILL, 1938-1941, p. 75.

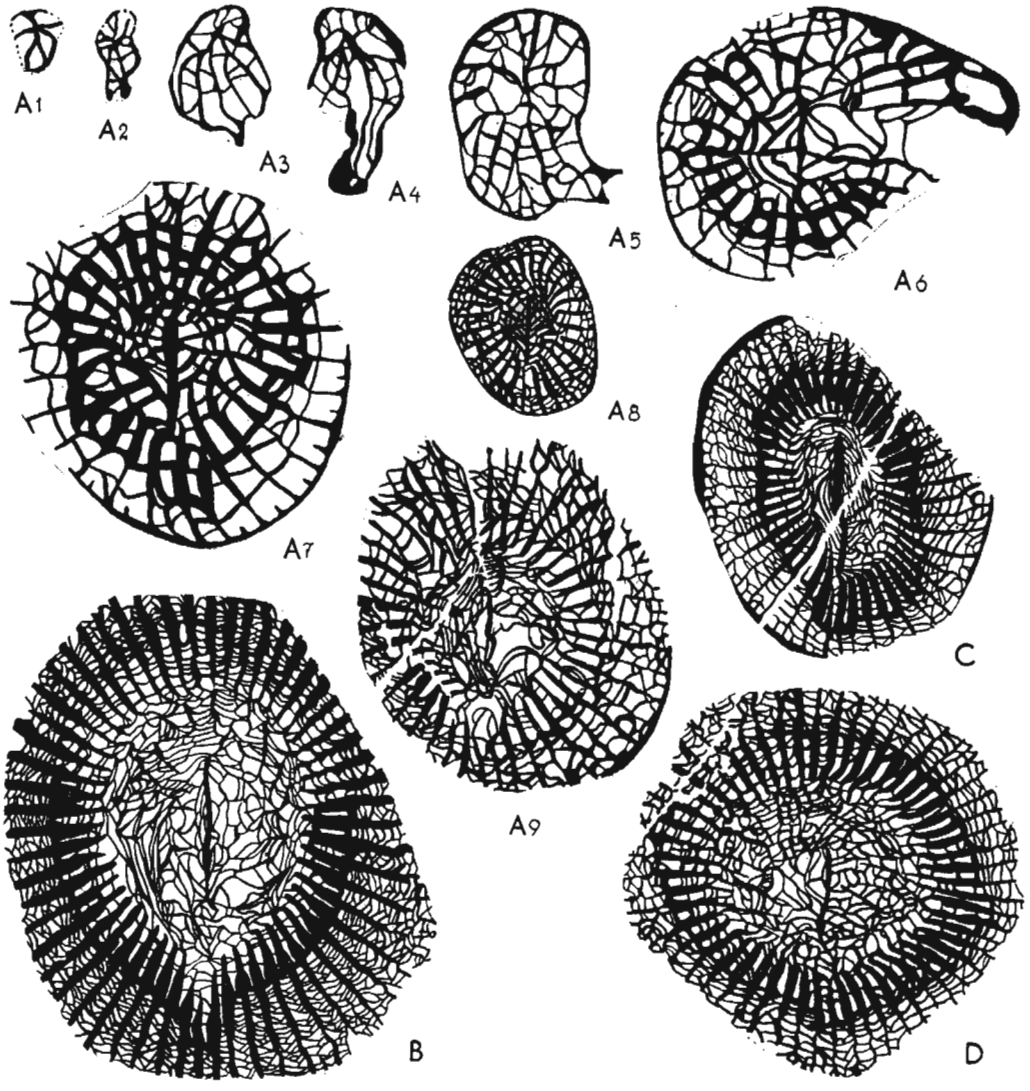

Fig. 19

Dibunophyllum bipartitum koninckí (M.-EDW. & H.): A_1 transverse section of the nepionic stage with 6 protosepta, × 5, A_{2-7} successive transverse sections of the neanic stage, × 5, A_8 transverse section of the early-ephebic stage, × 2, A_9 transverse section of the ephebic stage (Z. Pal. P. Tc-4/3168), × 2.

B transverse section of the ephebic stage (IG. OS-70/3174), Czerwieńczyce, Sudetes, Upper Viséan, D_2. *C* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2608); *D Dibunophyllum linnense* HILL, transverse section of the ephebic stage (Z. Pal. P. Tc-4/2545). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

All × 2

Remarks. — Many Polish specimens assigned to this subspecies, may be arranged in series leading to *D. bipartitum bipartitum* and *D. bipartitum craigianum*. There is also another group of specimens which could not be assigned to this development series and in which other morphological features are subject to changes such as, for instance, excessively and non-typically elongated minor septa which, with a short columella, make such corallites considerably similar to *Clisiophyllum keyserlingi*. Another type of variability is a large number of septa with an approximately the same diameter. A few corallites, including IG. OS-70/3174 and Z. Pal. P.Tc-4/2608 (Text-figs. 19*B*, *C*), display a specific modification of axial structure in which columella is long, almost straight and listlike, whereas septal lamellae wrap themselves around it and fuse with axial tabellae. They make up a fairly clearly separated group and perhaps exceed the boundaries of the individual variability of the species. In view of an almost straight columella characteristic rather of *D. bipartitum bipartitum*, their assignment to *D. bipartitum koninckі* may be also debatable. The writer believes that, despite the straight columella, specimens with such a very irregular axial structure could not be assigned to *D. bipartitum bipartitum*. In addition to the variability of septa and axial structure, considerable changes are recorded in the structure and width of dissepimentarium in which dissepiments of the herringbone type predominate, but in which angulo-concentric type is also observed and lateral cystose dissepiments are developed by some specimens. Changes correlated with the disappearance of columella are observed in the structure of tabularium. Axial tabellae take a vesicular form and arrange themselves in a domelike manner. A characteristic curvature of axial parts of tabellae turned upwards and to columella does not occur in numerous specimens. They reach columella in the form of a straight line, the same as in *Clisiophyllum*.

Occurrence. — Great Britain, France, Belgium, USSR, Japan, China, Poland — Upper Viséan.

Dibunophyllum bipartitum craigianum (THOMSON, 1874)

(Text-figs. 20*A*, B, 21; Pl. V, Figs. 4-8; Pl. XV, Figs. 7, 8)

1874. *Rhodophyllum craigianum* THOMSON; J. THOMSON, Descriptions..., p. 557, Pl. 20, Figs. 1, 1*a*.
?1882. *R. Carezi* BARROIS; CH. BARROIS, Recherches..., p. 311, Pl. 15, Fig. 9*a*, *b*.
1904. *Dibunophyllum Barboti* STUCKENBERG; A. STUCKENBERG, Korally i mšanki..., p. 55, Pl. 9, Fig. 6*a*, *b*.
1938-1941. *D. bipartitum craigianum* (THOMSON); D. HILL, A monograph..., p. 78, Pl. 3, Figs. 1-4 (*cum synon.*).

Material. — About 100 solitary corallites, without calices and with damaged proximal ends, only from the Holy Cross Mountains (this subspecies does not occur in the Sudetes). Measurable characters are given in a diagram in Text-fig. 21.

Diagnosis. — See HILL, 1938-1941, p. 78.

Remarks. — The main trends in the variability of axial structure in Polish specimens are as follows: 1) disappearance of columella with few slightly coiling septal lamellae; 2) disappearance of columella, septal lamellae axially coiled; axial part of structure looser than marginal; 3) septal lamellae extend towards columella and after its reduction they remain long; the extension of minor septa is sometimes correlated with this type of axial structure; 4) the "*Albertia*" THOMSON type of structure in which major septa are bluntly terminating and frequently deflected from cardinal fossula is seldom met with. Polish specimens differ from British ones mostly in more thickened structural elements, whereas a general structure, dimensions and trends of

variability are similar. A considerable individual variability seems to be a feature characteristic of the entire species *D. bipartitum*.

Occurrence. — Great Britain, D_2 (Upper Viséan) to E_{1-2} (Lower Namurian); USSR, Upper Viséan to Lower Namurian; France, Poland — Upper Viséan.

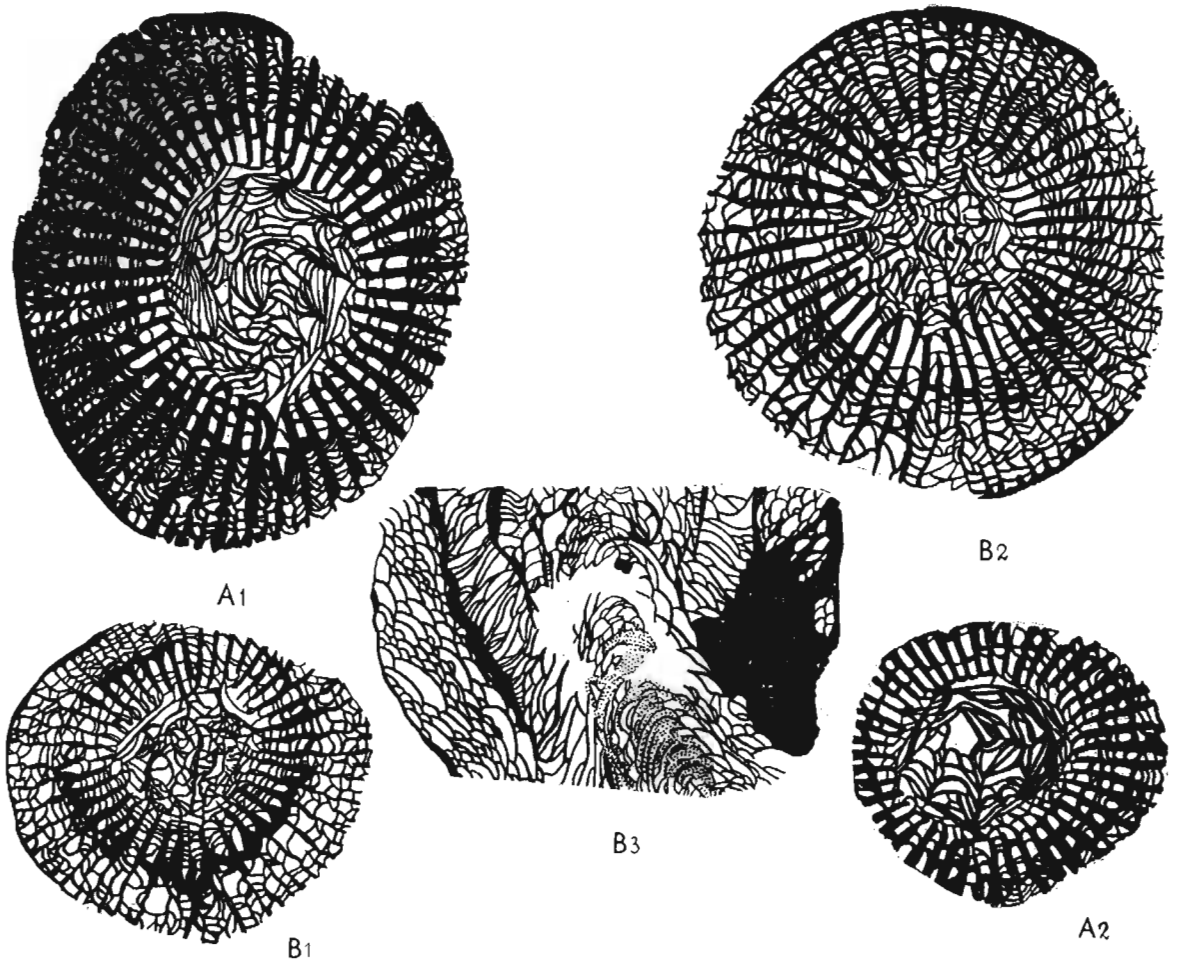

Fig. 20

Dibunophyllum bipartitum craigianum (THOMSON): A_1 transverse section of the ephebic stage, A_2 transverse section of the late-neanic stage (IG. OS-70/298); B_1 transverse section of the early-ephebic stage, B_2 transverse section of the ephebic stage, B_3 longitudinal section (IG. OS-70/243). Gałęzice, Holy Cross Mts., Upper Visean, D_2 (top); all × 2.

Dibunophyllum linnense HILL, 1938-1941

(Text-fig. 19*D*; Pl. V, Fig. 9)

1938-1941. *Dibunophyllum linnense* HILL; D. HILL, A monograph..., p. 81, Pl. 3, Figs. 5-7 (*cum synon.*).

Material. — One specimen, Z. Pal. P. Tc-4/2545.

Diagnosis. — See HILL, 1938-1941, p. 81.

Remarks. — The Polish specimen has a similar index of septa n/d = 56/28 as that, described by HILL (*l.c.*) from Scotland. Its morphology is also very like to HILL's holotype. Dissepimentarium is narrow, regular, minor septa short, or may be reduced, axial structure occupies more than 1/3 diameter of the corallite.

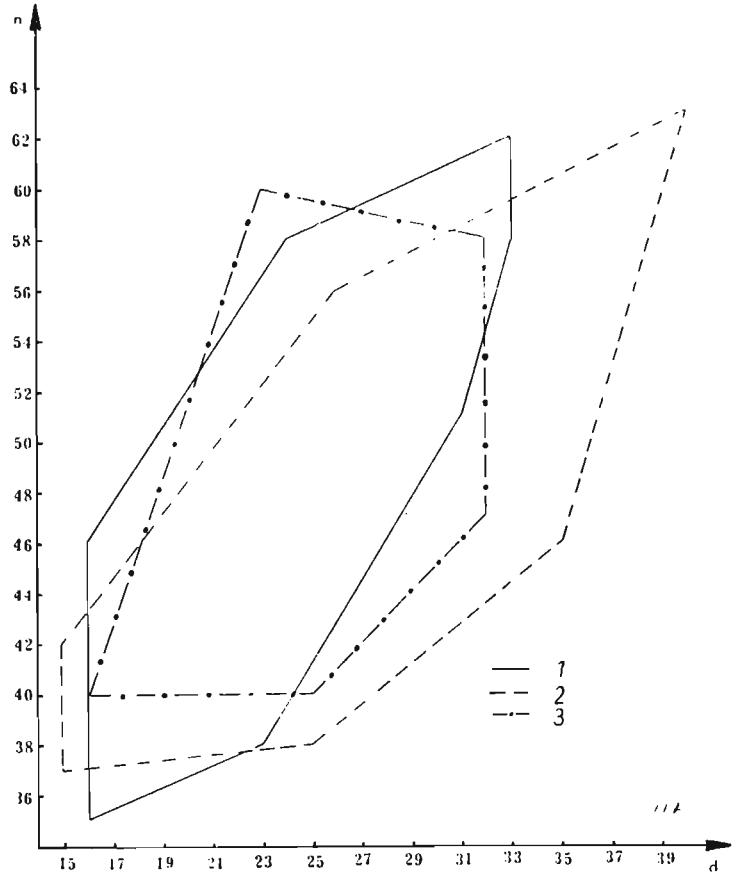

Fig. 21

Septal index (n/d) for some subspecies of *Dibunophyllum bipartitum* M'COY. Points corresponding to extreme species are united by lines. 1 — *D. bipartitum bipartitum* (M'COY), 2 — *D. bipartitum konincki* (M.-EDW & H.), 3 — *D. bipartitum craigianum* (THOM.).

The greatest differences between Polish specimen and holotype are: 1) axial structure occupies nearly 1/2 diameter of the corallite, 2) septal lamellae in the axial structure are more numerous than in the holotype. This last feature approximates the Polish specimen to the genus *Clisiophyllum*.

Occurrence. — Great Britain, Subzones E_1-E_2, Lower Namurian. Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Dibunophyllum pseudoturbinatum STUCKENBERG, 1904

Holotype: Specimens No. 106 and 107 (1 specimen, 2 fragments), collection No. 336 in TSCHERNYSCHEV's Museum, Leningrad. Specimen figured by STUCKENBERG (1904, Pl. 5, Figs. 7*b, c*) and the present paper (Text-figs. 22B_{1-2}).

Subspecies assigned: *Dibunophyllum pseudoturbinatum pseudoturbinatum* STUCKENBERG, 1904, *D. pseudoturbinatum medium* n. subsp., *D. pseudoturbinatum acolumellatum* n. subsp.

Diagnosis. — A *Dibunophyllum* 40 mm in diameter and with (46 to 56)×2 septa; axial structure occupies about 1/3 of the diameter of the corallite, minor septa long, at least some of them penetrating tabularium; cardinal fossula distinct; dissepimentarium occupies about 1/2 of the diameter of the corallite.

Remarks. — In addition to specimens with a regular axial structure, assigned to *D. pseudoturbinatum pseudoturbinatum*, the present writer's collection also contains corallites which display a clear trend in the variability of axial structure. In such specimens, columella becomes shortened, more and more irregular and finally, disappears. Only septal lamellae and axial tabellae remain in axial structure. It is, therefore, a development series which strictly corresponds to the *D. bipartitum bipartitum — konincki — craigianum* series. A morphological analysis of both species sensu lato (*D. bipartitum* and *D. pseudoturbinatum*) primarily results in the conclusion that they are extremely variable in almost all morphological details. There are two characters which by their stability are particularly conspicuous in this extensive range of variability. One of them, common for both species, is the width of axial structure which is always contained within 1/3 of the diameter of the corallite. The other stable feature is the length of minor septa characteristic of each of these species. In *D. bipartitum*, these septa penetrate not more than 1/2, sporadically at most 2/3 of the width of dissepimentarium and usually only 1/3. In *D. pseudoturbinatum*, at least some of minor septa in each section enter tabularium and thf shortest of them reach at least 2/3 of the width of dissepimentarium. Although this is an only character, in which both species differ from each other, but, since, as a result of its stability it predominates over the remaining, unusually variable characters, the present writer considers it to be a sufficient basis for maintaining STUCKENBERG'S species. Despite relatively great morphological differences, the specimens with a disappearing columella have, also on the basis of the length of minor septa, been considered as mere subspecies of *D. pseudoturbinatum*.

Dibunophyllum pseudoturbinatum pseudoturbinatum STUCKENBERG, 1904

(Text-figs. 22*A-D*, 25; Pl. VI, Figs. 1, 2; Pl. XV, Figs. 9, 10; Pl. XVI, Figs. 1*a-c*)

1904. *Dibunophyllum pseudoturbinatum* STUCKENBERG; A. STUCKENBERG, Korally i mšanki..., p. 56, Pl. 5, Fig. 7*a-c*
1913. *D. Douglasi* SALÉE; A. SALÉE, Le groupe..., p. 243, Pl. 9, Fig. 1, partim.
1923. *D. pseudoturbinatum* STUCKENBERG; A. J. PERNA; Korally..., p. 30, Pl. 3, Fig. 6.
1929. *D. vaughani* A. SALÉE; F. DAGUIN, Étude..., p. 25, Pl. 4, Fig. 3.
1935. *D. mülleri* HERITSCH; F. HERITSCH, Rugose Korallen..., p. 149, partim, Text-figs. 17, 18.
1937. *D. renzi* HERITSCH; F. HERITSCH, Rugose Korallen..., p. 209, Text-fig. 1.
1938. *D. tenniculum* GORSKY; I. I. GORSKY, Kamennougolnye..., p. 88, Pl. 12, Figs. 7-9; Text-figs. 45-47.
1938. *D. multiseptatum* GORSKY; I. I. GORSKY, *Ibid.*, p. 90, Pl. 13, Figs. 3, 4; Text-figs. 48, 49.
1951. *D. multiseptatum* GORSKY; I. I. GORSKY, Kamennougolnye..., p. 70, Pl. 16, Figs. 1*a-c*.
1951. *D.* aff. *douglasi* SALÉE; I. I. GORSKY, *Ibid.*, p. 70, Pl. 16, Fig. 3*a, b*.
1951. *D.* sp. aff. *vaughani* SALÉE; G. KOLOSVARY, Szabadbattyani..., p. 278, Pl. 7, Figs. 1-5; Pl. 8, Figs. 10, 11; Pl. 11, Fig. 25; Pl. 12, Fig. 30.
1960. *D. turbinatum longiseptata* VASSILJUK; N. P. VASSILJUK, Nižnekamennougolnye..., p. 135, Pl. 34, Figs. 2, 2*a*, 2*b*, Pl. 35, Figs. 1, 1*a*.
1960. *D. pseudoturbinatum* STUCKENBERG; N. P. VASSILJUK, *Ibid.*, p. 136, Pl. 35, Figs. 2, 2*a*.
?1964. *D. pseudoturbinatum* STUCKENBERG; N. P. VASSILJUK, Korally zon..., p. 74, Pl. 4, Fig. 11.
1964. *D. turbinatum longiseptata* VASSILJUK; N. P. VASSILJUK, *Ibid.*, p. 73.

Material. — About 100 solitary corallites without proximal ends, some of them with calices. Measurable characters shown in a diagram in Text-fig. 25.

Diagnosis. — A *Dibunophyllum pseudoturbinatum* with a regular axial structure and a long, straight columella.

TABLE 5

Morphologically-comparative table of *Dibunophyllum pseudoturbinatum* STUCKENBERG

Subspecies	Cardinal septum	Cardinal fossula	Major septa	Thickness of major septa	Minor septa	Axial structure	Median plate	Septal lamellae	Dissepimentarium	Axial structure in longitudinal section	n/d	dd/dc
Dibunophyllum pseudoturbinatum pseudoturbinatum STUCKENBERG	short	slightly merged in dissepimentarium	continuous, long	thickened of 1/2 dissepimentarium	into tabularium	regular	straight	straight	regular, rare, irregular or pseudo-herringbone	separated	55 : 29	~1/3
D. pseudoturbinatum medium n. subsp.	short	slightly merged in dissepimentarium	continuous, long	thickened of 1/2 dissepimentarium	= dissepimentarium or into tabularium	irregular	thin, curved, shortened	straight or twisted	regular, rare, irregular or pseudo-herringbone	separated	52 : 36	~1/3
D. pseudoturbinatum acolumellatum n. subsp.	short thin	slightly merged in dissepimentarium	continuous, long	thickened of 2/3 dissepimentarium	into tabularium or slightly shortened	irregular	reduced	straight or twisted	regular, rare, irregular or pseudo-herringbone	separated	52 : 38	~1/3

Remarks. — A few species (cf. synonymy), differing from each other in secondary characters, usually being subject to a considerable individual variability, were described by GORSKY (1938, 1951) from the Viséan and Namurian of Novaya Zemla. Since at least some of them are described on the basis of single specimens, this author does not determine the range of variability

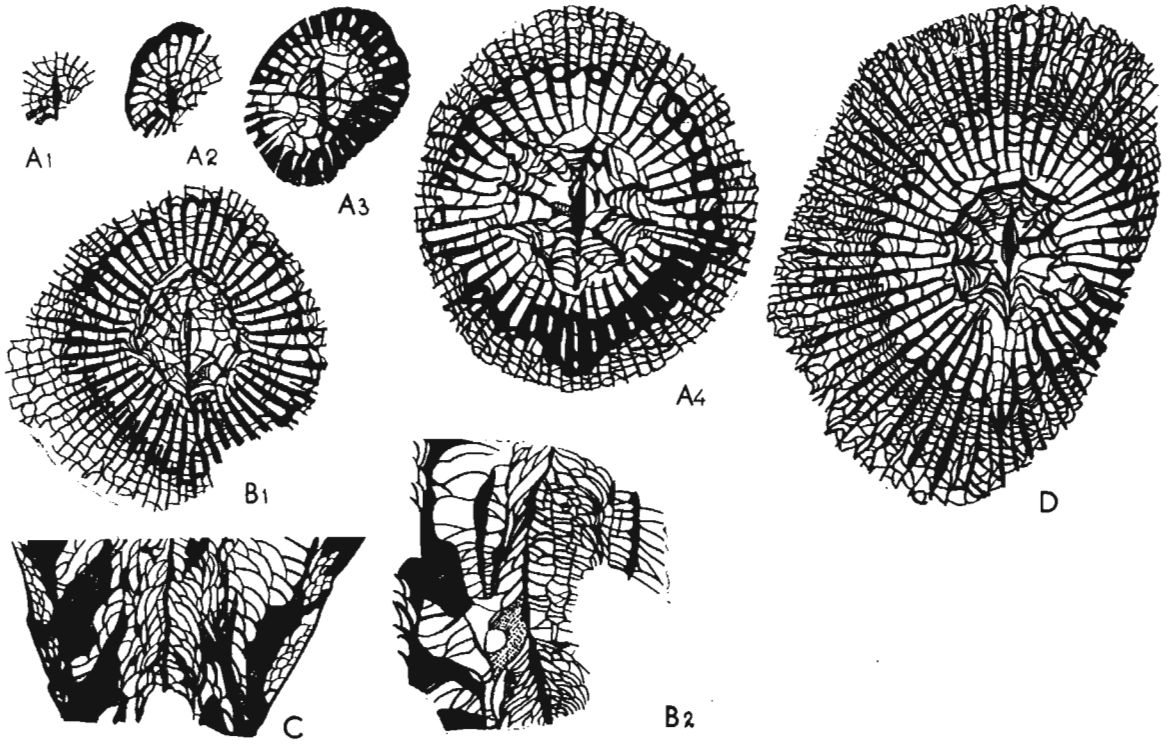

Fig. 22

Dibunophyllum pseudoturbinatum pseudoturbinatum STUCKENBERG: A_{1-3} successive transverse sections of the neanic stage, A_4 transverse section of the ephebic stage (IG. OS-70/2236); Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top). B_1 transverse section of the ephebic stage, holotype (No. 106/336), USSR, B_2 longitudinal section (the same specimen, but with No. 107/336), Lower Carboniferous; *C* longitudinal section (IG. OS-70/1256), Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); *D* transverse section of the ephebic stage (IG. OS-70/2423), the same locality and horizon. All × 2

of these species. In the present writer's opinion, they are conspecific with *D. pseudoturbinatum pseudoturbinatum* STUCKENBERG. Specimens, described by VASSILJUK (1960, 1964) as *D. pseudoturbinatum* STUCKENBERG and *D. turbinatum longiseptatum* VASSILJUK, are, according to the present writer who had the opportunity to study the originals, conspecific. The only difference, i.e. a larger or smaller regularity of axial structure, is not in VASSILJUK's specimens sufficiently predominant to consider it as diagnostic character. In all cases, columella is strongly developed and only septal lamellae are subject to changes. Among VASSILJUK's specimens, the least similar to the holotype is that recently described by her (1964, Pl. 4, Fig. 11). It has non-typically shortened minor septa, which makes it very similar to *D. bipartitum koninckí*. In the present paper, it has only with a reservation been included in the synonymy.

Polish specimens are marked by a considerable variability in dimensions and member of septa, width of dissepimentarium and extent to which septa are thickened. On the other hand, the width of axial structure in relation to the diameter of corallite, a long, strongly developed

columella and long minor septa are stable characters. These stable characters, also predominating in the remaining species included in the synonymy, have been considered by the present writer to be diagnostic features for *D. pseudoturbinatum pseudoturbinatum.*

Occurrence. — USSR (Ural Mts., Donets Basin, Novaya Zemla) — Upper Viséan to Lower Namurian; Czechoslovakia, Hungary, North Africa — Viséan; Belgium — Viséan; Poland (Holy Cross Mts.), Upper Viséan, D_2 (top).

Dibunophyllum pseudoturbinatum medium n. subsp.

(Text-figs. 23*A*, *B*, 25; Pl. VI, Fig. 3; Pl. XVI, Figs. 2-5)

Holotype: Specimen IG. OS-70/2136 (Pl. VI, Fig. 3).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *medium* — intermediate between *D. pseudoturbinatum pseudoturbinatum* and *D. pseudoturbinatum acolumellatum* n. subsp.

Material. — Twenty solitary corallites without proximal ends, one of them with a preserved calice. Measurable characters shown in a diagram in Text-fig. 25.

Diagnosis. — A *Dibunophyllum pseudoturbinatum* with an irregular axial structure in which columella is still preserved in the form of a shortened lamella.

Description. — *Transverse section* (Text-figs. 23 *A*, B_1; Pl. VI, Fig. 3; Pl. XVI, Figs. 2, 3*a*, 4, 5): Epitheca thin. Septal bases thickened. Major septa may be either fused with septal lamellae

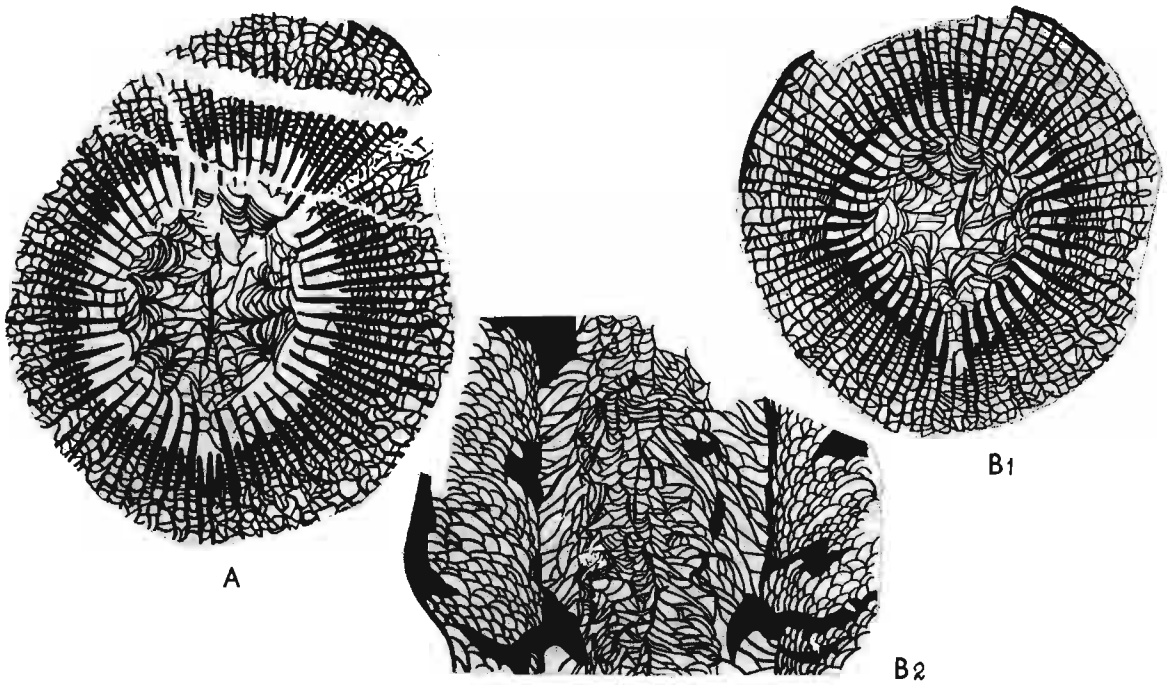

Fig. 23
Dibunophyllum pseudoturbinatum medium n. subsp.: *A* transverse section of the ephebic stage, holotype (IG. OS-70/2136); B_1 transverse section of the ephebic stage, B_2 longitudinal section (IG. OS-70/2137). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

or slightly penetrate axial structure. Minor septa reach at least the inner wall. In the inner part of tabularium and in dissepimentarium their ends are thickened. Axial structure of the intermediate type between the nominal subspecies and *D. pseudoturbinatum acolumellatum* n. subsp.

Longitudinal section (Text-fig. 23B_2; Pl. XVI, Fig. 3*b*): Dissepiments convex, varying in size, arranged semicircularly. Tabellae in axial structure small, irregularly and flatly arranged. Peripheral tabellae slightly elevated, axial structure, vesicular.

Individual variability. — Individual specimens differ from each other in the length and thickness of minor septa and in axial structure considerably varying in details. In sections of younger parts, columella almost straight and long; it may remain almost completely unchanged up to the end of ontogeny. In most specimens, it shortens, bends and becomes thinner and thinner. Sometimes, it happens to be difficult to distinguish from septal lamellae. The remaining morphological and measurable characters are subject to very small changes, the subspecies being exceptionally stable morphologically.

Remarks. — It differs from the remaining subspecies only in diagnostic characters.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Dibunophyllum pseudoturbinatum acolumellatum n. subsp.

(Text-figs. 24*A-F*, 25; Pl. VI, Figs. 4*a*, *b*, 5; Pl. XVI, Figs. 6, 7; Pl. XVII, Fig. 1)

Holotype: Specimen IG. OS-70/297 (Pl. VI, Fig. 4).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *acolumellatum* — devoid of columella.

Material. — About 50 solitary corallites, some of them with calices, without proximal ends. Measurable characters shown in a diagram in Text-fig. 25.

Diagnosis. — A *Dibunophyllum pseudoturbinatum* with axial structure devoid of columella.

Description. — *Transverse section* (Text-figs. 24*A*, C_1, $D_{1,2}$, *E*, *F*; Pl. VI, Figs. 4*a*, 5*a*; Pl. XVI, Figs. 6, 7): Epitheca to 0.5 mm thick, with growth wrinkles only. Septal bases thickened. In some specimens, major septa more strongly thickened in cardinal quadrants, mostly reaching axial structure. Three fossulae, i.e.: a cardinal one more strongly merged in dissepimentarium and two alar ones may be outlined in younger stages. In younger stages, axial structure has a columella, in the late-neanic and ephebic stages, only septal lamellae remain. They are distinct and in many cases arranged regularly when situated opposite each other, their axial ends are deflected from each other. Number of lamellae 12-18; usually, they are slightly whorled. Axial tabellae, more concentrated in the marginal part of the structure, occur between lamellae. Dissepiments mostly rectangular or irregular. Dissepiments of the herringbone type occur.

Longitudinal section (Text-figs. 24B, C_2; Pl. XVII, Fig. 1): Dissepimentarium consisting of convex dissepiments, varying in size and arranged semicircularly or steeply or, as is the case of a thickened inner row, even vertically. In the marginal part of tabularium, periaxial tabulae vesicular, convex, gently rising towards axial structure. Close to dissepimentarium, some tabellae are horizontal. Axial structure wide, devoid of columella, with a few sections of septal lamellae. Axial tabellae less convex and more densely arranged than peripheral ones.

Individual variability. — The following two groups of specimens may be distinguished in the subspecies described: 1) those more similar to the holotype and having wide axial structure in which lamellae are irregularly arranged on the margin and relatively few septa with a large diameter of corallites; 2) those consisting of smaller corallites having many septa. Axial structure occupies little more than 1/4 of the diameter of corallite and is formed by a few thick lamellae

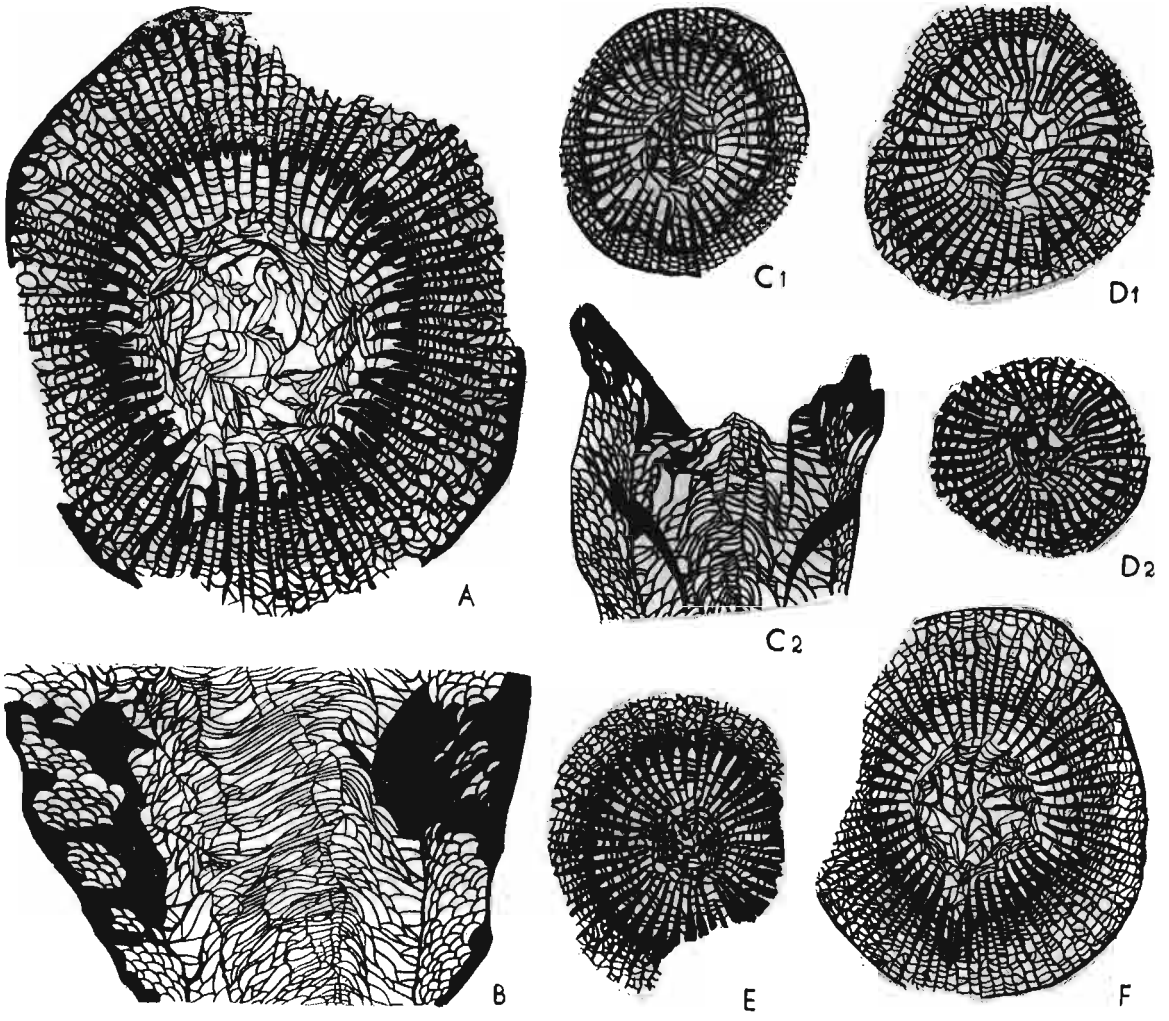

Fig. 24

Dibunophyllum pseudoturbinatum acolumellatum n. subsp.: *A* transverse section of the ephebic stage, holotype (IG. OS-70/297); *B* longitudinal section (IG. OS-70/477); C_1 transverse section of the ephebic stage, C_2 longitudinal section (IG. OS-70/924); D_1 transverse section of the ephebic stage, D_2 transverse section of the early-ephebic stage (IG. OS-70/1311*a*); *E* transverse section of the ephebic stage (IG. OS-70/806); *F* transverse section of the ephebic stage (IG. OS-70/2138). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

(specimen OS-70/924; Text-fig. 24C and others). Since in the ephebic stage they are devoid of columella and have long minor septa, both groups have been included by the writer to a common subspecies. Apart from those mentioned above, the most important differences are as follows:

1) the ratio of the width of axial structure to the diameter of corallite varies from 1/4 to 1/3; axial structure may be composed of a varying number of septal lamellae (8-16), arranged regularly or at random; 2) the width of dissepimentarium fluctuates between 1/4 to nearly 1/2 of the diameter of corallite; dissepimentaria of corallites younger ontogenetically are narrower but this correlation is not equally strict in all cases; 3) the length of minor septa is variable in all specimens, not excepting the holotype; numerous are the septa which penetrate tabularium, almost equally numerous being those reaching the inner wall only; shortened septa are, however, also met with in the same section with those mentioned above; 4) a developmental heterochronism is observed in axial structure in which columella may disappear either in the neanic or as late as in an advanced ephebic stage as, for instance, in the holotype.

Remarks. — Certain characters of the subspecies described relate it to the genera *Auloclisia* and *Slimoniphyllum*. These are: long minor septa, disappearance of columella and usually strong development of alar fossulae. However, the genera referred to above are primarily marked by a different ontogeny without a characteristic dibunophylloid stage. In addition, tabellae are a predominant element of axial structure in *Auloclisia*, whereas in *Slimoniphyllum* fossula

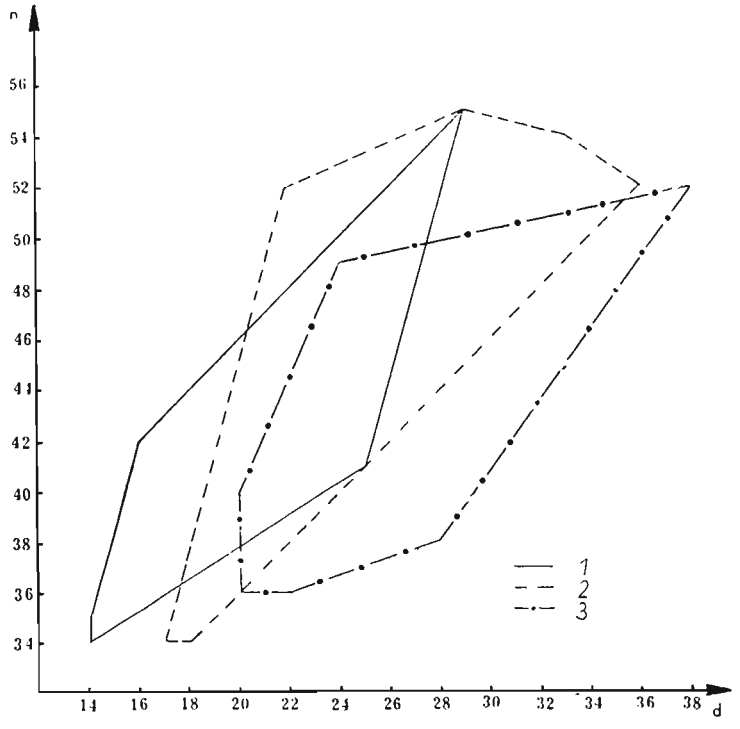

Fig. 25

Septal index (n/d) for some subspecies of *Dibunophyllum pseudoturbinatum*. The points corresponding to extreme specimens are united by lines. 1 — *D. pseudoturbinatum pseudoturbinatum* (STUCK.), 2 — *D. pseudoturbinatum medium* n. subsp., 3 — *D. pseudoturbinatum acolumellatum* n. subsp.

occurs near counter septum. None of these characters is recorded in the specimens described above. *Rhodophyllum* (= *Dibunophyllum*) *fukudai* MINATO & KATO, 1957 is a species the most similar to Polish specimens which differ from it only in the number of septa, denser axial structure

and tabularium (in longitudinal section) which in Japanese specimens consists mostly of complete tabulae stretched between dissepimentarium and axial structure. The subspecies described differs from the remaining subspecies of *D. pseudoturbinatum* in diagnostic characters.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Dibunophyllum lonsdaleioides VASSILJUK, 1960

(Text-figs. 26A_{1-3})

1960. *Dibunophyllum lonsdaleioides* VASSILJUK; N. P. VASSILJUK, Nižnekamennougolnye..., p. 143, Pl. 35, Figs. 3-3*b*.

Material. — A specimen with a partly preserved proximal end and calice. Dimensions: with a diameter of 0.7×1.0 cm — 26 septa and with a diameter of 2.2 cm — 34 septa.

Diagnosis. — "A middle-sized solitary corallite with a wide axial structure of the type of *D. bipartitum konincki* (E. & H.) and a peripheral zone consisting of small lonsdaleioid vesicles" (after VASSILJUK, 1960, p. 143).

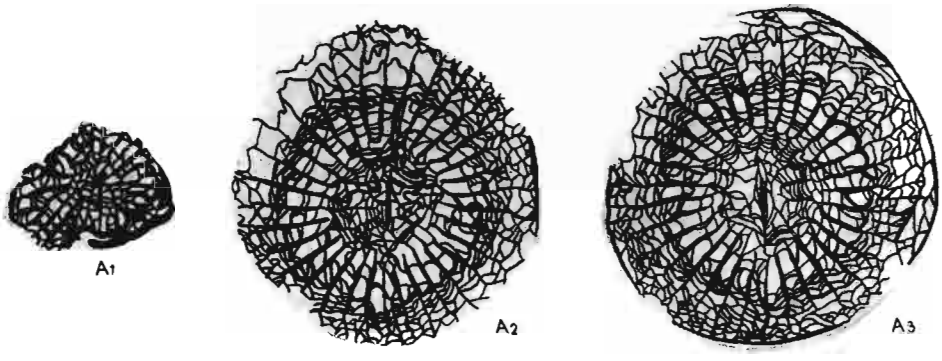

Fig. 26

Dibunophyllum lonsdaleioides VASSILJUK: A_1 transverse section of the neanic stage, $A_{2,3}$ transverse sections of the ephebic stage (IG. OS-70/167). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all $\times$ 2.

Remarks. — A detailed description and comparison of the species, based in fact also on a single specimen, was given by VASSILJUK (1960, pp. 143-145). The Polish specimen displays certain differences in the composition of axial structure consisting of septal lamellae more numerous and regularly arranged than those in the holotype. On the whole, they are not fused with columella. In addition, it has larger peripheral vesicles and dissepiments and with an approximating diameter, a somewhat smaller number of septa. As emphasized also by VASSILJUK (*l. c.*), since the occurrence of peripheral vesicles is not included in the diagnosis of the genus, the generic position is uncertain. However, on the basis of this single character it is difficult to erect even a new subgenus while all other characters are concordant. It is all the more inadvisable since only two specimens of this species have hitherto been described.

Occurrence. — USSR (Donets Basin), Lower Namurian; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Dibunophyllum lissitzini VASSILJUK, 1960

(Text-fig. 27*C-E*; Pl. XVII, Figs. 2*a-c*, 3*a*, *b*)

1960. *Dibunophyllum lissitzini* VASSILJUK; N. P. VASSILJUK, Nižnekamennougolnye..., p. 131, Pl. 31, Figs. 1-1*b*.

Material. — Five solitary corallites devoid of proximal ends and calices. Dimensions (in mm):

IG. OS-70/	Index of septa n/d
510	43 : 30×26
2102	46 : 29×26
2103	40 : 28×24
2104	40 : 26×23
2238	45 : 26×21

Revised diagnosis. — A *Dibunophyllum* to 30 mm in diameter and (40 to 46)×2 septa; axial structure irregular, occupying about 1/5 and dissepimentarium more than 1/2 of the diameter of corallite; most or all minor septa entering tabularium.

Description. — *Transverse section* (Text-fig. 27 $C_{1,2}$, D_1, *E*; Pl. XVII, Figs. 2*b*, *c*, 3 *a*, *b*): Epitheca to 0.5 mm thick, wavy; septa embedded in it are conspicuously thickened at their bases. Major septa are the widest in a thickened inner wall. Minor septa thin over their entire length in dissepimentarium clearly differing from major septa. Only their ends are thickened in tabularium. In some specimens, some minor septa are subject to strong atrophy and may be withdrawn as far as epitheca, whereas the remaining minor septa in this same section are normally developed (Text-fig. 27 D_1). Columella thin, extending as far as cardinal fossula and only in younger ontogenetic stages may be swollen in some specimens. Septal lamellae irregular, usually not fused with columella. Tabellae few, scattered at random.

Longitudinal section (Text-fig. 27 D_2; Pl. XVII, Fig. 2*a*): Dissepiments varying in size, convex, semicircularly arranged. Tabulae long, vesicular, some of them intersecting the entire peripheral part of tabularium. In axial structure, tabellae small, vesicular, arranged more or less in a domelike manner, in the marginal part of the structure almost vertical. Columella thin, twisted, discontinuous.

Individual variability. — The width of dissepimentarium varies from 1/2 to almost 2/3 of the diameter of corallite. Minor septa in principle entering tabularium but some of them may be subject to strong atrophy. With its very small and stable diameter, axial structure is so variable in details that, strictly speaking, it is different in each of the sections of one and the same corallite. A columella, extended towards cardinal fossula, occurs in all cases.

