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DEVONIAN BRYOZOANS OF THE HOLY CROSS MOUNTAINS, POLAND. PART II. CYCLOSTOMATA AND CYSTOPORATA

Abstract. — Descriptions are given of 33 species of Middle Devonian Bryozoa from the Holy Cross Mts., belonging to the orders Cyclostomata and Cystoporata. Cyclostomata are represented by 26 species (4 new: *Corynotrypa (Corynotrypa) skalensis, C. (C.) basiplata, Stomatopora varigemmata* and *Diversipora bitubulata* n. gen.). Cystoporata are represented by 7 new species: *Ceramoporella orbiculata, C. grandicystica, Favositella integrimuralis, Fistulipora boardmani, F. emphantica, Cyclotrypa nekhoroshevi* and *Fistuliramus astrovae*. The systematic assignment of the genus *Hederella* Hall, 1881 has been discussed and the "tabulate-like" microstructure of the zooecial walls of this genus examined. In addition, the epifauna and associated assemblages have been characterized as well as the geological and palaeoecological conditions in which the described Bryozoa occurred.

INTRODUCTION

Among the Middle Devonian Bryozoa of the Holy Cross Mts., the present author has, up to now, described Ctenostomata (Kiepura, 1965). The present paper is a continuation of her investigations on the Middle Devonian Bryozoa of this region and contains descriptions of 33 species belonging to 9 genera of the orders Cyclostomata and Cystoporata occurring in the Grzegorzowice — Skały profile. The bryozoan collection of the Palaeozoological Institute of the Polish Academy of Sciences also contains a rich material representing the orders Trepostomata and Cryptostomata from the Middle Devonian of the Holy Cross Mts., which will be described at a future date.

The material described in the present paper was collected by the author during several years of fieldwork (1950—1954). Part of the material, especially some epizoic Bryozoa, preserved on tetracorals, was made available for study by Prof. M. Różkowska. Specimens of *Fistuliramus astrovae* n.sp. were lent by Dr A. Stasińska. The studied collections of Ctenostomata, Cyclostomata and Cystoporata are housed in the Palaeozoological Institute

Table 1

Devonian Cyclostomata and Cystoporata from the Holy Cross Mts.

Order	Suborder	Family	Species	Locality I	Locality II	Incrusted organisms Ta	Tc	Bp	Br	Cr
CYCLOSTOMATA	Tubuliporina	Diastoporidae	*Corynotrypa (C.) skalensis* n.sp.		1					
			Corynotrypa (C.) basiplata n.sp.	2	4		×	×		×
			Stomatopora varigemmata n.sp.	2		×	×			
			Stomatopora sp.	1		×				
			Diversipora bitubulata n.gen., n.sp.	26			×		×	
	oidea	idae n. fam.	*Hederella (H.) canadensis* (Nicholson)	1	2		×			×
			Hederella (H.) concinna (Bassler)		1		×			
			Hederella (H.) parvirugosa (Bassler)	2					×	
			Hederella (H.) cirrhosa (Hall)	1			×			
			Hederella (H.) cf. *filiformis* (Billings)	1			×			
			Hederella (H.) alternata (Hall & Whitfield)	1	1		×			×
			Hederella (H.) brownae (Bassler)	1			×			
			Hederella (H.) thedfordensis (Bassler)	2					×	
			Hederella (H.) nicholsoni (Bassler)	11			×		×	
			Hederella (H.) adnata (Davis)	3			×		×	

	Hederell	Hederell	*Hederella (B.) alpenensis* (Bassler)	5			×			
			Hederella (B.) halyson (Fenton & Fenton)	3			×		×	
			Hederella (B.) persimilis (Bassler)	2			×			
			Hederella (B.) rugosa (Bassler)	2					×	
			Hederella (B.) conferta (Hall)	7			×		×	
			Hederella (M.) magna (Hall)	3			×			
			Hederella (M.) cf. *obesa* (Bassler)	3			×		×	
			Hederella (M.) reimanni (Bassler)	4		×	×		×	
			Hederella (P.) compacta (Bassler)	3	1					×
			Hederella (P.) bilineata (Bassler)	2			×			×
			Hederella (P.) louisvillensis (Bassler)	1			×			
CYSTOPORATA	Ceramoporoidea	Ceramoporidae	*Ceramoporella orbiculata* n.sp.	5	13				×	
			Ceramoporella grandicystica n.sp.	5			×		×	
			Favositella integrimuralis n.sp.	6			×			
	Fistuliporoidea	Fistuliporidae	*Fistulipora boardmani* n.sp.	4			×		×	
			Fistulipora emphantica n.sp.	3			×			
			Cyclotrypa nekhoroshevi n.sp.	13			×		×	
			Fistuliramus astrovae n.sp.	203						

Explanations: I — Grzegorzowice, Couvinian, II — Skały, Givetian, numerals indicate number of specimens found; *Ta* — tabulates, *Tc* — tetracorals, *Bp* — brachiopods, *Br* — bryozoans, *Cr* — crinoids.

of the Polish Academy of Sciences in Warsaw, for which the abbreviation Z. Pal. is used.

Work on this paper was carried out in the Palaeozoological Institute under the guidance of Prof. R. Kozłowski and Dr A. Stasińska, to whom the author wishes to express her sincere thanks. Acknowledgements are also due to: Prof. Z. Kielan-Jaworowska for her constructive criticism and helpful advice; Dr J. Małecki for kindly reading the manuscript; Dr G. Biernat for determination of brachiopods from the Givetian of Skały; Mrs. M. Pajchlowa, M. Sc. for discussions on the stratigraphy of the Devonian Grzegorzowice — Skały profile of the Holy Cross Mts.; Mrs. K. Budzyńska for the drawings after the authors sketches; Mrs. M. Czarnocka for photographs and Mrs. M. Nowińska for preparing thin sections.

The author wishes also to take this opportunity to record her gratitude to her colleagues in the Soviet Union for putting their Bryozoa collections at her disposal and for the many discussions during her two visits in the years 1960 and 1962: Prof. G. G. Astrova, Prof. I. P. Morozova, Dr N. A. Shishova (Palaeontological Institute of the Academy of Sciences of the Soviet Union, Moscow); Dr T. D. Troickaja (Department of Historical Geology of the Moscow University); Prof. V. P. Nekhoroshev and Prof. E. A. Modzalevskaja (VSEGEI, Leningrad); Dr L. V. Nekhorosheva (Scientific Institute of Arctic Geology, Leningrad) and Prof. R. Männil (Institute of Geology of the Estonian Academy of Sciences, Tallin).

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GENERAL PART

MATERIAL

The present paper is based on a collection of 348 specimens of bryozoan zoaria, 325 of which were found in the Couvinian of Grzegorzowice and 23 in the Givetian of Skały in the Holy Cross Mts.

Thirty bryozoan species were recognized in the Couvinian of Grzegorzowice, 23 belonging to the order Cyclostomata and 7 to Cystoporata. All these species, with the exception of *Fistuliramus astrovae* n.sp., are epizoic. Cyclostomata, rich in species, are represented by 86 zoaria, while Cystoporata, fewer in species, are represented by 239 zoaria. Seven species belonging to Cyclostomata (10 specimens) and 1 belonging to Cystoporata (13 specimens) were identified in the Givetian of Skały. Twenty-six species are characteristic for the Couvinian of Grzegorzowice and 3 for the Givetian of Skały (Table 1). The four following species are common to both localities: *Corynotrypa (Corynotrypa) basiplata* n.sp., *Hederella (Hederella) canadensis* (Nicholson, 1874), *H. (H) alternata* (Hall & Whitfield, 1873) and *Ceramoporella orbiculata* n.sp.

Preservation of specimens is generally good, representatives of *Fistuliramus astrovae* n.sp. being the best preserved. In our material great differences were observed in the size and morphology of zooaria. These are analyzed in detail in the systematic descriptions.

STRATIGRAPHICAL AND LITHOLOGICAL CONDITIONS

The Grzegorzowice-Skały profile, in which Devonian deposits of the eastern part of the Bodzentyn syncline are exposed, is interesting both from the palaeontological and geological point of view (Zeuschner, 1869; Gürich, 1896; Sobolev, 1904; Czarnocki, 1950; Pajchlowa, 1957; Biernat, 1954; Kielan, 1954; Różkowska, 1954, 1956; Stasińska, 1954, 1958; Adamczak, 1956; Duszyńska, 1956; Kiepura, 1965). The most detailed geological and stratigraphical data concerning this profile were given by Pajchlowa (1957).

The lithology of the Grzegorzowice-Skały profile is very variable (Text-figs 1, 2). At the base of this profile, in Lower Couvinian, occurs a sequence of mudstones, marls, sandstones, dolomites and limestones

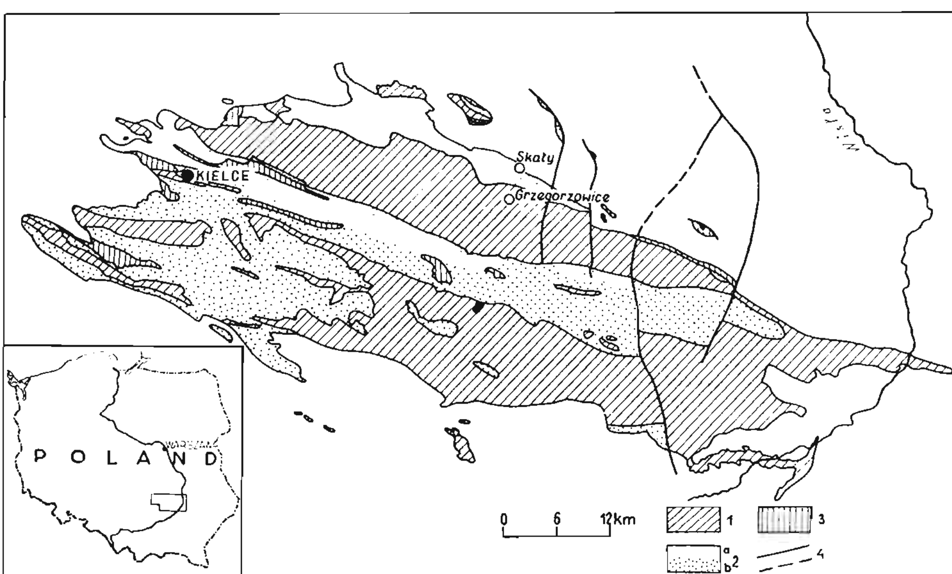

Fig. 1 — Devonian of Holy Cross Mts. (after Pajchlowa, 1968, modified by the author) *1* older Palaeozoic, *2a* Devonian of northern region (Łysa Góra), *2b* Devonian of southern region (Kielce), *3* younger Palaeozoic, *4* dislocations.

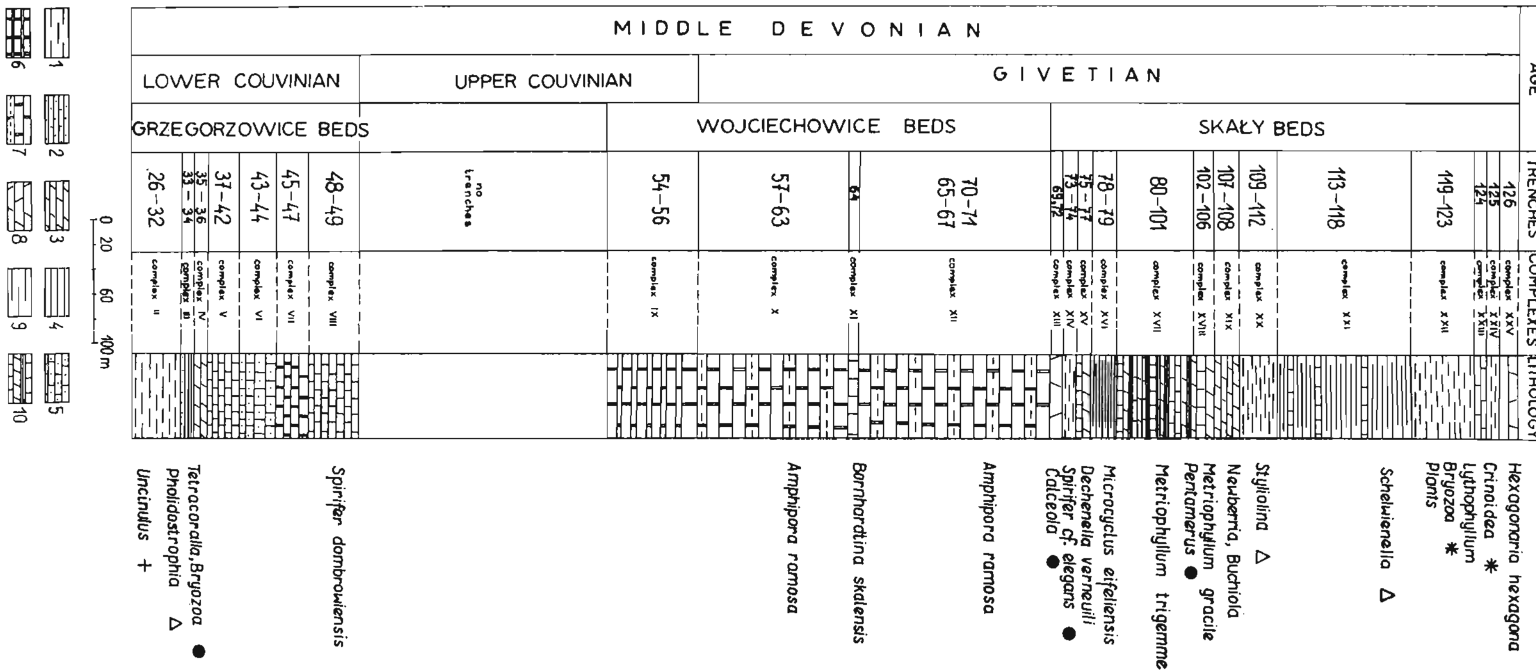

Fig. 2 — Grzegorzowice — Skały profile (after Pajchlowa, 1957, modified by the author). *1* clay and greywacke shales, *2* mudstones, *3* marls, *4* limestones, *5* sandstones, *6* dolomites, *7* marly plate dolomites, *8* coral dolomites, *9* clayey shales, *10* mudstones interbedded with marls and limestones.
∗ rock-forming, △ extremely numerous, ● numerous, + occurence in clusters.

designated as Grzegorzowice beds (Pajchlowa, 1957). These are followed by Upper Couvinian Wojciechowice beds consisting of dolomites, marly at the base, with amphipora and brachiopods yielding beds higher up. The sediments of the highest part of the profile, referred to Givetian and designated as Skały beds, are developed as interbedding clayey shales, marly shales, mudstones and limestones. Bryozoa come from the lowermost part of the profile (Grzegorzowice, complex III, trench 34; Pajchlowa, *l.c.*) and from the highest part (Skały, complex XXII, trench 119; Pajchlowa, *l.c.*)

Bryozoa are abundant in Grzegorzowice (trench 34) especially in mudstones, where incrusting species of Ctenostomata (Kiepura, 1965), Cyclostomata and Cystoporata occur. In sandy mudstones, apart from epizoic species, numerous branching Cystoporata were found. In marls (interbedded with mudstones and limestones) bryozoans are scarce and little differentiated. Only lattice-like zoaria of Cryptostomata are known from this area. Grzegorzowice sediments also yield abundant tetracorals, tabulates and brachiopods.

In the Skały beds (trench 119) bryozoans occur in mass (Text-fig. 3) in clayey shales with marl mudstone intercalations, together with numerous corals, brachiopods and crustaceans. They are represented by Cteno-

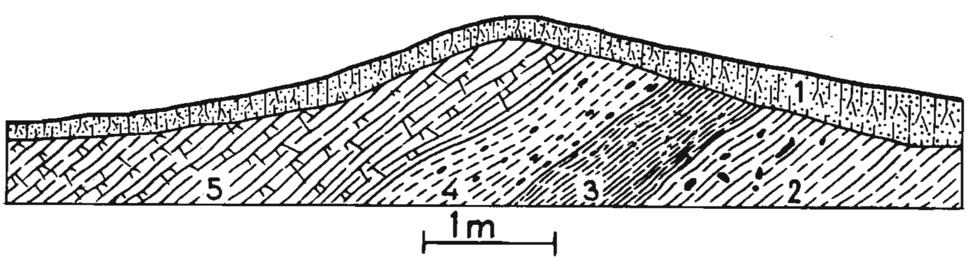

Fig. 3 — Section of Givetian layers occuring in trench 119 (according to Pajchlowa, 1957). *1* loess with sand, *2* clayey shales with limy and limonite concretions containing corals, and brachiopods, *3* clayey shales with mudstone intercalations and numerous ostracods, corals brachiopods and rock-forming bryozoans, *4* clayey shales with marly intercalations and preserved ostracods, *5* marly shales.

stomata (Kiepura, 1965), Cyclostomata, Cystoporata, Trepostomata and Cryptostomata.

The faunal assemblage of the Couvinian sediments in Grzegorzowice is characterized by large massive organisms (Tabulata, Tetracoralla) with richly developed epifauna (Bryozoa), while that of the Givetian sediments of Skały is characterized by small organisms (Tabulata, Tetracoralla, Mollusca) with poor epifauna (Bryozoa).

The occurrence of Cyclostomata and Cystoporata in other parts of the profile (Pajchlowa, 1957), in the Couvinian of Grzegorzowice (complex II, trench 26; complex V, trench 41) and Givetian of Skały (complex XVI, trench 79) is sporadic, specimens being badly preserved and fragmentary.

In Couvinian, Ctenostomata were found only in trench 34 in Grzegorzowice. Givetian Ctenostomata are known from a few outcrops in Skały, from coral limestone (complex XIII, trench 72), brachiopod shales (complex XIV, trench 73) and marls (complex XV, trench 76) (Kiepura, 1965).

The geographical distribution of Palaeozoic Bryozoa is very widespread. Among 26 species of Cyclostomata identified in the Holy Cross Mts., 21 species belong to genus *Hederella* Hall. They are also known from the Devonian of the United States (Stewart, 1927; Bassler, 1939; Stumm & Chilman, 1967) and one from the Middle Devonian of Australia (Bassler, 1939). Of the remaining 5 Cyclostomata species, 4 are new and one undefined. This does not necessarily suggest that the fauna is endemic, rather it points to the lack of descriptions of these forms from other regions.

PALAEOECOLOGICAL CONDITIONS

The epicontinental Middle Devonian Polish basin is, according to Pajchlowa (1957, 1958), characterized by a slow, gradual transgression. The Holy Cross Mts. profile shows a great lithofacial variability. The fauna of the neritic zone is comparatively rich in bryozoan species. There is considerable variability as to number of specimens within the representatives of other groups of animals.

Grzegorzowice. — The described Bryozoa assemblage comes from mudstones, also very rich in Hydrozoa, Tabulata, Tetracoralla, Gastropoda, Lamellibranchiata, Crinoidea, Brachiopoda, Trilobita and Ostracoda. The numerous bryozoans belong to 5 orders: Ctenostomata (Kiepura, 1965), Cyclostomata, Cystoporata, Trepostomata and Cryptostomata. The representatives of the two last orders are very rare. Within the Cyclostomata and Cystoporata occurring here (Table 1) 2 groups can be differentiated:

1. A group numerous in species including epizoic forms with small branching zoaria (*Corynotrypa(Corynotrypa) skalensis* n. sp., *C. (C.) basiplata* n. sp., *Diversipora bitubulata* n. sp., *Hederella (Hederella) parvirugosa* (Bassler)and others) and lamellar ones (*Ceramoporella grandicystica* n. sp., *Favositella integrimuralis* n. sp., *Fistulipora boardmani* n. sp.). The small dimensions of the zoaria suggest that the life of the colony was comparatively short (Duncan, 1957).

2. A group poor in species, including big, massive zoaria (*Cyclotrypa nekhoroshevi* n. sp.) as well as thickbranched ones (*Fistuliramus astrovae* n. sp.).

Generally, all bryozoans are considerably tolerant to depth, salinity and temperature of water. As the species from Grzegorzowice are eurytypic animals, some being eurybathic, they cannot determinate depth. However, being epizoic animals, they do indicate that the depth of the Grzegorzowice basin was not great. They inhabited a cumatic zone (Wells, 1957), with a lot of light and oxygen, clear water and only slightly muddy bottom. The intensive development of the epizoic species as well as the occurrence of only a few bryozoan species with „independent" zoaria may speak for an unconsolidated bottom (Hancock, *in* Ager, 1961).

Corals, being sensitive indicators of environmental changes, are valuable for ecological interpretation. These animals, by their comparatively big dimensions and large biomass, are better environment indicators than the other smaller animals accompanying them.

Different tetracoral assemblages, with characteristic species, occur in particular deposits (Różkowska, 1954). Tetracorals are numerous in mudstones exposed near Grzegorzowice in trench 34. They are represented here by solitary forms of such species as: *Blothrophyllum irregulare* Różk., *Ceratophyllum typus* Gür., *Ptenophyllum torquatum* (Schlüter), *Ropalophyllum heterophyllum* (E. H.), *Pseudozonophyllum halli* Wdkd., *Calceola sandalina sandalina* (L.). Incrusting bryozoans and other small epizoic organisms are most commonly found on these corals. Różkowska (*l. c.*), on the basis of the character of mudstones and features of coral skeletons, suggests that the mentioned assemblages existed in the quiet water of a bay and were preserved in their own biocoenosis.

Apart from tetracorals, tabulates are also numerous in the Couvinian of Grzegorzowice. Unlike tetracorals, they were very seldom host for incrusting bryozoans (Table 1). In mudstones, tabulates are represented by: *Alveolites fornicatus* Schlüter, *A. praelimniscus* Le Maître, *Favosites goldfussi eifeliensis* (Pencke), *Kozlowskiocystia polonica* Stasińska, *Thamnopora micropora* Lecompte, as well as Hydrozoa with *Chaetetes barrandi* Nicholson. On the base of the varied shape of the colonies, Stasińska (1958) suggests that they lived in agitated sea water (massive, hemispherical, smooth surfaced colonies).

Brachiopods are also numerous in the described paleobiocoenosis. The following species occur in mudstones: *Schizophoria interstrialis* Biernat, *Douvillina interstrialis* (Phillips), *Uncinulus orbignyanus eifeliensis* Biernat, *Schellwienella umbraculum minor* Biernat, *Pholidostrophia lepis polonica* Biernat, *Atrypa varistriata* Biernat, *Reticularia curvata* (Schloth.), *Platyorthis opercularis* (Vern.), *Camarotoechia hexatoma* (Schnur), *Alatiforma alatiformis variabilis* (Biernat), *Pholidostrophia* cf. *subtetragona* (Roemer), *Chonetes* cf. *sarcinulata* (Schloth.) and *Cyrtina heteroclita* Defr. On the base of the mentioned species, Biernat (1954) defines that part of the Grzegorzowice basin, as a shallow water environment, calm but with a current activity. This is in agreement wit the conclusion reached by Różkowska (1954) on the base of tetracorals.

Trilobites are comparatively rare, usually badly preserved and represented by *Otarion polonicum praecedens* Kielan, *Scutellum* (*Paralejurus*) *dormitzeri* cf. *dormitzeri* (Barrande) and *Phacops* (*Phacops*) *latifrons grzegorzowicensis* Kielan (Kielan, 1954). Crinoid stem fragments are common.

Gastropodes and bivalves are represented by: *Murchisonia* sp., *Pleurotomaria* sp. and *Nucula* sp. Incrusting hydrozoans are rare but well preserved.

The Couvinian Grzegorzowice basin appears to have had optimal environment conditions for life, and was inhabited by an assemblage of animals belonging to different groups. Larger animals, mainly coelenterates are predominant in mudstones, in the Couvinian paleobiocoenosis of Grzegorzowice. Among the Coelenterates there is a big percentage of large, often very large, solitary tetracorals and big colonies of tabulates. The remaining animal groups are represented by small but often very numerous forms.

Skały. — The described Bryozoa with associated fauna (Tabulata, Tetracoralla, Gastropoda, Lamellibranchiata, Crinoidea, Brachiopoda, Trilobita, Ostracoda) occur in clayey shales and marly-sandy shales. The most common forms in the paleobiocoenosis are bryozoans. Representatives of Ctenostomata (Kiepura, 1965) are here more numerous than in the Couvinian of Grzegorzowice. Cyclostomata and Cystoporata are rare, more so than in Grzegorzowice (Tab. 1). Order Trepostomata, represented mainly by Stenoporidae and order Cryptostomata, mostly with species of Fenestellidae, are very abundant both in species and specimens, unlike in Grzegorzowice. The bryozoan assemblage from Skały contains only a small percentage of epizoic species, the branching type of "independent" species (Trepostomata, Cryptostomata) and lattice-like ones (Cryptostomata) characteristic of a calm, deeper water, are predominant and occur in mass.

Tetracorals are here numerous. They are small, well preserved, conical or branching, belonging to the following species: *Metriophyllum gracile* Schlüter, *Nardophyllum* sp., *Lithophyllum sp.*, *Depasophyllum intermedium* (Gür.), *Thamnophyllum trigemme pajchelae* Różk., *Macgeea bathycalyx amabilis* Różk. and *Calceola sandalina sandalina* (L.) (Różkowska, 1956, pp. 276–277, beds No. 11). According to Różkowska (1956), these species are preserved in their original environment. These small forms most probably inhabited quiet waters. The absence of incrusting forms on tetracorals, including epizoic bryozoans speaks for a relatively deep basin.

Tabulates are poorly represented in the mentioned biotope, only the branching colonies of *Thamnopora reticulata* (de Blainville) and *Striatopora* Hall occur here. Massive colonies are absent. Branching Tabulata colonies are additional evidence of a quite deep unturbulent water.

Brachiopods collected here were determined by Dr Biernat (on author's request). The 10 following species were ascertained: *Atrypa depressa* Sobolev, *Desquamatia subzonata* Biernat, *Phragmophora schnurri* Cooper, *Leptaena analogaeformis* Biernat, *Eodevonaria* (Devonaria) *zeuschneri* (Sobolev), *Isorthis canalicula* (Schnur), *Aulacella eifelensis* (Verneuil), *Schellwienella (Schellwienella) umbraculum* (Schlotheim), *Schizophoria striatula* (Schlotheim) and *Productella varians* Biernat. Most of the above species were also described by Biernat (1959, 1964, 1966) from other outcrops in the Skały beds.

Bivalves — *Nucula* sp. numerous in specimens but poor in species, and a few gastropods — *Cyclonema* sp. occur in a layer of clayey shales with marly-mudstone intercalations.

The numerous crinoids are represented by stem fragments of various sizes, rarely by complete calyces. Usually they belong to *Haplocrinites* (Steininger). Accumulations of crinoids are rare, as they occur rather in shallower sea.

Ostracods are also common; probably represented by several genera. Their valves are well preserved, thick, with rich surface ornamentation. A few trilobites and sponges (in the form of triaxon and polyaxon spicules) are also present.

While the Givetian basin of Skały and the Couvinian basin of Grzegorzowice are both rich in fauna, the character of the fauna in the former differs fundamentally from that of the latter. Organisms from Skały are small, branching, lattice-like etc. Bryozoa are predominant and occur in banks. Remaining animals, belonging to different groups, are also small. Characteristic for the Grzegorzowice basin are, on the other hand, large organisms with massive skeletons (tabulates, tetracorals) with thickbranched zoaria (bryozoans) and tuberose colonies (tabulates). These organisms formed a favourable substratum for the richly developed epifauna, mainly incrusting bryozoans. It can be said that the character of the lithology and fauna from Skały indicates a fairly deeper neritic zone, while that of Grzegorzowice is typical of shallow water.

EPIFAUNA AND ASSOCIATED ASSEMBLAGES

Among the Cyclostomata and Cystoporata investigated, 29 are epizoic, 3 epizoic and free and 1 free. These bryozoans incrust the following organisms: tetracorals — 26 bryozoan species, other bryozoans — 14 species, crinoids — 4 species, tabulates — 2 species, and brachiopods — 1 species (Table 1). Tetracorals predominate in the accompanying faunistic assemblages, together with numerous tabulates, brachiopods, crinoids and ostracods. More rare are bivalves, gastropods and trilobites. The mentioned bryozoans usually incrust tetracorals and zoaria of other "independent" bryozoans (Ager, 1961). Rarely do they adhere to crinoid stems, tabulate colonies and brachiopod shells (Table 1). They were not found on gastropods or bivalve shells. No special order was observed on the distribution of epifauna on the surface of host organisms, contrary to the observations of Ager (1961), who was able to establish the position and succession of the epifauna incrusting shells of *Spinocyrtia iowensis* (Owen). Epizoic species occurring on the epitheca of solitary tetracorals from Grzegorzowice are distributed randomly on all sides. They are present on the proximal and distal parts of the corallum and sometimes on the calicinal edge. It is difficult to confirm in which particular case the coral was incrusted post mortem or before death. When a coral is surrounded by bryozoans, including its proximal part, one could conclude that it was erect and living.

It should be stated that the incrusting of tetracorals by numerous species of Bryozoa was observed only in the Couvinian of Grzegorzowice. Among the numerous tetracorals occurring here only some are incrusted by epizoic bryozoans and other associated organisms.

Epizoic bryozoans as well as other small organisms, also willingly settled on the thickbranched zoaria of *Fistuliramus astrovae* n. sp. Some large massive zoaria of *Fistulipora emphantica* n. sp. and *Cyclotrypa nekhoroshevi* n. sp. occurring in Couvinian of Grzegorzowice are also incrusted by epizoic bryozoans rarely by other fauna. The mode of incrusting the various zoaria is similar to that on tetracorals. It was observed that the epifauna settled on the bryozoan zoaria post-mortem. Evidence of this is the presence of epifauna on the frontal and basal sides of massive zoaria, which are attached at one point as well as in distal parts, in the growth zone, of branched zoaria.

Some tetracorals and bryozoans are incrusted in "layers". For example, on an epitheca of *Pseudozonophyllum* sp. the large lamellate zoarium of *Fistulipora emphantica* n. sp. can settle, forming a first layer. This in turn is covered by the branching zoarium of *Hederella* (*Magnederella*) cf. *obesa* (Bassler, 1939) as a second layer (Pl. VI; Fig. 1). Such type of "layer" incrustation is seen on some massive Bryozoa zoaria, for example on *Cyclotrypa nekhoroshevi* n.sp. (Z. Pal. No. Br. IV (17170) and *Fistulipora emphantica* n. sp. (Z. Pal. No. Br. IV/17173). Epizoic bryozoans on crinoids were found spread over one side or around a few segments of the stem (Pl. III, Fig. 3).

In the Givetian of Skały epizoic Ctenostomata, which are here abundant, incrusted brachiopod valves and crinoid stems (Kiepura, 1965).

Middle Devonian epizoic Bryozoa from the Holy Cross Mts. occur together with various, other incrusting organisms, forming associated assemblages. The composition of such assemblages varies considerably in number of species. In the described material, the associated assemblages are composed of some or all of the following organisms: Bryozoa, Annelida, Tabulata, Hydrozoa, Tetracoralla and Crinoidea. Bryozoa are usually present in the assemblages, Cyclostomata being represented by genera *Hederella* Hall and *Diversipora* n. gen., Cystoporata by *Ceramoporella* Ulrich, *Fistulipora* McCoy, *Cyclotrypa* Ulrich and Ctenostomata by *Allonema* Ulrich & Bassler and *Ascodictyon* Nicholson & Etheridge, Jr. On second place, as far as frequency is concerned, are annelids belonging to the genus *Spirorbis* Daudin. Often present are tabulates represented mainly by genus *Aulopora* Goldfuss.

Among the examined Bryozoa, two groups of species can be distinguished: 1°, group of 27 species, forming part of the associated assemblages, and 2°, group of 6 species, which are found separately.

SYSTEMATIC DESCRIPTIONS

Order **Cyclostomata** Busk, 1852
Suborder **Tubuliporina** Milne-Edwards, 1838
Family **Diastoporidae** Gregory, 1899

Genus *Corynotrypa* Bassler, 1911

Type species: *Corynotrypa (Corynotrypa) delicatula* (James, 1878). Ordovician.
Stratigraphical range: Ordovician — Cretaceous.

Corynotrypa (-Corynotrypa) skalensis n. sp.

Pl. I, Fig. 1; Text-fig. 4, 10A

Holotypus: Specimen Z. Pal. No. Br. IV/8574; Pl. I Fig. 1; Text-fig. 4.
Stratum typicum: Givetian, complex XXII, trench 119.
Locus typicus: Skały, Holy Cross Mts., Poland.
Derivatio nominis: from the locality Skały in the Holy Cross Mts.

Diagnosis. — Zoarium consisting of tubular zooecia, uniserially arranged; club-shaped zooecia with surface transversally striated; peristomal neck low; aperture circular, terminal.

Material. — One zoarium composed of six zooecia arranged uniserially.

Description. — Zoarium consisting of a single row of zooecia, 7 occur in 5 mm. Zooecia club-shaped, almost identical in length and shape. Basal surface convex. Apertures terminal, circular, with diameters ranging from 0.1 mm to 0.13 mm. The relation between diameters of proximal and distal parts of zooecium is from 1 : 3 to 1 : 4 respectively. Stolons short, narrow and difficult to distinguish from the rest of the tube. Zooecial surface is characteristically ornamented with transverse striae more or less equally spaced. The striae are delicately granulated and probably correspond to the successive stages of tube growth.

