

Main trends in stromatoporoid evolution during the Silurian

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Abstract: The Silurian was a period of the most intensive diversification of the Palaeozoic stromatoporoid fauna. By the end of this period all the main phylogenetic branches of the Palaeozoic stromatoporoids were formed. Half of the orders (Stromatoporellida, Actinostromatida, Stromatoporida) and most of the families originated in the Silurian. The most rapid expansion in diversity took place in Wenlock time. Progressive folding of the basal surface of the soft body, increasing the skeleton secreting ability of the basal pinacoderm, was the most general tendency in stromatoporoid evolution. The role of labechiids decreased and that of clathrodictyids increased rapidly. Stromatoporoids with regular continuous laminae (order Stromatoporellida), with a loose skeleton lattice (order Actinostromatida) and irregularly amalgamated structure (order Stromatoporida) appeared in the early Silurian. Parallel evolution of stromatoporoids with different kinds of microreticulate microstructure (ortho-, clino- and akosmoreticulate) was characteristic of the Silurian.

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INTENSIVE studies of stromatoporoids which started in the 1950s and progressed up to the middle of the 1970s caused rapid growth of the number of new taxa which could not be fitted within the bounds of H. NICHOLSON's classification (NICHOLSON, 1886). Therefore quite different classifications were used (LECOMPTE, 1951, 1956; GALLOWAY 1957; BOGOYAVLENSKAYA, 1969; KHALFINA & YAVORSKY, 1973; KHROMYCH, 1974, 1976; NESTOR, 1976). This also called forth increasing interest in the phylogeny of stromatoporoids which culminated at the I. International Symposium on Fossil Cnidaria, held in Novosibirsk in 1971. Several papers of the symposium were devoted to the problems of stromatoporoid evolution (BOGOYAVLENSKAYA, 1974; NESTOR, 1974; KHALFINA & YAVORSKY, 1974; KHROMYCH, 1974; LESSOVAYA, 1974; KOSAREVA, 1974). This period has also yielded the monograph by KAZMIERCZAK (1971) on the morphogenesis of stromatoporoids containing many original views. Later the trends of stromatoporoid evolution were treated by BOGOYAVLENSKAYA (1984). Unfortunately, numerous opposite points of view about the evolution and principles of stromatoporoid classification in these papers, have remained unsettled up to now.

Preparation for the new issue of the "Treatise on Invertebrate Paleontology" needs selection among the different principles of stromatoporoid classification not leaving aside the phylogenetic analysis. This accounts for the newly increased interest in the problems of stromatoporoid evolution and explains also returning to these topics in the present paper.

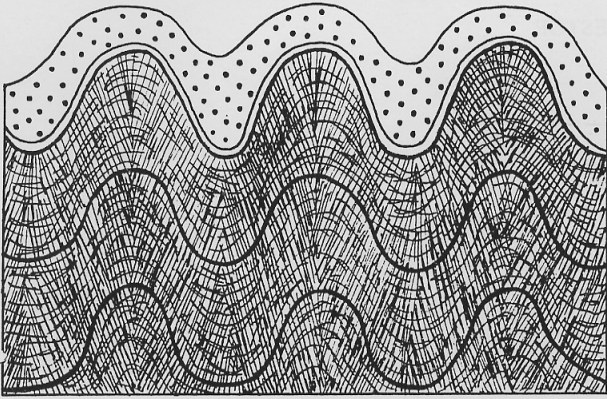
Main tendency in stromatoporoid evolution

One of the main tendencies in the evolution of stromatoporoids is illustrated by comparison of the main types of the structure of the stromatoporoid skeleton presented in Fig. 1.

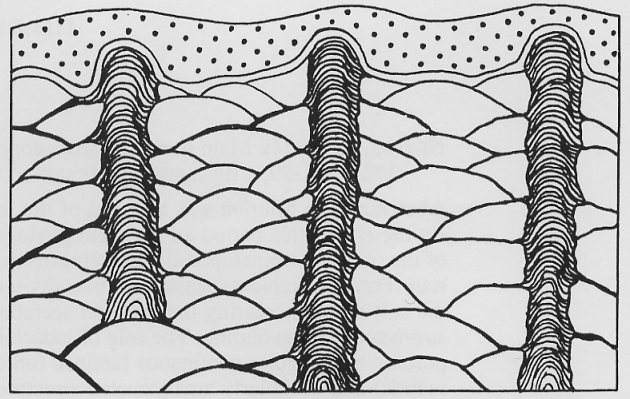
These types correspond to the orders in the classification of STEARN (1980), etc. The simplified reconstructions show the mutual position of the soft body and skeletal elements in the representatives of different orders and are generally in good accordance with far more detailed reconstructions by STEARN (1975). Definitions of the main morphological types of stromatoporoids (except the order Stromatoporellida added by STEARN) have also been given in the earlier papers of the present author (NESTOR, 1974, 1976). Here these views will be presented again in a somewhat modernized form.