Remarks. — *D. lissitzini* differs from the remaining species of *Dibunophyllum*, except for *D. lonsdaleioides*, in the occurrence of peripheral vesicles. This is, however, the only character in common with *D. lonsdaleioides*. VASSILJUK (1960, p. 132) compares *D. lissitzini* with the genus *Arachnolasma* to which it is similar in a narrow axial structure inconspicuous (in this author's specimens) in longitudinal section. The morphology of Polish specimens corresponds to those from Donets Basin only in transverse section. Slight differences such as a poorer development of peripheral vesicles and a somewhat narrower axial structure, may be disregarded. Longitudinal

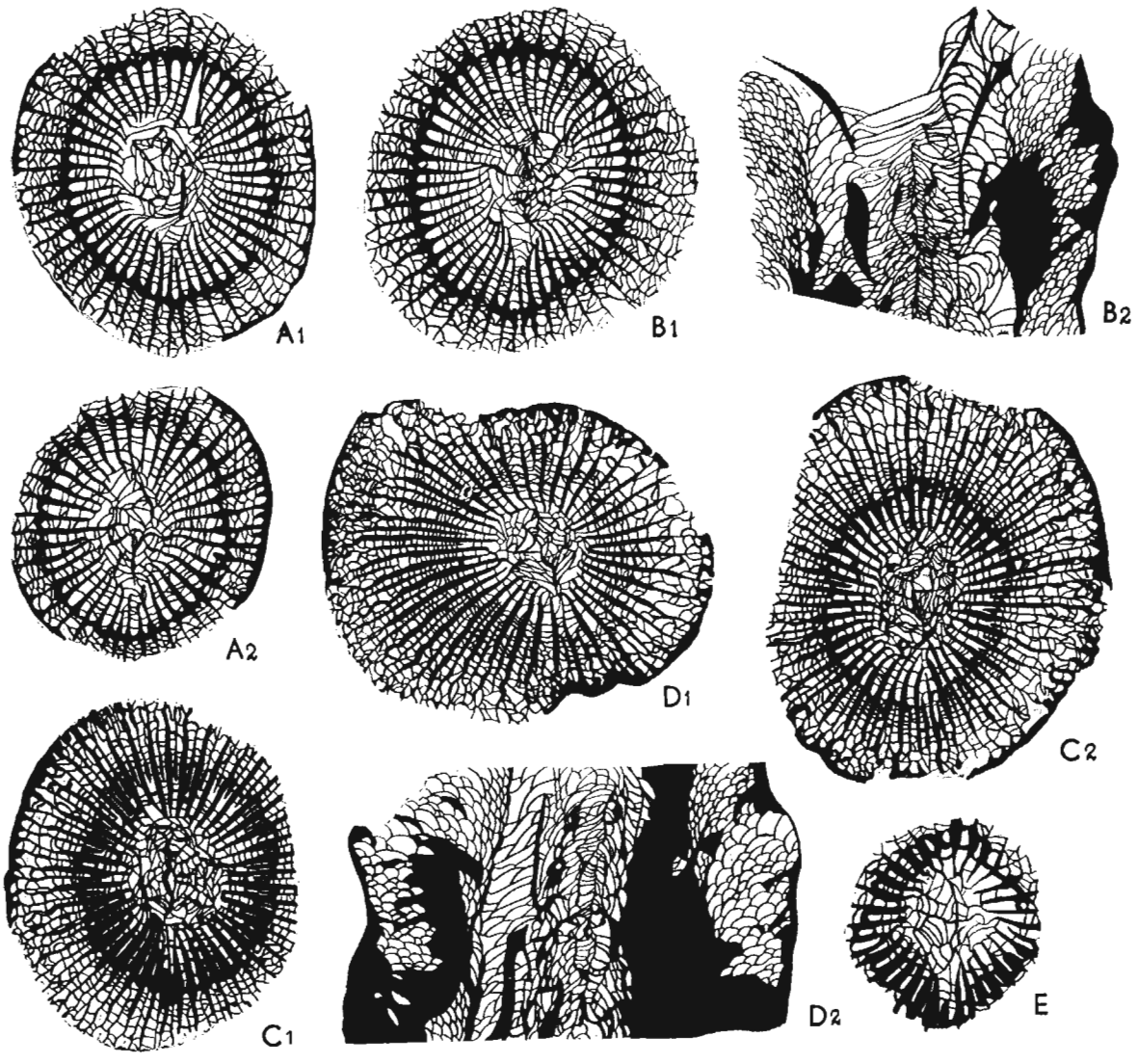

Fig. 27

Dibunophyllum reductum n. sp.: A_1 transverse section of the ephebic stage, holotype, A_2 transverse section of the early ephebic stage (IG. OS-70/869); B_1 transverse section of the ephebic stage, B_2 longitudinal section (IG. OS-70/865). *C-E Dibunophyllum lissitzini* VASSILJUK: C_1 transverse section of the early-ephebic stage, C_2 transverse section of the ephebic stage (IG. OS-70/2102); D_1 transverse section of the ephebic stage, D_2 longitudinal section (IG. OS-70/2103); *E* transverse section of the late-neanic stage (IG. OS-70/510). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

section is different. In Polish specimens, axial structure is conspicuous and irregular, whereas in those from Donets Basin it resembles the type of structure observed in *Koninckophyllum*. Despite this indubitably important difference, but on the basis of the similarity in transverse section, more important diagnostically, the writer has resolved to consider Polish specimens to be conspecific with those from Donets Basin.

Occurrence. — USSR (Donets Basin), Lower Viséan, $C_1^{\gamma}d$; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Dibunophyllum percrassum GORSKY, 1951

(Text-figs. 28*A-G*; Pl. VII, Figs. 1, 2; Pl. XVII, Figs. 4*a*, *b*; Pl. XVIII, Figs. 1, 2)

1951. *Dibunophyllum percrassum* GORSKY; I. I. GORSKY, Kamennougolnye..., p. 72, Pl. 16, Fig. 5*a*, *b*.
1960. *D. derbiensiformis* VASSILJUK; N. P. VASSILJUK, Kamennougolnye..., p. 140, Pl. 37, Figs. 1, 1*a*.
1960. *D. arachnoformis* VASSILJUK; N. P. VASSILJUK, *Ibid.*, p. 142, Pl. 37, Figs. 2, 2*a*.

Material. — More than 40 solitary corallites, some of them with calices and partly preserved proximal ends.

Dimensions (in mm):

Specimen	Index of septa n/d
IG. OS-70/	
641*a*	40 : 21
728	50 : 27
817	52 : 29
1686	42 : 20
2092	50 : 23
2643	49 : 24
2752	46 : 33
Z. Pal. P. Tc-4/	
2014	46 : 26
2934	48 : 21

Revised diagnosis. — A *Dibunophyllum* to 30 mm in diameter and with (40 to 52) ×2 septa; axial structure occupying 1/4—1/5 of the diameter of corallite, conspicuous in longitudinal section; mostly thick deposits of stereoplasma occur on major septa in tabularium and in dissepimentarium; minor septa shortened, sometimes reduced.

Remarks. — This species was described by GORSKY (1951) on the basis of one only specimen and consequently he did not take into account its specific variability. The following differences were observed by the present writer in Polish specimens:

1) Variability in axial structure. The width of axial structure in relation to the diameter of corallite and massive columella which, in the form of a thin lamella, extends towards cardinal septum, are relatively stable characters. The separation of axial structure is subject to a trend. In extreme cases, such as, for instance, IG. OS-70/2092 (Text-fig. 28 C_1), many lamellae are fused with septa and axial structure is not separated from them. In the holotype, axial structure is more conspicuous but many septa are still connected with lamellae, which was emphasized in GORSKY's (*l. c.*) description. This group of individuals with partly separated structure seems to be the most numerous. Extreme specimens, for instance, IG. OS-70/641 a (Text-fig. 28 *B*) have axial structure which is not only conspicuous but also even partly separated from septa by a stereoplasmatic wall.

2) The length of minor septa varies independently of other structural elements. Typically, they are very short and even disappear between some of major septa. In other specimens, examined by the writer, especially in narrow-dissepimental ones, they may reach 2/3 of the width of dissepimentarium. However, only some of minor septa are subject to elongation.

3) A characteristic thickening of septa in dissepimentarium, described by GORSKY (*l. c.*), seems to be on the whole typical and diagnostic for the species. The present writer would,

however, like to emphasize that the swellings of septa of the same type may also occur in other species of *Dibunophyllum*, described in the present paper, and consequently no great store should be set by this character. The degree of thickening is fairly different in particular corallites. In addition, dissepimental segments of septa may be thickened to a smaller and tabular to a greater extent than in the holotype (Text-fig. 28*B*, C_1). Tabular segments may also differ in length which is correlated with the width of dissepimentarium since, in all cases, septa reach points near axial structure.

4) An usually wider dissepimentarium consists of dissepiments of the rectangular, herring-bone and, on the periphery, frequently irregular type. The finest dissepiments occur near the inner wall. Each of the types of dissepiments mentioned above may predominate in some individuals. The width of dissepimentarium increases with the ontogenetic age of corallites and in the ephebic stage it fluctuates within limits of 1/3 and 1/2 of the diameter of corallite.

The ontogeny, studied by the writer (Text-fig. 28A_{1-14}), has not been here described being typical of the genus *Dibunophyllum*. Young ontogenetic stages of *D. percrassum* differ from ephebic stages in, among other characters, long minor septa. Characteristic differences in the ontogeny of two individuals, grown with each other, were shown.

Two species from Donets Basin, *D. arachnoforme* VASSILJUK and *D. derbiensiforme* VASSILJUK have been included by the writer in the synonymy of *D. percrassum*. They differ from each other in the thickness of columella and in some minor septa which are longer or shorter. These characters, as more than once found by the writer, are in *Dibunophyllum* very variable and no great store should be set by them. They differ from the holotype of *D. percrassum* mostly in less thickened septa in dissepimentarium and, with the same number of septa, in a slightly larger diameter. These are also not very significant characters which, as mentioned above, are, in *D. percrassum*, subject to considerable fluctuations. On the other hand, diagnostic characters, in particular the width of axial structure, as compared with the diameter of corallite, and longitudinal sections are similar to such an extent that erecting separate species becomes ill-founded.

Apart from the individual variability, discussed above, most Polish specimens differ from the holotype in the structure of major septa. Their tabular segments are longer and dissepimental less thickened. Likewise, no stereoplasmatic swellings have been found on axial tabellae of Polish specimens. Such swellings may occur only in the marginal part of axial structure. These characters make Polish specimens similar to those from Donets Basin. *D. percrassum* belongs to the group of species with a narrow axial structure related to the genus *Arachnolasma*. The conspicuous axial structure is the main character distinguishing this species.

Occurrence. — USSR (Novaya Zemla), Upper Viséan to Lower Namurian; Donets Basin, Lower Namurian. Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Dibunophyllum reductum n. sp.

(Text-figs. 27*A*, *B*; Pl. VI, Fig. 6; Pl. VII, Figs. 3, 4; Pl. XVII, Figs. 5, 6)

Holotype: Specimen IG. OS-70/869 (Pl. VII, Fig. 3).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *reductum* — after a reduced columella and atrophied minor septa.

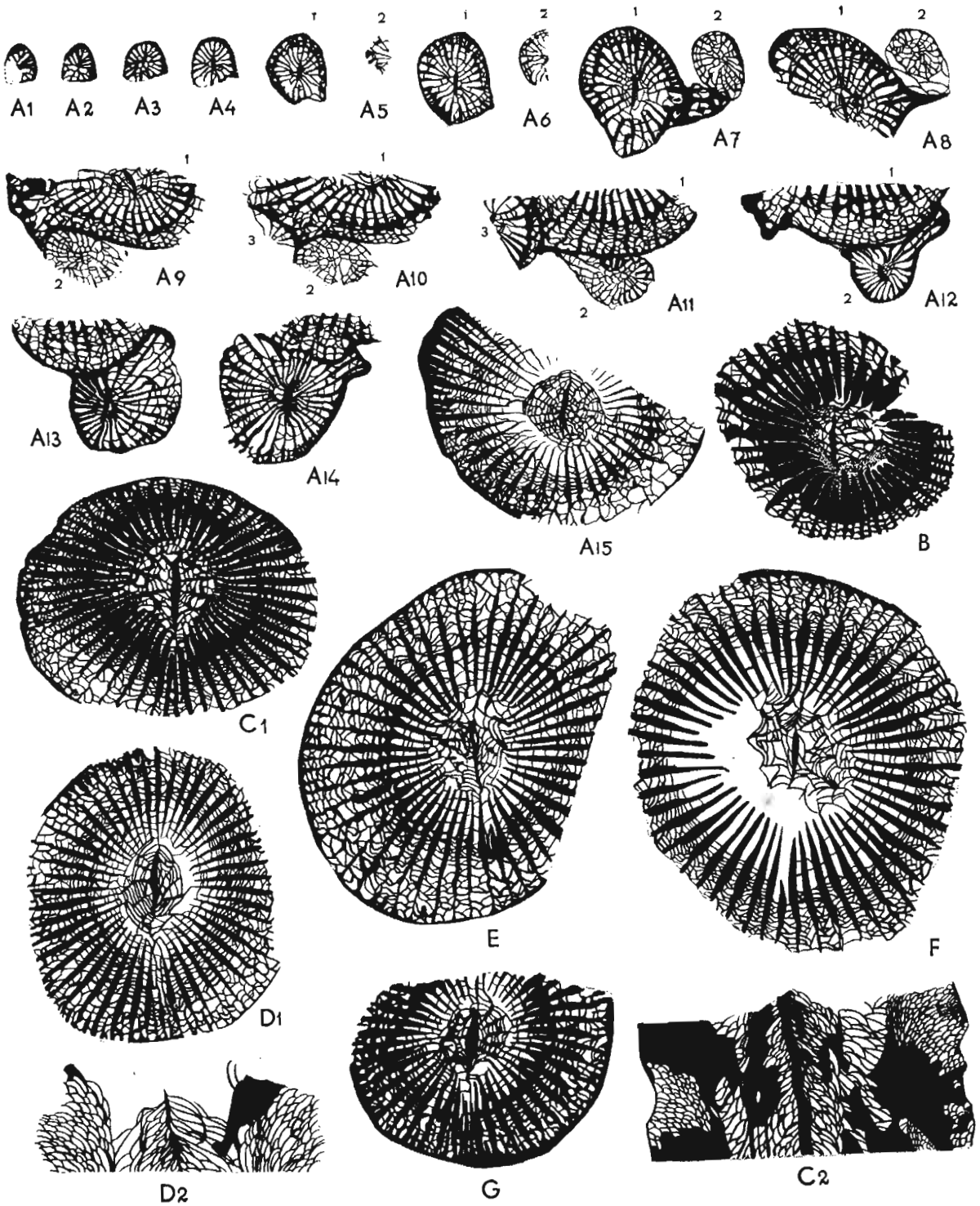

Fig. 28

Material. — Eight solitary corallites without calices and proximal ends. Dimensions (in mm):

IG. OS-70/	Index of septa n/d
865	48 : 24×22
869	49 : 24×22
869	41 : 19×17
876	46 : 21×16
924	41 : 19×18
928	44 : 17×16

Diagnosis. — A *Dibunophyllum* to 25 mm in diameter and with 49 septa; axial structure occupying less than 1/4 of the diameter of corallite; beginning with the late-neanic stage devoid of columella; cardinal fossula extended towards the axis; minor septa very short, in part atrophied.

Description. — *Transverse section* (Text-figs. 27$A_{1,2}$ B_1; Pl. VI, Fig. 6; Pl. VII, Figs. 3*a*, 4; Pl. XVII, Figs. 5*b*, 6): Major septa reaching axial structure near which their ends are deflected and, in some cases, fused with septal lamellae. One to three pairs of septa, adjoining cardinal septum, have axial ends deflected outwards and, consequently, cardinal fossula markedly extends, like in the genus *Palaeosmilia*, towards the axis. In the course of the ontogenetic development, minor septa shorten. Dissepiments mostly of the herringbone type, denser near the thickened inner wall. Axial structure, consisting — in younger sections — of a short columella, running in extension of cardinal septum close to cardinal fossula and a few thickened septal lamellae. Lamellae may be whorled as in the holotype or more radially arranged.

Longitudinal section (Text-fig. 27B_2; Pl. XVII, Fig. 5): Dissepiments semicircularly arranged. Axial structure differs from the rest of tabularium in the density of disposition of tabellae which here are smaller and less convex. Axial structure of the specimen illustrated (Text-fig. 27B_2) atrophies under the calyx and axial tabellae become flatter. Here takes place a rejuvenescence which, however, remains with no effect and corallite stops developing.

Individual variability. — This species is among those morphologically stable. The following differences have been observed: lamellae in axial structure are either mostly free or mostly fused with major septa and arranged distinctly radially or spirally, but the width of structure remains unchanged. Cardinal fossula is separated to a varying extent. Sometimes, in addition to cardinal septum, it contains 1-2 shortened major septa. Specimen OS 70/928 (Pl. VII, Fig. 4), has a few structures resembling fossulae. These structures seem, however, to be caused by some impurities, subsequently built round by the skeleton and, therefore, no diagnostic importance is attached to them by the writer.

Fig. 28

Dibunophyllum percrassum GORSKY: A_{1-4} successive transverse sections of the early-neanic stage of the corallite 1, A_{5-9} successive transverse sections of the neanic stage of corallites 1 et 2 (non typical, stoped development corallite 2), $A_{10, 11}$ to two preceding corallites joined the third, A_{12-14} corallite 1 probably deadened, corallite 2 began a normal, very quick, development in neanic stage, A_{15} transverse section of the ephebic stage of the corallite 2 (IG. OS-70/1993); *B* transverse section of the ephebic stage (IG. OS-70/641 a); C_1 transverse section of the ephebic stage, C_2 longitudinal section (IG. OS-70/2092); D_1 transverse section of the ephebic stage, D_2 longitudinal section (IG. OS-70/2643); *E* transverse section of the ephebic stage (IG. OS-70/2014); *F* transverse section at the base of calice (IG. OS-70/817); *G* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2098). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

Remarks. — In the composition of its axial structure, this species is similar to *D. pseudoturbinatum acolumellatum* from which it differs primarily in shortened minor septa and considerably narrower axial structure as compared with the diameter of corallite. In longitudinal section the composition of tabularium and axial structure considerably resembles that of the genus *Arachnolasma*. The species described has been assigned by the writer to the genus *Dibunophyllum* because of the atrophy of columella in axial structure, which is common in *Dibunophyllum* and never recorded in *Arachnolasma* whose species are marked by a perfect development of columella.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **KONINCKOPHYLLUM** THOMSON & NICHOLSON, 1876

(Type species: *K. magnificum* THOMSON & NICHOLSON, 1876)

Synonyms:
Cyathaxonia MICHELIN, 1846, partim,
Axophyllum THOMSON, 1877,
Acrophyllum THOMSON, 1883,
Lophophyllum M.-E. & H., 1850 sensu CARRUTHERS, 1913, partim,
Eostrotion VAUGHAN, 1915,
Yüaniphylloides FOMITSHEV, 1953,
non *Koninckophyllum* THOMSON & NICHOLSON, 1876 sensu PERNA, 1923,
non *Koninckophyllum* THOMSON & NICHOLSON, 1876 sensu PARKINSON, 1926,
non *Koninckophyllum* THOMSON & NICHOLSON, 1876 sensu KOSTIČ-PODGORSKA, 1957,
non *Koninckophyllum* THOMSON & NICHOLSON, 1876 sensu KOSTIČ-PODGORSKA, 1958,
non *Koninckophyllum* THOMSON & NICHOLSON, 1876 sensu VASSILJUK, 1960,
non *Koninckophyllum* THOMSON & NICHOLSON, 1876 sensu DE GROOT, 1963,
non *Koninckophyllum* THOMSON & NICHOLSON, 1876 sensu VASSILJUK, 1964.

Species assigned: *Cyathaxonia tortuosa* MICHELIN, 1846, ?*Cyathophyllum dianthoides* M'COY, 1849, *Koninckophyllum magnificum* THOMSON & NICHOLSON, 1876, *K. interruptum* THOMSON & NICHOLSON, 1876, *Lophophyllum minimum* STUCKENBERG, 1904, *L. trautscholdi* STUCKENBERG, 1904, *Koninckophyllum* VAUGHAN, 1905 (= *K. vaughani* n. sp.), *K. proprium* SIBLY, 1908, *Lophophyllum meathopense* GARWOOD, 1913, *L. fragile* GARWOOD, 1913, *L. vesiculosum* GARWOOD, 1913, *Koninckophyllum carlyanense* SMYTH, 1915, *Lophophyllum altaicum* WEBER, 1931, ?*Koninckophyllum tushanense* CHI, 1931, ?*K. trisectum* CHI, 1931, *Lophophyllum subtortuosum* GORSKY, 1932, ?*Koninckophyllum fraiponti* CHARLES, 1933, ?*Lophophyllum zaphrentiforme* VOJNOVSKY-KRIEGER, 1934, *Koninckophyllum ischimicum* VOLKOVA, 1941, *K. kiickpaanensis* VOLKOVA, 1941, *K. floriforme* VOLKOVA, 1941, *K. atbasaricum* VOLKOVA, 1941, *K. interruptoseptatum* VOLKOVA, 1941, *K. singulare* VOLKOVA, 1941, ?*Lophophyllum vacuum* GORSKY, 1935, ?*Koninckophyllum compositum* GORSKY, 1951, ?*Lophophyllum intermedium* FOMITSHEV, 1953, ?*L. topschinense* FOMITSHEV, 1953, ?*L. longissimum* FOMITSHEV, 1953, ?*L. posttortuosum* FOMITSHEV, 1953, *Yüaniphylloides gorskyi* FOMITSHEV, 1953, *Y. densum* FOMITSHEV, 1953, *Y. variabilis* FOMITSHEV, 1953, *Y. cruciforme* FOMITSHEV, 1953, *Koninckophyllum katzeri* KOSTIČ-PODGORSKA, 1955, ?*K. djambulicum* BIKOVA, 1966, *K. elegans* BIKOVA, 1966, *K. cinctum* n. sp., *K. protocolonicum* n. sp.

Some of the species mentioned above, in particular those with question marks, may not belong to the genus *Koninckophyllum*. Some others may turn out to be synonyms.

Stratigraphic and geographic range: Tournaisian to Upper Carboniferous; Eurasia, North Africa, North America.

Diagnosis. — See HILL, 1938-1941, p. 86.

Remarks. — The genera *Lophophyllum* M.-EDWARDS & HAIME and *Koninckophyllum* THOMSON & NICHOLSON were described and discussed many times. The interpretation of these genera has been particularly difficult since the revision of CARRUTHERS (1913) who, without an accurate study of holotypes and paratypes of M.-EDWARDS & HAIME and MICHELIN, united in one genus the species which have dissepiments (*Cyathaxonia tortuosa* MICHELIN,

1846) with those which have not (*Lophophyllum koninckі* M.-EDW. & HAIME, 1850). Later on, several authors took different standpoints, acknowledging the validity of either both or only one taxon, but as a rule accepting the occurrence of dissepiments in both genera (FOMITSHEV, 1953; DOBROLJUBOVA, 1966 and others). LECOMPTE (1955), who preliminarily revised the genus *Lophophyllum*, found that none of the specimens described by M.-EDWARDS & HAIME (1850) had dissepiments. In this group of corals, this character is of a fundamental importance as a diagnostic feature of a family and, therefore, it is beyond any doubt that *Koninckophyllum* and *Lophophyllum* are real genera, belonging to different families. The separation of solitary and colonial species or acknowledging them to be congeneric is, in the writer's opinion, a fundamental problem concerning the genus *Koninckophyllum*. In addition to the species which form normal colonies, for instance "*Koninckophyllum*" *echinatum*, there also occur those whose colonial state is of the beginning type and makes up a sort of rejuvenescence of not one but a few individuals. In the colonies of such type, budding is often parricidal in character and descendent individuals, if they do not die very early, do not as a rule reproduct. The beginning colonies of the same type as those in *Koninckophyllum* have been observed by the writer in the Carboniferous genus *Spirophyllum* n. gen. and the Devonian genus *Ceratophyllum* GÜRICH, 1896. A sporadic colonial state has also been found in some Famennian species (RÓŻKOWSKA, 1969). This phenomenon is probably relatively frequent among corals but not always maintained. In the writer's opinion, species with beginning colonies are congeneric with solitary corallites of appropriate genera, in this case, of *Koninckophyllum*. On the other hand, he believes that the species which are marked as typical colony builders such as, for instance "*K.*" *echinatum* (THOMSON), should be excluded from the genus *Koninckophyllum* and a separate genus should be erected for them. The genus *Yüaniphylloides* FOMITSHEV, 1953 differs from *Koninckophyllum* in the lack of cardinal fossula and an elongated counter septum which is fused with columella. In *Koninckophyllum*, these characters vary even in one and the same individual and, therefore, cannot be diagnostic for the genus. Most of the specimens, illustrated by FOMITSHEV (1953) probably belong to the same species, very closely related to *K. meathopense* (GARWOOD, 1913) whose extensive variability is presented below.

Koninckophyllum magnificum THOMSON & NICHOLSON, 1876

(Text-figs. 29*A-E*, 32; Pl. VII, Figs. 5-9; Pl. XVIII, Fig. 4)

1876. *Koninckophyllum magnificum* THOMSON & NICHOLSON; J. THOMSON & A. NICHOLSON, Contribution..., Pl. 12 Figs. 2, 2*a*.

1938-1941. *K. magnificum* THOMSON & NICHOLSON; D. HILL, A monograph..., p. 89, Pl. 3, Figs. 11-17; Pl. 4, Figs. 1-7 (*cum synon.*).

1951. *Lophophyllum* (*Koninckophyllum*) *postscarlattense* GORSKY; I. I. GORSKY, Kamennougolnye..., p. 49, Pl. 12, Figs. 4*a*, *b*.

Material. — About 50 solitary corallites without proximal ends, some of them with preserved calices. Measurable characters shown in a diagram in Text-fig. 32.

Diagnosis. — See HILL, 1938-1941, p. 89.

Remarks. — Maintaining approximately the same range of variability, Polish specimens differ from British: 1) in a more strongly developed, thicker columella; 2) in the shortening of minor septa which, at least in parts of corallites, do not reach inner wall; relatively numerous are also individuals with minor septa shortened up to 1/2—2/3 of the width of dissepimentarium; 3) in a frequent occurrence, on periphery, at septal bases, of a fine-dissepimental tissue which

TABLE 6

Morphologically-comparative table of *Koninckophyllum* THOMSON & NICHOLSON

Species	Cardinal septum	Cardinal fossula	Length of major septa	Thickness of major septa	Length of minor septa	Septal lamellae	Columella	Dissepimentarium	n/d	dd/dc	Longitudinal section	Shape
Koninckophyllum magnificum THOMSON & NICHOLSON	short thin	present	long	not thickened or slightly in tabularium	about 1/2 length of major septa	absent	commonly thin, shortened	various; at the periphery often pseudo-herringbone	56 : 34	1/5 to 1/3	tent-shaped, closely packed tabellae	simple
K. interruptum THOMSON & NICHOLSON	short thin	not always developed	long	not thickened or slightly in tabularium	about 1/2 length of major septa or shortened	absent	in ephebic lost	lonsdaleoid vesicles may occur	60 : 30	1/2	vesicular, tent-shaped or flat tabellae	simple
K. proprium SIBLY	= major septa or slightly shortened	not developed	short	not thickened	long, into tabularium	absent	thick, grain-shaped, short	rectangular	50 : 23	1/5 to 1/3	tent-shaped	simple
K. meathopense (GARWOOD)	slightly shortened	commonly present	short	sometimes in tabularium	long, = dissepimentarium	present	discontinuous, long	rectangular and irregular	53 : 24	1/4 to 1/3	tent-shaped with accessory plates	simple
K. vaughani n. sp.	short	present	long	slightly in tabularium	= dissepimentarium or into tabularium	absent	long, slightly thickened	rectangular and irregular	48 : 18	1/3	tent-shaped rare	simple
K. cinctum n. sp.	slightly shortened	present	in ontogeny shortened	in the inner part of dissepimentarium thick	into tabularium	present	thick, short	rectangular	54 : 25	1/3	tent-shaped	simple
K. protocolonicum n. sp.	short	present	long	slightly in tabularium	various in the same section	absent	in ephebic lost	rectangular and lonsdaleoid vesicles	47 : 28	1/3	flat	beginning colony

is arranged in an acinuslike manner. The latter two characters are related to the morphology of the genus *Neokoninckophyllum* FOMITSHEV, 1939. On the basis of a single fragmentary corallite, GORSKY (1951) introduces a new species, *K. postscarlattense* and compares it only with *K. scarlattense* LEWIS. The writer is of the opinion that GORSKY's illustrations (Pl. 12, Fig. 4*a*, *b*) are in a complete conformity with the diagnosis of *K. magnificum* and can be included in the range of its variability. The differences between *K. magnificum* and the remaining species, described in the present paper, have been given with the remarks concerning these species.

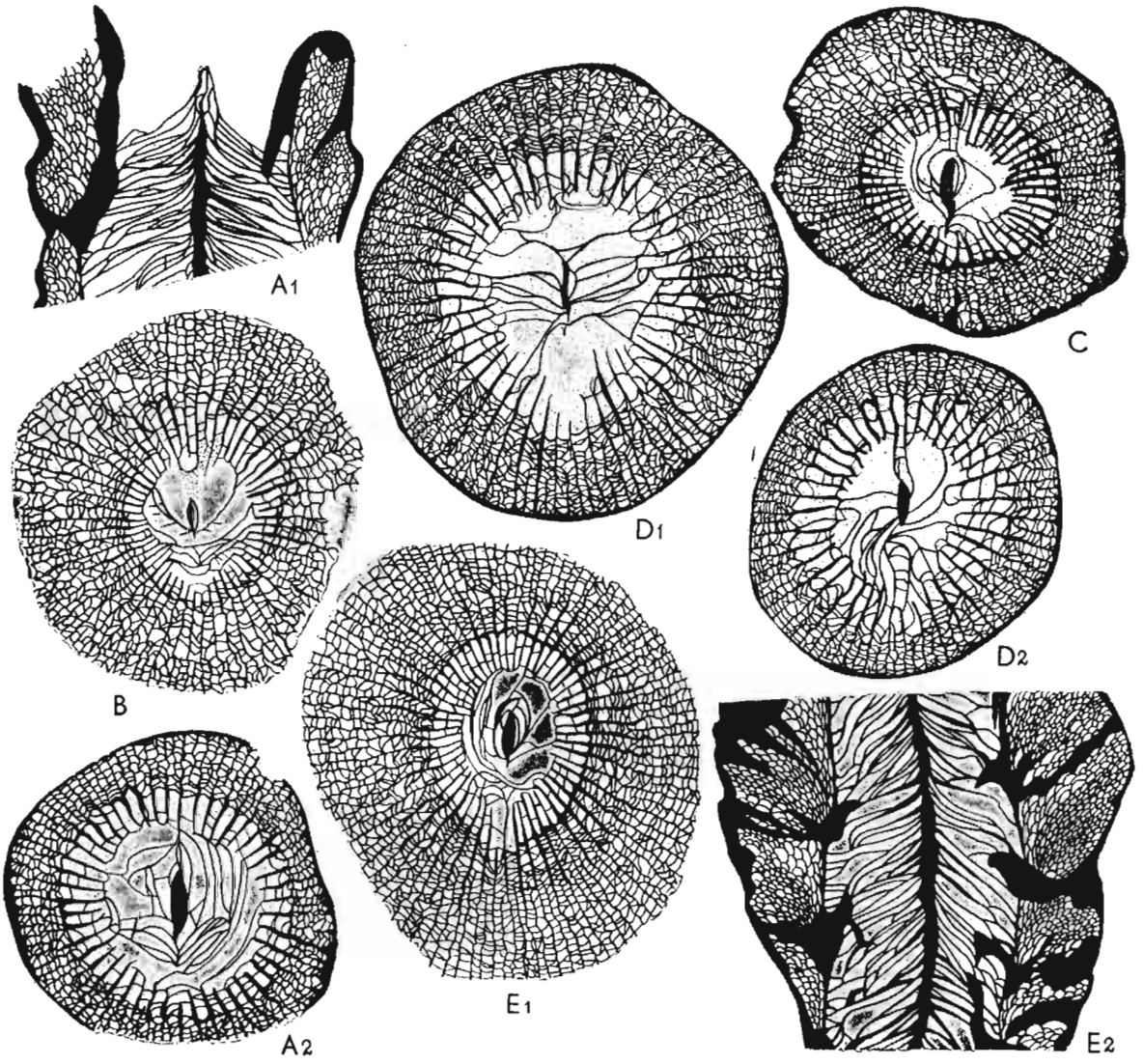

Fig. 29

Koninckophyllum magnificum THOMSON & NICHOLSON; A_1 longitudinal section of the ephebic stage and of the calice, A_2 transverse section of the ephebic stage (IG. OS-70/1320); *B* transverse section of the ephebic stage (IG. OS-70/953); *C* transverse section of the ephebic stage (Z. Pal. Tc-4/2074); Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top). D_{1-2} transverse sections of the ephebic stage (Z. Pal. P. Tc-4/3175), Czerwieńczyce, Sudetes, Upper Viséan, D_2; E_1 transverse section of the ephebic stage, E_2 longitudinal section (IG. OS-70/1176), Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top). All × 2

Occurrence. — Great Britain, Zone 3 (common) and Zone 4; USSR (Novaya Zemla), Upper Viséan — Lower Namurian; Poland (Holy Cross Mountains, Gałęzice), Upper Viséan, D_2 (top): and the Sudetes (Czerwieńczyce), Upper Viséan, D_2.

Koninckophyllum interruptum THOMSON & NICHOLSON, 1876

(Text-figs. 30*A-C*, 32; Pl. XVIII, Figs. 5-9)

1876. *Koninckophyllum interruptum* THOMSON & NICHOLSON; J. THOMSON & A. NICHOLSON, Contribution..., p. 121, Pl. 1, Figs. 3, 3*a*.

1929. *Lophophyllum* sp. MILNE-EDWARDS & HAIME emend. CARRUTHERS = *Koninckophyllum* sp. THOMAS (*sic*) & NICHOLSON; E. DAGUIN, Étude..., p. 26, Pl. 4, Fig. 5.

1935. *L.* (*Koninckophyllum*) cf. *interruptum* NICHOLSON & THOMSON; H. P. LEWIS, The Lower..., p. 133, Pl. 7, Figs. 3*a-c*, 4*a-c*.

1935. *L. interruptum* THOMSON & NICHOLSON; N. MENCHIKOFF & T. Y. HSU, Les polypiers..., p. 245, Pl. 10, Figs. 1*a-c*, 2.

1938-1941. *Koninckophyllum interruptum* THOMSON & NICHOLSON; D. HILL, A monograph..., p. 93, Pl. 4, Figs. 8-13 (*cum synon.*).

non 1933. *K. interruptum* THOMSON & NICHOLSON; F. HERITSCH, Rugose Korallen..., p. 155, Pl. 3, Figs. 15-19; Pl. 4, Figs. 20-25 (probably *Arachnolasma cylindrica* Yü).

non 1960. *K. interruptum* THOMSON & NICHOLSON; N. P. VASSILJUK, Nižnekamennougolnye..., p. 126, Pl. 30, Figs. 3-3*c* (a simple "*Aulina*").

non 1964. *K. interruptum* THOMSON & NICHOLSON; N. P. VASSILJUK, Korally zon..., p. 72, Pl. 3, Fig. 7 (a simple "*Aulina*").

Material. — More than 50 solitary corallites, some of them with younger ontogenetic stages and calices preserved. Measurable characters given in a diagram in Text-fig. 32.

Diagnosis. — See HILL, 1938-1941, p. 93.

Remarks. — Specimens which lost columella and reached the caninoid form are usually assigned to this species. It may well be that this common name has more than once been used to include quite different species or even genera. DOBROLJUBOVA's (1948, and in manuscript) and VOJNOVSKY-KRIEGER's (1956) studies have shown that many Carboniferous genera with columella and axial structure reached the caninoid stage. The lack of the description of ontogeny in most studies on *K. interruptum* does not allow one to determine for a certainty whether or not these specimens are conspecific. The present writer excludes the specimens, described by VASSILJUK (1960, 1964) from *K. interruptum* THOMSON & NICHOLSON. Their tabularium is of the *Aulina* type and in none of the stages examined they develop columella. Polish specimens may be included in the range of the individual variability of the species defined by HILL (*op. cit.*) even despite considerable differences that occur both between them and in comparison with the holotype. The following types of variability may be distinguished.

1) As compared with HILL's (*op. cit.*) data, they are smaller than the British specimens and, in relation to the diameter of corallite, have more numerous major septa (cf. diagram in Text-fig. 32).

2) As compared to tabularium, the width of dissepimentarium varies within limits of 2.2:1.0 and 2.2:1.5. In specimens having long minor septa, dissepiments near tabularium are rectangular and in those with short minor septa, dissepiments are of the herringbone type. Dissepiments of the pseudo-herringbone and rectangular type predominate near epitheca, with rectangular and lateral cystose ones occurring here and there.

3) The disappearance of columella in ontogeny is an individual and absolutely irregular feature. In some corallites, columella disappears as early as in the neanic stage, in some others

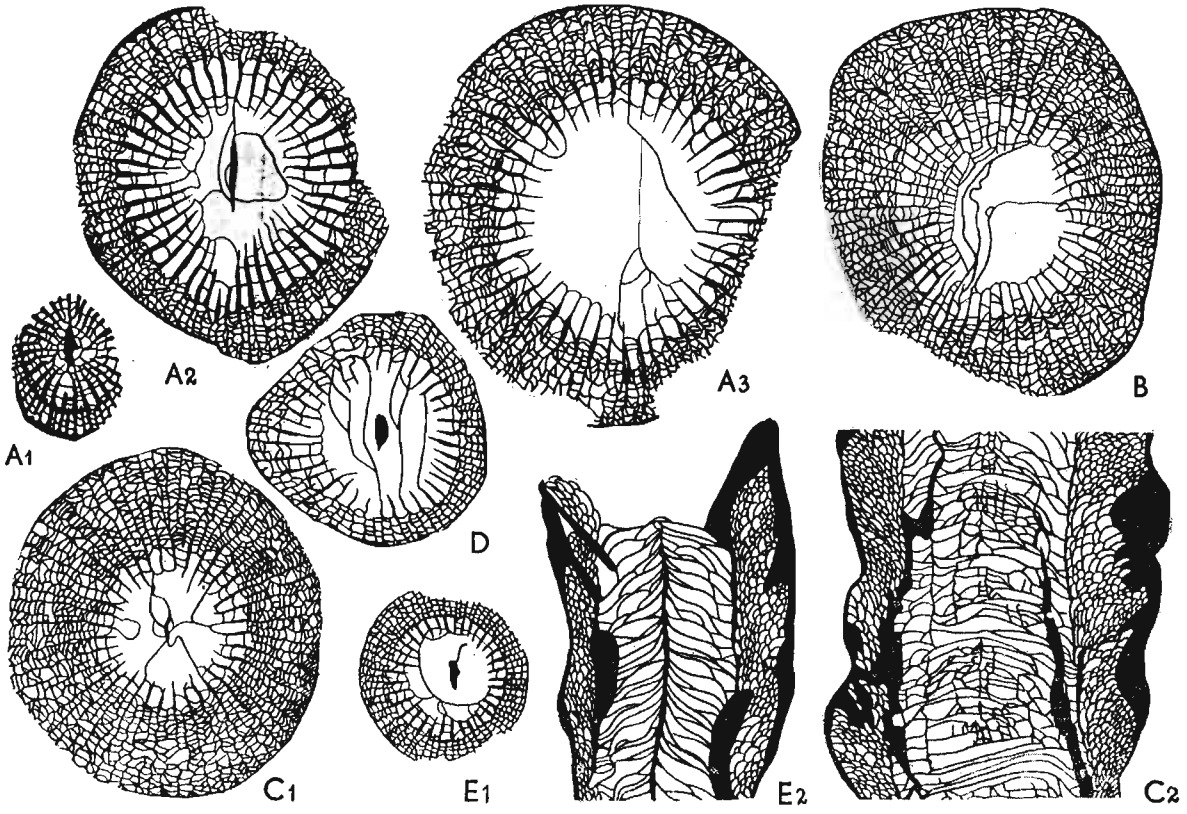

Fig. 30

Koninckophyllum interruptum THOMSON & NICHOLSON; A_1 transverse section of the neanic stage, A_2 transverse section of the early-ephebic stage, A_3 transverse section of the ephebic stage (IG. OS-70/162); *B* transverse section of the ephebic stage (IG. OS-70/2179); C_1 transverse section of the ephebic stage, C_2 longitudinal section (IG. OS-70/1138). *D, E Koninckophyllum proprium* SIBLY: *D* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2419); E_1 transverse section of the ephebic stage, E_2 longitudinal section (IG. OS-70/852).
Gałęzice, Holy Cross Mountains, Upper Viséan, D_2 (top); all × 2.

in the ephebic stage. Mostly, after the disappearance of columella, it never occurs again. It is only in rare cases that a discontinuous columella may be also observed.

Occurrence. — Great Britain, Zone 3; Nova Scotia, Upper Viséan; North Africa, Viséan; Poland: Holy Cross Mts., Gałęzice, Upper Viséan, D_2 (top), and the Sudetes, Czerwieńczyce, Upper Viséan, D_2.

Koninckophyllum proprium SIBLY, 1908

(Text-figs. 30*D, E*, 32; Pl. VIII, Figs. 9-12; Pl. XIX, Figs. 1-4)

1908. *Koninckophyllum proprium* SIBLY; T. F. SIBLY, The faunal..., p. 70, Pl. 1, Fig. 3.
1927. *K. columnatum* GEORGE; T. N. GEORGE, The Carboniferous..., p. 86 (partim), Pl. 2, Fig. 3 only.

Material. — About 50 solitary corallites, some of them with preserved calices. Measurable characters given in a diagram in Text-fig. 32.

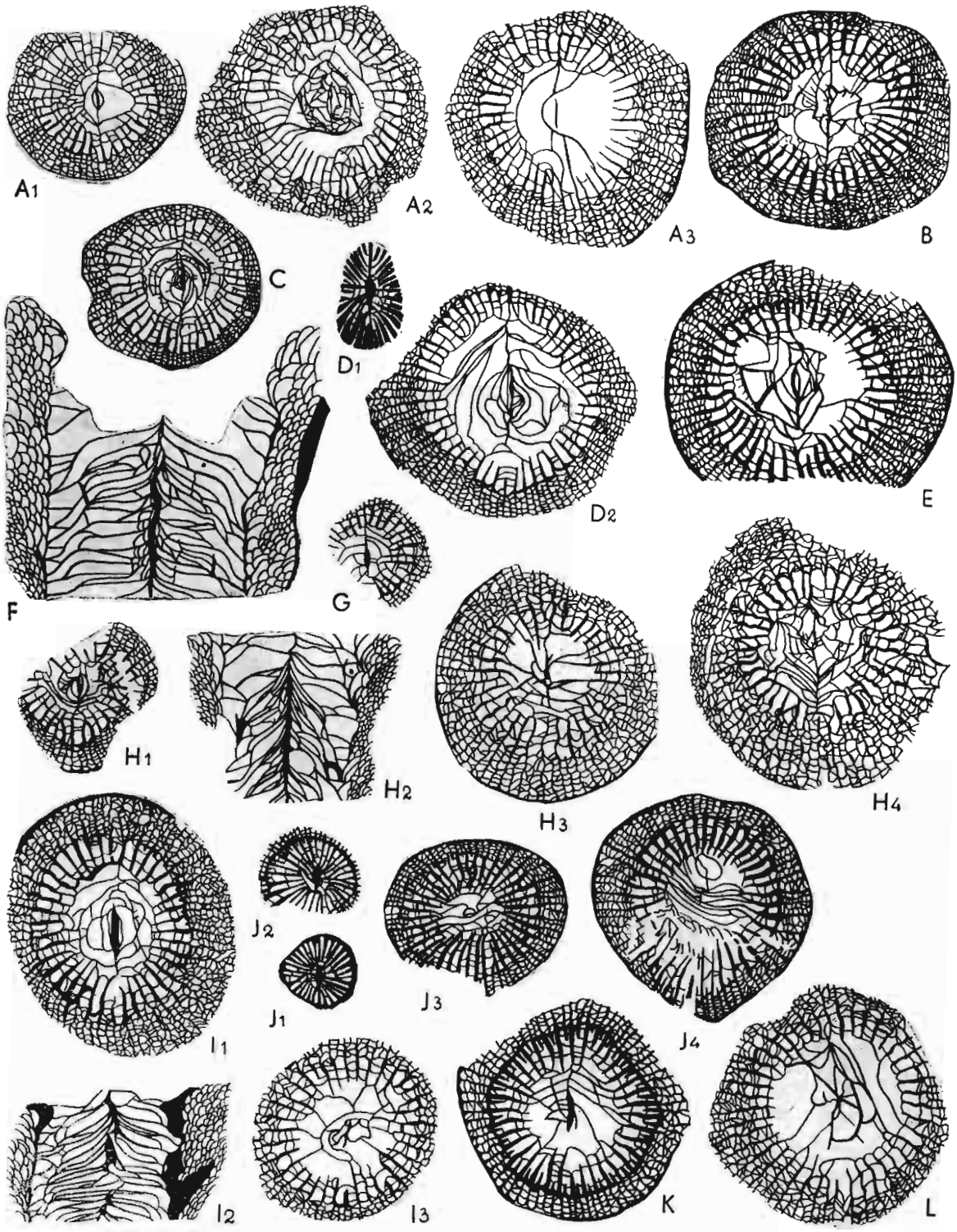

Fig. 31

Revised diagnosis. — A *Koninckophyllum* to 23 mm in diameter and with 50×2 septa; columella usually lenticulate, since the early stage free; axial regions wide, free of septa; dissepimentarium narrow, dissepiments mostly rectangular, minor septa shallowly entering tabularium, strongly developed.

Remarks. — As compared with other representatives of *Koninckophyllum*, this species is stable morphologically. However, certain development trends may be observed within its range. They are as follows: 1) Columella may remain in the form of a thick lens even in the calice (Pl. VIII, Fig. 12), at the end of the development it usually becomes thinner but does not disappear. In other specimens it may be almost completely atrophied and becomes thinner as early as the neanic stage. Such corallites are, as a rule, small. This may be a subspecies in the course of its individualization. 2) An abortion of cardinal fossula is typical of this species. Cardinal septum may be almost unshortened. Specimens with a distinct fossula are rare; they usually predominate among larger individuals, the small ones being often devoid of it.

K. proprium differs from type species (*K. magnificum*) in a considerably narrower and more regular dissepimentarium, short major septa, lenticulate columella, as well as smaller size and number of septa. On the other hand, a narrow, regular dissepimentarium makes this species similar to some representatives of *K. meathopense*.