Zooecia dimensions (in mm):

Z. Pal. No. Br.IV/8574	Length	Proximal diameter	Distal diameter	Aperture diameter
	0.75	0.06	0.26	0.10
	0.65	0.06	0.20	0.13
	0.60	0.08	0.26	0.10

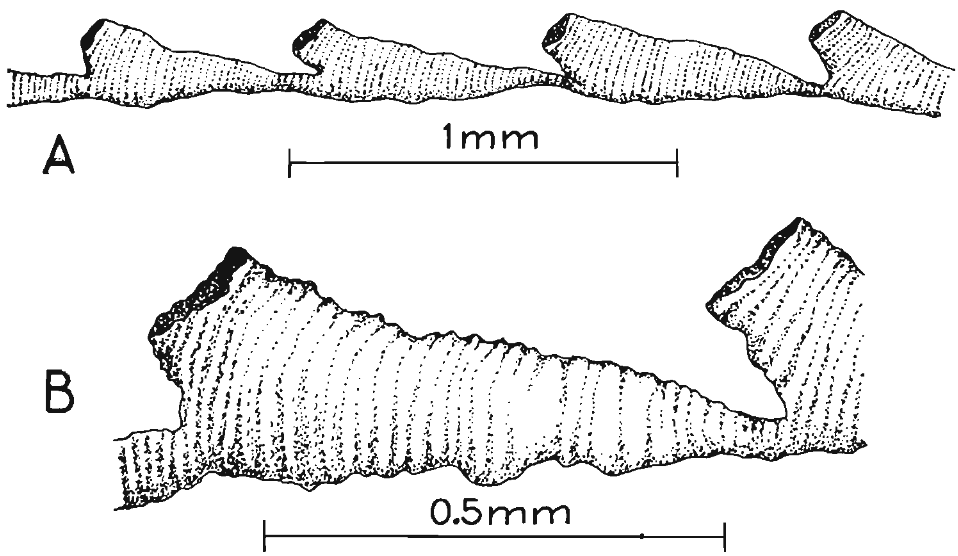

Fig. 4 — *Corynotrypa (Corynotrypa) skalensis* n.sp. (Z. Pal. Br. IV/8574, holotype): *A* fragment of a branch, side view; *B* single zooecium side view.

Comparison. — The new species differs from *Corynotrypa (Corynotrypa) devonica* (Oehlert, 1888) in the much greater dimensions of its zooecia, their more elongated, club-like shape and striated surface. From *C. (C.) nitida* (Bassler, 1911), it differs in its slightly shorter zooecia, their more shortened club-like shape and regular transversal striation.

Occurrence. — Poland: Skały, Givetian.

Corynotrypa (Corynotrypa) basiplata n. sp.
(Pl. I, Fig. 2; Text-fig. 5, 10.)

Holotypus: Specimen Z. Pal. No. Br. IV/8575; Text-fig. 5; Pl. I, Fig. 2.
Stratum typicum: Givetian, complex XXII, trench 119.
Locus typicus: Skały, Holy Cross Mts., Poland.
Derivatio nominis: Gr. *basis* = base, *platys* = flat; zooecia with flat basal surface.

Diagnosis. — Zoarium with pyriform uniserially arranged zooecia; basal surface of zooecia flat; apertures terminal or subterminal.

Material. — Six branched zoaria: two incrusting crinoid stems, two *Thamnophyllum* sp., one — *Pseudozonophyllum* sp. and one — the internal surface of *Atrypa* sp. valve. Some zoaria occur in association with *Ascodictyon sparsum* Ulrich & Bassler, 1904 and with a network of stolons of an undetermined species of Ctenostomata and *Stomatopora* sp.

Description. — Zoaria consisting of pyriform zooecia, 7 to 10 in 5 mm. Stolons very short and narrow, the differences between the proximal and distal diameters of zooecia are considerable, ranging from 1:2 to 1:4. Angle of divergence of 20°. Apertures circular, terminal or subterminal with diameters ca 0.12 mm. Basal surface of zooecia flat.

Comparison. — The described species differs from *Corynotrypa (Corynotrypa) skalensis* n.sp. in the pyriform shape of its zooecia, flat basal surface and lack of external ornamentation. In shape and dimensions,

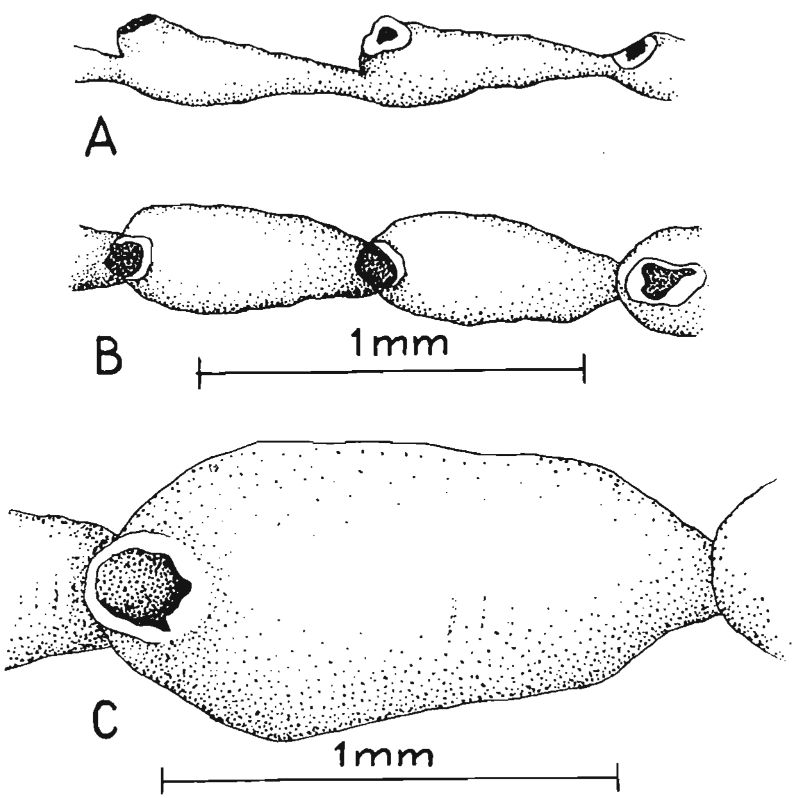

Fig. 5 — *Corynotrypa (Corynotrypa) basiplata* n.sp. (Z. Pal. Br. IV) 8575, holotype): *A* fragment of a branch, side view; *B* the sames fragment, top view; *C* single zooecium, top view.

C.(C.) basiplata resembles *C. (C.) inflata* (Hall, 1847), from which it differs in having slightly larger apertures (0.12 mm, while in *C. (C.) inflata* — 0.09 mm), terminally or subterminally developed and a smaller angle of divergence (20°, and in *C. (C.) inflata* — 40°).

Occurrence. — Poland: Grzegorzowice, Couvinian; Skały, Givetian.

Genus *Stomatopora* Bronn, 1825

Type species: Stomatopora dichotoma (Lamouroux, 1821), Jurassic.
Stratigraphical range: Ordovician — Recent.

Stomatopora varigemmata n.sp.
(Pl. II, Fig. 1, 2; Text-fig. 6A, 10B)

Holotypus: Specimen Z. Pal. No. Br. IV/8658; Pl. II, Fig. 1.
Stratum typicum: Couvinian, complex III, trench 34.
Locus typicus: Grzegorzowice, Holy Cross Mts., Poland.
Derivatio nominis: Lat. *varius* = variable, *gemmatus* = budding; with varying mode of branching within one zoarium.

Diagnosis. — Zoarium adnated, branching dichotomous, forming polygons or long single branches; zooecia subtubular; apertures circular or oval; ornamentation consisting of transverse striae.

Material. — Two well preserved zoaria; one covering 6 cm^2 of the surface of *Alveolites* sp., the second one — 4 cm^2 of the surface of *Pseudozonophyllum* sp.

Description. — Incrusting zoarium, dichotomously branching, composed of subtubular zooecia, arranged zigzag in one row or forming characteristic polygons, usually hexagonal. Zooecia, with edges more or less parallel, usually 2 mm long, rarely reach 3 mm; 2—2.5 zooecia occur in 5 mm. Diameter not always uniform for the whole length, often smaller proximally, ranging from 0.5 to 0.8 mm. Zooecial tubes usually wider towards apertures where they are free for about 0.1 mm and slightly raised towards the front. Apertures oval, occasionally circular, with diameters ranging from 0.4 to 0.7 mm. External ornamentation, badly preserved, consists of parallel transverse striation.

Comparison. — The new species, in its general appearance and mode of branching into hexagons, resembles *Stomatopora waltoni* Haime, 1854, differing from it mainly in having larger zooecia. It differs from the type species in diamensions of zooecial tubes and above all in their proportions: zooecia of new species being elongated, those of type species short and broad.

Occurrence. — Poland: Grzegorzowice, Couvinian.

Stomatopora sp.
(Pl. XVI, Fig. 2; Text-fig. 6C, 7, 10B).

Material. — One zoarium incrusting 2 cm^2 of surface of *Pseudozonophyllum* sp. It occurs in association with *Corynotrypa (Corynotrypa) basiplata* n.sp. and other undetermined bryozoans from the orders Ctenostomata and Cryptostomata.

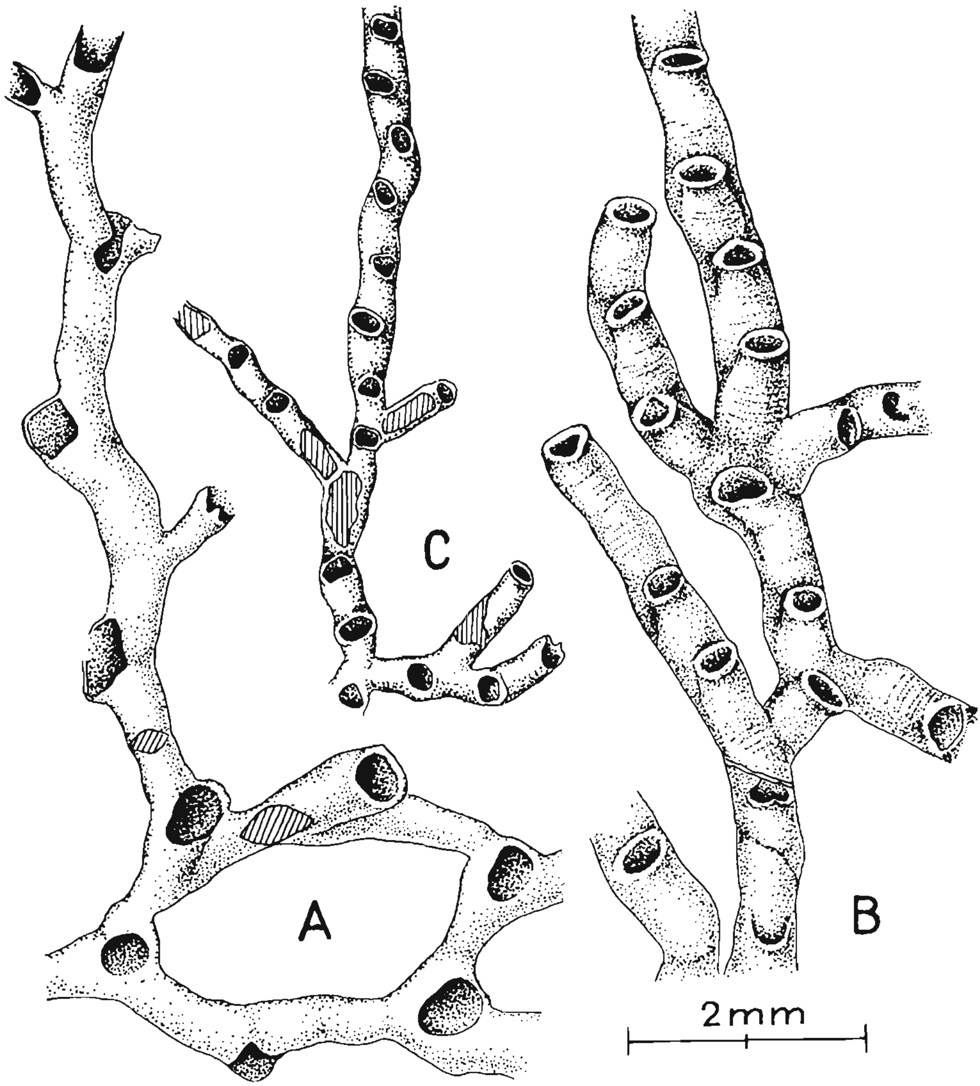

Fig. 6 — Fragment of branched zoaria. *A Stomatopora varigemmata* n.sp. (Z. Pal. Br. IV/8647), *B Diversipora bitubulata* n.gen. n.sp. (Z. Pal. Br. IV/8576, holotype), *C Stomatopora* sp. (Z. Pal. Br. IV/17153).

Description. — Zoarium uniserially arranged. Zoarial branches of varying length, formed as a result of terminal budding, contain from a few to more than 15 zooecia. Zooecia subtubular, flattened, oval in cross section, diameter about 0.3 mm, equal in both proximal and distal part. Length of zooecia from 0.8 to 1.0 mm, 5 or 6 occur in 5 mm. Apertures elliptical, terminal, about 0.2 mm in diameter. Peristome distinct, somewhat elevated over the surface of zooecial tube and inclined distally. Zoarium branching dichotomously, but "polygons", characteristic of other species of this genus, were not observed. Angle of divergence can be acute to right angle. Branches formed by lateral budding beginning at the proximal part of zooecium. Zooecia transversally delicately striated.

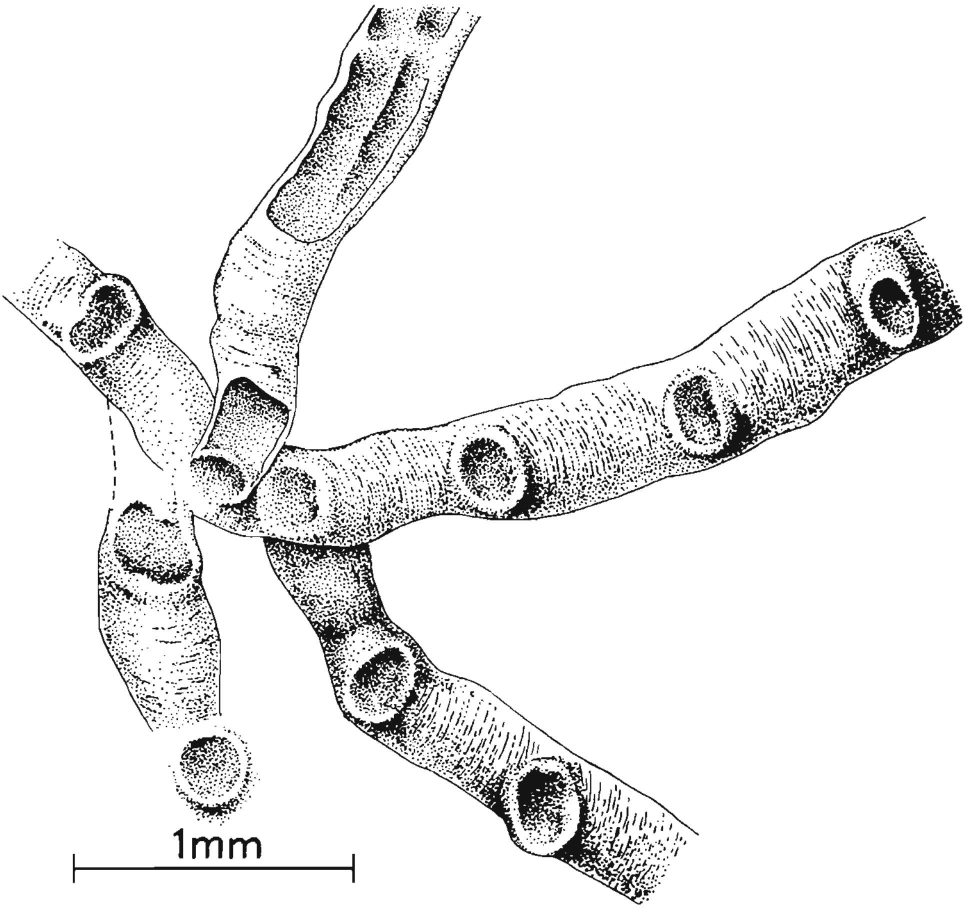

Fig. 7 — *Stomatopora* sp. (Z. Pal. Br. IV/8581) fragment of a branched zoarium.

Remarks. — *Stomatopora* sp. differs from *S. varigemmata* n.sp. in the smaller zooecia and different mode of branching. The state of preservation makes comparison with other known species difficult. In general appearance, proportions and development of zoarium somewhat resembles *Stomatopora antiqua* Haime, 1854 from French Jurassic (Moselle).

Occurrence. — Poland: Grzegorzowice, Couvinian.

Genus *Diversipora* n.gen.

Type species: Diversipora bitubulata n.sp.

Stratigraphical range: as for type species.

Derivatio nominis: Lat. *diversus* = different; *poros* = aperture; zoaria composed of zooecia of different structure than in other genera.

Diagnosis. — Adnated zoarium, tubular zooecia composed of basal and frontal parts and apertures surrounded by peristomes. Zooecia arranged in uniserial rows dichotomously branching.

Discussion. — *Diversipora* n.gen. is a monotypic genus. The new genus is included in the family Diastoporidae Gregory, 1899, on the base of the incrusting character of its zoaria and serial arrangement of zooecia. Among diastoporoids, the genus *Diversipora* n.gen. appears to be close to genera *Corynotrypa* Bassler, 1911 and *Stomatopora* Bronn, 1825. Features common to the three compared genera are terminal budding and dichotomous branching, *Diversipora* n.gen. forming more or less parallel rows, *Stomatopora* characteristic "rhombs" and *Corynotrypa* uniserial systems. A feature separating them, however, and considered sufficient to justify the erection of a new genus, is the different development of zooecia. These zooecia are composed of basal and frontal parts, the latter supplied with an aperture opening in the distal end of the tube. Frontal part of zooecium begins in the proximal end, where it is in contact with basal part, continues distally, ending with an aperture. In genera *Corynotrypa* and *Stomatopora*, the shorter or longer, vertical elements of tubes, elevated above the fundamental horizontal ones, begin in distal part, where they are in contact and here end with an aperture (Text-fig. 6B). Differences also apply to the dimensions and shape of zooecia of the compared genera, *Diversipora* n.gen. having larger zooecia, peripheral edges of tubes parallel and proximal and distal diameters equal. Genus *Stomatopora* in these features is closer to the genus *Diversipora* n.gen. than the genus *Corynotrypa*, the latter having very small, pyriform or club-shaped zooecia, with unequal proximal and distal diameters.

Diversipora bitubulata n.sp.

(Pl. I, Fig. 3, 4; Text-fig. 8C, D, 6B, 9, 10C).

Holotypus: Specimen Z. Pal. No. Br. IV/8576; Pl. I, Fig. 3; Text-fig. 6B.
Stratum typicum: Couvinian, complex III, trench 34.
Locus typicus: Grzegorzowice, Holy Cross Mts., Poland.
Derivatio nominis: Lat. *bis* = double, *tubulatus* = tube-like; zoarium with tube-like zooecia composed of a basal and frontal parts.

Diagnosis. — Zoarium composed of more or less parallel branches. Zooecia with strongly developed frontal part, beginning in proximal end and finishing with an aperture on the distal end. Apertures terminal, oval, seldom round with distinct peristome.

Material. — Twenty four zoaria of varying size, generally well preserved, 21 incrusting tetracorals (*Pseudozonophyllum halli* Wedekind, *Pseudozonophyllum* sp.), 3 incrusting zoaria of other bryozoans (*Fistuliramus astrovae* n.sp.). Some of the specimens are components of more or less diversified associations. For instance, on the surface of *Pseudozonophyllum*

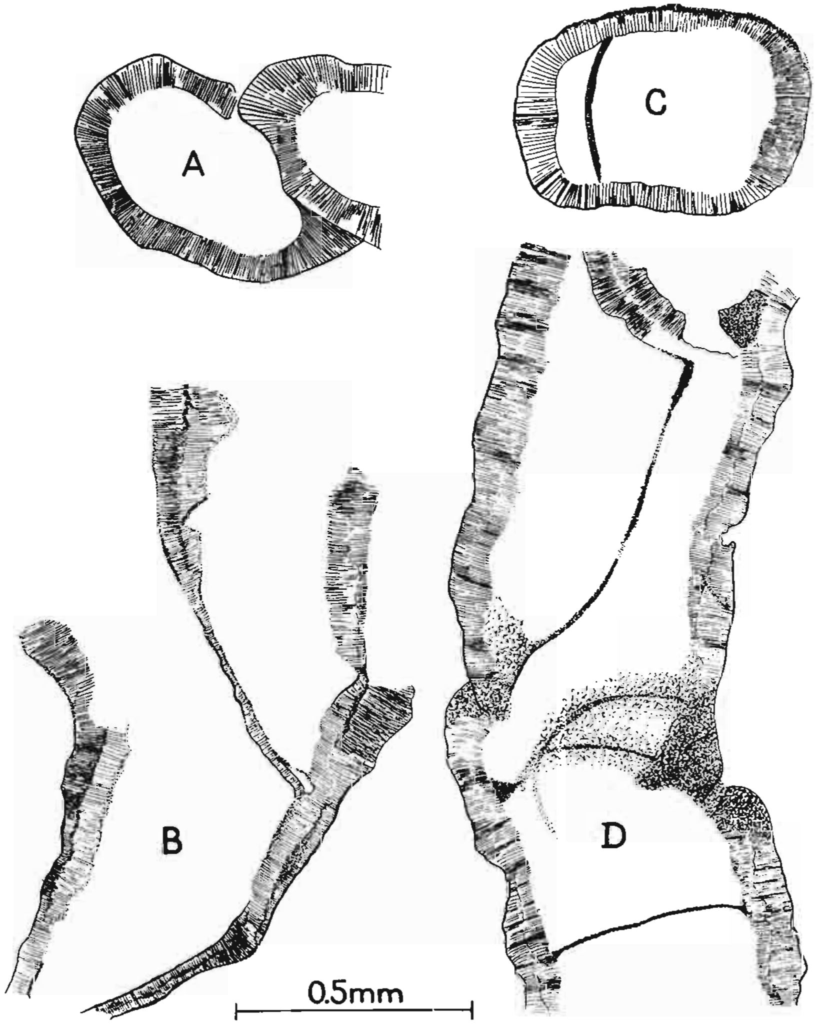

Fig. 8 — Wall microstructure of genera *Hederella* Hall, 1881 (*A, B*) and *Diversipora* n.gen (*C, D*): *A, C* transversal section of zooecia, *C* section of basal part; *B, D* longitudinal zooecial sections; *D* section of basal part with a fragment of frontal part.

sp. (Z. Pal. No. Br. IV) 8576), *Diversipora bitubulata* n.sp. appears together with *Ascodictyon sparsum* Ulrich & Bassler, *Ascodictyon* sp., *Hederella (H.) nicholsoni* (Bassler), *Ceramoporella* sp., *Lioclema* sp, and other unidentified species.

Description. — Adnated zoarium composed of zooecia arranged in uniserial, dichotomous branches (Text-fig. 6B). Branches usually consist of 2 to 3 zooecia, exceptionally 20 or more. Zooecia subtubular, flattened, with peripheral edges, more or less parallel, oval in cross section, consist of two parts: longer basal part closely adhering to the substratum and shorter frontal part lying on the surface of the basal one. The frontal part is shaped

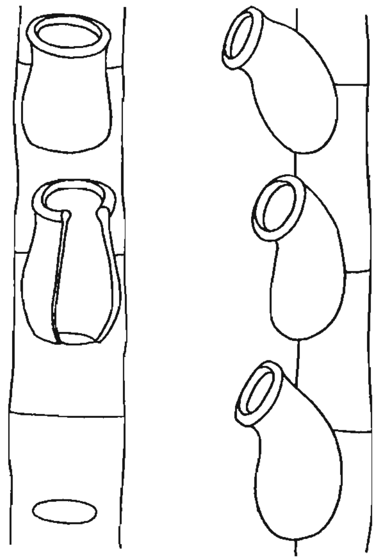

Fig. 9 — Zooecia of *Diversipora bitubulata* n.gen., n.sp. (Diagram). *A* top view, *B* side view.

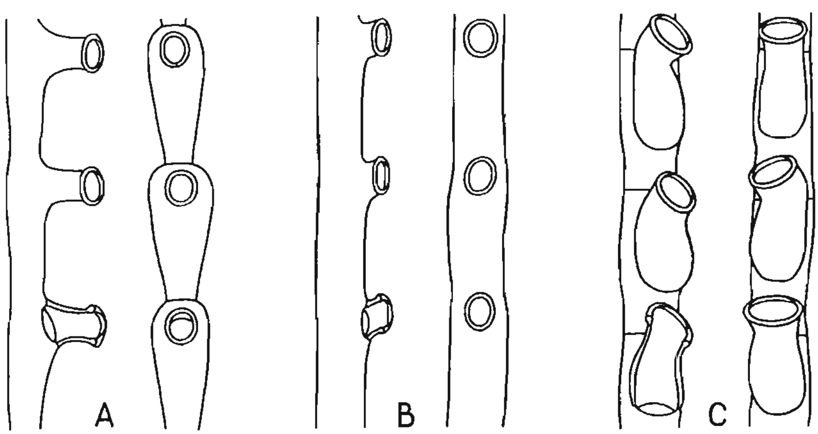

Fig. 10 — Monoserial, incrusting zoaria belonging to three genera (Diagram side view and top view: *A Corynotrypa* Bassler, 1911, *B Stomatopora* Bronn, 1825, *C Diversipora* n.gen.

as a little flattened tube, slightly swollen proximally, narrowing by aperture. Distally it is declined upwards. Frontal part of 0.7—1.0 mm in length, basal part of 1.0—1.7 mm. Usually 4 zooecia occur in 5 mm. Diameter similarly as length of zooecia variable, ranging from 0.43 to 0.75 mm. Apertures usually oval, rarely round, diametrs about 0.4 mm, sometimes less, with distinct peristomes. Walls of zooecial tubes rather thick. Zooecial surface transversally striated. Uniserial branches formed by terminal budding, lateral branchings by lateral budding. The angle of budding variable, from acute to obtuse (Text-fig. 6B).

Zooecial tubes. Tubular zooecia with both proximal and distal diameters equal, reaching 0.75 mm. Walls of frontal and basal parts usually of uniform thickness — 0.06 to 0.25 mm. Wall structure fibrous (Text-fig. 8C, D) similar to zooecial structure of genus *Hederella* (Text-fig. 8A, B; p. 342). In longitudinal section, some diaphragms are preserved. They are thin, usually slightly convex. Sometimes, along the basal part of zooecium, some fragments of the frontal wall are preserved (Text-fig. 8D). In cross section, the basal part of zooecium is oval. The wall of this part of tube is formed of thin, radial fibres; an epitheca is present. Sometimes, wall fragments of frontal part of zooecium are preserved internally (Text-fig. 8C).

Occurrence. — Poland: Grzegorzowice, Couvinian.

Suborder **Hederelloidea** Bassler, 1939

For Palaeozoic North American Bryozoa, with tube-like zooecia and incrusting zoaria, Bassler (1934) erected a separate taxonomic unit, Hederelloidea. At first, he assigned to it the rank of an order (Bassler, 1934), later changing this to suborder (Bassler, 1939). It comprised one family, Reptariidae Simpson, 1897, with the following six genera: *Hederella* Hall, 1881, *Reptaria* Rolle, 1851, *Hederopsis* Bassler, 1939, *Clonopora* Hall, 1881 and *Cystopora* Hall, 1881 (at present *Cystoporella* Bassler, 1953) (Table 2, p. 345). Within the genus *Hederella*, known from Silurian to Carboniferous, and represented by numerous species, Bassler (1939) introduced 4 groups: *Hederella canadensis* group (with 4 sections: *Hederella canadensis* section, *H. blainvillei* section, *H. vagans* section, *H. thedfordensis* section), *H. alpenensis* group, *H. magna* group and *H. parallela* group. The four above mentioned groups were later the base for Solle (1952, 1968) to erecting the subgenera: *Hederella* (*Hederella*) Hall, 1881, *Hederella* (*Bassiederella*) Solle, 1968, *Hederella* (*Magnederella*) Solle, 1952, *Hederella* (*Paralhederella*) Solle, 1952, to which he added another new subgenus, *Hederella* (*Rhenanerella*) Solle, 1952. Bassler & Solle based their decision on the differences in the structure of zooecia and zoaria, these differences being observed also on Middle Devonian material from the Holy Cross Mts. According to the present author, the morphological features of the zoaria of *Hederella*, i.e. development of tubular axis, as well as the great intrageneric variability, justify the introduction of a new, independent family with proposed name of Hederellidae. This family is represented by one genus — *Hederella* Hall. A comparison of the morphological features of the genus *Hederella* with those of the five remaining genera included, up to now, to the family Reptariidae Simpson, 1897, is given in Table 2, p. 345.

T a b l e 2

Comparison of genera belonging to the family Reptariidae Simpson, 1897 and Hederellidae n.fam.

Features \ Genera		*Hederella* Hall	*Hederopsis* Bassler	*Hernodia* Hall	*Reptaria* Rolle	*Clonopora* Hall	*Cystoporella* Bassler
Zoarium	general appearance						
	mode of attachment	incrusting	incrusting	incrusting	incrusting	erect	erect
	branches	with main axis	with main axis	with main axis	with parallel edged branches	cylindrical	cylindrical
Zooecium	shape	cylindrical, short	cylidndrical with longitudinal sep-tum and transver-se partitions	club-shaped	cylindrical, of uniform length	tubular	tubular, flask-shaped
	apertures	terminal, elliptical	terminal, round	terminal, elliptical	terminal, elliptical	terminal, elliptical	subterminal, elliptical
Ornamentation		striated, annulated	annulated	annulated	annulated	—	—
Budding		from lateral wall	from lateral wall	from lateral wall	from the base	—	—
Occurrence		Silurian—Carboniferous	Devonian	Upper Silurian, Devonian	Silurian—Devonian	Lower and Middle Devonian	Lower and Middle Devonian

Family **Hederellidae** n. fam.

Genus assigned: Hederella Hall, 1881.
Stratigraphical range: Silurian — Carboniferous.

Diagnosis. — Zoaria adnated, branching, with central axis. Zooecia tubular, striated, budding laterally. Apertures terminal, transversally elliptical.

Genus *Hederella* Hall, 1881

Type species: Hederella canadensis (Nicholson, 1874), Middle Devonian.
Stratigraphical range: Silurian — Carboniferous.

Discussion. — Among the here described Bryozoa, 21 species belong to genus *Hederella* Hall, 1881 (Table 1, p. 324), that is over 60%. Four subgenera were recorded: *Hederella* (*Hederella*) (10 species), *H.* (*Bassledere1la*) (5 species), *H.* (*Magnederella*) (3 species) and *H.* (*Paralhederella*) (3 species). As to the number of *Hederella* species, the assemblage described here occupies third place in the world. In second place is a group of 23 *Hederella* species described by Solle (1937, 1952, 1968) from the Rhenish Devonian of Germany. The largest collection in the world, is that composed of 59 Devonian species, 40 of which are Middle Devonian, described by Bassler (1939) from North America.

It shoud be noted that all the here described species are known from the North American Devonian, which shows the "American character" of the group. The predominance of American elements in the Middle Devonian of the Holy Cross Mts. is seen not only among the representatives of genus *Hederella*, but is also evident among the previously described Ctenostomata (Kiepura, 1965).

Till now, the genus *Hederella* is represented by about 90 species occurring from Silurian to Carboniferous. The largest amount, over 80 species, occurring in Devonian. According to investigations up to now the geographical range of the genus *Hederella* is limited to North America, Europe and Australia. In Europe, besides Poland, it is known from the Rhenish Devonian of Germany (Solle, 1936, 1937, 1952, 1968) and to a lesser extent from the Devonian of Czechoslovakia (Prantl, 1938) and the Soviet Union (Morozova, 1960). In Australian Devonian it is also sporadically represented (Talent, 1963). As mentioned, it most commonly occurs in North American Palaeozoic, especially in Middle Devonian (Bassler, 1939).

Incrusting species of the genus *Hederella* have, for a long time, been a subject of interest to a lot of authors (Billings, 1859; Nicholson, 1874; Hall, 1881; Davis, 1885; Hall & Simpson, 1887; Miller, 1889; Whiteaves, 1891, and others). These species were not always classified as Bryozoa, sometimes being assigned to Tabulata (Billings, 1859; Nicholson, 1874).

This interest in genus *Hederella* has grown over the last fifty years (Stewart, 1927; Fenton & Fenton, 1937; Solle, 1937, 1952, 1968; Prantl, 1938; Bassler, 1939; Condra & Elias, 1944; Morozova, 1960; Talent, 1963). Elias (1944), Morozova (1960) and Solle (1968) drew attention to the big similarity between *Hederella* and *Aulopora*. They suggest, on the base of morphological comparison of both genera, eventual systematic modifications, but they leave the genus *Hederella* among Bryozoa.

According to the present author, the position of genus *Hederella* within Bryozoa is not in doubt. Morphological similarity to the genus *Aulopora* is possibly a result of convergence. Neither does the genus *Hederella's* place in the order Cyclostomata give rise for concern. The author was able to confirm the presence of a few pores in the zooecial walls of *Hederella*, a diagnostic feature of this order. Condra & Elias (1944, p. 536), while describing the wall structure of *Hederella carbonaria* Condra & Elias, 1944, stressed that the delicate, transversal striation on the inner wall might indicate perforation. The wall structure, examined on Polish material, closely resembles that examined by Condra & Elias (1944). The calcitic, porous wall is delicately fibrous with fibres perpendicular to the surface (Text-fig. 8A, B).

The wall structure of *Hederella* is closest to that of certain Tabulata, especially to genus *Thamnopora* Steininger (Sokolov, 1962), although morphologically the latter is very different. Genus *Aulopora* Goldfuss is morphologically the closest among Tabulata, but has, according to some authors, a concentrically lamellar wall structure, i.e. different from the fibrous structure of genus *Hederella*. Thus, the external resemblance of these two genera can not determine the "tabulate nature" of *Hederella* in view of the number of varying morphological features (Elias, 1944) and different wall microstructure.

Subgenus *Hederella* (*Hederella*) Hall; Solle, 1952

Type species: *Hederella (Hederella) canadensis* (Nicholson, 1874), Middle Devonian.

Stratigraphical range: Silurian — Carboniferous.

Diagnosis. — According to Solle, 1952, p. 37.

Hederella (Hederella) canadensis (Nicholson, 1874)

(Pl. IV, Fig. 1)

1897\. *Hederella canadensis* Billings; G. B. Simpson, A handbook..., Pl. 25, Figs 12, 13.
1927\. *Hederella canadensis* (Nicholson); G. A. Stewart, Fauna of the Silica Shale..., p. 25, Pl. 1, Figs 16, 17.
1939\. *Hederella canadensis* (Nicholson); R. S. Bassler, The Hederelloidea..., p. 31, Pl. 7, Figs 2-4 (*here the rest of the synonymys*).

