Tabulate corals from the Givetian and Frasnian of the Holy Cross Mountains and Silesian Upland

ALEKSANDER NOWIŃSKI

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Tabulate corals and single species each of the heliolitid anthozoans and chaetetid sclerosponges mostly from the Givetian and Frasnian stromatoporoid-coral series of the Holy Cross Mts and the Silesia-Cracow Region are reviewed from an ecological and stratigraphical point of view. *Thamnopora*, or the branched pachyporids, and massive alveolitids are usually the most significant reef-builders. The most distinctive fauna, with *Caliapora battersbyi* and *Heliolites porosus*, thrived in the earlier Givetian bank habitats. Late Givetian biostromal-complex associations with *Alveolites obtortus*, *Striatopora enigmatica*, and especially *Alveolitella fecunda*, as well as the succeeding Frasnian *Alveolites*-dominated reef-complex faunas with *A. maillieuxi*, and later with *A. tenuissimus*, *Aulocystis* and syringoporids, are far more uniform. In addition, a local *Coenites laminosa-Chaetetes yunnanensis* fauna is recognized in the Middle Givetian of the Kostomłoty area. The transitional biogeographic position for Polish tabulate assemblages between Variscan Europe and Russia is clearly evident. Forty eight species have been identified. *Pachyfavosites polonicus* sp. n., *Striatopora enigmatica* sp. n., *Alveolitella polygona* sp. n., *Armalites minimus* sp. n., and *Syringoporella raritabulata* sp. n., *Alveolites edwardsi frasnianus* subsp. n., and *Caliapora battersbyi minor* subsp. n. are proposed.

K e y w o r d s: tabulates, Devonian, Poland, taxonomy, stratigraphical ditribution.

Aleksander Nowiński, Instytut Paleobiologii PAN, Aleja Żwirki i Wigury 93, 02-089 Warszawa, Poland.

Introduction

Tabulate coral colonies belong to the most conspicuous rock-forming skeletal elements in the Eifelian to Frasnian limestones of the Holy Cross Mountains and Silesia-Cracow Region. They were the subject of systematic studies as early as the end of 19th century (Gürich 1896). Their taxonomy and stratigraphical distribution is still not well known, with only some

groups such as Alveolitidae (Stasińska 1953), and localities, especially those in the northern part of the Holy Cross Mountains area (Stasińska 1958; Sarnecka 1987), have been more thoroughly studied.

The thick Givetian to Frasnian stromatoporoid-coral limestone of the Kowala Formation (see Racki 1993) is typical of the vast epicontinental shelf of southern Poland. The tabulates were comprehensively studied in the Lublin region (Stasińska & Nowiński 1976, 1978) and the Dębnik Anticline near Cracow (Nowiński 1976), but only in one borehole in the southernmost Holy Cross Mountains (Kulicka & Nowiński 1983).

The principal objective of the present paper is a taxonomic and biostratigraphical analysis of the fairly rich new material consisting of more than 700 colonies collected during the recent fieldwork by Drs G. Racki and T. Wrzołek of the Silesian University. This material comes from 27 localities (Fig. 1) from the southern part of the Holy Cross Mountains (Kielce Region). Several new sites from the more northern Kostomłoty area, and from the Siewierz Anticline in the Silesian Upland are also included.

Apart of the undoubted tabulates there are also sporadically occurring heliolitid anthozoans and chaetetid sclerosponges. There are 48 species, mostly of Alveolitidae and Pachyporidae, 7 species and subspecies new. The combination of the recently obtained and previously published data has enabled a review of the distributional patterns of these fossils.

The preservation of fossils is variable. Many, chiefly the branched coralla are broken; all are recrystallized and silicified to some degree. The collection is housed at the Institute of Paleobiology of the Polish Academy of Sciences in Warsaw (Cataloque Number ZPAL T XVIII) and in the Department of Earth Sciences of Silesian University in Sosnowiec (Cataloque Number GIUS-4-413).

Stratigraphic setting and localities

The basic data on all the tabulate-bearing sites, including lithostratigraphy and set subdivision are given in the register of localities in Racki (1993). Only a short stratigraphical summary, based on the general paleogeography of the area, is presented herein.

Kielce region and Silesia area

In the Gałęzice Syncline and Chęciny Anticline in the western part of the Kielce facies region (Fig. 1B) most the sampled sections represent biostromal stromatoporoid-coral limestone of the Kowala Formation.

The oldest Givetian tabulate heliolitid faunas were collected from the main part of the *Stringocephalus* Beds in, among others, Sowie Górki (set B) and Ołowianka. More abundant material came from the coeval deposits from mainly set E in the Jurkowice-Budy Quarry in the easternmost part

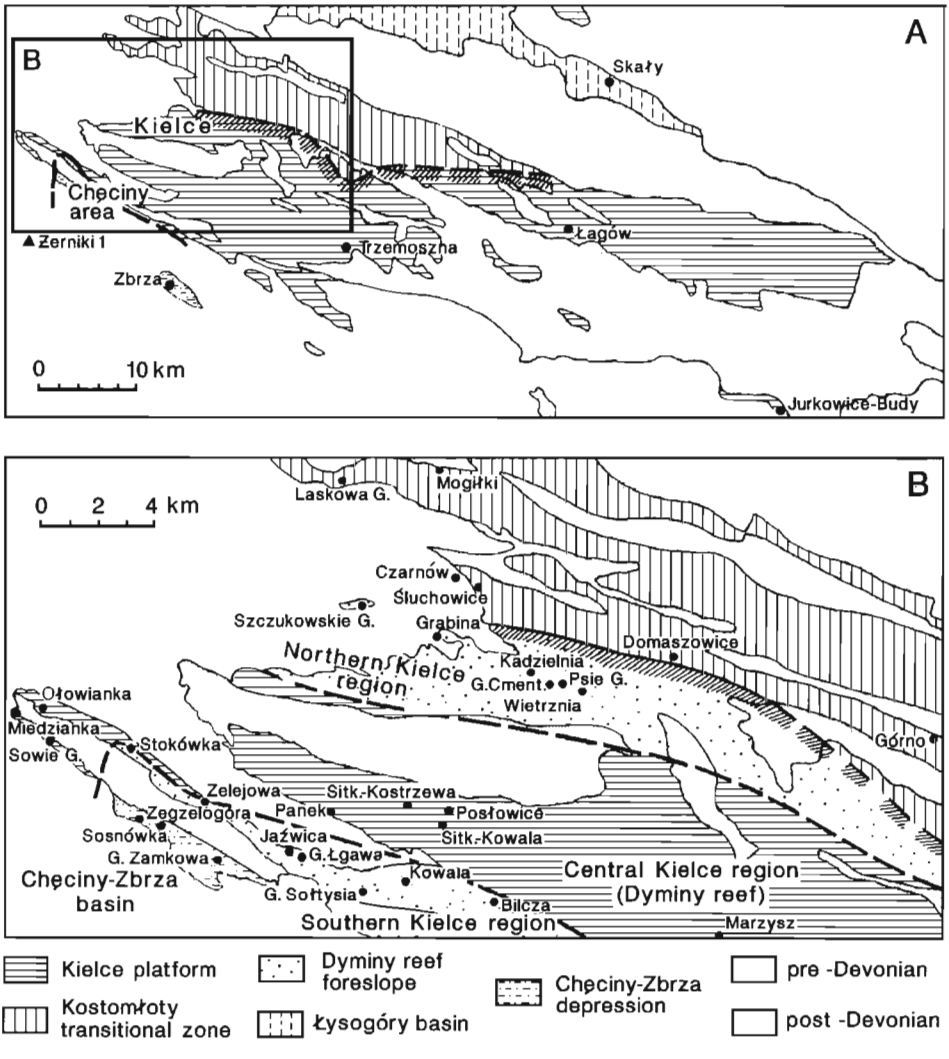


Fig. 1. Location of tabulate-bearing sections in the Holy Cross Mts, against late Givetian (A) and early Frasnian (B) paleogeographic scheme (after Racki 1993: Fig. 2). Points indicate exposures, triangles boreholes, edge of the Kielce Region platform hatchured.

of the area (cf. Nowiński *in* Baliński 1973), as well as from the Dziewki Limestone of the Brudzowice-Dziewki hill near Siewierz, Silesian Upland.

Slightly younger and considerably scarcer specimens are derived from the topmost *Stringocephalus* Beds (the Ambocoeliid Level of Racki 1993) cropping out at Sołtysia Góra, Jaźwica and Posłowice.

The topmost Givetian Jaźwica Limestone Member yielded only rare specimens in two localities, at Posłowice and Marzysz, but a rich collection was made in the approximately coeval Crinoid-Coral Level of the Sowie Górki locality. Also some biostromes of the lower Sitkówka and Chęciny

Beds – especially the *Hexagonaria/Alveolitella* Level – are typically constructed of rock-forming tabulates, particularly in the Posłowice, Trzemoszna, Sitkówka-Kostrzewa and Zegzelogóra sections. At many other sites such as Bilcza, Jaźwica, Zamkowa Góra, and also Łagów in the eastern part of region, the tabulates are less numerous.

The tabulates are well known rock formers in the case of the upper Sitkówka Beds (*Alveolites-Thamnophyllum* Level) and also their biohermal variety the Kadzielnia Limestone Member (Stasińska 1953, 1958; Szulczewski & Racki 1981). These early Frasnian rocks were sampled at Kowala railway cutting, Jaźwica, Sitkówka-Kowala (set C), Sowie Górki (set G), Cmentarna Góra, Zelejowa, Miedzianka and Ołowianka.

The anthozoans are generally less frequent in younger, mostly detrital strata (Racki *et al.* 1989), but fairly extensive collections were obtained from several localities such as Góra Łgawa (set R), Panek, Grabina, Miedzianka, and Szczukowskie Górki.

Kostomłoty facies zone

Specimens from the Kostomłoty area are quite abundant, although gathered from only a few sections. The oldest Givetian assemblage is in the *Stringocephalus* Beds of the Czarnów section; an abundant collection was made from the Laskowa Góra Beds, the Middle Givetian type section (Racki *et al.* 1985). At both sections the directly overlying mostly marly Szydłówek Beds, as well as the possibly coeval Laskowa Góra Beds at Góra Józefka at Górno, are characterized by restriction of the corals to rare detrital and biostromal partings.

The Frasnian tabulate assemblages are considerably impoverished in this facies zone, but several specimens were collected from various detrital limestones of both the Early Frasnian Wietrznia Beds at Czarnów (set D), and Late Frasnian Kostomłoty Beds at Śluchowice, Domaszowice, and Kostomłoty-Mogiłki Quarry.

Distribution of species

Included below are data on all the identified species, with special emphasis on taxa either new or poorly known, or reported for the first time from Poland. Taxa based on poorly preserved and/or fragmentary material, which cannot be assigned with any certainty to particular species, are mostly omitted.

The data on fossil occurrences in the Holy Cross Mountains is in part from literature and in part from current conodont datings provided by Dr. G. Racki. The following literature sources are used: Stasińska (1953, 1958), Kulicka & Nowiński (1983), and Sarnecka (1987, 1988) for the Holy Cross Mountains; Stasińska & Nowiński (1976, 1978) for the Lublin area; Nowiński (1976) for the Cracow area Dębnik Anticline; Wrzołek *in* Racki *et*

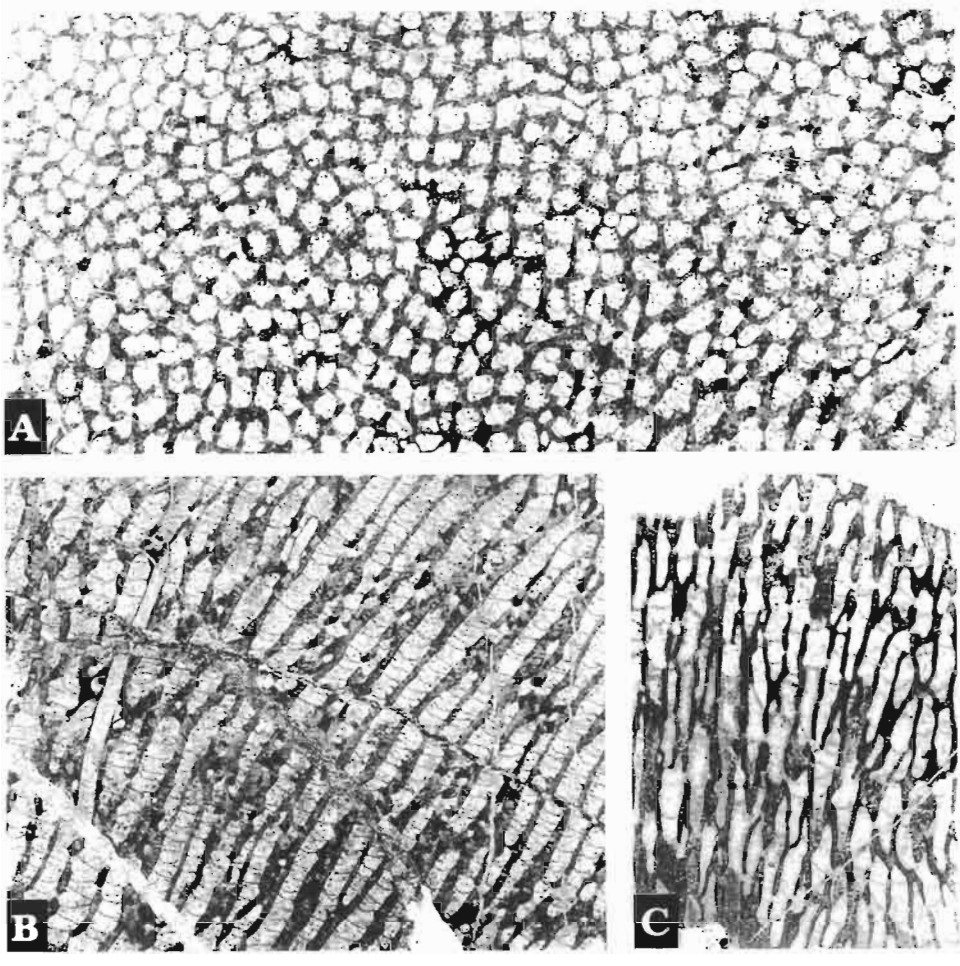


Fig. 2. ❑A-B. *Pachyfavosites polonicus* sp. n. holotype, ZPAL T XVIII 24/2; transverse (A) and longitudinal (B) sections, Sowie Górki, set G, upper Sitkówka Beds of the Kowala Formation, Middle Frasnian. ❑C. *Pachyfavosites* sp. A, ZPAL T XVIII-3/1 in longitudinal section, Cmentarna Góra, Kadzielnia Mbr. of the Kowala Formation, Early Frasnian. All × 5.

al. (in press) for the Silesia area Siewierz Anticline; Stasińska (1969) and Nowiński & Prejbisz (1986) for Pomerania; Lecompte (1933, 1936) for the Dinant Basin, Ardennes, Belgium and other western European countries with the exception of the Rhenish Slate Mountains which are covered by Birenheide (1985); Hladil *in* Galle *et al.* (1988) for Moravia; Dubotalov (1959, 1963) for the Kuznetsk Basin; Sokolov (1952) and Yanet (1959, 1972) for the Russian Platform and the Urals; Mamedov & Rzhonsniskaya (1985) for Transcaucasus; and Barskaya (1980) for the Siberian Platform. Stratigraphic nomenclature and stage assignment of occurrences in the former Soviet Union are revised according to the current concepts (Stratigraphic Dictionary of the USSR 1975; Rzhonsnitskaya 1988).