1. Compact stromatoporoids (order Lophiostromatida). The skeleton has a compact structure, not differentiated into skeletal elements, cavities are lacking. The primary microstructure seems to have been fibro-lamellar (KAZMIERCZAK, 1971, etc.). The soft body covered the skeleton as a continuous layer, the poorly folded basal pinacoderm evenly secreted the skeletal material on the whole extent of the basal skeleton.

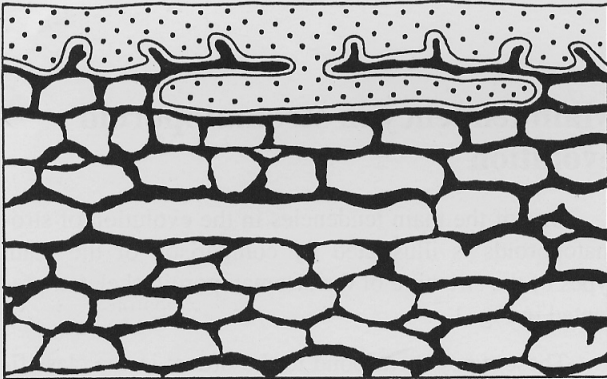
2. Vesicular stromatoporoids (Labechiida). The skeleton consists of convex plates with relatively isolated vesicular cavities between them. To these plates various vertical elements are added (denticles, pillars, vertical blades, columns). The soft body covered the



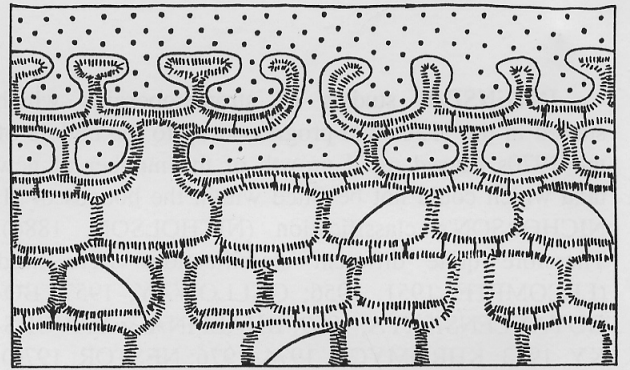
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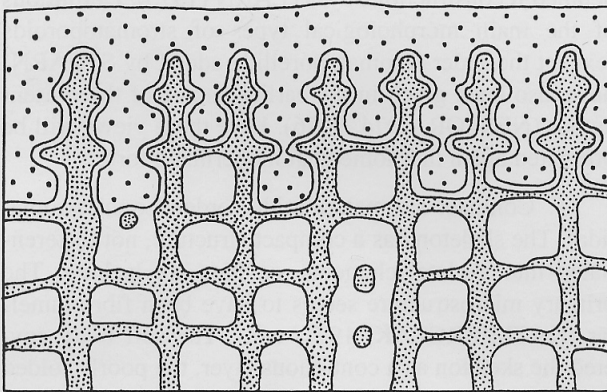
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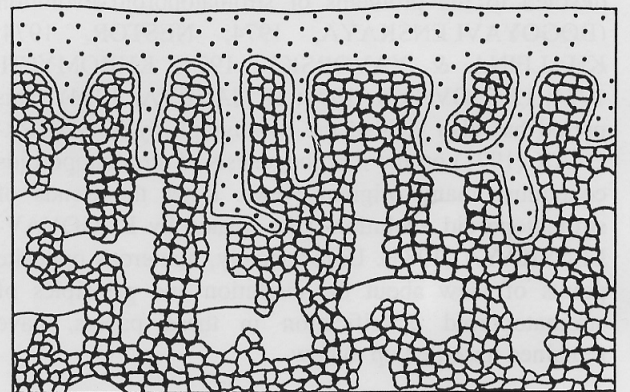
SUBLAMINAR



LAMINAR



RETICULAR



IRREGULAR

Figure 1. Main types of the skeleton structure of the Palaeozoic stromatoproids with simplified reconstructions of the mutual position of the skeleton and soft body (dotted area).

skeleton as a poorly differentiated continuous layer as in the compact type, but the secretion of the skeleton took place unevenly in separate vesicle plates. The existence of vertical skeletal elements promoted certain folding of

the basal part of the soft body.