Material. — Three specimens badly preserved: one incrusting *Calceola* sp., second — crinoid stem, and third — *Pseudozonophyllum* sp. The last is associated with *H. (H.) concinna* (Bassler), *H. (Magnederella) major* (Bassler) and with undefined Trepostomata, Ctenostomata (*Allonema* Ulrich & Bassler) and *Spirorbis* sp.

Description. — Zoarium with tubular axis branching at 5 mm intervals, angle of divergence 70° to 90°. Zooecia short, 1 mm in length, diameters about 0.2 mm, are slightly bent and arranged alternately on both sides of tubular axis. They are free for at least half their length, sometimes are in contact with the main axis. In 5 mm occur 3 to 5 zooecia. Budding angle of about 30°. Apertures transversally oval. Surface of zooecial tubes transversally striated.

Remarks. — This species has some of features in common with *H. (H.) concinna* (Bassler) and *H. (H.) filiformis* (Billings).

Occurrence. — Poland: Grzegorzowice, Couvinian; Skały, Givetian. USA: Michigan, Middle Devonian. Canada: Ontario, Middle Devonian.

Hederella (Hederella) concinna (Bassler, 1939)

(Pl. VIII, Fig. 2; Pl. X, Fig. 2)

1939. *Hederella concinna* Bassler; R. S. Bassler, The Hederelloidea..., p. 32, Pl. 7, Figs 10-15; Pl. 15, Fig. 2.

Material. — Two specimens preserved on the surface of *Pseudozonophyllum* sp. together with *H. (H.) canadensis* (Nicholson), *H. (Magnederella) major* (Bassler), *?Ceramopora* sp., *Allonema* sp., and numerous tubes of genus *Spirorbis*.

Description. — Delicate zoarium in the form of wavily prostrated branche, 12 mm in length. Zooecia usually not over 1 mm in length (exceptionally 1,8 mm), diameters range from 0.3 to 0.5 mm. On average, 4 zooecia occur in 5 mm. Budding angle of 25°, rarely 30°. Zooecial tubes close to main axis, adhering almost completely to the substratum, only by the apertures do they bend straight upwards. Apertures transversally oval, ended by peristomes. Zooecial surface transversally striated, 3 or 4 striae are thicker than others. Number of these striae is not in proportion to the length of zooecium, for example zooecia of 0.7 mm and 1.8 mm in length have 3 thick striae, zooecium of 1.0 mm — 4 striae.

Remarks. — Polish specimens have larger zooecia than those from United States (width 0.3 mm as compared with 0.3 mm, length 1.0 mm as compared with 0.75 mm). Species under discussion is close to *H.(H.) filiformis* (Billings) in dimensions and shape of zooecia. It differs in angle of budding (25° against 45°) and uniform order of zooecia (contacting, as compared with free and contacting).

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Michigan, Ohio, Middle Devonian. Canada: Ontario, Middle Devonian.

Hederella (Hederella) parvirugosa (Bassler, 1939)
(Pl. VII, Fig. 1)

1939. *Hederella parvirugosa* Bassler; R. S. Bassler, The Hederelloidea..., p. 33, Pl. 6, Figs 12-14.

Material. — Two badly preserved zoaria incrusting branches of *Fistuliramus astrovae* n. sp. One of the specimens accompanies *Lioclema* sp. and a few tubes of *Spirorbis* sp. The second is found with *Hederella (H.) thedfordensis* (Bassler).

Description. — Zoarium with elongated, straight or slightly bent branches, up to 10 mm in length. Angle of divergence 50° to 90°. Zooecia not longer than 1 mm, diameter not over 0.3 mm. Zooecia can be free on entire length or adhere completely or partly to the main axis. Apertures usually transversally elliptical. Angle of budding, on average 30°. Four to five zooecia occur in 5 mm. Ornamentation of zooecial surface in the form of transverse striation, badly preserved.

Remarks. — Zoaria from Holy Cross Mts. are, in comparison with these from United States, more compact (space between branchings 1 mm to 4 mm against 7 mm), and have a different arrangement of zooecia (free or contacting, compared with free). The described species, according to Bassler (1939), is close to *H. (H.) concinna* (Bassler), *H. (H.) regularis* (Bassler) and *H. (H.) arachnoidea* (Clarke).

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Indiana, Ohio, Michigan, Middle Devonian. Canada: Ontario, Middle Devonian.

Hederella (Hederella) cirrhosa (Hall, 1881)
(Pl. VIII, Fig. 1)

1927. *Hederella cirrhosa* Hall; G. A. Stewart, Fauna of the Silica Shale..., p. 26, Pl. 1, Fig. 18.
1939. *Herderella cirrhosa* Hall; R. S. Bassler, The Hederelloidea..., p. 34, Pl. 6, Figs 1-8 (*here the rest of synonymy*).

Material. — One specimen preserved on 12 cm² of the surface of *Pseudozonophyllum* sp.

Description. — In a zoarium of this species, distinct symmetry is often observed, as a result of which, the part of zoarium on the right of the main axis is a mirror image of that on the left. Zoarial branches usually parallel, slightly wavy, mostly 1.5 mm apart, rarely 7 mm apart. Angle of divergence ranges from 30° to 50°. Angle of alternate budding[1] from 20° to 25°. Zooecial tubes may be in contact or free for greater or smaller distances,

[1] Exceptionally, budding occurs on one side of a branch, a feature observed also by Bassler (1939) on American material.

and are 0.3 mm in diameter, 1 mm to 1.7 mm in length, with usually 3 zooecia in 5 mm. Zooecial tubes slightly bent, ending in transversally elliptical apertures. Surface delicately transversally striated.

Remarks. — *Hederella (H.) cirrhosa* (Hall) is similar to *H. (H.) parvirugosa* (Bassler), but has longer zooecial tubes arranged at a smaller angle.

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Indiana, Michigan, Middle Devonian. Canada: Ontario, Middle Devonian.

Hederella (Hederella) cf. *filiformis* (Billings, 1859)

(Pl. IV, Fig. 2; Text-fig. 11).

Material. — Zoarium incrusting a coral surface together with two undetermined species of this genus.

Description. — Small zoarium with slightly wavy to zigzag branches. Arrangement of zooecia sometimes irregular: 3 zooecia can occur in 2 mm along one side, while being 2.4 mm apart on the other side. Zooecia slightly broader by apertures, somewhat bent, of varying dimensions. The larger, reaching 1.0 mm, free on their whole length. The shorter, under 0.7 mm, contact all the way to the branch. Diameters of both types equal, usually 0.28 mm. On average, 2 to 4 zooecia occur in 5 mm. Differentiation of

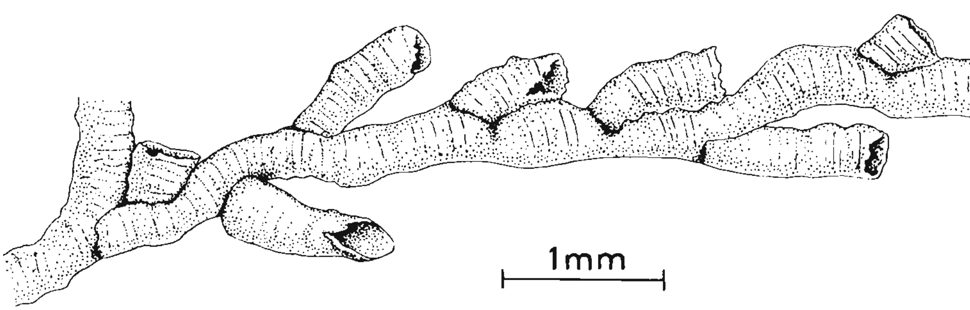

Fig. 11 — *Hederella (Hederella)* cf. *filiformis* (Billings, 1859), (Z. Pal. Br. IV/8604) a fragment of a branched zoarium.

zooecia is joined with the angle of budding, which for the longer ranges from 30 to 45° (rarely 80°), while for the shorter it is only 10°. Angle of branching about 80°, distances between branches 1 mm. Zooecial apertures elliptical. Surface ornamentation consists of distinct, transversal striae of variable thickness.

Remarks. — The described form is similar to *H. (H.) filiformis* (Billings) in general appearance, angle of branching, shape and length of zooecial tubes. It differs in the smaller diameters of its zooecia (0.28 mm against 0.5 mm), smaller budding angle (10° and from 30° to 40° in comparison to 45°) and closer spacing of branches (1.0 mm in comparison to 5.5 mm).

Dimensions of described species are close to *H.* (*H.*) *parvirugosa* (Bassler).

Occurrence. — Poland: Grzegorzowice, Couvinian. *H. (H.) filiformis* (Billings) occurs in USA: New York, Ohio, Wisconsin, Michigan, Middle Devonian.

Hederella (*Hederella*) *alternata* (Hall & Whitfield, 1873)
(Pl. XIII, Fig. 2)

1924. *Hederella alternata* Fenton & Fenton; M. A. Fenton & C. L. Fenton, Stratigraphy and Fauna..., p. 72, Pl. 17, Figs 5, 6.
1939. *Hederella alternata* (Hall & Whitfield, 1873); R. S. Bassler, The Hederelloidea..., p. 36, Pl. 5, Figs 1-3.

Material. — Two zoaria. One incrusting 12 cm^2 of surface of *Pseudozonophyllum* sp., together with two other badly preserved species of this genus and with *Ceramoporella* sp., *Aulopora* sp. and *Spirorbis* sp. The second incrusts a crinoid surface, together with *H.* (*Paralhederella*) *compacta* (Bassler).

Description. — Branches straight, zooecia alternating on the right and left side. Individual branches arranged more or less parallel, usually 3.5 mm apart. Zooecia 1 mm in length, rarely 1.5 mm, with diameter 0.3 mm, can be contacting or free. Zooecia slightly broader by apertures, with surface ornamentation consisting of transversal striation present in some places. Budding angle varies: in contacting zooecia, from 10° to 20°, in free zooecia up to 40°. Angle of branching about 60°. Three to four zooecia occur in 5 mm.

Remarks. — Described species shows some resemblance to *H.* (*H.*) *linearis* (Fenton & Fenton, 1924). Nevertheless, the latter differs by its slightly larger dimensions of zooecia (length 1.2 mm width 0.35 mm) and greater (6.5 mm) distances between zoarial branches.

In comparison with zoaria of *H.* (*H.*) *alternata*, described by Bassler (1939) from Devonian of United States, zoaria of Poland differ in having a smaller angle of branching (60° against 90°).

Occurrence. — Poland: Grzegorzowice, Couvinian; Skały, Givetian. USA: Iowa, Devonian.

Hederella (*Hederella*) *brownae* (Bassler, 1939)
(Pl. VI, Fig. 2)

1939. *Hederella brownae* Bassler; R. S. Bassler, The Hederelloidea..., p. 36, Pl. 1, Fig. 13.

Material. — Two specimens incrusting 20 cm^2 of surface of *Pseudozonophyllum* sp.

Description. — Broad, branching zoarium. Individual branches 3 mm apart. The well developed zoarium clearly shows a tendency to form clusters of zooecia. They are formed in regions of intensified branching and budding in younger peripheral parts of zoarium. Angle of branching usually about 60°. Zooecia swollen, diameters 0.4—0.5 mm, length to 2 mm, can be in complete contact with the main axis, or partly or completely free. In the first instance, they bud at an angle of 15°, in the second — 30°. On a distance of 5 mm, measured on one side of main axis, occur 3 to 4 zooecial tubes (usually 3). Apertures transversally elliptical, with diameters equal or slightly larger than these of zooecial tubes. Surface ornamentation in the form of transverse striation.

Remarks. — Zoarium from Holy Cross Mts. in comparison with that described by Bassler (1939) from Devonian of New South Wales (Australia) has longer zooecia (2 mm against 1.6 mm) with practically identical diameters and smaller angle of budding (from 15° to 30° in comparison to 45°). In general appearance of zoarium, budding and branching angles, the described species approaches to *H.* (*H.*) *thedfordensis* (Bassler, 1939), from which it differs in proportions of zooecial dimensions.

Occurrence. — Poland: Grzegorzowice, Couvinian. Australia: New South Wales, Taemas, Middle Devonian.

Hederella (*Hederella*) *thedfordensis* (Bassler, 1939)
(Pl. I, Fig. 5)

1939. *Hederella thedfordensis* Bassler; R. S. Bassler, The Hederelloidea..., p. 43, Pl. 1, Figs 7-12; Pl. 13, Fig. 2 (here older synonymy).

Material. — Two specimens incrusting surface of *Fistuliramus astrovae* n.sp. One is accompanied by *H.* (*H.*) *parvirugosa* (Bassler).

Description. — Bush-like zoaria formed from long branches, about 3 cm, diverging at an angle of 60°. Spacing of branches varies considerably from 1.5 to 4 mm. Characteristic zooecial clusters are formed of a few closely contacting tubes, situated on both sides of main axis. Zooecia broader by apertures, where they are usually damaged, 1.5 to 2.5 mm in length, rarely 3 mm. Diameters of zooecia, in contrast to length, stable, usually 0.7 mm. Two zooecia, as a rule, occur in 5 mm. Zooecial tubes can be completely in contact with the central branch when the budding angle is 10°, or they can be completely free on the whole length with a budding angle of 40°. Surface ornamentation usually very delicate in the form of transversal striation.

Remarks. — Described species in general appearance reminds one of *H.* (*H.*) *nicholsoni* (Bassler, 1939), from which it differs, according to Bassler, in having another arrangement of zooecia. According to the present author, it differs also in its somewhat larger dimensions of zooecia, more variable spacing of branches, different budding (10°—40° compared to 35°) and branching angles (60° compared to 45°). Unlike specimens described by Bassler, specimens from the Holy Cross Mts. have the younger parts of zoaria preserved but are devoid of basal part with closely arranged zooecial tubes.

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Ohio, Michigan, Middle Devonian. Canada: Ontario, Middle Devonian.

Hederella (Hederella) nicholsoni (Bassler, 1939)

(Pl. III, Fig. 2; Pl. V Fig. 1, 2; Text-fig. 12, 13)

1939. *Hederella nicholsoni* Bassler; R. S. Bassler, The Hederelloidea..., p. 44, Pl. 4, Figs 8, 8′; Pl. 12, Fig. 4.

Material. — Eleven fragmentary zoaria in various state of preservation. Seven incrusting coral surfaces (*Pseudozonophyllum* sp.) and 4 incrusting bryozoan surfaces (*Fistuliramus astrovae* n. sp.). Some specimens are accompanied by *Diversipora bitubulata* n. sp., *Ceramopora* sp., *Discotrypa* sp., *Aulopora* sp. and *Spirorbis* sp.

Description. — Zoarium composed of long, up to 20 mm, branches. Angle of branching variable, ranging from 10° to 80°. As a result, arrangement of branches in relation to main axis of zoarium, radial or subparallel. Zoaria branch more intensively or less, distances between branches from 0.5 to 3.0 mm. Zooecial tubes 0.4 to 0.5 mm in diameter and to 2.0 mm in length, are enlarged in various degree by apertures. On typical branches, zooecia are characteristically arranged (Text-fig. 12, 13): a few (3 to 4) successive zooecia closely adhere to the main axis on one side (budding angle only 10°), on the opposite side of the main axis, the zooecia are completely free, often bent (budding angle of about 35°). Two to three zooecial tubes occur in 5 mm. Transversally elliptical apertures very often damaged. Well marked surface ornamentation consisting of distinct striae of various thickness.

Remarks. — Zoaria of *H.* (*H.*) *nicholsoni* (Bassler, 1939) from the Holy Cross Mts. in comparison with those described from United States, have less stable budding angles (from 10° to 35° in comparison to 35°) and branching angles (from 45° to 80° against 45°) as well as different spacing between branches (from 0.5 mm to 3.0 mm in comparison to 5—6 mm).

The described species differs from *H.* (*H.*) *mandelensis* Solle, 1952, mainly in the distance between branches (0.5—3.0 mm in comparison to 4—7 mm) and smaller budding angle (10° to 35° against 45°—80°, usually 60°).

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Michigan, Middle Devonian.

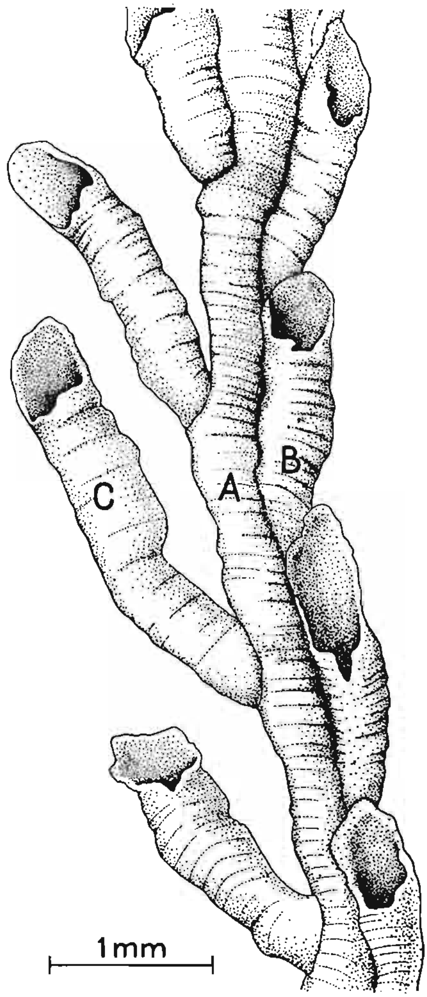

Fig. 12 — ***Hederella (Hederella) nicholsoni*** **(Bassler, 1939), (Z. Pal. Br. IV/8628) fragment of a branch: *A* main axis, *B* zooecium in contact with the main axis, *C* zooecium completely free.**

Hederella (Hederella) adnata (Davis, 1885)

(Pl. IX, Fig. 2)

1939. *Hederella adnata* (Davis, 1885); R. S. Bassler, The Hederelloidea..., p. 46, Pl. 11, Figs 10—12 (*here older synonymy*).

Material. — Three fairly well preserved specimens. Two incrusting the surface of *Fistuliramus astrovae* n. sp. (9 cm²) and associated with *Diversipora bitubulata* n. sp., *Hederella* (*H.*) sp., ?*Ceramopora* sp., *Lioclema* sp. and *Spirorbis* sp. The third incrusts about 20 cm² of *Pseudozonophyllum* sp. and is accompanied by a crinoid and *Spirorbis* sp.

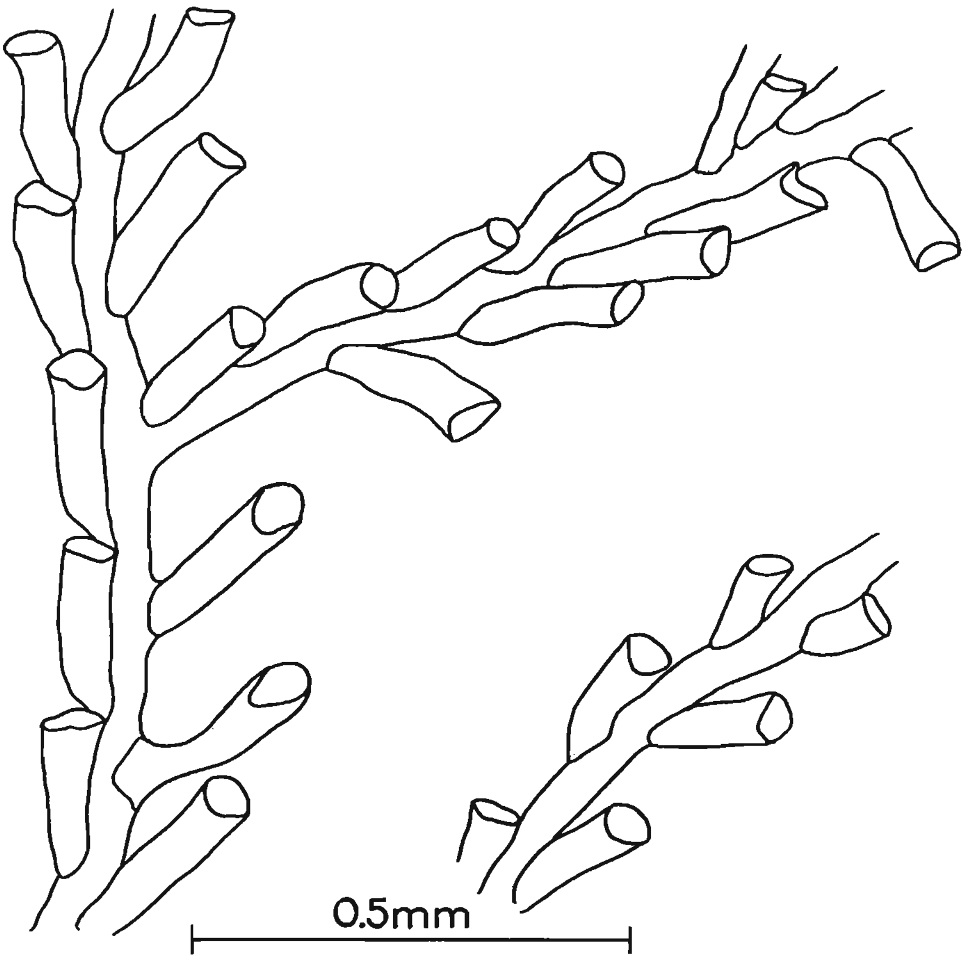

Fig. 13 — *Hederella (Hederella) nicholsoni* (Bassler, 1939), (Z. Pal. Br. IV/8628), fragment of zoarium, with zooecia in contact with the main axis, on one side and free on the opposite side.

Description. — Bush-like zoarium, long to 20 mm, branches almost parallel, disposed at intervals of 5 to 6 mm, angle of branching varying from 60° to 70°. Zooecial tubes long, usually 2.5 mm with diameters from 0.4 to 0.6 mm. In 5 mm usually occur 2, sometimes 3 zooecia. Zooecia either contact on their whole length, or are partly or completely free, in which case they are bent to varying degrees. Budding angle ranges from 10° to 40° often 30°. Apertures transversally elliptical. External ornamentation consists of transverse striae of various thickness.

Remarks. — The described species, in dimensions of zooecia, number of zooecia in 5 mm, angle of budding and branching approches *H. (H.) thed-*

fordensis (Bassler, 1939), from which it differs by absence of the characteristic zooecial clusters.

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: Kentucky, Middle Devonian.

Subgenus *Hederella* (*Basslederella*) Solle, 1968

Type species: Hederella (Basslederella) alpenensis (Bassler, 1939). Middle Devonian.
Stratigraphical range: Devonian.

Diagnosis. — According to Solle, 1952, pp. 37—38 (see also Solle, 1968, p. 26).

Hederella (*Basslederella*) *alpenensis* (Bassler, 1939)

(Pl. II, Fig. 3; Pl. XVI, Fig. 1)

1939. *Hederella alpenensis* Bassler; R. S. Bassler, The Hederelloidea..., p. 47, Pl. 3, Figs 1—6.

Material. — Five sufficiently well preserved zoaria. All incrusting about 3 cm^2 of surface of the tetracorals and all accompanied by other epizoic bryozoans (*Allonema* sp., *Ascodictyon* sp., *Eliasopora* sp., *Diversipora bitubulata* n. sp., *Discotrypa* sp., ?*Ceramopora* sp.), with *Aulopora* sp., *Spirorbis* sp. and unidentified, incrusting hydrozoans.

Description. — Small, frequently branching zoaria. Zooecial tubes parallel, often in contact with the main axis. In a branch, zooecia vary as to size and arrangement, in older part being arranged alternately in two. Interior of zooecium much shorter than exterior, often in the relation 1 : 2. In younger parts, however, zooecia occur singly, alternately arranged on both sides with length similar to that of internal zooecia in the older parts of a branching. Therefore, the length ranges from 0.6 mm to 1.2 mm. On one side of a branch, 3 to 5 zooecia occur in 5 mm. The middle axis visible only on some fragments of zoaria. It is composed, as in other Hederelloidea, from the narrow proximal parts of successive zooecial tubes. Diameters of conical zooecia reach 0.4 mm in distal part and correspondingly less in proximal part. By the aperture, zooecia are inclined outward, protruding over zooecial tube, surface transversally striated, terminal apertures transversally elliptical, with subrounded peristomes. Diameter of apertures usually 0.3 mm. Frequency of zoarial branching varies, occurring at intervals of 2 to 6 mm. Angle of branching also varying — 50°, 70° or 100°. Budding angle always acute, 10°.

Remarks. — Described species shows considerable resemblance to *H.* (*B.*) *graciliora* (Clarke, 1900) in the compact aspect of zoaria, diameters of zooecia, their varying length and similar budding angle. Differences lie in intervals between branchings, number of zooecia in 5 mm, and angle of branching.

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: Michigan, Ohio, Wisconsin, Middle Devonian.

Hederella (Basslederella) halyson (Fenton & Fenton, 1924)

1924. *Hernodia halyson* Fenton & Fenton; M. A. Fenton & C. L. Fenton, Stratigraphy and Fauna..., p. 73, Pl. 17, Fig. 4; Pl. 18, Fig. 4.
1939. *Hederella halyson* (Fenton & Fenton, 1924); R. S. Bassler, The Hederelloidea..., p. 48, Pl. 2, Fig. 6; Pl. 5, Figs 4, 5; Pl. 12; Fig. 1.

Material. — Three zooaria, two of which incrust surface (3.5 cm^2, 16 cm^2) of Tetracoralla and are in association with *Diversipora bitubulata* n. sp., *H.* (*H.*) *delicatula*? (Bassler, 1939), ?*Ceramopora* sp., *Lioclema* sp., *Discotrypa* sp. and *Spirorbis* sp. One is preserved on 2 cm^2 of the surface of *Fistuliramus astrovae* n. sp. together with *Lioclema* sp., undetermined bryozoan belonging to the family Fenestellidae and *Spirorbis* sp.

Description. — Zoarium with loosely arranged zooecia. Zooecial tubes 1 to 2 mm in length, diameters about 0.5 mm, rarely more. As a result, budding angle varies from 10° to 30°, zooecia in close contact with branches, or free on the whole length. Two to three zooecial tubes occur in 5 mm. Side branchings emerge at an angle of 80°, often parallel and at intervals of up to 2 mm. Zooecial surface ornamented with transverse striae.

Remarks. — *H.* (*B.*) *halyson* (Fenton & Fenton) is close to *H.* (*B.*) *persimilis* (Bassler, 1939). It differs mainly in not forming groups of zooecia close to site of bifurcation and in less compact zoarium.

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: Iowa, Wisconsin, Middle Devonian.

Hederella (Basslederella) persimilis (Bassler, 1939)
(Pl. IV, Fig. 3; Pl. XIV, Fig. 1)

1939. *Hederella persimilis* Bassler; R. S. Bassler, The Hederelloidea..., p. 49, Pl. 2, Figs 4, 5.

Material. — Two specimens preserved on surfaces (8 cm^2 and 26 cm^2) of two Tetracoralla, one occurring with *Diversipora bitubulata* n. sp., *Aulopora* sp. and *Spirorbis* sp.

Description. — In the older basal part, zoarium is very compact with closely arranged zooecia. In the younger part, arrangement is looser with single branches, varying in length (to 15 mm), showing greater or lesser tendency to form clumps of zooecia close to bifurcations. They arise at intervals of 5 mm at peripheries of zoarium and, in the compact part, every 1 to 2 mm. Angle of branching usually 40°. Length of zooecial tubes narrowed proximally about 2 mm, diameters ranging from 0.3 mm to 0.4 mm. Along one side of a branche, 3 to 4 zooecia occur in 5 mm. The budding angle ranges from 10° to 30°, rarely 40°, majority of zooecia bud at an angle of 10°. By their low budding angle, zooecia are in close contact with axis. Terminal apertures ended by small, slightly rised peristomes, shape is elliptical or more rarely quadrangular. Ornamentation of zooecial surface expressed as transverse striae of various thickness.

Remarks. — Described zoaria differ considerably from these from United States, in having slightly shorter (from 1 mm to 2 mm against 2 mm or sometimes 3 mm) and slightly narrower (from 0.3 mm to 0.4 mm in comparison to 0.5 mm) zooecia, more compact zoaria and distances between branches smaller (up to 5 mm against 6 mm). Described species resembles *H.* (*B.*) *rugosa* (Bassler, 1939) in similar length and number of zooecia, their number in 5 mm and angle of branching.

Occurrence — Poland: Grzegorzowice, Couvinian. USA: New York, Michigan, Middle Devonian. Canada: Ontario, Middle Devonian.

Hederella (Basslederella) rugosa (Bassler, 1939)

(Pl. VII, Fig. 3A; Text-figs: 8A, B, 14A-C.)

1939. *Hederella rugosa* Bassler; R. S. Bassler, The Hederelloidea..., p. 49, Pl. 2, Fig. 7; Pl. 3, Figs 7, 8.

Material. — Two specimens incrusting a *Fistuliramus astrovae* n. sp. State of preservation good. One specimen in association with *Hederella (Basslederella) conferta* (Hall, 1881), the second with *Spirorbis* sp.

Description. — Zoarium with branches of variable sizes, up to 15 mm in length, diverging at an angle of 90° at intervals of 1 to 4 mm. Branches parallel to each other and perpendicular to the main axis. Zooecia broader by apertures, narrower in the proximal end. They are, to a more or lesser degree, inclined to the main axis, to which they remain in close contact. Length of zooecia ranges from 1.2 mm to 1.8 mm, often 1.5 mm, diameters from 0.6 to 0.7 mm; 3 to 4, sometimes only 3, zooecial tubes occur in 5 mm. Budding angle acute, from 10° to 20°. Oval shaped apertures. Surface ornamentation in the form of distinct, transverse striation.

Zooecial tubes. Proximal diameter of conical zooecium 0.06 mm distal — 0.53 mm. Thickness of wall ranges from 0.01 to 0.08 mm. Wall is finest where it is fixed to the base, from 0.01 to 0.05 mm thick, and thickest on external side, where it varies from 0.02 mm to 0.08 mm. Also, in older parts of zooecia, wall thickness is usually lesser, while in younger parts greater. Wall structure distinctly fibrous (Text-fig. 8 A, B). Radially arranged fibres appear as thin, light coloured striae, of maximal width 0.01 mm. Their ornamentation consists of 5 to 6 granules arranged in

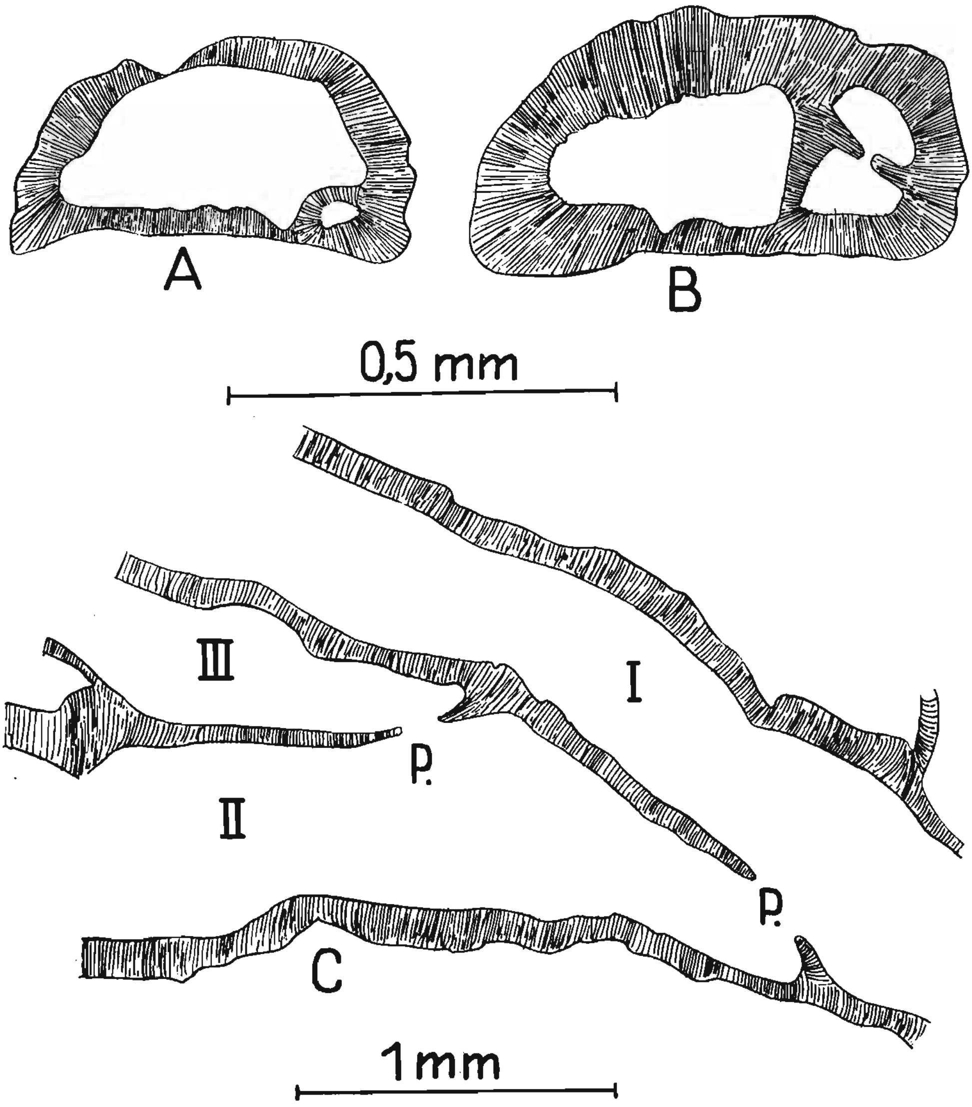

Fig. 14 — Stages of intramural budding of genus *Hederella* Hall, 1881: *A, B* transversal sections with buds preserved in the wall of a mother zooecial tube; *C* longitudinal section, I, II, III three successively budding zooecial tubes, *p* communication pore.

a row. Fibres sometimes dichotomously branched, their length usually equalling, or slightly less than the thickness of walls. On some thin sections a comparatively large pore (communication pore; interzooidal pore; Brood, 1972), can be observed on the interior side of the proximal part of zooecial tube (Text-fig. 14 C). Pore, 0.10 to 0.18 mm in diameter, surrounded by decidedly thinner walls. Microstructure of an epitheca similar to that of the wall proper, thickness about 1/4 to 1/5 that of walls. Diaphragms very rarely developed in tubes. When present, they are of varying thickness, often concave in the proximal part of tube and horizontal or slightly oblique distally.