***Pachyfavosites polonicus* sp. n.** (Fig. 2A, B, see also p. 202).– *P. polonicus* is recorded from the Middle Givetian to Middle Frasnian at Laskowa Góra (set A), Posłowice (set C) and Sowie Górki (set G) in the Holy Cross Mountains.

***Pachyfavosites* sp. A** (Fig. 2C).– A fragmentary corallum, referred to *Pachyfavosites* from the Early Frasnian of Góra Cmentarna (set B) is close to *P. polonicus* sp. n., but differs in thinner corallites (0.4-0.7 mm), more widely spaced connecting pores, lack of septal apparatus and more widely spaced tabulae.

***Roemerolites lublinensis* Stasińska & Nowiński 1978**.– Three almost complete coralla of *R. lublinensis* are from the later Frasnian deposits of Panek. The species was previously described from strata of similar age in the Tyszowce IG-2 borehole, Lublin area.

***Thamnopora boloniensis* (Gosselet 1877)**.– Sixty four coralla of *T. boloniensis*, in the Holy Cross Mountains range in age from Givetian to Middle Frasnian in Laskowa Góra (set A), Jurkowice-Budy, Ołowianka (set B), Bilcza (set B), Czarnów (set B), Posłowice (set B), Sowie Górki (sets B-C), Trzemoszna, Sitkówka-Kostrzewa and Kowala, Jaźwica (set H), Miedzianka (set A). *T. boloniensis* is reported also from the Silesia-Cracow Region's Givetian in Siewierz and Dębnik, Lublin area's Givetian in Płusy IG-1 borehole, Pomerania's Frasnian in Miastko 1 and Wyszebórz 1 borehole, Sudetes' Frasnian, as well as from Belgian Frasnian: 'F2c-F2i', Austrian Middle Devonian, German Frasnian, French undetermined Devonian, Moravian Late Givetian to Early Frasnian, Kuznetsk Basin's Early Frasnian, Vassino horizon and Australia's Givetian.

***Thamnopora cervicornis* (de Blainville 1830)**.– There are four coralla referred to *T. cervicornis* from the Givetian to Middle Frasnian beds of Jurkowice-Budy, Laskowa Góra (set A), Sitkówka-Kowala (set C) and Sitkówka-Kostrzewa. The species has been listed from Lublin area Givetian in Bąkowa IG-1 and Korczmin IG-1 boreholes, Ardennes' Givetian, 'Gia-Gid', Rhenish Slate Mountains Early Givetian Dreimühlen to Rodert Formations, Main Devonian Field's Early to Middle Frasnian, Chudovo to Svinord subhorizons, West Uralian Emsian, Vyazovaya horizon, Kuznetsk Basin's Late Givetian to Early Frasnian, Kerlegesh to Vassino horizons, Siberian Platform's Givetian, Transcaucas' Middle Givetian and North America's Givetian and Frasnian.

***Thamnopora irregularis* Lecompte 1939**.– The only almost complete corallum of *T. irregularis* is from the Early Frasnian of Jaźwica (set H). The species has been reported from the Givetian of Pomerania, Ardennes ('Gia-b') and Eifel Mountains (Dreimühlen to Rodert Formations).

***Thamnopora micropora* Lecompte 1939**.– There are three coralla of *T. micropora* from the Laskowa Góra Beds at the type section. In the Holy Cross Mountains the species ranges from the latest Emsian(?) to Middle Givetian, and according to Stasińska (1958) and Sarnecka (1988) occurs in Grzegorzowice, Łagów 1, 2, and Wierzbontowice 1 boreholes. It was previously described from the Frasnian of Belgium ('F2i') and Germany.

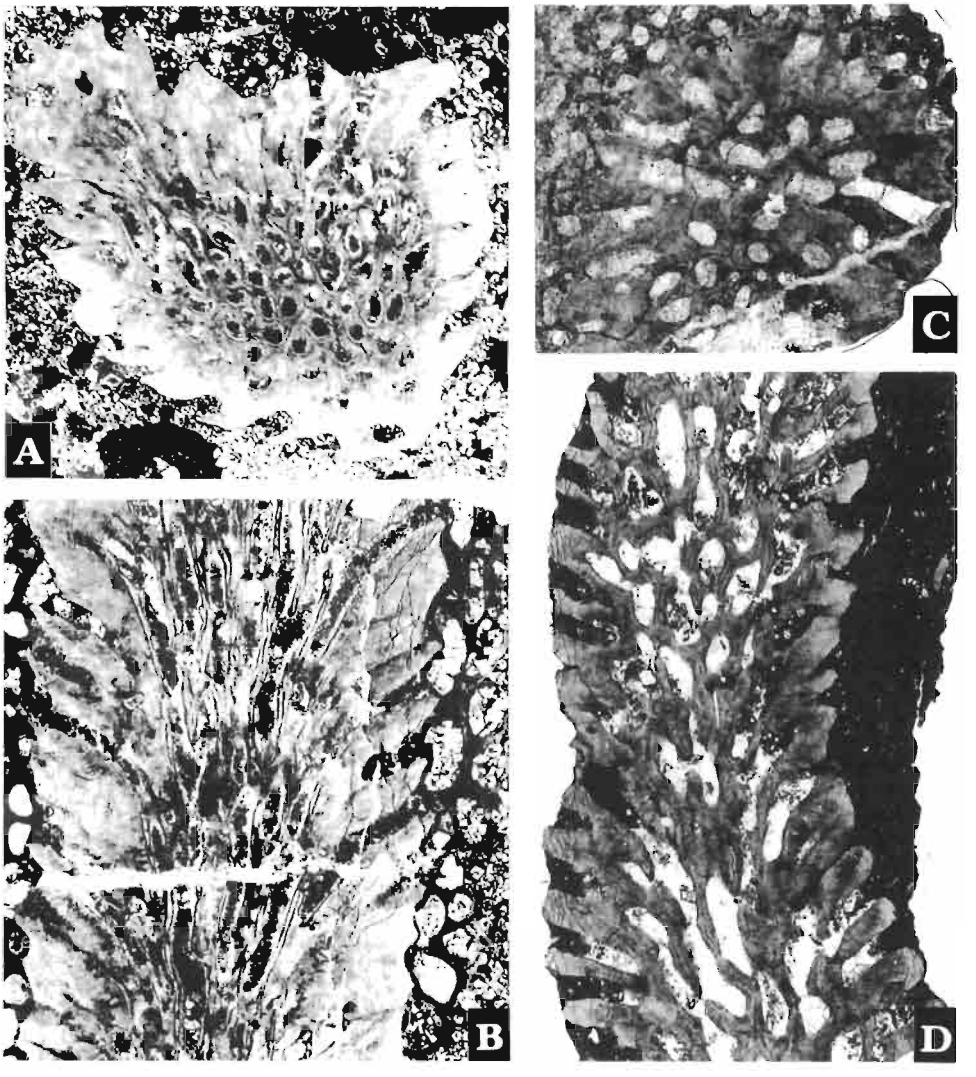


Fig. 3. ❑A-B. *Striatopora tenuis* Lecompte 1939, ZPAL T XVIII-12/22; transverse (A) and longitudinal (B) sections, Laskowa Góra, set A, Laskowa Góra Beds, Middle Givetian. ❑C-D. *Striatopora* aff. *tenuis* Lecompte 1939; C – ZPAL T XVIII-21/9, transverse section, Sitkówka (Kowala quarry), set C, upper Sitkówka Beds of the Kowala Formation, Middle Frasnian; D – ZPAL T XVIII-7/7, longitudinal section, Jaźwica, set A, upper *Stringocephalus* Beds, Middle Givetian; All × 10.

***Thamnopora tumefacta* Lecompte 1939**.– Two specimens of *T. tumefacta* are from the Givetian of Jurkowice-Budy and Trzemoszna. Previous records are from Pomeranian Givetian, Belgian Givetian, 'Gia-Gib', German Givetian, Moravian Early Givetian and Kuznetsk Basin's Eifelian.

***Cladopora gracilis* (Salee in Lecompte 1939)**.– Five almost complete coralla of *C. gracilis* from the Holy Cross Mountains were recovered from

the latest Emsian at Grzegorzowice to the Frasnian at Posłowice, set B and Miedzianka, set D, and also from Dębnik Anticline's Frasnian, Dinantian Basin's Late Frasnian ('F2g, i-j'), West Uralian Late Frasnian (Askyn suite) and Vietnam's Givetian.

***Striatopora enigmatica* sp. n.** (Fig. 4A-B, see also p. 202).– The new species of *Striatopora* occurs in the Holy Cross Mountains Middle Givetian to Early Frasnian at Sowie Górki (set B), Bilcza (set B), Jaźwica (set A), Sosnówka (set B), Sitkówka-Kostrzewa, Ołowianka (set G), Kowala (set C).

***Striatopora tenuis* Lecompte 1939** (Fig. 3A-B).– One almost complete corallum from Laskowa Góra (set A) identified with *S. tenuis* differs from those of the Ardennes Eifelian ('Co2b-c') (Lecompte 1939) by more widely spaced connecting pores and less strongly developed tabulae. *S. tenuis* is present also in the Holy Cross Mountains Eifelian in Jeziorki 1 borehole, as well as in the Givetian of the Siberian Platform.

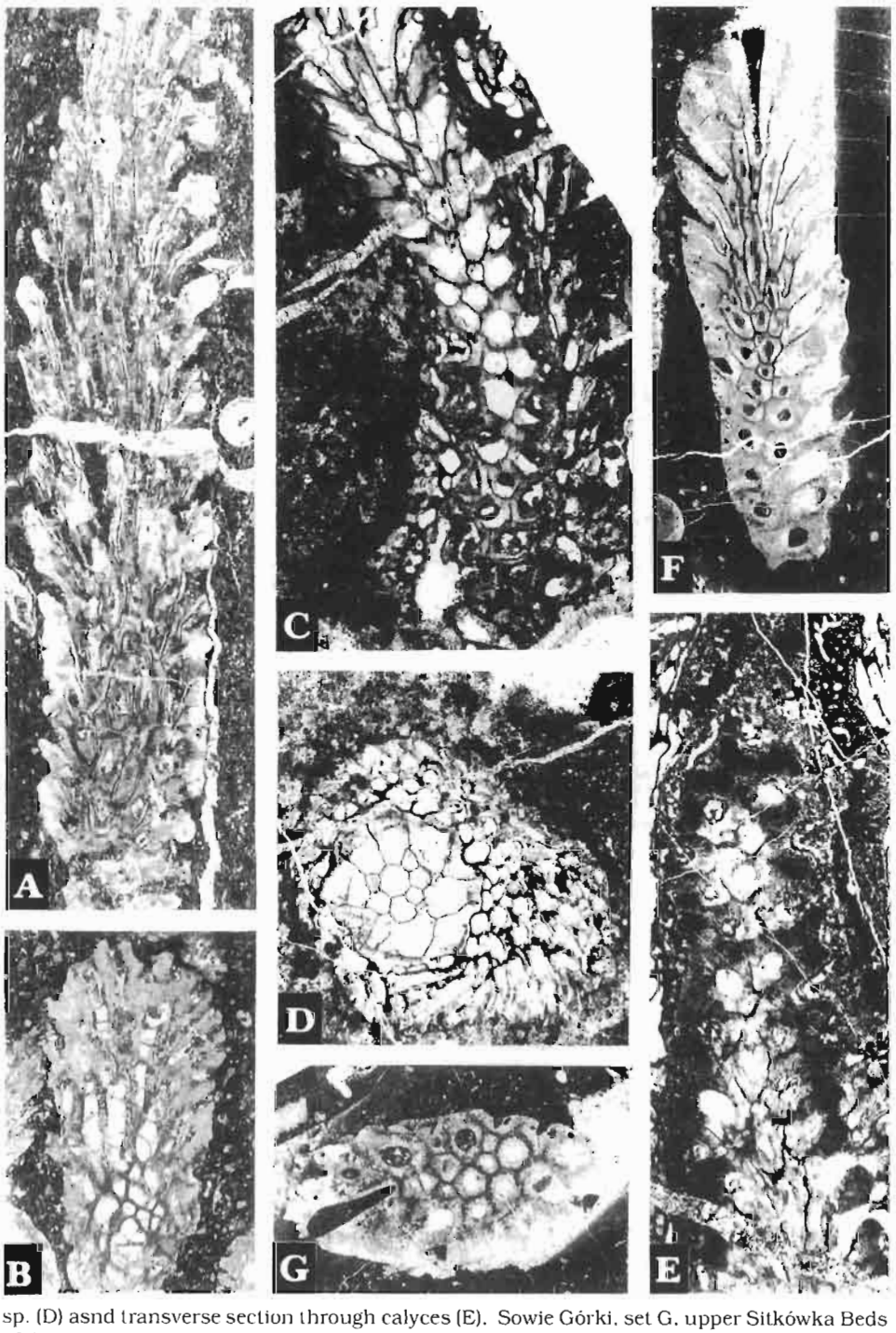
***Striatopora* aff. *tenuis* Lecompte 1939 *sensu* Sokolov 1952** (Fig. 3C-D).– Eleven coralla from the Holy Cross Mountains referred with a qualification to *S. tenuis* are from the Late Givetian to Middle Frasnian of Zegzelogóra (set B), Sołtysia Góra (set A), and Sitkówka-Kowala; previous records include the Central Asia's Eifelian Tas-Khayatakh and the North Uralian Emsian Eifelian passage beds, Bija horizon.