3. Sublaminar stromatoproids (Clathrodictyida). The skeleton has an incompletely laminar structure consisting of weakly differentiated, inflected laminae and

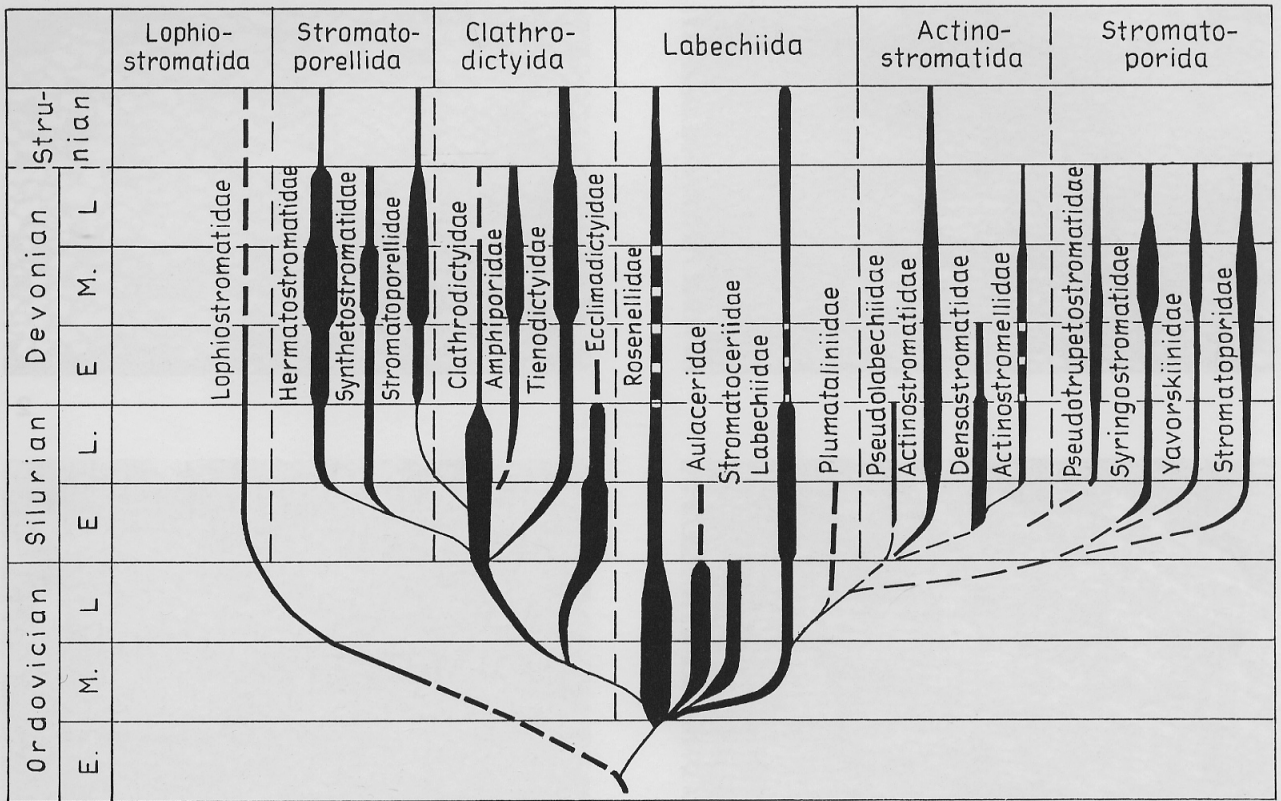


Figure 2. Phylogenetic relationships and stratigraphic ranges of the families and orders of the Palaeozoic stromatoporoids based on author's earlier papers (NESTOR, 1974, 1976).

pillars separated by cavities which form irregular galleries. The soft body secreted the skeleton by storeys, the basal pinacoderm was uneven, wrinkled. In places the soft tissue could extend also inside the skeleton (e.g. by astrorhizal systems), probably limiting itself to the uppermost galleries.