Budding. Examination of the material from the Holy Cross Mts. gave similar results to these obtained by Bassler (1939) and confirm that bryozoans belonging to genus *Hederella*, bud from the lateral wall of zooecial tube. According to the present author, descendant zooecium arise in the wall of mother zooecium (Text-fig. 14). This is inner wall, intramural budding. Present in transverse sections of a wall 0.06 mm thick, is an oval bud of diameters 0.03×0.04 mm (Text-fig. 14 A). A second section shows two buds of diameters 0.06×0.12 mm and 0.08×0.12 mm placed in one mother zooecium. Diameters of mother zooecium 0.28×0.60 mm, maximum thickness of the wall 0.07 mm and minimum thickness 0.02 mm. Those parts of wall, in common, separating descendant zooecia from each other and from mother zooecium are thin, 0.02 mm in thickness. A distinct pore, 0.01 mm in diameter, occurs in the middle of the wall separating descendant zooecia (Text-fig. 14 B). In longitudinal sections one can observe the descendant zooecium beginning in the wall of the mother zooecium (Text-fig. 14 C). The wall of the latter, 0.07 mm in thickness, rapidly about doubles its thickness. With further development, a short section of a new zooecial wall, about 0.1 mm in length, is formed, this length being rather stable. Present, above the latter is a communication pore, from 0.08 to 0.10 mm in diameter. A new wall, at first thin (0.02 mm), gradually broadening (0.07 mm) continues above the pore for about 1 mm, rapidly widening distally with a new zooecial tube budding from it, its development identical to that of previous tube. The described mode of budding does not contribute to establishing the systematic assignment of the genus *Hederella*. The lack of detailed data on budding in the similar, to some extent, genus *Aulopora* Goldfuss (Tabulata), makes closer comparison impossible. It is known that this type of budding occurs in corals.

Remarks. — Similarity of *H.* (*B.*) *rugosa* to *H.* (*B.*) *halyson* (Fenton & Fenton, 1924) lies in the dimensions of zooecial tubes and similar number of zooecia in 5 mm. Differences apply to the budding of zoaria (irregular arrangement of branches in comparison to regular, radial), angle of branching (90° against 60°) and arrangement of zooecial tubes in relation to the main axis (closely contacting as compared with free for a considerable portion of zooecium).

Polish zoaria of *H.* (*B.*)*rugosa* (Bassler) differ from American ones, in the angle of branching (90° against 60°) and their considerable variability.

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Michigan, Middle Devonian. Canada: Ontario, Middle Devonian.

Hederella (Basslederella) conferta (Hall, 1881)
(Pl. VII, Fig. 3 B; Text-fig. 15)

1939. *Hederella conferta* (Hall, 1881); R. S. Bassler, The Hederelloidea..., p. 50, Pl. 9, Figs 4, 5 (*here older synonymy*).

Material. — Seven zoaria, 6 incrusting to 15 cm² of surface of tetracorals, the seventh expanding upon *Fistuliramus astrovae* n. sp.; the latter specimen accompanied by *H. (B.) rugosa* (Bassler, 1939), the other 6 — by *Allonema* sp., *Diversipora bitubulata* n. sp. *H.* (*Magnederella*) sp., *Aulopora* sp., *Ceramopora* sp. and undetermined hydrozoans.

Description. — Infrequently branching zoaria; branches up to 25 cm long, occurring at intervals of 2 to 6 mm, usually, 1.5 to 2 mm in length,

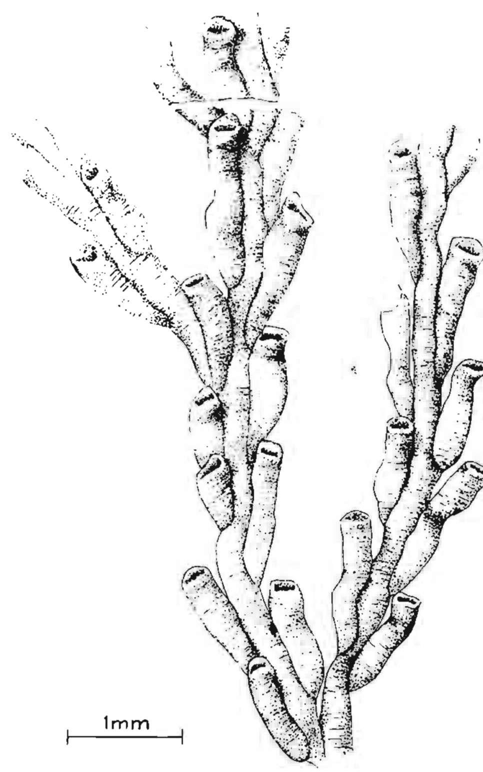

Fig. 15 — *Hederella (Basslederella) conferta* (Hall, 1861), (Z. Pal. Br. IV/8640) fragment of a zoarium.

0.3 to 0.4 mm in diameter. On one side of a branch, 3 to 5 zooecia occur in 5 mm. Zooecial tubes in contact with the main axis or partly free. Budding angle 15°—40°. Apertures transversally elliptical. Distinct surface ornamentation in the form of transverse striation.

Remarks. — Polish specimens in comparison with the American ones have a larger branching angle (70° against 45°), a smaller budding angle (15°—40° as compared to 45°) and greater variability.

As observed by Bassler (1939), specimens of *H. (B.) conferta* (Hall, 1881) are similar to *H. (B.) equidistans* (Bassler, 1939) in size of zooecia and general appearance of zoarium, while differing in branching angles and frequency of budding.

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Middle Devonian.

Subgenus *Hederella* (*Magnederella*) Solle, *1952*

Type species: Hederella (Magnederella) magna (Hall, 1881), Middle Devonian.
Stratigraphical range. — Devonian.

Diagnosis. — According to Solle, 1952, p. 39.

Hederella (Magnederella) magna (Hall, 1881)
(Pl. IX, Fig. 1)

1927. *Hederella magna* Hall; G. A. Stewart, Fauna of the Silica Shale..., p. 26, Pl. 1, Fig. 19.
1939. *Hederella magna* Hall, 1881; R. S. Bassler, The Hederelloidea..., p. 51, Pl. 3, Figs 9, 10 (*here older synonymy*).

Material. — Two zoaria incrusting single tetracorals (surfaces of 2 cm^2, 5 cm^2). Specimens occur in association with undetermined Ctenostomata, *Diversipora bitubulata* n. sp., *Hederella* (*Hederella*) sp., *Ceramopora* sp., *Lioclema* sp. and *Spirorbis* sp.

Description. — Zoaria with branches 25 mm long, arranged at 1.5 to 3 mm intervals. Branching infrequent. Zooecial tubes 1.5 to occasionally 2.3 mm in length and 0.6 to 0.7 mm (rarely 1 mm) in width. Angle of branching 60° to 90°. Zooecia narrow proximally, wider distally, alternately arranged at long intervals. Just like the central axis, they are swollen and usually in complete contact with it, in which case the budding angle ranges from 10° to 20°. Free zooecia also occur and then the budding angle varies from 40° to 45°. Budding infrequent. Usually on one side of a branch, 2 zooecia occur in 5 mm. Zooecial apertures more often round than oval. Surface ornamentation composed of transverse striae of various thickness, or of distinct annulation.

Remarks. — Described species is similar in dimensions of zooecial tubes to *H. (Magnederella) magna praecedens* (Bassler, 1939). In the latter, however, 5 zooecia occur in 5 mm instead of 2 and are always in close contact. They also differ in shape, having blunt proximal ends and parallel sides, compared with the conical, narrower proximal ends of our specimens. Also branching angle differs — 45° instead of 60° to 90°.

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Ohio, Middle Devonian. Canada: Ontario, Middle Devonian.

Hederella (Magnederella) cf. *obesa* (Bassler, 1939)
(Pl. VI, Fig. 1)

Material. — Three zoaria incrusting 5, 25 and 42 cm² of *Pseudozonophyllum* sp. One of them spreading over *Fistulipora* sp. placed on a coral. All in association with *Crepipora* sp., *Aulopora* sp. and *Spirorbis* sp.

Description. — Zoarium with branches of various length up to ca 35 mm, and varied branching frequency. Branching angle — 40°. Distances between branches about 5 mm. Zooecia usuallly narrower proximally, bluntly terminated and swollen, alternately arranged, remaining in close contact with central axis. Length of zooecia varying from 1.5 to 2.5 mm, diameter — 0.6 mm. On one side of a branch, 2 to 3 zooecia in 5 mm. Budding angle ranging from 10° to 20°. Apertures round or oval. Surface ornamentation, not always well preserved, composed of transverse, grained striations.

Remarks. — *H. (Magnederella) obesa* (Bassler), described from United States Middle Devonian differs from the Couvinian species from the Holy Cross Mts. in the following features: smaller dimensions of zooecial tubes, more loosely arranged zooecia, zooecial branching at smaller intervals, and distinct surface ornamentation composed of transverse grained striations.

Described species resembles *H. (Magnederella) michiganensis* (Bassler, 1939) in dimensions of zooecia, number of zooecia in 5 mm, and frequency of branching. They differ in budding angle (20° instead of 45°), the angle of branching (40° instead of 90°) and in the general appearance of zoarium.

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Middle Devonian.

Hederella (Magnederella) reimanni (Bassler, 1939)
(Pl. III, Fig. 1; Pl. X, Fig. 1; Text-figs 16, 17)

1939. *Hederella reimanni* Bassler; R. S. Bassler, The Hederelloidea..., p. 55, Pl. 12, Fig. 8.

Material. — Three well preserved zoaria. One incrusting about 3.5 cm² of the surface of *Fistuliramus astrovae* n. sp. and occurring in association with ?*Ceramopora* sp., *Lioclema* sp. and *Spirorbis* sp. The second, with preserved ancestrula, incrusting 8.5 cm² of *Pseudozonophyllum* sp. in association with ?*Ceramopora* sp., *Hederella* sp., *Lioclema* sp., *Spirorbis* sp. and undetermined hydrozoans. The third incrusts 2 cm^2 of *Favosites* sp. colony accompanied by *Spirorbis* sp.

Description. — Rarely branching zoarium with branches up to 20 mm in length, spaced at 3 mm, 7 mm and 13 mm intervals. Branching angle 50 to 110°. Zooecial tubes large 2.5 to 4.0 mm in length, 1.0 mm in diam-

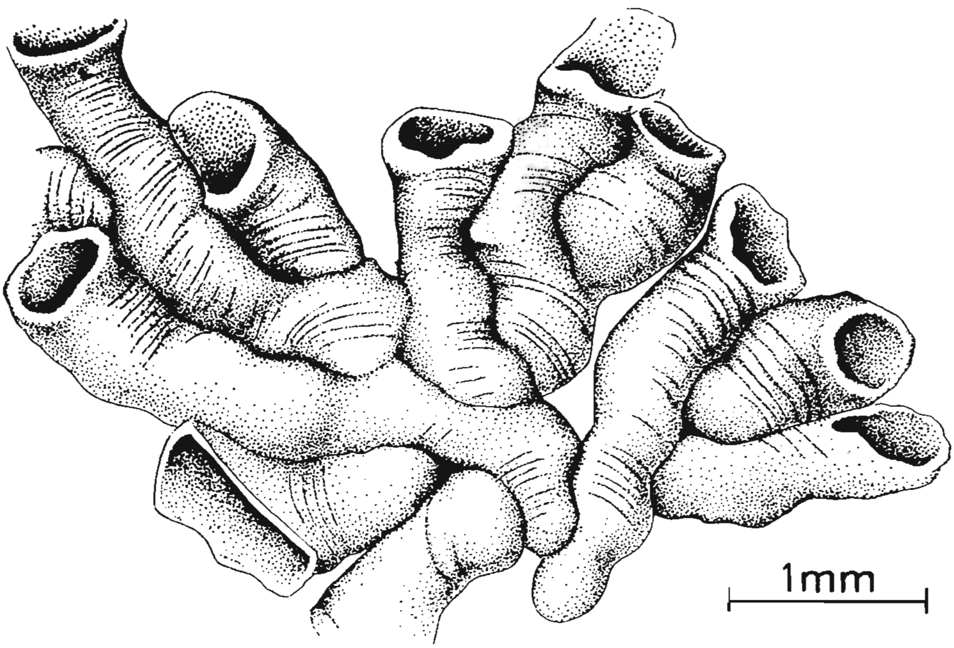

Fig. 16 — *Hederella (Magnederella) reimanni* (Bassler, 1939) (Z. Pal. Br. IV/8606) fragment of a zoarium, initial stage of development with preserved ancestrula.

eter. One to 2 zooecia occur in 5 mm. Proximal ends of zooecia blunt, sides parallel. Mostly, zooecia remain in close contact with branches and then budding angle equals 10°. Some, however, are partially or completely free with a budding angle up to 40°. Zooecia, like central axis, swollen with distinct surface ornamentation. This consists of distinct, closely arranged transverse striation, with annulated swollings, intermediately, irregularly disposed. Apertures round or oval.

Astogenesis. Astogenetic development of this species originates in a bulb-like ancestrula 0.3×0.4 mm in size, from which the first zooecium arises, this latter being 2.2 mm long, narrowed proximally with diameter of 0.25 mm and wider distally, where it is 0.6 mm in diameter (Text-Figs 16, 17). This zooecium buds proximally to the left, over the ancestrula giving rise to a second zooecium measuring 3.0 mm in length, with proximal diameter 0.25 mm and distal diameter 1.0 mm. A third zooecium originates on the right side of the first — mother one, 0.4 mm from the beginning of proximal part. It is 2.5 mm in length, with proximal diameter 0.25 mm distal diameter 0.75 mm. The mother zooecium does not bud further and its development ends. Now, colony develops from the second and third zooecium. Development from the second, located on the left, ontogenetically older, is more intensive than that of the third, placed on the right and ontogenetically younger. The second zooecium buds three times emitting branches I, II and III. The oldest branching — I — develops more intensively giving rise to 2 new branchings 1,2. The third zooecium on the right emitts only two branchings I', II'. Development of the older branching I'cannot be described as this fragment of zoarium is missing. Branching II' also ends its development with only two zooecia.

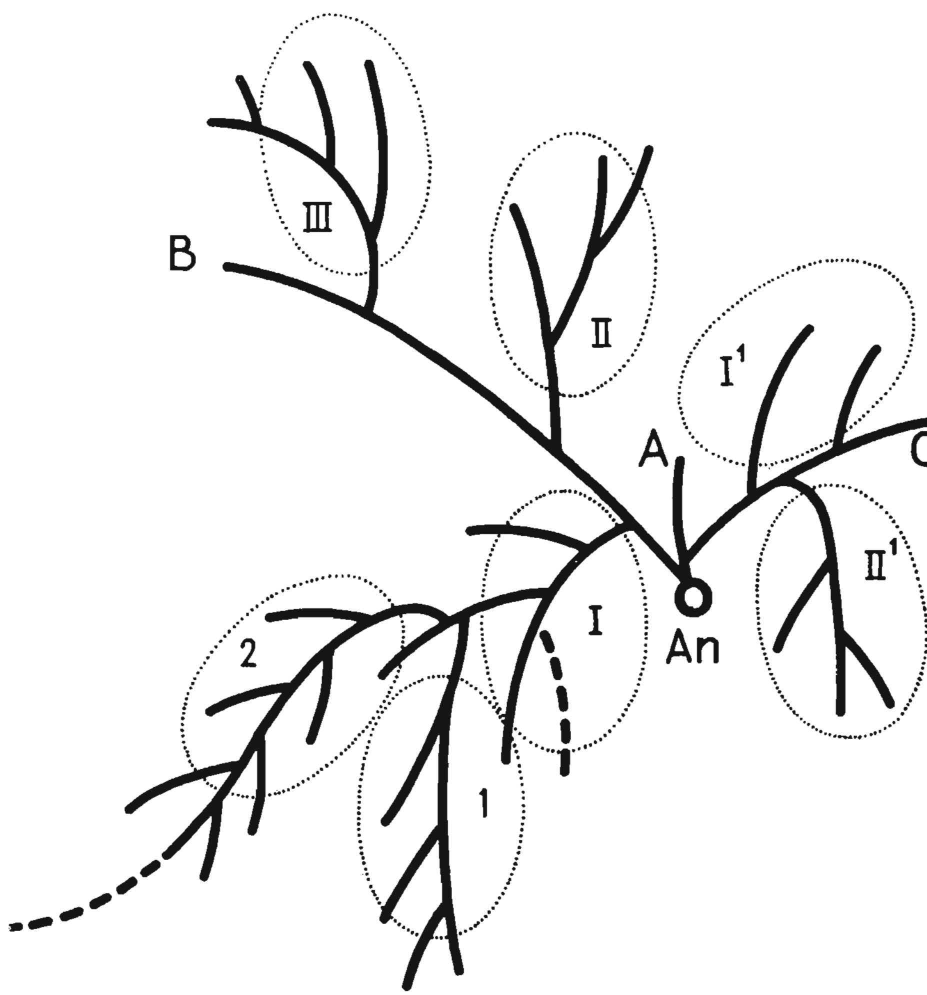

Fig. 17 — *Hederella (Magnederella) reimanni* (Bassler, 1939). Diagram of zoarial development in early ontogenetic stages. Explanation in text, p. 364—366.

A colony in this stage of development covers a surface of about 1 cm². An entire zoarium covers 4.5 cm² and develops from branching 2, which originates from branching I.

Remarks. — Described species approaches *H. (Magnederella) major* (Bassler, 1939) in: the branching angle of some branches, shape and size of zooecia, and number of zooecia in 5 mm (1 to 2 compared with 2). The two species differ in the arrangement of zooecia. Zooecia of *H. (Magnederella) reimanni* are in contact with branching or free and bud at an angle of 10°—40°. Usually, on one side of a branching, zooecia are compactly arranged, on the other side more loosely. Zooecia of *H. (Magnederella) major* are in close contact for most of their length, bud at an acute angle, and are always compactly arranged.

Occurrence. — Poland: Grzegorzowice, Couvinian; Skały, Givetian. USA: New York, Ohio, Middle Devonian.

Subgenus *Hederella (Paralhederella)* Solle, 1952

Type species: Hederella (Paralhederella) parallela (Bassler, 1939). Middle Devonian.
Stratigraphical range: Devonian.

Diagnosis. — According to Solle, 1952, pp. 38—39.

Hederella (Paralhederella) bilineata (Bassler, 1939)
(Pl. XV, Fig. 1)

1939. *Hederella bilineata, Bassler*; R. S. Bassler, The Hederelloidea..., p. 56, Pl. 5, Figs 9—11.

Material. — Two zoaria. One incrusting 3 cm² of surface of tetracoral and associated with *Eliasopora* sp., *Diversipora bitubulata* n.sp., *Ceramopora* sp., ?*Crepipora* sp.,*Aulopora* sp., *Spirorbis* sp. and hydrozoan. The second expanding upon 3 cm² of surface of crinoid.

Description. — Zoarium small, zooecial tubes arranged in two parallel rows. Branchings frequent, nevertheless there are branchings 10 mm long and not divided. Close spacing of branchings from 1 to 3 mm; angle of branching 60° to 90°. Branches arising at the smaller angle of 60° are more frequent and are parallelly arranged. Zooecia rectangular in outline, length 1 to 1.3 mm (exceptionally 1.5 mm), diameters 0.25 to 0.3 mm. Three to 5 zooecia occur in 5 mm along on one side of a branching. Usually zooecia adhere closely to zoarial branchings, occasionally they are free on various sections of their length. Budding angle acute — 10°. Apertures small, round or oval, slightly but distinctly raised outwards. Surface ornamentation composed of distinct, transverse, annulated swellings, disposed at regular intervals of 0.1 mm, 3 to 5 occurring on the surface of a zooecial tube and central axis.

Remarks. — Polish specimens, compared with specimens described from United States, are of varying lengths (1 to 1.3 mm compared with 1 mm) and possess different surface ornamentation. Zoaria in our material are ornamented with transverse annulated swellings disposed at about 0.1 mm intervals, while the American ones, according to Bassler (1939, p. 56), "...are decorated with delicate transverse wrinkles".

Described species is similar to *H. (Paralhederella) consimilis* (Bassler, 1939) in general appearance and dimensions. It differs in smaller distances between branchings (1 to 3 mm in comparison to 4.5 mm), angle of branching (from 60° to 90° in comparison to 90°), budding angle (10° against 25°) and in arrangement of zooecia (contacting in comparison to free).

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: New York, Ohio, Kentucky, Middle Devonian. Canada: Ontario, Middle Devonian.

Hederella (Paralhederella) compacta (Bassler, 1939)
(Pl. III, Fig. 3)

1939. *Hederella compacta*, Bassler; R. S. Bassler, The Hederelloidea..., p. 56, Pl. 5, Fig. 13.

Material. — One specimen incrusting, together with *Hederella (Hederella) alternata* (Hall & Whitfield, 1873), a crinoid surface.

Description. — Zoarium composed of very closely arranged branches up to 12 mm in length, forming a compact mass of zooecial tubes, in which it is difficult to distinguish the central axis. Zooecial tubes, more or less rectangular in outline, length 1 to 1.5 mm, diameter 0.4 to 0.5 mm, four to 5 zooecia occur in 5 mm. Zoarium less compact at peripheries, where zooecia are alternately disposed and distances between branches ranging from 0.5 to 2 mm. Budding angle very low, not over 10°, when measured at peripheries — 20° to 30°. Branching frequent, for example zoarium branches 3 times in 4 mm. Apertures transversally elliptical. Surface ornamentation in form of delicate, transverse striation.

Remarks. — Comparing the zoaria from Poland with these described by Bassler, the former are more variable in length (from 1 to 1.5 mm in comparison to 1.5 mm) and of smaller diameters (from 0.4 to 0.5 mm compared to 0.7 mm). Branching angle also variable and sometimes wider (from 20° to 30° compared to 20°).

In dimensions of tubes, described species is similar to *H. (Paralhederella) louisvillensis* (Bassler, 1939). It differs in budding angle (10° compared to 25°), branching angle (from 20° to 30° against 50°) and in the variable spacing of branches (from 0.5 to 2 mm compared to 10 mm).

Occurrence. — Poland: Skały, Givetian. USA: Michigan, Middle Devonian.

Hederella (Paralhederella) louisvillensis (Bassler, 1939)
(Pl. VII, Fig. 2)

1939. *Hederella louisvillensis*, Bassler; R. S. Bassler, The Hederelloidea..., p. 57, Pl. 5, Fig. 8.

Material. — One zoarium incrusting 1 cm² of the surface of *Blothrophyllum* sp.

Description. — Zoarium with regular branches to 10 mm in length. Angle of branching 50°. Zooecia usually wider by apertures, narrower proximally, in close contact or can be free to a greater or lesser degree. Length from 1 to 1.5 mm, diameter 0.3 mm. Budding angle of contacting zooecial tubes acute — 10°, of free tubes — 25°. Four to 5 zooecia occur in 5 mm on one side of a branch. Intervals between branches variable, ranging from 1 to 2 mm, sometimes 5 mm. Beside bifurcating branches often occur single branches, about 8 mm in length. Apertures usually transversally elliptical. Surface ornamentation distinct, composed of more or less frequently arranged transverse striae. Striae often covered with small granules.

Remarks. — Described species resembles *H. (Paralhederella) bilineata* (Bassler, 1939) in diameters and arrangement of zooecial tubes, but it differs in shape of zooecia (narrowed proximally against rectangular), in length of zooecia (to 1.5 mm compared to 1 mm), more frequent branching and smaller distances between branchings (from 1 to 2 mm compared to 3 mm).

Occurrence. — Poland: Grzegorzowice, Couvinian. USA: Kentucky, Middle Devonian.

Order **Cystoporata** Astrova, 1964
Suborder **Ceramoporoidea** Bassler, 1913
Family **Ceramoporidae** Ulrich, 1882
Genus *Ceramoporella* Ulrich, 1882

Type species: Ceramoporella distincta Ulrich, 1890. Ordovician.

Stratigraphical range: Orodowician — Devonian.

Ceramoporella orbiculata n. sp.
Pl. XI, Figs 2, 3; Text-fig. 18, 19)

Holotypus: Specimen Z. Pal. No Br. IV/8576; Pl. XI, Fig. 3.
Stratum typicum: Couvinian, complex III; trench 34.
Locus typicus: Grzegorzowice, Holy Cross Mts., Poland.
Derivatio nominis: Lat. *orbiculatus* = disk-like; *Ceramoporella* with disk-like zoaria.

Diagnosis. — Zoaria incrusting, disk-like, usually rounded. Six to 8 apertures, usually 6, occur in 2 mm. Cystopores with diaphragms.

Material. — Twenty two zoaria in different state of preservation. Seven incrusting a surface of *Fistuliramus astrovae* n. sp. in association with *Allonema* sp., *Diversipora bitubulata* n. sp., *Hederella* sp., *Aulopora* sp., *Spirorbis* sp. and undetermined tetracoral. Fifteen incrust a branching *Lioclema* sp. accompanied by *Spirorbis* sp. Among these latter, 2 zoaria are much larger and not typically rounded and disk-like. Six thin sections.

Description. — Zoaria incrusting, disk-like, usually rounded, diameters from 5 to 12 mm, height not over 0.5 mm. The whole of their base adhering to substratum or free on peripheries. The epitheca with very delicate, concentric wrinkles is visible in free, peripheral parts. Only one monticule, sometimes slightly raised or lowered, occurs at the centre of zoarium on external side. Zooecia tube-like, very short, oblique, arranged radially around the central monticule. Both, the zooecia adjacent to the monticule and those not, are usually of equal size. Zooecia isolated by one, more rarely two rows of cystopores.

Tangential section. Zooecial apertures, usually pear-shaped, with diameters 0.42×0.21 mm, arranged in longitudinal rows. Zooecia in narrowed part, to more or less half of its circumference, form a rather distinct lunarium. Lunarial deposit widest in middle part of lunarium (0.09 mm) and narrowest at distal ends (0.04 mm). Distal ends of lunarium protrude to a greater or lesser degree, into the aperture. Zooecial walls have a delicate, laminar microstructure. Lamellae usually arranged parallel to apertures or, in places, radial. In lunaria no specific lamination or so called "cores" are observed (Utgard, 1968). Cystopores of different dimensions, the largest up to half the size of apertures (0.21×0.10 mm), round, oval or close to triangular. Eight to ten cystopores occur in 2 mm (Pl. XI, Fig. 2, 3; Text-fig. 18).

Longitudinal section. Walls of zooecial tubes, both in endozone and exozone, thin (from 0.01 to 0.02 mm). Diaphragms thin, at least half that of walls of zooecial tubes, disposed at intervals of 0.3 to 0.4 mm. Some diaphragms in adjacent zooecia are developed almost at the same level. Diaphragms, usually straight, arranged slightly obliquely. Cystopores, narrower than zooecia (diameters from 0.08 to 0.14 mm), have more diaphragms (from 6 to 8), convex or straight, densely and regularly distributed at intervals of 0.06 to 0.9 mm. Microstructure of zooecial and cystopore walls similar, showing slight lamination. Laminated structure is well visible in transverse sections (Text-fig. 19).

Comparison. — *Ceramoporella orbiculata* n.sp. is the first representative of genus *Ceramoporella* Ulrich, described from the Middle Devonian (Couvinian and Givetian of Holy Cross Mts.). Two species were previously

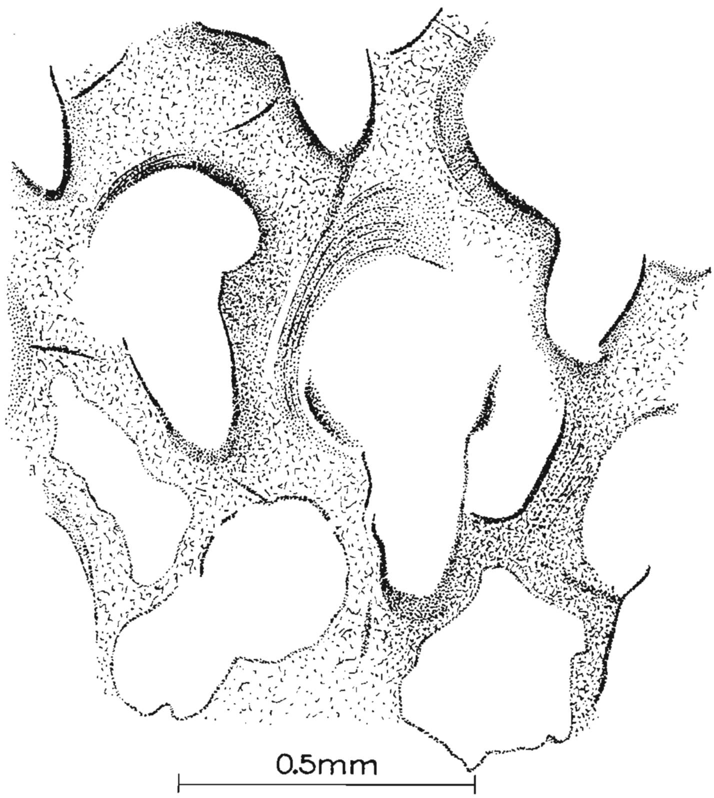

Fig. 18 — *Ceramoporella orbiculata* n.sp. (Z. Pal. Br. IV/8083). Tangential section, zooecial apertures with lunaria; cystopores usually filled with limy sediment.

described by Orlovskij (1964) from the Lower Devonian (Gedinnian, South Fergana, Soviet Union). They are: *Ceramoporella devonica* Orlovskji, 1964 and *C. convexa* Orlovskji, 1964. The new species differs from the former in the shape of zoarium (incrusting, discoidal instead of branch-like), presence of monticules, larger (0.42×0.21 mm, insted of 0.35×0.18 mm) and pear-like, instead of oval or eliptical, apertures. From the second of mentioned species, it differs in smaller dimensions of zoaria, larger diameters of zooecia (0,42×0.21 mm, instead of 0.25×0.21 mm), cystopores with diaphragms (instead of cystopores with no diaphragms) and in the absence of peristomes.

The new species is similar to *Ceramoporella distincta* Ulrich, 1890 in having zooecia with distinct lunaria and numerous cystopores separating zooecial apertures with single or double rows.

Ceramoporella orbiculata n.sp. reminds one of *Ceramoporella ohioensis* (Nicholson, 1875) in having a similar number of zooecia occurring in 2 mm similar dimensions of apertures and distinct lunaria.

Occurrence. — Poland: Grzegorzowice, Couvinian; Skały, Givetian.

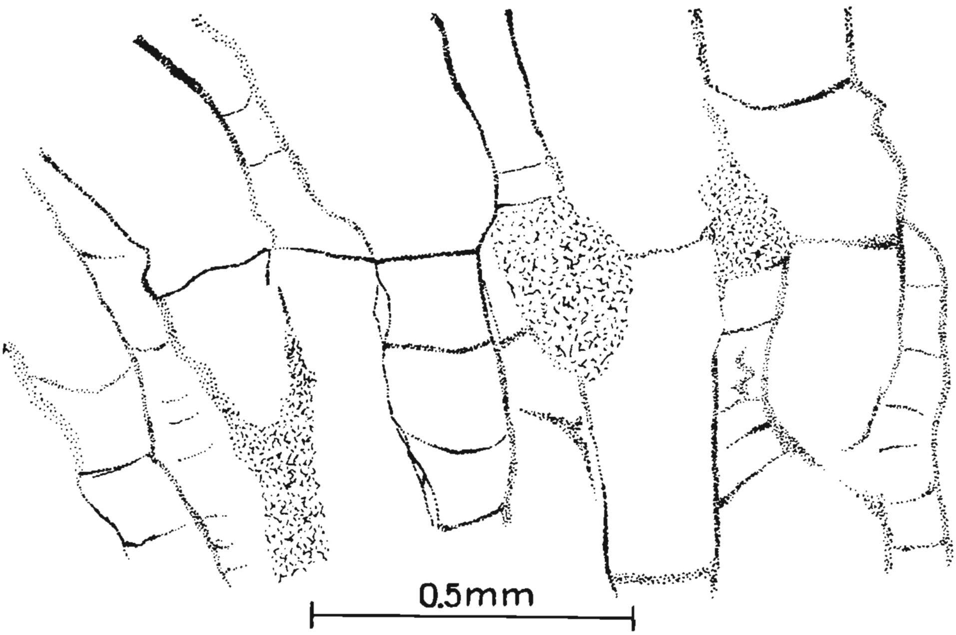

Fig. 19 — *Ceramoporella orbiculata* n.sp. (Z. Pal. Br. IV/8083). Longitudinal section, zooecial tubes with rare diaphragms, cystopores arranged in single rows.

Ceramoporella grandicystica n.sp.

(Pl. XIII, Fig. 1 Pl. XIV, Fig. 3; Text-figs 20, 21)

Holotypus: Specimen Z. Pal. No. Br. IV/17184; Pl. XIV, Fig. 3; Text-fig. 20.
Stratum typicum: Couvinian, complex III, trench 34.
Locus typicus: Grzegorzowice Holy Cross Mts, Poland.
Derivatio nominis: Lat. *grandis* = great: *cystis* = vesicle, species with vesicular, large cystopores.

Diagnosis. — Zoaria incrusting, lamellate; three to four apertures occur in 2 mm. One row of very large cystopores with diaphragms.

Material. — Five zoaria, 9 thin sections. Three zoaria are preserved on Tetracoralla and associated with *Hederella* sp., *Favositella* sp., *Aulopora* sp., *Alveolites* sp. and *Spirorbis* sp. The two remaining ones incrust Bryozoa: *Fistulipora* sp. and *Fistuliramus astrovae* n.sp., and are accompanied by *Hederella* sp., *Aulopora* sp. and *Spirorbis* sp.

Description. — Zoaria thin, incrusting, lamellate, 2 mm in thickness. Diameters of largest zoarium up to 15×35 mm. They adhere to the substratum by a very thin, basal epithecate layer. Monticules more or less at the same level as the surface of the zoarium, the groups of cystopores forming them, more or less round. Zooecial tubes, adjacent to the monticules, not differing in shape or dimensions from the rest of zooecia.