Occurrence. — Great Britain, Upper Viséan, D_2; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Koninckophyllum meathopense (GARWOOD, 1913)

(Text-figs. 31*A-L*, 32; Pl. VIII, Figs. 1-8)

1913. *Lophophyllum meathopense* GARWOOD; E. J. GARWOOD, The Lower..., p. 557, Pl. 48, Fig. 2*a-e*.
1913. *L. ashfellense* GARWOOD; E. J. GARWOOD, *Ibid.*, p. 559, Pl. 50, Figs. 9, 9*a*.
1917. *L. meathopense* GARWOOD; E. J. GARWOOD, The faunal..., Pl. 13, Figs. 5, 6 (Figs. only).
1929. *Lophophyllum*(?) sp.; E. NEAVERSON, Faunal..., p. 120, Pl. 3, Fig. 1.
?1961. *Koninckophyllum* aff. *ashfellense* (GARWOOD); V. ŽUKALOVA, Spodnokarbonská..., p. 318, Pl. 1, Figs. 1-3.
?1964. *Lophophyllum ashfellense* GARWOOD; W. S. WU, Lower Carboniferous..., p. 55, Pl. 11, Figs. 7, 8.

Material. — More than 60 solitary corallites with incomplete proximal ends, some of them with calices. Measurable characters are given in a diagram in Text-fig. 32.

Revised diagnosis. — A *Koninckophyllum* 20-45 mm in diameter and 40-53 septa, the latter number being not always correlated with the diameter; columella thin, listlike, frequently connected with counter septum, sometimes also with cardinal septum; minor septa varying

Fig. 31

Koninckophyllum meathopense (GARWOOD): A_1 transverse section of the early-ephebic stage, $A_{2,3}$ successive transverse sections of the ephebic stage (IG. OS-70/1773); *B* transverse section of the ephebic stage (IG. OS-70/2330); *C* transverse section of the early-ephebic stage (IG. OS-70/1568); D_1 transverse section of the neanic stage, D_2 transverse section of the ephebic stage (IG. OS-70/1519); *E* transverse section of the ephebic stage (IG. OS-70/1236); *F* longitudinal section of the ephebic stage and of the calice (IG. OS-70/1957); *G* transverse section of the late-neanic stage (IG. OS-70/1029); H_1 transverse section of the late-neanic stage, H_2 longitudinal section, $H_{3,4}$ successive transverse sections of the ephebic stage (IG. OS-70/1049); I_1 transverse section of the ephebic stage, I_2 longitudinal section, I_3 transverse section of the early ephebic stage (IG. OS-70/950); $J_{1,2}$ successive transverse sections of the neanic stage, $J_{3,4}$ successive transverse sections of the ephebic stage (IG. OS-70/1973); *K* transverse section of the ephebic stage (IG. OS-70/1228); *L* transverse section of the ephebic stage (IG. OS-70/3277). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2

in length; cardinal fossula slightly developed; dissepimentarium regular, occupying less than 1/3 of the diameter of the corallite.

Individual variability. — The large number of the specimens available enabled a relatively accurate study of the individual variability and assignment of seemingly different individuals to one and the same species. Usually, the writer made a few sections of a corallite and only such a procedure allowed him to find its significant characters and range of variability.

Columella varying in thickness, listlike, twisted, may be connected with counter septum, with cardinal and counter septum or it may be loose. Septal lamellae may be scattered at random or form a sort of a dibunophylloid axial structure, but, as seen in longitudinal section, they never affect the structure of tabularium. In most corallites major septa are thin. The length of septa variable and mostly correlated with the width of dissepimentarium. Their tabular segments slightly vary in length. The length of minor septa is directly proportional to the width of dissepimentarium. Minor septa, entering deeper into tabularium or excessively shortened, occur rarely.

In the ontogeny, the variability is expressed by the degree of thickening of structural elements, shortening of major septa and a heterochronous development of dissepimentarium. As seen in Text-figs. 31 D_1, G, $I_{1,2}$, juvenile specimens with an approximately the same diameter and number of septa are to a different extent advanced in morphological development.

Remarks. — On the basis of a considerable individual variability and the changes which occur in the course of the development of one and the same individual, the writer has considered the assignment of taxons mentioned in synonymy along with the Polish specimens to one and the same species to be admissible. It is very likely that this species can also include at least some of the specimens described by FOMITSHEV (1953) as different species of the genus *Yüaniphylloides*. The genus was assigned by the present writer to *Koninckophyllum*. *K. meathopense* differs from *K. proprium* SIBLY, the most closely related species, in a thin, listlike, frequently discontinued columella, development of septal lamellae in the axial part of corallite and in a wider and more irregular dissepimentarium. Corallites with a discontinued columella are related to *K. interruptum*. Despite its frequent absence in part of ontogeny, for instance, neanic stage, columella may occur even in calice. *K. vaughani* n. sp. is marked by longer major septa almost reaching columella which extends, passes into cardinal fossula and frequently is connected with cardinal septum.

Occurrence. — Great Britain, γ to S_2; Czechoslovakia(?), Tournaisian-Viséan turn; China(?), *Yuanophyllum* Zone, Upper Viséan; Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Koninckophyllum vaughani n. sp.

(Text-figs. 33*C*, *D*; Pl. VIII, Figs. 13, 14; Pl. IX, Figs. 1*a*, *b*; Pl. XIX, Figs. 8, 9)

1905. *Koninckophyllum* Θ. VAUGHAN; A. VAUGHAN, The palaeontological..., p. 282, Pl. 23, Fig. 4.
1926. *Lophophyllum* (*Koninckophyllum*) Θ. VAUGHAN; L. B. SMYTH, A contribution..., p. 148, Pl. 4, Fig. 4*a*, *b*.
1930. *Koninckophyllum columnatum* GEORGE (early form); H. P. LEWIS, The Avonian..., p. 273, Pl. 22, Fig. 1.

Holotype: Specimen IG. OS-70/956 (Pl. VIII, Fig. 14).
Type locality: Gałęzice, Holy Cross Mountains.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: *vaughani* — named in honour of Dr A. VAUGHAN.

Material. — Seven solitary corallites, most of them with calices and partly preserved proximal ends.

Dimensions (in mm):

IG. OS/70/	Index of septa n/d
956	40 : 24×19
986	44 : 20×15
1852	44 : 13×12
2335	48 : 18×15

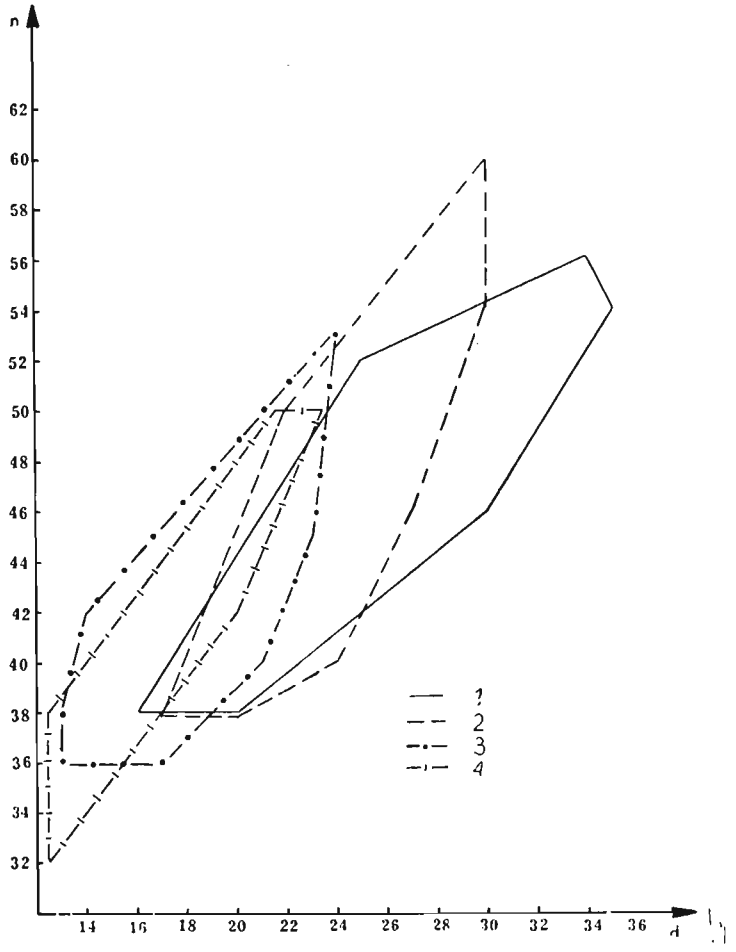

Fig. 32

Septal index (n/d) for some species of *Koninckophyllum*. The points corresponding to extreme specimens are united by lines. 1 — *K. magnificum* TH. & NICH., 2 — *K. interruptum* TH. & NICH., 3 — *K. meathopense* GARW., 4 — *K. proprium* SIBLY.

Diagnosis. — A *Koninckophyllum* with a long, listlike columella which frequently happens to be connected with a cardinal and counter septum; major septa long, in cardinal quadrants arranged in a pinnate manner; minor septa may enter tabularium.

Description. — Calice about 8 mm deep, with vertical walls, convex bottom having a strongly projecting columella and with a sharp edge. Surface of corallites almost completely smooth except for fine growth wrinkles.

Transverse section (Text-figs. 33*C*, D_1; Pl. VIII, Figs. 13, 14; Pl. IX, Figs. 1*a*, *b*; Pl. XIX, Figs. 8*a*, *b*, 9*b*): Arrangement of major septa in cardinal quadrants pinnate, particularly clearly

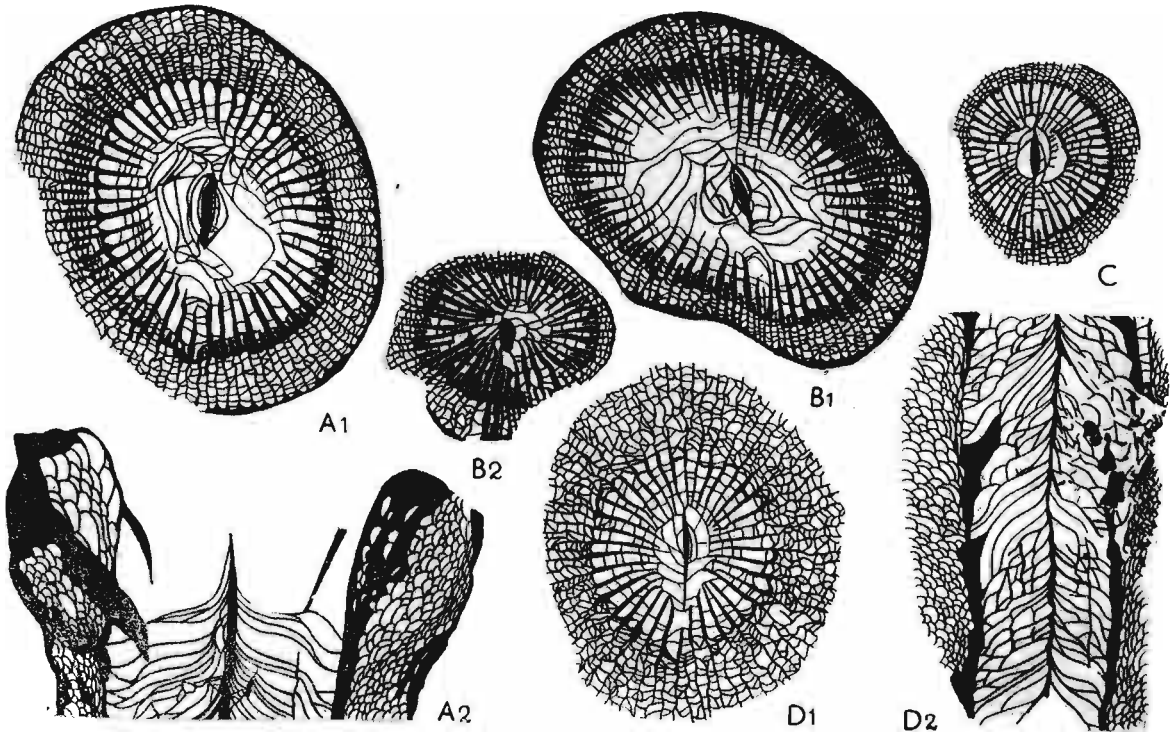

Fig. 33

A, *B Koninckophyllum cinctum* n. sp.: A_1 transverse section of the ephebic stage, A_2 longitudinal section of the ephebic stage and of the calice (IG. OS-70/1868); B_1 transverse section of the ephebic stage, B_2 transverse section of the neanic stage (IG. OS-70/2644), holotype.

C, *D Koninckophyllum vaughani* n. sp.: *C* transverse section of the early-ephebic stage (IG. OS-70/1852); D_1 transverse section of the ephebic stage, D_2 longitudinal section (IG. OS-70/956), holotype.

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

marked in younger ontogenetic stages. Axial ends of septa are frequently bent upward over cardinal fossula. Alar fossulae clearly visible in younger ontogenetic stages. In the final development stage, minor septa may be shortened. Columella, extending in the form of thin lamellae towards cardinal and counter septa, may fuse with either both, in particular in younger ontogenetic stages, or with one of them. Frequently, it happens to be free.

Longitudinal section (Text-fig. 33D_2; Pl. XIX, Fig. 9*a*): Dissepiments small, convex, arranged subvertically. Inner row of flatter dissepiments is thickened. Tabularium loose. Columella variable in thickness, slightly wavy. Tabulae mostly complete, raised towards columella in a tentlike manner. Few horizontal accessory plates occur in the peripheral part.

Individual variability. — Columella may be fused with either both cardinal and counter septa, or with one of them, or may be free. It may be reached by a few axial ends of septa which, in various

corallites, are of a different length. Dissepimentarium may consist of rectangular or irregular dissepiments which in particular appear in the corallites which have more twisted septa.

Remarks. — This species was distinguished by VAUGHAN (1905) as *Koninckophyllum Θ*. Polish specimens of this species have on the whole a greater number of septa with a given diameter, are slightly smaller and have narrower dissepimentaria. In the writer's opinion, these do not, however, hinder from considering them conspecific with British specimens since the differences mentioned above are secondary in character.

K. vaughani n. sp. differs from the type species in a long columella, long major septa almost reaching columella and, besides arranged in cardinal quadrants in a pinnate manner, as well as in measurable characters. From *K. meathopense*, which is one of the most closely related species, it differs in considerably longer major septa, wider dissepimentarium, arrangement of major septa and structure of tabularium as seen in longitudinal section.

Occurrence. — Great Britain, Upper Viséan, D_1; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Koninckophyllum cinctum n. sp.

(Text-figs. 33*A*, *B*; Pl. IX, Figs. 2, 3; Pl. XIX, Figs. 5, 6)

Holotype: Specimen Z. Pal. P. Tc-4/2644 (Pl. IX, Fig. 3).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *cinctum* — after a ring of septal swellings.

Material. — Six solitary corallites without proximal ends. Dimensions (in mm):

Specimen	Index of septa n/d
IG. OS-70/	
1369	50 : 20×20
1868	48 : 26×21
Z. Pal. P. Tc-4/	
2195	52 : ca. 22
2644	54 : 25×19

Diagnosis. — A *Koninckophyllum* to 26 mm in diameter and (48 to 54)×2 septa; major and minor septa strongly thickened in the internal part of dissepimentarium; columella thick, rollerlike; a few septal lamellae occur in axial part; dissepimentarium narrow, dissepiments rectangular; axial tabellae very steeply ascending towards columella.

Description. — Calice deep, with vertical walls and a pointed columella projecting from the bottom. Surface of corallites without longitudinal ribbing. Growth lines shallow.

Transverse section (Text-fig. 33A_1, B_1; Pl. IX, Fig. 3; Pl. XIX, Figs. 5, 6): Septa with swollen bases, penetrating epitheca. Major septa in the peripheral part of dissepimentarium thin, almost straight. In the internal part of dissepimentarium all of them suddenly thicken, much the same as axial ends of minor septa which produces a wide band of thick structures separating a delicate peripheral part of corallite from the axial part.

Longitudinal section (Text-fig. 33 A_2; Pl. IX, Fig. 2): Dissepiments convex, zonally varying in size, very steep or even vertical. Inner row may be thickened. Tabularium unizonate. Columella thick, in calice pointed. Tabulae mostly complete, near dissepimentarium horizontal. Axial part of tabulae extended very steeply and high towards columella. Near inner wall, accessory plates horizontal or disposed downwards from dissepimentarium towards tabula. A few vesicular tabellae may appear axially.

Ontogeny. — The neanic stage, from which the writer succeeded to study the development, has a very thick, beadlike columella fused neither with cardinal nor counter septum. Alar fossulae strongly developed. Cardinal septum and a pair of neighbouring major septa, strongly thickened also in dissepimentarium, clearly differ from the remaining major septa. Minor septa long. Thickenings of septa and of the minor verticil of dissepiments (Text-fig. 33 B_2), characteristic of the species already occur in this stage.

Remarks. — This species is most closely related to *K. meathopense* from which it differs in the type of thickening of major and minor septa, shape of columella, which is always roller-like and relatively short, and in the structure of the neanic stage, in which in fact this species also differs from all young stages of *Koninckophyllum* examined. Longitudinal sections of both species also differ from each other. The similarity to the remaining species is limited to the generic characters only.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Koninckophyllum protocolonicum n. sp.

(Text-figs. 34 A_{1-3}; Pl. IX, Fig. 4; Pl. XIX, Fig. 7)

Holotype: Specimen IG. OS-70/336 (Pl. IX, Fig. 4).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *protocolonicum* — forming beginning colonies.

Material. — Six corallites forming beginning colonies, damaged, with or without fragmentarily preserved parent corallites, usually devoid of calices.

Dimensions (in mm):

Specimen	Index of septa n/d
IG. OS-70/ 336	46 : 27×25
336	47 : 28×27
3072	38 : 19×17
2824	35 : 20×15
Z. Pal. P. Tc-4/2330	35 : 14×14

Diagnosis. — A *Koninckophyllum* forming beginning colonies; cardinal septum shortened, columella atrophied in various ontogenetic stages, minor septa long, reaching tabularium; lonsdaleoid vesicles present.

Description. — *Transverse section* (Text-figs. 34 A_{1-3}; Pl. IX, Fig. 4; Pl. XIX, Fig. 7): Major septa in dissepimentarium thin, wavy, in tabularium slightly thickened to an equal extent in

all quadrants. In younger corallites, minor septa may penetrate tabularium, in older are shortened. Columella thin, irregular, discontinuous, in the holotype abortive as early as the neanic stage, in one of the paratypes well-developed even in calice, but this is a specimen with juvenile characters. Lonsdaleoid vesicles are not a permanent element and may be replaced once again by complete septa and rectangular dissepiments (for instance, in the holotype).

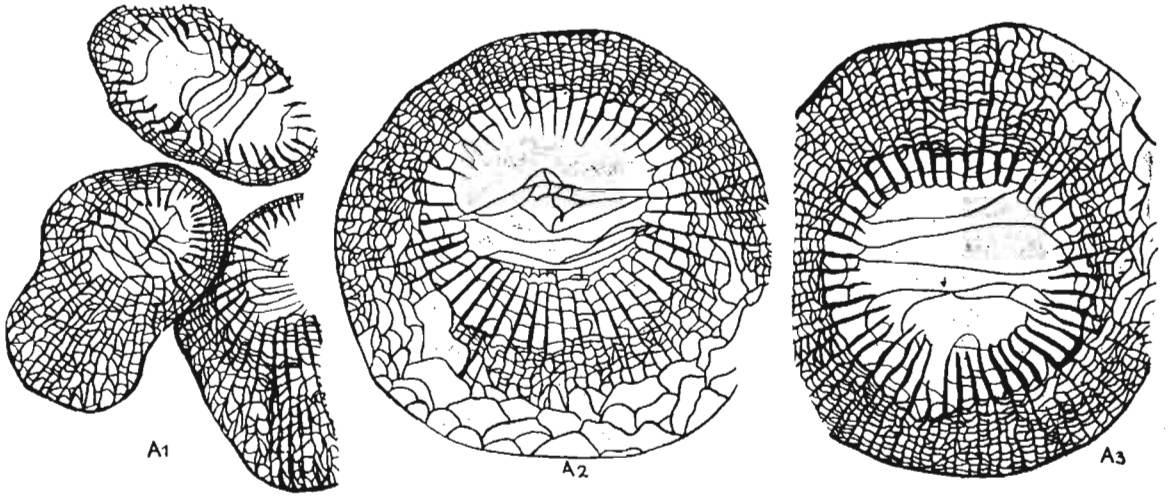

Fig. 34

Koninckophyllum protocolonicum n. sp.: A_1 transverse section of the hystero-neanic stage, $A_{1,2}$ successive transverse sections of the ephebic stage, holotype (IG. OS-70/336). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

Remarks. — The fragmentary parent corallites, which have only been preserved in the collection, allow one to find that young individuals actually budded inside their calices and did not attach themselves to the corallite from the outside. They are, however, insufficient as a basis, for describing the species. Under such circumstances, the specimen with most strongly developed descendant corallites has been selected as a holotype. This species is related to *K. interruptum* in an atrophying columella and the occurrence of lonsdaleoid vesicles. Since *K. interruptum* is a solitary species, this similarity is, however, fairly superficial. If the colonies developed by *K. dianthoides* (M'Coy) would have turned out to be beginning, it might be also a related species.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **ARACHNOLASMA** Grabau, 1922

(Type species: *Lophophyllum sinense* Yabe & Hayasaka, 1920)

Synonyms:
Lophophyllum M.-E., & H., 1850 sensu Carruthers, 1909,
Lophophyllum M.-E. & H., 1850 sensu Yabe & Hayasaka, 1920,
Koninckophyllum Thomson & Nicholson, 1876 sensu Chi, 1931, partim,
Dibunophyllum Thomson & Nicholson, 1876 sensu Chi, 1931, partim,
Koninckophyllum Thomson & Nicholson, 1876 sensu Heritsch, 1933,
Koninckophyllum Thomson & Nicholson, 1876 sensu Chi, 1935,
Lophophyllum M.-E. & H., 1850 sensu Wu, 1964, partim,
non *Arachnolasma* Grabau, 1922 sensu Minato, 1955 (which is probably *Spirophyllum* n. gen.).

Species assigned: *Lophophyllum sinense* YABE & HAYASAKA, 1920, *L. cherneyense* CARRUTHERS, 1909, *Koninckophyllum grabaui* CHI, 1931, *Dibunophyllum yunnanense* CHI, 1931, *Arachnolasma cylindrica* YÜ, 1933, *A. equiseptata* YÜ, 1933, *A. tingfanense* YÜ, 1933, *A. kasachstanica* GORSKY in ILINA, 1939, ?*A. vesiculosa* VOLKOVA, 1941, ?*A. stereocolumellata* VOLKOVA, 1941, ?*A. elegans* VOLKOVA, 1941, ?*A. variabile* VOLKOVA, 1941, *A. dibunophylloides* GORSKY in VOLKOVA, 1941, ?*A. crassicolumellata* VOLKOVA, 1941, *A. hunanense* WU, 1964, *A. lophophylloidea* WU, 1964, *A. lianyuanense* WU, 1964, *A. stereoseptata* WU, 1964, *Dibunophyllum subpercrassum* VASSILJUK, 1964, *Arachnolasma kusbassica* DOBROLJUBOVA, 1966, *A. paucicolumellata* BIKOVA, 1966, *A. longiseptata* GORSKY in BIKOVA, 1966, *A. karatawica* BIKOVA, 1966, *A. biseptata* n. sp., *A. microcolumella* n. sp.

Many of the species mentioned above require revision. Part of them will probably turn out to be synonyms, but some of them may be of another genus.

Stratigraphic and geographic range: Upper Tournaisian to Lower Namurian; Eurasia.

Revised diagnosis. — Solitary corallites with a clisiophylloid ontogeny; columella biseptal, usually thickened; axial structure, with a different degree of complexity, occupying about 1.5 of the diameter of corallite; major septa complete, in some cases more strongly thickened in cardinal quadrants, frequently fused with lamellae; cardinal septum shortened; cardinal fossula clisiophylloid; tabularium with a separated or non-separated axial structure; dissepimentarium strongly developed.

Remarks. — *Arachnolasma* is a genus based on a not very characteristic type species causing controversies and a certain arbitrariness in interpreting it. Separating the genus *Arachnolasma* from *Lophophyllum* (= *Koninckophyllum*), GRABAU (1922) paid attention to the differences separating these two genera rather than to a similarity of *Lophophyllum sinense* YABE & HAYASAKA (type species of *Arachnolasma*) to the genus *Dibunophyllum*. This similarity is so great that, for instance, HILL (Treatise..., 1956, p. F288), giving the diagnosis of *Arachnolasma* based on the type species, found only quantitative characters (a smaller number of septal lamellae) differing this genus from *Dibunophyllum*. This is undoubtedly correct in regard to *A. sinense* which might be considered as an extreme species of *Dibunophyllum*. Since the separation of the genus *Arachnolasma* many species have, however, been described deviating in important qualitative characters from *Dibunophyllum* and, at the same time, markedly similar to *A. sinense*. The necessity of maintaining a separate genus for these species seems to the present writer to be beyond any doubt. Species assigned to *Arachnolasma* are grouped by YÜ (1937) in two morphological types: type *Dibunophyllum* and *Lophophyllum* type. This move seems to the present writer to be very essential, since it perfectly places the genus *Arachnolasma* in taxonomy and phylogeny and elucidates a morphological differentiation within the genus. The duality of the genus may be more than once surprising when the transverse and longitudinal sections of the same corallite are compared. Frequently, a unizonal, more or less vesicular tabularium corresponds to a dibunophylloid transverse section and vice-versa, a distinct axial structure — to a single columella seen in longitudinal section.

Many species of *Arachnolasma* from Kazakhstan were described by VOLKOVA (1938, 1941) and BIKOVA (1966). They either belong to YÜ's both morphological types or constitute a transition between them. Considerable part of these species should be probably excluded from the genus *Arachnolasma*. Many of them are probably synonyms. BIKOVA (1966, p. 126) introduces a new subgenus of the genus *Arachnolasma*, i.e. *Arachnolasmia*. In the present writer's opinion, this subgenus does not, however, display any essential new characters. The stereoplasmatic thickening of major septa, considered by BIKOVA as one of the main diagnostic characters of the subgenus suggested, are mostly treated as an individual variability. Specimens described by DOBROLJUBOVA (1966) as *A. topkiense* n. sp. and *A. kamyshnense* n. sp. from the Tournaisian of the Kuznetsk Basin and which the present writer had an opportunity to examine in Moscow, do not display differences of the generic rank as compared with *Yuano-*

TABLE 7

Morphologically-comparative table of *Arachnolasma* GRABAU

Species	Cardinal septum	Cardinal fossula	Length of major septa	Thickness of major septa	Length of minor septa	Axial structure	Septal lamellae	Columella	Dissepimentarium	n/d	ds/dc	dd/dc	Longitudinal section	
													Axial structure	Tabularium
Arachnolasma sinense (YABE & HAYASAKA)	shortened	merged in dissepimentarium	long, to axial structure	mostly in tabularium	various; 1/2-1/5 dissepimentarium	dibunophylloid	regular 4-6 of both sides	free, commonly very thick	rectangular and herringbone	61 : 28	1/5	1/3	partly separated	vesicular and continuous tabellae
A. cylindricum YÜ	long	not always developed	long, partly to columella	mostly in tabularium	short	irregular	often continuous major septa	free, long, thin	rectangular and herringbone	46 : 24	1/6	1/4 to 1/3	distinct, partly separated	continuous, rare vesicular
A. subpercrassum (VASSILJUK)	long	slightly merged in dissepimentarium	long, to axial structure	thickened of 1/3 dissepimentarium	short	regular	regular, 2-4 of both sides	unite with cardinal and counter septum	rectangular, irregular and herringbone	52 : 25	1/6	1/2	not separated, vesicular	vesicular
A. biseptatum n. sp.	shortened in ephebic stage	slightly merged in dissepimentarium	long, to axial structure	thickened of 1/4 dissepimentarium	long, into tabularium	regular	various, 2-5 of both sides	free, long	rectangular and irregular	43 : 25	1/5 to 1/6	1/2	partly separated	continuous, rare vesicular
A. microcolumella n. sp.	long or slightly shortened	not always developed	long, often to columella	various on the all length	very short	irregular	irregular, thickened, or septa continuous	short, thin	various; rectangular, irregular and herringbone	55 : 22	1/6	1/4	separated	continuous, rare vesicular
Arachnolasma sp.	shortened	slightly merged in dissepimentarium	long	thickened of 1/2 dissepimentarium	short	dibunophylloid	5 of both sides	short, thickened	irregular	52 : 26	1/7	1/2		

phyllum kansuense YÜ, described by DOBROLJUBOVA (*l.c.*, p. 55). According to the present writer they do not rather belong to *Arachnolasma*. A certain similarity to this genus is also revealed by some species from the Lower Carboniferous of Great Britain such as *Arachniophyllum simplex* SMYTH, 1915, *Koninckophyllum divisum* LEWIS, 1930 and others. They differ from *Arachnolasma* rather in secondary characters.

Arachnolasma sinense (YABE & HAYASAKA, 1920)

(Text-fig. 35*A*, *B*; Pl. IX, Fig. 5; Pl. XIX, Fig. 11)

1920. *Lophophyllum sinense* YABE & HAYASAKA; H. YABE & I. HAYASAKA, Palaeontology..., Pl. 6, Fig. 2*a-g* (Figs. only).
1922. *Arachnolasma sinense* (YABE & HAYASAKA); A. GRABAU, Palaeozoic..., p. 59, Text-fig. 66.
1933. *A. sinense* (YABE & HAYASAKA); C. C. YÜ, Lower Carboniferous..., p. 34, Pl. 1, Fig. 6*a-c*; Pl. 2, Fig. 4*a-c*.
1937. *Lophophyllum* (*Arachnolasma*) *sinense* (YABE & HAYASAKA); C. C. YÜ, The Fenginian..., p. 26 (partim, Pl. 6 Figs. 1*a-c*, only).
1964. *Arachnolasma sinense* (YABE & HAYASAKA); W. S. WU, Lower Carboniferous..., p. 57, Pl. 12, Figs. 1, 2.
1964. *A. sinense densum* WU; W. S. WU, *Ibid.*, p. 57, Pl. 12, Figs. 15-17.

Material. — More than 20 solitary corallites without calices and with damaged proximal ends. Measurable characters — see diagram in Text-fig. 40.

Diagnosis. — An *Arachnolasma* to 28 mm in diameter and with (47 to 61)×2 septa; axial structure dibunophylloid, occupying about 1/5 of the diameter of corallite and conspicuous also in longitudinal section; minor septa shortened.

Description. — *Transverse section* (Text-figs. 35$A_{1,2}$, B_1; Pl. IX, Fig. 5; Pl. XIX, Fig. 11): Major septa complete, with swollen bases, the thinnest near the periphery. Tabular segments of septa straight or, at axial ends, bent, sometimes reaching axial structure. Some of them fused

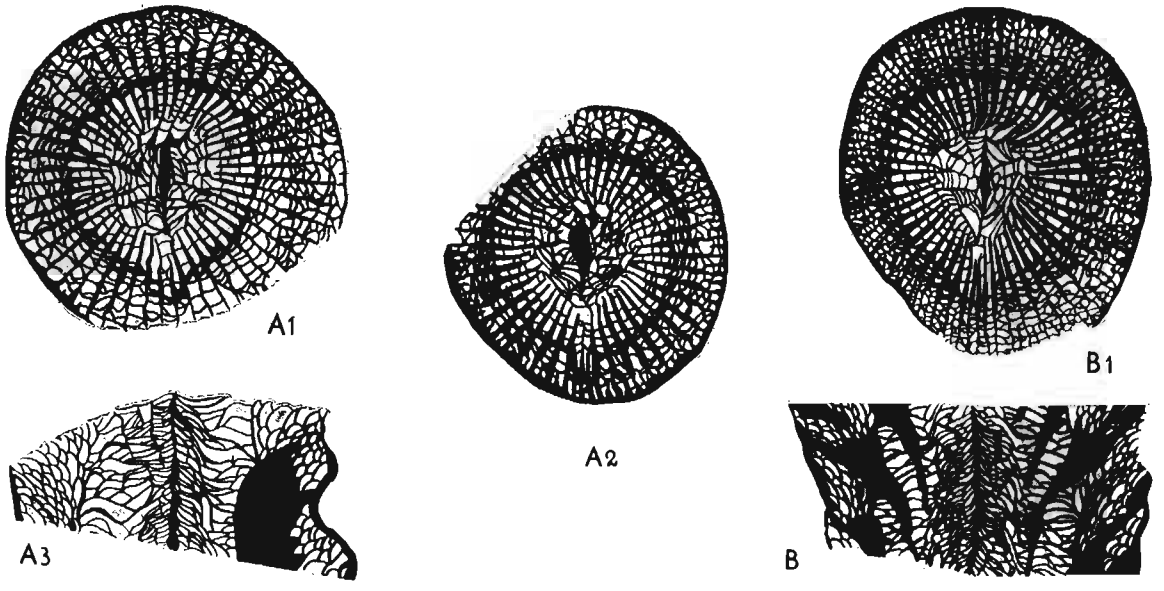

Fig. 35
Arachnolasma sinense (YABE & HAYASAKA): $A_{1,2}$ transverse sections of the ephebic stage, A_3 longitudinal section (Z. Pal. P. Tc-4/2151); B_1 transverse section of the ephebic stage, B_2 longitudinal section (Z. Pal. P. Tc-4/2359). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

with septal lamellae. Columella may be elongated, in the form of a thin lamella, towards cardinal fossula. Some of lamellae connected with columella. Axial tabellae few, usually disposed at random. The largest and most irregular dissepiments occur in the central part of dissepimentarium.

Longitudinal section (Text-figs. 35A_3, B_2): Dissepiments varying in size, convex, arranged semicircularly, inner row vertical. Axial tabellae, less convex and more densely arranged than the marginal ones, reaching columella which varies in thickness. In the peripheral part of tabularium, vesicular periaxial tabulae are arranged near dissepimentarium horizontally and towards the inside ascend obliquely. Usually, they pass directly into axial tabellae.

Individual variability. — 1) Axial structure dibunophylloid in transverse section but fairly strongly connected with septa. The most important are fluctuations in the thickness of columella. Usually, it is considerably thicker in younger ontogenetic stages, but also it may remain thick in the late-ephebic stage. At the end of the ontogenetic development of some corallites (Text-fig. 35B_1) axial structure strongly resembles that in *Dibunophyllum*. 2) Thickness of major septa: predominant are the corallites with septa thickened to the greatest extent in the inner part of dissepimentarium and peripheral part of tabularium and consequently the inner wall seems to be more thickened than it is actually. 3) Axial structure is conspicuous in longitudinal section in principle only as a result of a denser arrangement of tabellae. In fragments of some corallites, marginal tabellae of the structure may be disposed vertically and, if such is the case, it is actually separated from tabularium.

Remarks. — As emphasized in remarks on the genus, *A. sinense* is a species considerably related to *Dibunophyllum*. Polish specimens, assigned to this genus, also display this similarity and maybe even to a greater extent than the holotype. Their septal lamellae in axial structure are more numerous and some specimens have in the late-ephebic stage a relatively thin columella and regular axial structure (Text-fig. 35B_1). Regardless of the differences referred to above, of major septa frequently thicker in dissepimentarium and of a more conspicuous inner wall, the Polish specimens have been included by the present writer in *A. sinense*. He feels entitled to do so due to considerable differences which occur between specimens of this species described so far and to the variability in the development of the holotype which may be observed on numerous section (YABE & HAYASAKA, 1920, Pl. 6, Fig. 2*f*).

Occurrence. — China, Upper Viséan; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Arachnolasma cylindricum YÜ, 1933

(Text-figs. 36*A-E*, 40; Pl. IX, Figs. 6-8; Pl. XIX, Fig. 10; Pl. XX, Figs. 1, 2)

1933. *Arachnolasma cylindrica* YÜ; C. C. YÜ, Lower Carboniferous..., p. 35, Pl. 2, Figs. 1-3.
1933. *A. cylindrica* var. *multiseptatum* YÜ; C. C. YÜ, *Ibid.*, p. 36, Pl. 1, Figs. 7*a*, *b*, 8*a*, *b*.
1933. *Koninckophyllum interruptum* THOMSON & NICHOLSON; F. HERITSCH, Rugose Korallen..., p. 155, Pl. 3, Figs. 15-19; Pl. 4, Figs. 20-25.
1937. *Lophophyllum* (*Arachnolasma*) *sinense* (YABE & HAYASAKA); C. C. YÜ, The Fenginian..., p. 26, partim, Pl. 6, Figs. 2, 3, 5, only).
1957. *Arachnolasma* cf. *cylindrica* YÜ; M. MINATO & M. KATO, Upper Viséan..., p. 493, Pl. 1, Fig. 10.
1959. *A. cylindricum* YÜ; M. KATO, Some Carboniferous..., p. 269.
1964. *A.* ex gr. *cylindrica* YÜ; N. P. VASSILJUK, Korally zon..., p. 84, Pl. 6, Fig. 8.

Material. — More than 70 solitary corallites, mostly devoid of calices and with damaged proximal ends. Measurable characters are given in a diagram in Text-fig. 40.

Revised diagnosis. — An *Arachnolasma* 22-25 mm in diameter and with (42 to 48) × 2 septa; minor septa shortened; major septa mostly not separated from septal lamellae; columella long, listlike; cardinal fossula poorly visible or lacking.

Individual variability. — Axial structure. Columella straight or twisted. It may be situated in almost empty axial region (Text-fig. 36E_1) or may be reached by axial ends of a varying number of septa. Sometimes, they are quite numerous (Text-fig. 36*B*). Few septal lamellae may be also separated. Axial structure in longitudinal section koninckophylloid or separated. Various width of dissepimentarium.

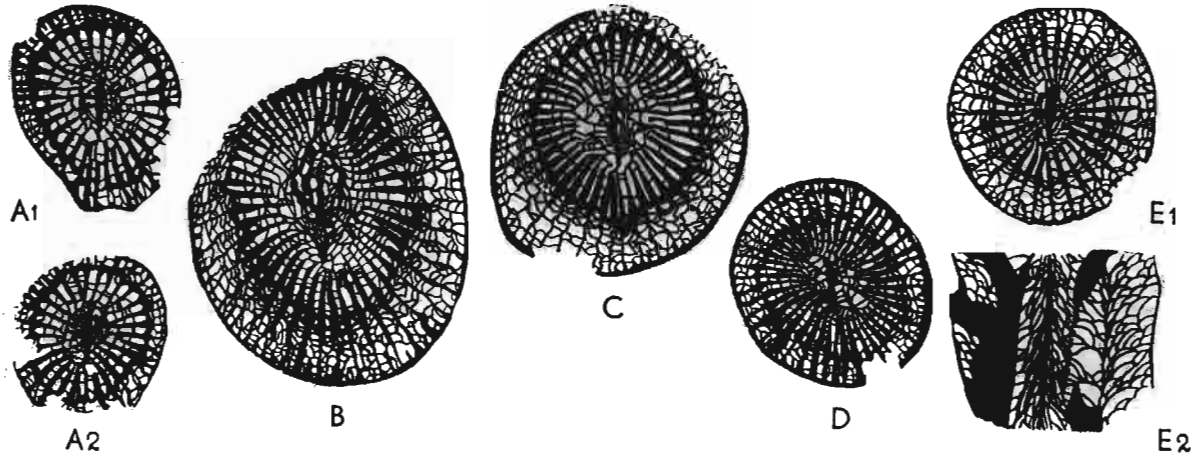

Fig. 36

Arachnolasma cylindricum Yü: $A_{1,2}$ transverse sections of the early-ephebic stage (Z. Pal. P. Tc-4/2893); *B* transverse section of the ephebic stage (IG. OS-70/883); *C* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2317); *D* transverse section of the ephebic stage (IG. OS-70/687); E_1 transverse section of the ephebic stage, E_2 longitudinal section (IG. OS-70/85). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

Remarks. — In their morphological characters Polish specimens are more related to those separated by Yü (1933) as *A. cylindrica multiseptatum* and in measurable features to his nominal subspecies. Some corallites with juvenile characters have a great number of septa with a small diameter. In the writer's opinion the differences between these subspecies are too small as compared with the individual variability of the species and, therefore, he does not acknowledge Yü's (*l. c*) division into the subspecies. A few corals from the Upper Viséan of Carnic Alps were described by HERITSCH (1933) as *Koninckophyllum interruptum* THOMSON & NICHOLSON. They differ from *K. interruptum* in a strongly developed columella and septal lamellae in the axial part. On the other hand, they correspond in these characters, as well as in the length of minor septa, width of dissepimentarium, measurable characters to *Arachnolasma cylindrica* to which they have been included in the present paper. Specimens from Donets Basin, described by VASSILJUK (1964), also slightly differ from both Polish and Chinese ones in long, straight major septa which almost reach columella.

Occurrence. — China, Upper Viséan, *Yuanophyllum* zone; Japan, Upper Viséan; Carnic Alps, Upper Viséan; USSR (Donets Basin), Lower Namurian; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Arachnolasma subpercrassum (VASSILJUK, 1964)

(Text-figs. 37*A-C*, 40; Pl. XX, Figs. 3-5)

1964. *Dibunophyllum subpercrassum* VASSILJUK; N. P. VASSILJUK, Korally zon..., p. 75. Pl. 4, Figs. 4—7.

Material. — Twenty-eight solitary corallites, mostly without calices and proximal ends. Measurable characters are given in a diagram in Text-fig. 40.

Revised diagnosis. — An *Arachnolasma* to 25 mm in diameter and 52×2 septa; major septa thickened in dissepimentarium and tabularium; columella very long, usually connected with cardinal and counter septa; few lamellae in axial structure.

Description. — *Transverse section* (Text-figs. 37*A*, B_1, *C*; Pl. XX, Figs. 3, 4*a*, 5): Epitheca about 0.3 mm thick, at the bases of septa slightly thickened. Major septa reaching axial structure, but are not fused with it and only in very rare cases may be connected with septal lamellae. Columella listlike. Axial tabellae regularly stretched between lamellae. Dissepimentarium the densest near the inner wall, consisting of flat, rectangular dissepiments, which towards periphery gradually pass into larger and larger herringbone or irregular dissepiments. The largest and the most irregular dissepiments occur half-way the width of dissepimentarium. Near epitheca, small rectangular dissepiments occur once again between major and minor septa.

Longitudinal section (Text-fig. 37B_2; Pl. XX, Fig. 4*b*): Dissepiments convex, arranged

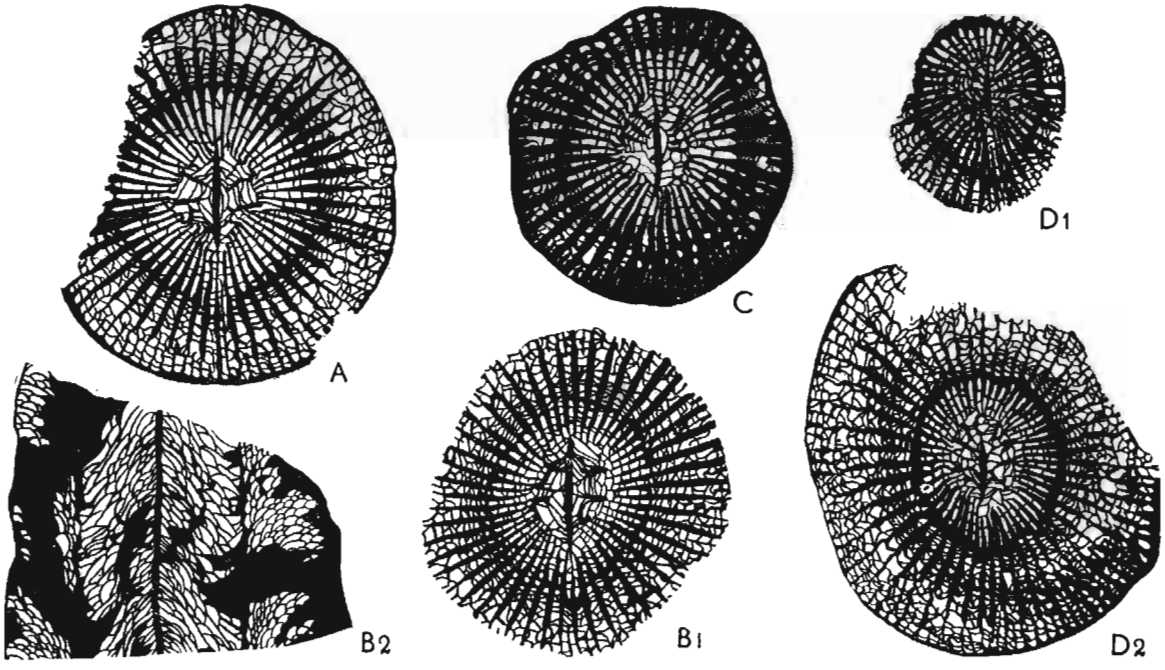

Fig. 37

A-C Arachnolasma subpercrassum (VASSILJUK): *A* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2492); B_1 transverse section of the ephebic stage, B_2 longitudinal section (IG. OS-70/2219); *C* transverse section of the ephebic stage (Z. Pal. P. Tc-4/2358).

D Arachnolasma sp.: D_1 transverse section of the late-neanic stage, D_2 transverse section of the ephebic stage (Z. Pal. P. Tc-4/2565).

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

semicircularly, near epitheca horizontally, near inner wall very steeply or vertically. Inner wall thickened. Tabularium unizonal, consisting of vesicular tabellae arranged at a more or less the same angle (about 45°) between inner wall and columella. Peripheral accessory plates flatly arranged alternating with oblique ones, occur only close to dissepimentarium. The size of tabellae gradually decreases towards the axis near which they get less convex.

Individual variability. — Variability is observed mostly in such secondary characters as degree of thickening of major septa, length of minor septa, as well as detaching columella from cardinal and counter septa, or from one of them, at the end of the development of some corallites.

Remarks. — This species, a typical representative of the genus, displays characters opposing each other, that is in transverse section an exemplary, well-developed, dibunophylloid axial structure and in longitudinal section — a complete lack of this structure. Polish specimens are marked by longitudinal section very similar to that of the holotype, in the type of the thickening of major septa, long, listlike columella, fused with cardinal and counter septa and in identical width and structure of dissepimentarium. On the other hand, they have more numerous septa and less septal lamellae. In specimens from Donets Basin lamellae may be limited to the peripheral part of axial structure only. The most closely related species are *A. cylindrica* YÜ whose long columella may be also fused, in some corallites, with cardinal or counter septum, and *A. biseptatum* n. sp. marked by a similar character.

Occurrence. — USSR (Donets Basin), Upper Viséan; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Arachnolasma biseptatum n. sp.

(Text-figs. 38*A*, *B*; Pl. XX, Figs. 6, 7)

?1964. *Dibunophyllum* cf. *m'chesnei* THOMSON & NICHOLSON; W. S. WU, Lower Carboniferous..., p. 50, Pl. 10, Figs. 4, 5.
1966. *D. derbiensiformis* VASSILJUK; M. S. BIKOVA, Nižnekamennougolnye..., p. 64, Pl. 4, Figs. 1, 2.

Holotype: Specimen IG. OS-70/123 (Pl. XX, Fig. 7).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *biseptatum* — after well-developed major and minor septa.

Material. — Six solitary corallites with partly preserved proximal ends and lacking calices.

Dimensions (in mm):

Specimen	Index of septa n/d
IG. OS-70/	
123	38 : 23
123	32 : 15
225	40 : 19
578	42 : 17
641	43 : 25
641	40 : 17
2590	34 : 18
Z. Pal. P. Tc-	
4/2944	38 : 23

Diagnosis. — An *Arachnolasma* to 25 mm in diameter and 43×2 septa; axial structure occupying 1/6—1/5 of the diameter of corallite; columella listlike, long; tabellae few; major septa thickened also in dissepimentarium; minor septa penetrating tabularium; dissepimentarium occupying about 1/2 of the diameter of corallite.