***Gracilopora vermicularis* (McCoy 1850)**.– There are eight specimens of *G. vermicularis* from the Middle Givetian to Late Frasnian strata at Laskowa Góra (sets A, B), Posłowice (set B), Kowala (sets A-B) and Góra Łgawa. This pachyporid species has been recorded from the Frasnian in the Rachanie IG-1 borehole, Lublin area, from the Eifelian ('Co2b', 'Co2d') of the Dinant Basin, the Russia Late Givetian Pashija and Kyn Horizons, West Uralian Emsian to Frasnian Koiva horizon to Askyn suite, East Uralian Eifelian, and Kuznetsk Basin's Late Frasnian Hlubokaya horizon.

***Hillaepora circulipora* (Kayser 1879)** (Fig. 4C-G).– Fourteen coralla of *H. circulipora* from the Holy Cross Mountains Middle Givetian to Middle Frasnian are from Laskowa Góra (set A), Marzysz, and Sowie Górki (set G). *H. circulipora* is also present in the Ardennes' Givetian ('Gib'), East Uralian Emsian to Eifelian, and Moravian Eifelian to Givetian passage beds Čelechovice Limestone. The specimens examined differ from the Belgian and Uralian Givetian representatives of the species (Lecompte 1939; Yanet 1972) by the presence of septa.

***Alveolites complanatus* Lecompte 1939**.– The three specimens of *A. complanatus* studied were obtained from the Late Givetian to Late Frasnian deposits at Czarnów (set C), Jaźwica (set H) and Grabina. Stasińska (1953) described this species from Wietrznia (sets A-?D) and Kadzielnia (set A). *A. complanatus* is also known from the Dinantian Basin's Late

Fig. 4. ❑A-B. *Striatopora enigmatica* sp. n., A – holotype ZPAL T XVIII-11/2-5, longitudinal and transverse sections, Kowala (railroad cut), set C, upper Sitkówka Beds of the Kowala Formation, Early Frasnian; B – ZPAL T XVIII-7/5, longitudinal section, Jaźwica, set A, upper *Stringocephalus Beds*, Middle Givetian. ❑C-G. *Hillaepora circulipora* (Kayser 1879); C-E – ZPAL T XVIII-24/18, longitudinal section (C), transverse section, corallum overgrown by *Alveolitella*



sp. (D) asnd transverse section through calyces (E). Sowie Górki, set G, upper Sitkówka Beds of the Kowala Formation. Middle Frasnian: F-G – ZPAL T XVIII-12/14. 15 longitudinal (F) and transverse (G) sections, Laskowa Góra, set A, Laskowa Góra Beds, Middle Givetian. All × 5.

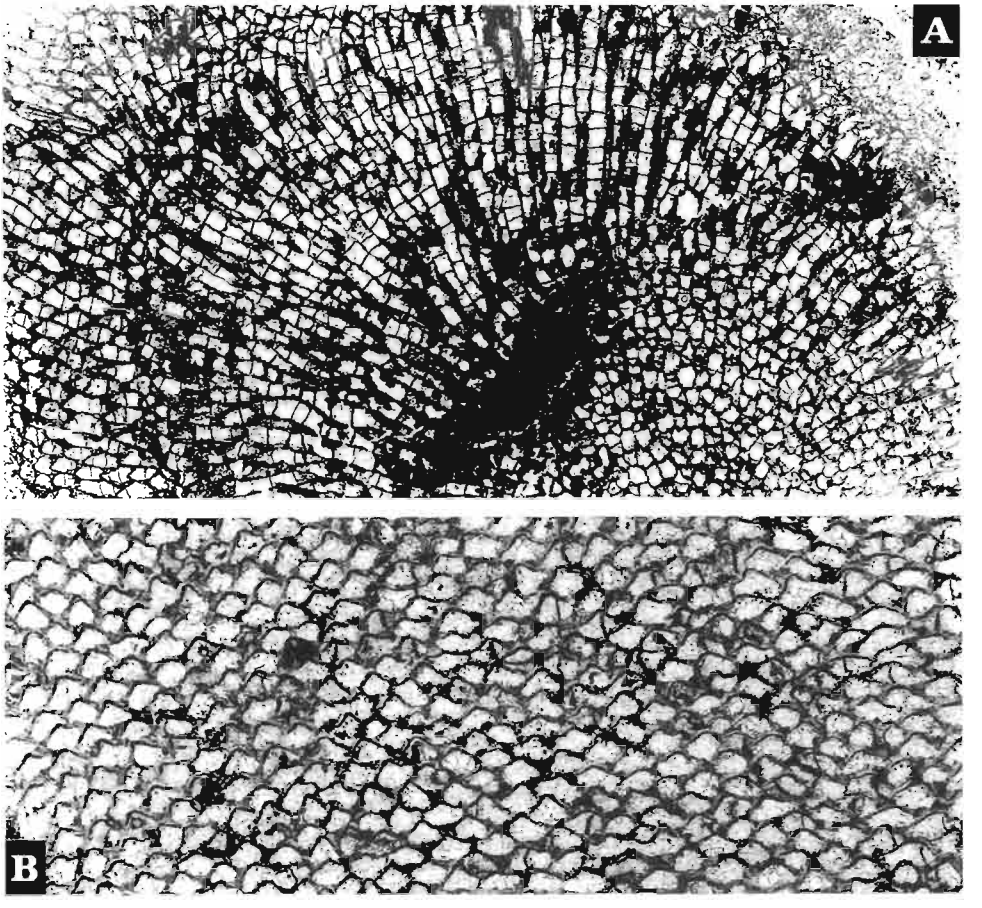


Fig. 5. *Alveolites compressus* Milne-Edwards & Haime 1853: A – ZPAL T XVIII-12/29, longitudinal and transverse sections of a corallum, Laskowa Góra, set B, Szydłówek Beds, Late Givetian, × 3; B – ZPAL T XVIII-12/25, transverse section, Laskowa Góra, set A, Laskowa Góra Beds, Middle Givetian. All × 5.

Frasnian ('F2i-j'), Moravian Middle Frasnian upper Ochoz Cycle and the Central Devonian Field of Russia Middle Frasnian, Semiluki horizon.

***Alveolites compressus* Milne-Edwards & Haime 1853** (Fig. 5).– The Polish specimens of *A. compressus* differ from the Belgian Frasnian specimens (Lecompte 1933) in the absence of a concentric arrangement of corallites about the corallum center, thinner corallite walls and less well developed septal apparatus. Seven complete coralla from the Kostomłoty area, come from the Middle Givetian to Frasnian of Laskowa Góra and Śluchowice. *A. compressus* is present also in Devonshire's Frasnian, the Dinant Basin's Frasnian, 'F2c' to 'F2i', Namur Basin's Frasnian, 'F2IIc' and German Middle Devonian.

***Alveolites edwardsi frasnianus* subsp. n.** (Fig. 6A-B, see also p. 204).– The new subspecies of *A. edwardsi* is described below from the Holy

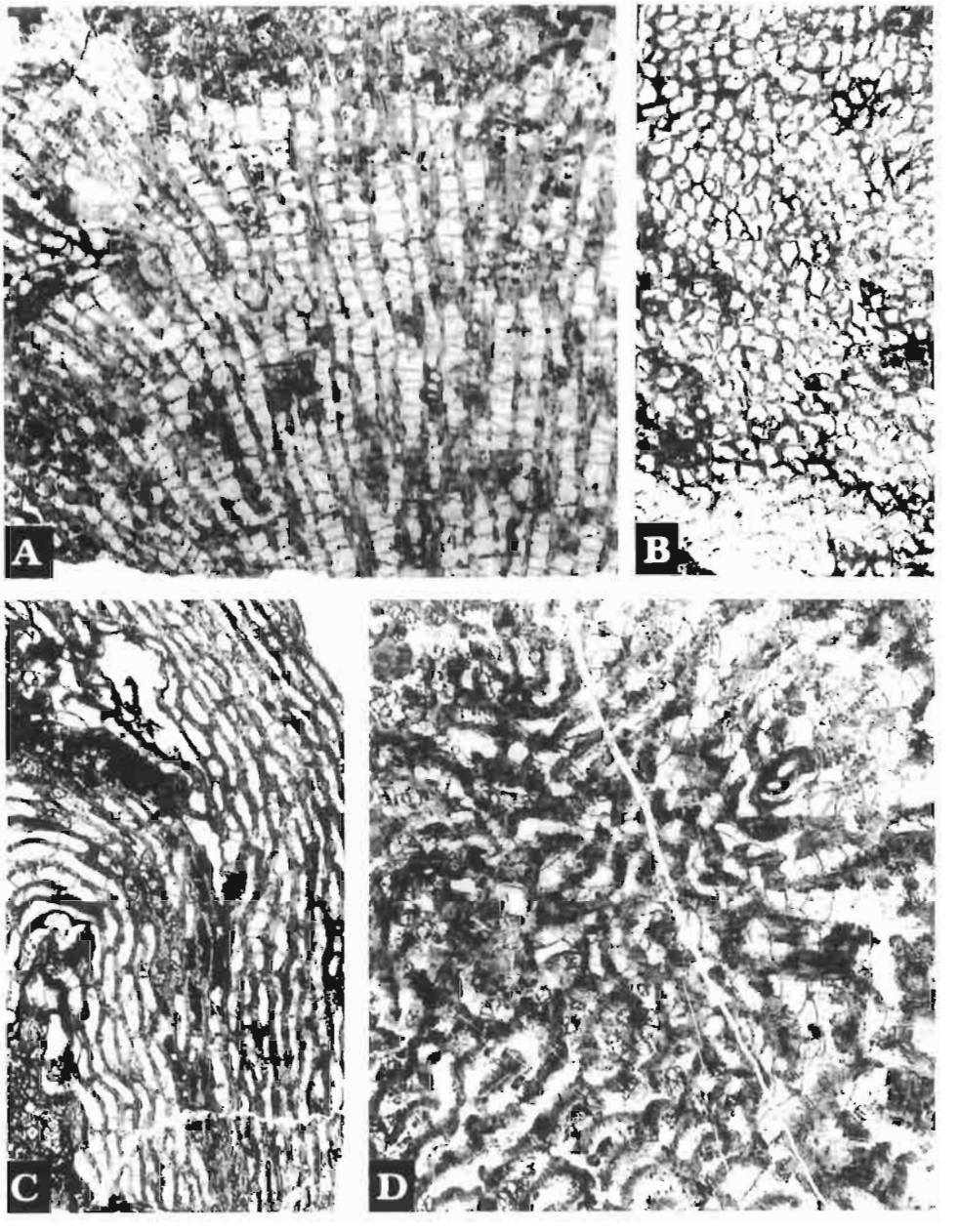


Fig. 6. ❑A-B. *Alveolites edwardsi frasnianus* subsp. n., holotype, ZPAL T XVIII-30/1; longitudinal (A) and transverse (B) sections. Domaszewice, Kostomloty Beds, Late Frasnian. ❑C-D. *Alveolites elongatus* Lecompte 1939; C – ZPAL T XVIII-12/31, longitudinal and transverse sections; D – ZPAL T XVIII-12/32, longitudinal section, parallel with elongated diameter of corallites; both from Laskowa Góra, set A, Laskowa Góra Beds, Middle Givetian. All × 5.

Cross Mountains Late Frasnian, *P. rhenana* Zone of Góra Łgawa and Domaszewice.

***Alveolites elongatus* Lecompte 1939** (Fig. 6C-D).– Four almost complete coralla of *A. elongatus* from Laskowa Góra, set A and Szczukowskie Górki, are Middle Givetian to Frasnian in age. This species is also present in the Ardenne Late Frasnian ('F2j').

***Alveolites* cf. *lecomptei* Stasińska 1958**.– Poor preservation and fragmentary nature of the single available corallum from the Laskowa Góra Beds at Laskowa Góra forbids closer identification despite obvious similarities to the Eifelian species.

***Alveolites maillieuxi* Lecompte 1933**.– Eight coralla of *A. maillieuxi* are avaible from the Eifelian to Frasnian of Jurkowice-Budy, Czarnów (set C), Jaźwica (set I), Sitkówka-Kowala, Zelejowa, Szczukowskie Górki and Góra Łgawa. The species occurs also in the Lublin area's Givetian of the Płusy IG-1 borehole, Moravia's Late Givetian to Early Frasnian, Ochoz Cycle, Dinant Basin's Givetian 'Gib-d', Russian Givetian, Staryj Oskol horizon, West Uralian Givetian, Chusovaya and Cheslavka suites, Kuznetsk Basin's Givetian Safonovo horizon and Altai's Givetian.

***Alveolites obtortus* Lecompte 1939**.– Twenty six coralla of *A. obtortus* are from the Middle Givetian to Middle Frasnian of the Holy Cross Mountains. Source localities include Ołowianka (set B), Łagów, Marzysz, Posłowice (sets B-C), Sosnówka, Stokówka, Trzemoszna, Zegzelogóra, Góra Cmentarna, Jaźwica (set I), Sitkówka-Kowala, Sowie Górki (set G), Wietrznia (sets A-?D), Żerniki IG-1 borehole, and the Middle Givetian of Siewierz in the Silesian Upland. The species is present in the Pomeranian Late Givetian to Early Frasnian, and in the Frasnian of Sudetes; Moravian upper Ochoz Cycle, Dinant Basin's 'F2g-h', Kuznetsk Basin's Shubkino beds and Vietnam.

***Alveolites parvus* Lecompte 1939**.– Five coralla of *A. parvus* come from the Givetian of Laskowa Góra (set A), Górno, and Sowie Górki (sets B-C). The species ranges up to Late Frasnian at Pokrzywianka, Skały, Jurkowice-Budy, Wietrznia (set B), Kadzielnia (set A) and Psie Górki (set ?G). It has been also reported from the Lublin areas Gvetian in Bąkowa IG-1 and Płusy IG-1 boreholes, Dinant Basin's Early Frasnian 'F2b-e', and the Central Devonian Field of Russia Middle Frasnian, Semiluki Beds.