Tangential section. Oval or pear-like zooecial apertures 0.25×0.20 mm in diameter, are often arranged diagonally. Apertures with a wide, (maxi-

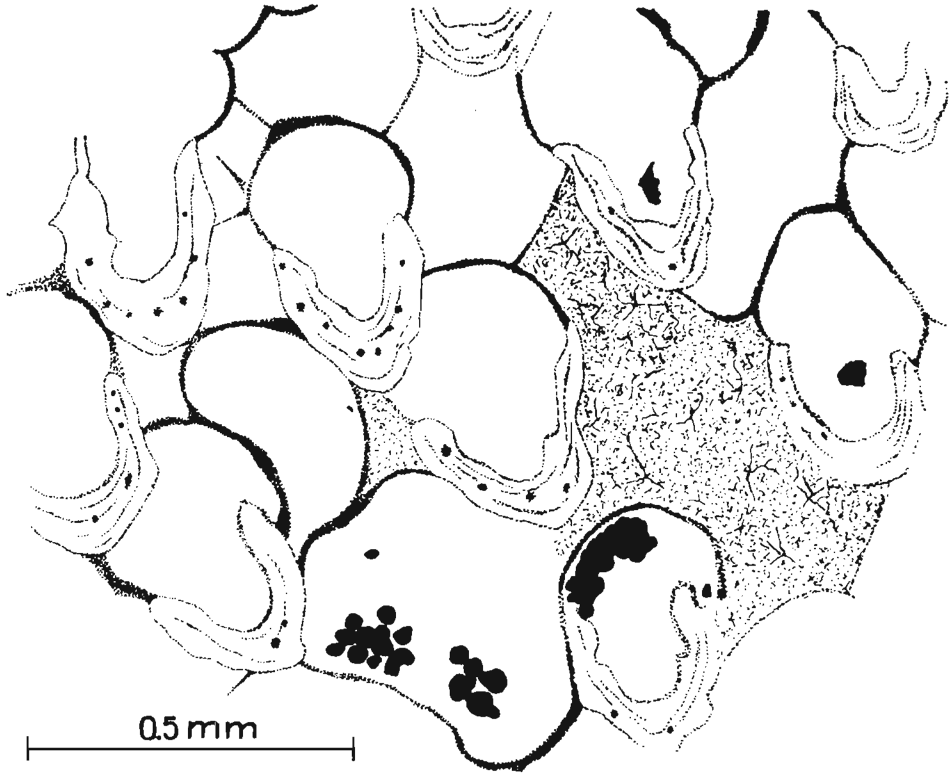

Fig. 20 — *Ceramoporella grandicystica* n.sp. (Z. Pal. Br. IV/17184, holotype). Tangential section, zooecial apertures with large lunaria and distinct cores; large cystopores; brown bodies inside of zooecia and cystopores.

mum from 0.06 to 0.07 mm), and distinct lunarium. Lunarium is widest in the middle, narrower by the ends. Lunarial ends protrude distinctly into the zooecial cavity. From 2 to 8 cores and laminated structure visible in lunaria. More or less distinct lamination, parallel to the edges of lunaria, and concentric by the cores. Similar cores were observed by Utgaard (1968) while examining some North American ceramoporoids. In zooecial walls, darker in colour than lunaria, lamination is not distinct. Zooecial apertures usually separated by comparatively large cystopores. Nevertheless, zooecial apertures not separated by cystopores frequently occur. Cystopores arranged in a single rows oval, triangular or polygonal in shape. Size of cystopores varies, diameters for example 0.36×0.24 mm, 0.20×0.18 mm, and they can be smaller, equal or larger than zooecial apertures; 3 to 4 cystopores occur in 2 mm, i.e. the same number as apertures. Cystoporal walls usually thinner than those of zooecia and without distinct lamination. Aggregations of brown bodies occur inside cystopores and zooecial apertures, being a product of degeneration of autozooids (apertures) or modified polypides (cystopores) (Utgaard, 1968). Individual brown bodies are round of different diameters (0.02, 0.04, 0.18 mm). Often brown bodies form groups of different shape and size. Diameters of these groups ranging from 0.24×0.20 mm to 0.30×0.17 mm (Text-fig. 20).

Longitudinal section. Zooecial tubes obliquely arranged, equal or narrower in endozone (0.36 mm) or vice-versa. Zooecial walls straight or slightly undulatory, thin in endozone (0.012 mm), and wider in exozone 0.02 mm). Laminar structure of zooecial tubes not distinct. Lunarial deposit, ranging from the endozone to the surface of zoarium, can be observed in zooecial tubes. Diaphragms lacking. Cystopores, like zooecia, slightly obliquely arranged in single rows. They are very wide, wider in endozone (the opposite to zooecia) (0.36 mm) and narrower in exozone (0.24 mm), beginning in the basal layer and extending up to surface of zoarium. Thickness of cystoporal walls the same as for zooecial walls. Microstructure of cystopore walls not well proserved (Text-fig. 21).

Comparison. — The large cystopores of the described species resemble those of *Ceramoporella devonica* Orlovskij, 1964. The latter species differing in its rarely occurring lunaria and branched zoarium.

The incrusting character of zoarium, distinct wide lunaria and dimensions of apertures make *Ceramoporella grandicystica* n.sp. closest to *Ceramoporella distincta* Ulrich, 1890. Differences occur in the number and size of cystopores, the new species having a few large cystopores, *Ceramoporel-*

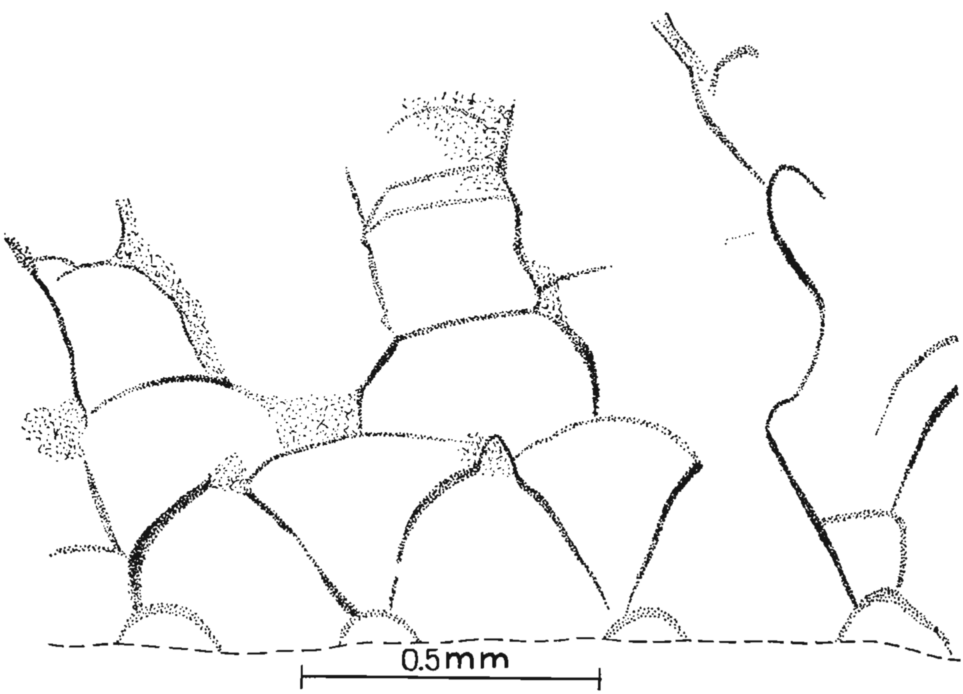

Fig. 21 — *Ceramoporella grandicystica* n.sp. (Z. Pal. Br. IV/17185). Longitudinal section, broad zooecial tubes separated by one row of wide cystopores.

la distincta numerous. From the disk-like zoarium of *Ceramoporella orbiculata* n.sp. the present species differs in having a lamellar, larger zoarium, smaller diameters of zooecia (0.25×0.20 mm, instead of 0.42××0.21 mm) and larger cystopores (0.36×0.24 mm, 0.18×0.15 mm, compared to 0.21×0.10 mm), 3 to 4 occurring in 2 mm, instead of 8 to 10.

Occurrence. — Poland: Grzegorzowice, Couvinian.

Genus *Favositella* Etheridge & Foord, 1884

Type species: Favosites interpunctus Quenstedt, 1881. Silurian, Wenlockian.
Stratigraphical range: Ordovician — Middle Devonian.

Favositella integrimuralis n.sp.

(Pl. X, Fig. 3; Pl. XI, Fig. 1; Pl. XIV, Fig. 2; Text-figs 22, 23)

Holotypus: Specimen Z. Pal., No. Br. IV/17160; Text-fig. 22, 23; Pl. XI, Fig. 1.
Stratum typicum: Couvinian, complex III, trench 34.
Locus typicus: Grzegorzowice, Holy Cross Mts., Poland
Derivatio nominis: Lat. *integer* = entire; *muralis* = wall; species with integrata type of zooecial walls and with zooecia separated by a dark line.

Diagnosis. — Zoarium incrusting, lamellar, round. Usually 4 apertures occur in 2 mm. Lunaria crescent-shaped. Long protrusions, plate-like or rod-like. Wall pores rare, irregularly distributed. Cystopores of small dimensions, short, rare, with diaphragms.

Material. — Three well preserved zoaria incrusting Tetracoralla; 12 thin sections.

Description. — Zoaria incrusting, round in outline, about 4×6 mm in diameter, in the form of thin (not over 1 mm) lamella. Zooecia short, tube-like, wide apertures of diameters, on an average, 0.3×0.4 mm and crescent-shaped lunaria. Zooecia arranged slightly obliquelly, usually close to each other or more rarely separated by single cystopores. As a rule, they are wider in exozone and narrower in endozone. Cystopores comparatively small with diameters mostly 0.1×0.2 mm. Monticules, visible on the surface of zoarium, flush with it, or occasionally slightly depressed. Zooecia, surrounding a monticule, radially arranged and of larger diameters (0.4×0.5 mm).

Tangential section. Zooecial apertures of multilateral, usually quadrangular shape with rounded corners. Diameters of apertures are 0.36××0.42 mm; 0.45×0.48 mm; 0.36×0.57 mm. More or less crescent-shaped lunaria, maximum width 0.04 mm, protrude into zooecial cavity. Distances between lunarial ends ranging from 0.14 to 0.18 mm. Protrusions (see Utgaard, 1969) extend, similar to lunaria, into zooecial cavity. Protrusions are comparatively long (from 0.12 to 0.14 mm) and are of plate-like or rod-like shape. Cystopores rare, narrow, in exozone doubling their thickness, characterized by their variable shape: multilateral, quadrangular, triangular or oval. Diameters of cystopores ranging from 0.12×

×0.24 mm to 0.18×0.30 mm. A distinct zooecial boundary expressed as a dark line, is preserved in walls between adjacent zooecia, or zooecia and cystopores. Zooecial walls usually slightly thicker in subsurface part of zoarium, where it ranges from 0.02 to 0.03 mm. Wall pores, usually semicircular, rarely preserved. Microstructure of zooecial and **cystoporal** walls laminar (Text-fig. 22).

Longitudinal section. Basal layer thin, gently undulated, from 0.01 to 0.02 mm in width, distinguished by an oblong, laminate structure.

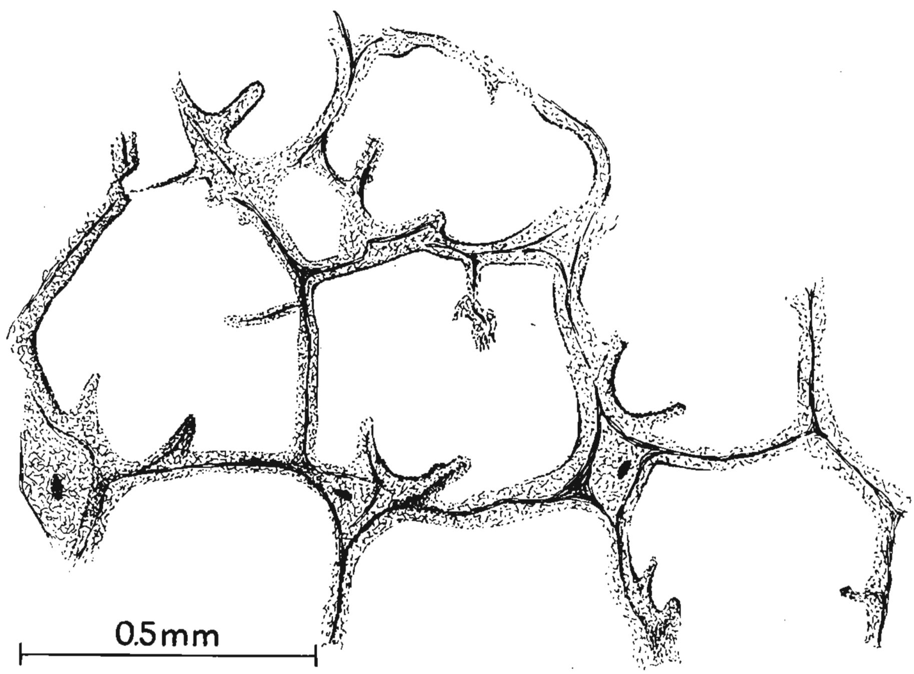

Fig. 22 — *Favositella integrimuralis* n.sp. (Z. Pal. Br. IV/17160, holotype). Tangential section, large apertures with distinct crescent lunaria and protrusions zooecial walls with a dark zooecial boundary, single small cystopores.

Zooecial tubes broad, broader in exozone, with diameters range from 0.30 to 0.54 mm, usually with well developed recumbent portion and well developed recumbent sinuses. Zooecial tubes obliquely arranged with very rare, thin diaphragms at 0.3 mm intervals. Zooecial walls of integrate type are of medium thickness 0.02 mm, slightly thicker in exozonal part. Sometimes, a few wall pores are preserved, irregularly distributed, diameters about 0.01 mm. Wall microstructure with convex, obliquely or radially arranged laminae. Sometimes, visible in walls, are light coloured elements, characteristic, parallelly arranged, which resemble probably mural lacunae (see Utgaard, 1969, p. 294). Distinct protrusions present on walls of zooecial tubes. Their microstructure similar to that of walls, laminar. Protrusions occur only on one side of zooecial tube at distances of 0.1 to

0.18 mm, usually arch-shaped, comparatively long and sometimes up to half the diameter of a zooecial tube. Sometimes, a lunarial deposit is preserved and extends from endozone to exozone. Microstructure of lunarial deposit laminar, similar to that of walls. Cystopores variable in size and shape, narrow and short. Diameters about 0.1 mm in proximal part and 0.22 mm distally (Text-fig. 23).

Comparison. — Walls of described species remind one of the type of wall occurring in order Trepostomata, suborder Integrata (name of described species taken from here). The occurrence of the dark line is contrary to the diagnosis of the genus given by Utgaard (1969, p. 294), according to which, the genus *Favositella* has amalgamate type walls. This feature is known in other the ceramoporoid genera, for instance in *Papillalunaria* (Utgaard, 1969, p. 290).

The described species, with its lamellar and round zoarium, has no corresponding species among those presently known. In the tangential section it is nearest to *Favositella interpuncta* (Quenstedt), illustrated by Utgaard (1969, Pl. 53, Fig. 1). Similar to the compared species are the dimensions, shape of apertures and crescent-shaped lunaria.

Favositella integrimuralis n.sp. approaches *F. mirabilis* (Astrova, 1965) [2] in similar dimensions and shapes of apertures, but differs in the character of walls, their thickness, shape and width of lunaria, dimensions and shape of cystopores and smaller wall pores.

Occurrence. — Poland: Grzegorzowice, Couvinian.

Fig. 23 — *Favositella integrimuralis* n.sp. (Z. Pal. Br. IV/17160, holotype). Longitudinal section, broad zooecial tubes, raised from a thin undulated basal layer; zooecial walls with protrusions and a few pores; rare cystopores, usually filled with limy sediment.

[2] Species was described by Astrova (1965) as *Dnestropora mirabilis* n. gen., n. sp. Utgaard (1969) included genus *Dnestropora* Astrova, 1965 to the synonymy of genus *Favositella* Etheridge & Foord, 1884, which seems to be, according to the present author, justified.

Suborder **Fistuliporoidea** Astrova, 1964
Family **Fistuliporidae** Ulrich, 1882
Genus *Fistulipora* McCoy, 1850

Type species: Fistulipora minor McCoy, 1850. Carboniferous.
Stratigraphical range: Ordovician — Permian.

Fistulipora boardmani n.sp.
(Text-fig. 24 A, B)

Holotypus: Specimen Z. Pal. No. Br. IV/17166; Text-fig. 24 A, B.
Stratum typicum: Couvinian, complex III, trench 34.
Locus typicus: Grzegorzowice, Holy Cross Mts., Poland.
Derivatio nominis: boardmani — named in honour of Dr. R. S. Boardman, Washington, Smithsonian Institution, USA.

Diagnosis. — Lamellar zoaria composed of one to three layers, incrusting or free, round apertures and poorly developed lunaria. Cystopores often in single rows.

Material. — Four zoaria, 12 thin sections. Two zoaria incrusting Tetracoralla, one incrusting *Fistuliramus astrovae* n.sp., one free.

Description. — Zoaria incrusting or free, of different dimensions (30×30 mm, 10×15 mm) composed of 1—3 layers. Thickness of a layer ranging from 1 to 2 mm. Free zoarium covered from the basal side by an epitheca, concentrically wrinkled. One or two maculae 0.9×1.5 mm in size are raised or flush with the rest of zoarium. Zooecia arranged obliquely, so the shape of apertures is usually oval. Lunaria visible only on surface as narrow, crescent-shaped swellings, ranging from 1/3 to 1/2 of the zooecial apertures.

Tangential section. Zooecia with round or oval apertures, occurring at intervals of 0.06 to 0.18 mm. Apertural diameters about 0.26×0.29 mm; 0.33×0.33 mm; 0.36×0.36 mm. Four apertures occur in 2 mm measured in various directions. Apertures separated usually by one, or rarely two or three rows of cystopores. Cystopores differ in shape and dimensions. They are hexagonal, pentagonal or quadrangular, rarely rounded and always smaller than apertures. Thickness of zooecial walls, usually larger than that of cystopores, ranges from 0.01 to 0.03 mm. Maculae, few in number (1 to 2), 0.9×1.5 mm in size, oval, composed of cystopores. Zooecial apertures surrounding them, have larger diameters (0.39×0.39 mm) and are wider spaced than the rest of zooecia. Eight to 12 cystopores occur in 2 mm measuring obliquely (Text-fig. 24 A).

Longitudinal section. Zooecia emerge from a thin, about 0.03 mm, epitheca. Zooecial tubes arranged at angles of 90° or 60°, usually narrower basally (from 0.09 to 0.16 mm in diameter) and wider in the subsurface part (from 0.26 to 0.33 mm). Complete diaphragms very thin, concave,

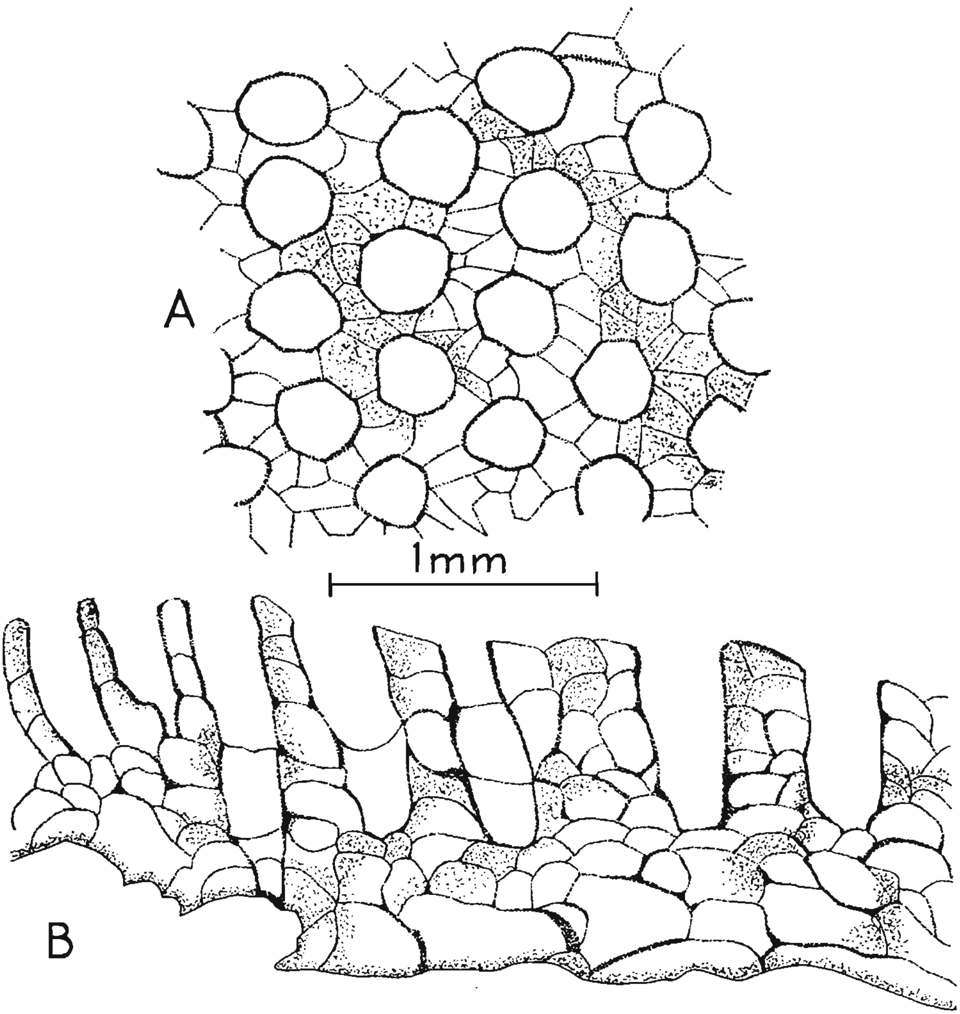

Fig. 24 — *Fistulipora boardmani* n.sp. (Z. Pal. Br. IV/17166, holotype): *A* tangential section, apertures surrounded by cystopores; *B* longitudinal section, zooecial tubes separated by cystopores.

straight or oblique, arranged at 0.33 mm intervals. Each zooecium separated, usually by one, rarely two or three rows of cystopores. Diameters not uniform on the whole length of cystopores, but range from 0.06 to 0.17 mm. As in tangential sections, width of zooecial walls usually greater than that of cystopores — from 0.01 to 0.03 mm (Text-fig. 24 B).

Comparison. — *Fistulipora boardmani* n.sp. differs from *F. emphantica* n.sp. mainly in the shape and larger dimensions of apertures, less developed lunaria and larger cystopores. Similar to both species are the incrusting or free character of zoaria and development of maculae, which consist of cystopores.

Occurrence. — Poland: Grzegorzowice, Couvinian.

Fistulipora emphantica n.sp.

(Pl. XV, Fig. 2; Pl. XVI, Fig. 3a, b; Text-fig. 25-27)

Holotypus: Specimen Z. Pal., No. Br. IV/17164; Text-fig. 26, 27.
Stratum typicum: Couvinian, complex III, trench 34.
Locus typicus: Grzegorzowice, Holy Cross Mts., Poland.
Derivatio nominis: Gr. *emphantikos* = distinct; species with the typical, distinct features of *Fistulipora*.

Diagnosis. — Zoaria small, incrusting or large and free, composed of 2 to 3 layers. Apertures transversally oval with well developed lunaria. Cystopores numerous, small. Maculae regularly distributed.

Material. — Three zoaria, 15 thin sections. Two small zoaria incrusting Tetracoralla and occurring in association with *Diversipora bitubulata* n.sp., *Hederella* sp. and *Spirorbis* sp. One large zoarium, multilayered, accompanied by *Aulopora* sp., *Hederella* sp., *Spirorbis* sp. and incrusted by a massive, multilayered zoarium of *Cyclotrypa nekhoroshevi* n.sp.

Description. — Zoarium small, incrusting, composed of one layer (diameter 10×10 mm, thickness 1 mm) or massive, multilayered (diameter 60×9.5 mm, thickness of layers from 1 to 6 mm). Surface of massive zoarium uneven, with maculae regularly distributed (usually every 5 mm), visible on smoother fragments of zoarium. Maculae with diameters of 1.5 mm, round, slightly raised or flush with the rest of zoarium surface, are composed of apertures. Zooecial cystopores surrounding maculae larger than the rest, arranged concentrically, lunaria always directed towards the centre of a maculae.

Tangential section. Zooecia oval, diameters from 0.19×0.26 mm to 0.33×0.36 mm, longitudinal diameter always smaller than transversal one. Four to 5 zooecial apertures occur in 2 mm measured diagonally. Thickness of zooecial walls about 0.03 mm. Lunaria usually narrow, thickness from 0.02 to 0.03 mm, crescent. Transversal diameter of lunaria ranging from 0.09 to 0.19 mm, usually 0.13 mm. Lunarial longitudinal diameters from 0.06 to 0.13 mm, usually 0.06 mm. Maximal thickness up to 0.04 mm, usually 0.03 mm. Zooecia separated by 1 to 6 cystopores. Cystopores vary in dimensions. Besides very small cystopores, occur others 2, 3 or 5 times larger, but always smaller than zooecia. Shape of cystopores usually polygonal, mostly hexagonal. Walls half the thickness these of zooecia; 10 to 14 cystopores occur in 2 mm, measured horizontally (Text-fig. 25, 26).

Longitudinal section. Each layer of zoarium growing from a basal lamina, which is undulated and of thickness ranging from 0.03 to 0.04 mm. Zooecia obliquely arranged at an angle of 60°, with undulating, zigzag outlines, so diameters in one tube are uneven, ranging from 0.16 to 0.39 mm. Diameters measured by the surface usually larger. Diaphragms few, convex or straight; usually 1 or 2 occurring in the proximal part of a tube. Spaces between zooecia filled with one or three vertical rows of

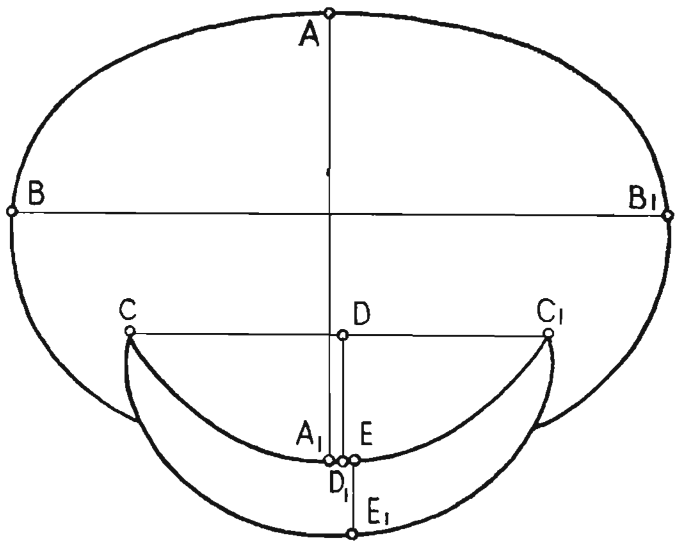

Fig. 25 — *Fistulipora emphantica* n.sp. Tangential section of zooecium (diagram): *AA*' longitudinal diameter of zooecium, *BB*' transversal diameter of zooecium, *CC*' transversal diameter of lunarium, *DD*' longitudinal diameter of lunarium, *EE*' maximum thickness of a lunarium.

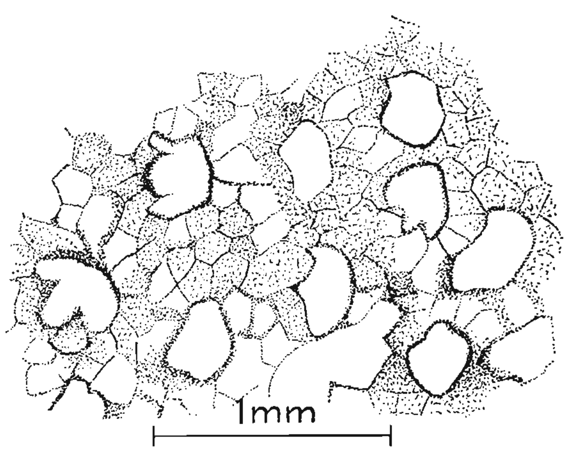

Fig. 26. — ***Fistulipora emphantica*** **n.sp. (Z. Pal. Br. IV/17164, holotype). Tangential section, obliquely arranged zooecial tubes separated by cystopores.**

cystopores. Cystoporal diaphragms straight, oblique or convex, unevenly distributed. Cystopores in subsurface part filled with a limy sediment (Text-fig. 27).

Comparison. — Both species from the Couvinian of the Holly Cross Mts., i.e. *Fistulipora boardmani* n.sp. and *F. emphantica* n.sp., as well as *F. pillarensis* Phillips-Ross, 1961 from the Middle Devonian of Australia (Phillips-Ross, 1961), differ from species, described from the Givetian of the Soviet Union, in the absence of peristomes.

The new species differ from *F. pillarensis* Phillips-Ross, 1961 in much thinner basal lamella (= epitheca; 0.03 to 0.04 mm, instead of 0.6 to 1.5 mm), shape of apertures (oval instead of round) and by lunaria (1/3 of apertural circumference instead of 1/5). *F. emphantica* n.sp. differs mainly

Fig. 27 — *Fistulipora emphantica* n.sp. (Z. Pal. Br. IV/17164, holotype). Longitudinal section, obliquely arranged zooecial tubes separated by cystopores.

from the Chinese Middle Devonian *F. kwangsiensis* Yang, 1954 and *F. youngehunensis* Yang, 1954 (Yang, 1954), in the absence of cystiphragms.

Detailed comparison of here described species and *F. boardmani* n.sp. — see p. 378.

Occurrence. — Poland: Grzegorzowice, Couvinian.

Genus *Cyclotrypa* Ulrich, 1896

Type species: Fistulipora communis Ulrich, 1890. Devonian.
Stratigraphical range: Silurian — Permian.

Cyclotrypa nekhoroshevi n.sp.

(Pl. XII, Fig. 1a, b; Pl. XIII, Fig. 3; Pl. XIV, Fig. 4; Pl. XV, Fig. 3a, b; Text-figs 28-30)

Holotypus: Specimen Z. Pal. No. Br. IV/17169; Pl. XII, Figs 1a, b; Pl. XIII, Fig. 3; Pl. XIV, Fig. 4; Pl. XV, Fig. 3a, b.
Stratum typicum: Couvinian, complex III, trench 34.

Locus typicus: Grzegorzowice, Holy Cross Mts., Poland.
Derivatio nominis: *nekhoroshevi* — named in honour of Prof. Dr V. P. Nekhoroshev, a Soviet investigator of palaeozoic Bryozoa; Leningrad, VSEGEI, USSR.

Diagnosis. — Zoaria incrusting, multilayered and massive possessing an epitheca and maculae. Zooecial apertures round with granulate peristomes. Diaphragms few complete. Numerous cystopores in 1 to 4 rows. Minutopores numerous, small.

Material. — Thirteen zoaria, 5 of which are free (2 large, massive, multilayered; 3 small, composed of one or two layers) and 8 incrusting (large and small, composed of 1 to 4 layers). Among incrusting zoaria, five are spreading over Tetracoralla, one — *Fistuliramus astrovae* n.sp., one — *Fistulipora emphantica* n.sp., one — *Leptotrypa* sp.? All specimens are accompanied by a very large associated assemblage, especially with other species of Bryozoa (*Allonema moniliforme aggregatum* Ulrich & Bassler, 1904, *Ascodictyon sparsiforme* Kiepura, 1965, *Eliasopora stellata* (Nicholson & Etheridge, Jr., 1877), *Diversipora bitubulata* n.sp., *Hederella* sp., *Ceramoporella* sp., *Favositella integrimuralis* n.sp. *Fistulipora emphantica* n.sp., *Fistuliramus astrovae* n.sp., *Cyphotrypa* sp., *Lioclema* sp., *Fenestella* sp.), and Tabulata (*Aulopora* sp.), Annelida (*Spirorbis* sp.), Hydrozoa, Crinoidea, Tetracoralla. 94 thin sections. State of preservation good.

Description. — Zoaria large, massive, multilayered up to maximum dimensions 45×65×70 mm, thickness of layers from 1 to 5 mm, incrusting, some also free, or small, lamellar ones, mainly incrusting, composed of one or two layers up to 5 mm thick, 25 mm in diameter. All zoaria developed a wrinkled epitheca of various thickness. Tubes of zooecia and cystopores emerging from the epitheca, are prostrate in basal part, later bending vertically. Zooecial apertures round with a peristome formed from 12 to 14 regular granules joined in laminar elements, visible on interior and exterior of zooecial tubes (Pl. XIII, Fig. 3; Pl. XIV, Fig. 4). Cystoporal tubes multilateral, often filled with a limy sediment. Maculae, present as groups as the cystopores, round, 2 mm in diameter, occurring usually on the same level of zoarium, rarely are they slightly raised or depressed. Distance between maculae, measured from their centres, range from 5 to 8 mm. Apertures of zooecia, surrounding maculae, slightly larger — 0.3×0.3 mm.

Tangential section. Zooecial apertures, in sections closest to surface (Pl. XII, Fig. 1b; Text-fig. 28) from round to asteroidal. Apertural diameters ranging from 0.23×0.26 to 0.31×0.33 mm. Distances between zooecia from 0.13 to 0.50 mm. Zooecia develop distinct peristomes from 0.06 to 0.07 mm and exceptionally 0.09 mm in width. Sometimes peristomes of adjacent apertures adhering. Peristomes usually of lighter colour and similar shape as apertures. Minutopores round or oval, about 0.03 mm in diameter, visible in peristomes. They are spaced from 0.01, 0.03 to 0.12 mm

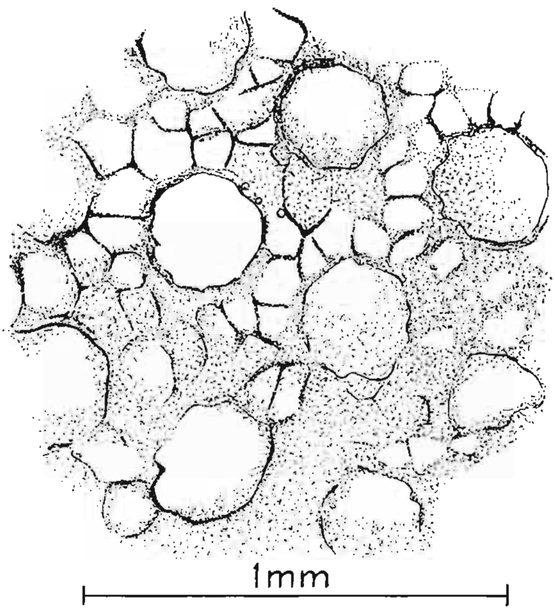

Fig. 28 — *Cyclotrypa nekhoroshevi* n.sp. (Z. Pal. Br. IV/17178). Tangential section, large apertures surrounded by peristomes, rare minutopores; numerous small cystopores usually filled with limy sediment.