4. Laminar stromatoporoids (Stromatoporellida). The laminar skeleton consists of well-differentiated continuous laminae and pillars. The laminae are mostly tripartite (also ordinicellular), the galleries are perfectly developed and horizontally well connected. The lower part of the soft body evidently filled the upper gallery and secreted the topmost lamina from both sides (see STEARN, 1975: Fig. 5).

5. Reticulate stromatoporoids (Actinostromatida). The skeleton has a latticed structure, consisting of rod-shaped vertical (pillars) and horizontal (colliculi) elements. The cavities remaining between them are well connected horizontally as well as vertically. Therefore we may presume that the protrusions of the living soft tissue extended relatively deep into the interior of the skeleton.

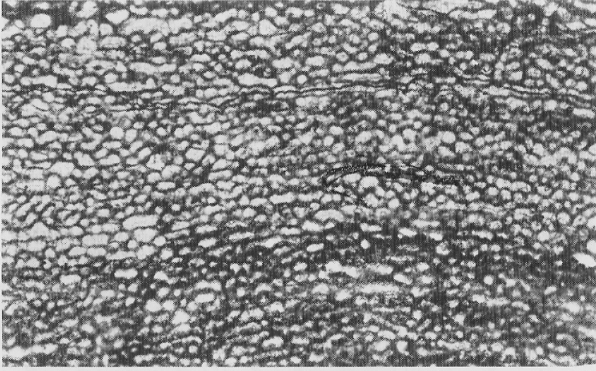
6. Irregular stromatoporoids (Stromatoporida). The skeleton consists of relatively thick, amalgamated, weakly differentiated vertical and horizontal elements which

have predominantly a microreticulate or cellular microstructure. Between them there occur vermicular cavities (astrorhizal canals, pseudozooidal tubes) with reduced dissepiments or tabulae, through which, during the organism's lifetime, the foldings of the soft body extended deeper between the skeletal elements.

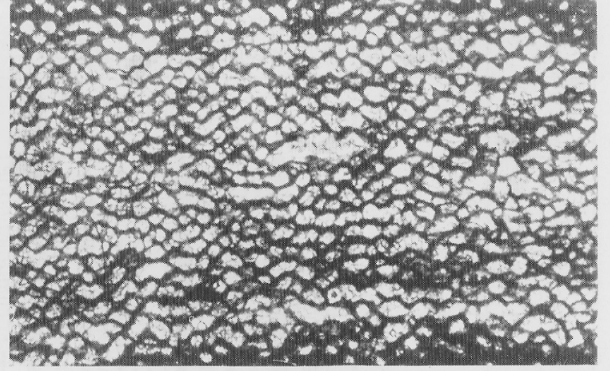
The representatives of the first three types (orders) appeared in the Ordovician, whereas those of the three other types are known in the geological record beginning with the Silurian System. The comparison of the reconstructions (Fig. 1) shows that the main tendency in the Paleozoic stromatoporoid evolution was the progressing folding of the basal part of the soft body and its extension deeper into the skeleton. This increased the area of the basal pinacoderm, thus raising the skeleton secreting ability of the organism. It also offered soft tissues better protection from biotic, as well as abiotic factors (predators, tidal desiccation, etc.).

Diversification of fauna

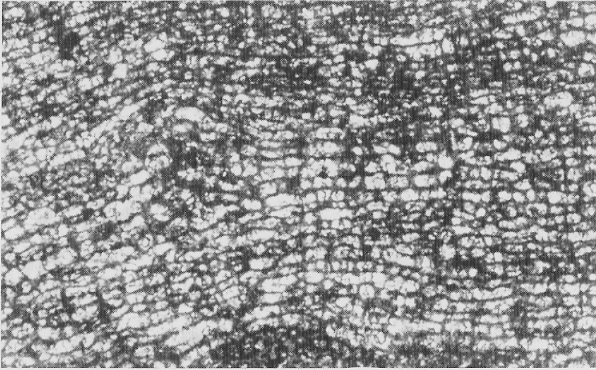
During the Silurian Period all the main phylogenetic branches of the Paleozoic stromatoporoids were formed on the order level. Moreover, Fig. 2, presenting the rela-