Description. — *Transverse section* (Text-figs. 38 A_1, B_1; Pl. XX, Fig. 7): Epitheca thin, without longitudinal ribbing. Major septa half-way the dissepimentarium reach, in some specimens about 0.7 mm in thickness and, therefore, they are wider than interseptal spaces. In the inner

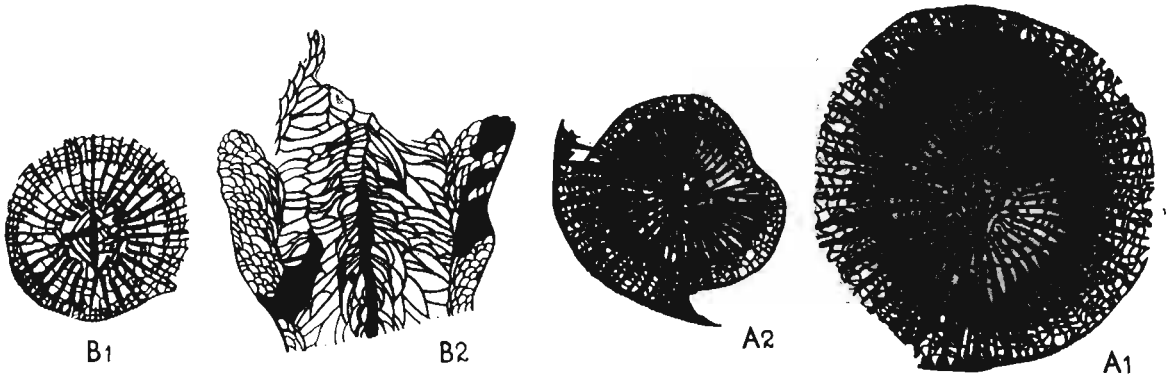

Fig. 38
Arachnolasma biseptatum n. sp.: A_1 transverse section of the ephebic stage, A_2 transverse section of the rejuvenescence (IG. OS-70/641); B_1 transverse section of the early-ephebic stage, B_2 longitudinal section (Z. Pal. P. Tc-4/2944). Gałęzice, Holy Cross Mts., Upper Viséan D_2 (top); all × 2.

wall, they may be yet wider. In some specimens, in particular in younger ontogenetic stages, alar fossulae may be marked. Minor septa are several times narrower than major septa. Columella usually slightly penetrates cardinal fossula. Some lamellae fused with columella. Axial tabellae few. In the inner part of dissepimentarium rectangular, and in the peripheral — irregular, or, sometimes, pseudo-herringbone dissepiments are predominant.

Longitudinal section (Text-fig. 38 B_2; Pl. XX, Fig. 6*a*): Dissepiments convex, small, oblique to epitheca. In the younger part of corallite, columella is very thick, at the end of ontogeny becoming thinner. Tabularium, bizonal, with a relatively clearly separated axial structure, consisting of steeply arranged tabellae which, on the margin lean against each other and axially reach columella. With the growth of corallite, they become flatter and flatter and the axial part of corallite distinguishes itself only in a denser arrangement of tabellae.

Individual variability. — Rectangular or irregular and pseudo-herringbone dissepiments may predominate in the structure of dissepimentarium. Major septa are only very seldom as thick as those in the holotype, on the whole they are markedly thickened in dissepimentarium but less so than in the holotype. Axial structure may be limited almost to columella and tabellae only or more or less complex with a different number of lamellae which not always are regularly arranged. Its width may reach, in some sections, as much as almost 1/4 of the diameter of corallite.

Remarks. — Specimens described by Wu (1964) as *Dibunophyllum* cf. *m'chesnei* Thomson & Nicholson have been included by the writer in the synonymy of this species. Their narrow axial structure, long columella, long minor septa are identical with those of Polish specimens to which they are also related by measurable characters of the specimens illustrated. Since

the Chinese text of the description was available in original only, the writer could make use of WU's (*op. cit.*) illustrations only. According to HILL (1938-1941), original British specimens of *D. m'chesnei* belong to *Dibunophyllum bipartitum bipartitum*.

Under the name of *Dibunophyllum derbiensiforme* VASSILJUK such corallites were described by BIKOVA (1966) which, in the present writer's opinion, correspond to the diagnosis of *A. biseptatum* n. sp. and considerably differ from *D. derbiensiforme* (according to the writer, equalling *D. percrassum* GORSKY) primarily in very long minor septa. No longitudinal section was presented by BIKOVA. *A. biseptatum* is one of the species which may be placed on the boundary between *Dibunophyllum* and *Arachnolasma*. Particularly dibunophylloid is the longitudinal section of a younger part of corallite.

Occurrence. — China, Upper Viséan; USSR (Kazakhstan), Namurian; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Arachnolasma microcolumella n. sp.

(Text-figs. 39*A-D*, 40; Pl. IX, Figs. 9-12; Pl. X, Fig. 1; Pl. XX, Fig. 9; Pl. XXI, Figs. 1, 2)

Holotype: Specimen IG. OS-70/1795 (Pl. XXI, Fig. 1).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *microcolumella* — after a small columella.

Material. — More than 20 solitary corallites without proximal ends, some with preserved calices. Measurable characters are shown in a diagram in Text-fig. 40.

Diagnosis. — An *Arachnolasma* 20-25 mm in diameter and (46 to 55)×2 septa; major septa long, mostly reaching the region of columella, frequently fused together, in axial part by stereoplasma; minor septa variable in length, may penetrate tabularium; axial structure in longitudinal section separated, in transverse section fused with septa; columella small, similar in thickness to lamellae.

Description. — *Transverse section* (Text-figs. 39A_4, B_1, C_1, D_1; Pl. IX, Figs. 9*b*, 10-12; Pl. X, Fig. 1; Pl. XX, Fig. 9; Pl. XXI, Fig. 1): The following description has been prepared only on the basis of the holotype. A considerable individual variability is presented below. Major septa thickened but these thickenings are absolutely uncoordinated which on the whole is never recorded in Aulophyllidae. They may be the thickest near epitheca, in the inner part of dissepimentarium, as well as near to the inner wall. In dissepimentarium, these thickenings sometimes take the form of nodes. Lamellae fused with septa, irregularly thickened, centripetally arranged. Tabellae few. Dissepimentarium variously formed in different parts of one and the same section. Regularly arranged herringbone dissepiments predominate here and there increasing towards the periphery. In other parts of the section, more numerous are irregular or rectangular dissepiments.

Longitudinal section (Text-figs. 39B_2, C_2, D_2; Pl. XXI, Fig. 2): Dissepiments mostly very small and near the tabularium almost vertical. In axial structure tabellae smaller and more densely arranged than in the peripheral part of tabularium, gently ascending towards columella, in some sections they are vesicular. In the peripheral part of tabularium tabulae are convex, vesicular, larger and somewhat less densely arranged than in axial structure. Close to dissepimentarium fine horizontal accessory plates may in some parts form a regular zone.

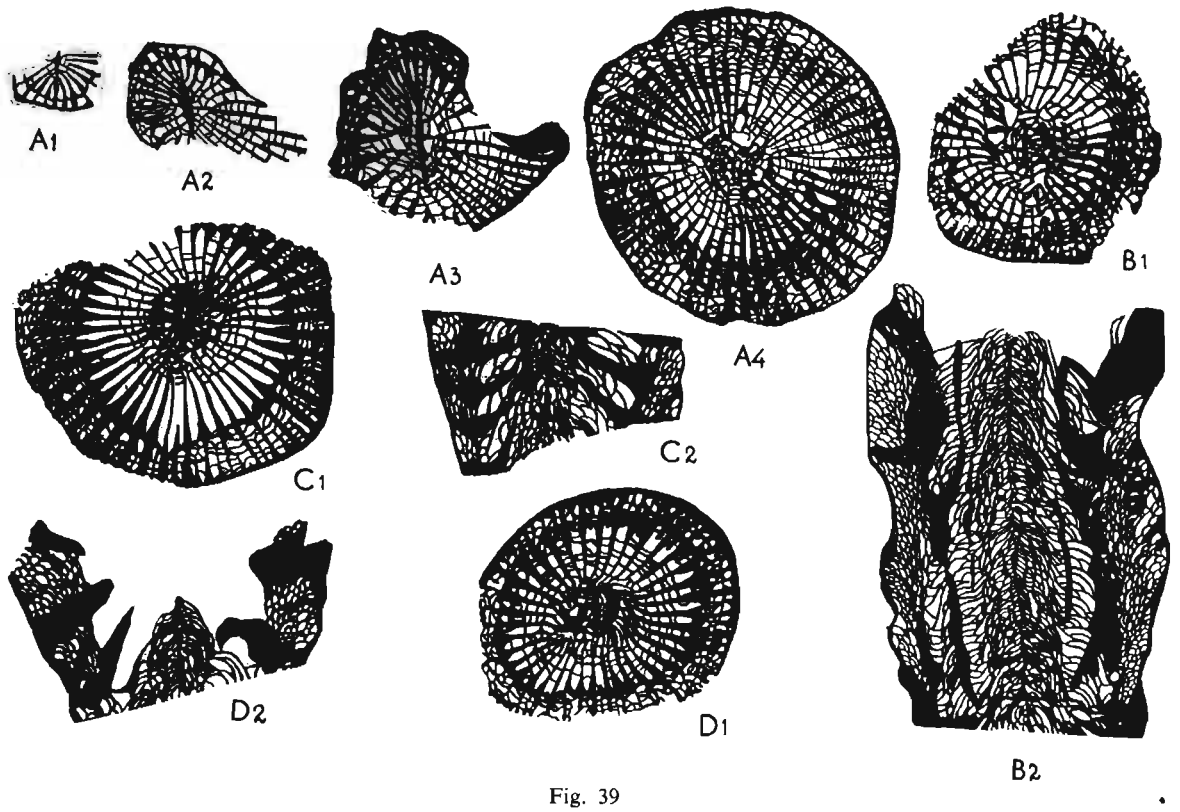

Fig. 39

Arachnolasma microcolumella n. sp.: A_{1-3} successive transverse sections of the neanic stage, × 4, A_4 transverse section of the ephebic stage, holotype (IG. OS-70/1795), × 2; B_1 transverse section of the ephebic stage, B_2 longitudinal section (IG. OS-70/1789); × 2; C_1 transverse section of the ephebic stage, C_2 longitudinal section (IG. OS-70/1874), × 2; D_1 transverse section of the ephebic stage, D_2 longitudinal section (IG. OS-70/1958), × 2. Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

Ontogeny. — Starting with a fairly advanced neanic stage, the writer succeeded in examining only parts of the development, which displayed characters typical of Clisiophyllinae. In the younger part of the neanic stage examined (Text-figs. 39$A_{1,2}$), columella is fused with counter and probably also with cardinal septum. Columella is thick, sublenticulate. In counter quadrants it is reached by septa which are arranged in a pinnate manner, increasing their length from counter septum to alar septa, only 1-2 last pairs being slightly shortened. Alar septa long, fused with columella. Major septa in cardinal quadrants are also arranged in a pinnate manner and decrease their length towards cardinal septum. In this stage, dissepimentarium occurs already, but no minor septa occurred as yet. A successive section (Text-fig. 39A_3) has still a similar system of major septa and a very long, now listlike columella. Minor septa are differentiated from the beginning; some of them reach inner wall, some others are visible only in the microstructure of outer wall. In the course of further development, columella shortens.

Individual variability. — 1) Axial structure in all cases very narrow and slightly separated from septa, many of which reach columella. Deposits of stereoplasma connecting axial ends of septa may occur on the boundary of axial structure. These stereoplasmatic swellings pass in some corallites (Text-figs. 39C_1, D_1) to the entire axial structure, also occurring on axial tabellae which may be observed in longitudinal section. Septal lamellae and axial ends of septa may be arranged radially and easily to discern, or more or less irregularly and

tangled with tabellae. In some specimens (Text-fig. 39 D_1), septa leave a narrow, free axial region in which, in addition to columella, axial tabellae are situated, some of them considerably thickened. 2) In most corallites, minor septa are short and even, here and there, reduced. In some specimens, part of minor septa strongly extend and enter tabularium. Other ones in the same section are shortened.

Remarks. — The species described differs from the remaining species of *Arachnolasma* in the structure of axial part in which columella is not, in contrast to those species, a predominant element. Axial ends of septa may be fused together by stereoplasma in a sort of aulos non-typical of *Arachnolasma*. This character is not, however, sufficiently stable so as it could be accepted as a diagnostic feature and it does not occur either in all specimens with otherwise identical morphology or over the entire ontogeny of a single corallite. The type of axial structure, as seen in transverse section, slightly relates this species to *Turbophyllum* PARKS, 1951, but longitudinal sections are quite different. Any doubts that may arise concerning the taxonomic position of the species are, in the present writer's opinion, quite unequivocally dispelled by the typical ontogeny.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

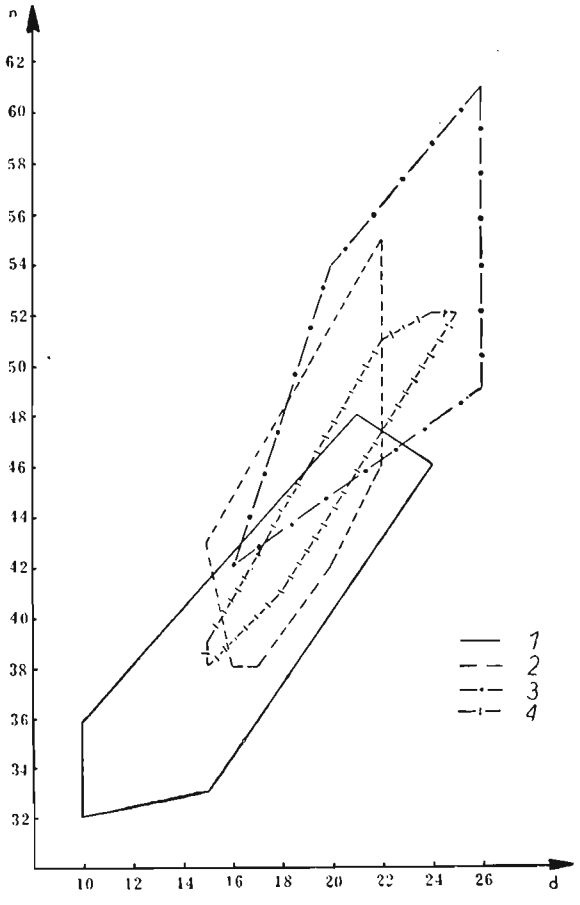

Fig. 40

Septal index (n/d) for some species of *Arachnolasma*. The points corresponding to extreme specimens are united by lines. 1 — *A. cylindricum* YÜ, 2 — *A. microcolumella* n. sp., 3 — *A. sinense* (YABE & HAYASAKA), 4 — *A. subpercrassum* (VASSILJUK).

Arachnolasma sp.

(Text-fig. 37 $D_{1,3}$; Pl. XX, Fig. 8)

Material. — A specimen Z. Pal. P. Tc-4/2565.

Dimensions (in mm): diameter of corallite 26 × 23, of tabularium 12 × 9.5, of axial structure 5.5 × 4, number of septa 52 × 2.

Description. — Major septa thickened to the greatest extent in inner wall. Lamellae, thickened on the margin of the structure and mostly fused with major septa. Tabellae few, irregular. Between major and minor septa dissepiments rectangular. Flat rectangular ones also occurring close to a strongly thickened inner wall; in the remaining part of dissepimentarium, dissepiments are of the herringbone type. A section of the late-neanic stage (Text-fig. 37 D_1) is similar to that of the ephebic stage, but differs in a considerably narrower dissepimentarium and a less conspicuous axial structure.

Remarks. — In the manner of thickening of major septa and in their number the specimen described is fairly closely related to *A. subpercrassum*. It differs from it: 1) in a more fusiform columella separated already in the neanic stage from cardinal and counter septa, 2) in an uncommonly narrow tabularium separated by a thick inner wall, and 3) in irregular septal lamellae frequently connected with septa.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **NEOKONINCKOPHYLLUM** FOMITSHEV, 1939

(Type species: *N. tanaicum* FOMITSHEV, 1939)

Synonyms:
Histiophyllum THOMSON, 1879 sensu FOMITSHEV, 1953,
non *Neokoninckophyllum* FOMITSHEV, 1953, sensu NATIONS, 1963.

Species assigned: *Neokoninckophyllum tanaicum tanaicum* FOMITSHEV, 1939; *N. tanaicum vesiculosum* FOMITSHEV, 1939; *N. tanaicum planum* FOMITSHEV, 1953; *N. simplex* MOORE & JEFFORDS, 1945; *N. arcuatum* MOORE & JEFFORDS, 1945; *N. gracile* MOORE & JEFFORDS, 1945; *N. soshkinae* FOMITSHEV, 1953; *N.*(?) *antipovi* FOMITSHEV, 1953; *N. stepanovi* FOMITSHEV, 1953; *N. campophylloides* FOMITSHEV, 1953; *Histiophyllum mediocarbonicum* FOMITSHEV, 1953; *Neokoninckophyllum nipponense* KATO, 1959; *N. multiseptatum* n. sp.; *N. trifossulum* n. sp.

Stratigraphic and geographic range: Lower to Middle Carboniferous; Eurasia, North America.

Revised diagnosis. — Solitary corals; columella formed by the connection of cardinal and counter septum, may be discontinued or atrophied, situated nearer a shortened cardinal septum with which it may be fused; counter septum happens to be sometimes extended as far as outside the axis of corallite, reaches columella laterally; cardinal fossula clisiophylloid or bothrophylloid; dissepimentarium mostly complex, wide, latero-cystose and pseudo-herringbone dissepiments as a rule developed, rectangular dissepiments less typical, peripheral vesicles occurring sporadically; axial structure in longitudinal section inconspicuous; axial tabellae slightly raised, flat, vesicular or, in the case of the atrophy of columella, horizontal.

Remarks. — An independent existence of this genus may arise certain doubts. HILL (1956) includes it only conditionally to *Koninckophyllum*. Its diagnostic characters are relatively fluid and fluctuate between the genera *Koninckophyllum* and *Bothrophyllum* which belong to

TABLE 8

Morphologically-comparative table of *Neokoninckophyllum* FOMITSHEV

Species	Cardinal septum	Counter septum	Cardinal fossula	Alar fossulae	Length of major septa	Thickness of major septa	Length of minor septa	Columella	Dissepimentarium	n/d	dd/dc	Longitudinal section
Neokoninckophyllum tanaicum FOMITSHEV	short	shortened in ephebic stage	present	absent	long	tabular sectors in young part	various; in ontogeny shortened	thin, short, free	lateral-cystose dissepiments not always developed; lonsdaleoid vesicles may occur	42 : 45	2/3	
N. soshkinae FOMITSHEV	short thick	reach the columella of the flank	slightly merged in dissepimentarium	in young stages	long	in tabularium	1/2 to 3/4 dissepimentarium	thin, long	lateral-cystose and pseudo-herringbone common at the periphery	44 : 30	1/2 to 2/3	bothrophylloid type
N. multiseptatum n. sp.	short	reach to the columella of the flank	slightly merged in dissepimentarium	absent	long	slightly in tabularium	shortened, partly reduced	thin, long, sometimes free	various; lateral-cystose and pseudo-herringbone not always developed	56 : 35	1/2	cyclic, axial part distinct
N. trifossulum n. sp.	short	reach the columella of the flank	merged in dissepimentarium	present, merged in dissepimentarium	long	in tabularium, more in cardinal quadrants	long	thin, short	rectangular, herringbone, rarely pseudo-herringbone and lateral-cystose	55 : 50	1/2	cyclic, axial tabellae tent-shaped

different families. The fact of this transitional nature of morphological features combined with a few new characters (cf. diagnosis) is a main argument for an actual necessity of separating the genus *Neokoninckophyllum*. In an extensive discussion, FOMITSHEV (1953, p. 352) justifies the necessity of erecting not only this genus, but also the family Neokoninckophyllidae. However, FOMITSHEV, the same as other authors who described *Neokoninckophyllum*, failed to illustrate younger ontogenetic stages of this genus. The present writer succeeded in part in filling this gap. Although in the collection available, there was not a single completely preserved specimen, some of them had, however, the younger parts of the neanic stage preserved. They are considerably related to corresponding ontogenetic stages of the remaining Clisiophyllinae. The separation by FOMITSHEV (*l. c.*) of the family Neokoninckophyllidae, included in the present paper in the synonymy of Clisiophyllinae, seems, therefore, not to be justified. The thickness of structural elements is, in the ontogeny of particular species of this genus, an individual character and, therefore, it cannot be considered a diagnostic feature for a family or a genus as believed by FOMITSHEV (*l. c*). Specimens which in the ephebic stage have thin septa and columella may have them in the neanic stage strongly thickened and *vice-versa*. The diagnosis of the genus *Neokoninckophyllum* was extended by MOORE and JEFFORDS (1945). The American species described by these authors have a mostly loose and non-complicated dissepimentarium, without latero-cystose dissepiments. Counter septum from which frequently columella does not detach, is conspicuous by its length. Of similar type is a Japanese species described by KATO (1959). This group of species, together with *N. stepanovi* FOMITSHEV and partly *N. tanaicum planum* FOMITSHEV can be hardly compared at all with *Koninckophyllum*. *Caninostrotion* EASTON, 1943, which in principle differs only in the capability of developing permanent colonies, is a genus related morphologically.

Neokoninckophyllum tanaicum FOMITSHEV, 1939

(Text-fig. 41 $A_{1\text{-}3}$; Pl. X, Figs. 2, 3)

1939. *Neokoninckophyllum tanaicum* FOMITSHEV; V. D. FOMITSHEV, Atlas..., p. 58, Pl. 8, Fig. 2*a*, *b*.
1953. *N. tanaicum* FOMITSHEV; V. D. FOMITSHEV, Korally Rugosa..., p. 354, Pl. 24, Figs. 1-6.

Material. — Two corallites, IG. OS-70/3144, 35 × 33 mm in diameter, with 42 × 2 septa and without proximal end.

Revised diagnosis. — A *Neokoninckophyllum* to 45 mm in diameter and with (38 to 42) × 2 septa; minor septa are subject to partial atrophy; dissepimentarium reaches more than 2/3 of the diameter of corallite; columella persists to the end of ontogeny.

Remarks. — This species was discussed and described in detail by FOMITSHEV (1953). For this reason, the present writer confines himself only to the differences between the Polish specimen and those from Donets Basin, which increase together with the ontogenetic development. In the oldest part the Polish specimen has considerably more reduced minor septa, which here and there are divided into segments, less complex dissepimentarium which does not include pseudo-herringbone and lateral-cystose ones but does include those with fine lonsdaleoid vesicles, as well as a short and completely free columella. This stage is particularly related to the genus *Koninckophyllum*. On the other hand, younger stages (Text-figs. 41 $A_{2,3}$) are, in the present writer's opinion, typical of *N. tanaicum* and do not differ from FOMITSHEV'S (*l. c.*) description and illustrations.

Occurrence. — USSR (Donets Basin), Westphalian, Limestone M_5; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

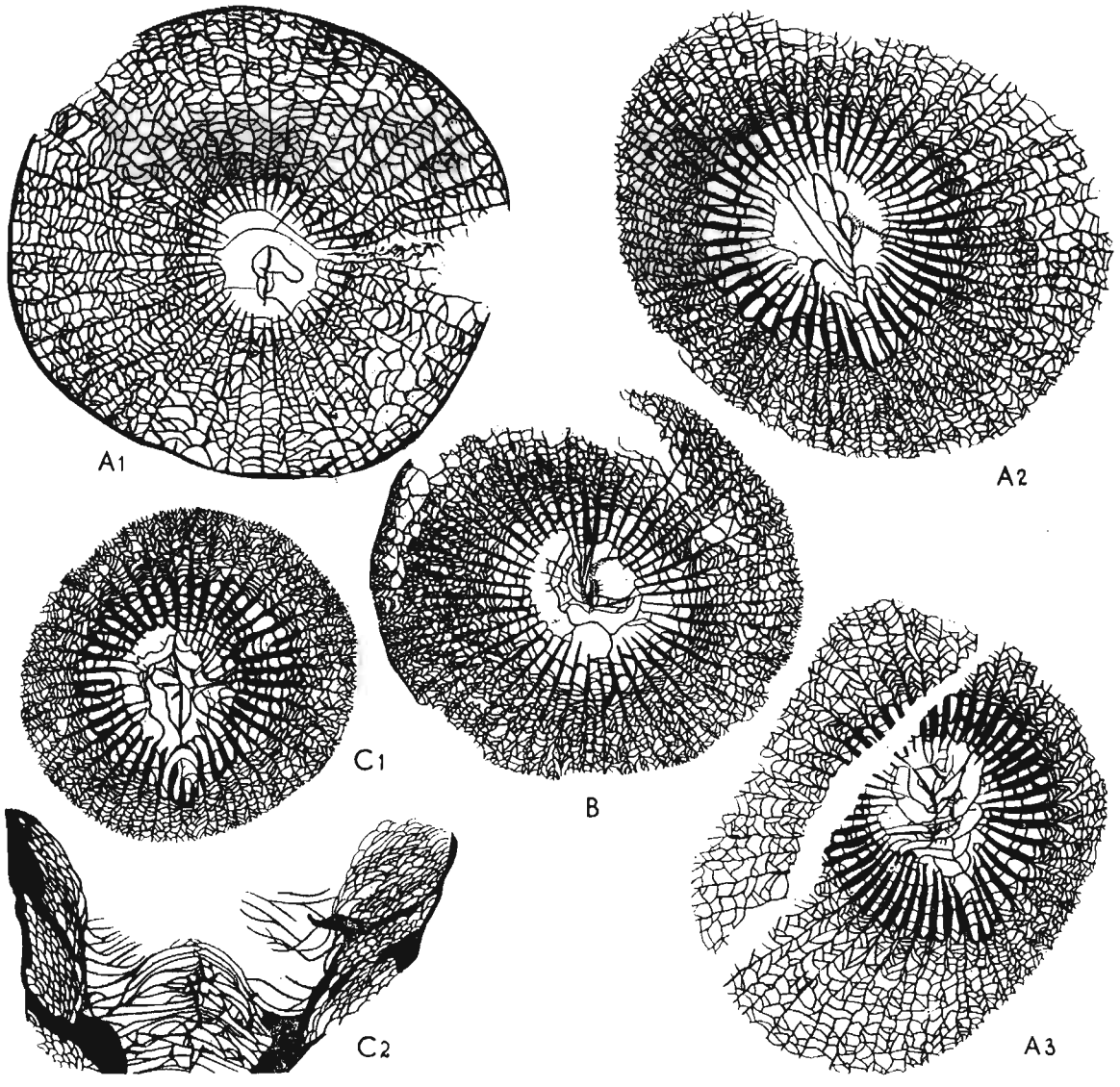

Fig. 41

Neokoninckophyllum tanaicum FOMITSHEV: A_1 transverse section of the late-ephebic stage, A_2 transverse section of the early-ephebic stage, A_3 transverse section of the late-neanic stage (IG. OS-70/3144);
B, C Neokoninckophyllum soshkinae FOMITSHEV: *B* transverse section of the ephebic stage (IG. OS-70/595); C_1 transverse section of the ephebic stage, C_2 longitudinal section (IG. OS-70/79). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

Neokoninckophyllum soshkinae FOMITSHEV, 1953

(Text-figs. 41 *B*, *C*; Pl. X, Fig. 8; Pl. XXI, Figs. 3-5)

1953. *Neokoninckophyllum soshkinae* FOMITSHEV; V. D. FOMITSHEV, Korally Rugosa..., p. 366, Pl. 25, Figs. 2-5.

Material. — Five solitary corallites without proximal ends and with partly preserved calices.

Dimensions (in mm):

IG. OS-70/	Index of septa n/d
79	40 : 23×23
595	41 : 27×25
623	39 : 22×20
2587	44 : 27×27

Revised diagnosis. — A *Neokoninckophyllum* to 30 mm in diameter and with (38 to 44) × 2 septa; minor septa reach about a half of the width of dissepimentarium; longitudinal section of the bothrophylloid type; columella may disappear at the end of ontogeny; many pseudo-herringbone and lateral-cystose dissepiments occur on the periphery.

Remarks. — In their size and number of septa Polish specimens slightly predominate over those from Donets Basin. They preserve juvenile or primitive characters, such as the outline of alar fossulae, development of columella or a stronger thickening of tabular segments of major septa for a longer time. Probably, this may be ascribed to a older geological age of Polish specimens. The most similar are the structure of dissepimentarium in transverse section and the longitudinal section, particularly so as compared with the holotype which, in the present writer's opinion, is more related to Polish specimens than the paratypes illustrated by FOMITSHEV (1953).

Occurrence. — USSR (Donets Basin), Westphalian, Limestones H_5-L_1; Poland (Holy Cross Mts., Gałęzice), Upper Viséan, D_2 (top).

Neokoninckophyllum multiseptatum n. sp.

(Text-figs. 42*A-F*; 43; Pl. X, Figs. 4-7; Pl. XXI, Figs. 6, 7)

Holotype: Specimen IG. OS-70/177 (Pl. XXI, Fig. 6).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *multiseptatum* — with many septa.

Material. — More than 30 solitary corallites, some of them with calices, one with almost complete proximal end. Measurable characters are given in a diagram in Text-fig. 43.

Diagnosis. — A *Neokoninckophyllum* with (46 to 56) × 2 septa and 25-35 mm in diameter, columella long; major septa complete; cardinal fossula slightly extended towards axis; minor septa varying in length; in the younger part ontogeny clisiophylloid.

Description. — *Transverse section* (Text-fig. 42 *B*, *C*, D_1, *E*, F_1; Pl. X, Figs. 4*a*, 5-7; Pl. XXI, Figs. 6*b*, 7): The species is marked by a considerable individual variability, discussed below. Description is based on the holotype only. In dissepimentarium, major septa are thin, wavy, in tabularium — straight. Frequently, they are more thickened in cardinal quadrants. Columella, thickened in the axial part, extends in the form of a tortuous lamella towards cardinal septum and joins it. Part of counter septum, extended towards the axis, bends and takes a position parallel to the sections of axial tabellae, from which it may be distinguished only either owing to its microstructure, or by tracing it from its very beginning. It reaches columella outside the axis of corallite on the side of cardinal septum or it may terminate loosely and differ

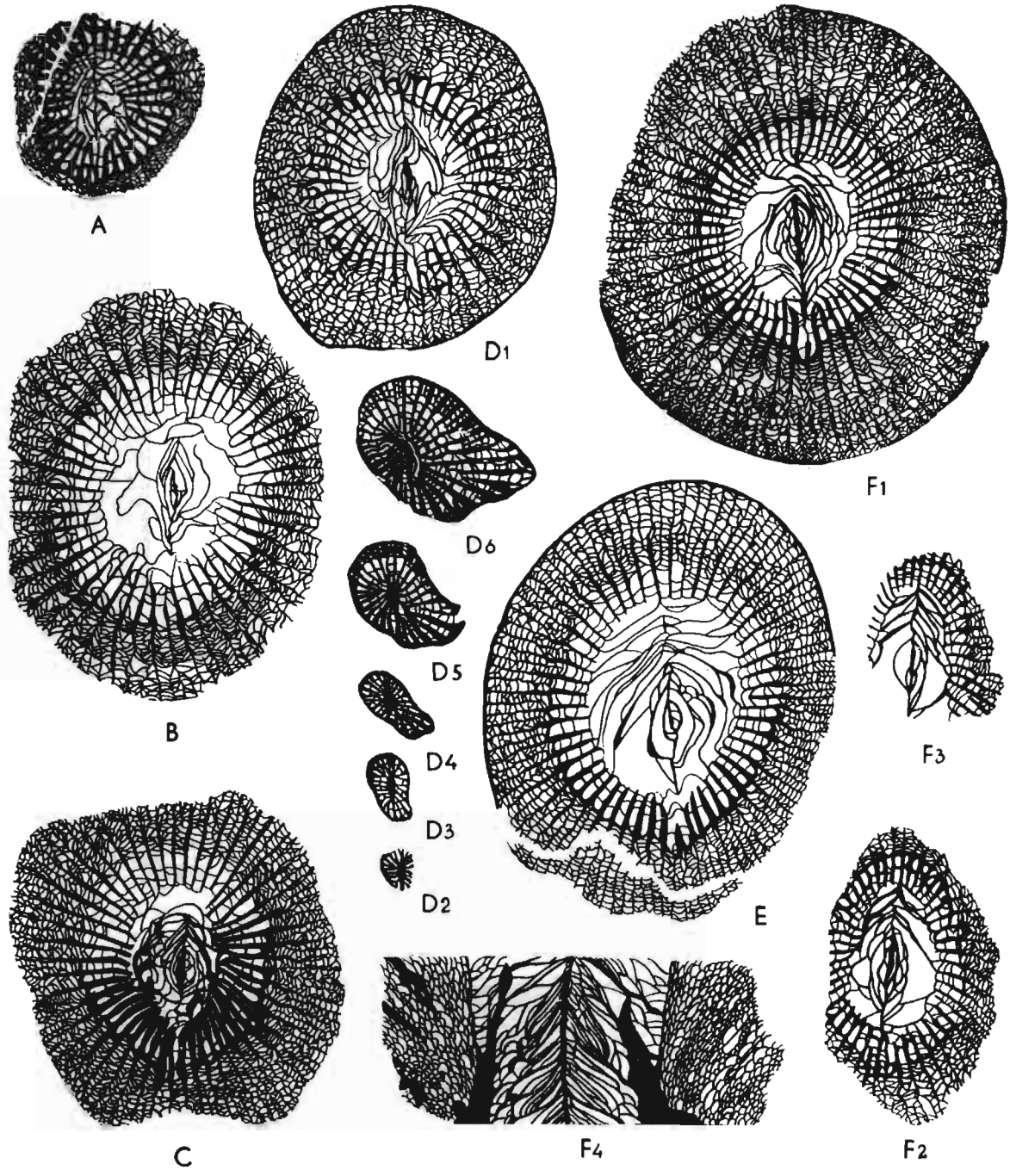

Fig. 42

Neokoninckophyllum multiseptatum n. sp.: *A* transverse section of the late-neanic stage (IG. OS-70/19); *B* transverse section of the ephebic stage (IG. OS-70/470); *C* transverse section of the ephebic stage (IG. OS-70/2645); D_1 transverse section of the ephebic stage, D_{2-6} successive transverse sections of the neanic stage (IG. OS-70/237); *E* transverse section of the ephebic stage (IG. OS-70/2822); F_1 transverse section of the ephebic stage, $F_{2,3}$ transverse sections of the late neanic stage, F_4 longitudinal section, holotype (IG. OS-70/177). Galęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

from each other in various sections of the holotype. It is also in the ephebic stage that columella is, therefore, more closely connected with the cardinal than counter septum. Herringbone type dissepiments predominate in the inner part of dissepimentarium and pseudo-herringbone and angular ones in the peripheral part. Lateral-cystose dissepiments are few and their occurrence is limited mostly to the central part of dissepimentarium.

Longitudinal section (Text-fig. 42F_4; Pl. XXI, Fig. 6*b*): Dissepiments varying in size, mostly small, convex and steeply arranged, near tabularium vertical. Peripheral part of tabularium composed of convex, vesicular tabellae, arranged obliquely to the axis. Inner part consisting of long tabellae, gathered in systems and reaching columella. A tabella beginning among peripheral tabellae and reaching columella forms a basis of each of the systems of axial tabellae. Such a tabella is usually thickened. Shorter and shorter tabellae, reaching columella below a successive, thickened and longer tabella, are supported by the first tabella described above. The number of tabellae in a system is variable and one side of the corallite does not correspond to the other.

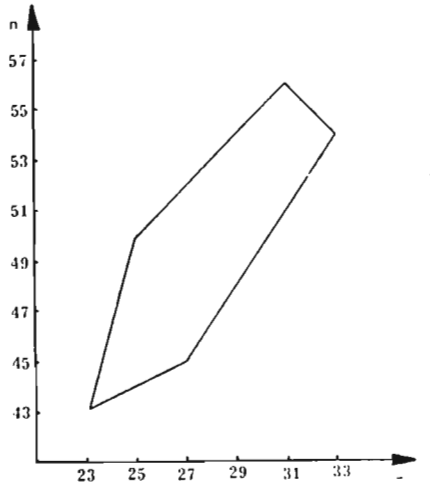

Fig. 43
Septal index (n/d) for *Neokoninckophyllum multiseptatum* n. sp. The points corresponding to extreme specimens are united by lines.

Ontogeny. — The part of ontogeny, studied by the present writer, is sufficiently complete to find its similarities and differences from the ontogeny of the remaining Clisiophyllinae. These differences are accepted here as a generic character. In the younger part of the neanic stage, all structural elements are strongly thickened. Alar fossulae slightly marked, columella thick, directly connected with cardinal and counter septa (Fig. 42D_{2-6}). With the growth, counter septum and major septa of counter quadrants become thinner earlier than septa of cardinal quadrants. Counter septum may be distinguished from neighbouring major septa only owing to the microstructure, because it constitutes a direct extention of columella. Minor septa and dissepimentarium are formed even when the corallite is 6×3 mm in diameter (Text-fig. 42D_4). A change in structure, considered by the writer to be a generic character, occurs with a diameter of 12×9 mm in specimen IG. OS-70/237 and of 18×13 mm in specimen IG. OS-70/177 (Text-figs. 42D_6, F_2). Columella continues to be closely connected with cardinal septum, whereas counter septum detaches itself from it bending laterally but not shortening. With the growth

of corallite, an increase is observed in the length of counter septum which may reach as far as outside the axis of corallite. Although this type of the structure of counter septum is not mentioned by FOMITSHEV (1953), it may be observed on the illustrations of the holotype of the type species of *Neokoninckophyllum*, as well as in Pl. 24, Figs. 2, 4, 8.

Individual variability. — This species is very variable and it may well be that some of the morphological types, differing from the holotype, exceed the range of the intra-specific variability. The following three groups have been distinguished by the present writer: 1) Corallites, whose type may be represented by specimen IG. OS-70/470 (Text-fig. 42*B*), are marked by major septa of the caninoid type, very short minor septa and a wide dissepimentarium composed mostly of herringbone dissepiments. This type of structure is most similar to that of *Bothrophyllum*. 2) Corallites with long minor septa which, as a rule, reach the boundary of tabularium, with a wide dissepimentarium composed mostly of rectangular dissepiments and with a strongly developed, clisiophylloid cardinal fossula. This group of specimens, represented by specimen IG. OS-70/2822 (Text-fig. 42*E*), particularly deviates from the group described above. 3) Corallites related to specimen IG. OS-70/2645 (Text-fig. 42*C*), with a typically developed dissepimentarium and minor septa average in length, having major septa in cardinal quadrants thickened in the form of strong rollers, thick and short columella and axial structure composed mostly of thickened axial tabellae.

Remarks. — *N. multiseptatum* n. sp. is most closely related to the type species, from which it differs primarily in measurable characters. Corallites are smaller by 10-15 mm and, at the same time, have 6-14 more major septa. Morphological differences are not so conspicuous. This species has a more strongly developed columella and sometimes even a sort of axial structure, a different and specific structure as seen in longitudinal section and usually abortive lateral-cystose dissepiments. Of the remaining species, also related is *N. soshkinae* FOMITSHEV, American species, closely related to *Bothrophyllum*, are conspicuously different.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Neokoninckophyllum trifossulum n. sp.

(Text-figs. 44*A-C*; Pl. X, Fig. 9; Pl. XI, Figs. 6, 7; Pl. XXI, Fig. 8)

Holotype: Specimen IG. OS-70/1455 (Pl. XI, Fig. 6).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *trifossulum* — after the three fossulae developed (one cardinal and two alar ones).

Material. — Three trochoidal corallites with preserved calices and incomplete proximal ends.

Dimensions (in mm):

IG. OS-70/	Septal index n/d	Length of specimen	Depth of calyx
1454	57×2 : 45×40	40	6
1455	55×2 : 50×43	40	10
1915	57×2 : 36×36	30	5

Diagnosis. — A *Neokoninckophyllum* with (55 to 57)×2 septa and 36-50 mm in diameter. Alar fossulae strongly developed almost to the end of the ontogenetic development; columella

distinct; major septa thickened only in tabularium; dissepiments mostly of the rectangular and herringbone type.

Description. — A trochoid shape of corallites, whose diameter near margin of calice is larger than the length, is characteristic of all available specimens. A very shallow calice with

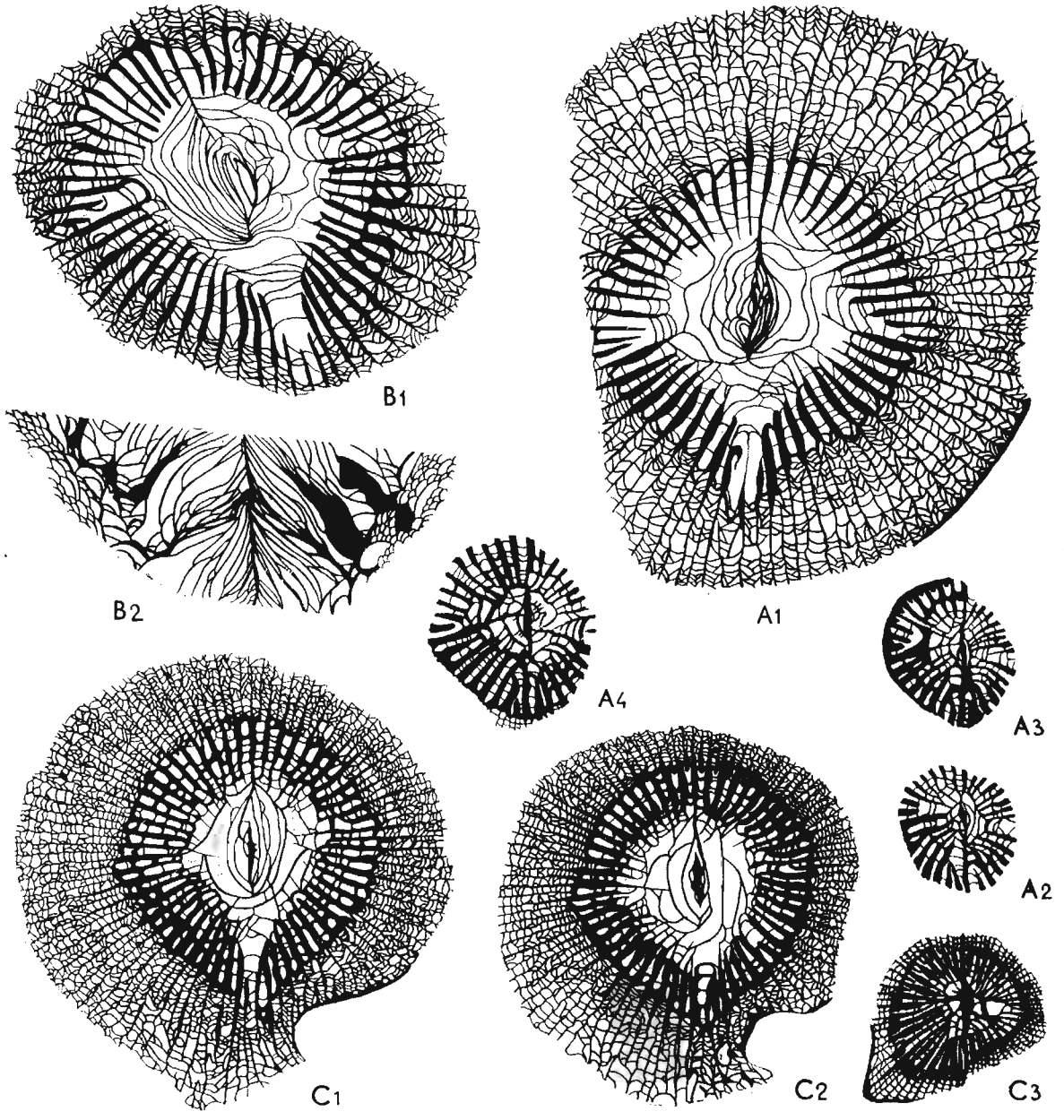

Fig. 44

Neokoninckophyllum trifossulum n. sp.: A_1 Transverse section of the ephebic stage, A_{2-4} successive transverse sections of the neanic stage, holotype (IG. OS-70/1455); B_1 transverse sections of the ephebic stage, B_2 longitudinal section (IG. OS-70/1454); $C_{1,2}$ transverse sections of the ephebic stage, C_3 transverse section of the neanic stage (IG. OS-70/1915). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

a sharp, strongly developed margin, normal in tetracorals, is another essential external character. Despite the ratio of width to depth of the calice being about 6:1, the calice was sufficiently large to lodge the entire polyp. Surface of specimens, devoid of longitudinal ribbing, has fine and dense transverse wrinkles.

Transverse section (Text-figs. 44A_1, B_1, $C_{1,2}$; Pl. X, Fig. 9; Pl. XI, Figs. 6, 7): Major septa in dissepimentarium thin; two septa, neighbouring with cardinal septum, are shortened. Alar septa usually longer than septa of cardinal quadrants and considerably longer than a few last septa of counter quadrants. Axial part of corallite is occupied by a sort of axial structure composed of axial tabellae and a columella, which is centrally situated and joins counter septum in a manner typical of the genus.

Longitudinal section (Text-fig. 44B_2; Pl. XXI, Fig. 8): Dissepiments convex, varying in size, vertical, their inner, thickened row forming an inner wall. Tabularium on the whole unizonal. In the peripheral part, tabellae shorter, vesicular, spaced at random, in the axial part long, raised in a tentlike manner towards columella, gathered in systems supported by thickened and long tabellae or tabulae which reach dissepimentarium. These systems are non-typical and may be distinguished due to the thickening of tabellae which form their bases. Columella variable in thickness, usually thin.

Ontogeny. — The development, only partly studied, without the nepionic and younger part of the neanic stage, is similar to that of *N. multiseptatum*. In the species here under study, an excellent development of alar fossulae is recorded from early stages which is one of its diagnostic characters.

Remarks. — *N. tanaicum* FOMITSHEV, *N. multiseptatum* n. sp. and *N. soshkinae* FOMITSHEV are the most closely related species. The species in question differs from them in the ratio of the number of septa to the diameter of corallite, in a more regular dissepimentarium, in the type of thickening of major septa and in alar fossulae which are preserved almost to the end of the development. The shape of corallites and a very wide, shallow calyx are also features characteristic of this species. The manner of connecting columella with counter septum and the ontogeny are characters in which this species is similar to the remaining ones.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **AMANDOPHYLLUM** HERITSCH, 1941

(Type species: *Clisiophyllum carnicum* HERITSCH, 1936)

Synonyms:
Clisiophyllum M'COY, 1849 sensu HERITSCH, 1936,
Dibunophyllum THOMSON & NICHOLSON, 1876 sensu HERITSCH, 1936,
Corwenia SMITH & RYDER, 1926 sensu HERITSCH, 1936,
Palaeosmilia M.-E. & H. 1850 sensu HERITSCH, 1936,
Cyathoclisia DINGWALL, 1926 sensu DOBROLJUBOVA, 1937,
Dibunophyllum THOMSON & NICHOLSON, 1876 sensu FELSER, 1937,
Cyathoclisia DINGWALL, 1926 sensu DOBROLJUBOVA & KABAKOVITSH, 1948,
Dibunophyllum THOMSON & NICHOLSON, sensu JEFFORDS, 1948,
Dibunophylloides FOMITSHEV, 1953,
Huangia(?) MINATO, 1955,
Corwenia SMITH & RYDER, 1926 sensu DE GROOT, 1963, partim.