***Alveolites regularis* Sokolov 1952** (Fig. 7A-B).– From the Uralian representatives of *A. regularis* the Polish specimens differ only by the absence of a septal apparatus, which even in the Russian specimens is only weakly developed. Their range at Sitkówka-Kowala in the Holy Cross Mountains is limited to the basal Middle Frasnian, while in the Western Urals they occur in the Late Frasnian Askyn suite.

***Alveolites suborbicularis* Lamarck 1801**.– This cosmopolitan *A. suborbicularis* is represented in the collection by eight coralla. It ranges form the Eifelian to Frasnian at Laskowa Góra (set A), Trzemoszna, Czarnów (set B) Jaźwica (set C), Sosnówka, Sitkówka-Kowala, Wietrznia (sets A-E), Kadzielnia (sets A-C). *A. suborbicularis* is recorded from the Cracow-Silesia area's Givetian, Lublin area's Bąkowa IG-1 borehole's Givetian, Sudetan Frasnian, Dinant Basin's Middle Givetian to Frasnian, 'F1b-c' and 'F2a-j'.

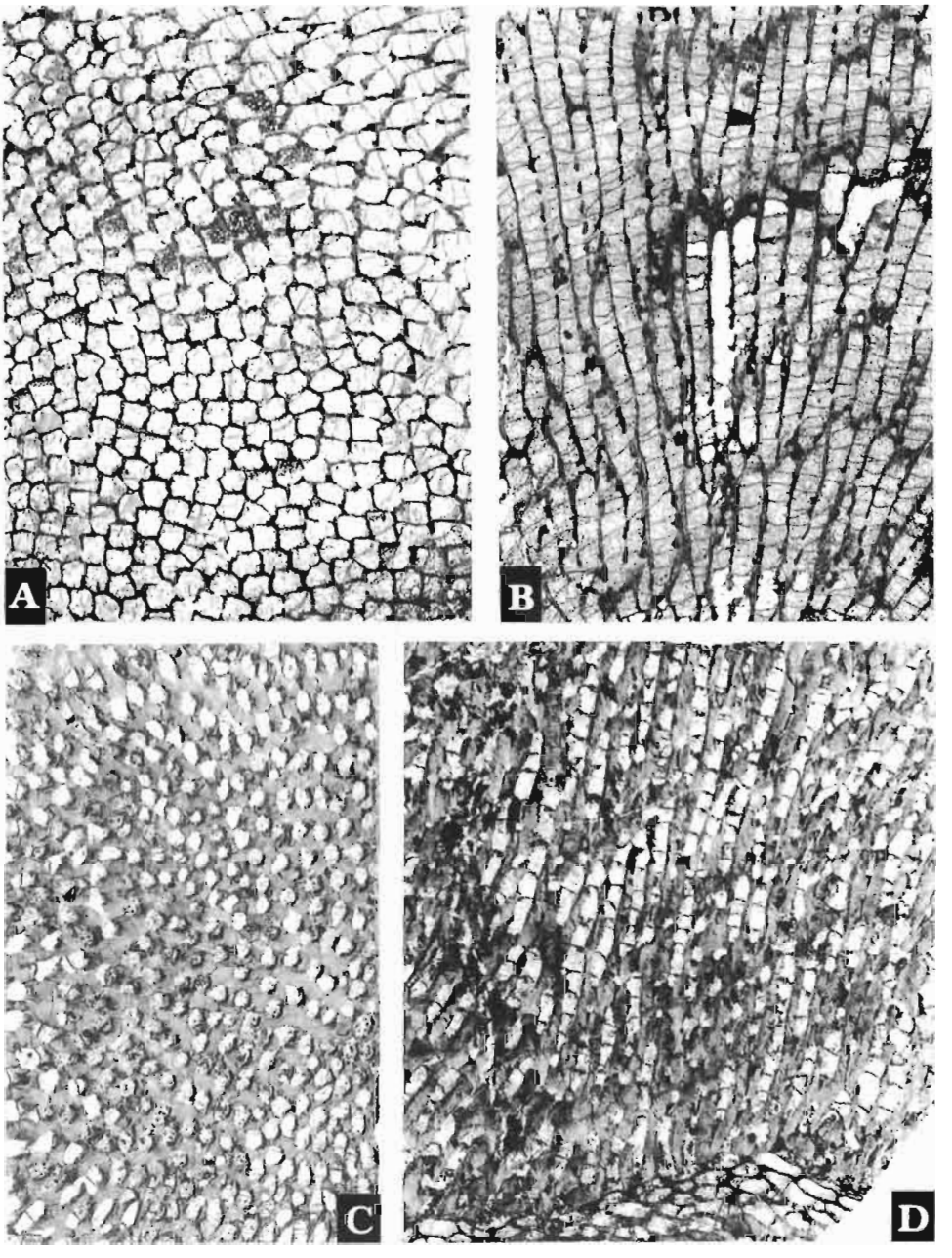


Fig. 7. ❑A-B. *Alveolites regularis* Sokolov 1952, ZPAL T XVIII-21/12; transverse (A) and longitudinal (B) sections, Sitkówka (Kowala quarry), set C, upper Sitkówka Beds, Midle Frasnian. ❑C-D. *Crassialveolites cavernosus* (Lecompte 1933); C – ZPAL T XVIII-18/15, transverse section, Posłowice, set A, upper *Stringocephalus* Beds, Middle Givetian; D – ZPAL T XVIII-24/26, longitudinal section, Sowie Górki, set B, lower *Stringocephalus* Beds, Middle Givetian. All × 5.

France's and Spanish Eifelian to Frasnian, German and Morawian Eifelian to Early Frasnian, English Frasnian, Russian Frasnian, Sargayevo and Semiluki horizons, West Uralian Middle to Late Frasnian (Domanik to Askyn suites), Kuznetsk Basin's Frasnian Vassino horizon, Volhynia, Armenia, Timan, Transcaucas and Siberian Middle Devonian to Frasnian, Indian undetermined Late Devonian, Chinese Middle Devonian, North American Middle Devonian and Australian Early and Middle Devonian.

***Alveolites taenioformis minor* Kulicka & Nowiński 1983**.– Six complete coralla of *A. taenioformis minor* from Góra Łgawa represent this distinctive Late Frasnian alveolitid in the southern Holy Cross Mountains. The taxon was originally described the Żerniki IG-1 borehole.

***Alveolites tenuissimus* Lecompte 1933**.– *A. tenuissimus*, represented by twenty one coralla, occurs in Middle and particularly Late Frasnian sites at Grabina, Psie Górki (set C), Góra Łgawa, Mogiłki, Śluchowice, Kadzielnia (sets A-B), Wietrznia (sets ?C-E), and Bolechowice-Panek. The Frasnian occurrences are in the Sudetes at Mokrzyszów, and in the Dinant ('F2g-j') and Namur Basins of Ardennes.

***Crassialveolites cavernosus* (Lecompte 1933)** (Figs 7C-D).– Four almost complete coralla referred to *C. cavernosus* have been derived from the Middle and Late Givetian Sowie Górki (set B), Posłowice (set A), and Trzemoszna. This species is also present in the Dinant Basin's Early Givetian, 'Gib-d', Moravian Givetian, Byči Skala Cycle and Kuznetsk Basin's Early Frasnian, Izyly horizon, Zarubinaya beds.

***Crassialveolites crassus* (Lecompte 1939)**.– Nine coralla of *C. crassus* ranging in age from Middle Givetian to Frasnian at Laskowa Góra (set A), Jurkowice-Budy, Sowie Górki (set B), Czarnów (sets A and C), Posłowice (set C), Góra Cmentarna, Wietrznia (sets C-E), and Psie Górki (set G). It has been reported from the Givetian of the Lublin area Bąkowa IG-1 borehole and Pomerania (Miastko 1 borehole), as well as from the Moravian Givetian, Byči Skala Cycle, Dinant Basin's Givetian, ('Gia-d'), Russian Givetian Ardatovo subhorizon, West Uralian Late Emsian to Givetian Biya horizon to Cheslavka suite, Kuznetsk Basin's Late Emsian to Givetian, Shanda beds to Safonovo horizon and Peri-Salair's Early Devonian.

***Crassialveolites evidens* Dubatolov 1963** (Fig. 8).– Ten coralla of *C. evidens* from the Holy Cross Mountains come from the later Givetian at Sowie Górki (set B), Czarnów (set B), Góra Zamkowa (set G) and Zegzelogóra (set B). It has been reported from the Early Frasnian Vassino horizon of Kuznetsk Basin and Moravia Ochoz Cycle.

***Crassialveolites multiperforatus* (Lecompte 1933)**.– *C. multiperforatus*, represented by nine coralla, occurs in the Holy Cross Mountains in the Middle Givetian to Middle Frasnian of Sowie Górki (set B), Posłowice (set A), Górno, Stokówka (set C), Góra Cmentarna, Wietrznia (sets A-C), Kadzielnia (set ?A), and Psie Górki (sets ?D-?E). Previously, the species has been reported from the Dinant Basin's Frasnian, 'F2a-j', Moravian Middle Frasnian, Russian Givetian Ardatovo subhorizon, West Uralian Late Givetian Kyn horizon and Canadian Middle Frasnian.

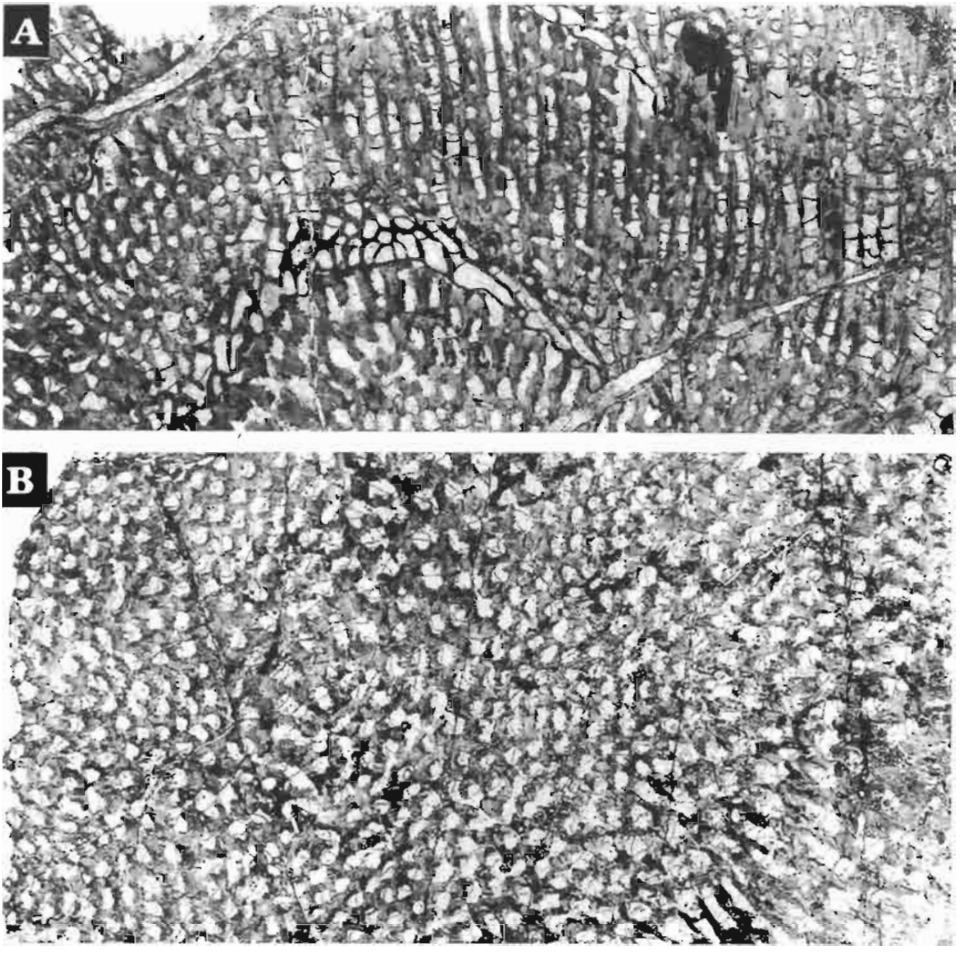


Fig. 8. *Crassialveolites evidens* Dubatolov 1963; A – ZPAL T XVIII-24/29, longitudinal section, Sowie Górki, set B, lower *Stringocephalus* Beds, Middle Givetian. B – ZPAL T XVIII-4/11, transverse section, Czarnów, set B, Szydłówek Beds, Late Givetian. All × 5.

***Alveolitella fecunda* (Lecompte 1933).**– This commonly occurring species is represented by 53 coralla in the Givetian to Middle Frasnian strata in Czarnów (set A), Laskowa Góra (set B), Górno (set A), Trzemoszna, Marzysz and Posłowice (sets B-C). Stasińska (1953) found it in Wietrznia (sets C-?D) and it is also reported from the Cracow area's Late Frasnian, Lublin area's Givetian, Bąkowa IG-1 and Korczmin IG-1 boreholes, Pomerania's Givetian, Dinant Basin's Givetian 'Gib-F1b', Moravian Givetian, Byči Skala Cycle and Kuznetsk Basin's Givetian to Early Frasnian, Kerlegesh to Izyly horizons.

***Alveolitella polygona* sp. n.** (Fig. 9, see also p. 205).– This new species known only from its type locality (Posłowice) in the Holy Cross Mountains. Its age is Late Givetian.

***Caliapora battersbyi* (Milne-Edwards & Heime 1851).**– Thirteen coralla of *C. battersbyi* have been recovered from three localities, i.e. Jurkowice-Budy, Czarnów (set A), Sowie Górki (set C) which span the whole Givetian. This notably Givetian alveolitid was reported from Żerniki IG-1 borehole, and also from the Silesia-Cracow Region at Siewierz and Dębnik (Nowiński 1976), Lublin Region Płusy IG-1 borehole, and from Pomerania and Moravia. It was originally described from England and Belgium ('Gib-d').