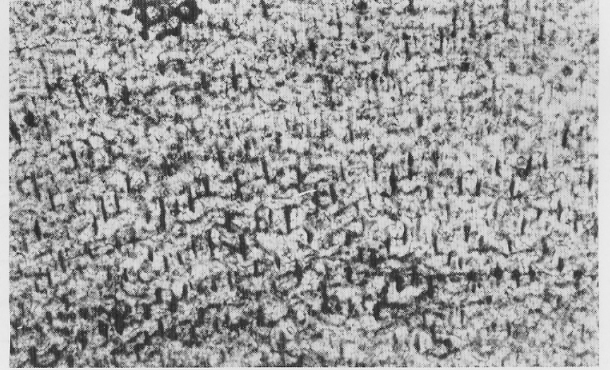
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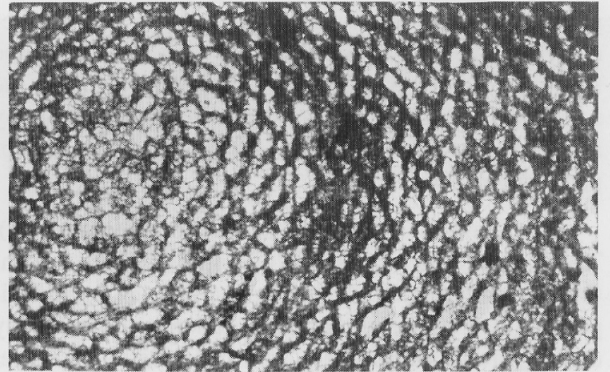
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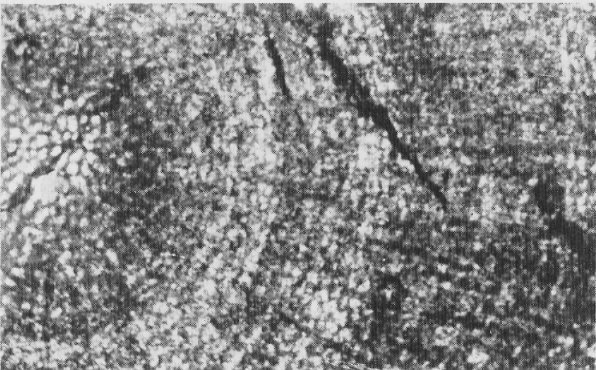
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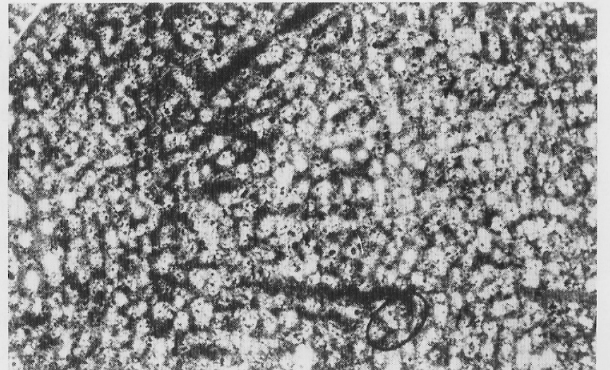
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tionships of stromatoporoids on the family level, shows that by the end of the Silurian Period almost all families had appeared as well. The concrete stratigraphical distribution of the Silurian families and genera is given in the Appendix. It shows that the most rapid expansion in the diversity of the stromatoporoid fauna took place in the Wenlock time, somewhat decreasing in the Pridoli.

Below some more conspicuous evolution trends of the Silurian stromatoporoids will be discussed.

Decay of vesicular stromatoporoids

By the Silurian Period vesicular stromatoporoids of the order Labechiida had passed through the period of the most intensive adaptive radiation (Fig. 2, Append.). The relatively long-ranging genera (*Labechia* M. EDW et HAIME, *Rosenella* NICHOLSON, *Pachystylostroma* NESTOR) were supplemented by rare new forms only (*Cystocerium* NESTOR, *Rosenellinella* YAVORSKY, *Stromatodictyon* KHALFINA), which belong to different families and are not connected with the main evolution lines of this order, but rather with certain side-branches of the family tree.