Species assigned: In addition to the species assigned to *Amandophyllum* by MINATO & KATO, 1965, here belong: (?)*Cyathoclisia simmetrica* DOBROLJUBOVA, 1937, (?)*C. myatshkovensis* DOBROLJUBOVA 1937, *Dibunophylloides longiseptatus* FOMITSHEV, 1953, *Dibunophyllum moorei* JEFFORDS, 1948, *D. exigum* JEFFORDS, 1948, *Amandophyllum delicatum* n. sp.

Stratigraphic and geographic range: Lower Carboniferous to Lower Permian; Eurasia, North America.

Diagnosis. — Solitary corallites with a strongly developed dissepimentarium; in transverse section axial structure inconspicuous or not separated from septa; columella thin, frequently indistinguishable from septal lamellae; major and minor septa complete, reaching epitheca; cardinal fossula mostly inconspicuous; in longitudinal section axial structure does not occur, only vesicular tabellae oblique to columella are visible in this place.

Remarks. — Species of *Amandophyllum* were placed by most authors who described them in different genera of the family Aulophyllidae. MINATO and KATO (1965) assign *Amandophyllum* to a new family Durhaminidae. These authors also do not accept the congenerity of Alpine and American species with the remaining European ones and, on the basis of de GROOT's work (1963), erroneously consider the Soviet species of *Amandophyllum* to be colonial forms. These species are only solitary, which the present writer could find by personal observation and by direct discussions with T. A. DOBROLJUBOVA and N. V. KABAKOVITSH. The writer has resolved to reject MINATO's and KATO's suggestion, at least till the ontogeny of *Amandophyllum* will be studied on original Alpine material. He is induced to do this by JEFFORDS's (1948) studies on two American species assigned by this author to *Dibunophyllum*. The morphology of these species is strongly coinciding with that of *A. symmetricum*. JEFFORDS (1948, Text-fig, 3*a*, *b*) illustrates their neanic stages. Their coincidence with corresponding stages of Clisiophyllinae is clearly visible: a septum of this species, mostly counter one is connected with columella and axial structure is composed of septal lamellae directly connected with septa. However, there are also certain differences, such as the lack of cardinal fossula, clearly marked in most Clisiophyllinae; this lack causes the structure to be more radial. In the present writer's opinion, this ontogeny indicates that the American species should be assigned to Clisiophyllinae and that, in relation to *Dibunophyllum*, they represent a different genus. Several solitary genera and colonial ones having permanent colonies are placed together by DE GROOT under the generic name of *Corwenia*. The present writer does not share this view and considers the capability of forming permanent colonies to be an important character of the rank of genus.

Amandophyllum delicatum n. sp.

(Text-figs. 45$A_{1,2}$; Pl. XXII, Figs. 1*a*, *b*)

Holotype: Specimen IG. OS-70/2291 (Pl. XXII, Fig. 1).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *delicatum* — after thin structural elements.

Material. — Two solitary corallites without calices and proximal ends. Septal index n/d = 49:21 and 52:21.

Diagnosis. — An *Amandophyllum* with minor septa reduced to the form of spines on epitheca; cardinal septum fused with counter septum without a conspicuous columella; cardinal fossula marked by a slight depression in dissepimentarium; in longitudinal sections only vesicular tabellae occur in tabularium and axial structure is absent.

Description. — *Transverse section* (Text-fig. 45A_1; Pl. XXII, Fig. 1*a*): Epitheca very thin, septal bases, penetrating it, are triangular. Major septa long, thin, only in inner wall slightly thickened. Their axial ends, varying in length, do not form a clear boundary of axial area. Some of them enter between sections of tabellae of axial structure, some others extend in the form of lamellae as far as columella. The rest of them usually terminate on some accidental tabella. Owing to such an arrangement of septa, axial structure is a natural, quite inconspicuous continuation of peripheral structures. Columella does not differ in thickness from lamellae and axial ends of septa. In the holotype, it directly connects cardinal with counter septum and it is absolutely indistinguishable from these septa. In the paratype, it does not reach cardinal septum. Some septal lamellae do not fuse with major septa. Uncommonly short minor septa usually penetrate only the first verticil of dissepiments. Among the remaining major septa, cardinal septum is quite indistinguishable. Cardinal fossula is marked by a very slight contraction of dissepimentarium only. Dissepimentarium occupies more than 1/3 of the diameter of corallite. It consists of a narrow belt of flat herringbone or rectangular dissepiments near the inner wall and of large, irregular ones in the remaining part.

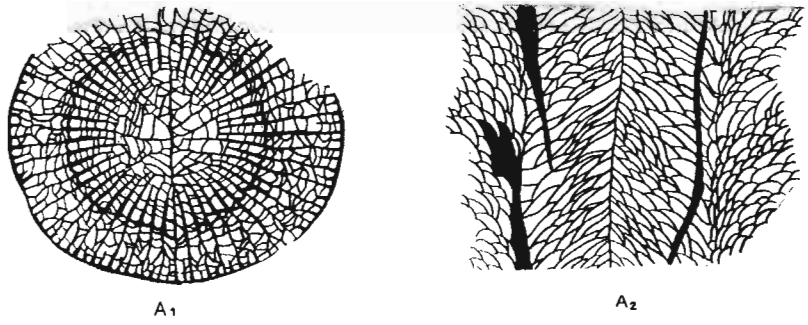

Fig. 45
Amandophyllum delicatum n. sp.: A_1 transverse section of the ephebic stage, A_2 longitudinal section, holotype (IG. OS-70/2291). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

Longitudinal section (Text-fig. 45A_2; Pl. XXII, Fig. 1*b*): Dissepiments mostly convex, arranged semicircularly, the smallest ones flat and vertically situated inside. Tabularium homogeneous, composed only of vesicular tabellae, which, towards axis, are gradually less and less convex, raised at a small angle towards a very thin, straight columella.

Remarks. — Polish specimens are the oldest geologically of all those described so far and, at the same time, they have the largest dimensions and number of septa. They are more related morphologically to the Moscow, Donets and, what is rather surprising, American (*A. moorei*) specimens, than to the type species from Carnic Alps. They differ from it mostly in the composition of axial structure with radially arranged lamellae, whereas in *A. carnicum* many lamellae are parallel to columella. Other species, described by HERITSCH from Carnic Alps and from the U.S.A. have not, however, this feature which, therefore, is probably a specific character only. Likewise, the Soviet specimens have radially situated lamellae. The longitudinal section through Polish specimens is identical with that through *A. symmetricum*.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **NERVOPHYLLUM** VASSILJUK, 1959 emend.

(Type species: *Nervophyllum besheviense* VASSILJUK, 1959)

Species assigned: *Nervophyllum besheviense* VASSILJUK, 1959, *N. primitivum* n. sp., *N. intermedium* n. sp., *N. superius* n. sp.

Stratigraphic and geographic range: Upper Viséan to Lower Namurian; Eastern and Central Europe.

Diagnosis. — Solitary corallites with a strongly developed dissepimentarium; axial structure complex; columella usually fused with cardinal septum or, at the end of development, disappearing; septal lamellae converge towards the central part of columella; number of lamellae varying from that corresponding to the number of major septa to the total number of major and minor septa; major septa reaching epitheca or may be split lengthwise along a dark line; the length of minor septa is characteristic of the species; cardinal fossula open; in longitudinal section axial structure not always conspicuous; axial tabellae conical or semicircular.

Remarks. — This genus has so far been known only from Donets Basin. Its full ontogeny is unknown. Late-neanic stages, studied by the present writer, display a close relationship of this genus to the group of *Dibunophyllum* — *Clisiophyllum* and related genera. VASSILJUK'S diagnosis has been extended by the writer primarily in regard to axial structure, since specimens related to *Dibunophyllum* (*N. primitivum* n. sp.) and *Aulophyllum* (*N. superius* n. sp.) were in the Polish collection. The axial structure of the last-named species becomes, in the late-ephebic stage, rounded, columella disappeared, and many lamellae yet more strongly suggest the similarity and maybe even relationship of both genera. The genus *Berkhia*, described on the basis of one specimen and illustrated by only two transverse sections, has been erected by GORSKY (1951, p. 77). Its multilamellar axial structure, similar to that of *N. superius*, is devoid of columella in the section older ontogenetically and has a thin columella in the section younger ontogenetically. The arrangement of lamellae in axial structure is different. Despite this fact we cannot preclude the possibility of the genus *Berkhia* being an older synonym of *Nervophyllum*. But the better proved name of *Nervophyllum* is accepted by the writer, at least till a possible revision of the genus *Berkhia* and a presentation of its more accurate data.

In the present writer's opinion, the genera *Nervophyllum* and *Dibunophyllum*, with which such species as, for instance, *N. primitivum* n.sp. may be identified, are closely related to each other. The writer believes that the genus *Dibunophyllum* is a starting genus of *Nervophyllum* and that *N. primitivum* n.sp. referred to above is a species related to the transitional one. It has a conspicuous axial structure in longitudinal section and few septal lamellae in transverse section. However, the arrangement of these lamellae in relation to columella, the connection of columella with cardinal septum only and the occurrence of lamellae, corresponding to minor septa, in fragments of axial structure are characters typical of *Nervophyllum*. Unfortunately, the occurrence of Polish fauna on a reworked deposit and a not very abundant material, prevent one from proving the phylogenetic development from *N. primitivum* to *N. superius*, which is clearly visible in their morphology.

Nervophyllum primitivum n. sp.

(Text-figs. 46*A-D*, 47; Pl. XI, Figs. 1-5; Pl. XXII, Fig. 2)

Holotype: Specimen IG. OS-70/285 (Pl. XI, Fig. 1; Pl. XXII, Fig. 2).

Type locality: Holy Cross Mountains, Gałęzice.

Type horizon: Upper Viséan, D_2 (top).

Derivation of the name: Lat. *primitivum* — after a simple structure.

TABLE 9

Morphologically-comparative table of *Nervophyllum* VASSILJUK

Species	Cardinal septum	Cardinal fossula	Length of major septa	Thickness of major septa	Structure of major septa	Length of minor septa	Axial structure			n/d	ds/dc	dd/dc	Longitudinal section		
							columella	number of septal lamellae	structure of septal lamellae				axial structure	tabularium	dissepimentarium
Nervophyllum primitivum n. sp.	thin, slightly shortened	slightly merged in dissepimentarium	long, to axial structure	various in tabularium	continuous	very short (1 mm) partly reduced	long in all stages	slightly more or less than major septa	mostly united with septa	43 : 20	1/5 to 1/3	1/3	separated, axial tabellae closely packed	mostly continuous and convex, rare small tabellae	small, steeply directed to the periphery
N. intermedium n. sp.	very thin, shortened	indistinct	long, to axial structure	best thickened in dissepimentarium	splitted in ephebic stage	to inner wall or in tabularium	long, roller-shaped	less than major septa	thickened	47 : 20	1/3	1/3	non separated; vesicular, dome-shaped tabellae	vesicular tabellae	small, steeply directed to the periphery
N. superius n. sp.	short	merged in dissepimentarium	long, to axial structure	in tabularium roller-shaped	continuous	= 1/2 to 3/4 dissepimentarium	atrophic in late ephebic stage	2 × major septa	in young ephebic stage united with major septa, lately free	43 : 19	1/3	1/3	nonseparated; dome-shaped tabellae	concave, on the periphery loose tabellae	small, steeply directed to the periphery

Material. — About 30 solitary corallites, some of them with calices and partly preserved proximal ends. Measurable characters are given in a diagram in Text-fig. 47.

Diagnosis. — A *Nervophyllum* about 20 mm in diameter and with 32-43 major septa; minor septa shortened, partly atrophied; columella usually fused with cardinal septum; lamellae more numerous on the periphery of axial structure; axial structure conspicuous in longitudinal section.

Description. — Calice about 7 mm deep, with vertical walls and a sharp margin. Axial structure, with columella projecting from it, is raised about 2-3 mm above the bottom of calice.

Transverse section (Text-figs. 46$A_{1,2}$, B, C_1, D; Pl. XI, Figs. 1-4*a*, 5; Pl. XXII, Fig. 2*b*): Major septa slightly wavy, with extended bases. Columella listlike, usually somewhat thicker than septal lamellae and reaching the region of cardinal septum or, more frequently, connecting with it. It penetrates not deeper than 2/3 of the width of axial structure on the side of cardinal septum. Lamellae may be either thinner or thicker than axial ends of septa. They are more densely distributed on the periphery of axial structure. In the holotype, and relatively numerous paratypes, a few or some dozen small, slight lamellae, corresponding to minor septa, occur in the higher part of the ephebic stage between lamellae which correspond to major septa. Dissepimentarium composed mostly of small, herringbone dissepiments, much more densely arranged near the thickened inner wall.

Longitudinal section (Text-figs. 46A_4, C_2; Pl. XI, Fig. 4*b*; Pl. XXII, Fig. 2*a*): Peripheral tabellae may be convex or S-shaped, frequently almost vertical, with smaller and more convex vesicular tabellae occurring between them. Columella thin, straight. Near columella, axial tabellae are arranged in a tentlike manner and slightly raised. In the peripheral part of axial structure, they are more vesicular and frequently vertical or steeply sloping.

Individual variability. — The ratio n/d is subject to considerable fluctuations (cf. diagram), but corallites with few major septa are predominant. Not numerous are corallites marked by a wide axial structure (Text-fig. 46C_1). They make up a fairly isolated group of individuals, mostly related to *Dibunophyllum*. Due to a close connection of cardinal septum with columella and the presence of many septal lamellae, approximately corresponding in number to septa, these individuals have been included in the species under study. Specimen Z. Pal. P. Tc-4/2890 (Text-fig. 46 *D*) considerably deviates from the holotype and cannot be placed within the range of individual variability of the species. The present writer, who does not want to erect for it a new taxon, includes it in this range with a reservation. The most important morphological changes are marked in axial structure of the remaining corallites. These changes may range from more dibunophylloid to nervophylloid ones. This is particularly true of lamellae, corresponding to minor septa and which appear in the marginal part of axial structure. This character is not marked in all corallites and, since these lamellae appear as late as a very advanced ephebic stage, perhaps these corallites are too young ontogenetically.

Remarks. — This species may be placed on the boundary between *Dibunophyllum* and *Nervophyllum*. Its assignment to either of these two genera may be debatable. Due to abundantly occurring septal lamellae, which frequently are fused with major septa, as well as to the occurrence, in axial structure, of lamellae which are more numerous than major septa, the present writer has resolved to include this species in *Nervophyllum*. The last-named character has never been recorded in *Dibunophyllum*. The collection examined, unfortunately, did not include even one specimen with a completely preserved ontogeny and, therefore, this most important diagno-

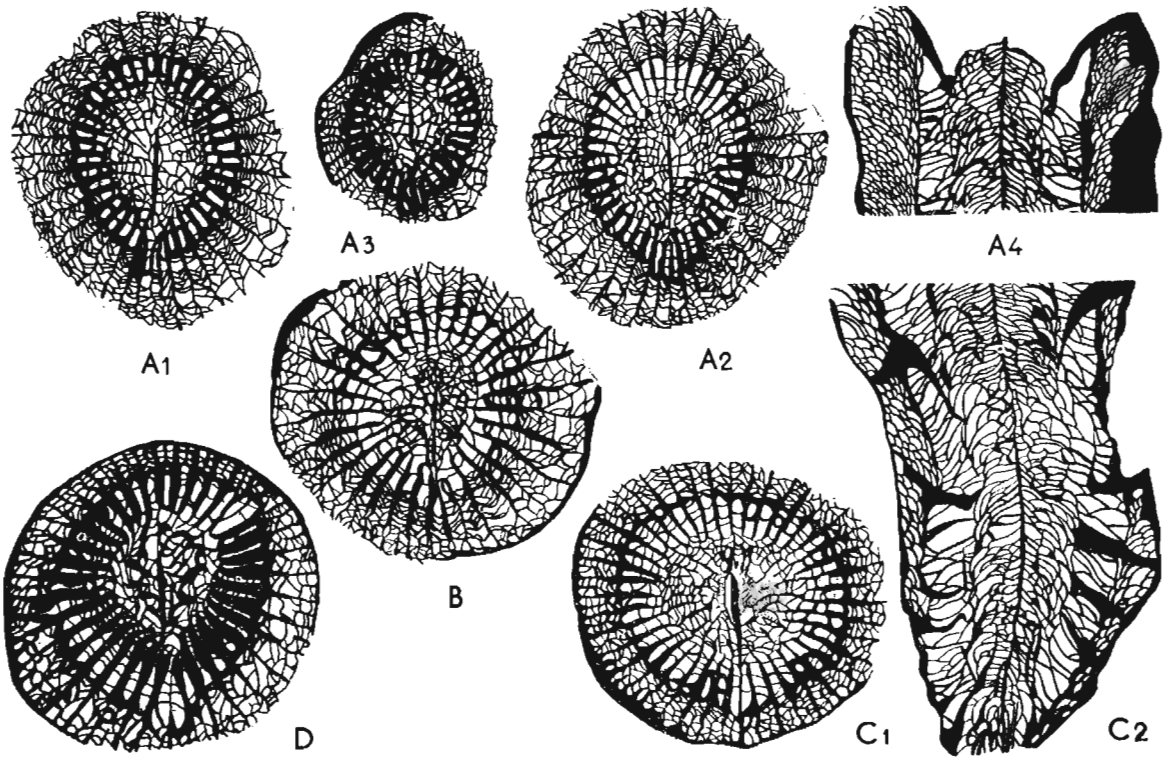

Fig. 46

Nervophyllum primitivum n. sp.: $A_{1, 2}$ transverse sections of the ephebic stage, A_3 transverse section of the late-neanic stage, A_4 longitudinal section, holotype (IG. OS-70/285); *B* transverse section of the ephebic stage (IG. OS-70/2186); C_1 transverse section of the ephebic stage, C_2 longitudinal section (IG. OS-70/2125); *D* transverse section of the ephebic stage, of the nontypical corallite, designated to this species with restriction (Z. Pal. P. Tc-4/2890). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

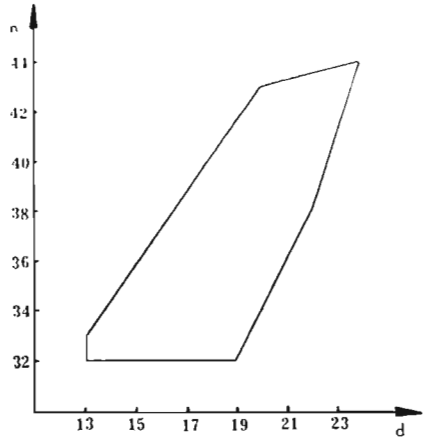

Fig. 47

Septal index (n/d) for *Nervophyllum primitivum* n. sp. The points corresponding to extreme specimens are united by lines.

stic character was unavailable for the studies. The available late-neanic stages differ from corresponding stages of *Dibunophyllum* in a considerably thinner columella and in different thickness of septal lamellae and septa. These are not, however, characters of a fundamental importance. *N. primitivum* n.sp. differs from the type and remaining species primarily in dibunophylloid characters and in the structure of dissepimentarium composed almost exclusively of herringbone dissepiments.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2.

Nervophyllum intermedium n.sp.

(Text-figs. 48A_{1-4}; Pl. XXII, Figs. 4*a-c*)

Holotype: Specimen IG. OS-70/1588.
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *intermedium* — with intermediate characters.

Material. — A corallite with a calice and a partly preserved proximal end. Here and there, the surface of the specimen is abraded.

Diagnosis. — A *Nervophyllum*, 20×18 mm in diameter and with 47×2 septa; septal lamellae slightly less numerous than major septa; major septa the thickest in dissepimentarium where some of them are split lengthwise; some minor septa penetrate tabularium; axial structure inconspicuous.

Description. — *Transverse section* (Text-fig. 48A_{1-3}; Pl. XXII, Fig. 4*a*, *b*): Major septa straight, except for axial ends which are bent and, on the periphery, split lengthwise. The number of split septa increases with the ontogenetic age. Columella, reaching cardinal fossula, does not fuse with cardinal septum. No lamellae corresponding to minor septa are recorded. In the

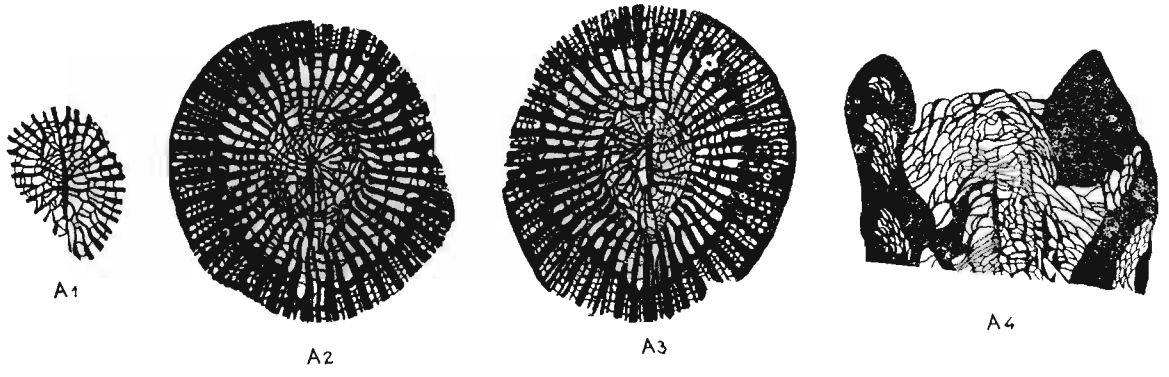

Fig. 48
Nervophyllum intermedium n. sp.: A_1 transverse section of the neanic stage, $A_{2,3}$ successive transverse sections of the ephebic stage, A_4 longitudinal section, holotype (IG. OS-70/1588). Gałęzice, Holy Cross Mts., Upper Viséan, D_2(top); all × 2.

younger part of corallite, most of lamellae fuse with major septa, in the older — axial structure is more conspicuous. It is elongated in the form — typical of the genus — of a drop flowing into cardinal fossula. Most lamellae are turned towards the end of columella nearer the counter septum. Nearly all dissepiments are of the rectangular type.

Longitudinal section (Text-fig. 48A_4; Pl. XXII, Fig. 4*c*): Peripheral tabellae almost do not differ at all from axial ones. This results in axial structure being conspicuous only owing the sections of septal lamellae which condense it slightly more than the peripheral part of tabularium. Columella variable in thickness, under the bottom of calice and in calice discontinuous, partly atrophied.

Ontogeny. — The neanic stage, from which the examination of the development has been started, is marked by axial structure of the dibunophylloid type, i.e. by a columella which is fused with cardinal and counter septum. Septal lamellae, not numerous, correspond to every second or third septum, mostly fused with septa and reaching columella. Dissepimentarium is formed early.

Remarks. — This specimen differs from the remaining species of *Nervophyllum* in a longitudinal splitting of major septa, in the length of minor septa and composition of axial structure, a similar composition being recorded only in *N. primitivum*. This form combines in itself both primitive characters such as, for instance, a poorly developed axial structure in longitudinal section and characters of an advanced development, i.e. major septa split lengthwise. The composition of axial structure slightly resembles that in some species of *Clisiophyllum*.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Visean, D_2 (top).

Nervophyllum superius n.sp.

(Text-figs. 49A_{1-4}; Pl. XXII, Fig. 3*a-d*)

Holotype: Specimen IG. OS-70/196 (Pl. XXII, Fig. 3).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *superius* — after a higher stage of the phylogenetic development.

Material. — A corallite with preserved calice but without proximal end.

Diagnosis. — A *Nervophyllum* 19 mm in diameter and with 43×2 septa; minor septa shortened; axial structure occupies 1/3 of the diameter of corallite; columella disappearing; septal lamellae considerably more numerous than major septa.

Description. — *Transverse section* (Text-fig. 49A_{1-3}; Pl. XXII, Fig. 3*a*, *b*): Major septa long, only in the stage with atrophied columella are slightly withdrawn from axial structure. Alar fossulae slightly marked up to the end of the ontogenetic development. In the younger part of the ephebic stage, axial structure consists of a thin columella, slightly penetrating cardinal fossula, and of septal lamellae which are twice as numerous as major septa. They are tortuous, sometimes running parallel to each other and towards the end of columella nearer the counter septum. Lamellae which correspond to major septa are mostly fused with them. In the older part of the ephebic stage, lamellae are arranged centripetally. Axial structure becomes rounded and takes a form very similar to that in *Aulophyllum* or *Berkhia*. Herringbone dissepiments are developed over shortened minor septa. Dissepiments situated between major and minor septa are mostly of the pseudo-herringbone type.

Longitudinal section (Text-fig. 49A_4; Pl. XXII, Fig. 3*d*): Few complete tabulae and tabellae raise towards the centre of corallite forming a cupola. In axial part, tabellae are irregular, mostly convex and raised towards a thin columella. Many short sections of septal lamella condense this part of corallite. No true axial structure is observed.

Ontogeny. — The study included only the neanic stage, relatively advanced but still without dissepimentarium. A very early and strong development of axial structure is particularly important in this stage. Columella, conspicuously thickened in axial part, connects, by thin lamellae, with cardinal and counter septum. Lamellae corresponding to major septa with which

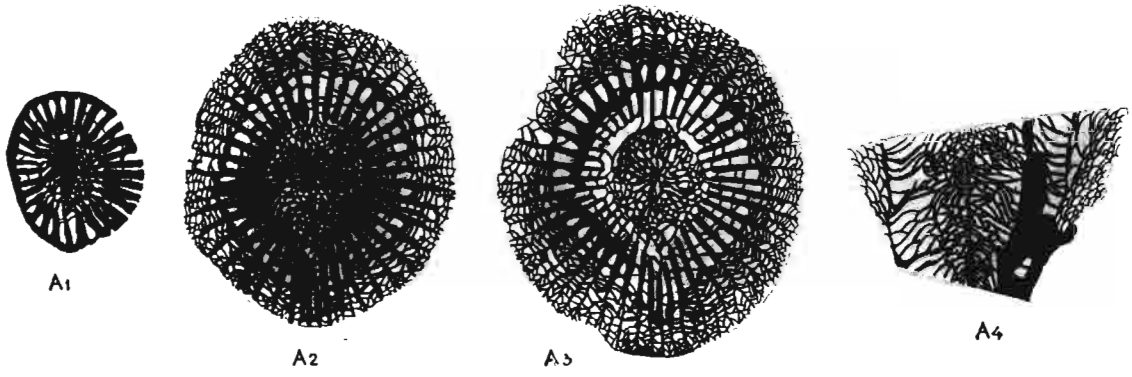

Fig. 49

Nervophyllum superius n. sp.: A_1 transverse section of the neanic stage, $A_{2, 3}$ successive transverse sections of the ephebic stage, A_4 longitudinal section, holotype (IG. OS-70/196). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

they are connected and free lamellae corresponding to minor septa already occur in this stage. Minor septa, separated only in the microstructure of the outer wall, slightly enter the inside of the corallite.

Remarks. — The most closely related is the type species (*N. besheviense* VASSILJUK) to which in turn the most similar is the younger part of the ephebic stage having columella. Different is the older part of this stage in which columella disappears. In addition, *N. superius* has shorter minor septa and much more strongly developed pseudo-herringbone dissepiments which occur in the marginal part of dissepimentarium.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **BIPHYLLUM** n. gen.

(Type species: *Biphyllum vallum* n. sp.)

Species assigned: One species only — *B. vallum* n. sp.

Stratigraphic and geographic range: Upper Viséan, Poland (Holy Cross Mountains).

Derivation of the name: *Biphyllum* — with structure as that in *Dibunophyllum* and counter septum as that in *Slimoniophyllum*.

Diagnosis. — Solitary corals with ontogeny similar to a clisiophylloid one; dissepimentarium strongly developed; major and minor septa complete; cardinal and counter septa in the ephebic stage shortened to an almost equal extent; alar fossulae marked till the end of the development; in transverse section, axial structure at least partly delimited by a stereoplasmatic wall, variable, in longitudinal section — conspicuous; columella occurring till the end of the ontogenetic development.

Remarks. — In certain morphological characters, *Biphyllum* n. gen. is related to *Dibunophyllum*. Particularly similar are longitudinal sections and the composition of axial structure as seen in transverse section. The main differences are as follows: 1) ontogeny (cf. description

of *B. vallum* n. sp.); 2) shortening of counter septum; 3) development of alar fossulae till the end of ontogeny, even in calice; 4) delimitation of axial structure by the stereoplasmatic wall. These characters do not occur in *Dibunophyllum*. The shortening of counter septum is, among Carboniferous tetracorals, a rare character. So far, it was described in *Bifossularia* DOBROLJUBOVA (1966), which is quite different a genus, belonging to another family and not requiring opposition. In addition, the shortening of counter septum was described in the two genera of Aulophyllidae: 1) *Auloclisia* LEWIS (only *A. mutatum* LEWIS, 1927 in which this septum is only very slightly marked) and 2) *Slimoniphyllum* KATO & MITCHELL (1961), a genus close to *Biphyllum* n. gen. in which the shortening of counter septum is conspicuous and diagnostic in character. There are the following differences between these two genera: 1) ontogeny (cf. development of *B. vallum* n.sp., and of *S. slimonianum* (THOMSON)); 2) occurrence in *Biphyllum* of columella till the end of ontogeny; 3) a separation of axial structure by the stereoplasmatic wall, in *Biphyllum* and a frequent lack of such a structure in *Slimoniphyllum*. The shortening of counter septum also occurs in the genus *Koninckinaotum* n. gen. Quite different morphology of this genus, both in longitudinal and transverse section, makes a detailed comparison superfluous. The remaining genera, not having a shortened counter septum are, in the present writer's opinion, so different that they do not require discussion.

Biphyllum vallum n. sp.

(Text-figs. 50*A-E*; Pl. XII, Fig. 4; Pl. XXII, Fig. 5; Pl. XXIII, Figs. 1-4)

Holotype: Specimen IG. OS-70/1593 (Pl. XXII, Fig. 5).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *vallum* — a wall, after an axial structure separated by a wall.

Material. — Eight solitary corallites. The holotype with a preserved calice and partly preserved proximal end.

Dimensions (in mm):

IG. OS-70/	Index of septa n/d
114	43 : 25×23
841	60 : 23×19
1593	53 : 29×24
2642	51 : 21×19
2856	58 : 27×26
2897	41 : ca. 20
3329	45 : 34×34

Diagnosis. — As for the genus.

Description. — Calice with vertical walls everted towards the margin from a point more or less halfway the depth. Axial structure, elevated like a dome and with columella projecting from it, reaches halfway the height of calice. Edge of calice sharp.

Transverse section (Text-figs. 50A_5, *B*, *C*, D_2, $E_{1,2}$; Pl. XII, Fig. 4; Pl. XXII, Fig. 5*e*, Pl. XXIII, Figs. 1, 2*a*, 3, 4): Septa with thickened bases, penetrating epitheca. Major septa are thin only in the marginal part of dissepimentarium, at 1/3 of its width they begin to thicken and reach their largest width in inner wall on the side of tabularium. They almost reach axial structure. Axial ends of septa bluntly terminating, only some of them extend in the

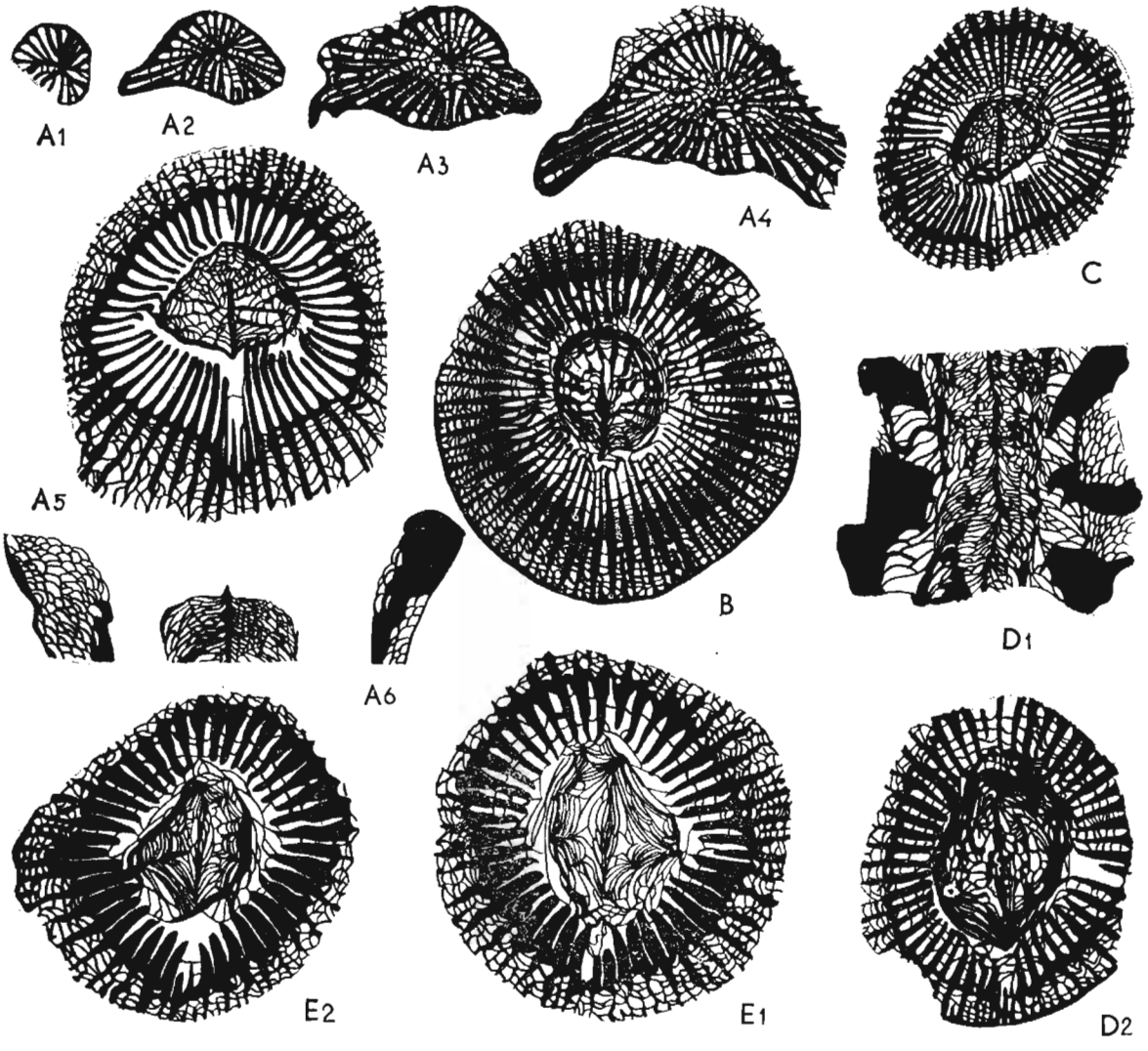

Fig. 50

Biphyllum vallum n. gen., n. sp.: A_{1-4} successive transverse sections from the early to late-neanic stage, A_5 transverse section near base of calice, A_6 longitudinal section of the calice (IG.OS-70/1593), holotype; *B* transverse section of the early-ephebic stage (Z. Pal. P. Tc-4/2856); *C* transverse section of the early-ephebic stage (IG. OS-70/841); D_1 longitudinal section, D_2 transverse section of the ephebic stage (IG. OS-70/2642); $E_{1,2}$ transverse sections of the ephebic stage (IG. OS-70/114). Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

form of thin lamellae which may even penetrate axial structure. Minor septa thin, varying in length, in the holotype are longer in counter quadrants. They do not reach deeper as halfway the depth of dissepimentarium. Cardinal septum shortened, cardinal fossula usually sunk in dissepimentarium. Alar fossulae mostly clearly marked due to the shortening of the last 1-3 pairs of septa of counter quadrants. Counter septum shortened. This shortening takes place in different corallites i n various stages of development, sometimes as late as the advanced ephebic stage. Axial structure very conspicuous, separated from tabularium by a deposit of stereoplasma on peripheral tabellae of the structure. Columella long, listlike, sometimes slightly extended towards cardinal fossula. Septal lamellae, 7-10 on each side of them, are thickened to a different

extent. Tabellae regularly distributed, but most densely occurring in the marginal part of the structure. Dissepimentarium occupies more than 1/3 of the diameter of corallite. In the inner part dissepiments of the rectangular or herringbone type, in the outer part larger and irregular.

Longitudinal section (Text-figs. 50A_6, D_1; Pl. XXII, Fig. 5*b*; Pl. XXIII, Fig. 2*b*): Dissepiments varying in size, convex, steep, near inner wall vertical. Inner wall thickened. Axial structure very conspicuous, particularly so at the end of the ontogeny. It consists of columella and small, domelike tabellae. Inner tabellae slightly raised towards columella, outer vertically and deeply descending. Periaxial tabularium differentiated. Long tabellae, situated at an angle of about 40° to axial structure and occupying about 3/4 of tabularium, predominate in tabularium. Among them, complete tabellae occur which connect dissepimentarium with axial structure, as well as many, small, vesicular tabellae. Thick layers of stereoplasma are cyclically deposited on tabellae, particularly in axial structure. Stereoplasma mostly covers the marginal tabellae of axial structure and forms a stereoplasmatic wall. In addition to tabellae and columella, relatively numerous sections of septal lamellae occur in axial structure.

Ontogeny. — The writer succeeded in examining ontogeny from a stage with a diameter of 5×4 mm with 20 major septa zaphrentoidally arranged. Cardinal fossula and alar fossulae strongly developed. Counter-lateral septa reach, in a pinnate form, counter septum. Alar septa and a pair of metasepta of counter quadrants reach columella. The acceleration of the growth of septa in counter quadrants amounts to 3/6:3/6. Minor septa lacking (Text-fig. 50A_1). In the next section, the arrangement of septa and speed of their growth remain unchanged (Text-fig. 50A_2). A successive section has a cardinal fossula extended towards the axis and strongly developed alar septa. Cardinal septum and counter septum continue to be connected with columella which, in addition, is joined by a few metasepta on each side. Their axial ends do not penetrate columella which remains biseptal. At the end of the neanic stage (Text-fig. 50A_4) columella grows thin, bends and separates from cardinal septum, being connected with counter septum only. Axial part of corallite is filled with numerous lamellae which mostly are still connected with septa. Axial structure individualizes and separates as late as the ephebic stage. Dissepimentarium first appears near counter septum and develops towards cardinal septum. Minor septa appear, at first being short.

Individual variability. — Considerable differences are observed in morphology and measurable features. The shortening of counter septum attracts particular attention in some of the sections. This is, as emphasized above, a juvenile character persisting in some corallites even to the beginning of the ephebic stage. Not less important are the changes which take place in axial structure. They lead from a regular structure represented by the holotype, through more and more irregular structure of specimens IG. OS-70/841 and 70/114 (Text-fig. 50C, $E_{1,2}$), to axial structure of the corallite IG. OS-70/2642 (Text-fig. 50D_2), in which septal lamellae are very irregular and similar to the sections of tabellae. In the last-named specimen, the width of axial structure is, in relation to the diameter of corallite, especially large. The ratio of the number of septa to the diameter of corallites is subject to considerable fluctuations. This ratio is usually correlated with the thickness of major septa. With a given diameter, less numerous are thicker septa. The length of minor septa is different in particular specimens and in various parts of this same section. In some specimens, longer minor septa occur in cardinal and in some others in counter quadrants. Even the longest of them do not reach more than 3/4 of the width of dissepimentarium.

Remarks. — As for the genus.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **KONINCKINAOTUM** n. gen.

(Type species: *Koninckinaotum pseudocoloniale* n. sp.)

Species assigned: One species only — *K. pseudocoloniale* n. sp.

Stratigraphic and geographic range: Upper Viséan; Poland (Holy Cross Mountains, Gałęzice).

Derivation of the name: *Koninckinaotum* — corallites with naotic septa and with columella identical with that in *Koninckophyllum*.

Diagnosis. — Solitary corals with a biseptal columella connected with cardinal septum or free; in the ephebic stage, counter septum is shortened to an equal extent as cardinal septum; minor septa reduced to a different extent; naotic septa occur in the older part of the ephebic stage; dissepimentarium with strongly developed lonsdaleoid vesicles occurring in the middle part and with pseudo-herringbone dissepiments on the periphery; tabularium unizonal, with complete tabulae; groups of corallites, forming pseudocolonies occur usually.

Remarks. — Of the two genera from which the generic name of *Koninckinaotum* n. gen. was derived, only *Koninckophyllum* THOMSON & NICHOLSON is similar and maybe related. Only the name of naotic septa was borrowed from the Silurian genus *Naos* SMITH which is quite different morphologically. *Koninckinaotum* is most similar to *Koninckophyllum* in its late-neanic stage, in which both genera have an almost identical structure. The differences occur: 1) at the beginning of ontogeny, in the arrangement of proto- and the first metasepta and in the separation of columella which in *Koninckinaotum* first separates from counter septum; 2) in the ephebic stage, counter septum in *Koninckinaotum* shortens to the same extent as cardinal septum and naotic septa occur on the periphery. Of the remaining genera, only *Symplectophyllum* HILL is similar to *Koninckinaotum* in the development of naotic septa. This genus has, however, a different axial structure and unshortened counter septum.

Koninckinaotum pseudocoloniale n. sp.

(Text-figs. 51 *A*, *B*; Pl. XII, Figs. 5, 6; Pl. XXIII, Figs. 5, 6)

Holotype: Specimen Z. Pal. P. Tc-4/2883 (Pl. XII, Fig. 5).

Type locality: Holy Cross Mountains, Gałęzice.

Type horizon: Upper Viséan, D_2 (top).

Derivation of the name: Gr. *pseudocoloniale* — after the fusion of corallites in the form of pseudocolonies.

Material. — Eleven fragmentary pseudocolonies, containing between 2-3 and a dozen or so corallites each.

Dimensions (in mm):

Z. Pal. P. Tc-4/	Index of septa n/d
2775	36 : 19×15
2775	40 : 30×24
2880	30 : 14×10
2880	38 : 14×14
2865	40 : 18×18
2883	39 : 26×21
2883	36 : 16×15
2883	36 : 12×12
2883	33 : 12×11

Diagnosis. — As for the genus.

Description. — Corallites are bunched, a few in each group, and strongly cling to the individual on which their larvae settled, which is more strongly developed ontogenetically and gives an impression of a parent corallite. Individual corallites are isolated from each other but as, for instance, in the holotype are distributed so close to each other that they deceptively resemble a subcerioid colony (Text-fig. 51A_6). An entire group of such corallites has been selected by the writer to emphasize their characteristic accumulation.

Transverse section (Text-figs. 51$A_{5,6}$, B_1; Pl. XII, Figs. 5, 6; Pl. XXIII, Figs. 5, 6*a*): Epitheca thin, directly connected with a tissue composed of densely arranged flat dissepiments of the pseudo-herringbone type, mostly occurring in the early-ephebic stage when the peripheral parts of septa are still complete (Text-figs. 51$A_{5,6}$). In the case in which they transform into naotic septa (specimen Z. Pal. P. Tc-4/2775; Text-fig. 51B_1), particular plates are so close to epitheca that they almost completely fuse with it and with each other. More to the inside, the arrangement of plates is looser. The structure of the peripheral part of corallite of this type is encountered in, among other genera, *Symplectophyllum* HILL. Above this zone, there is a zone of lonsdaleoid vesicles which at first interrupt minor septa only; vesicles, varying in size, are usually flat. They do not comprise the entire circumference of corallite, developing most strongly in the older ephebic stage. In some places, they may also reach epitheca. The structure of the inner part of dissepimentarium depends on the presence and length of minor septa. Dissepiments of the herringbone type occur most frequently, less so of the rectangular or angular and exceptionally of the lateral-cystose type. Inner wall slightly thickened. In one and the same section, major septa may be complete or divided into inner and peripheral segments or, on the periphery, into naotic ones. Dissepimental segments of major septa thin, wavy, platelike; segments lying near inner wall thickened, pointedly terminating and usually shorter than the dissepimental ones. Differences in length of particular segments of septa are particularly distinct in specimens older ontogenetically and with a wider dissepimentarium. Counter septum shortened to an almost equal extent as cardinal septum. Cardinal fossula may be distinguished on the basis of the arrangement of septa and a small depression in dissepimentarium which does not occur in counter septum. Columella is also extended towards cardinal septum. Minor septa long, usually divided into peripheral and periaxial segments, are subject to naosoid changes or atrophy. The sequence of reduction of particular segments of minor septa is irregular. On one and the same section, we may observe complete to fully reduced minor septa. In the younger part of corallite columella long, almond-shaped or lenticulate. It extends in the form of a thin lamella towards cardinal septum and joins it sometimes still at the beginning of the ephebic stage. At the end of ontogeny, it becomes considerably thinner and shortens but never atrophies completely.

Longitudinal section (Text-fig. 51B_2; Pl. XXIII, Fig. 6*b*): Dissepimentarium varying in width. Dissepiments considerably variable in size, usually the smallest close to epitheca and inner wall. In some places occur large, flat vesicles, which occupy the entire width of dissepimentarium, in some other places — *vice versa* — the entire width of dissepimentarium is filled by small, convex dissepiments. Tabularium regular in size and structure. Tabulae raised in a tentlike manner towards a slightly wavy columella. Complete tabulae are predominant. Few tabellae, mostly limited to the peripheral part of tabularium, in which they form a horizontal compilation of tabulae.