***Caliapora battersbyi minor* subsp. n.** (Fig. 10, see also p. 206).– Three colonies of the new subspecies from the Holy Cross Mountains at Czarnów (set A) and Silesian Upland at Siewierz are probably limited to the Middle Givetian.

***Caliapora uralica* Yanet 1959** (Fig. 11).– The two Middle Givetian coralla from Dziewki differ from the typical forms (Yanet 1959; Dubatolov 1963) in the more differentiated wall thickness and concave – rarely wavy or straight – tabulae. From the Uralian representatives they differ in the slightly smaller pore diameters and wider spaces between the pores. *C. uralica* occurs in the East Uralian Eifelian and Kuznetsk Basin's Late Emsian Shanda Beds.

***Caliapora venusta* Yanet 1972** (Fig. 12A-B).– Two coralla of *C. venusta* from the Holy Cross Mountains are from the Middle (?Early) Givetian at Czarnów (set A). The species occurs also in the East Uralian *Stringocephalus* Beds and the Moravian Givetian Byči Skala Cycle.

***Coenites clathratus minor* Stasińska 1958.**– The Middle Givetian Laskowa Góra Beds at the type section have yielded two almost complete coralla of *C. clathratus minor*, originally described from the 'Couvinian' of Wydryszów.

***Coenites laminosa* Gürich 1896** (Fig. 12C-D).– *C. laminosa* is represented by twenty coralla in the Givetian assemblages from Laskowa Góra (set A) and Sowie Górki (set C). It ranges from the topmost Eifelian to Givetian at Pokrzywianka, Skały and Miłoszów (Stasińska 1958), and has been recorded also from the Lublin area's Givetian of the Bąkowa IG-1, Płusy IG-1 and Korczmin IG-1 boreholes.

***Planocoenites escharoides* (Steininger 1853).**– Seven coralla of *P. escharoides* were collected from the Middle Givetian Laskowa Góra Beds, but the species occurs as early as the latest Emsian at Grzegorzowice, Jeziorko 1 borehole and Skały (Sarnecka 1987), as well as in the Givetian of Pomerania. *P. escharoides* is a cosmopolitan species, known from the Rhenish Slate Mountains' Eifelian, 'Crinoid Beds' and Givetian, Dinant Basin's Eifelian, 'Co2c-d' and Givetian, 'Gia', Kuznetsk Basin's Givetian, Safonovo horizon, and undetermined Devonian rocks of Siberia, Indochina and Australia.

***Natalophyllum giveticum* Radugin 1938.**– Four coralla of *N. giveticum* are from Givetian sites at Czarnów (set A), Ołowianka (set B) and Trzemoszna. The species was hitherto known from the Givetian of Dębnik

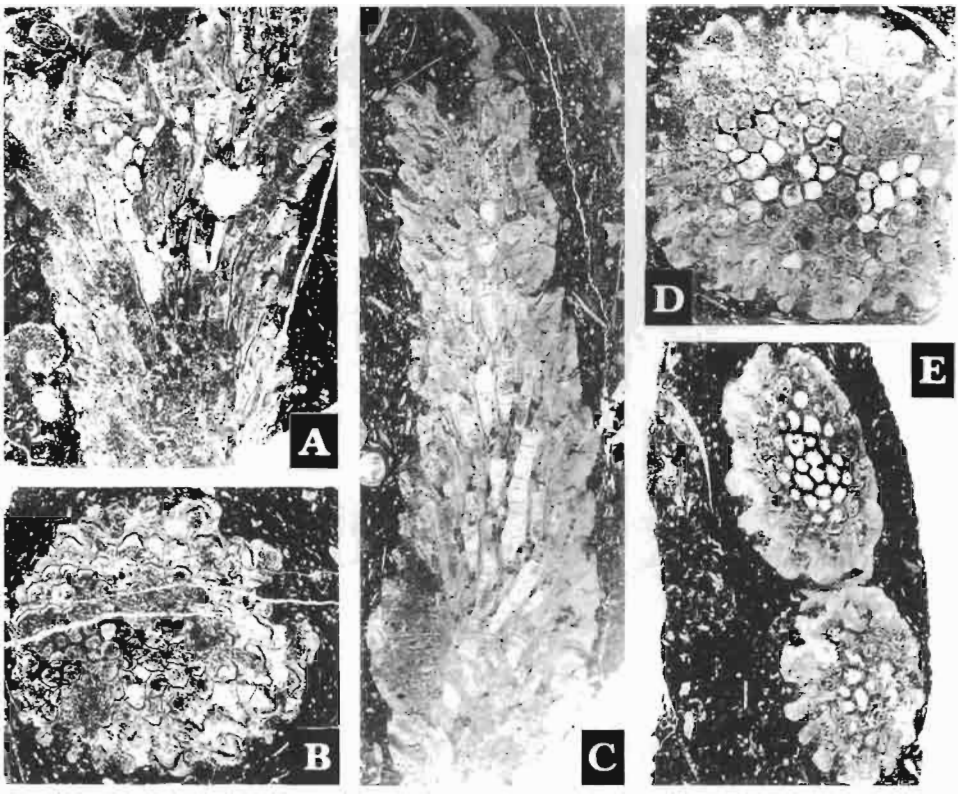


Fig. 9. ❑A-E. *Alveolitella polygona* sp. n.; A – holotype ZPAL T XVIII-18/51, longitudinal (A) and transverse (B) sections; C – ZPAL T XVIII-18/47, longitudinal section; D – ZPAL T XVIII-18/48, transverse section; E – ZPAL T XVIII-18/52,53, transverse section throuh the fusing branches; all from Posłowice, set B, Jaźwica Limestone Member of the Kowala Formation, Late Givetian. All × 5.

Anticline and Pomerania in Poland and was previously described from the Kuznetsk Basin's Givetian, Kerlegesh to Alchedat horizons.

***Scoliopora denticulata* (Milne-Edwards & Haime 1851).**– There are seven specimens of *S. denticulata* from the Givetian at Czarnów (set A) and Trzemoszna. In Poland this species is reported also from the Givetian of the Silesia-Cracow Region and Pomerania, Givetian and Frasnian of the Lublin area (Bąkowa IG-1, Kock IG-1, Korczmin IG-1, Tyszowce IG-2 and Lublin IG-1 boreholes), and undetermined Middle Devonian of the Sudetes. This is a common species listed from the Dinant Basin's Givetian, 'Gib'-'F1c', Moravian Givetian to Frasnian, Rhenish Slate Mountains' Middle Devonian, Asturia's Middle Devonian to Frasnian, Kuznetsk Basin's Early Frasnian Vassino horizon, East Uralian Givetian, *Stringocephalus* Beds, Armenian Middle Devonian and Chinese Famennian of Yunnan.

***Syringopora volkensis* Tchernyshev 1938** (Fig. 13A-B).– Three almost complete specimens of *S. volkensis* come from Givetian to Frasnian

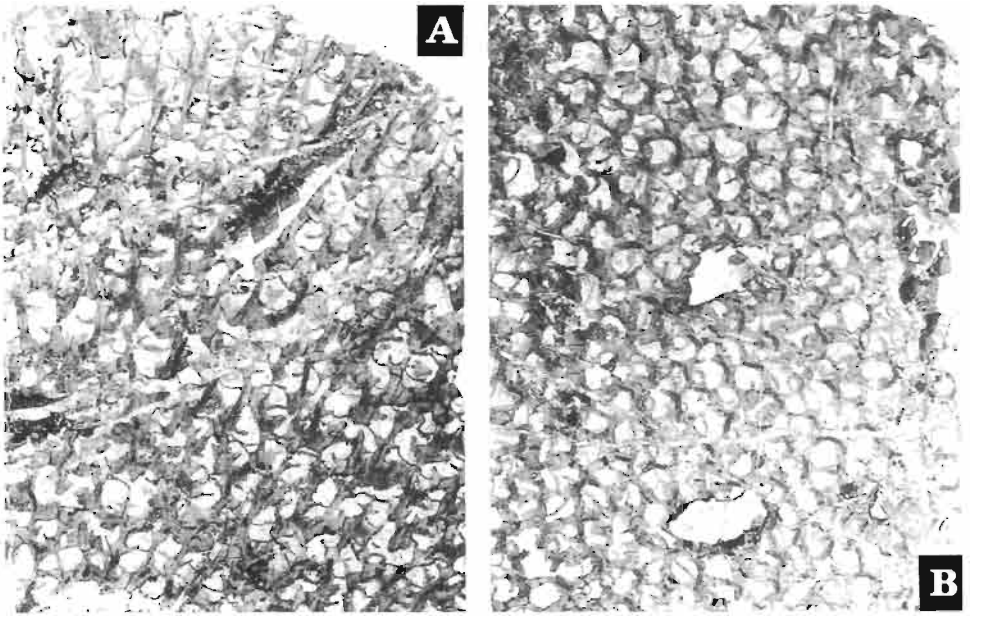


Fig. 10. *Caliapora battersbyi minor* subsp. n.; holotype ZPAL T XVIII-4/20, longitudinal (A) and transverse (B) sections, Czarnów, set A, lower *Stringocephalus* Beds of the Kowala Formation, Early(?)-Middle Givetian; both × 5.

localities at Domaszowice, Góra Łgawa (set R), and Jurkowice-Budy. The species was earlier described from Vaygatch Island's Middle and Late Devonian, and listed from the earliest Famennian of the Moravia Mokra Cycle.

***Armalites minimus* sp. n.** (Fig. 13C-D, see also p. 208).– *A. minimus* is restricted to the Late Frasnian *P. rhenana* Zone, at Góra Łgawa (set R).

***Syringoporella raritabulata* sp. n.** (Fig. 14, see also p. 208).– *S. raritabulata* is known only from the Early to Middle Frasnian Sowie Górki (set G) and Jaźwica (set K).

***Aulopora* sp. (cf. *A. verticillata* Sokolov 1952).**– Two fragmentary and poorly preserved Givetian *Aulopora* from Czarnów (set B) and Jurkowice-Budy are probably allied to the Russian auloporoid species.

***Aulocystis tikhyi* Sokolov 1952.**– Seven specimens of *A. tikhyi* are from the Late Givetian to Middle Frasnian deposits at Posłowice (set A), Jaźwica (set I), Kowala (set A) and Sitkówka-Kowala (set C). The species is known also from the Żerniki IG-1 borehole, from Late Frasnian, Voronezh horizon in the Central Devonian Field and Early Frasnian, Sargayevo horizon in southeastern Russia.

***Aulocystis tikhyiformis* Stasińska & Nowiński 1978.**– *A. tikhyiformis* is represented in the collection by one corallum from the Frasnian Góra Łgawa (set R), but it has been earlier reported from the Żerniki IG-1 borehole, and described from the Lublin area Rachanie IG-1 and Tyszowce IG-2 boreholes.

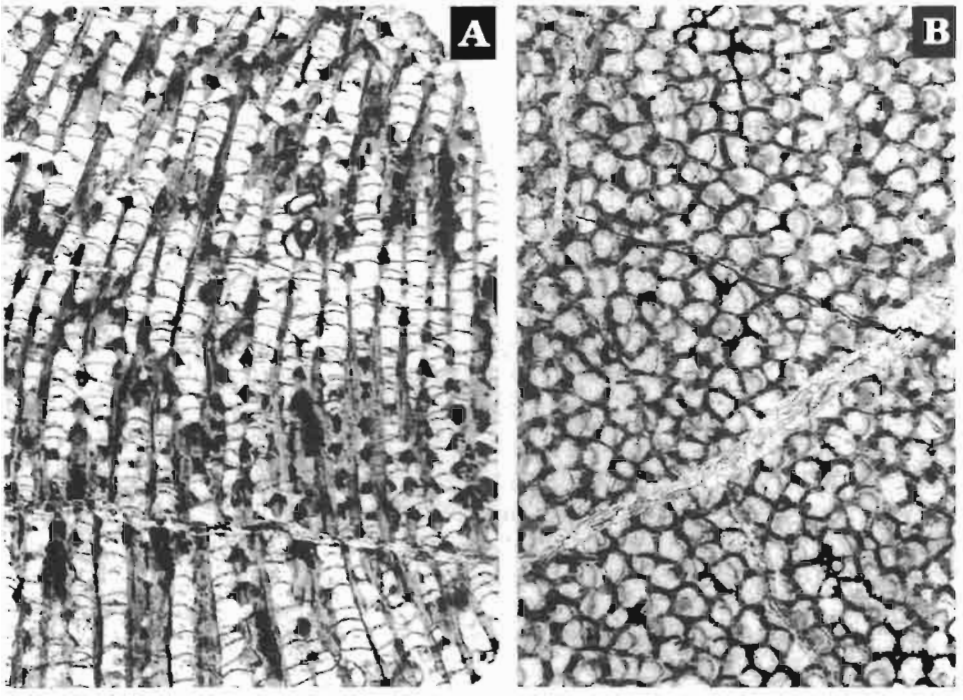


Fig. 11. *Caliapora uralica* Yanet 1959; ZPAL T XVIII-20/15, longitudinal (A) and transverse (B) sections, Dziewki, set C, Dziewki Limestone, Middle Givetian; both × 5.

***Heliolites porosus* (Goldfuss 1826)** (Fig. 15).– Four more or less complete specimens of *H. porosus* in the Holy Cross Mountains range from the earliest (?)Eifelian to Givetian in Ołowianka (set G), Sowie Górki (set B-C), Grzegorzowice, Zbrza, Skały and Pokrzywianka (Stasińska 1958). The species is also found in the Givetian of Dziewki and Eifelian/Givetian boundary beds of Moravia (Čelechovice Cycle). The species has a world-wide distribution, having been reported from the Late Emsian to Givetian rocks of the Austrian Carnic Alps, England, France, Germany, North Manyar Republic Africa, Burma, Indonesia and Vietnam.

***Chaetetes yunnanensis* (Mansuy 1914)** (Fig. 16).– Seven complete coralla of *C. yunnanensis* were found in the Middle Givetian at Laskowa Góra (set A). This species is known from the Early Givetian at Skały and Pokrzywianka (Stasińska 1958). It occurs in the Eifelian of the Dinant Basin ('Co2d'), Basin d'Ancenis in France, Marocco and Yunnan and Kwang-Si provinces in China (Mansuy 1914), as well as in the Emsian and Eifelian of Vietnam.