Diversification of laminar stromatoporoids

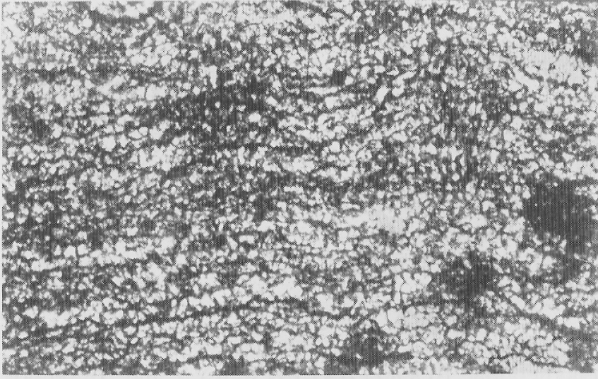
For the representatives of the order Clathrodictyida the Silurian was the period of the most intensive adaptive radiation. The most characteristic of the Silurian were the families Clathrodictyidae KÜHN and Ecclimadictyidae STEARN, typical genera of which appeared by the end of the Middle Ordovician (the first genus is characterized by more gently inflected, the other by crumpled laminae – see Figs. 3.1, 3.2). These families under-

went parallel development in the Silurian, demonstrated in Figure 3. One trend was the appearance of long additional pillars (*Oslodictyon* MORI, Fig. 3.3 and *Yabeodictyon* MORI, Fig. 3.4), another one was the development of subcylindrical to dendroid skeletons (*Clavidictyon*? ex gr. *cylindricum*, Fig. 3.5 and *Neobeatricea* RUKHIN, Fig. 3.6), and the third one was combining of long pillars with the cylindrical shape of the skeleton (*Labechiina* KHALFINA, Fig. 3.7 and *Actinodictyon* PARKS, Fig. 3.8).

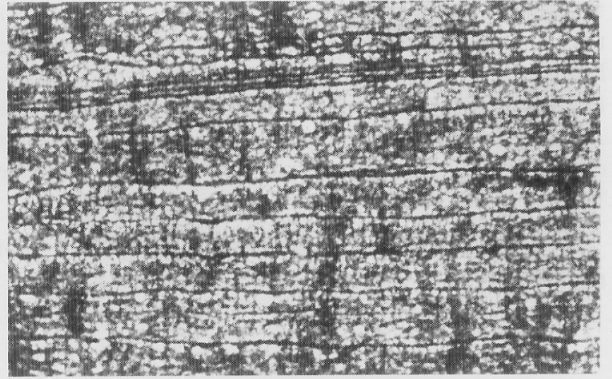
In the Silurian also some genera of the families Tienodictyidae BOGOYAVLENSKAYA and Amphiporidae RUKHIN appeared (see Append.), but these families became more widespread in the Devonian. The earlier Silurian representatives of these, perhaps polyphyletic groupings (BOGOYAVLENSKAYA, 1971: 104; 1984: 72), show their derivation from the representatives of the families Clathrodictyidae or Ecclimadictyidae (see NESTOR, 1974: Fig. 3).

The most important trend in the evolution of the laminar stromatoporoids was the transition from sublaminar clathrodictyids with irregularly crooked laminae and weakly differentiated pillars to the genuine laminar stromatoporoids of the order Stromatoporellida with straight continuous laminae and well-differentiated pillars. The central role in such a transition belongs to the genus *Petridiostroma* STEARN recently distinguished from the redefined *Simplexodictyon* BOGOYAVLENSKAYA (STEARNS, 1992). *Petridiostroma* is characterized by simple laminae and short rounded pillars. Separation of *Petridiostroma* from *Clathrodictyon* obviously took place in the late Llandovery and is marked by such species as *Clathrodictyon regulare* (ROSEN) and *Petridiostroma simplex* (NESTOR). *Petridiostroma*, in turn, could be considered as the ancestor of all main branches of the order Stromatoporellida. Splitting and further complicating of laminae led to the appearance of *Simplexodictyon* BOGOYAVLENSKAYA, emend. (synonym *Diplostroma* NESTOR) – a typical representative