Ontogeny. — Ontogeny has been studied from the nepionic stage with four protosepta and 1 mm in diameter (Text-fig. 51A_1). Protosepta connected axially. Cardinal and counter

protosepta predominate in thickness. The corallite develops slowly and, of many peels made, only the most characteristic ones are shown in illustrations. The next figure (Text-fig. 51 A_2) presents the beginning of a neanic stage with two pairs of metasepta separated and a slightly marked swelling of columella. The development of columella is discontinuous. The successive section (Text-fig. 51 A_3) shows, in addition to that described above, a simultaneously developing individual which lost its columella in a very early stage. It will start developing a new columella

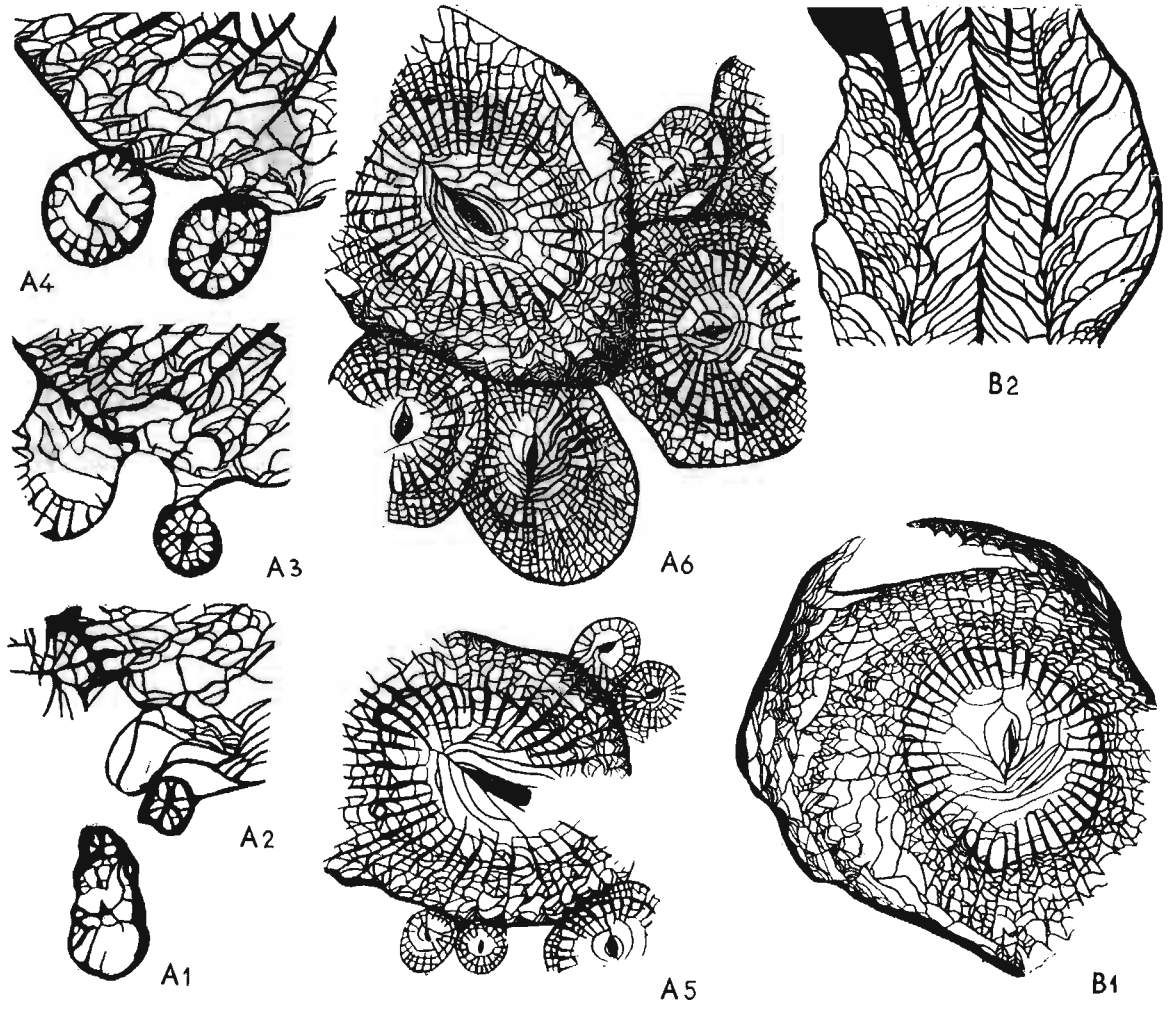

Fig. 51

Koninckinaotum pseudocoloniale n. gen., n. sp.: A_1 nepionic stage with 4 protosepta of one specimen of pseudocolony designated as a holotype, A_2 early-neanic stage of the same corallite, $A_{3,4}$ transverse sections of the neanic stage with unsteady columella, all × 5; $A_{5,6}$ transverse sections, the central corallite in ephebic stage, corallites growing to him — in neanic and late-neanic stage, holotype (Z. Pal. P. Tc-4/2883), × 2; B_1 transverse section of the ephebic stage, B_2 longitudinal section (Z. Pal. P. Tc-4/2775), × 2. Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

during further stages of its ontogeny. The arrangement of septa is characteristic of an early neanic stage. A predominant role of four, first developed protosepta: cardinal, counter and two alar ones, is maintained. Short counter-lateral protosepta pinnately fuse with counter septum. The first pair of metasepta fuse with cardinal septum in an identical manner. Alar

septa reach an almond-shaped columella. Since no fossula is developed and the arrangement of metasepta does not clearly indicate the direction of their insertion, the corallite may be accurately oriented only on the basis of higher ontogenetic stages. In the corallite described, considered by the writer as typically developing, columella separates first from counter septum (Text-fig. 51 A_4). This takes place even before the development of minor septa and the first verticil of dissepiments. In the other of the corallites illustrated, columella is, in a similar ontogenetic stage, completely free. It is clear from further observations (Text-fig. 51 A_{1-5}) that the connection of columella with cardinal and counter septa and its separation from them may take many times during ontogeny. It is more strongly bound with cardinal septum with which it connects more frequently. The appearance of the first dissepiments precedes that of minor septa (Text-fig. 51 A_5).

Individual variability. — Individual corallites in the pseudocolony considerably differ from each other, but this is rather a result of the differentiation of the ontogenetic age. Many of them perish before reaching the ephebic stage. Corallites of various pseudocolonies in the ephebic stage only slightly differ from each other. There are certain fluctuations in the length and thickness of columella which may connect itself with cardinal and sometimes also counter septum and, if such is the case, this cardinal septum is not shortened. The remaining differences, such as dimensions of corallites, width of dissepimentarium, development of small marginal vesicles on the periphery, are also connected with the ontogenetic age and changes take place rather regularly.

Remarks. — The species described was at first considered by the writer to be a typically colonial form. It was only an attempt at studying the blastogenesis and making a series of thin sections and peels of the holotype that led to the identification of its solitary nature. The problem of the formation of such closely associated groups of corallites which, in the writer's opinion, is very interesting, has been more extensively dealt with in the remarks on ecology. The remaining remarks — as for the genus.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

Genus **MIRA** n. gen.

(Type species: *Mira prima* n. sp.)

Species assigned: One species only — *Mira prima* n. sp.
Stratigraphic and geographic range: Upper Viséan; Poland (Holy Cross Mountains, Gałęzice).
Derivation of the name: *Mira* — after the first name of the writer's wife.

Diagnosis. — Solitary corals; dissepimentarium complex, with many lateral-cystose dissepiments; major and minor septa reaching epitheca; cardinal septum shortened; axial structure multilamellar; lamellae, at first connected with major septa, become shortened at the end of the ontogenetic development; columella biseptal, listlike, periodically connected with cardinal septum; cardinal fossula in the younger part of the neanic stage closed; axial part of tabularium in longitudinal section separated.

Remarks. — *Mira* n. gen. is similar *Neokoninckophyllum* FOMITSHEV in ontogeny in which its counter septum fuses laterally with columella, in structure of dissepimentarium and a closer relationship of columella to cardinal than to counter septum. *Mira* n. gen. differs from it primarily in a multilamellar axial structure, occurring till the end of ontogeny in some signs in ontogeny (see diagnosis) and in the separation of axial structure in longitudinal section. In

the present writer's opinion, these are very closely related genera. Somewhat similar is also the genus *Nervophyllum* VASSILJUK from which *Mira* n. gen. differs primarily in the ontogeny with closed cardinal fossula in the younger part of the neanic stage, then in the lateral fusion of counter septum with columella, in the arrangement of lamellae in axial structure, which in *Mira* resembles the nervation of a leaf, and in the structure of tabularium as seen in longitudinal section in which a zone of long axial tabellae is separated in *Mira* n. gen. The remaining genera are similar to *Mira* n. gen. in family characters only.

Mira prima n. sp.

(Text-figs. 52A_{1-9}; Pl. XII, Figs. 1-3)

Holotype: Specimen IG. OS-70/2413 (Pl. XII, Fig. 1).
Type locality: Holy Cross Mountains, Gałęzice.
Type horizon: Upper Viséan, D_2 (top).
Derivation of the name: Lat. *prima* — the first species of the new genus.

Material. — Four corallites with calices and partly preserved neanic stages. Dimensions (in mm):

IG. OS-70/	Index of septa n/d
2340	48 : 31×24
2413	62 : 36×27

Diagnosis. — As for the genus.

Description. — *Transverse section* (Text-figs. 52A_{6-8}; Pl. XII, Figs. 1*a-c*, 2, 3): Major septa complete, slightly wavy, gradually thickening towards inner wall, in cardinal quadrants somewhat thicker than in counter quadrants. Cardinal septum, thinner than neighbouring major septa, shortened. Cardinal fossula open. Alar fossulae not marked in the ephebic stage. Counter septum does not differ in length from the remaining major septa. Minor septa thin, variable in length, mostly do not exceed a half of the width of dissepimentarium. Axial structure occupying about 1/6 of the diameter of corallite and not delimited clearly. Columella long, very thin, situated nearer cardinal septum, free. Septal lamellae short, thin, divided into radial segments which are mounted on axial tabellae. Few axial tabellae with irregular section. Dissepimentarium complex, occupying about 1/2 of the diameter of corallite. Peripheral part looser, composed mostly of irregular or pseudo-herringbone dissepiments. The most complex is the central part just above axial ends of minor septa. Here occur lateral-cystose dissepiments interlaced by herringbone or flat, rectangular ones. More to the inside, lateral-cystose dissepiments atrophy and only herringbone or, less frequently, rectangular dissepiments are left.

Longitudinal section (Text-fig. 52A_9; Pl. XII, Fig. 1*d*): Dissepiments convex, mostly very small, oblique, near tabularium vertical, inner row thickened. The rejuvenescence, through which the section has been cut, is marked in the structure of dissepimentarium only. On the one side, it is contracted and, on the other, forms a belt of large dissepiments passing, towards the inside of corallite, once again in small ones. Tabularium bizonal. Peripheral part narrow, composed of short, vesicular, peripheral tabellae, arranged near tabularium horizontally. Some of these tabellae penetrate axial part of tabularium, composed of long tabellae which on the margins rest against each other and are slightly raised towards columella. Sections of septal lamellae few, columella tortuous, variable in thickness.

Ontogeny. — In the early-neanic stage, columella is connected with cardinal and counter septa. Unfortunately, on the specimen under study, this part was decalcified and the writer did not succeed in making a clear preparation and, consequently, a drawing (Text-fig. 52 A_{1-5}). About 2 mm above, columella is already connected with cardinal septum only. Cardinal fossula strongly developed, closed by axial ends of major septa inclined to each other over it and con-

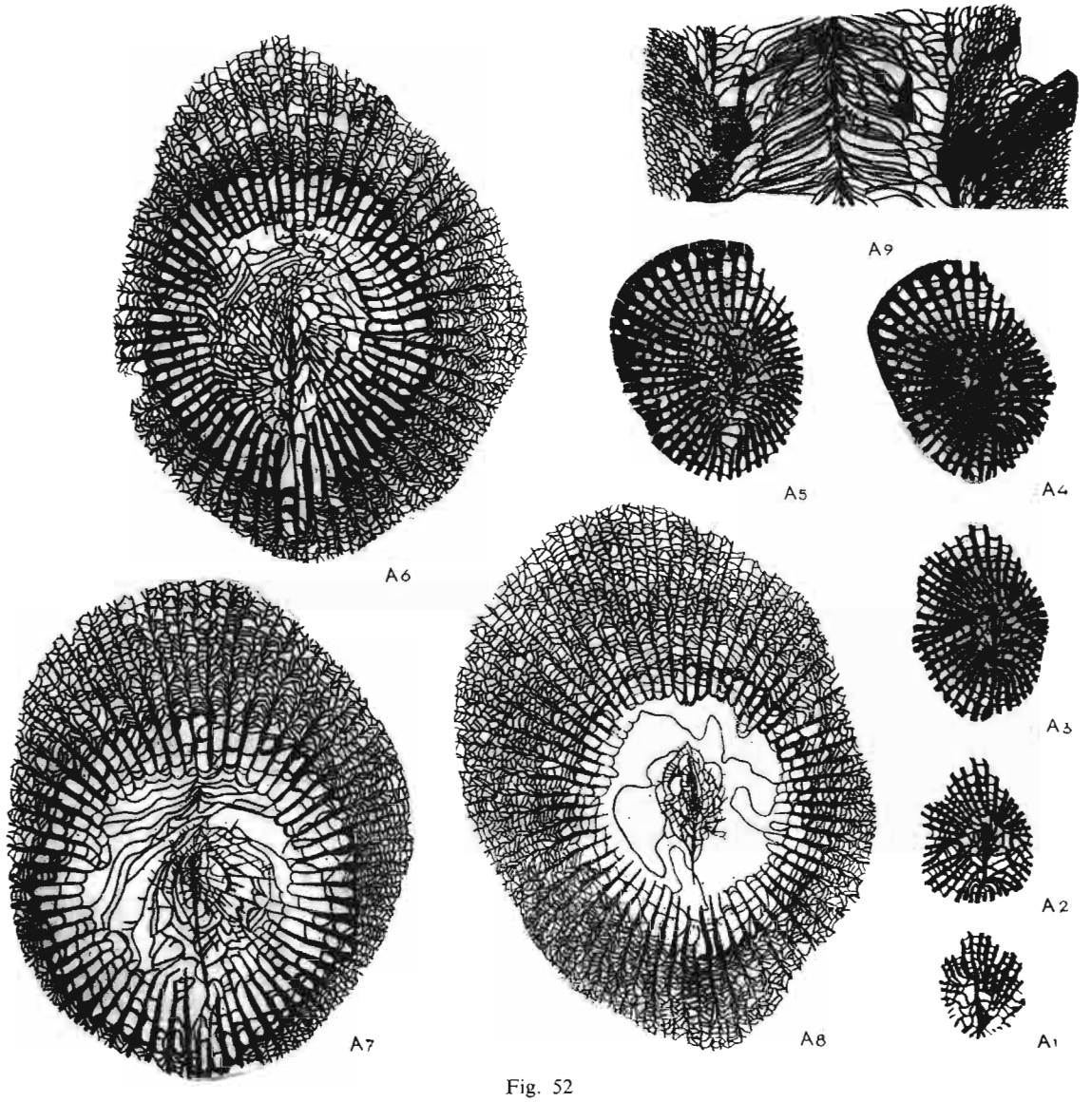

Fig. 52

Mira prima n. gen., n. sp.: A_{1-5} successive transverse sections of the neanic stage, A_{6-8} successive transverse sections o the ephebic stage, A_9 longitudinal section (IG. OS-70/2413), holotype. Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top); all × 2.

tacting each other. Alar fossulae distinct. A thick, rollerlike columella and a few septal lamellae occur axially. Counter septum shortened (Text-fig. 52 A_2). In the next section (Text-fig. 52 A_3), cardinal septum also detaches from columella which remains free till the early-ephebic stage. At the same time, counter septum extends in the form of a semicircular lamella parallel to

sections of axial lamellae. This lamella may later fuse laterally with columella (Text-fig. 52A_5). In this stage, fossulae disappear and instead more and more numerous lamellae are developed, which, in principle are only extended axial ends of septa. Minor septa and dissepimentarium still lacking. Very strongly swollen peripheral parts of major septa form septotheca (Text-fig. 52A_5). A further development up to the early-ephebic stage has not been illustrated. Here, the most important are the appearance of minor septa and dissepiments, as well as a repeated fusion of columella with cardinal septum which is also visible in the early-ephebic stage (Text-fig. 52A_6). A structure, normal in the ephebic stage, described above, is very early reached by dissepimentarium. On the other hand, very important is the development of axial structure. Its complexity progresses uniformly, from the neanic to the early-ephebic stage, by an increase in the number of septal lamellae (Text-fig. 52A_6). They are always thin, at first long, complete and mostly connected with septa. From each side they are directed towards one end of columella which gives impression of a spiral despite the fact that lamellae are mostly straight. Counter septum is longer than the neighbouring septa but, as compared with the length in the late-neanic stage, considerably shortened and, with development, it equalizes in length with neighbouring minor septa. Midway the ephebic stage (Text-fig. 52A_7), columella continues to be very long almost reaching cardinal septum and the number of lamellae has already decreased. They are also considerably shorter than at the beginning of the ephebic stage and frequently divided into radial segments resting on axial tabellae.

In its part corresponding to the mid-neanic stage, the ontogeny described displays all features of *Neokoninckophyllum*, in particular its characteristic development of counter septum. In the later part of the neanic stage, this ontogeny reaches a character which is not developed in *Neokoninckophyllum*, i.e. a dense, lamellar axial structure is formed. The development of a closed cardinal fossula, which occurs in the early-neanic stage, is also a character peculiar of this genus.

Remarks. — As for the genus.

Occurrence. — Poland (Holy Cross Mts., Gałęzice); Upper Viséan, D_2 (top).

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ALPHABETICAL INDICES

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Systematic names cited only are indicated by *italic*, and names accompanied by descriptions are indicated by roman letters.

Numerals which indicate the page, on which the species is cited only, are standard; numerals, which indicate pages with descriptions, are **bold**.

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J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

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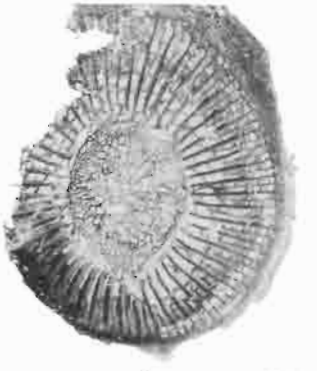

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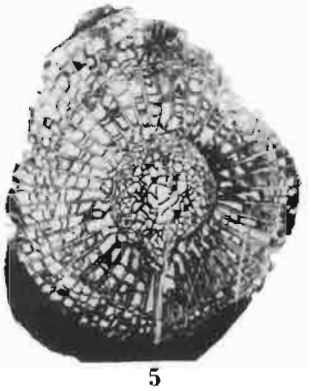

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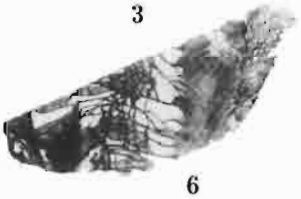

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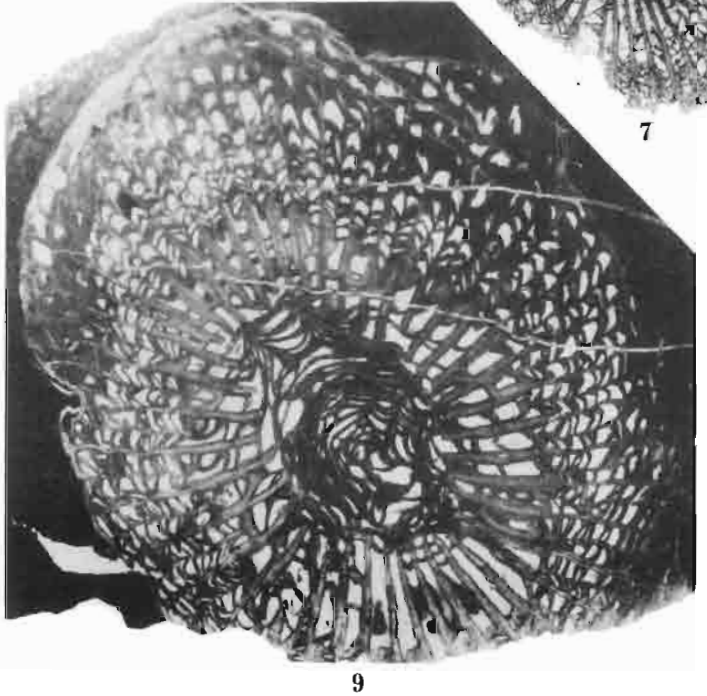

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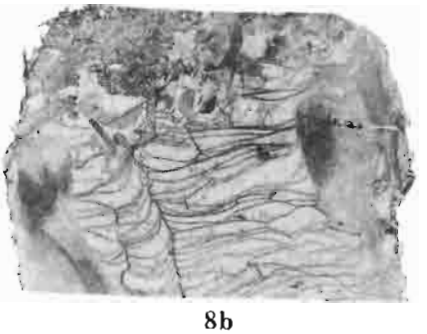

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PLATE II

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Clisiophyllum delicatum nanum n. subsp. 47

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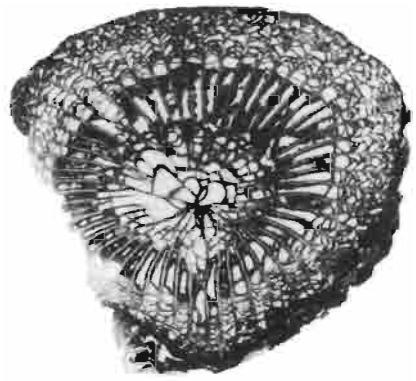

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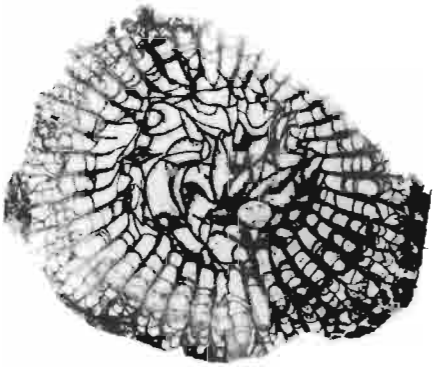

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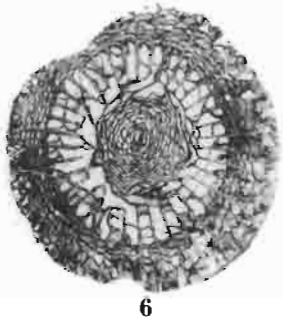

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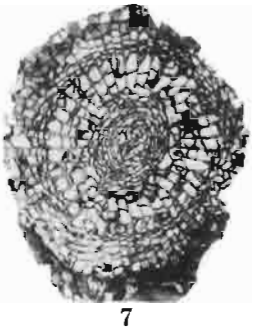

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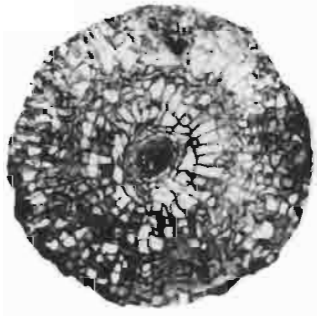

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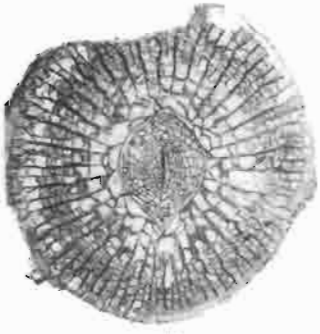

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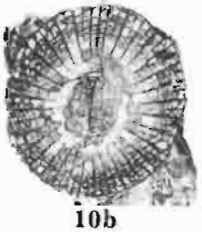

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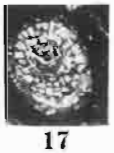

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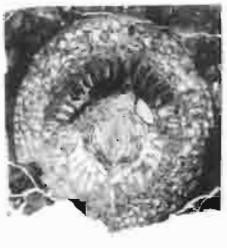

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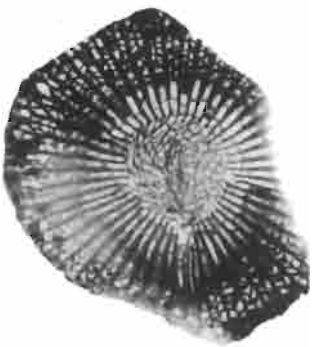

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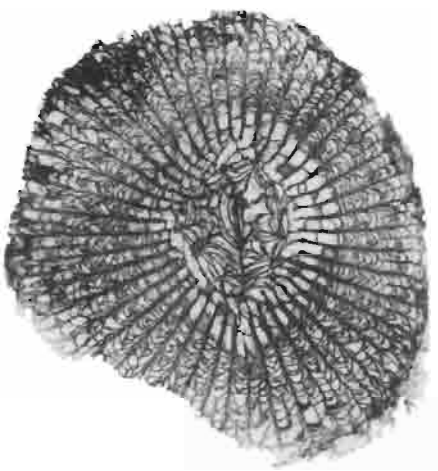

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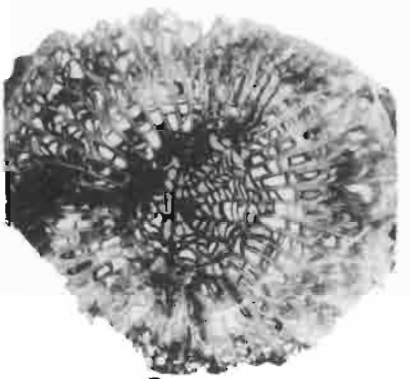

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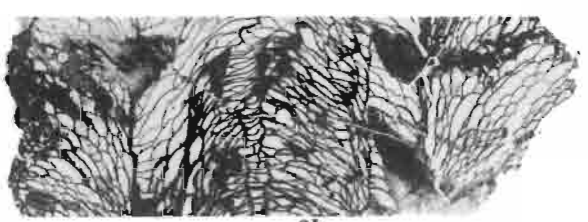

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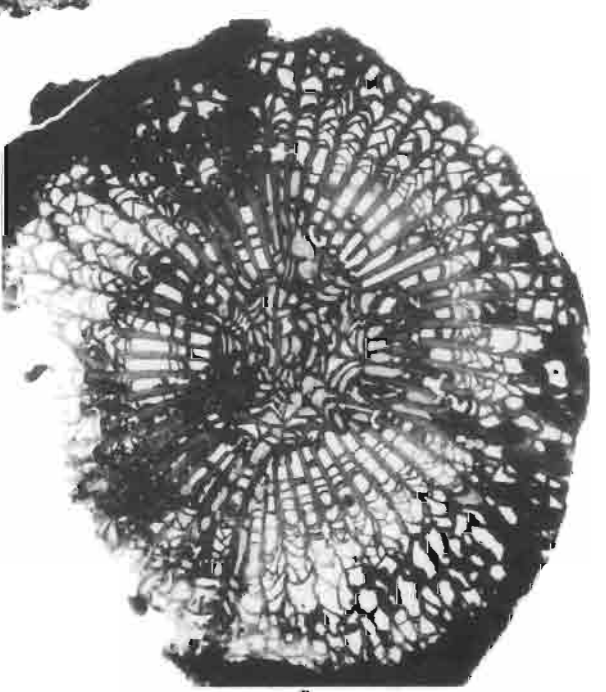

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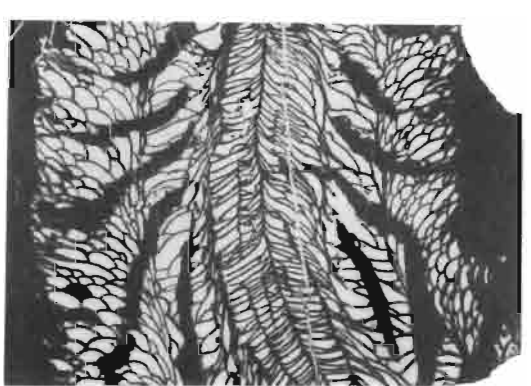

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Fig. 7. Transverse section of the ephebic stage (Z. Pal. P. Tc-4/2442).

Fig. 8. *a* Transverse section of the ephebic stage, *b* longitudinal section (IG. OS-70/301).

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

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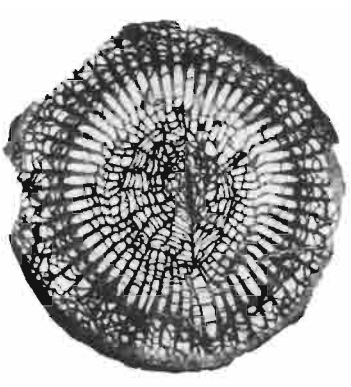

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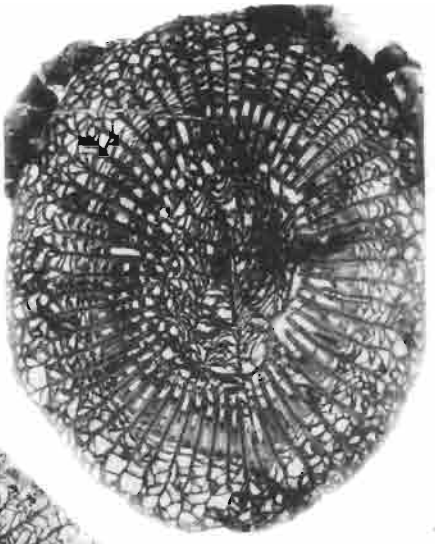

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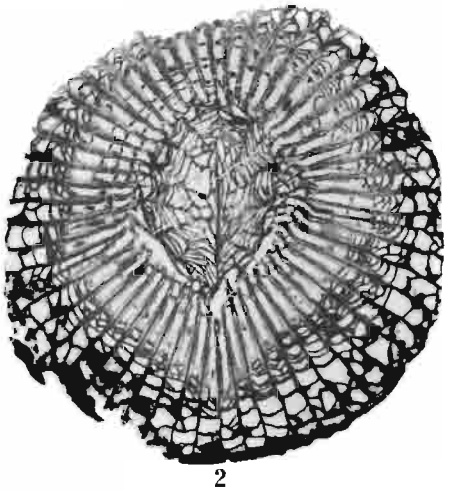

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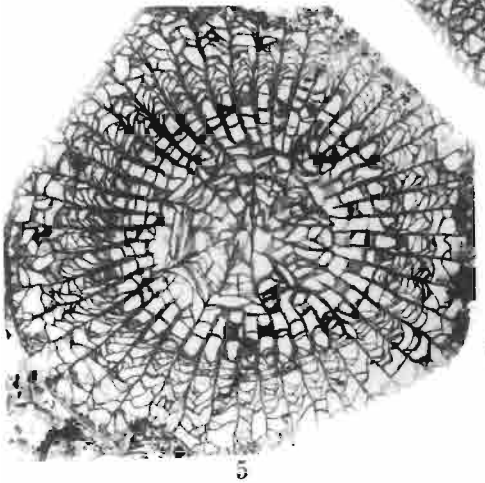

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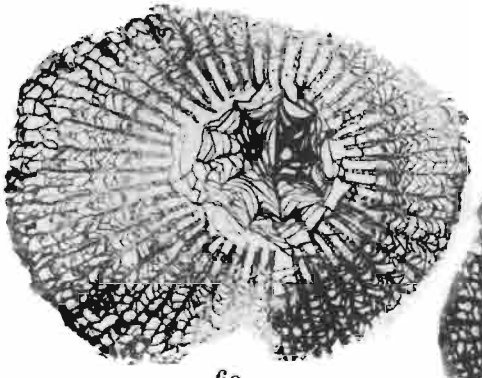

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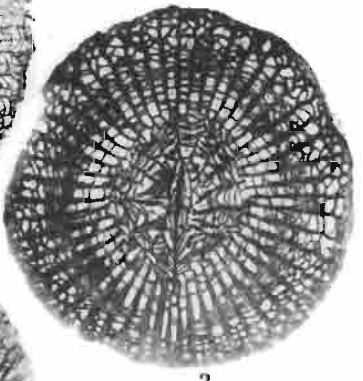

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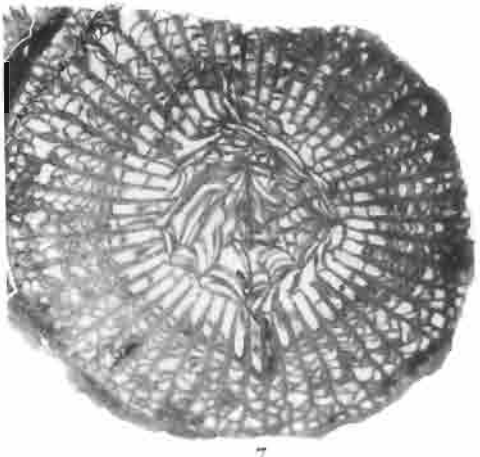

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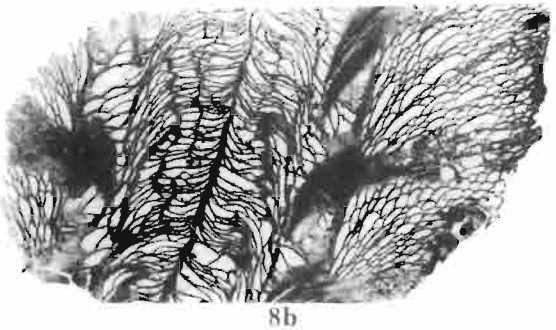

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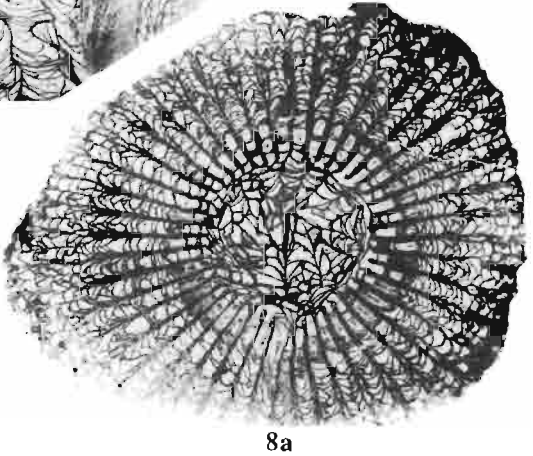

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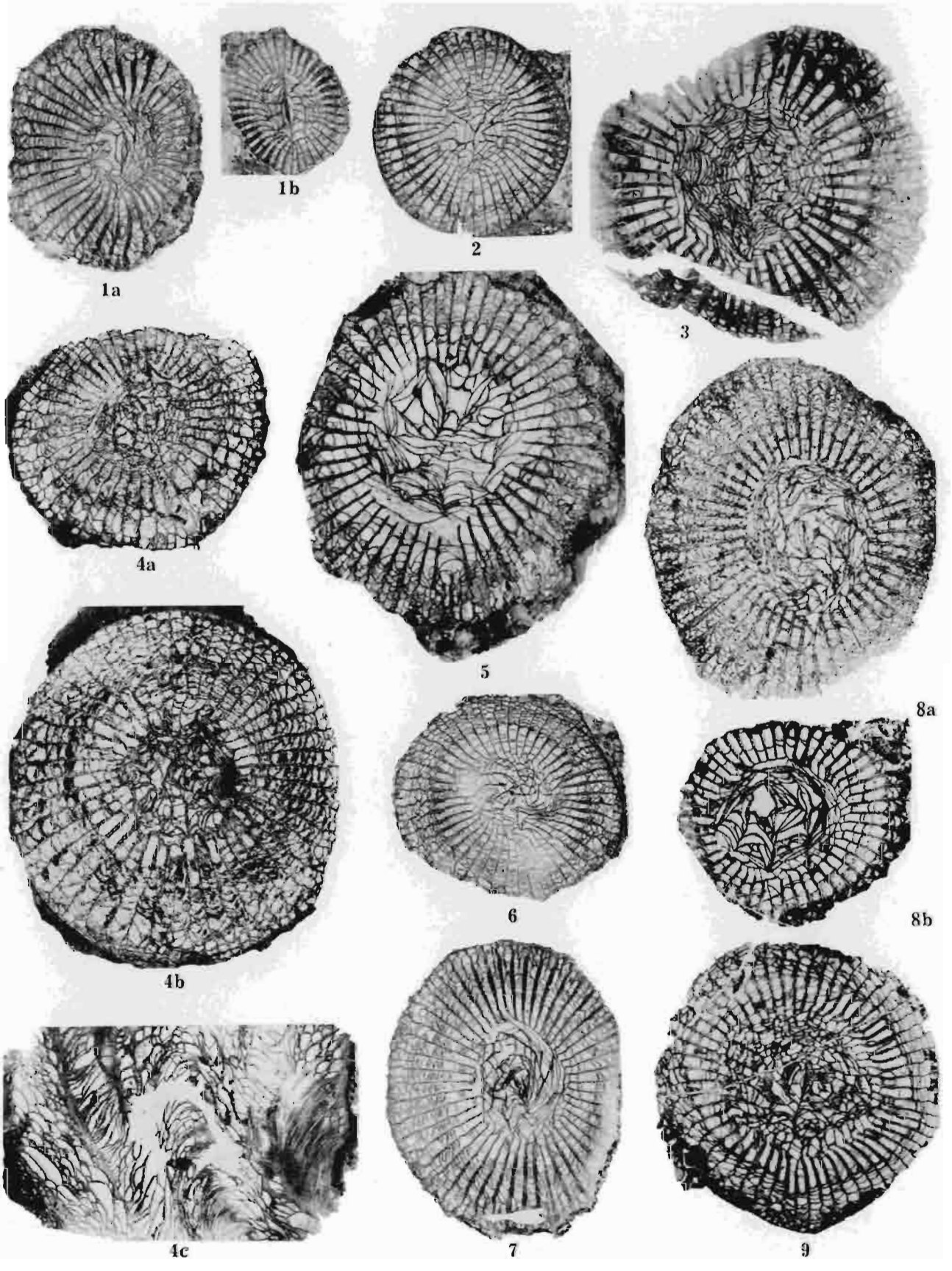
PLATE V

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All figures × 2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8b
4c
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9

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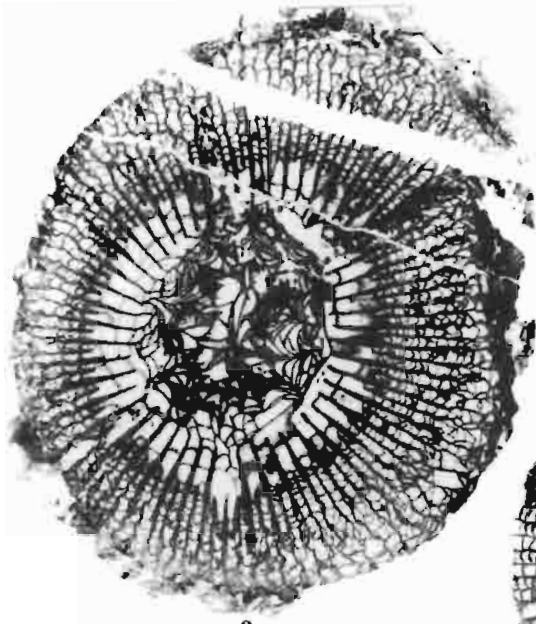
J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE VI

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All figures × 2



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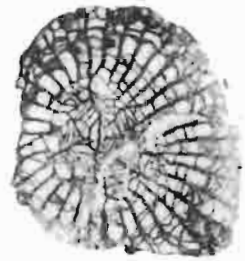

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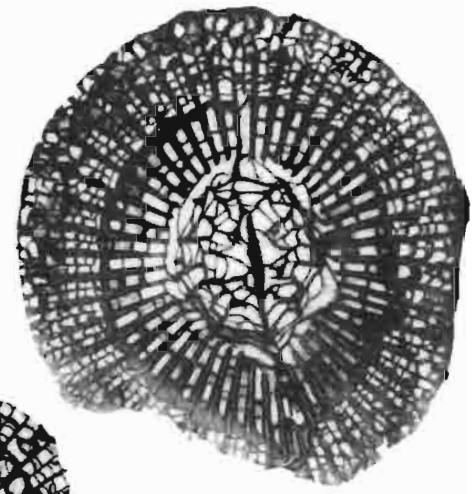

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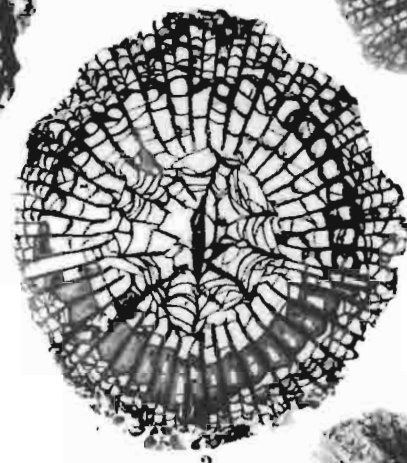

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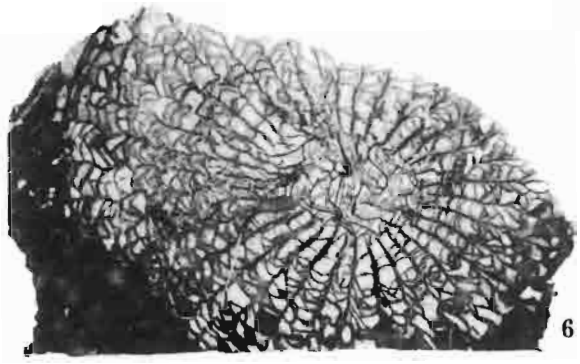

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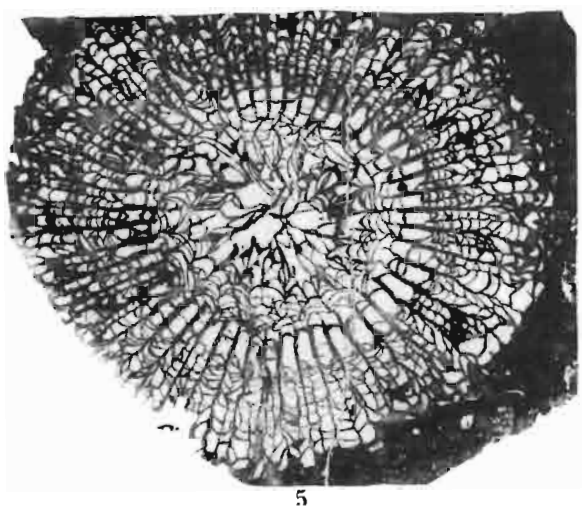

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4b

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J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE VII

Page

Dibunophyllum percrassum GORSKY 74

Fig. 1. *a* Transverse section of the ephebic stage, *b* transverse section of the early ephebic stage (IG. OS-70/2094), Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

Fig. 2. Transverse section of the ephebic stage (IG. OS-70/2092), the same locality and horizon.

Dibunophyllum reductum n. sp. 75

Fig. 3. *a* Transverse section of the ephebic stage, *b* transverse section of the late neanic stage, holotype (IG. OS-70/869), Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

Fig. 4. Transverse section of the ephebic stage (IG. OS-70/928), the same locality and horizon.

Koninckophyllum magnificum THOMSON & NICHOLSON 79

Fig. 5. Transverse section of the ephebic stage (Z. Pal. P. Tc-4/2323), Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

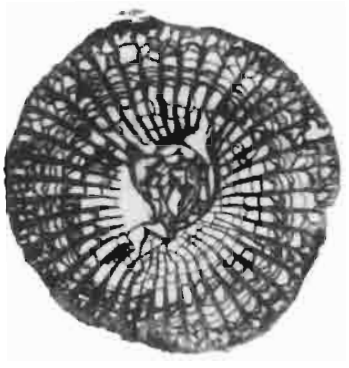
Fig. 6. Transverse section of the ephebic stage (IG. OS-70/1684), the same locality and horizon (peel).

Fig. 7. Transverse section of the ephebic stage (Z. Pal. P. Tc-4/687), Czerwieńczyce, Sudetes, Upper Viséan, D_2.

Fig. 8. Transverse section of the ephebic stage (IG. OS-70/1132), Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top).

Fig. 9. *a* Transverse section of the ephebic stage, *b* longitudinal section (IG. OS-70/1176), the same locality and horizon.

All figures × 2



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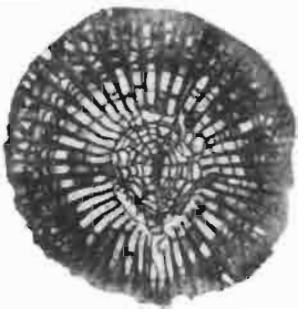

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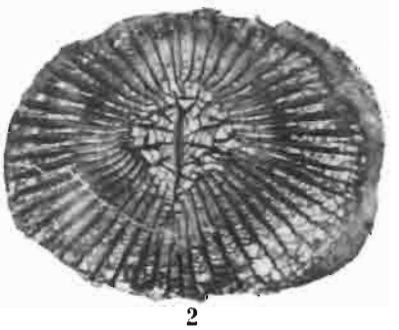

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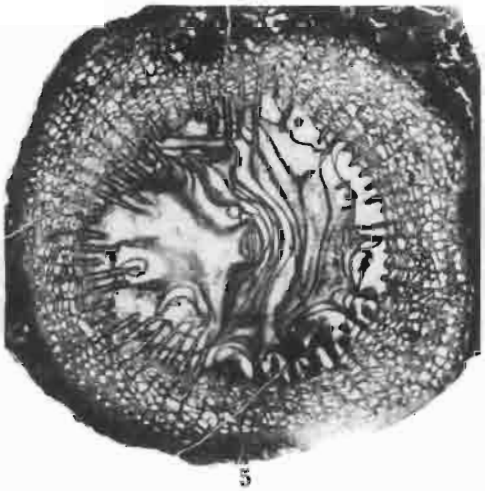

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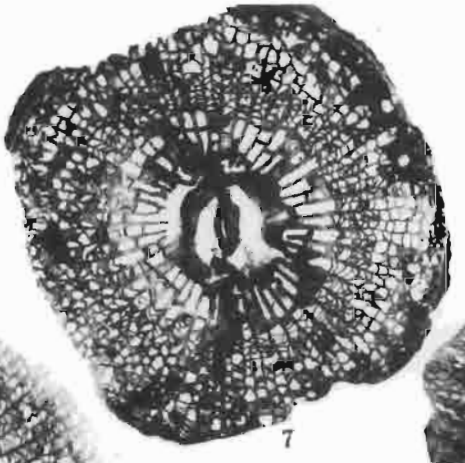

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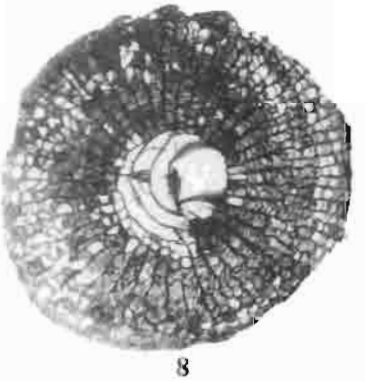

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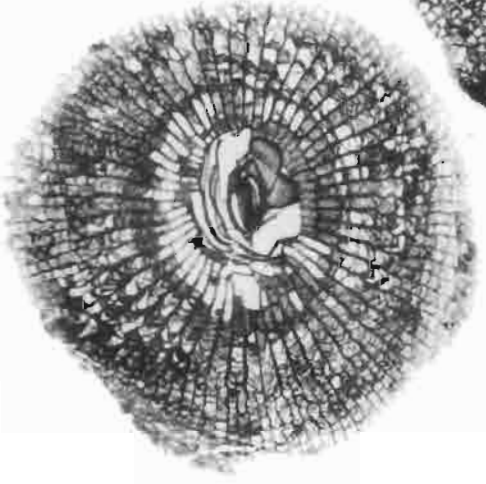

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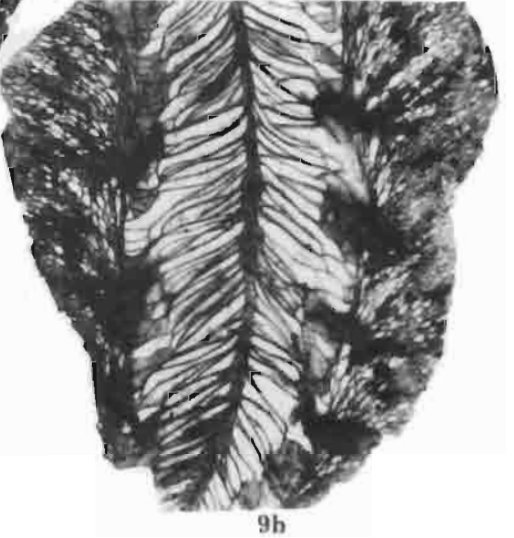

9b

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J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE VIII

Page

Koninckophyllum meathopense (GARWOOD) 85

Fig. 1. *a*, *b* Transverse sections of the ephebic stage (IG. OS-70/1581).
Fig. 2. Transverse section of the ephebic stage (IG. OS-70/1411).
Fig. 3. *a* Transverse section of the ephebic stage, *b* longitudinal section (IG. OS-70/950).
Fig. 4. Transverse section of the ephebic stage (IG. OS-70/1049).
Fig. 5. Transverse section of the ephebic stage (IG. OS-70/1073).
Fig. 6. Transverse section of the ephebic stage (IG. OS-70/1948).
Fig. 7. Transverse section of the ephebic stage (IG. OS-70/1568).
Fig. 8. Transverse section of the ephebic stage (IG. OS-70/1417).