Diagnoses of new species

Order Favositida Sokolov 1962
Suborder Favositina Sokolov 1950

Family Favositidae Dana 1846
Subfamily Favositinae Dana 1846
Genus *Pachyfavosites* Sokolov 1952

Pachyfavosites polonicus sp. n.

Fig. 2A-B.

Holotype: ZPAL T XVIII-24/2; Fig. 2.

Type horizon: Upper Sitkówka Beds of the Kowala Formation, Middle Frasnian.

Type locality: Western quarry in Sowie Górki, set G, Holy Cross Mountains.

Diagnosis.– Corallite diameter most commonly 0.6-0.8 mm (ranging from 0.5 to 0.9 mm); corallite walls 0.05-0.15 mm thick; connecting pores 0.08-0.2 mm in diameter, spaced 0.7-1.0 mm; tabulae straight or concave, locally with one end abutting a septal spine; septal spines thick.

Material.– Five mostly complete coralla.

Description.– The coralla are small, bulbous and irregular with maximum diameter 60 mm. The corallites are long, twisted, in transverse section irregularly polygonal and rounded-polygonal. The corallite lumen is irregularly-rounded or oval. The corallite walls show indistinct fibronormal microstructure. The median line is very thin, light-coloured, discontinuous. The conecting pores are numerous, circular, arranged in 1 or 2 vertical rows on corallite walls. Septal spines are also numerous, thick, conical, sharp, hook-shaped, bent towards corallite apertures. The tabulae are very numerous thin, straight or concave, spaced 0.2-0.6 mm apart, locally incomplete, with free end fixed to septal spines. Numerous worm tubes inveriably attached to coralla are weakly twisted and subparallel to corallites. Their walls are very thin, with microstructure similar to that of the corallite walls. In transverse section they are regularly circular or slightly oval, 0.3-0.5 mm in diameter.

Remarks.– *Pachyfavosites polonicus* is similar to *P. abnormis* Dubatolov 1964 from the Latest Eifelian of Siberia. The new species differs from the Siberian form in larger diameters of the connecting pores, more densely spaced tabulae, and significantly thinner corallite walls. From the type species of the genus, *P. polymorphus* (Goldfuss 1826), from the Late Eifelian and Early Givetian of Europe and the Urals (Lecompte 1936; Tchernychev 1951; Sokolov 1952), *P. polonicus* differs because of smaller corallites with much thinner walls, smaller connecting pores and spaced tabulate.

Suborder Thamnoporina Sokolov 1962
Family Pachyporidae Gerth 1921
Genus *Striatopora* Hall 1851

Striatopora enigmatica sp. n.

Fig. 4A-B.

Holotype: ZPAL T XVIII-11/2-5; Fig. 4A.

Type horizon: Upper Sitkówka Beds of the Kowala Formation, Early Frasnian.

Type locality: Kowala railway cuting, set C, Holy Cross Mountains.

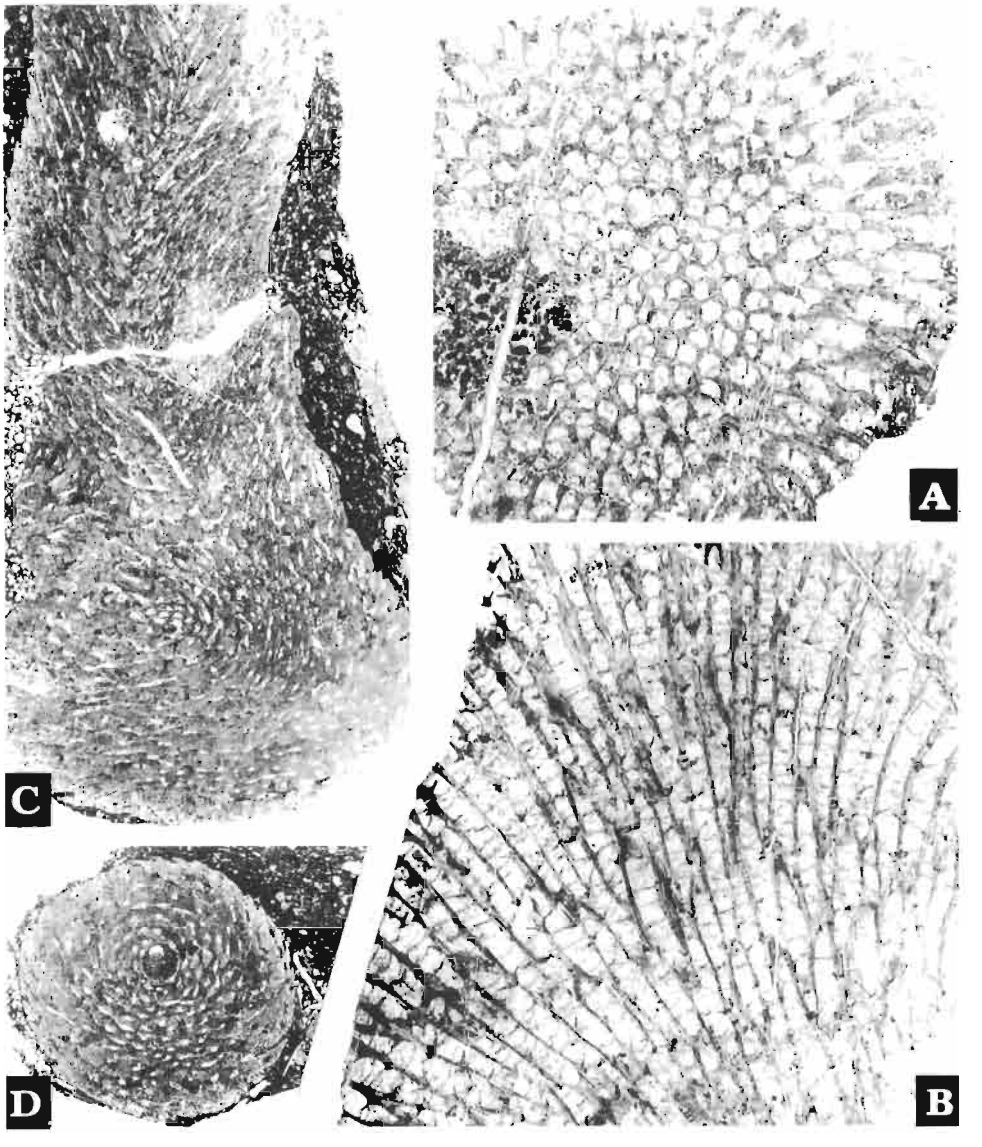


Fig. 12. ❑A-B. *Caliapora venusta* Yanet 1972; ZPAL T XVIII-4/23; transverse (A) and longitudinal (B) sections, Czarnów, set A, lower *Stringocephalus* Beds of the Kowala Formation, Early(?)-Middle Givetian. ❑C-D. *Coenites laminosa* Gürich 1896; ZPAL T XVIII-12/52, longitudinal (C) and transverse (D) sections, Laskowa Góra, set A, Laskowa Góra Beds, Middle Givetian. All × 5.

Diagnosis.– Branches cylindrical, 2.5-5.5 mm in diameter. Corallites polygonal, their diameters 0.3-0.6 mm in the axial part to 0.5-0.8 mm in peripheral part of coralla. Corallite walls 0.04-0.08 mm thick in axial and 0.1-0.2 mm thick in peripheral parts of coralla. Connecting pores 0.1 mm in diameter. Tabulae rare, spaced 0.2-0.8 mm. Septal spines absent.

Material.– Twenty one coralla.

Description.– Small, branching coralla; the branches are short, cylindrical, may be slightly oval in transverse section, with broad axial and narrow marginal zones; the corallites and thick-walled, wavy-curved, irregularly polygonal in transverse section; the lumen of corallites in transverse section is strongly and irregularly rounded; the corallite walls are relatively thick; the wall microstructure is fibro-normal, indistinct; the median line is thin, dark and discontinous; the calices are deep, funnel-shaped, oblique to the colony surface; the connecting pores are rare, circular, about 0.1 mm in diameter; tabulae are rare, thin, horizontal or oblique, straight, rarely curved, irregularly spaced; the septal spines are absent.

Remarks.– The generic assignment of the new species is somewhat ambiguous, but the taxon is similar to *S. tenuis* Lecompte from the Eifelian of the Dinant Basin (Lecompte 1939, see also below). The similarity is mostly expressed by the diameter and wall thickness of peripheral zone corallites and by diameter of the connecting pores. *S. enigmatica* differs, however, from the Belgian species in its somewhat larger corallites in the axial parts of the colonies in branches of larger diameter, and in the axial and peripheral zones which are not so well distinguished. Moreover its corallites are more strongly curved, have thicker walls in the axial zone and have the tabulae better developed than in *S. tenuis*.

Alveolites edwardsi frasnianus sp. n.

Fig. 6A-B.

Holotype: Specimen ZPAL T XVIII-30/1; Fig. 6A-B.

Type horizon: Kostomłoty Beds, Late Frasnian.

Type locality: In overgrown quarry east of the village of Domaszewice, Holy Cross Mountains.

Diagnosis.– Corallites rounded-polygonal and rhomboid in transverse sections, 0.4-0.7 mm in diameter and oval, crescent-shaped, bean-shaped and meandroid, sized 0.3-0.5 × 0.5-0.9 mm; corallite walls 0.005-0.08 to 0.1-0.15 mm thick; pores 0.1-0.16 mm in diameter, spaced 0.4-0.7 mm; septal spines thick, sharp; tabulae numerous, horizontal or oblique, spaced 0.2-0.6 mm.

Material.– Four coralla.

Description.– The coralla are hemispherical, bulbous or elongated, their diameter up to 50 mm; the corallites are long, twisted, arranged radially and perpendicularly to colony surface; in transverse section the corallites vary considerably in shape: from rounded-polygonal and rhomboidal to oval, elongated, crescent-shaped, bean-shaped and meandroid; the corallite walls are twisted and of variable thickness; the microstructure of walls (?fibro-normal) is radially-fibrous; the median line is thin, dark, discontinous and but weakly distinguished; the connecting pores are numerous, and oval and circular in slape; the septal spines are elongated, thick and sharply aligned, in single rows; the tabulae are numerous, thin, horizontal or obligue, striatal or weakly curved.

Remarks.– From the type population of *A. edwardsi* in the Givetian and Frasnian of Ardennes (Lecompte 1939) the Holy Cross Mountain material

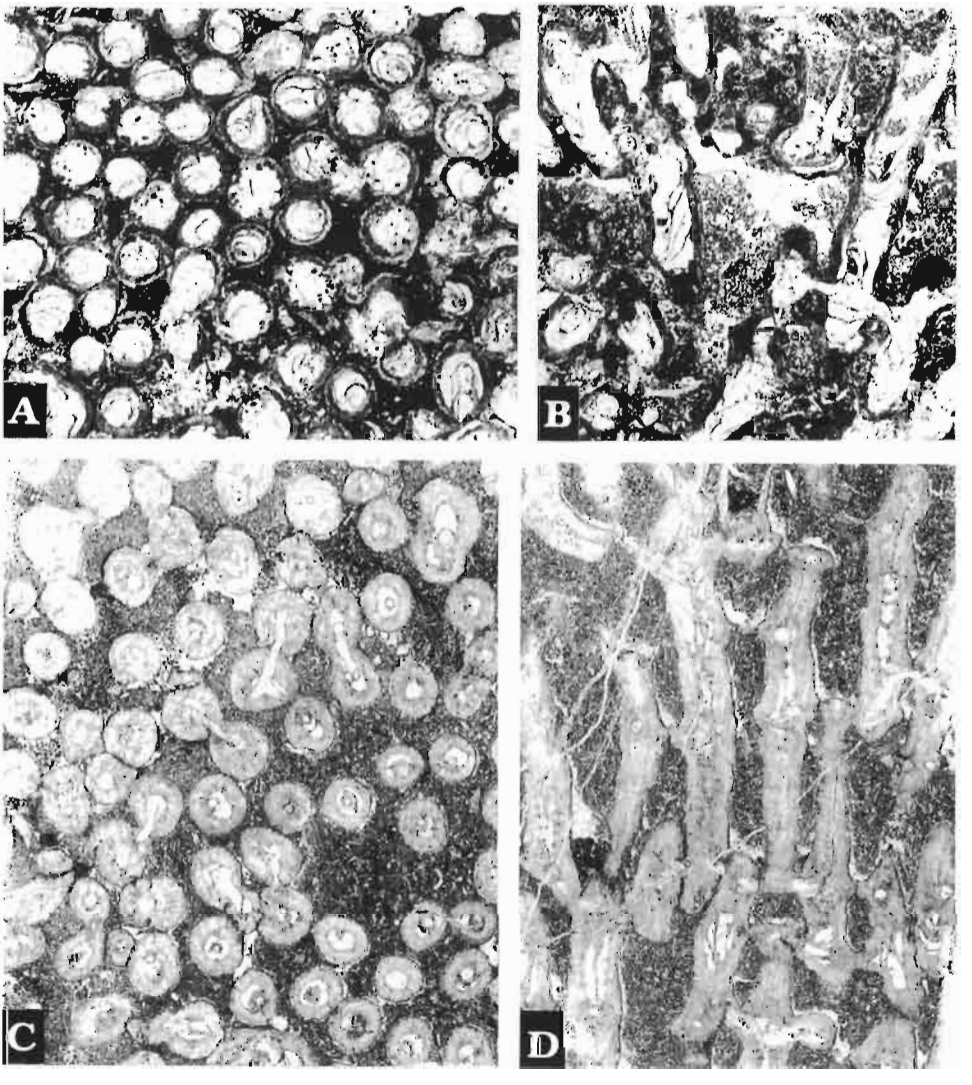


Fig. 13. ❑A-B. *Syringopora volkensis* Tchernyschev 1938; ZPAL T XVIII-14/32, transverse (A) and longitudinal (B) sections. ❑C-D. *Armalites minimus* sp. n.; holotype ZPAL T XVIII-14/34, transverse (C) and longitudinal (D) sections. Both specimens from Góra Łgawa (Jaźwica quarry), set R, nodular-marly beds, Late Frasnian. All × 5.

differs in smaller and non-lamellar coralla, presence of meandroid corallites, variable thickness of the corallite walls, lack of small septal spines (a single row of big spines only), and more numerous connecting pores.