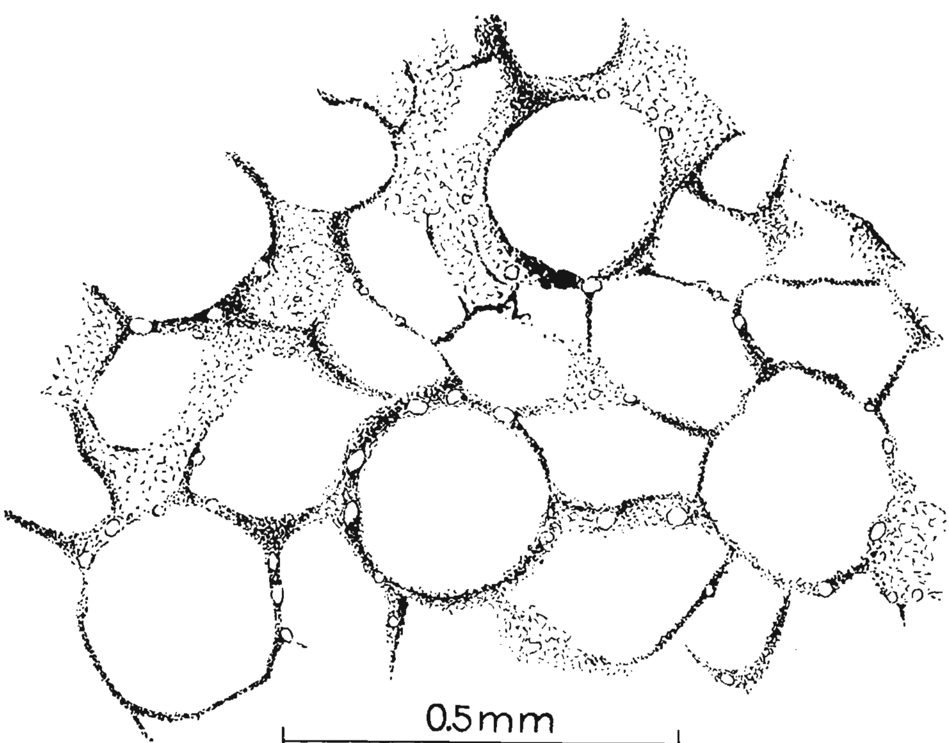

Fig. 29 — *Cyclotrypa nekhoroshevi* n.sp. (Z. Pal. Br IV/17171). Tangential section, large zooecial apertures and cystopores with distinct minutopores in both.

apart. Cystopores placed between zooecia are impregnated with a limy sediment, or present in sections in the form of geometrical figures.

Zooecial apertures in deeper, tangential sections (Pl. XV, Fig. 3a; Text-fig. 29) are, as a rule, round with slightly larger diameters. In zooecial and cystoporal walls small minutopores are preserved. Minutopores round, oval, sometimes triangular, with diameters from 0.01 to 0.03 mm, are usually 0.03 to 0.04 mm apart; 3 to 7 minutopores occur in the wall of one zooecial aperture. Zooecial apertures separated usually by one to four rows of cystopores, i.e. at a distance of 0.08—0.5 mm. Four zooecia occur, on an average, in 2 mm. Zooecial walls are of equal or greater thickness (from 0.01 to 0.03 mm) than these of cystopores (from 0.008 to 0.01 mm). Cystopores in sections multilateral or round and very variable as to size. As well as small cystopores of diameters 0.06×0.09 mm occur also larger ones 0.23×0.29 mm in diameter; 5 cystopores occur in 1 mm.

Longitudinal section. Zooecial tubes usually of uniform width on their whole length, ranging from 0.26 to 0.29 mm. Diaphragms mostly concave, straight or oblique are present in a tube; 3 to 5 diaphragms occur in 1 mm at intervals of 0.33 to 0.66 mm, exceptionally 0.23 to 0.69 mm. Some zooecial tube walls are thicker — from 0.03 to 0.06 mm. Minutopores, 16 in

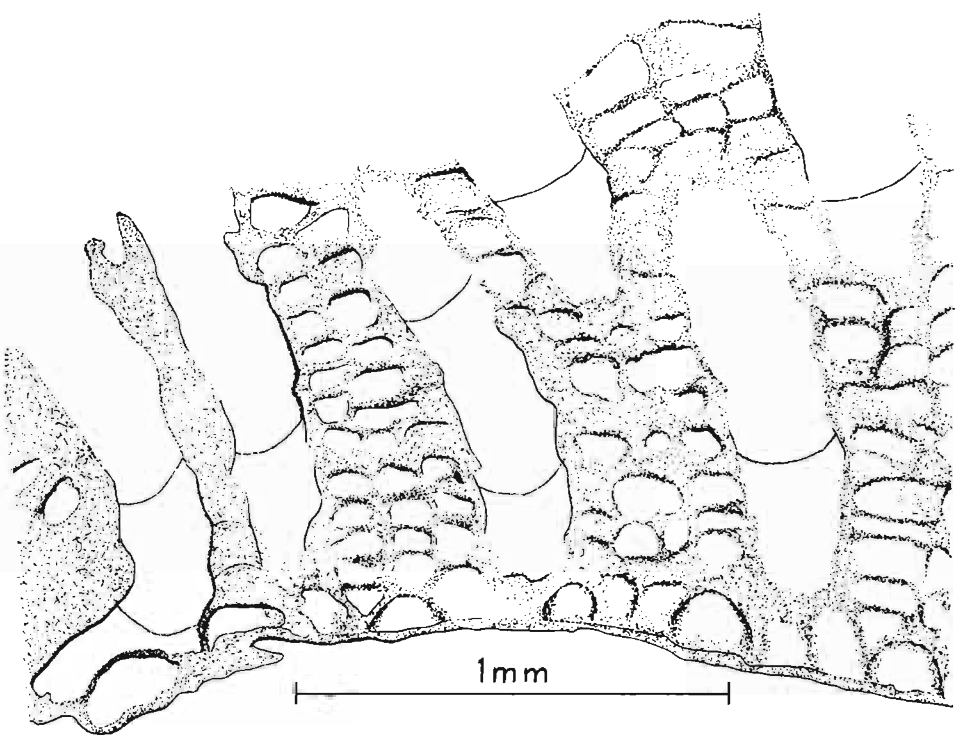

Fig. 30. — *Cyclotrypa nekhoroshevi* n.sp. (Z. Pal. Br. IV/17178). Longitudinal section, zooecial tubes with rare diaphragms, separated by cystopores often filled with limy sediment.

1 mm, small, round or oval regularly spaced inside the zooecial and cystoporal walls. Their diameters ranging from 0.006 to 0.01 mm. Each zooecial tube separated by 1 to 4 rows of cystopores. In some sections, especially in single rows, arrangement, shape and dimensions of cystopores regular (Pl. XV, Fig. 3b; Text-fig. 30). Cystoporal diaphragms straight, oblique or convex, arranged every 0.09—0.46 mm. Adjacent cystopores form in the basal parts of zoaria, diaphragms numerous, straight and placed at the same level. Towards the zoarial surface, diaphragms are more rare, unevenly distributed, oblique or convex; 5 to 7 cystoporal diaphragms occur in 1 mm. Zooecia and cystopores perpendicular or oblique to the epitheca. Width of the undulating epitheca up to 0.03 mm.

Comparison. — *Cyclotrypa nekhoroshevi* n.sp. differs from *Cyclotrypa tubularia* Nekhoroshev, 1948 (Nekhoroshev, 1948) in appearance of zoaria (massive, multilayered or small, lamellar in comparison to tubiform), larger maculae (2×2 mm, against 1—1.25 mm) with wider spacing (5—8 mm compared to 4—5 mm), presence of minutopores, larger dimensions of apertures (0.23×0.26 mm against 0.17—0.20 mm) with exception of those surrounding maculae, (0.31×0.33 mm against 0.35 mm), peristomes and greater number of cystoporal rows (1—4 against 1—2). Similar to both species are: round apertures and maculae present as groups of cystopores.

Occurrence. — Poland:Grzegorzowice, Couvinian.

Genus *Fistuliramus* Astrova, 1960

Type species: Fistuliramus sinensis Astrova 1960. Silurian, Ludlovian.
Stratigraphical range: Silurian — Devonian.

Fistuliramus astrovae n.sp.
(Pl. XVII, Fig. 1a-d; Pl. XVIII, Figs 1-5)

Holotypus: Specimen Z. Pal., No. Br. IV/17183; Pl. XVII, Fig. 1a-d.
Stratum typicum: Couvinian, complex III, trench 34.
Locus typicus: Grzegorzowice, Holy Cross Mts., Poland.
Derivatio nominis: astrovae — named in honour of Prof. Dr G. G. Astrova, Soviet investigator of palaeozoic Bryozoa; Moscow, Palaeontological Institute of Academy of Sciences, USSR.

Diagnosis. — Frequently branching zoarium. Apertures oval, or round with small lunaria. Cystopores with numerous, convex diaphragms densely distributed in mature zone and more rare, convex in immature zone.

Material. — About 200 fragments of branching zoaria in a good state of preservation. Maximum length of a branch up to 60 mm. The following epizoic organisms of Tabulata (*Aulopora* sp., *Kozlowskiocystia* sp.), Bryozoa (*Allonema* sp., *Ascodictyon* sp., *Hederella* sp., *Ceramoporella orbiculata* n.sp., *Ceramoporella* sp., *Fenestella* sp.), Tetracoralla, Hydrozoa and others are present on surfaces of most specimens; 50 thin sections.

Description. — Zoaria branching, fragmentary, with branches variable in length and round, rarely oval in cross section. Diameters of oval branches range from 9×14 to 18×25 mm, and round ones — from 10 mm to 13 mm. Branching zoaria often changing into incrusting ones and form layers 1 to 2 mm in thickness. Zoaria can be branched irregularly, dichotomously (Pl. XVIII, Figs 1-5) or anastomosing (Pl. XVIII, Fig. 4). Branches ending in a dome and with arrested growth are present (= stunted branches of Boardman, 1960) (Pl. XVIII, Figs. 2, 3).

Maculae composed of cystopores, oval, 1×2 mm in diameter, arranged diagonally at distances from 4 to 5 mm apart, when measured from the centers of two adjacent maculae. Apertures surrounding maculae larger, 0.32×0.32 mm in diameter. Lunaria poorly developed, triangular, directed outwards from the macula. Maculae usually slightly elevated, more rarely concave or flush with zoarium (Pl. XVIII, Fig. 2).

Tangential section. Apertures on the more subsurface sections (Pl. XVII, Figs 1a, 1d), round, oval or triangular, with diameters ranging from 0.14×0.18 to 0.31×0.31 mm and surrounded by more or less distinct peristomes, from 0.03 to 0.04 mm in width. Peristomes with preserved structure, characterized by a concentric arrangement of lamellae. Shape of peristomes usually corresponds to that of apertures. Lunaria small, triangular, their lamellar structure joining that of peristomes, occur in some zooecial apertures. The interzooecial spaces filled with a grained limy sediment. Distances between apertures rather large, ranging from 0.2 to 0.4 mm. In deeper tangential sections these spaces are correspondingly smaller; 4 to 5 apertures occur in 2 mm, measured in different directions.

Diameters of apertures measured in deeper sections, i.e. 2 to 2.5 mm from surface, are often (but not always) smaller, ranging from 0.13×0.16 to 0.18×0.29 mm. Peristomal rims very narrow, usually 0.01 mm, sometimes 0.03 mm in width. No traces of lunaria present. The interzooecial spaces decreases to 0.09—0.16 mm; 5 to 6 apertures occur in 2 mm. A grained limy sediment present between apertures.

The diameters of apertures and interzooecial spaces do not change much in the deeper tangential sections (3 to 3.5 mm from the surface), where the limy sediment is, in some places, not crystallized. Some cystopores, however, are visible (Pl. XVII, Fig. 1d). Cystopores vary in shape from round to multilateral or triangular. Diameters from 0.09×0.09 to 0.12×0.13 mm. Lunaria very rare, thin, crescent. Lunaria in places of maximum thickness (0.04 mm) widened tongue-like. They are 0.04 mm in width, 0.19 mm in length and cover about 1/3 of zooecial apertures. Peristomes 0.02 mm in width, or their fragments, are preserved in some apertures.

Longitudinal section. Mature zone up to 3 mm in width, immature zone- up to 15 mm. Cystopores and, more rarely, zooecial tubes in the whole mature zone, often completely filled with a limy sediment (Pl. XVII, Fig. 1b, c).

Mature zone. Zooecial tubes obliquely arranged 0.16 to 0.36 mm in diameters. Diaphragms straight, oblique, concave or convex; 3 of them occur in 1 mm at intervals of 0.13 to 0.52 mm. Cystopores occur in groups of 2 to 6, rarely singly. Their diameters from 0.06 to 0.23 mm. Cystoporal diaphragms straight or convex, densely arranged (8 in 1 mm), at 0.06 to 0.13 mm intervals. Thickness of zooecial walls — 0.03 mm, cystoporal walls — 0.01 mm. In both very small minutopores, not over 0.01 mm in diameter, occur.

Immature zone. Zooecial tubes 0.33—0.52 mm in diameter and cystoporal tubes, 0.06—0.16 mm, arranged obliquely. Zooecial diaphragms rare, evenly distributed; 3 diaphragms straight, oblique or convex, occur in 1 mm of a zooecial tube. In cystopores, 6 similarly developed diaphragms occur in 1 mm. Zooecial and cystoporal walls thin, not over 0.03 mm. Minutopores, present in these walls, very small, 0.01 mm in diameter, 12 to 15 occurring in 1 mm.

Comparison. — *Fistuliramus astrovae* n.sp. differs from *Fistuliramus varians* (Nekhoroshev, 1948) in development of peristomes, smaller diameters of apertures, smaller number of diaphragms in 1 mm, greater number of rows of cystopores.

It differs from *Fistuliramus sinensis* Astrova, 1960, in larger zoaria, smaller number of apertures in 2 mm, wider peristomes, smaller dimensions of cystopores and greater number of cystoporal rows.

From *Fistuliramus intermedius* (Nekhoroshev, 1948) it differs in larger diameters of zooecial branches, slightly smaller diameters of apertures, greater number of apertures in 2 mm, more distinct peristomes, smaller number of diaphragms in cystopores.

Similar to all compared species are: the branch form of zoaria, similar shape of zooecial apertures and poorly developed lunaria.

Occurrence. — Poland: Grzegorzowice, Couvinian.

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BRYOZOA DEWOŃSKIE GÓR ŚWIĘTOKRZYSKICH
CZĘŚĆ II. CYCLOSTOMATA I CYSTOPORATA

Streszczenie

Praca niniejsza jest kontynuacją badań nad paleozoicznymi mszywiołami Polski. Opracowano w niej środkowo-dewońskie Cyclostomata i Cystoporata z Gór Świętokrzyskich. Dotychczas opisano stąd Ctenostomata (Kiepura, 1965), a licznie zgromadzone Trepostomata i Cryptostomata będą przedmiotem dalszych badań.

Opisane tutaj mszywioły pochodzą z profilu Grzegorzowice-Skały, opracowanego stratygraficznie przez Pajchlową (1957). Opracowana kolekcja liczy 348 zoariów, wśród których zidentyfikowano 33 gatunki, w tym 11 nowych dla nauki. 26 gatunków (w tym 4 nowe) należy do Cyclostomata, a 7 gatunków (wszystkie nowe) do Cystoporata. Większość gatunków tj. 30 pochodzi z osadów kuwińskich Grzegorzowic, z żywetu Skał stwierdzono 7 gatunków, przy czym 4 gatunki są wspólne dla Grzegorzowic i Skał. (Tabela 1).

Paleozoiczne Bryozoa cechuje szerokie rozprzestrzenienie paleogeograficzne (Bassler, 1906; 1911; Duncan, 1957; Kaisin, 1942; Nechorosev, 1926 i inni). Większość zbadanych mszywiołów ze środkowego dewonu Gór Świętokrzyskich potwierdza to całkowicie. Wśród zidentyfikowanych 26 gatunków rodzaju *Hederella* (Cyclostomata) 21 jest znanych w dewonie Stanów Zjednoczonych (Stewart, 1927; Bassler, 1939; Stumm & Chilman, 1967). Pozostałe gatunki rzędu Cyclostomata i wszystkie rzędu Cystoporata są nowe, z wyjątkiem jednego nienazwanego. Opracowany zespół wykazuje największe podobieństwo do północno-amerykańskich dewońskich mszywiołów.

Zbadany zespół mszywiołów z Grzegorzowic pochodzi z utworów mułowcowych, które charakteryzuje bardzo bogata fauna (Hydrozoa, Tabulata, Tetracoralla, Gastropoda, Lamellibranchiata, Crinoidea, Brachiopoda, Bryozoa, Trilobita, Ostracoda). Licznie występujące tutaj mszywioły są reprezentowane przez 5 rzędów: Ctenostomata (Kiepura, 1965), Cyclostomata, Cystoporata, Trepostomata i Cryptostomata. Występują tutaj prawie wyłącznie gatunki epizoiczne. Ogół mszywiołów wykazuje dużą tolerancję na głębokość, zasolenie i temperaturę wody. Mszywioły z Grzegorzowic jako zwierzęta eurytypowe, a w szczególności eurybatyczne nie wyznaczają głębokości zamieszkiwanego zbiornika, lecz jako zwierzęta epizoiczne (Tabela 1) wskazują na nieznaczną głębokość zbiornika. Zamieszkiwały one wody strefy kumatycznej (*cumatic zone*, Wells, 1957), dobrze prześwietlonej, o dużej zawartości tlenu, czyste o nieznacznym zamuleniu.

Kuwiński basen Grzegorzowic stanowił środowisko o optymalnych warunkach bytowych. W paleobiocenozie zachowanej w kuwińskich mułowcach Grzegorzowic dominowały organizmy duże, głównie Coelenterata. Wśród masowo występujących tutaj Coelenterata znaczny procent stanowiły duże, a często bardzo duże, osobnicze Tetracoralla i duże kolonie Tabulata. Natomiast pozostałe grupy zwierząt są reprezentowane przeważnie przez formy stosunkowo małe, chociaż często bardzo liczne.

Opisane tutaj mszywioły ze Skał oraz bogata fauna im towarzysząca (Tabulata, Tetracoralla, Gastropoda, Lamellibranchiata, Crinoidea, Brachiopoda, Bryozoa, Trilobita, Ostracoda) pochodzą z łupków ilastych i marglisto-piaszczystych. Najobficiej w zespole paleobiocenotycznym Skał są zachowane mszywioły, wśród których rząd Ctenostomata (Kiepura, 1965) ma liczniejszych przedstawicieli niż w kuwinie Grzegorzowic. Rzędy Cyclostomata i Cystoporata występują tu nielicznie i rzadziej niż w Grzegorzowicach (Tabela 1). Rząd Trepostomata, obejmujący głównie Stenoporidae i rząd Cryptostomata, z przewagą gatunków z rodziny Fenestellidae, są bardzo liczne gatunkowo i osobniczo. W kuwinie Grzegorzowic natomiast przedstawicieli tych dwóch ostatnich rzędów spotyka się bardzo rzadko. W zespole skalskich mszywiołów gatunki epizoiczne stanowią niewielki procent. Dominują tutaj gatunki „wolne" typu gałązkowego (Trepostomata, Cryptostomata) i siateczkowego (Cryptostomata), charakteryzujące spokojne, głębsze środowisko. Występują one masowo.

Masowe występowanie, cechy morfologiczne mszywiołów oraz charakter całego zespołu fauny towarzyszącej i litologia osadów mogą świadczyć o morzu, głębokiej strefy nerytycznej. Fauna opisanego tutaj żyweckiego basenu Skał różni się zasadniczo od fauny opisanego powyżej kuwińskiego basenu Grzegorzowic. Wprawdzie obydwa baseny cechuje obfitość fauny, lecz charakter tej fauny jest całkowicie różny. Organizmy zwierzęce basenu skalskiego to formy drobne, gałązkowe, siateczkowe itp. Dominującą grupą są tutaj Bryozoa występujące ławicowo. Pozostałe organizmy należące do różnych grup zwierzęcych, zachowane w różnej liczebności okazów, są także formami małymi. Basen grzegorzowicki natomiast charakteryzowały organizmy duże, o masywnych szkieletach. Organizmy te stanowiły dogodne podłoże dla obficie rozwiniętej epifauny, wśród której znaczną większość stanowiły inkrustujące Bryozoa. Charakter fauny basenu skalskiego świadczy o głębszym środowisku morskim, a cechy fauny basenu grzegorzowickiego wskazują na typowo płytkowodne środowisko.

Wśród zbadanych tutaj gatunków Cyclostomata i Cystoporata 29 jest epizoicznych, 3 epizoiczne i wolne oraz 1 wolny. Do organizmów porastanych przez opisane mszywioły należą: Tetracoralla, Bryozoa, Crinoidea, Tabulata i Brachiopoda. Zbadany zespół mszywiołów najchętniej inkrustuje koralowiny Tetracoralla oraz zoaria innych „wolnych" mszywiołów. W rozmieszczeniu na powierzchni porastanych organizmów nie obserwuje się określonego porządku. Epizoiczne gatunki zachowane na epitekach osobniczych Tetracoralla z Grzegorzowic są bezplanowo rozmieszczone na całej koralowinie, ze wszystkich jej stron. Znajdują się one zarówno na proksymalnych jak i dystalnych odcinkach koralowiny, a niekiedy na krawędzi kielicha. Trudno ustalić w jakich przypadkach porastanie koralowin następowało po śmierci, w jakich za życia korala. W przypadku występowania mszywiołów wokół całej koralowiny, do proksymalnych odcinków włącznie, można przypuszczać, że porastały one koralowiny znajdujące się w pozycji pionowej, a więc osobniki żyjące.

Wśród porośniętych organizmami epizoicznymi pewnych Tetracoralla i niektórych Bryozoa spotyka się okazy „warstwowo" inkrustowane (Pl. IV, Fig. 1).

W żywecie Skał, epizoiczne Ctenostomata inkrustują nie Tetracoralla, lecz skorupki Brachiopoda lub łodygi Crinoidea (Kiepura, 1965). Pozostaje to w ścisłym związku z odmiennymi typami środowisk i ich warunkami ekologicznymi cechującymi kuwin Grzegorzowic i żywet Skał.

Epizoiczne mszywioły ze środkowego dewonu Gór Świętokrzyskich są stowarzyszone z różnymi, również inkrustującymi organizmami. Tworzą one zespoły asocjacyjne. Skład takich zespołów asocjacyjnych bywa bardzo różny, pod względem liczby komponentów i liczby gatunków.

МАРИЯ КЕПУРА

ДЕВОНСКИЕ МШАНКИ СВЕНТОКШИСКИХ ГОР
ЧАСТЬ II. CYCLOSTOMATA И CYSTOPORATA

Резюме

Настоящая работа включает продолжение исследования палеозойских мшанок Польши. В ней представлено описание среднедевонских Cyclostomata и Cystoporata Свентокшиских гор. До этого здесь были описаны Ctenostomata (Kiepura, 1965), а многочисленные Trepostomata и Cryptostomata будут предметом дальнейших исследований.

Описанные мшанки собраны в разрезе Гжегожовице — Скалы, стратиграфически исследованном Пайхлёвой (1957). Обработанная коллекция включает 348 зоарий, среди которых определены 33 вида, в том числе 11 новых в науке видов. 26 видов (в том числе 4 новых) относятся к Cyclostomata, а 7 видов (все новые) к Cystoporata. Большинство (30) видов было приурочено к кювенским отложениям Гжегожовице, а 7 видов — к живетским отложениям Скалы, 4 же вида общие для обоих местонахождений (таблица I).

Палеозойские Bryozoa характеризуются широким палеогеографическим распространением (Bassler, 1960, 1911; Duncan, 1957; Kaisin, 1942; Nekhorosev, 1926 и др.). Большинство исследованных мшанок из среднего девона Свентокшиских гор полностью подтверждает это заключение. Из числа определенных 26 видов рода *Hederella* (Cyclostomata) 21 вид известен в девоне США (Stewart, 1927; Bassler, 1939, Stumm & Chilman, 1967). Остальные виды отряда Cyclostomata и все виды отряда Cystoporata новые, за исключением одного ненаименованного. Исследованное сообщество проявляет наибольшее сходство с североамериканскими девонскими мшанками.

Сообщество мшанок из местонахождения Гжегожовице добыто из алевритовых осадков, характеризующихся обильным содержанием фауны (Hydrozoa, Tabulata, Tetracoralla, Gastropoda, Lamellibranchiata, Crinoidea, Brachiopoda, Bryozoa, Trilobita, Ostracoda). Представленные здесь в большом количестве мшанки принадлежат к 5 отрядам: Ctenostomata (Kiepura, 1965), Cyclostomata, Cystoporata, Trepostomata и Cryptostomata. Здесь представлены почти исключительно эпизойские виды. Мшанки в общем переносят значительные колебания глубины, солености и температуры воды, однако мшанки из Гжегожовице (таблица I) обитали в неглубоком водоеме куматической зоны (cumatic zone, Wells, 1957), характеризующейся прозрачной, чистой водой, с богатым содержанием кислорода.

Водоем кювенского возраста в районе Гжегожовице представлял среду с оптимальными условиями обитания. В палеобиоценозе алевролитов этого местонахождения преобладают крупные организмы, главным образом Coelenterata. Среди массового количества Coelenterata большая доля приходится на крупные, часто гигантские, одиночные Tetracoralla и крупные колонии Tabulata. Осталь-

ные же группы животных представлены, как правило, небольшими относительно формами, хотя часто многочисленными.

Описанные мшанки из местонахождения Скалы и сопровождающая их фауна (Tabulata, Tetracoralla, Gastropoda, Lamellibranchiata, Crinoidea, Brachiopoda, Bryozoa, Trilobita, Ostracoda) находятся в глинистых и мергелисто-песчанистых сланцах. В палеобиоценозе этого местонахождения наиболее обильно представлены мшанки, среди которых отряд Ctenostomata (Kiepura, 1965) отличается большим числом представителей в сравнении с местонахождением Гжегожовице. Отряды Cyclostomata и Cystoporata встречаются здесь редко, в меньшем количестве чем в Гжегожовице (таблица 1). Отряд Trepostomata, охватывающий, главным образом, Stenoporidae и отряд Cryptostomata с преобладанием видов семейства Fenestellidae весьма обильны в отношении видов и особей. В местонахождении Гжегожовице представители двух указанных отрядов встречаются крайне редко. В сообществе мшанок местонахождения Скалы эпизойские виды составляют небольшую долю. Здесь преобладают „свободные" виды ветвистого типа (Trepostomata, Cryptostomata) и сетчатого типа (Cryptostomata), характеризующие спокойную, более глубоководную среду. Они представлены в массовом количестве.

Массовое распространение мшанок, их морфологические признаки, а также характер всего сообщества сопровождающей фауны и литологический состав осадков определяют условия глубокой неритовой зоны. Оба описанных здесь бассейна — в районе Гжегожовице и в районе Скалы характеризуются массовым распространением фауны, однако по своему характеру фауна этих бассейнов отличается существенным образом. В бассйне района Скалы представлены мелкие, ветвистые и сетчатые формы. Господствующей группой являются мшанки, образующие слои. Остальные организмы, принадлежащие к разным систематическим группам и представленные в разном количестве особей, тоже характеризуются мелкими формами. В отличие от этого, бассейн района Гжегожовице характеризовался распространением крупных форм с массивными скелетами. Эти организмы представляли хороший субстрат для обильно развивающейся эпифауны, сложенной в основном обызвествленными мшанками. Фауна бассейна района Скалы своим характером определяет более глубоководную морскую среду, а фауна бассейна района Гжегожовице указывает на типичную мелководную среду.

Среди исследованных видов Cyclostomata и Cystoporata 29 видов эпизойских, 3 эпизойские и свободные и 1 вид свободный. Организмы, к которым прикреплялись описанные мшанки, представлены: Tetracoralla, Bryozoa, Crinoidea, Tabulata, Brachiopoda. Изученное сообщество мшанок чаще всего образует инкрустации на кораллах Tetracoralla и колониях других „свободных" мшанок. В их распределении на поверхности других организмов не наблюдается какая-либо закономерность. Виды, прикрепленные к эпитекам одиночных Tetracoralla в районе Гжегожовице, располагаются беспорядочно на всем кораллите, как на проксимальной, так и дистальной сторонах, а иногда и на краю чашечки. Трудно установить в каких случаях мшанки прикреплялись к кораллиту при жизни коралла, а в каких после его отмирания. Когда мшанки порастают вокруг всего кораллита, включая его проксимальную часть, можно предполагать, что они прикреплялись к вертикально стоящей особи, следовательно при жизни коралла.

Среди некоторых Tetracoralla и Bryozoa наблюдается „слоистое" скопление инкрустированных мшанок (табл. IV, фиг. 1).

В местонахождении Скалы эпизойские Ctenostomata прикреплены не к Tetracoralla, а к створкам Brachiopoda или стеблям Crinoidea (Kiepura, 1965). Это явление обусловлено разными экологическими условиями среды обитания в районе Гжегожовиц и районе Скал.

Эпизойские мшанки среднего девона Свентокшиских гор образуют сообщества с другими инкрустированными организмами. Состав таких ассоциаций характеризуется большим разнообразием в отношении количества составных компонентов и видов.

EXPLANATION OF PLATES

Plate I

Fig. 1. *Corynotrypa (Corynotrypa) skalensis* n. sp. (Z. Pal., No. Br. IV/8574, holotype): six joined zooecia, side view, ×15.

Fig. 2. *Corynotrypa (Corynotrypa) basiplata* n. sp. (Z. Pal., No. Br. IV/8575, holotype): fragment of zoarium incrusting a crinoid stem, external aspect, top view, ×7.

Fig. 3. *Diversipora bitubulata* n. gen., n. sp. (Z. Pal., No. Br. IV/8576, holotype): fragment of zoarium incrusting *Pseudozonophyllum halli* Wdkd., external aspect, top view, ×7.

Fig. 4. The same species (Z. Pal., No. Br. IV/17147): fragment of zoarium incrusting *Pseudozonophyllum* sp., external aspect, top view, ×10.

Fig. 5. *Hederella (Hederella) thedfordensis* (Bassler, 1939) (Z. Pal., No. Br. IV/8670): fragment of zoarium incrusting *Fistuliramus astrovae* n. sp., external aspect, top view, ×7.

Plate II

Fig. 1. *Stomatopora varigemmata* n. sp. (Z. Pal., No. Br. IV/8658, holotype): fragment of zoarium incrusting and incrusted by *Alveolites* sp., external aspect, top view.

Fig. 2. The same species (Z. Pal., No. Br. IV/8647): fragment of zoarium incrusting *Pseudozonophyllum* sp., external aspect, top view.

Fig. 3. *Hederella (Basslederella) alpenensis* (Bassler, 1939) (Z. Pal., No. Br. IV/8631): fragment of zoarium, external aspect, top view.

All figures ×7

Plate III

Fig. 1. *Hederella (Magnederella) reimanni* (Bassler, 1939) (Z. Pal., No. Br. IV/8108): fragment of zoarium incrusting *Fistuliramus astrovae* n. sp. associated with *Lioclema* sp. and *Spirorbis* sp., external aspect, top view.

Fig. 2. *Hederella (Hederella) nicholsoni* (Bassler, 1939) (Z. Pal., No. Br. IV/8617): fragment of zoarium, external aspect, top view.

Fig. 3. *Hederella (Paralhederella) compacta* (Bassler, 1939) (Z. Pal., No. Br. IV/8598): fragment of zoarium incrusting a crinoid stem, external aspect, top view.

All figures ×7.

Plate IV

Fig. 1. *Hederella (Hederella) canadensis* (Nicholson, 1874) (Z. Pal., No. Br. IV/8602): fragment of zoarium incrusting *Pseudozonophyllum* sp. associated with *Spirorbis* sp., external aspect, top view.

Fig. 2. *Hederella* (*Hederella*) cf. *filiformis* (Billings, 1859) (Z. Pal., No. Br. IV/8604): fragment of zoarium incrusting *Pseudozonophyllum* sp. in association with other unidentified species of the same genus, external aspect, top view.

Fig. 3. *Hederella (Basslederella) persimilis* (Bassler. 1939) (Z. Pal., No. Br. IV/17139): fragment of zoarium incrusting a tetracoral in association with *Aulopora* sp. and *Spirorbis* sp., external aspect, top view.

All figures ×7.

Plate V

Hederella (Hederella) nicholsoni (Bassler, 1939)

Fig. 1. (Z. Pal., No. Br. IV/8651): fragment of zoarium incrusting *Pseudozonophyllum* sp., external aspect, top view.

Fig. 2. (Z. Pal., No. Br. IV/8171): fragment of zoarium incrusting *Fistuliramus astrovae* n. sp., with preserved tubes of *Spirorbis* sp., external aspect, top view.

All figures ×7.

Plate VI

Fig. 1. *Hederella (Magnederella)* cf. *obesa* (Bassler, 1939) (Z. Pal., No. Br. IV/17140): fragment of zoarium incrusting a *Fistulipora emphantica* n. sp., adhered to the epitheca of *Pseudozonophyllum* sp. (layered incrustation), external aspect, top view.

Fig. 2. *Hederella (Hederella) brownae* (Bassler, 1939) (Z. Pal., No. Br. IV/8638): fragment of zoarium incrusting *Pseudozonophyllum* sp., external aspect, top view.

All figures × 7.

Plate VII

Fig. 1. *Hederella (Hederella) parvirugosa* (Bassler, 1939) (Z. Pal., No. Br. IV/8659): fragment of zoarium incrusting *Fistuliramus astrovae* n. sp., associated with *Spirorbis* sp., external aspect, top view.