Koninckophyllum proprium SIBLY 83

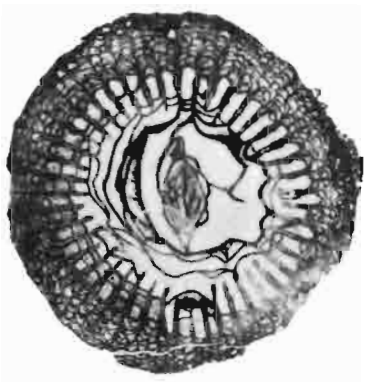
Fig. 9. Transverse section of the ephebic stage (IG. OS-70/2295).
Fig. 10. Transverse section of the ephebic stage (Z. Pal. P. Tc-4/2419).
Fig. 11. *a* Transverse section of the early ephebic stage, *b* longitudinal section (IG. OS-70/852), peels.
Fig. 12. Transverse section at base of calice (IG. OS-70/1665).

Koninckophyllum vaughani n. sp. 86

Fig. 13. Transverse section of the early ephebic stage (IG. OS-70/1852).
Fig. 14. Transverse section of the ephebic stage, holotype, peel (IG. OS-70/956).

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All figures × 2



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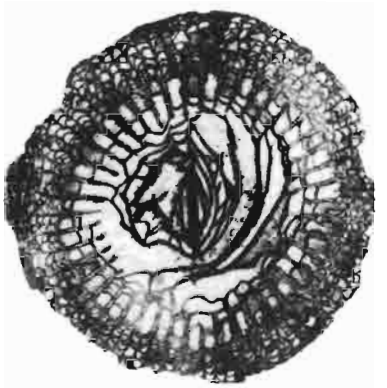

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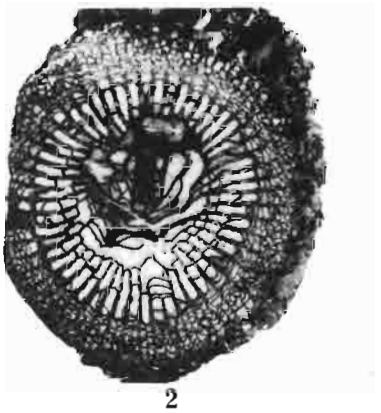

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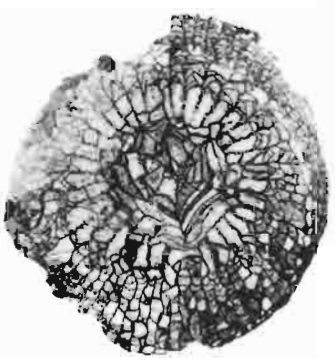

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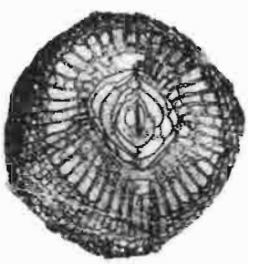

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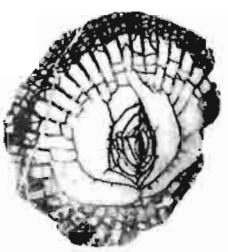

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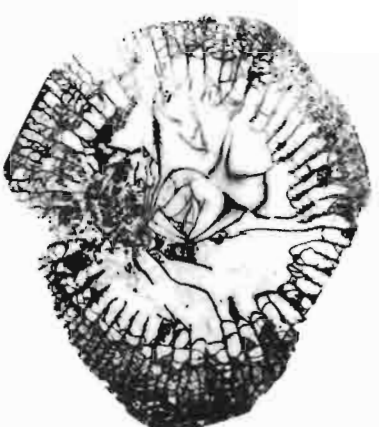

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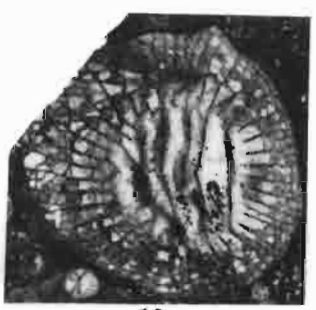

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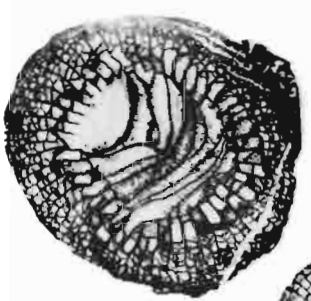

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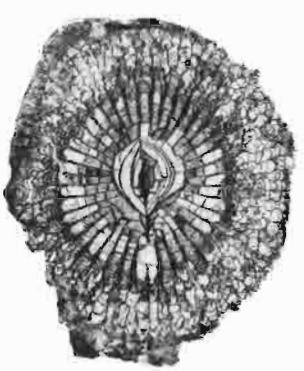

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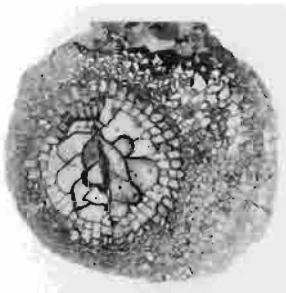
J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE IX

Gałęzice, Holy Cross Mts., Upper Viséan D_2 (top)

All figures × 2



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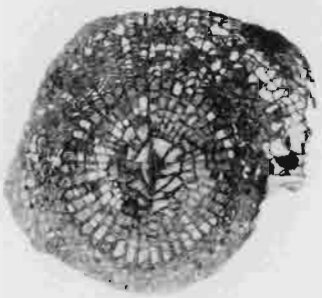

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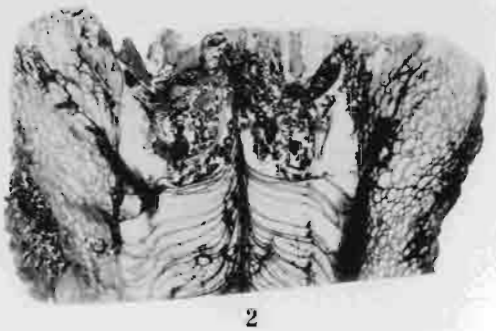

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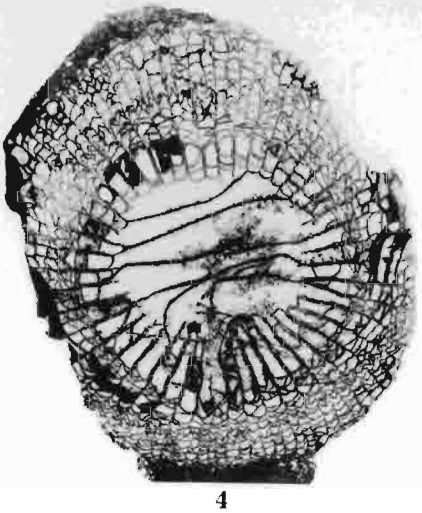

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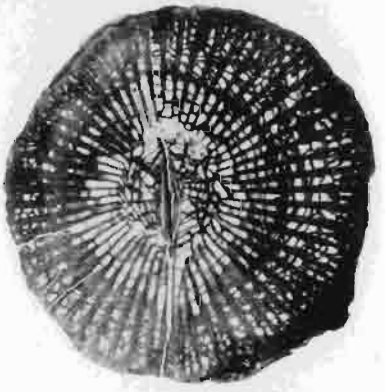

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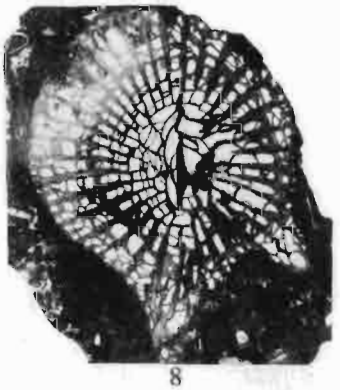

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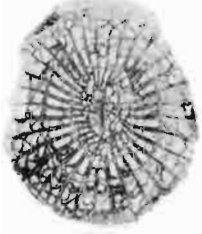

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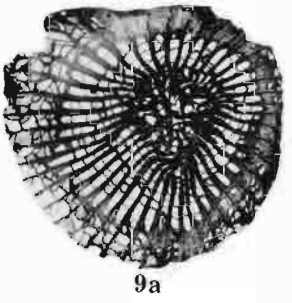

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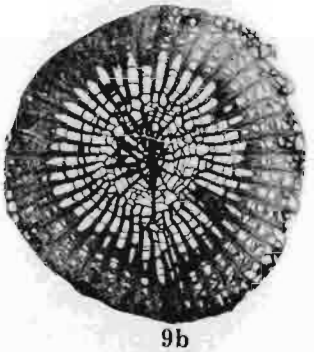

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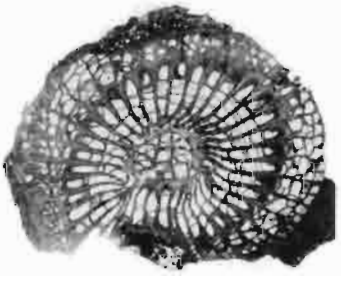

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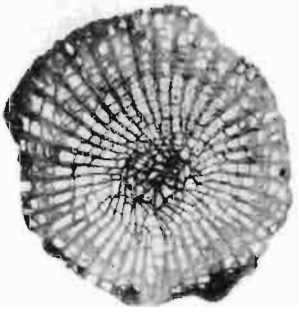

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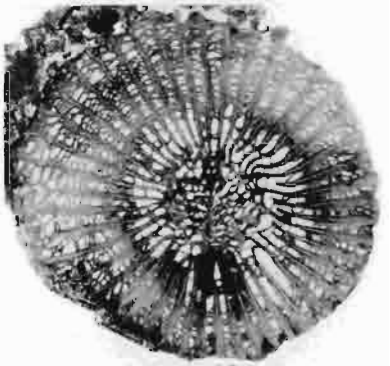

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J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE X

Page

Arachnolasma microcolumella n. sp. 99

Fig. 1. Transverse section of the early ephebic stage (IG. OS-70/1396).

Neokoninckophyllum tanaicum FOMITSHEV 104

Fig. 2. Transverse section of the ephebic stage (IG. OS-70/396).
Fig. 3. Transverse section of the late ephebic stage (IG. OS-70/3144).

Neokoninckophyllum multiseptatum n. sp. 106

Fig. 4. *a* Transverse section of the ephebic stage, *b* transverse section of the late neanic stage (IG. OS-70/2296).
Fig. 5. Transverse section of the ephebic stage (IG. OS-70/468).
Fig. 6. Transverse section of the ephebic stage (IG. OS-70/2681).
Fig. 7. Transverse section of the ephebic stage, holotype (IG. OS-70/177).

Neokoninckophyllum soshkinae FOMITSHEV 105

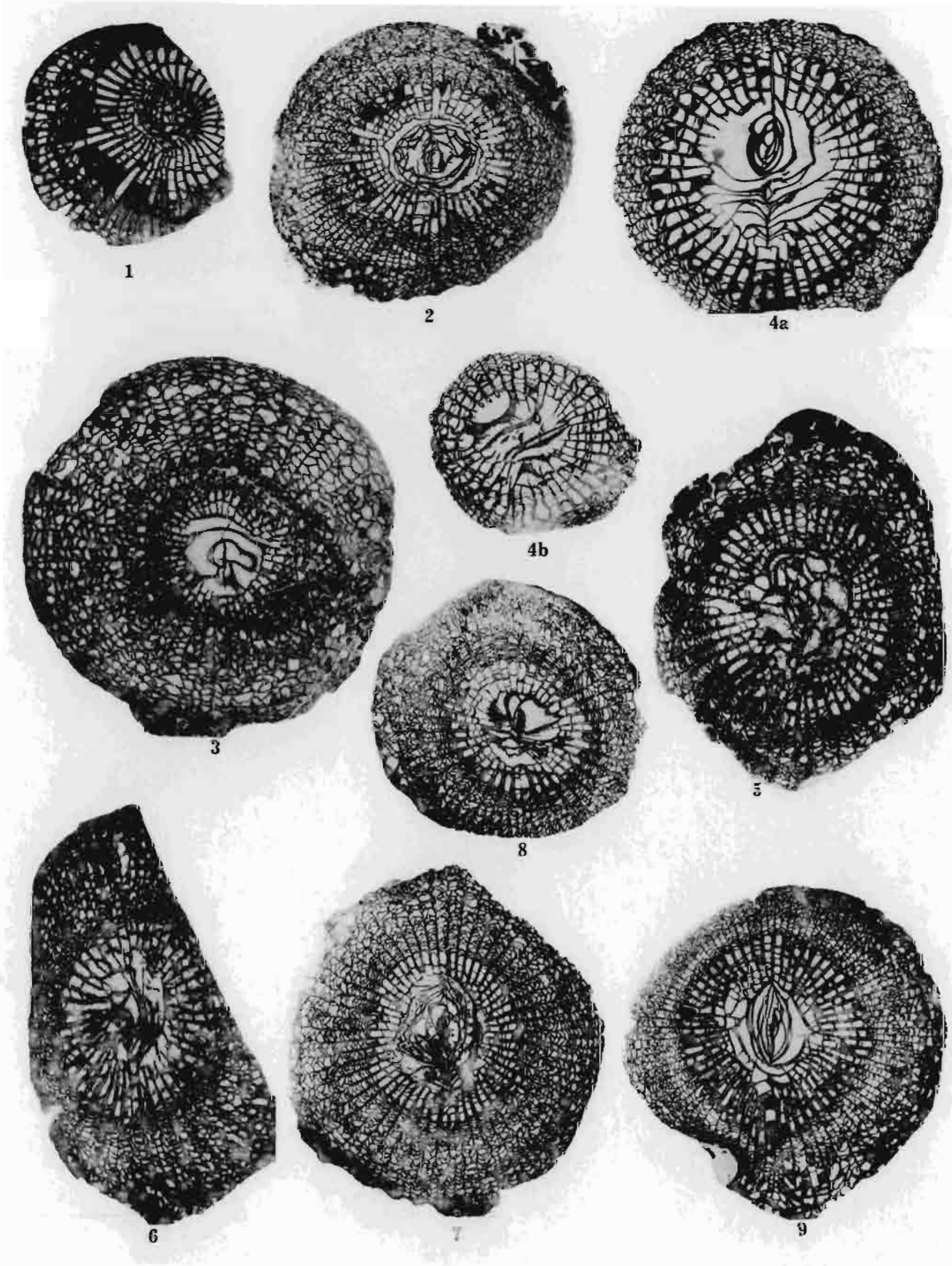
Fig. 8. Transverse section of the ephebic stage (IG. OS-70/595).

Neokoninckophyllum trifossulum n. sp. 109

Fig. 9. Transverse section of the ephebic stage (IG. OS-70/1915).

Gałęzice, Holy Cross Mts., Upper Viséan D_2 (top).

All figures × 2



J. Fedorowski: Aulophyllidae from the Upper Viséan

J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XI

Page

Nervophyllum primitivum n. sp. 114

Fig. 1. Transverse section of the early ephebic stage, holotype (IG. OS-70/285).
Fig. 2. *a, b* Transverse sections of the ephebic stage, peels (IG. OS-70/2186).
Fig. 3. Transverse section of the ephebic stage, peel (IG. OS-70/2126).
Fig. 4. *a* Transverse section of the ephebic stage (peel), *b* longitudinal section (IG. OS-70/2125).
Fig. 5. Transverse section at base of the calice, peel (IG. OS-70/2185).

Neokoninckophyllum trifossulum n. sp. 109

Fig. 6. Transverse section of the ephebic stage, holotype (IG. OS-70/1455).
Fig. 7. Transverse section of the ephebic stage (IG. OS/70/1454).

Gałęzice, Holy Cross Mts., Upper Viséan D_2 (top)

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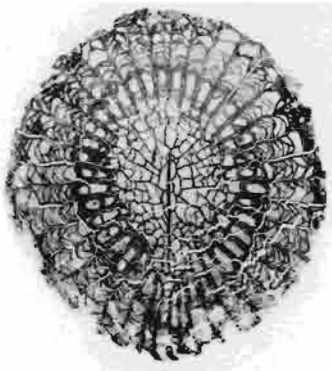

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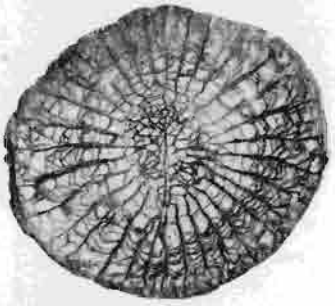

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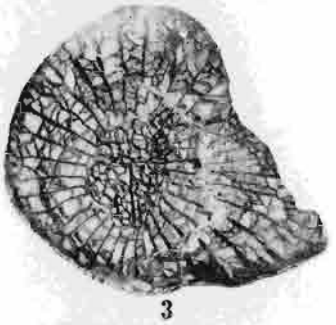

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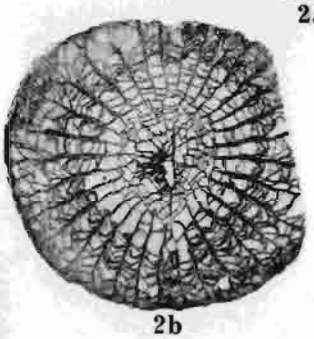

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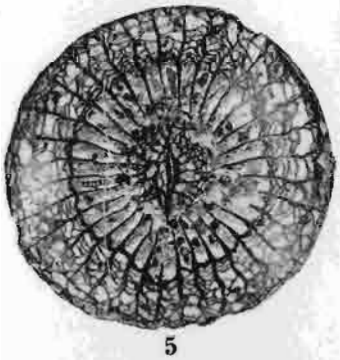

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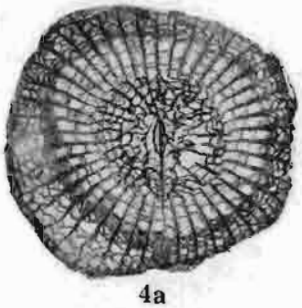

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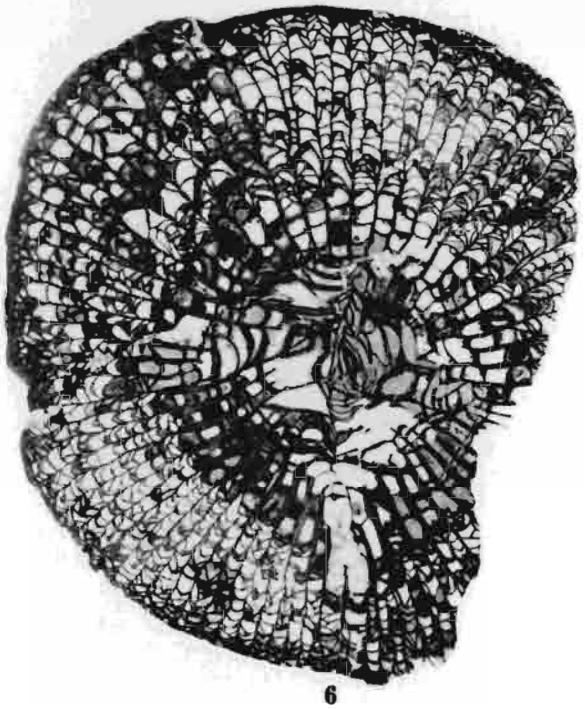

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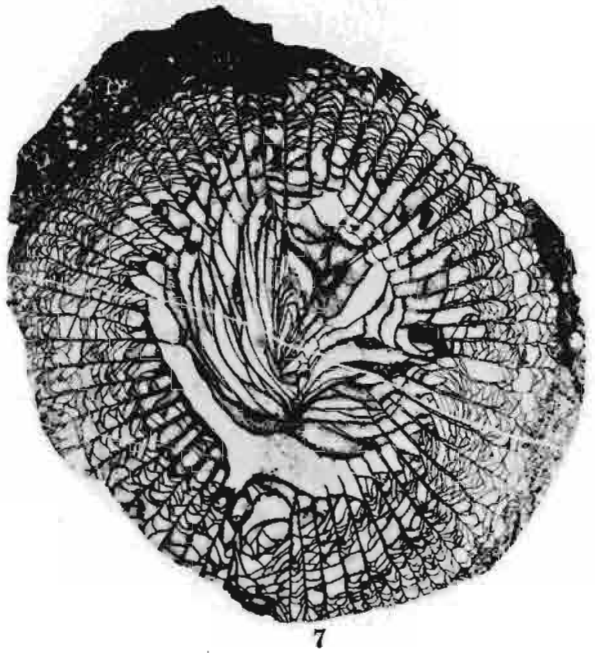

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J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XII

Page

Mira prima n. gen., n. sp. 127

Fig. 1. *a* Transverse section of the late ephebic stage, *b* transverse section of the ephebic stage (peel), *c* transverse section of the another fragment of ephebic stage, *d* longitudinal section (peel); holotype (IG. OS-70/2413).

Fig. 2. Transverse section of the ephebic stage (IG. OS-70/2340).

Fig. 3. Transverse section of the ephebic stage, peel (IG. OS-70/2943).

Biphyllum vallum n. gen., n. sp. 120

Fig. 4. Transverse section of the ephebic stage (IG. OS-70/114).

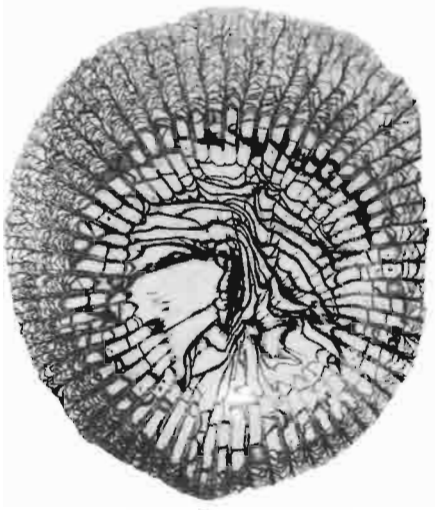
Koninckinaotum pseudocoloniale n. gen., n. sp. 123

Fig. 5. Transverse section of the pseudocolony, holotype (Z. Pal. P. Tc-4/2883).

Fig. 6. Transverse section of the early ephebic stage (Z. Pal. P. Tc-4/2798).

Gałęzice, Holy Cross Mts., Upper Viséan D_2 (top)

All figures × 2



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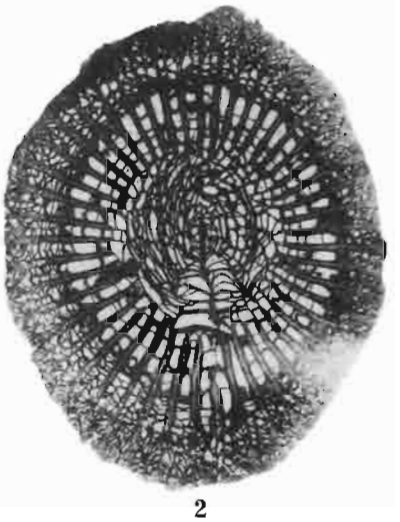

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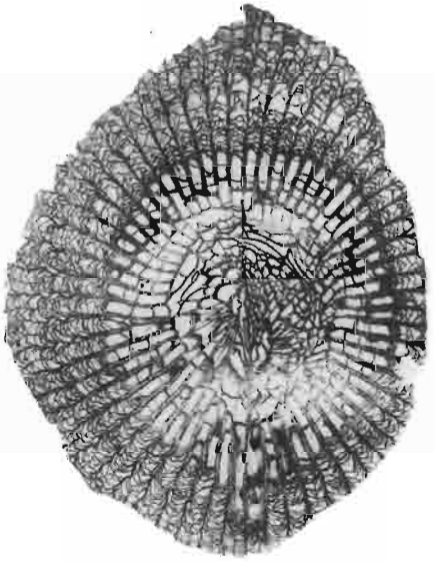

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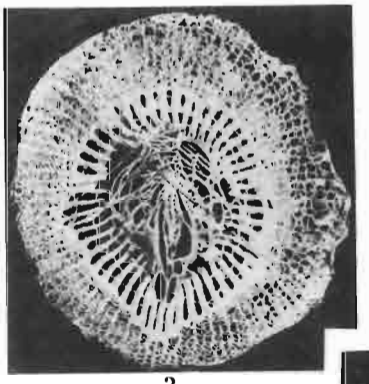

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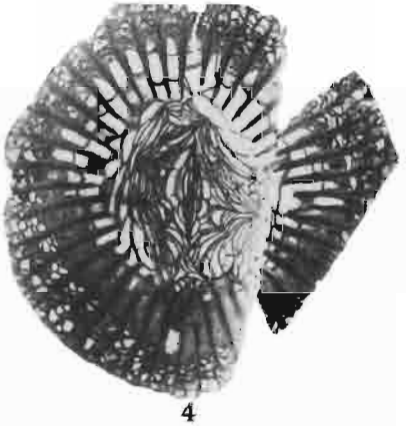

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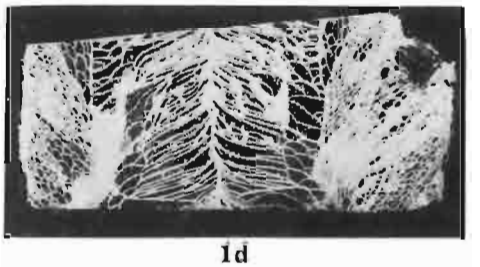

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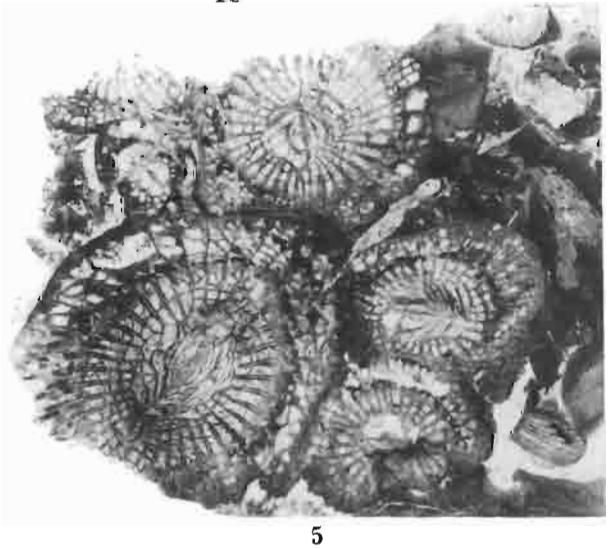

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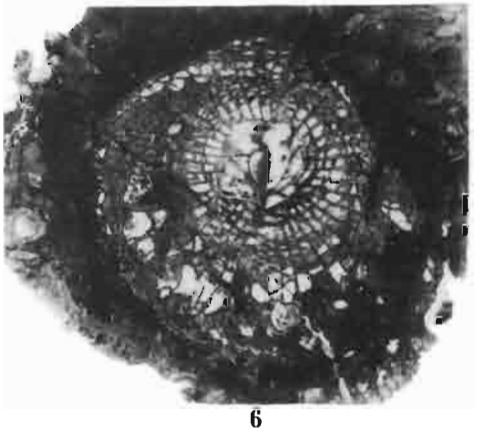

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J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XIII

Page

Zakowia parva n. gen., n. sp. 32

Fig. 1. Transverse section of the ephebic stage (IG. OS-70/3140).
Fig. 2. Transverse section of the ephebic stage, holotype (IG. OS-70/3125).
Fig. 3. Transverse section of the ephebic stage (IG. OS-70/2713).

Zakowia sanctaecrucensis n. gen., n. sp. 30

Fig. 4. *a* Longitudinal section, *b* transverse section at base of calice (IG. OS-70/52).
Fig. 5. *a* Transverse section of the late ephebic stage, *b* transverse section of the neanic stage, holotype (IG. OS-70/366).

Zakowia sp. 34

Fig. 6. Transverse section of the ephebic stage (IG. OS-70/448).

Clisiophyllum delicatum delicatum SMYTH 41

Fig. 7. Transverse section of the ephebic stage (IG. OS-70/1217).
Fig. 8. Longitudinal section (IG. OS-70/1155).
Fig. 9. Longitudinal section (IG. OS-70/699).

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

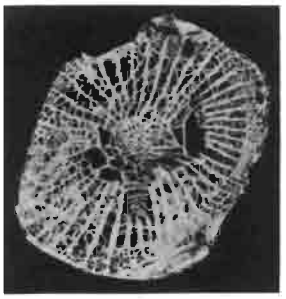
Clisiophyllum keyserlingi M'COY 37

Fig. 10. *a* Transverse section of the neanic stage, *b* transverse section of the ephebic stage (Z. Pal. P. Tc-4/385), Sokolec, Sudetes, Upper Viséan, D_2.
Fig. 11. Transverse section of the ephebic stage (Z. Pal. P. Tc-4/273), the same locality and horizon.

Slimoniphyllum slimonianum (THOMSON) 27

Fig. 12. *a* Transverse section of the late neanic stage, *b* longitudinal section (Z. Pal. P. Tc-4/3166), Czerwieńczyce, Sudetes, Upper Viséan, D_2.

All photographs from peels, ×2



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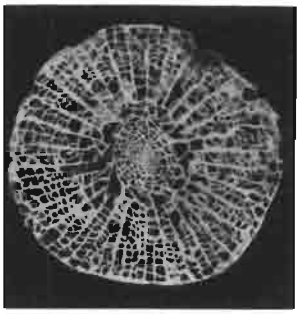

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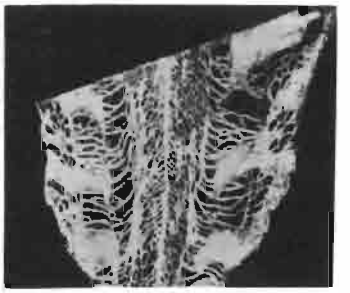

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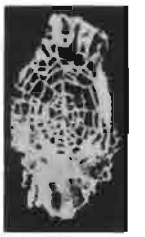

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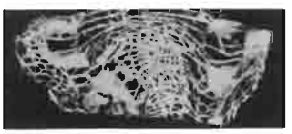

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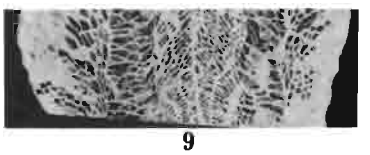

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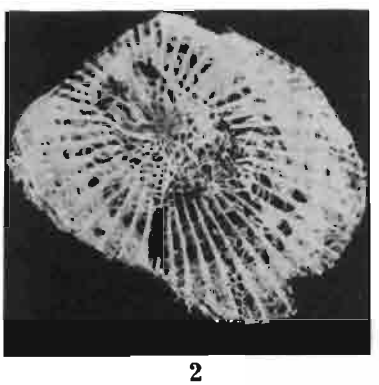

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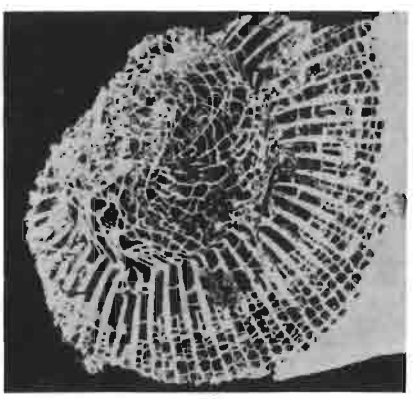

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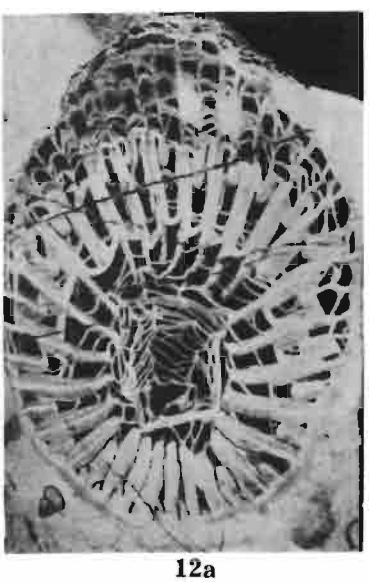

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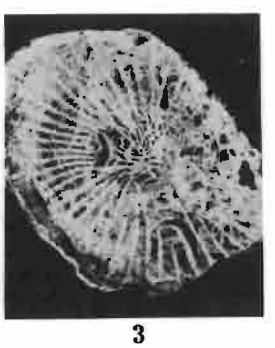

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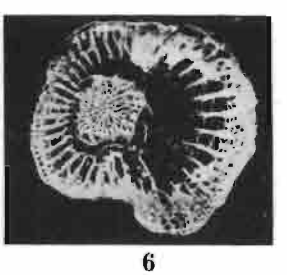

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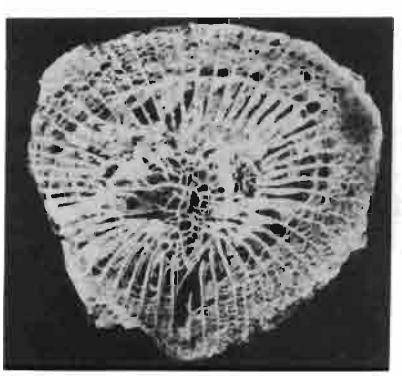

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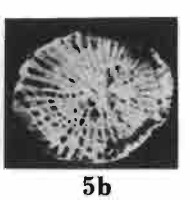

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12b

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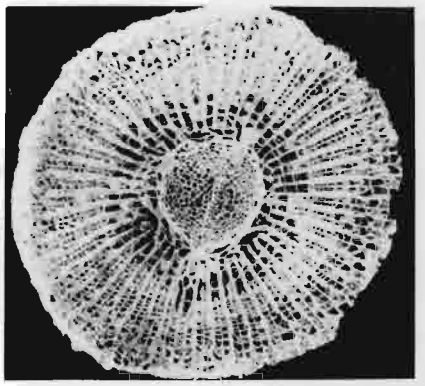
J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XIV

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All photographs from peels, × 2



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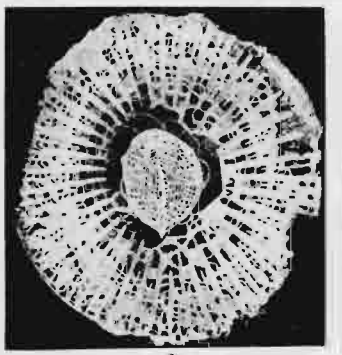

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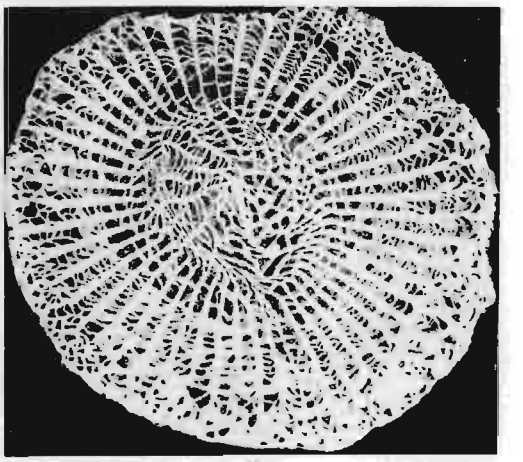

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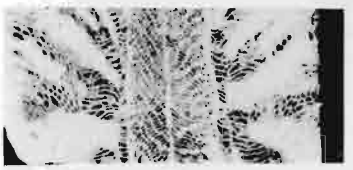

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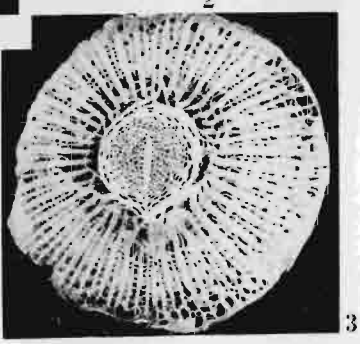

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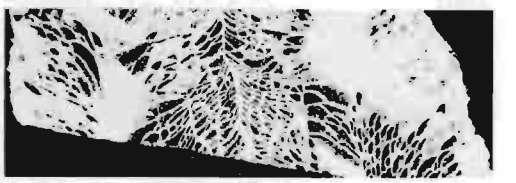

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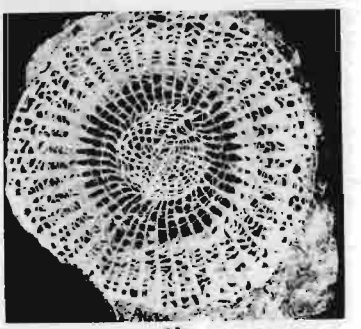

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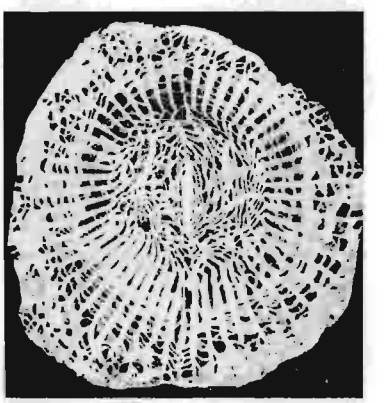

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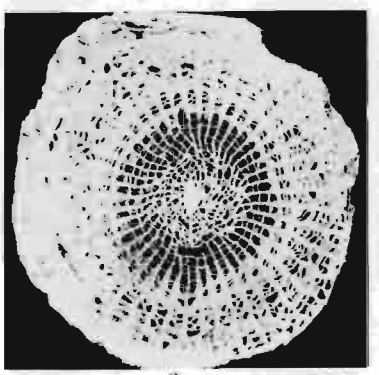

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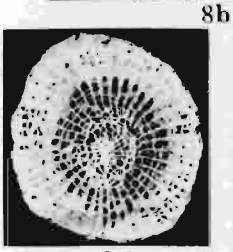

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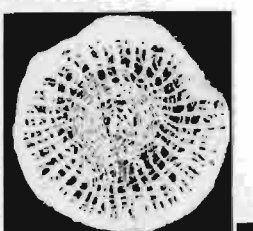

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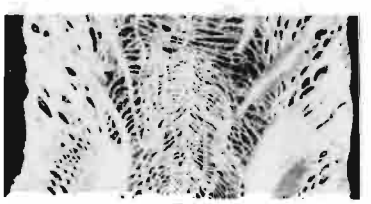

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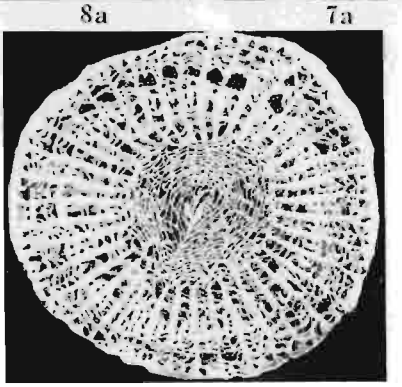

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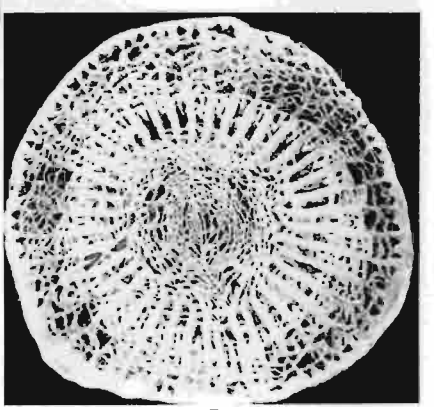

7c

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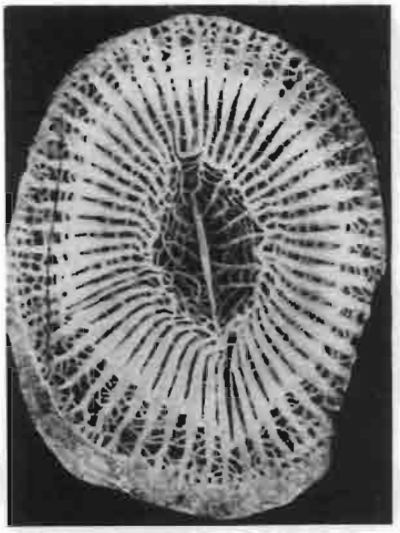
J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XV

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All photographs from peels, × 2



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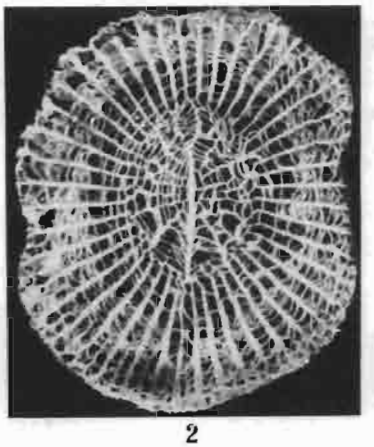

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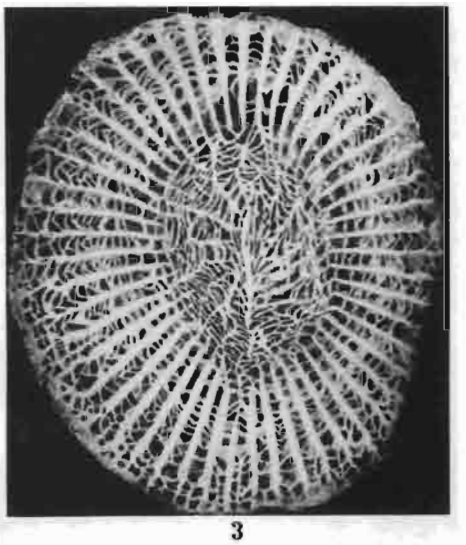

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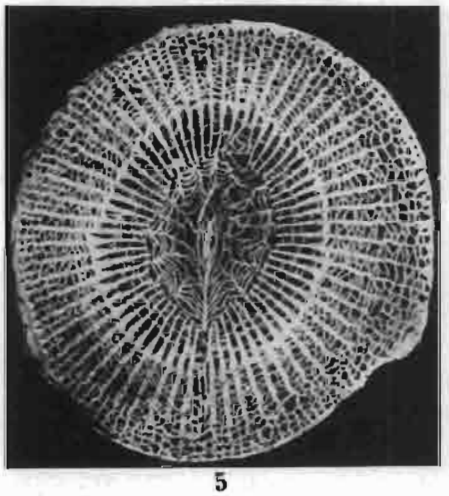

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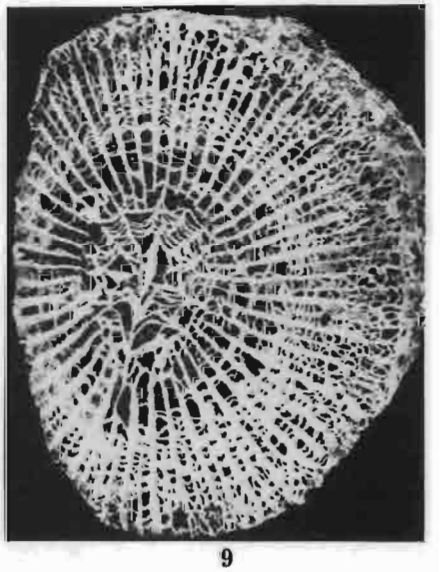

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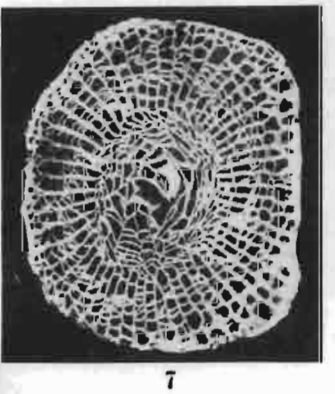

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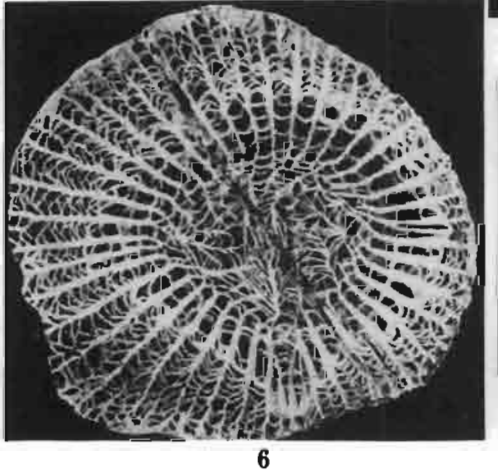

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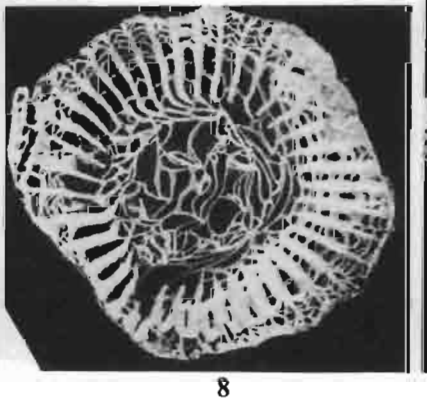

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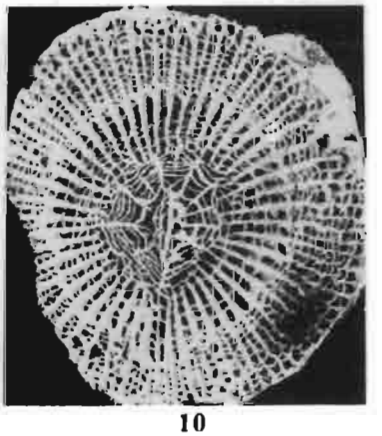


10

Palaeontologia Polonica, No. 24, 1970

J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XVI

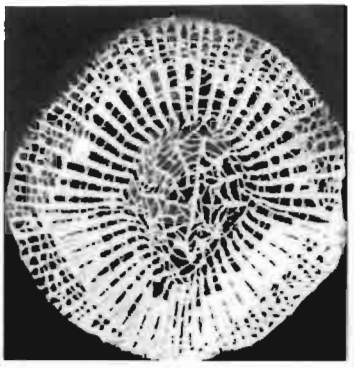
Fig. 1. *a* Transverse section of the early ephebic stage, *b* transverse section of the ephebic stage, *c* longitudinal section (IG. OS-70/1256).

Fig. 2. Transverse section of the ephebic stage (IG. OS-70/3177).
Fig. 3. *a* Transverse section of the ephebic stage, *b* longitudinal section (IG. OS-70/2137).
Fig. 4. Transverse section of the ephebic stage (IG. OS-70/3253).
Fig. 5. Transverse section of the ephebic stage (IG. OS-70/2139).

Fig. 6. Transverse section of the ephebic stage (IG. OS-70/2422).
Fig. 7. Transverse section of the ephebic stage (IG. OS-70/2138).