Figure 3. Sublaminar stromatoporoids (Clathrodictyida). Vertical or radial sections of the skeleton, all $\times 10$. – Fig. 3.1, *Clathrodictyon gregale* NESTOR. Upper Ordovician, Porkuni Stage; Estonia, loc. Koigi-Torevere. Holotype Co 3047 in the Institute of Geology, Estonian Academy of Sciences (IGEAS) shows gently inflected laminae and weakly differentiated pillars. – Fig. 3.2, *Ecclimadictyon koigiense* NESTOR. The same locality and horizon. Holotype Co 3076 IGEAS shows crumpled laminae. – Fig. 3.3, *Oslodictyon suevicum* (NICHOLSON). Llandovery, Adavere Stage; Estonia, loc. Tammikääre. Specimen Co 3096 IGEAS shows *Clathrodictyon*-type laminae and scattered long additional pillars. – Fig. 3.4, *Yabeodictyon franklinense* (PARKS). Middle Silurian; Canada; Beechy Island, Lancaster Sound. Oblique section of the type specimen 9125a in Geological Survey of Canada (GSC) showing regularly crumpled laminae and additional long pillars. Photo T. BOLTON. – Fig. 3.5, *Clavidictyon*? *cylindricum* (YAVORSKY). Wenlock, Khakom Suite; Siberian Platform, Moiero River, loc. 55/11, Specimen Co 3229 IGEAS, cross-section through the subcylindrical skeleton with inflected laminae of *Clathrodictyon*-type. – Fig. 3.6, *Neobeatricea nikiforovae* (YAVORSKY). The same area and horizon, loc. 56/13. Cross-section of the specimen 109 IGEAS through the subcylindrical skeleton with crumpled laminae. – Fig. 3.7, *Labechiina cylindrica* (KHALFINA). Lowermost Devonian, Sukhaya Suite; Siberia, Salair, village Aleksandrovka. Holotype No. 401/50a in the Institute of Geol. and Geofiz., Siberian Branch of Acad. Sci. USSR showing cylindrical skeleton with gently inflected laminae and long additional pillars. Photo V.G. KHROMYCH. – Fig. 3.8, *Actinodictyon neptuni* PARKS. Middle Silurian; Canada, Hudson Bay, Southampton Island. Type specimen 9128c GSC showing cylindrical skeleton with irregularly crumpled laminae and long additional pillars. Photo T. BOLTON.



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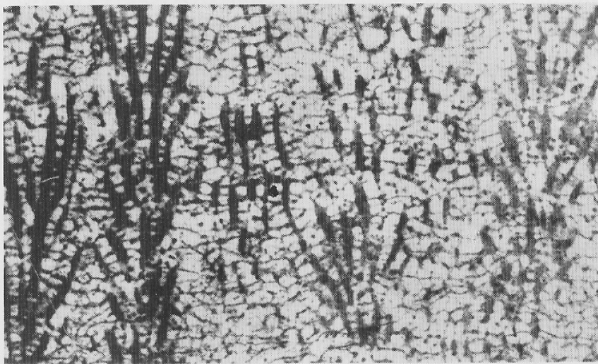
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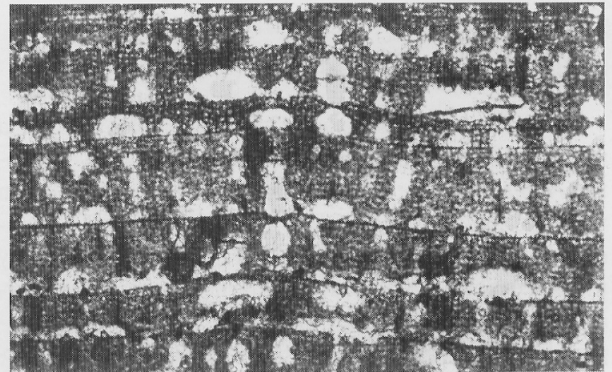
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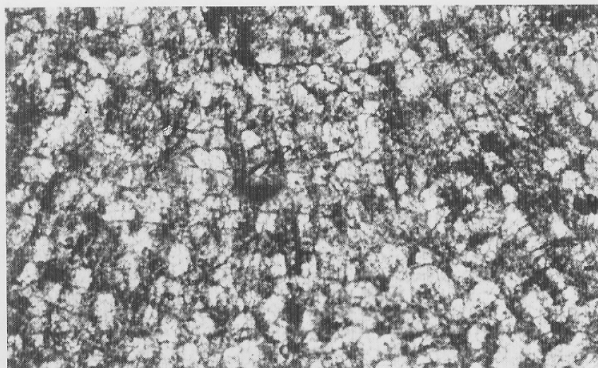
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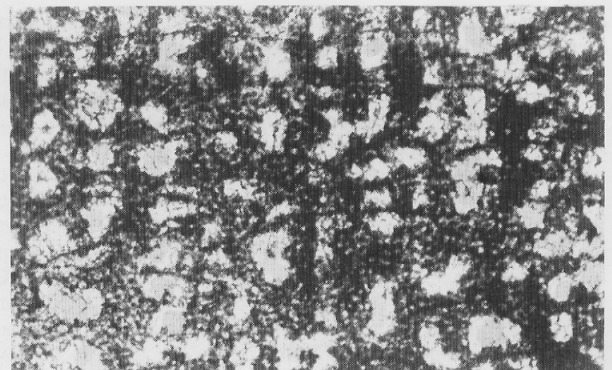
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of the family Synthetostromatidae KHROMYCH. Another morphogenetic trend, the formation of long superposed pillars, created the family Hermatostromatidae NESTOR. *Gerronodictyon* BOGOYAVLENSKAYA, which appeared in the Wenlock and, *Gerronostroma* YAVORSKY, known from the Ludlow onwards, mark the beginning of this evolution lineage continuing in the Devonian.