Alveolitella polygona sp. n.

Fig. 9A-E.

Holotype: Specimen ZPAL T XVIII-18/51; Fig. 9A-B.

Type horizon: Jaźwica Limestone Member of the Kowala Formation, Late Givetian.

Type locality: Outcrop in the western end of the hill at Posłowice, set B, Holy Cross Mountains.

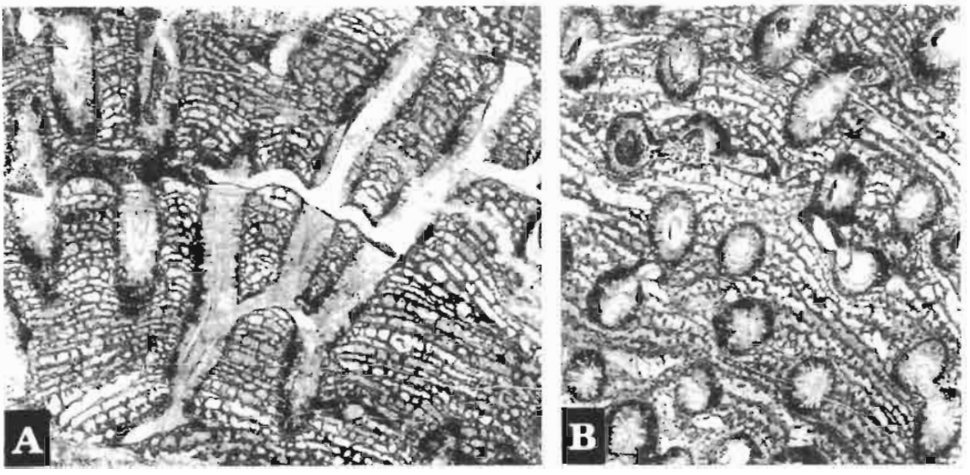


Fig. 14. *Syringoporella raritabulata* sp. n.; holotype ZPAL T XVIII-24/38, longitudinal (A) and transverse (B) sections, Sowie Górki, set G, upper Sitkówka Beds of the Kowala Formation, Middle Frasnian; both × 5.

Diagnosis.– Branches cylindrical, 4.0-8.0 mm in diameter, or oval, sized 3.0-7.0 × 4.0-8.0 mm; corallites polygonal, 0.3-0.6 mm in diameter; corallite walls 0.04-0.1 mm thick axially to 0.1-0.25 mm in peripheral zone; pores 0.1-0.12 mm in diameter, spaced 0.8-1.0 mm; tabulae thin, straight or bent, spaced 0.3-0.8 mm; septal spines lacking.

Material.– Eight large fragments of coralla.

Description.– A small ramose coralla, with branches cylindrical or flattened, commonly fusing lateraly with each other; the branches in transverse section are either circular or oval; the axial zone occupies 3/4 to 4/5 of diameter of a branch, clearly distinguishable only in young branches; the corallites are elongated, weakly twisted, strongly oblique to branch surface; in transverse sections corallites are more or less regularly polygonal; the lumen is broad, polygonal with rounded corners in transverse section; the corallite walls are thinner axially and thicker at the periphery; the microstructure of walls is fribro-normal, indistinct; the median line is thin, dark, locally interropted; the connecting pores are scarce, circular, spaced regularly; the tabulae are thin, straight or weakly curved, horizontal or weakly oblique; the septal spines are absent.

Remarks.– *Alveolitella polygona* sp. n. differs from all the other species of the genus by thin-walled, polygonal corallites with a weakly distinguished axial zone in its branches, and scarce and small connecting pores.

Caliapora battersbyi minor subsp. n.

Fig. 10.

Holotype: Specimen ZPAL T XVIII-4/20: Fig. 10.

Type horizon: *Stringocephalus* Beds of the Kowala Formation, earlier Givetian.

Type locality: Czarnów, set A, Holy Cross Mountains.

Derivation of name: Minor – displaying smaller dimensions than in the nominate subspecies.

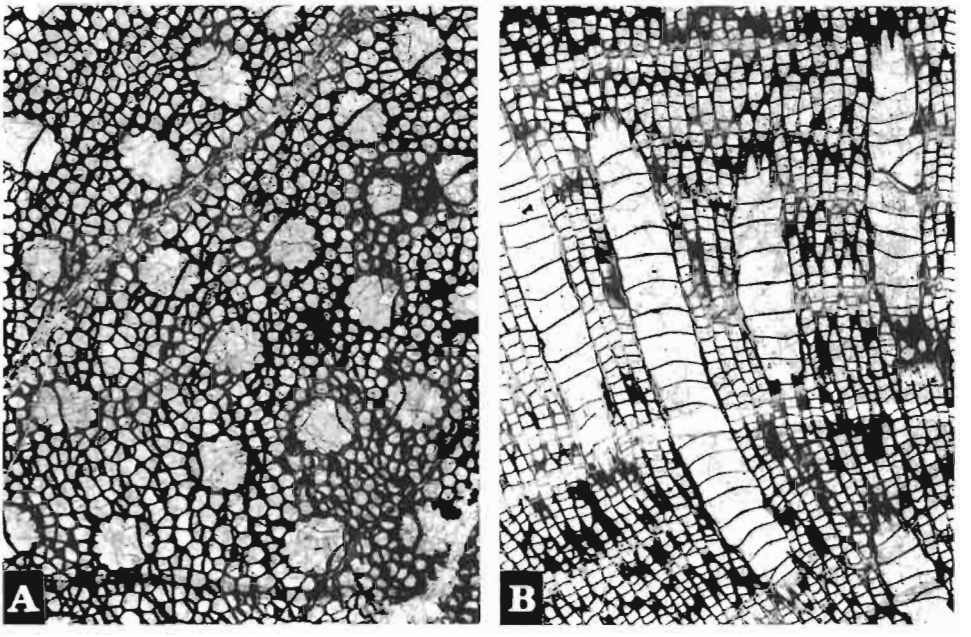


Fig. 15. *Heliolites porosus* (Goldfuss 1826); ZPAL T XVIII-20/16, transverse (A) and longitudinal (B) sections, Dziewki, set C, Dziewki Limestone, Middle Givetian; both × 5.

Diagnosis.– Corallites rounded-polygonal, 0.6-0.8 mm in diameter; corallite walls 0.05-0.12 mm thick; squamulae thick, massive, spaced 0.6-0.8 mm; pores of 0.15-0.18 mm diameter, spaced 0.6-0.8 mm; tabulae thin, concave, spaced 0.3-0.5 mm.

Material.– Three coralla.

Description.– The coralla are irregular and bulbous, their diameter up to 40 mm; the corallites are long and straight, or slightly bent, arranged parallely to each other, rounded-polygonal in transverse section (5-7 – sided) or polygonal-elongated; the lumen in transverse section is oval or irregular; the corallite walls are of variable length and thickness, with indistinct fibro-normal microstructure; the median line is dark, thick, of uneven thickness, dispersed, discontinous, and locally visible as a row of isolated pigmentation points; the squamulae are numerous, massive, very coarse and long, with broad base and rounded distal end, arranged in a few vertical rows on corallite walls, with their length typically exceeding the corallite radius; in longitudinal section squamulae are arranged alternately, and are crescent-shaped; the connecting pores are numerous, circular or locally slightly oval, up to 0.2 mm in diameter, arranged in vertical rows; the tabulae are thin, concave or wavy, rarely straight, and incomplete, with one of their ends attached to a squamula.

Remarks.– *C. battersbyi minor* differs from the nominate subspecies in smaller diameter of corallites, smaller spaces between the better developed, distally rounded squamulae, smaller diameters of the connecting pores and less densely spaced tabulae.

Genus *Armalites* Tchudinova 1964

Armalites minimus sp. n.

Fig. 13C-D.

Holotype: Specimen ZPAL T XVIII-14/34; Fig. 13C-D.

Type horizon: Nodular-marly beds, Late Frasnian (*rhenana* Zone, *Frechastraea pentagona* Zone).

Type locality: Jaźwica Quarry on Góra Łgawa, set R, Holy Cross Mountains.

Diagnosis.– Corallites circular in transverse sections, 1.2-1.8 mm in diameter or irregularly oval, sized 1.5-1.7 × 1.8-2.6 mm; corallite walls most frequently 0.4-0.6 mm thick; connecting tubes short, with 0.5-0.7 mm diameter; diameters of the connecting canals 0.2-0.3 mm; septal spines big, conical, spaced 0.2-0.6 mm; tabulae thin, irregularly funnel-shaped, strongly oblique or deeply concave, spaced 0.1-0.5 mm.

Material.– One complete corallum.

Description.– Big, irregularly dendroid coralla; the corallites relatively are short, thick-walled, cylindrical or markedly scolecoid, spaced irregularly 0.1-1.0 mm apart or in contact with each other; in transverse section isolated corallites are circular or only weakly elliptical, whereas those in contact are elliptical, elongated or irregularly-shaped; the corallite walls are very thick at 0.2-0.7 mm, with weakly distinguished, bilamellar structure; the internal layer is lamellar, with strongly undulating lamellae, the external layer is fibrous, with fibres more or less oblique to the wall surface; the epitheca is thin, weakly distinguished; the connecting tubes between the 'isolated' corallites are short and thick; the connecting pores between the corallites in contact are 0.2-0.3 mm in diameter; the connecting pores and tubes between neighboring groups of corallites occur at the same level, giving the colony a quasi-layered aspect; in other parts of the colony the arrangement seems completely disordered; the septal spines are large, thick, pointed, deeply embedded in the wall stereoplasma, arranged in a few vertical rows; the tabulae are rare, thin or covered with secondary stereoplasma, irregularly funnel shaped, strongly oblique, twisted, locally strongly concave, forming short, interrupted axial canal; the tabulae are commonly continuous through pores or connecting canals into the neighboring corallites.

Remarks.– From all the known representatives of the genus *Armalites*, *A. minimus* differs by extremely small corallite diameters and peculiar wall microstructure.

Family Multithecoporidae Sokolov 1950

Genus *Syringoporella* Kettner 1934

Syringoporella raritabulata sp. n.

Fig. 14.

Holotype: Specimen ZPAL T XVIII-24/38; Fig. 14.

Type horizon: Upper Sitkówka Beds of the Kowala Formation. Middle Frasnian.

Type locality: Western quarry in Sowie Górki, set G, Holy Cross Mountains.

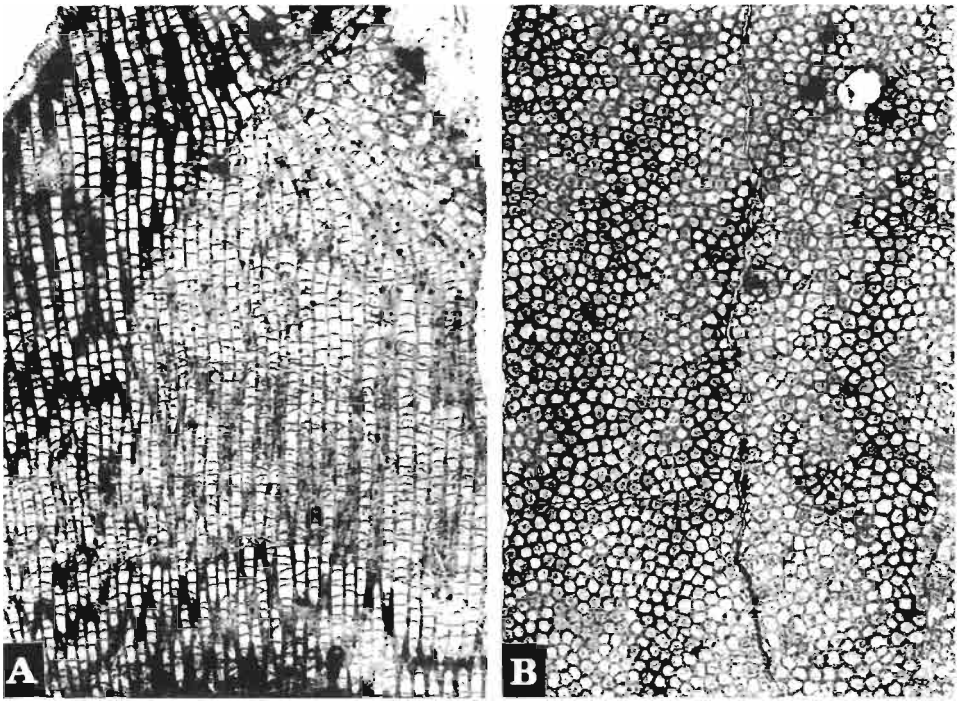


Fig. 16. *Chaetetes yunnanensis* (Mansuy 1914); ZPAL T XVIII-12/70, longitudinal (A) and transverse (B) sections, Laskowa Góra, set A, Laskowa Góra Beds, Middle Givetian; both × 5.

Diagnosis.– Corallites cylindrical, most commonly 1.2-1.5 mm in diameter, irregularly spaced (0.5-2.0 mm); corallite walls 0.3-0.5 mm thick; connecting tubes arched distally, 0.5-0.6 mm in diameter, vertically spaced 2.5-3.0 mm; tabulae rare, thin, spaced 0.1-0.3 mm, occur only in local concentrations.

Material.– Two almost complete coralla.

Description.– A small hemispherical-dendroid coralla 40 mm in diameter; the corallites are short, cylindrical, locally weakly curved, irregularly spaced in transverse section, circular or weakly oval, 0.9-1.6 mm across; the corallite walls have uniform, in distinct, fibro-normal microstructure; the epitheca is thin, dark, poorly preserved; the connecting tubes are long, most commonly distally arched, frequently at the same level, in neighboring corallites giving the colony a quasi-layered appearance; the tabulae are rare, thin, concave or strongly oblique, twisted, locally concentrated in groups of few tabulae in short corallite segments; most commonly very long segments of corallites are totally devoid of any tabulae; the septal spines are absent.

Remarks.– *Syringoporella raritabulata* sp. n. differs fromother species of the genus by extremely large corallite diameters, zonal arrangement of connecting tubes and rare, locally concentrated tabulae. In addition, from the type species of the genus *S. moravica* (Roemer 1880; Kettner 1937;

Dubatolov 1963), the new species differs by the larger size of all the basic structural elements of the corallites and of the colony and by the presence in fibro-normal microstructure in its walls (lamellar microstructure in *S. moravica*).