Fig. 2. *Hederella (Paralhederella) louisvillensis* (Bassler, 1939) (Z. Pal., No. Br. IV/8637): fragment of zoarium incrusting *Blothrophyllum* sp., external aspect, top view.

Fig. 3A. *Hederella (Basslederella) rugosa* (Bassler, 1939) (Z. Pal., No. Br. IV/8622): fragment zoarium incrusting a tetracoral, external aspect, top view.

Fig. 3B. *Hederella (Basslederella) conferta* (Hall, 1881) (Z. Pal., No. Br. IV/8622): fragment zoarium incrusting a tetracoral, in association with *Hederella (Basslederella) rugosa* (Bassler, 1939), external aspect, top view.

All figures ×7.

Plate VIII

Fig. 1. *Hederella (Hederella) cirrhosa* (Hall, 1881) (Z. Pal., No. Br. IV/8652): fragment of zoarium incrusting *Pseudozonophyllum* sp., external aspect, top view.

Fig. 2. *Hederella (Hederella) concinna* (Bassler, 1939) (Z. Pal., No. Br. IV/17155): fragment of zoarium incrusting *Pseudozonophyllum* sp., external aspect, top view.

All figures ×7.

Plate IX

Fig. 1. *Hederella (Magnederella) magna* (Hall, 1881) (Z. Pal., No. Br. IV/8643): fragment of zoarium incrusting a tetracoral, external aspect, top view.

Fig. 2. *Hederella (Hederella) adnata* (Davis, 1885) (Z. Pal., No. Br. IV/8620): fragment of zoarium incrusting *Fistuliramus astrovae* n. sp., external aspect, top view.

All figures ×7.

Plate X

Fig. 1. *Hederella (Magnederella) reimanni* (Bassler, 1939) (Z. Pal., No. Br. IV/8606): fragment of zoarium with ancestrula, in association with *Lioclema* sp. and incrusting *Pseudozonophyllum* sp., external aspect, top view, ×7.

Fig. 2. *Hederella (Hederella) concinna* (Bassler, 1939) (Z. Pal., No. Br. IV/8602): fragment of zoarium incrusting a tetracoral in association with *Allonema* sp. and *Spirorbis* sp., external aspect, top view, ×10.

Fig. 3. *Favositella integrimuralis* n. sp. (Z. Pal., No. Br. IV/8606): fragment of zoarium with maculae (groupings of cystopores), in association with *Hederella (Magnederella) reimanni*, *Ceramoporella* sp., incrusting *Pseudozonophyllum* sp., external aspect, top view, ×10.

Plate XI

Fig. 1. *Favositella integrimuralis* n. sp. (Z. Pal., No. Br. IV) 17160, holotype): tangential section, large zooecial apertures with distinct lunaria, zooecial walls with dark line and comparatively small cystopores visible, ×60.

Fig. 2. *Ceramporella orbiculata* n. sp. (Z. Pal., No. Br. IV/8084): tangential section, zooecial apertures with distinct lunaria arranged in rows, cystopores of different dimensions, ×50.

Fig. 3. *Ceramoporella orbiculata* n. sp. (Z. Pal., No. Br. IV/8576, holotype): zoarium incrusting a tetracoral in association with *Diversipora bitubulata* n. gen., n. sp., external aspect, top view, ×7.

Plate XII

Cyclotrypa nekhoroshevi n. sp.

Fig. 1. (Z. Pal., No. Br. IV/17169, holotype): *a* longitudinal section of zoarium with minutopores visible in zooecial and cystoporal walls; *b* tangential section of zoarium (slighly deeper), with minutopores visible within peristomes and walls of cystopores.

All figures ×35.

Plate XIII

Fig. 1. *Ceramoporella grandicystica* n.sp. (Z. Pal., No. Br. IV) 3260): fragment of zoarium incrusting a branching zoarium of *Lioclema* sp., external aspect, top view, ×15.

Fig. 2. *Hederella (Hederella) alternata* (Hall & Whitfield, 1873) (Z. Pal. No. Br. IV/8630): fragment of zoarium incrusting *Pseudozonophyllum* sp., external aspect, top view, ×7.

Fig. 3. *Cyclotrypa nekhoroshevi* n. sp. (Z. Pal., No. Br. IV/17169, holotype): fragment of zoarium with oval maculae (groupings of cystopores), external aspect, top view, ×10.

Plate XIV

Fig. 1. *Hederella (Basslederella) persimilis* (Bassler, 1939) (Z. Pal., No. Br. IV/8648): fragment of zoarium incrusting a tetracoral, in association with *Spirorbis* sp. and an unidentified pelecypod, external aspect, top view, ×7.

Fig. 2. *Favositella integrimuralis* n. sp. (Z. Pal., No. Br. IV/8154): fragment of zoarium with maculae, external aspect, top view, ×7.

Fig. 3. *Ceramoporella grandicystica* n. sp. (Z. Pal., No. Br. IV/17184, holotype): tangential section, zooecial apertures with distinct lunaria, indistinct cores and large cystopores, ×50.

Fig. 4. *Cyclotrypa nekhoroshevi* n. sp. (Z. Pal., No. Br. IV) 17169, holotype): fragment of zoarium, zooecial apertures round with granulate peristomes, external aspect, top view, ×25.

Plate XV

Fig. 1. *Hederella (Paralhederella) bilineata* (Bassler, 1939) (Z. Pal., No. Br. IV/8662): fragment of zoarium incrusting a crinoid stem, external aspect, top view, ×7.

Fig. 2. *Fistulipora emphantica* n. sp. (Z. Pal., No. Br. IV/17164, holotype): *a* fragment of zoarium, external aspect, top view, ×10; *b* fragment of the same zoarium, external aspect, top view, ×25.

Fig. 3. *Cyclotrypa nekhoroshevi* n. sp. (Z. Pal., No. Br. IV/17169, holotype): *a* tangential section, large apertures and cystopores with minutopores, ×90; *b* longitudinal section, with minutopores visible within walls of zooecia and cystopores, ×90.

Plate XVI

Fig. 1. *Hederella (Basslederella) alpenensis* (Bassler, 1939) (Z. Pal., No. Br. IV/8611): fragment of zoarium incrusting a tetracoral, external aspect, top view, ×7.

Fig. 2. *Stomatopora* sp. (Z. Pal., No. Br. IV/17153): fragment of zoarium incrusting a tetracoral, in association with *Spirorbis* sp., external aspect, top view, ×7.

Fig. 3. *Fistulipora emphantica* n. sp. (Z. Pal., No. Br. IV) 17164, holotype): *a* longitudinal section, ×50; *b* (Z. Pal., No. Br. IV/17162) tangential section, apertures with distinct lunaria, ×50.

Plate XVII

Fig. 1. *Fistuliramus astrovae* n. sp. (Z. Pal., No. Br. IV/17183, holotype): *a* transversal section, adult zone with cystopores usually completely impregnated by a limy sediment, ×25; *b* longitudinal section, mature zone with cystopores partly impregnated by a limy sediment, ×25; *c* longitudinal section with mature and immature zones, zooecial tubes and cystopores free from impregnation with limy sediment, ×25; *d* tangential section, closest to the surface (A) with cystopores completely impregnated by a limy sediment, sometimes slightly deeper (B) with cystopores free from impregnation with limy sediment, ×15.

Plate XVIII

Fistuliramus astrovae n. sp.

Fig. 1. (Z. Pal., No. Br. IV/8111): fragment of zoarium with a stunted branch, incrusted by epizoic *Hederella* sp. and *Spirorbis* sp.

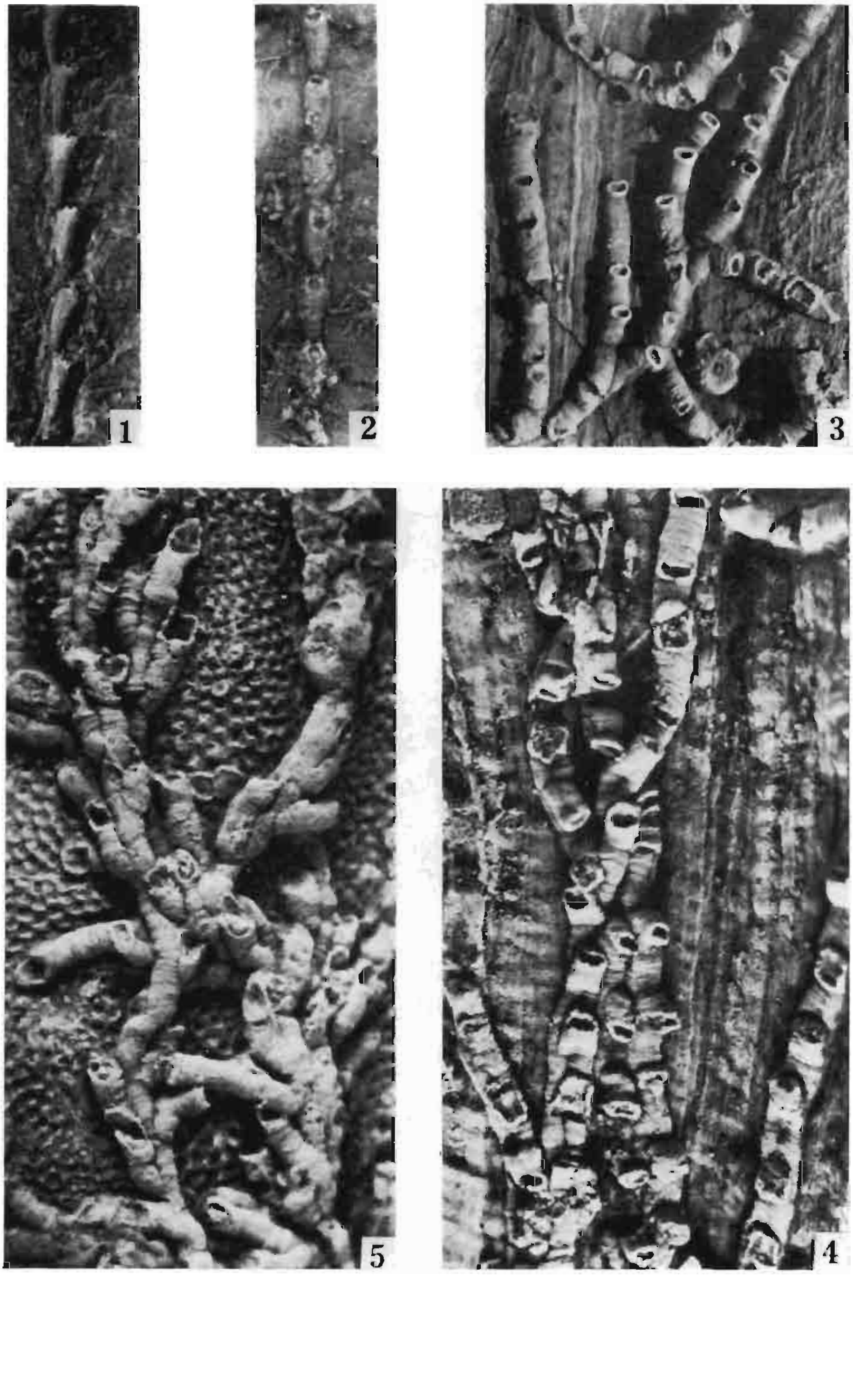
Fig. 2. (Z. Pal., No. Br. IV/8130): fragment of zoarium with a stunted branch and visible maculae, incrusted by epizoic zoarium of an unrecognized bryozoan and *Spirorbis* sp.

Fig. 3. (Z. Pal., No. Br. IV/8174): fragment of zoarium with a stunted branch and visible maculae.

Fig. 4. (Z. Pal., No. Br. IV/8094): fragment of zoarium branching irregularly and anastomosing, with epizoic *Spirorbis* sp.

Fig. 5. (Z. Pal., No. Br. IV/8102): fragment of zoarium branching irregularly, dichotomously, with epizoic *Spirorbis* sp. and unrecognized pelecypod.

All figures ×2.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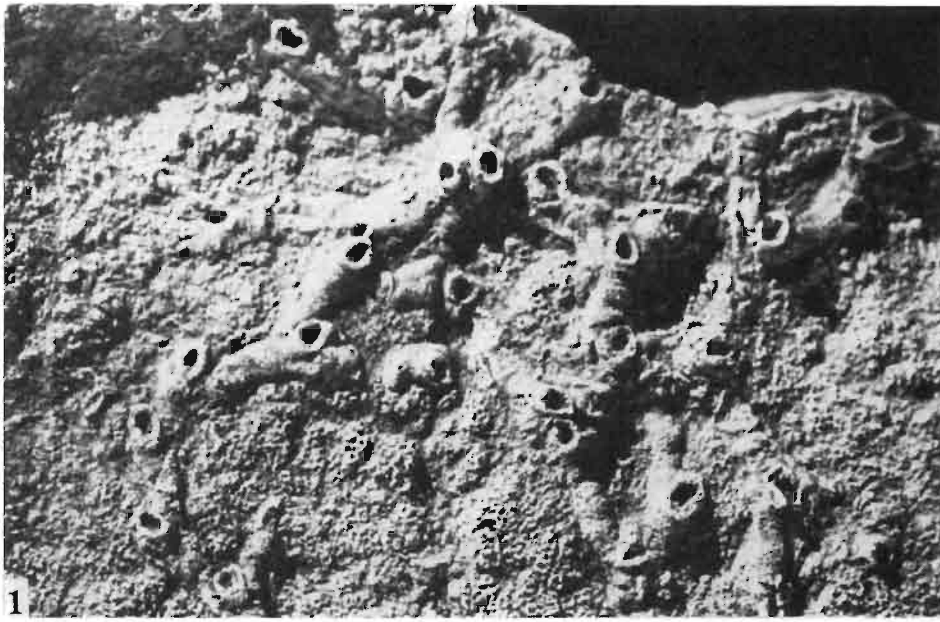
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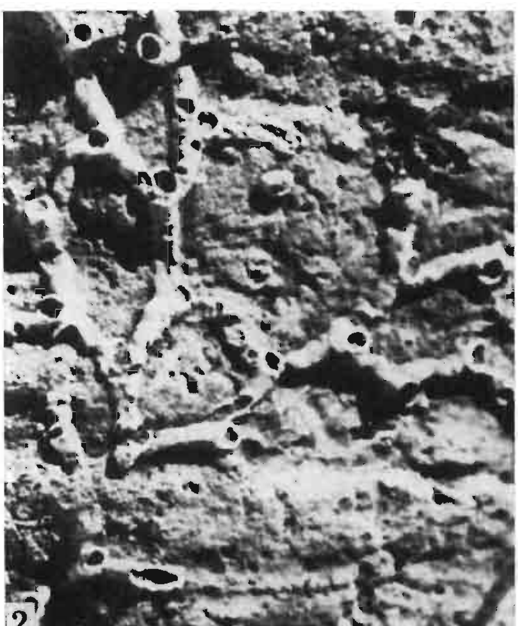
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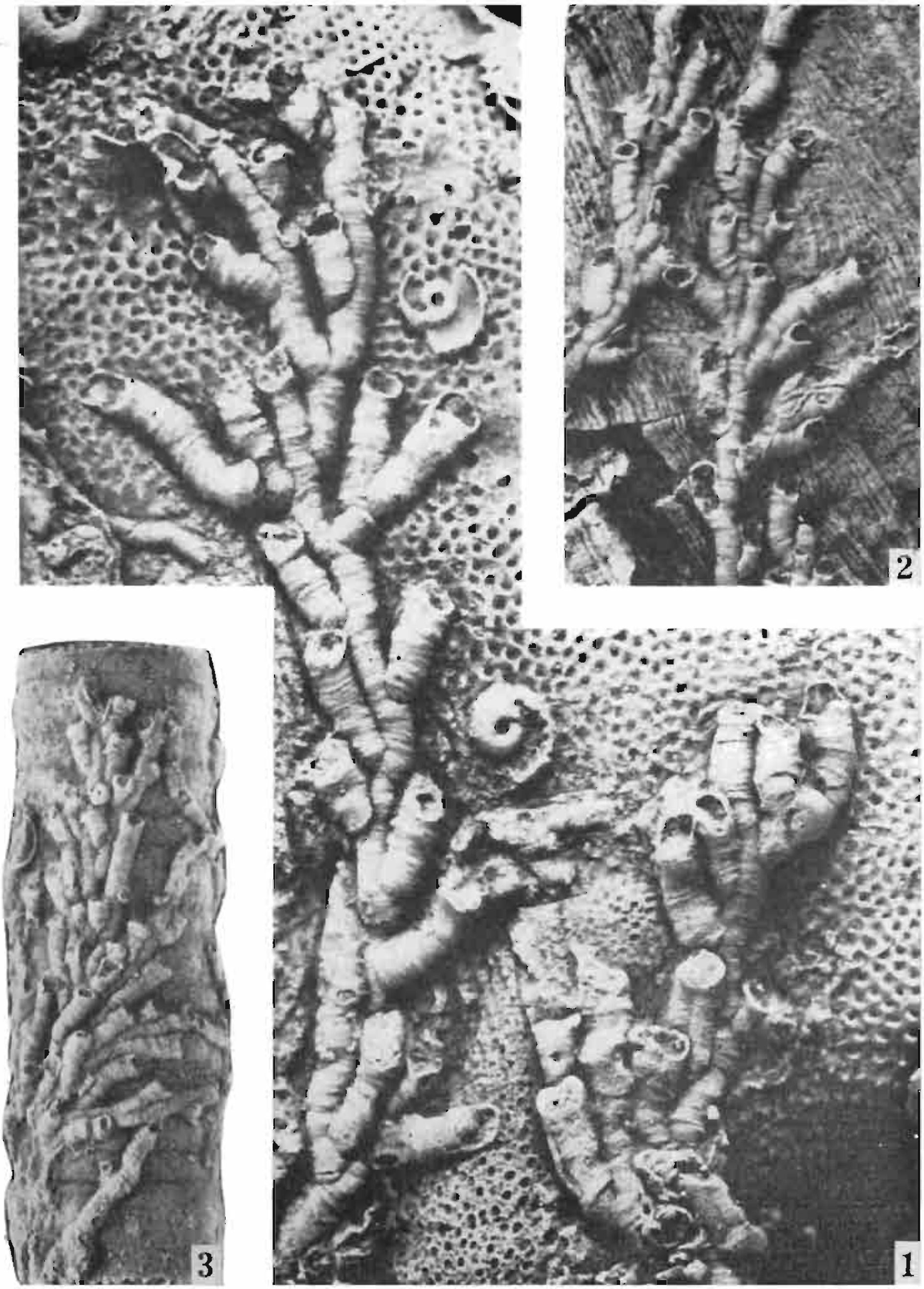
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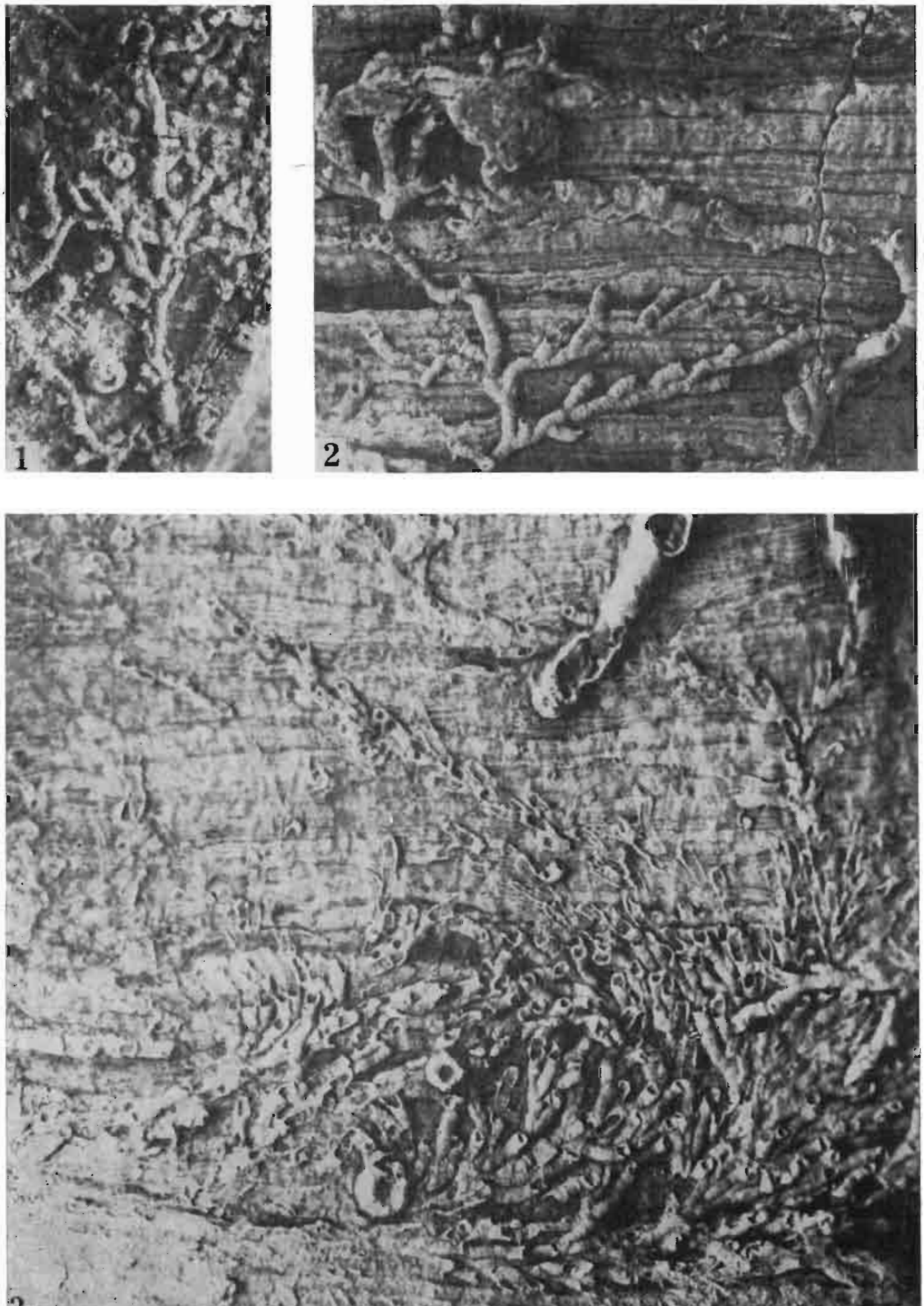
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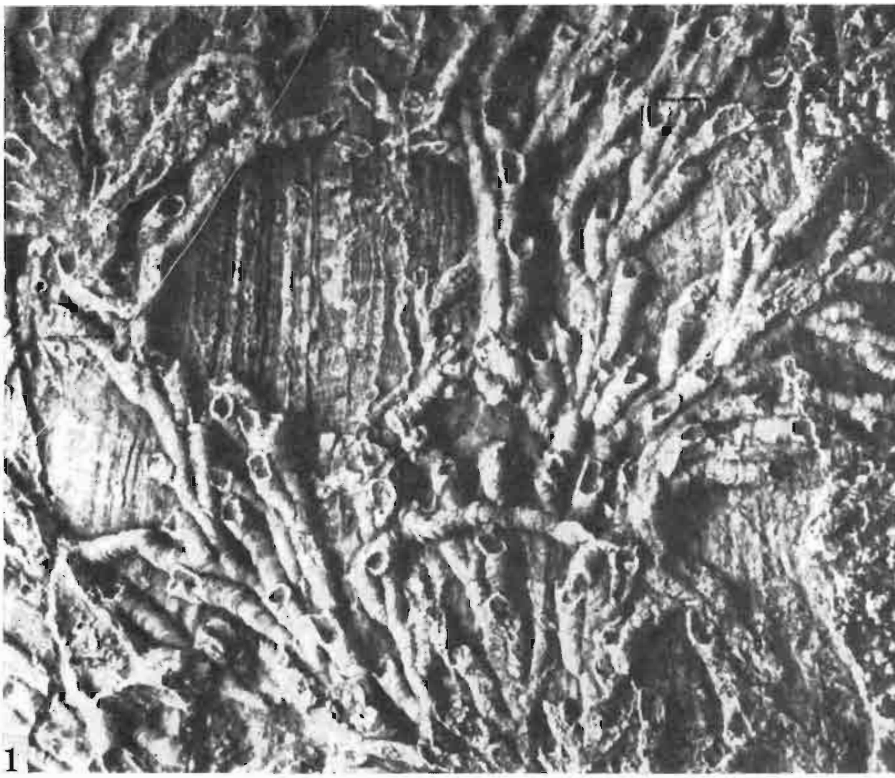

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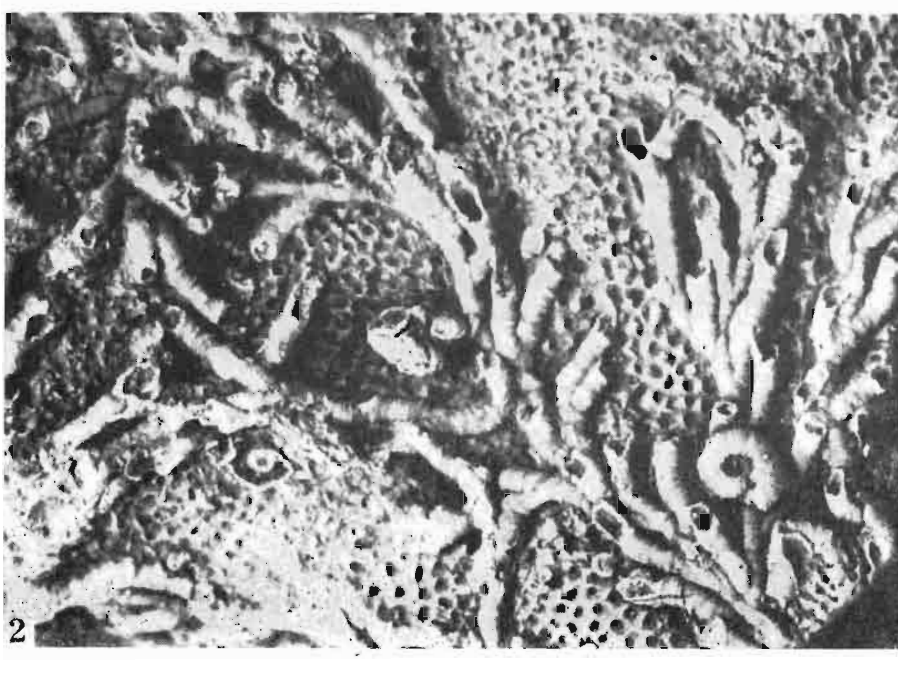

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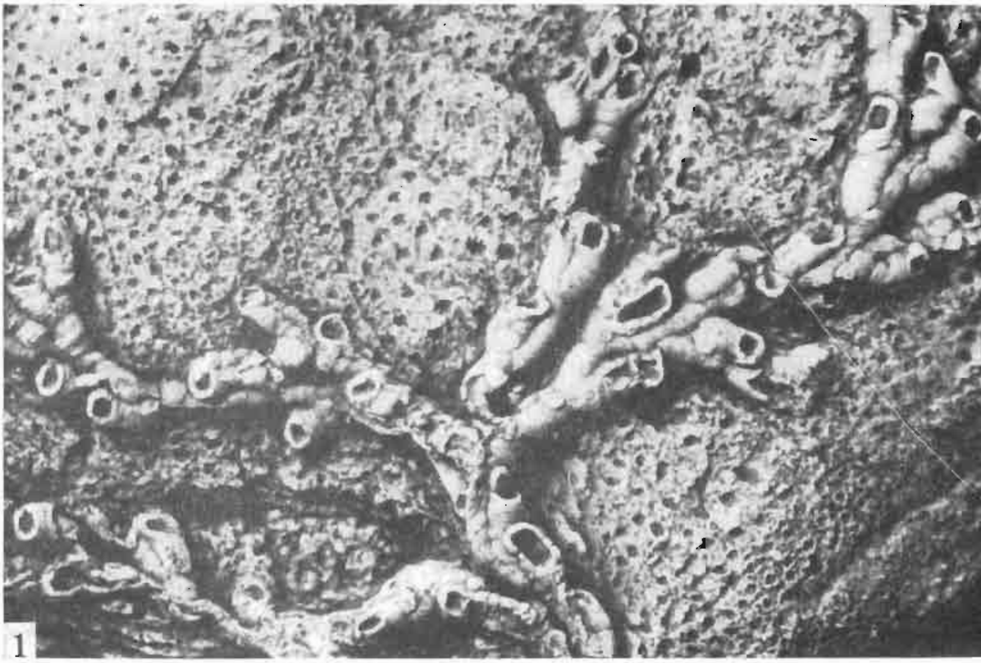

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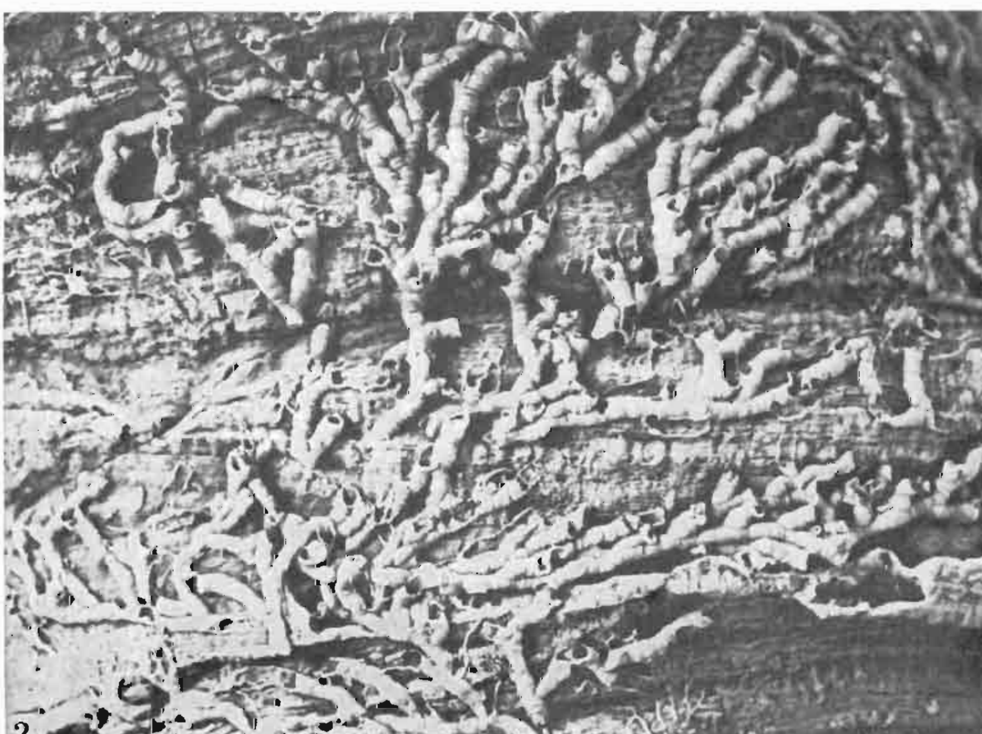