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All photographs from peels, × 2



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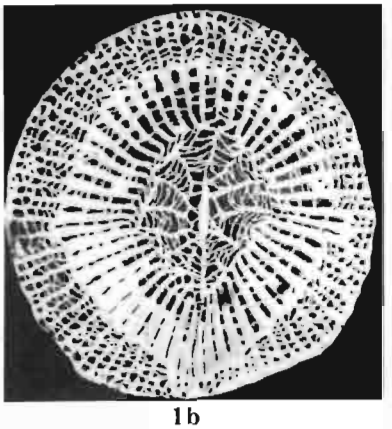

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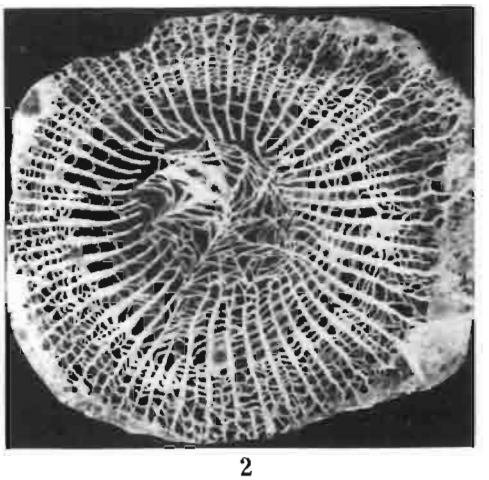

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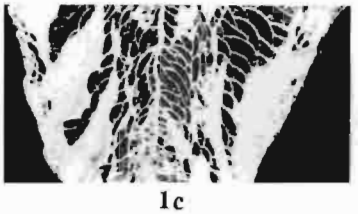

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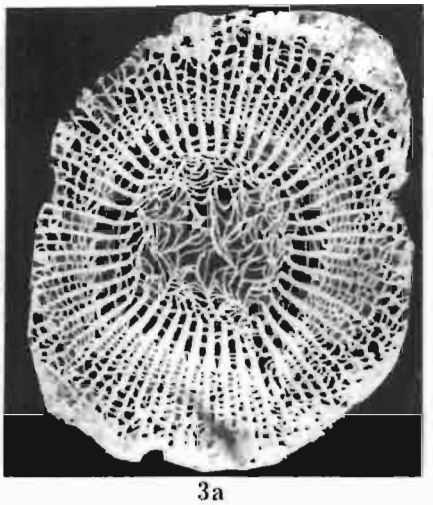

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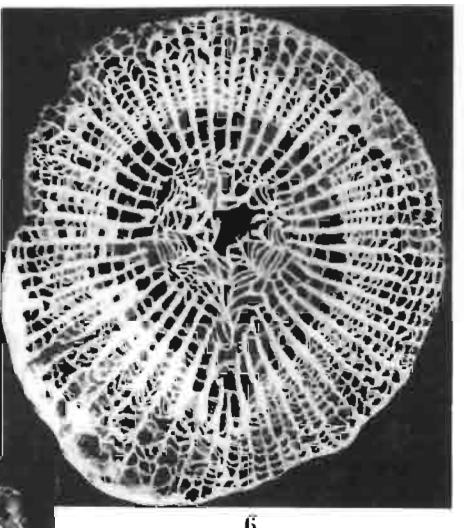

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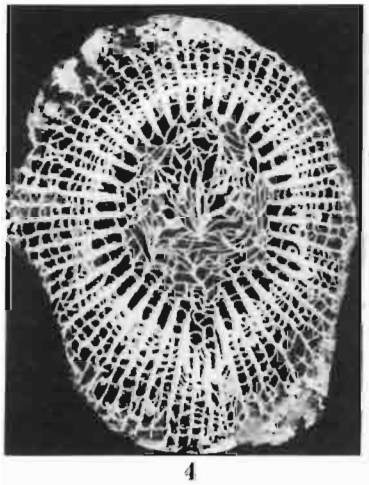

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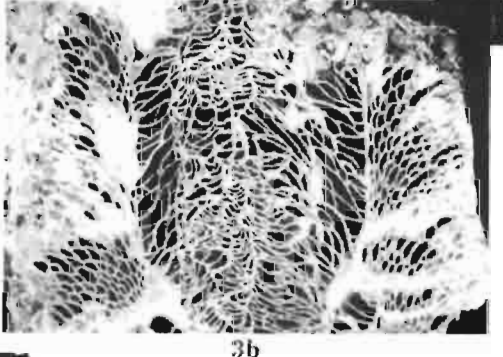

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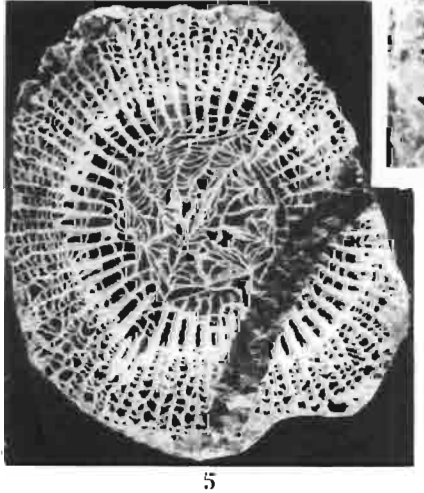

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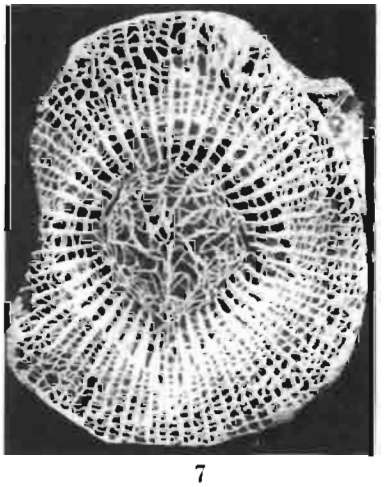

7

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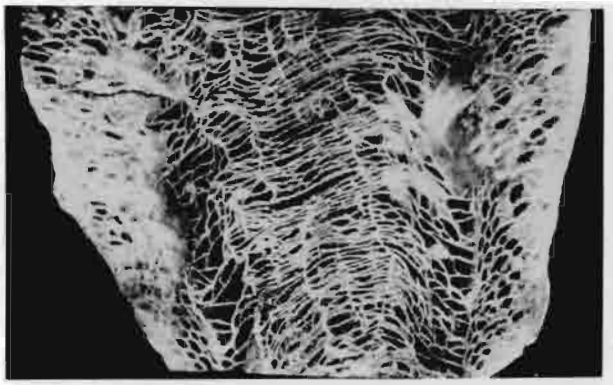
J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XVII

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All photographs from peels, × 2



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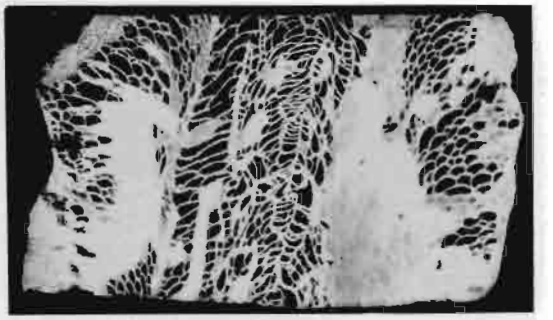

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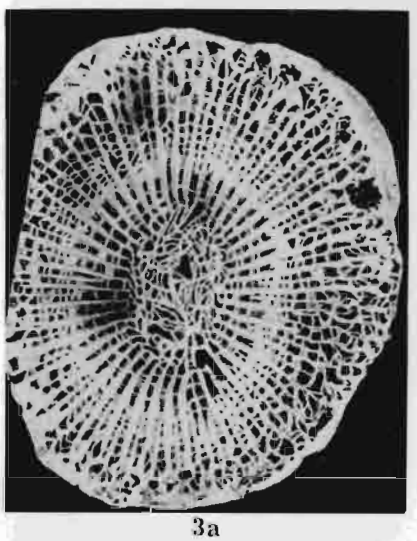

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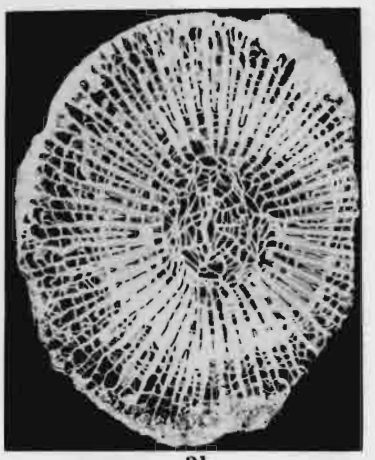

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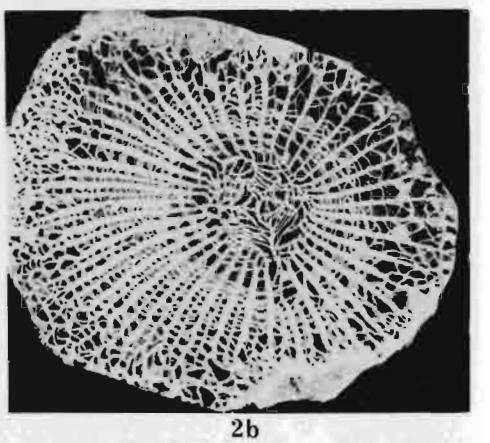

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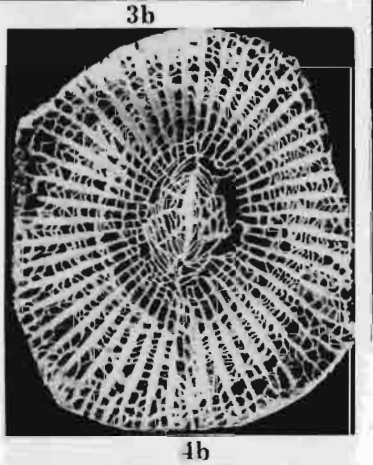

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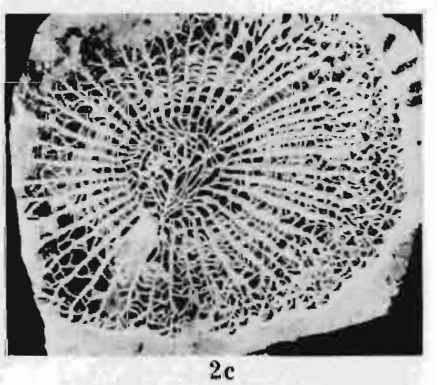

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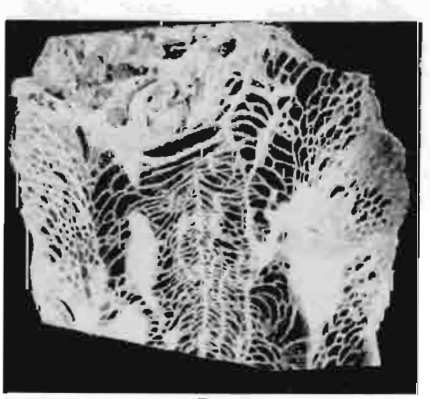

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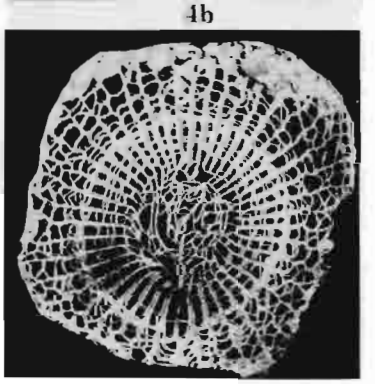

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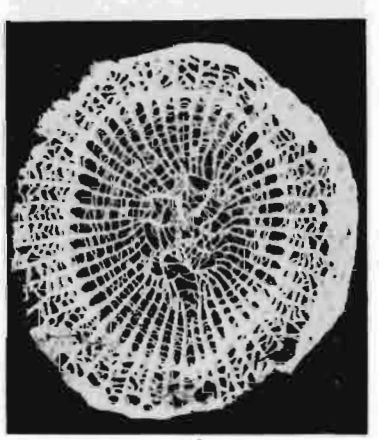

5b

J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

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PLATE XVIII

Page

Dibunophyllum percrassum GORSKY 74

Fig. 1. Transverse section of the ephebic stage (IG. OS-70/2752).
Fig. 2. Transverse section of the early ephebic stage (IG. OS-70/817).

Koninckophyllum magnificum THOMSON & NICHOLSON 79

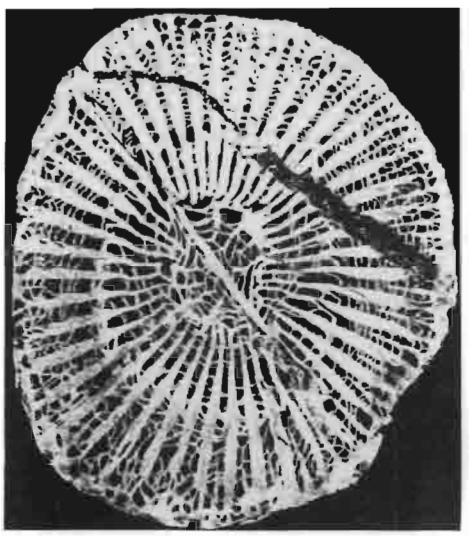
Fig. 3. *a* Transverse section of the ephebic stage, *b* rejuvenescence (IG. OS-70/953).
Fig. 4. Longitudinal section (IG. OS-70/205).

Koninckophyllum interruptum THOMSON & NICHOLSON 82

Fig. 5. Transverse section of the ephebic stage (IG. OS-70/2179).
Fig. 6. *a* Transverse section of the ephebic stage, *b* longitudinal section (IG. OS-70/2390).
Fig. 7. *a* Transverse section of the ephebic stage, *b* longitudinal section (IG. OS-70/2393).
Fig. 8. Transverse section of the ephebic stage (IG. OS-70/896).
Fig. 9. Transverse section of the ephebic stage (Z. Pal. P. Tc-4/2866).

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All photographs from peels, × 2



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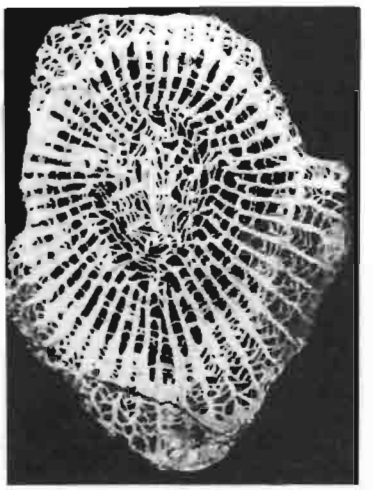

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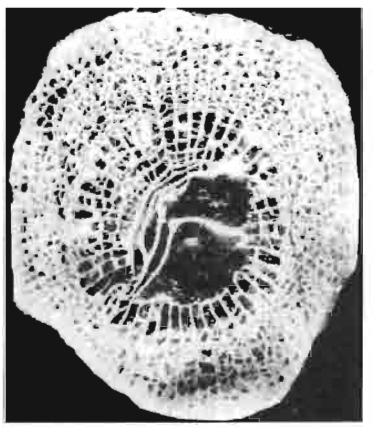

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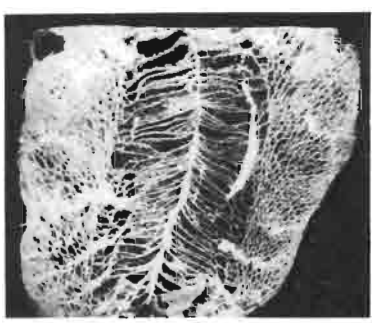

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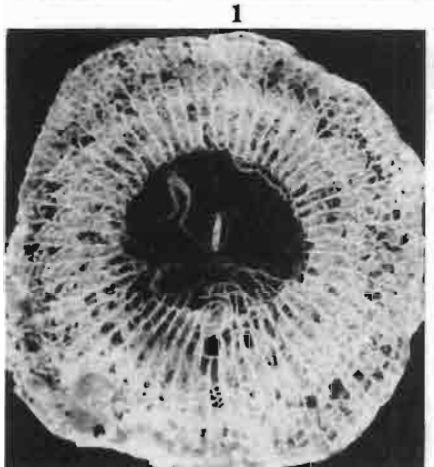

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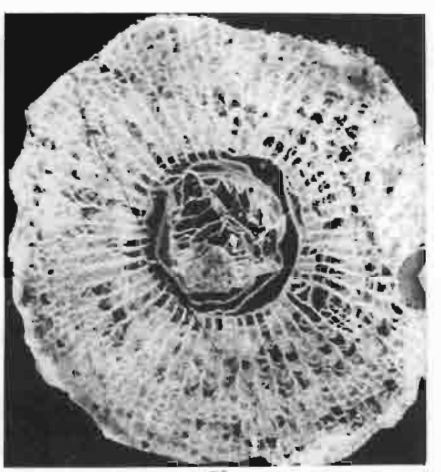

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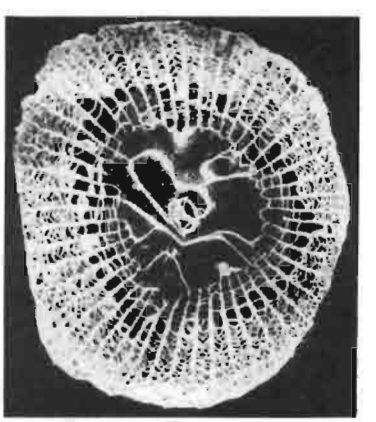

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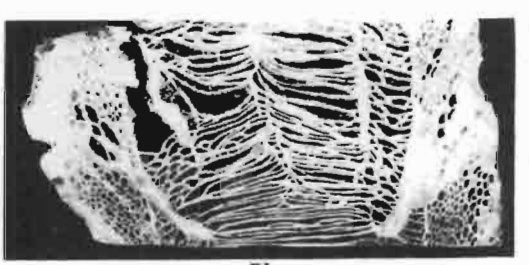

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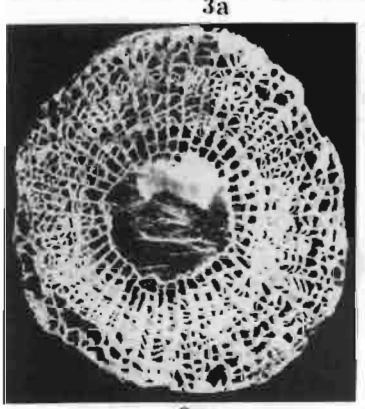

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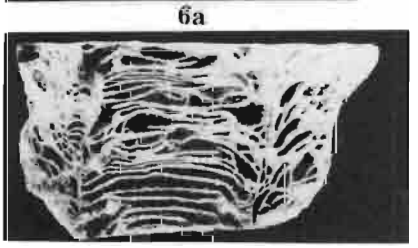

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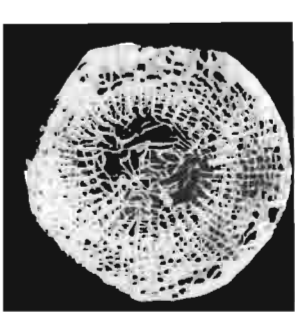

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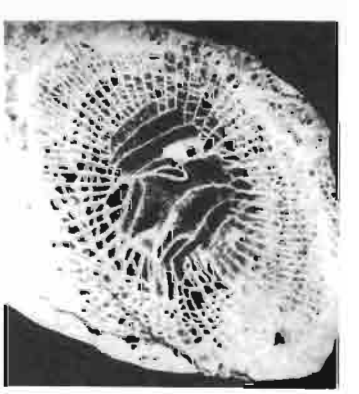

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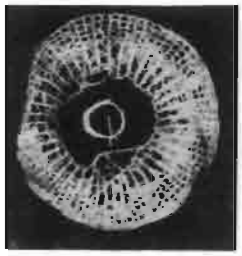
J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XIX

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All photographs from peels, × 2



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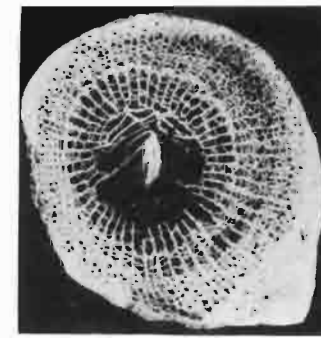

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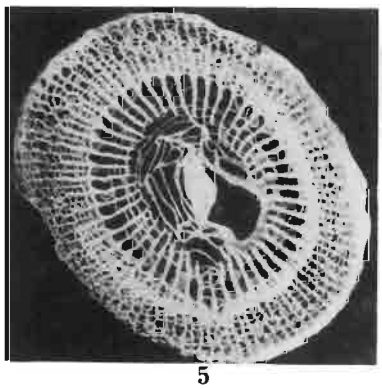

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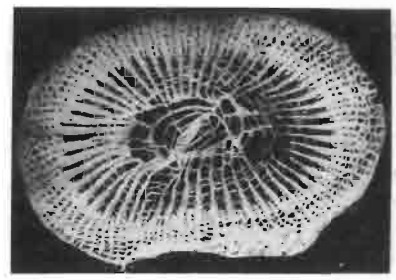

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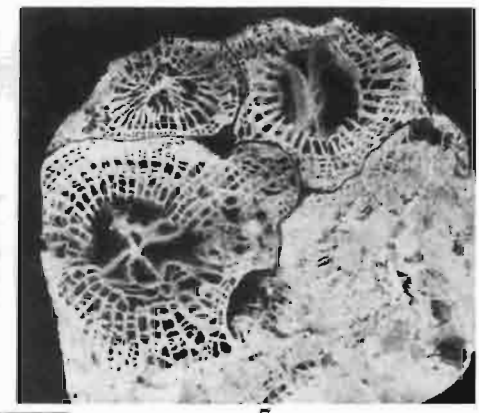

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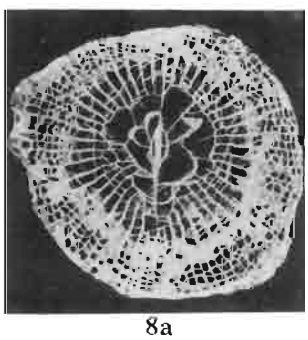

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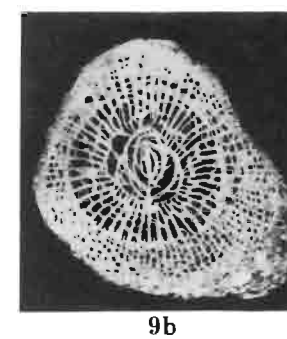
9a



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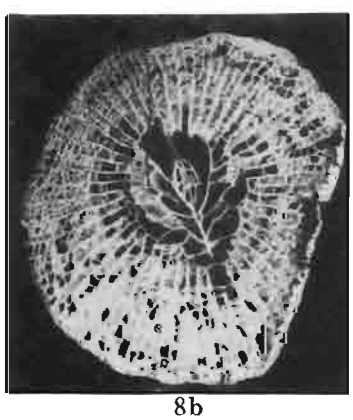

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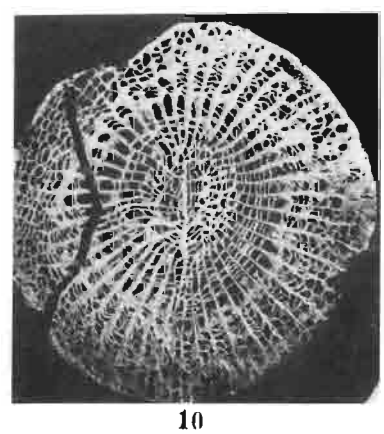

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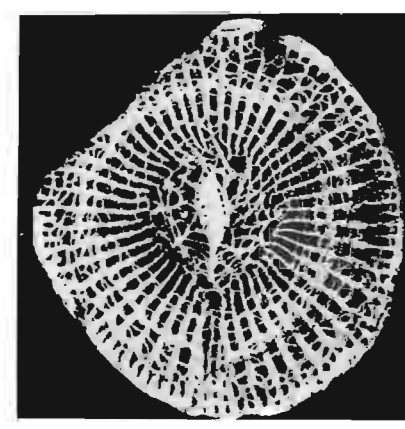

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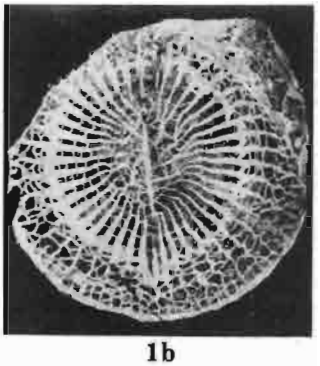
J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XX

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All photographs from peels, × 2



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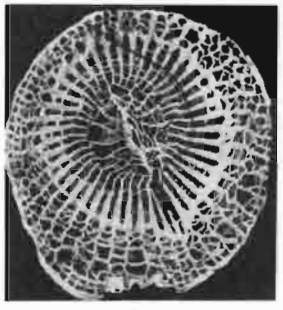

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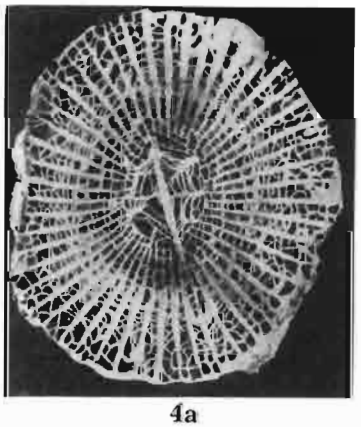

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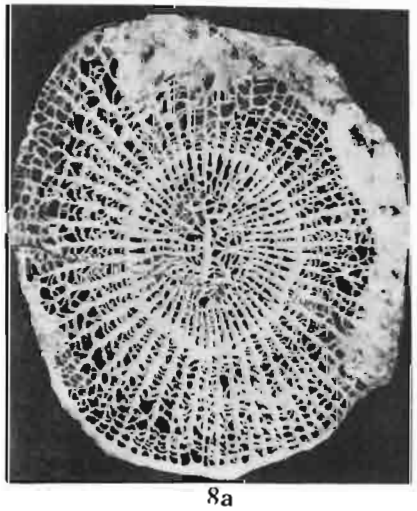

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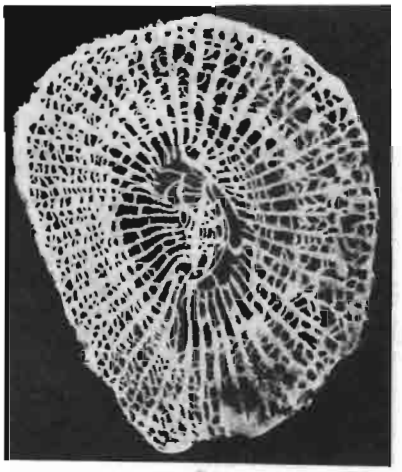

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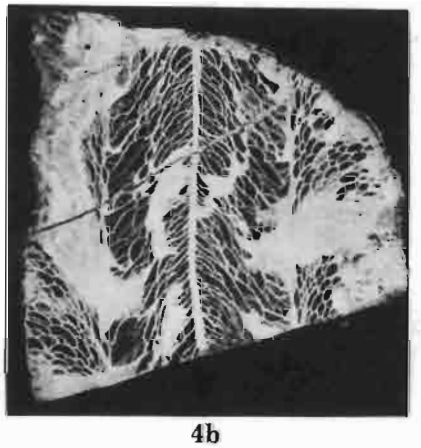

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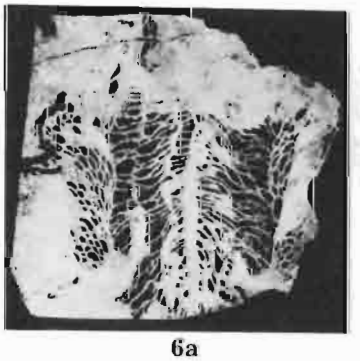

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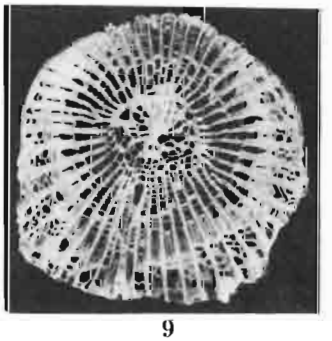

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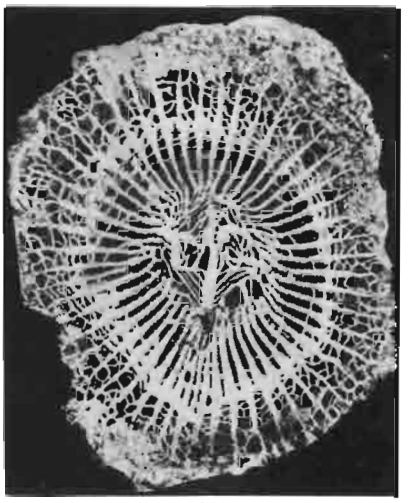

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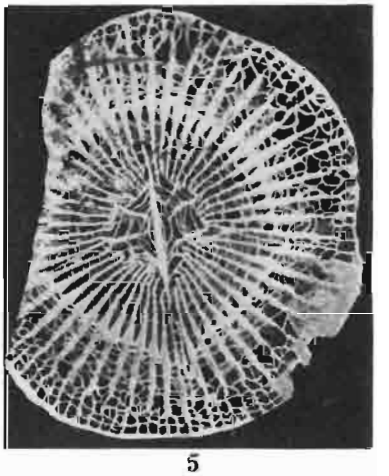

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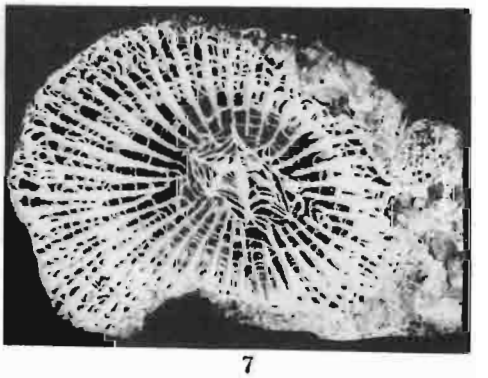

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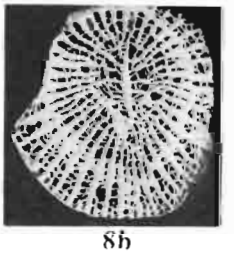

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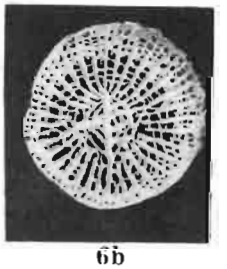

6b

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J. FEDOROWSKI: AULOPHYLLIDAE FROM THE UPPER VISÉAN

PLATE XXI

Page

Arachnolasma microcolumella n. sp. 99

Fig. 1. *a* Transverse section of the ephebic stage, *b* transverse section of the late neanic stage, *c* transverse section of the neanic stage, holotype (IG. OS-70/1795).
Fig. 2. Longitudinal section (IG. OS-70/1789).

Neokoninckophyllum soshkinae FOMITSHEV 105

Fig. 3. *a* Transverse section of the ephebic stage, *b* longitudinal section (IG. OS-70/79).
Fig. 4. Longitudinal section (IG. OS-70/2122).
Fig. 5. *a* Transverse section of the ephebic stage, *b* longitudinal section (IG. OS-70/623).

Neokoninckophyllum multiseptatum n. sp. 106

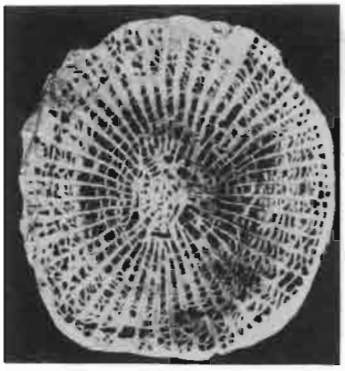
Fig. 6. *a* Transverse section of the ephebic stage, *b* longitudinal section, holotype (IG. OS-70/177).
Fig. 7. Transverse section of the ephebic stage (IG. OS-70/2822).

Neokoninckophyllum trifossulum n. sp. 109

Fig. 8. Longitudinal section (IG. OS-70/1454).

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All photographs from peels, × 2



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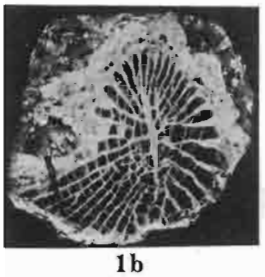

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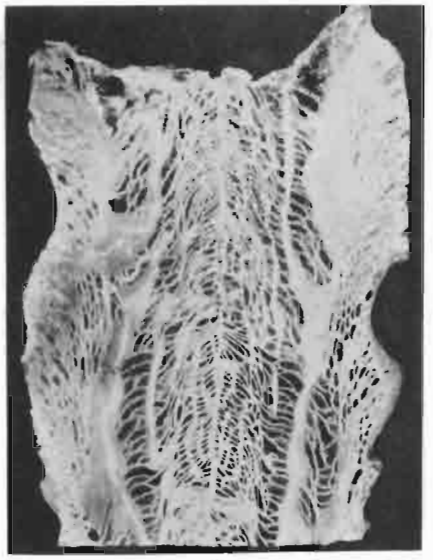

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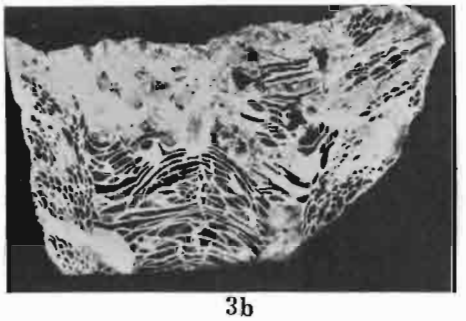

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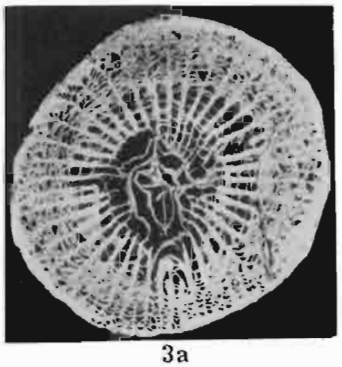

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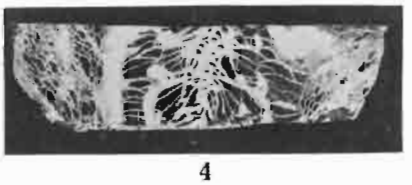

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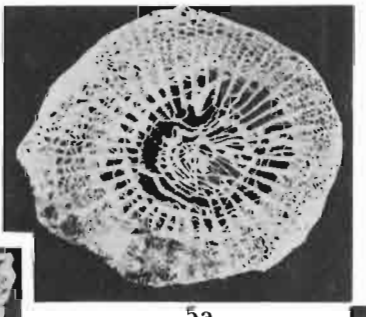

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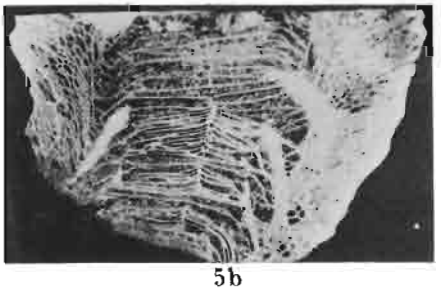

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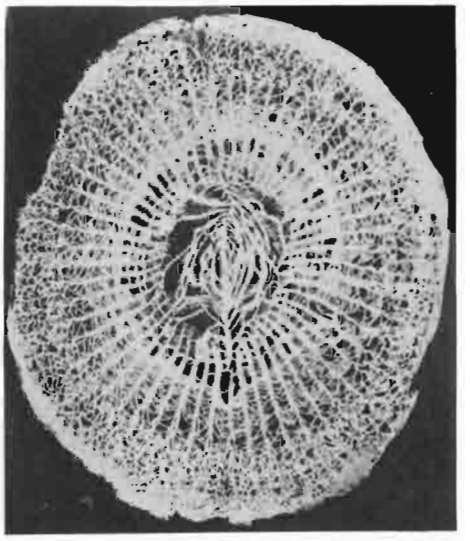

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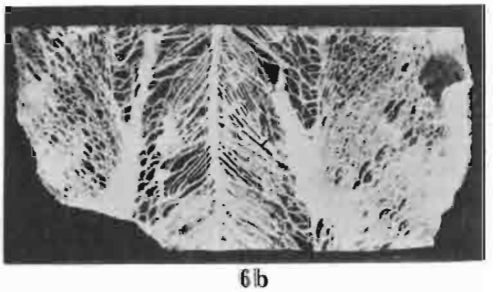

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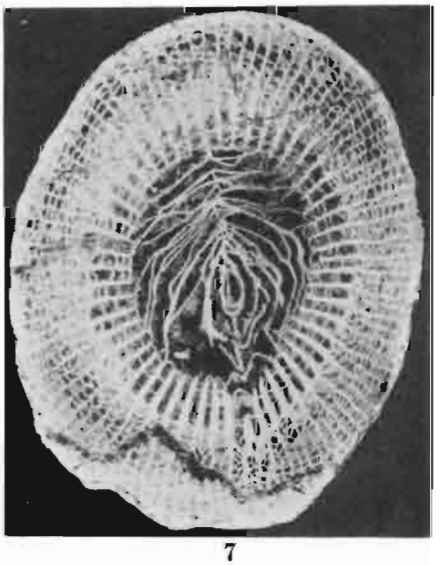

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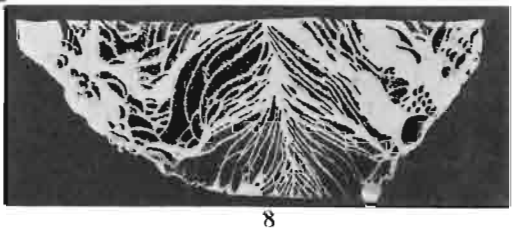

8

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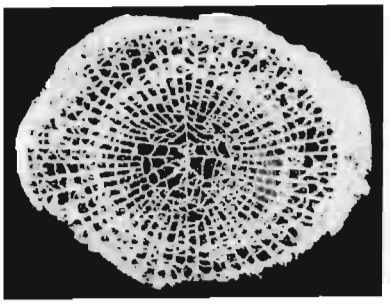
PLATE XXII

Gałęzice, Holy Cross Mts., Upper Viséan D_2 (top)

All photographs from peels, × 2



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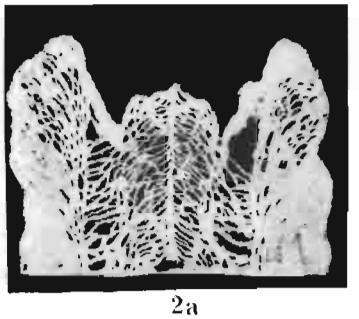

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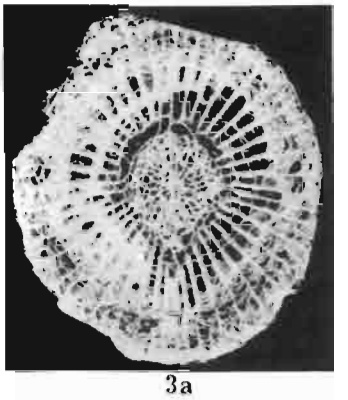

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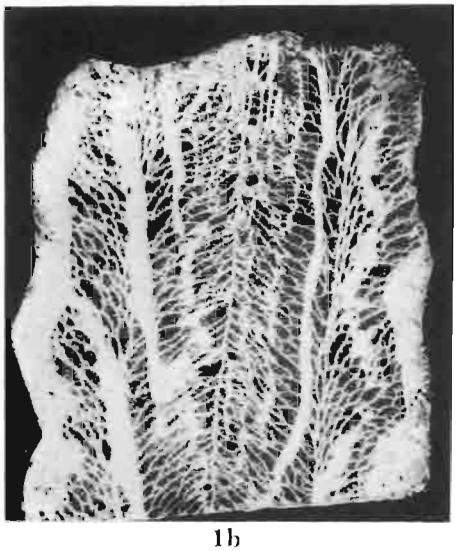

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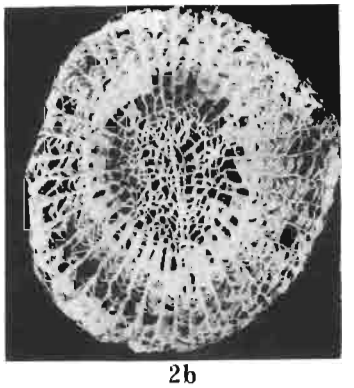

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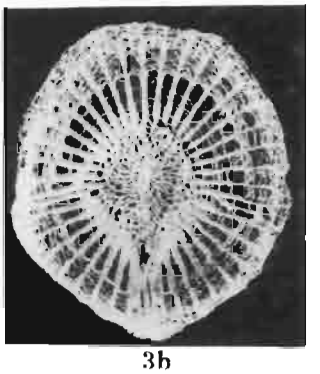

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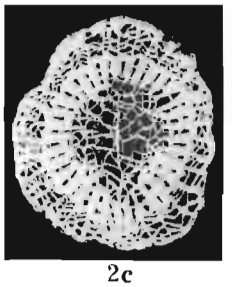

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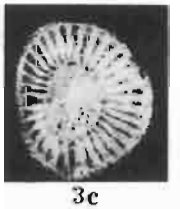

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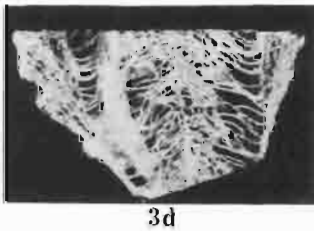

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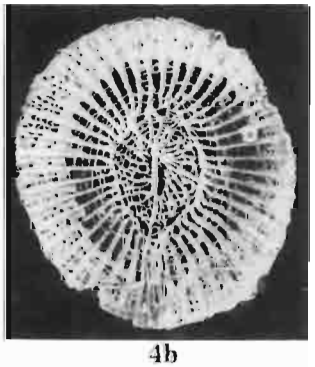

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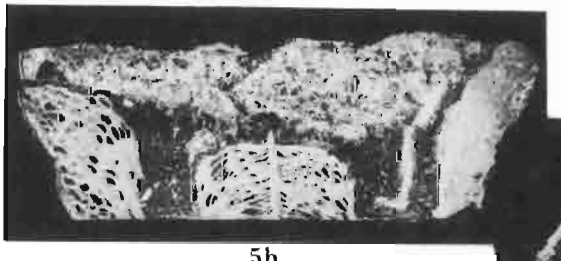

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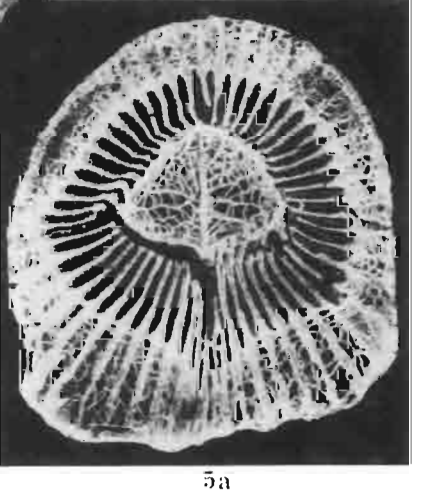

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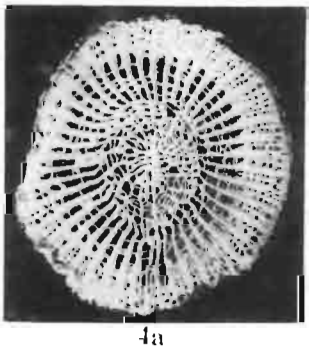

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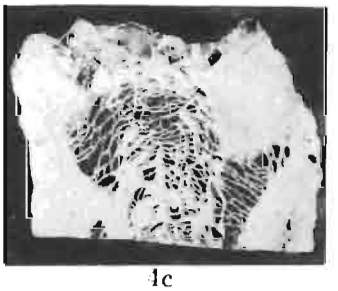

4c

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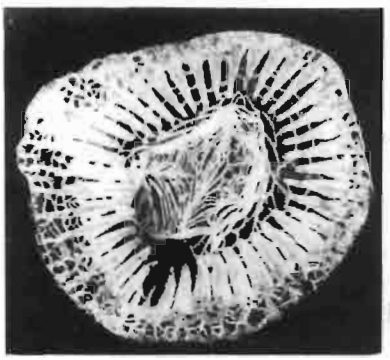
PLATE XXIII

Fig. 1. Transverse section of the ephebic stage (IG. OS-70/114).
Fig. 2. *a* Transverse section of the ephebic stage, *b* longitudinal section (IG. OS-70/2642).
Fig. 3. Transverse section of the ephebic stage (Z. Pal. P. Tc-4/2897).
Fig. 4. Transverse section of the ephebic stage (IG. OS-70/225).

Fig. 5. Transverse section of the early ephebic stage (Z. Pal. P. Tc-4/2875).
Fig. 6. *a* Transverse section of the ephebic stage, *b* longitudinal section (Z. Pal. P. Tc-4/2775).

Gałęzice, Holy Cross Mts., Upper Viséan, D_2 (top)

All photographs from peels, × 2



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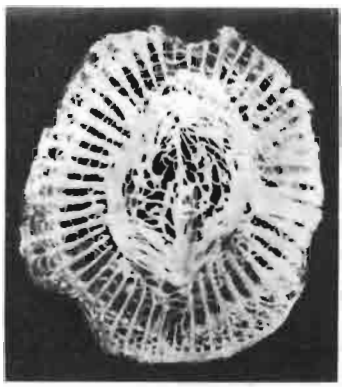

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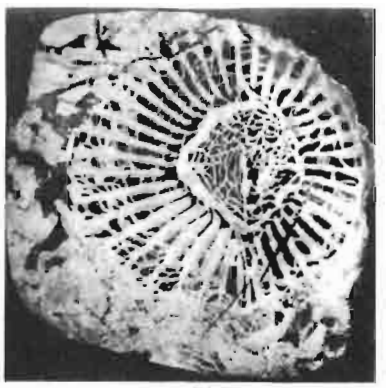

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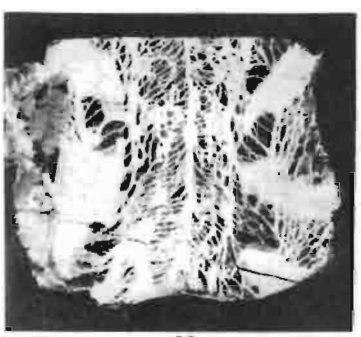

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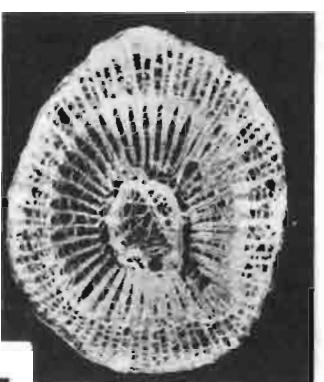

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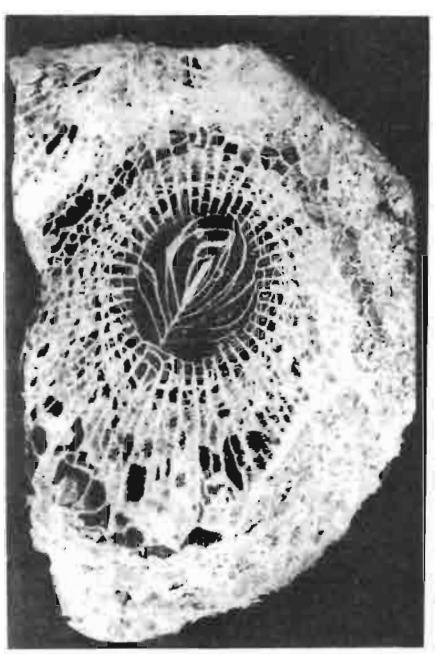

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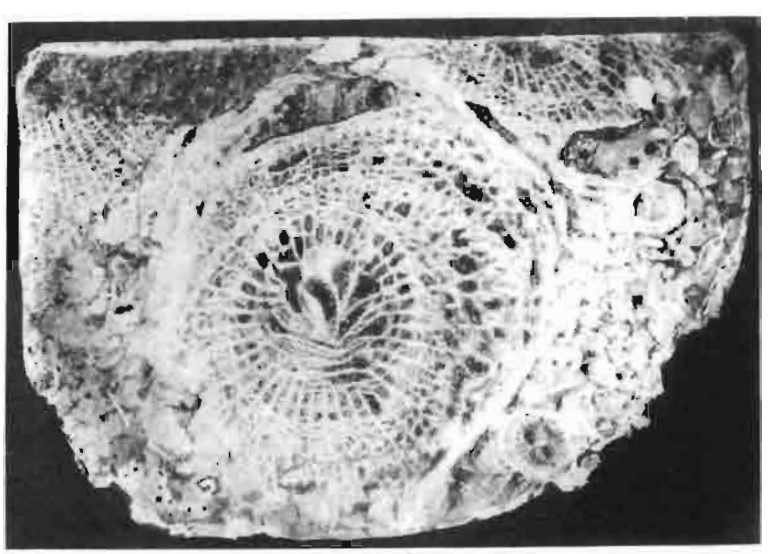

6a

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