Distribution of tabulate faunas

The distribution of the 62 known taxa in the localities studied, and the composition of their assemblages expressed quantitatively at the generic level (Fig. 17), allows the recognition of some relationships between the varying coral faunas and particular developmental phases in the bank to reef complex Kielce Region succession. The corals, second after the stromatoporoids as rock-builders, are the main component of several principal macrobenthic aggregations reviewed by Racki (1993), such as *Thamnopora* and *Alveolitella fecunda* Assemblages. More precise biostratigraphic and ecologic evaluation would be premature because of insufficent material and extensive range of the strata considered. Some tabulate assemblages with apparently diachronous boundaries are difficult to date because of an almost complete lack of independent time markers.

Nevertheless, comparison with the adjacent areas of the southern Poland shelf (Nowiński 1976; Stasińska & Nowiński 1976; Kulicka & Nowiński 1983; Wrzołek *in* Racki *et al.* 1992), and the Moravian Devonian basin (Hladil *in* Galle *et al.* 1988) reveals its generally continuous nature with limited species exchange after great initial (?earliest Givetian) colonization (Racki 1988). However, some supra-regional turning points in the tabulate succession have been identified.

Givetian platform phase.– Vast Early to Middle Givetian (*Stringocephalus*) undifferentiated bank was characterized by largely low-energy, partly muddy shoals and patch reefs (Kaźmierczak 1971), populated by distinctive coral assemblages. Apart from common *Thamnopora* thickets (see the Ołowianka site in Fig. 17), there were diverse associations with massive alveolitids with flourished in more agitated and/or open marine portions of the mounds. Wide distribution of bulbous *Caliapora* – chiefly *C. battersbyi* – colonies which make up to 30% of collections in Dziewki, Jurkowice-Budy, and Czarnów is the prominent feature for this stage of tabulate succession as well as the presence of the heliolitids. The unique youngest occurrence is dated as the Late Givetian at the Sowie Górki locality (set C).

The bank-dwelling fauna shows significant generic (10) and species (at least 23) differentiation. Similar tabulate-heliolitid assemblages are widely distributed in the Givetian of Poland (Nowiński 1976; Stasińska & Nowiński 1976), including Pomerania (Stasińska 1969). On the other hand, the Kostomłoty variety of this assemblage from Czarnów is distinguished by numerous branching colonies of *Scoliopora denticulata, Alvolitella fecunda*, and *Caliapora venusta*. Up till now the species have not been recorded in coeval (?or slightly younger) southern faunas of the Holy Cross Moun-

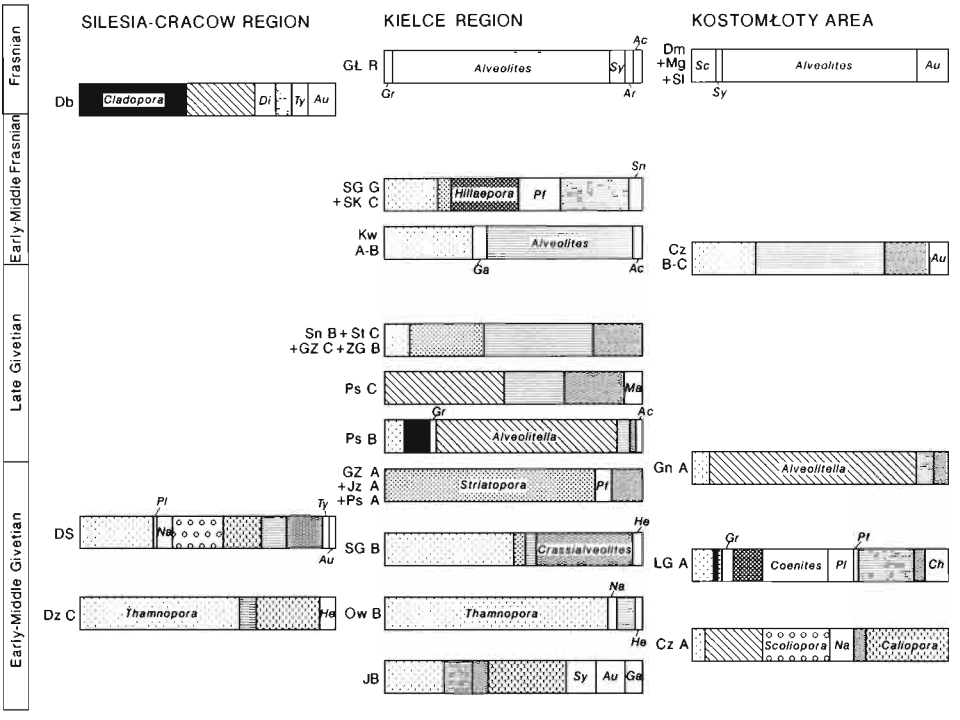


Fig. 17. Stratigraphic distribution of the Givetian to Frasnian tabulate faunas (in generic terms) in the Kielce Region and Kostomloty area, and in the Silesia-Cracow Region (compiled from Nowiński 1976). Abbreviations: Dz – Dziewki, DS – Dębnik-Siedlec, Db – Dębnik, JB – Jurkowice-Budy, Ow – Ołowianka, SG – Sowie Górki, Ps – Posłowice, Jz – Jaźwica, GS – Góra Sołtyia, ZG – Zeglelogóra, GZ – Góra Zamkowa, St – Stokówka, Sn – Sosnówka, Kw – Kowala (railroad cut), SK – Sitkówka-Kowala, GŁ – Góra Łgawa, Cz – Czarnów, LG – Laskowa Góra, Gn – Górno, Sl – Śluchowice, Mg – Kostomłoty-Mogiłki, Dm – Domaszowice; *Ac – Aulocystis, Ar – Armalites, Au – Aulopora, Ch – Chaetetes, Di – Dictyofavosites, Ga – Grabaulites, Gr – Gracilopora, He – Heliolites, Ma – Matopora, Na – Natalophyllum, Pf – Pachyfafosites, Pl – Planocoenites, Sc – Scoliopora, Sn – Syringoporella, Sy – Sringopora, Ty – Tyrganolites.*

tains, but occur in the Silesia-Cracow area and Moravia (Galle *et al.* 1988: Tab. C).

The widespread *Caliapora-Heliolites* fauna is locally replaced by a rich tabulate-chaetetid fauna, recently known only from the type locality of the Middle Givetian Laskowa Góra Beds. The lower slope-inhabiting associations in the Kostomłoty facies zone constructed both variable marly biostromes (e.g. with coenitids), and alveolitid-rich and chaetetid-rich micrite bioherms (Racki *et al.* 1985: Pls 4-6). The Sowie Górki site (set C) might be treated as a transitional one to the Kielce Region due to the presence of coenitids.

The Laskowa Góra fauna is diverse – with 12 genera and at least 18 species determined – especially in branching pachyporids and massive alveolitids. The occurrence of numerous chaetetid sclerosponges is a

unique feature of this fauna coupled with local predominance of coenitids and *Trachypora*. The assemblage evidently developed from the Early Givetian faunas of the Łysogóry Region, particularly those from the Skały and Pokrzywianka Beds (Stasińska 1958; Sarnecka 1988), and is also recognizable in the Lublin region, too (Stasińska & Nowiński 1976).

The transition into a more differentiated platform setting such as the Late Givetian Sitkówka biostromal-complex was linked with the disappearance, possibly extinction, of such genera as *Caliapora*, *Natalophyllum*, *Heliolites* and *Coenites*, without any more pervasive changes in the remaining cosmopolitan alveolitid-pachyporid 'stock'. Despite considerable inter-locality variations, the most specific associations are known around the transgressive Jaźwica Member. This is manifest in widespread *Alveolitella fecunda* calm-water biostromes (*Hexagonaria/Alveolitella* Level in Racki 1993) asociated with 19 other species.

Other tabulate assemblages, living partly in that high-energy bank rim margin, are devoid of distinct dominant species. *Alveolites obtortus* and *Striatopora enigmatica* are the most numerous in collections from both the topmost *Stringocephalus* Beds, and lower parts of the Sitkówka and Chęciny Beds.

An approximately coeval tabulate fauna from the open shelf Kostomłoty area is less diverse and shows first order similarity due to mass occurrence of *Alveolitella fecunda* in the Górno locality. A closely similar assemblage is known from the Givetian of Lublin area.

Frasnian reef phase.– Earlier Frasnian faunas are from the Alveolitid-*Thamnophyllum* Level in the higher Sitkówka Beds, Kadzielnia Limestone Member, and Wietrznia Beds, together with related detrital beds (Stasińska 1953, 1958).

The diverse assemblages which include at least 12 genera and 23 species, have rock-forming tendencies owing to nodular to platy coralla of *Alveolites*. At least eight chiefly cosmopolitan and long ranging species, but particularly *A. maillieuxi*, *A. suborbicularis*, and *A. complanatus* (Stasińska 1953), are present in association with the abundant branching colonies of *T. boloniensis*. Restricted occurrences of *Hillaepora*, which could be a relict, and favositids again suggests some habitat peculiarity in the Miedzianka sites. However, lateral relationships between the coral associations on the flanks of growing Dyminy reef seem to be complex and poorly known (see Szulczewski & Racki 1981 for the Kadzielnia mounds). This makes comparison with other Frasnian tabulate associations, reported from southern Poland, difficult. A good example is the fauna with *Cladopora* and *Alveolitella* from Dębnik (Nowiński 1976; but see Hladil *in* Galle *et al.* 1988).

All the later Frasnian tabulates were collected from the Kostomłoty Beds as well as from the detrital and marly deposits which overlyie and/or laterally replace the Kowala Formation in the Kielce Region. Most of the material was recovered from strata directly below the Frasnian/Famennian extinction level (Racki *et al.* 1989) in such localities as Góra Łgawa,

Miedzianka, Śluchowice, and Panek (see Stasińska 1953 for supplementary data). The drop in tabulate diversity down to 9 genera and 18 taxa in respect to older assemblages is a distinctive feature connected with predominance of massive alveolitids which number at least 11 species (Fig. 17) as in the Moravian faunas. Higher contribution of syringoporoids is typical also of the last phase of the submerging Dyminy reef.

Conclusions

Few tabulate corals are good guide fossils. Those that are used to date the conodont-poor units in the Kowala Formation (Racki 1993), *Caliapora battersbyi*, *C. venusta*, *Natalophyllum giveticum*, and *Thamnopora tumefacta*, occur throughout the Givetian of both the Variscan Europe and Russia, being typical of the early part of the stage.

In the Frasnian, an acme of *Aulocystis tikhyi* (?also *Syringoporella raritabulata* development) is the only tabulate marker for the early part of the stage in the Holy Cross Mountains, as well as in the Żerniki IG 1 section. On the other hand, the occurrence of such typically later Frasnian species as *Alveolites tenuissimus*, *A. smithi*, *A. taenioformis minor*, and *Aulocystis tikhyiformis* are important for the recognition of the higher part of the stage.

As shown by the above review of the distribution of individual species, the transitional biogeographic nature of the Polish fauna between the west Variscan and the east Euroasiatic faunas is apparent (Kulicka & Nowiński 1983). Some 'anomalies' in the recorded ranges in areas studied are of interest. For example, the oldest Polish occurrences of *Alveolites elongatus*, *Crassialveolites evidens*, *C. complanatus*, *Thamnopora micropora*, and possibly several others are in the Givetian or older, whereas they occur in the adjacent domains in Frasnian strata only. While some species such as *Alveolites regularis*, *Crassialveolites cavernosus*, and *Thamnopora irregularis* reveal progressively higher stratigraphic ranges from west to east, examples of contrary distribution patterns are seen in *Crassialveolites crassus*, *Caliapora uralica*, *Trachypora circulipora*, *Thamnopora cervicornis*. Possibly, this is a reflection of more general and complex patterns of faunal dispersion within the Laurasian Shelf.

Acknowledgements

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Streszczenie

Pospolite i zróżnicowane koralowce Tabulata, jak też rzadsze Heliolitida (inne koralowce) i Chaetetida (sklerogąbki), z żywetu i franu Gór Świętokrzyskich i regionu Siewierza zostały opisane i przedyskutowane pod względem biostratygraficznym.

Następstwo tych koralowców wstępnie ujęto w 4 szeroko rozpowszechnione zespoły (fauny), z których dwa są żyweckie (*Caliapora battersbyi* - *Heliolites porosus*, zastąpiony w sekwencji przez *Alveolites obtortus* - *Striatopora enigmatica*), a dwa – frańskie (*Alveolites maillieuxi* - *Aulacystis*

tikhyi, wyżej – *Alveolites tenuissimus*). Nadto, wyróżniono specyficzną faunę *Coenites laminosa-Chaetetes younnanensis*, ograniczoną do środkowego żywetu regionu łysogórskiego. Nowe dane potwierdzają koncepcję biogeograficznie przejściowego charakteru polskiej fauny tabulatowej między Zachodnią i Wschodnią Europą.

Zidentyfikowano 59 taksonów, w tym 5 gatunków i 2 podgatunki nowe: *Pachyfavosites polonicus* sp. n., fawositid o małym, półkulistym korallum z grubościennymi koralitami, wykazujący pewne analogie morfologiczne z żyweckim *P. polymorphus*; *Striatopora enigmatica* sp. n., pachyporid o gałązkowym korallum, który mimo wyraźnej homeomorfii z *S. tenuis* (eifel-żywet), różni się od niej większymi koralitami i silniej rozwiniętymi denkami w aksialnej strefie korallum; *Alveolites edwardsi frasnianus* subsp. n.; *Alveolitella polygona* sp. n., z bardzo cienkościennymi, pryzmatycznymi koralitami w osiowej strefie gałązek i bardzo drobnymi porami; *Caliapora battersbyi minor* subsp. n.; *Armalites minimus* sp. n., syringoporid z rzadko występującego rodzaju, charakteryzujący się ekstremalnie małymi średnicami koralitów; *Syringoporella raritabulata* sp. n., syringoporid różniący się od znanych gatunków tego rodzaju niezwykle dużymi średnicami koralitów i zonalnością w rozmieszczeniu denek.