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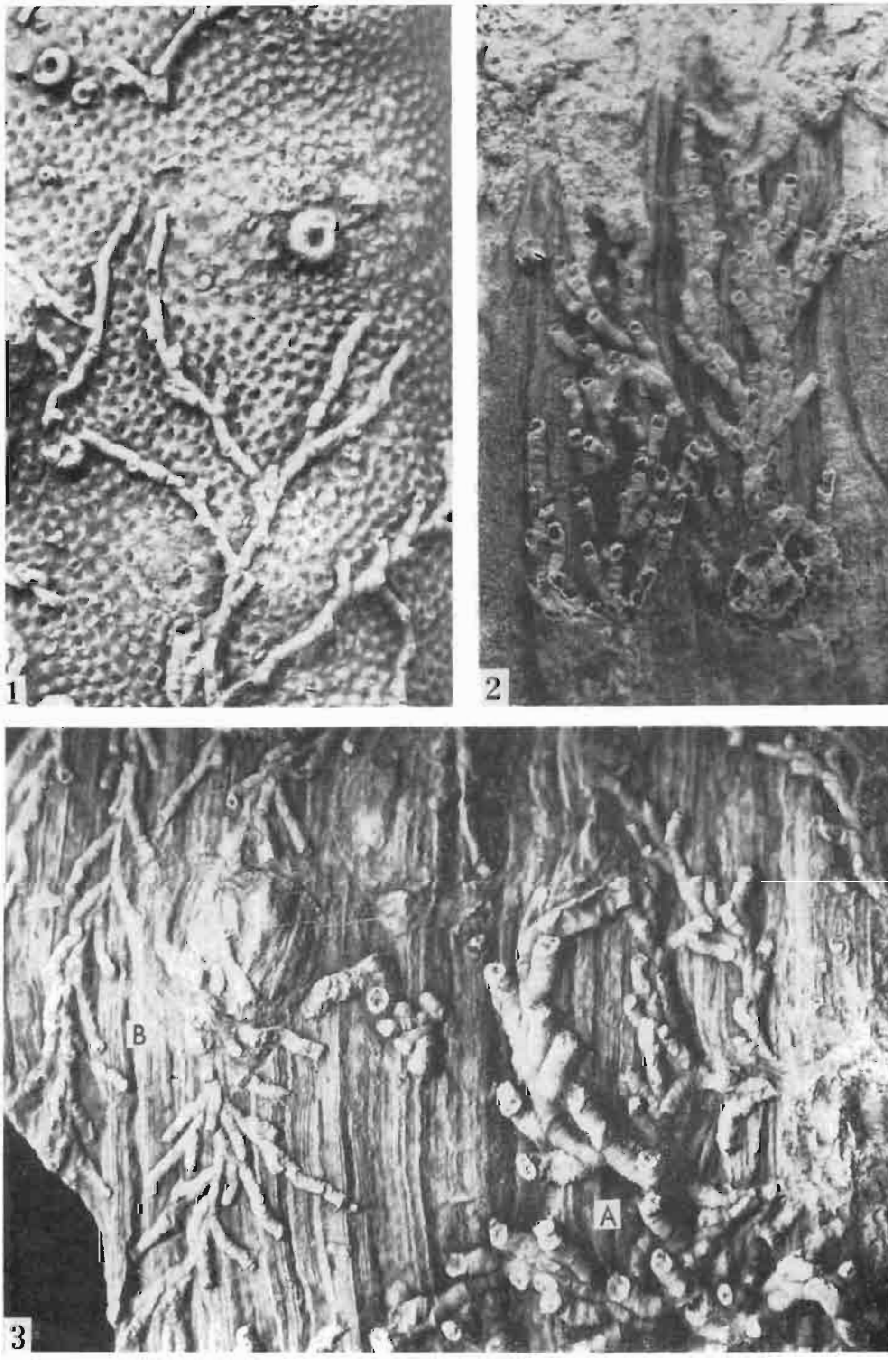
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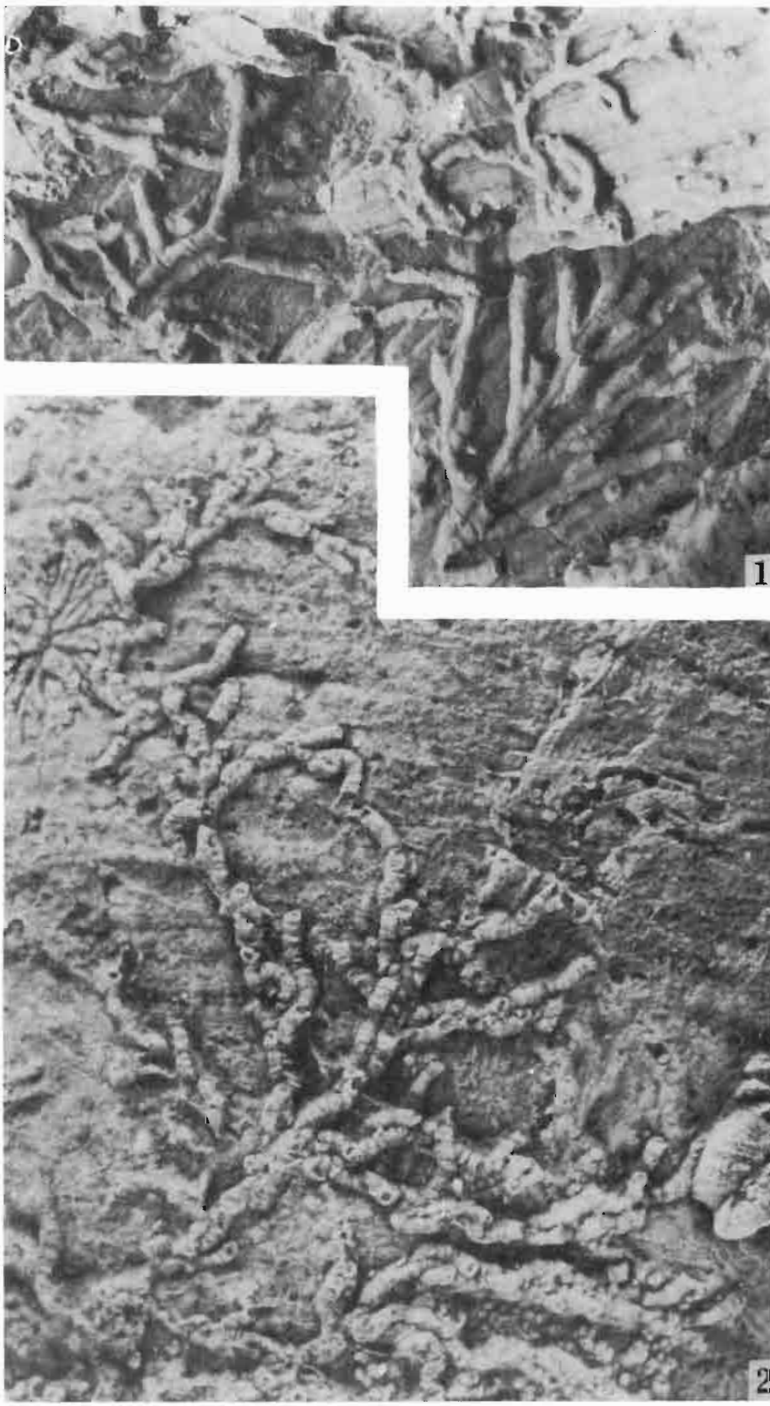
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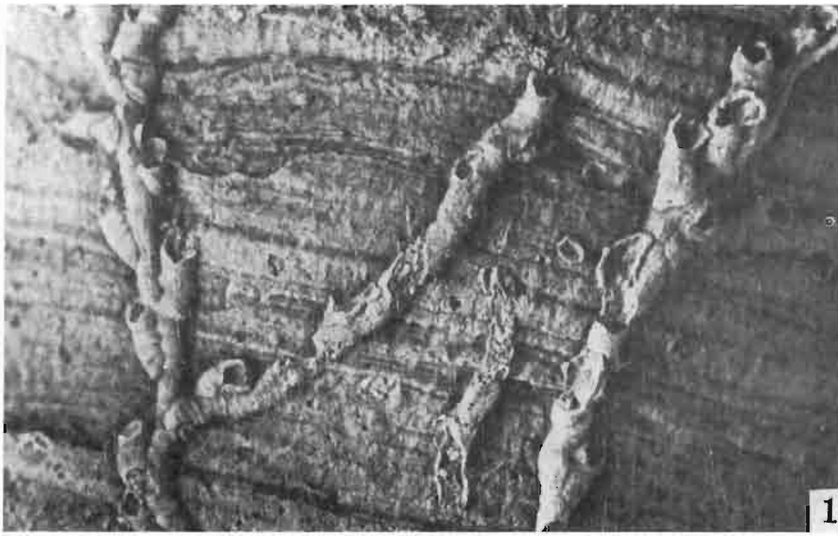

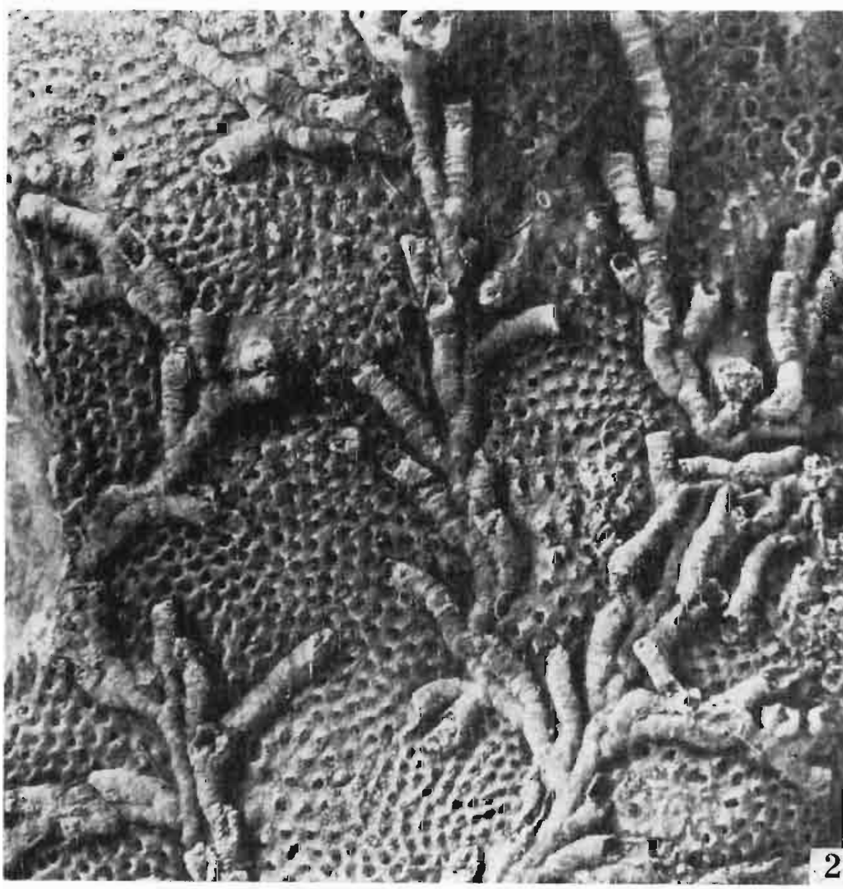

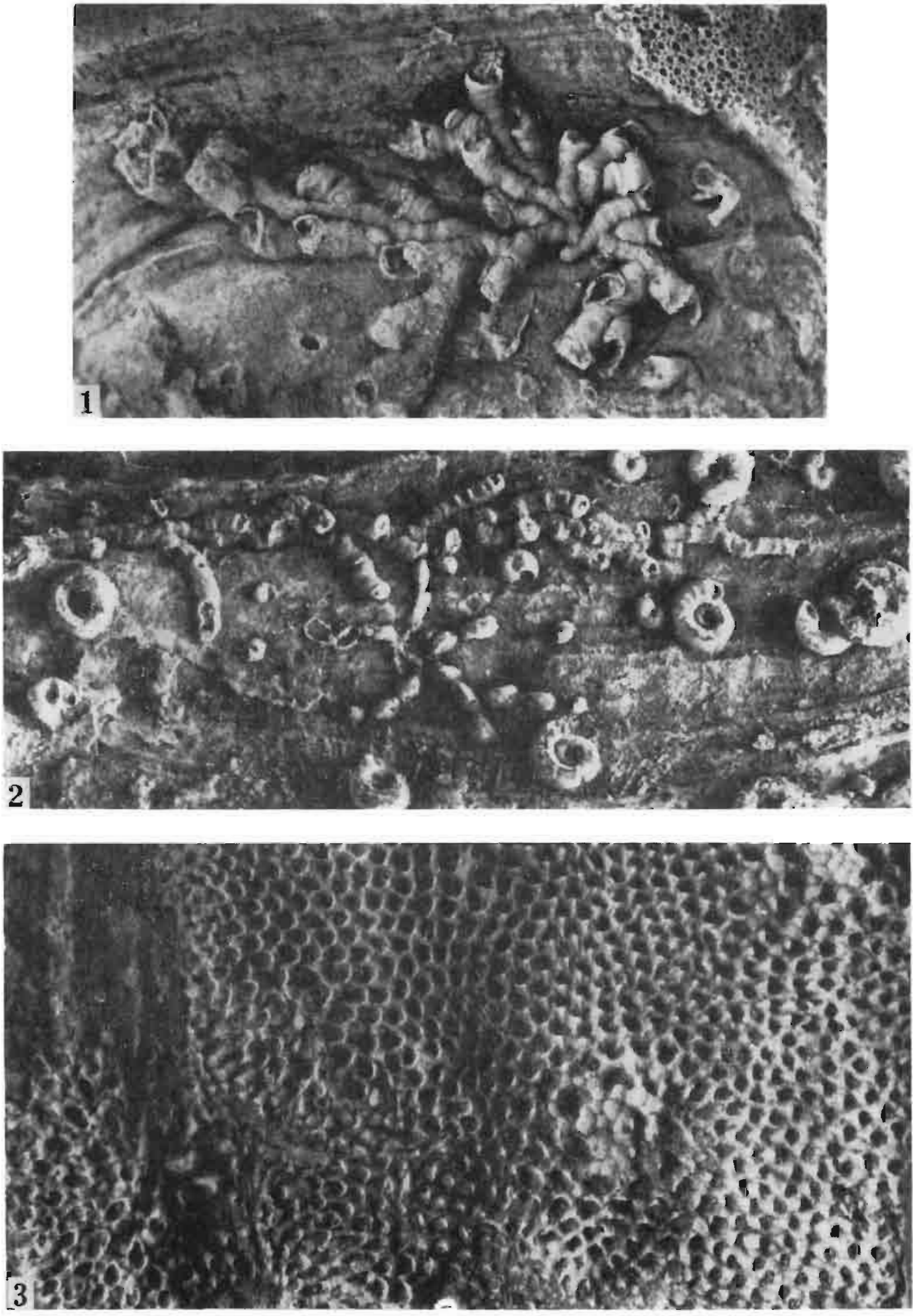
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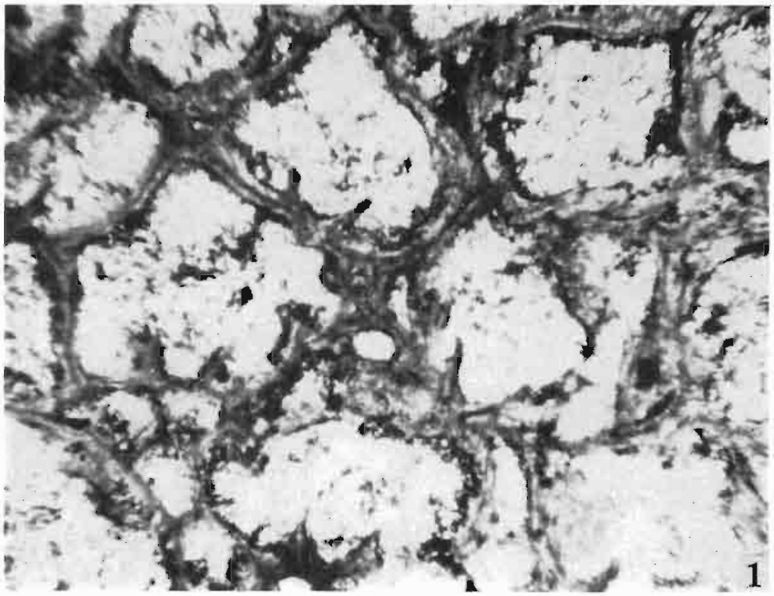

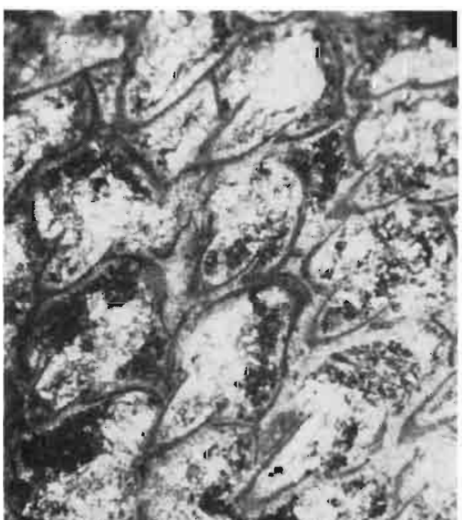

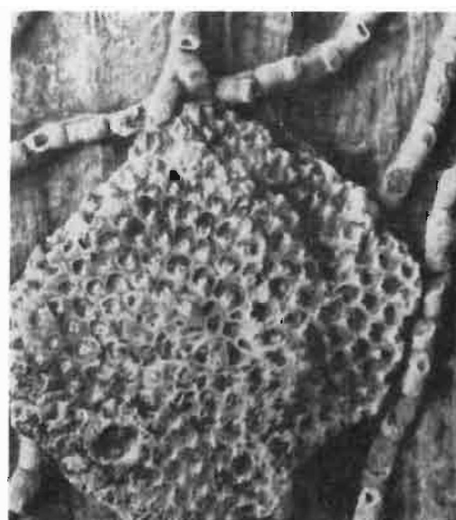

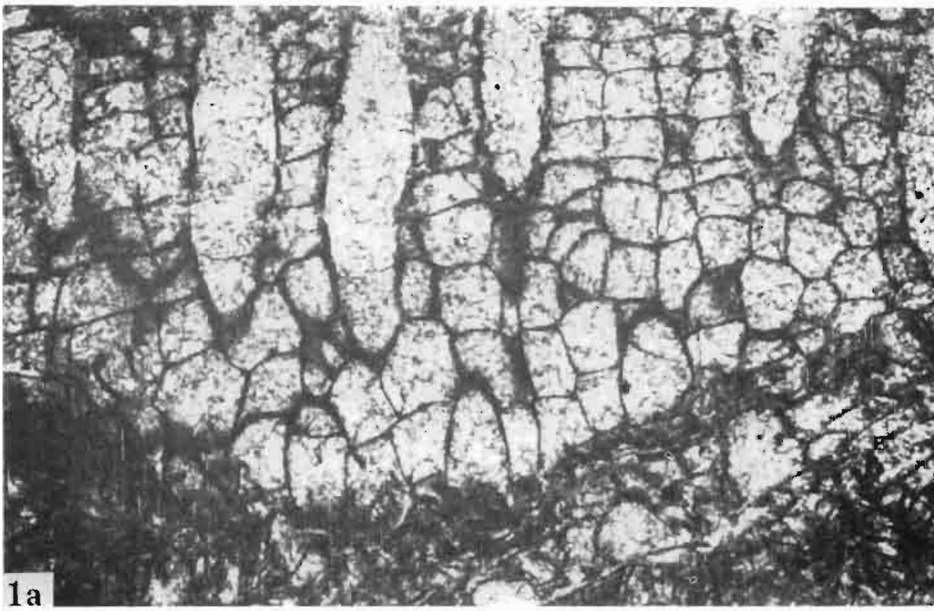
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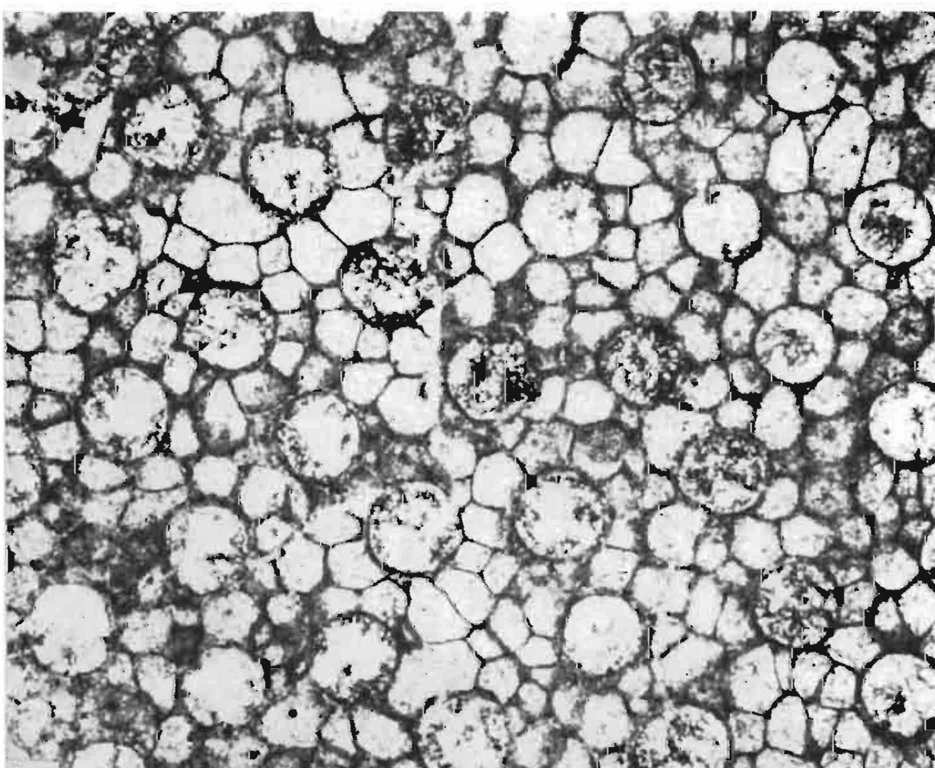
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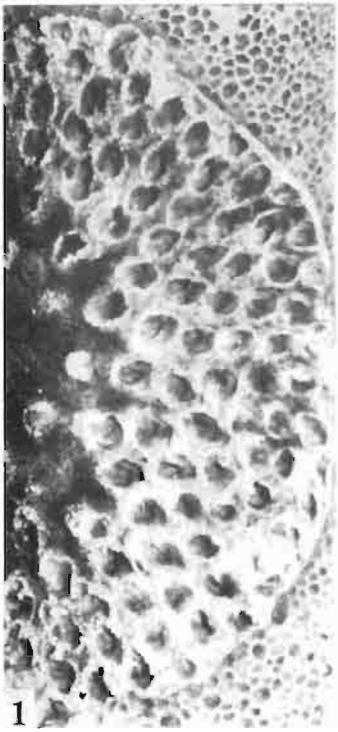

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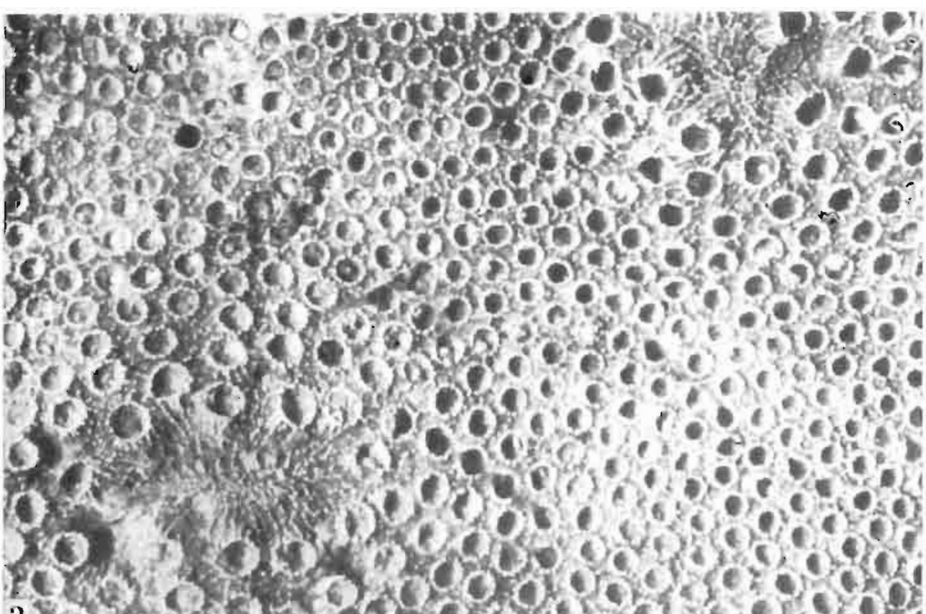

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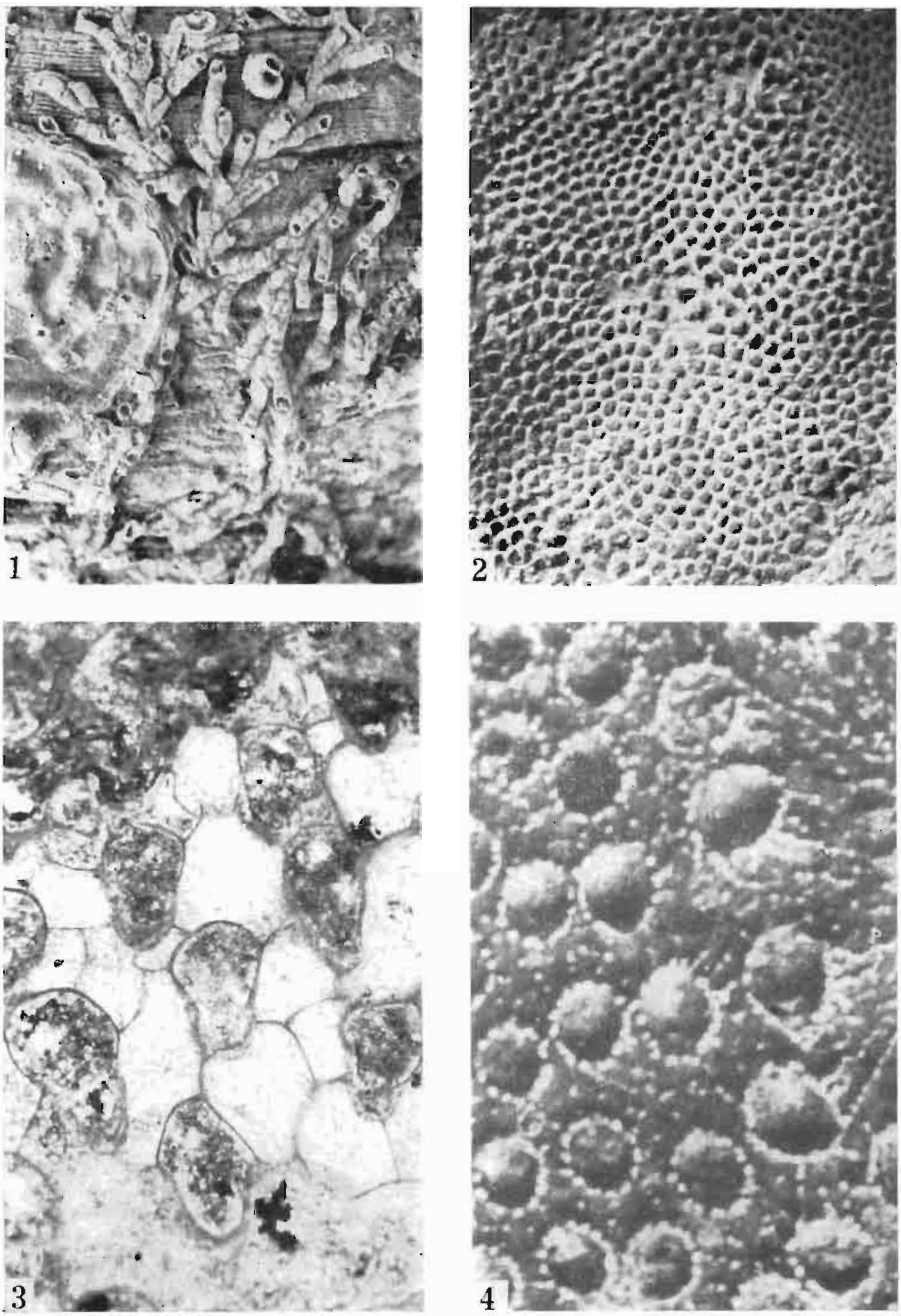

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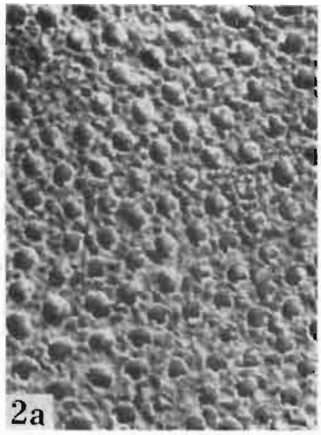

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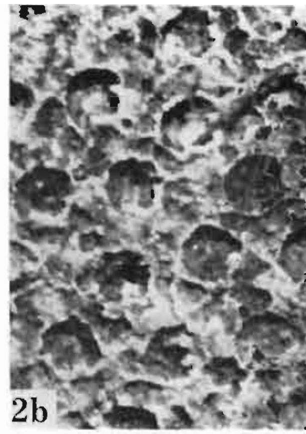

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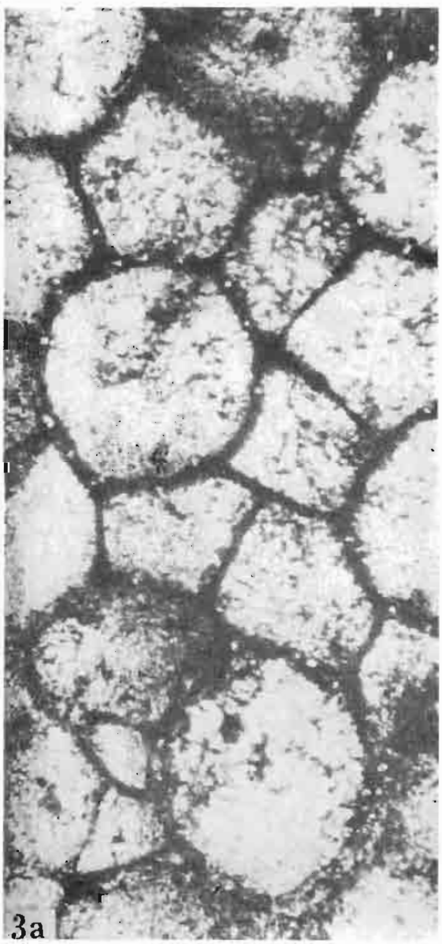

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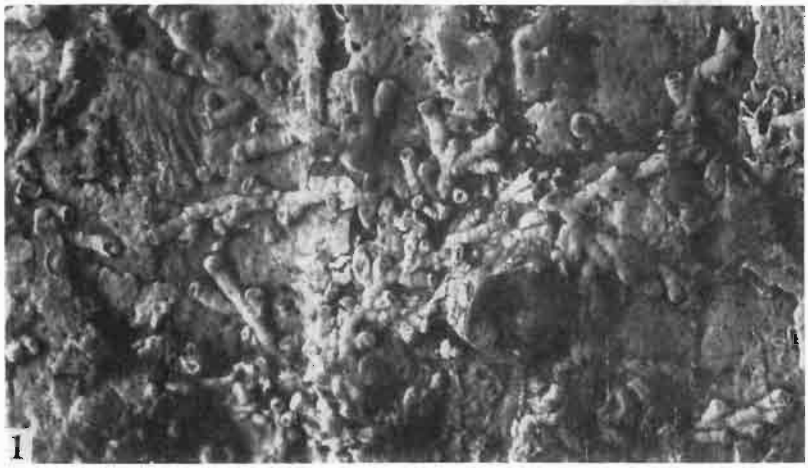
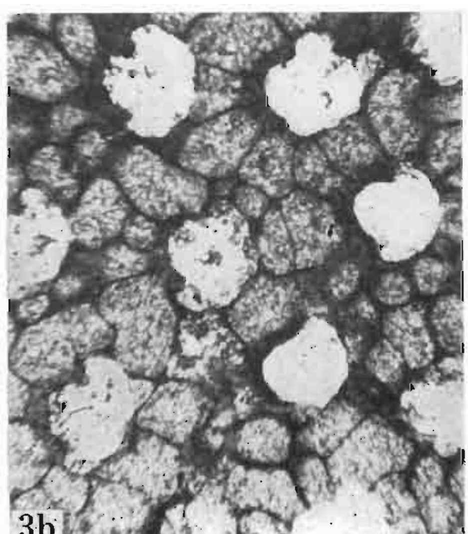
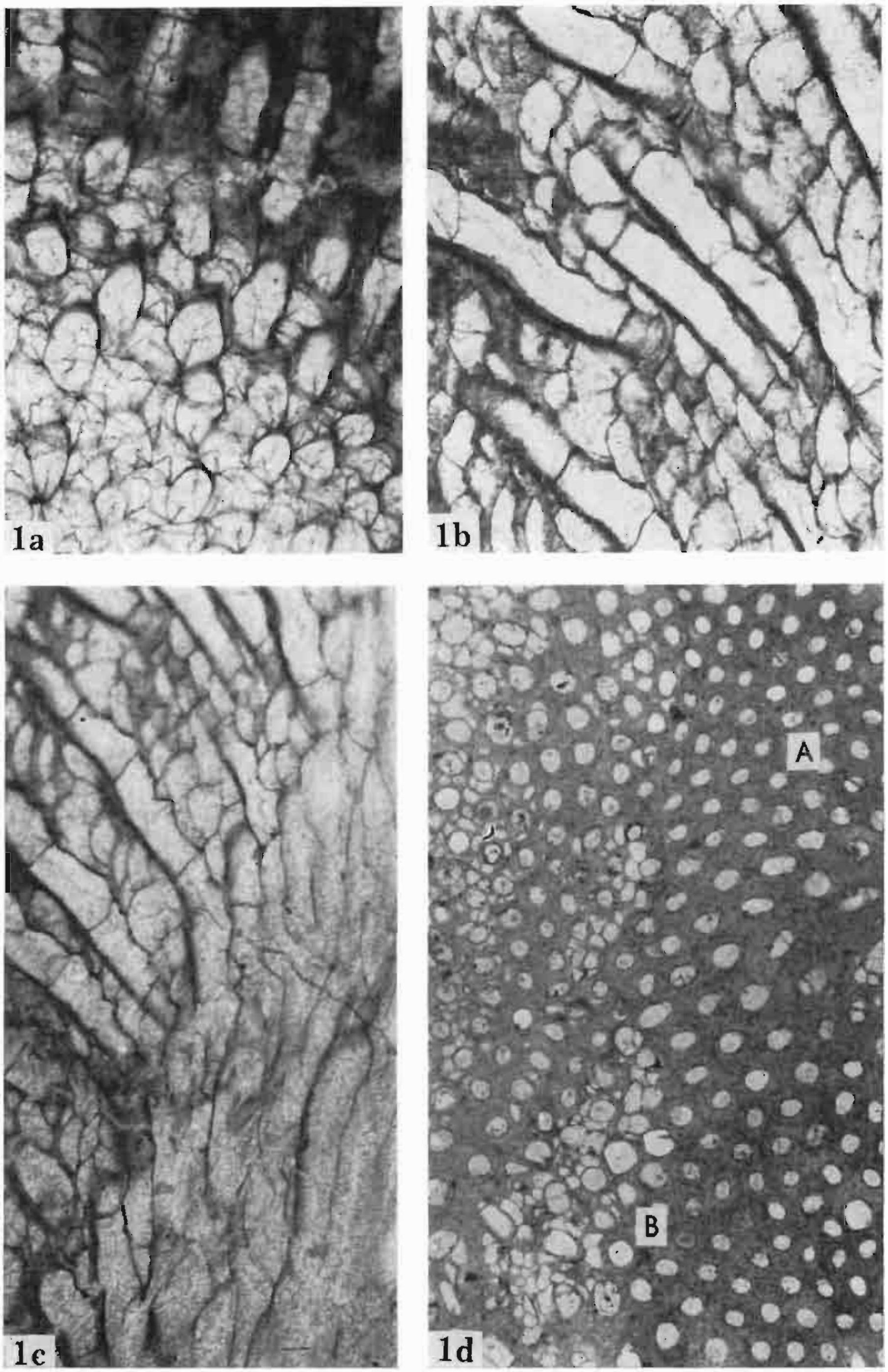
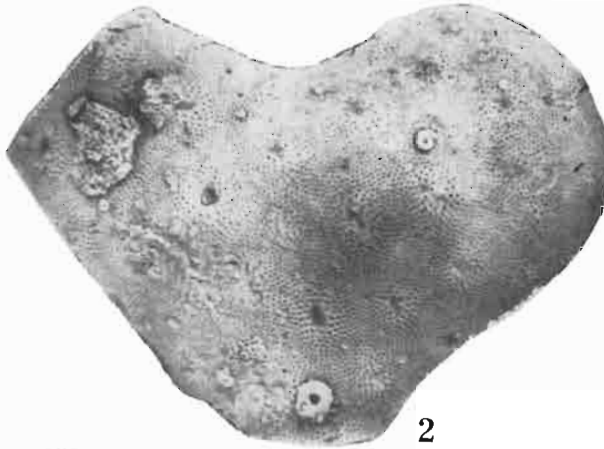
3b






1a
1b
1c
1d
A
B

1



2

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4

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