In the Silurian the order Stromatoporellida was still rather poorly represented (Append.) and its divergence was the most intensive in the Devonian Period.

The appearance of reticulate stromatoporoids

The species *Plectostroma necopinatum* NESTOR from the Lower Llandovery of Estonia can be considered as the oldest known representative of the order Actinostromatida and family Actinostromatidae. Since the Wenlock the genus *Plectostroma* NESTOR became common. In *Plectostroma intertextum*, the type species of the genus, colliculi are often irregularly concave or curved, somewhat resembling cyst plates of labechiids. Besides, long pillars are very unevenly developed. These features suggest that actinostromatids may have evolved from *Labechia*-like ancestors, whose cyst plates have been reduced to rod-shaped colliculi. Below an alternative possibility of the origin of reticulate stromatoporoids will be discussed.

The earliest representatives of the family Pseudolabechiidae BOGOYAVLENSKAYA are also known from the Wenlock (*Pseudolabechia gorskii* in Podolia). In *Pseudolabechia* long pillars, connected by the ray-shaped colliculi, are arranged in bundles (columns) with a very irregular fine-reticulate tissue between (Fig. 4.3). The role of this family in the evolution of actinostromatids has also been interpreted differently.

The origin of fine-reticulate stromatoporoids

The most numerous and diverse group of Silurian actinostromatids consists of fine-reticulate forms ascribed to the family Densastromatidae BOGOYAVLENSKAYA. Their skeleton structure corresponds in size to the microstructure of skeletal elements of other stromatoporoids (Figure 4). Densastromatids appeared suddenly at the beginning of the Wenlock (*Densastroma pexisum* YAVORSKY in the Baltic area) and passed through a period of rapid radiation in the Silurian (see Append.). At the end of the Silurian the densastromatids gradually lost their significance and in the Lower Devonian only single representatives of *Araneosustroma* and *Lamellistroma* BOGOYAVLENSKAYA are known. Thus, apart from the families Clathrodictyidae and Ecclimadictyidae, densastromatids were among the most characteristic elements of the Silurian stromatoporoid fauna.

KAZMIERCZAK (1971) considered fine-reticulate densastromatids (namely *Densastroma*) as an initial point for many evolution lineages of stromatoporoids. He supposed that during further evolution the uniform fine-reticulate skeletal network of *Densastroma* differentiated and condensed into various vertical and horizontal skeletal elements of descendants.

Practically opposite views have been expressed by BOGOYAVLENSKAYA (1984), who has treated the Upper Ordovician genus *Plumatalinia* NESTOR as an ancestral form of actinostromatid stromatoporoids. It has flat cyst plates like members of the order Labechiida, combined with irregular fine-reticulate tissue in vertical columns (Fig. 4.1). The related Silurian form is *Stromatodictyon* KHALFINA (Fig. 4.3) with fused skeletal network in complicated vertical skeletal elements. According to BOGOYAVLENSKAYA the further evolution of actinostromatids proceeded through *Pseudolabechia*-type forms, in the columns of which the irregular fine-reticulate tissue has been replaced by bundles of

Figure 4. Microreticulate stromatoporoids. Vertical sections of the skeleton; magnification $\times 20$, if not marked otherwise. – Fig. 4.1, *Plumatalinia ferax* NESTOR. Upper Ordovician, Pirgu Stage; Estonia, loc. Niibi. Specimen Co 3024 IGEAS showing irregular akosmoreticular skeleton tissue. – Fig. 4.2, *Densastroma podolicum* (YAVORSKY). Ludlow, Paadla Stage; Estonia, loc. Himmiste-Kuigu. Specimen Co 3153 IGEAS showing orthoreticular skeleton tissue. – Fig. 4.3, *Stromatodictyon repentinum* (KHALFINA). Wenlock, Khakom Suite; Siberian Platform, Moiero River, loc. 55/6. Specimen Co 3236A IGEAS showing very fine, fused akosmoreticular tissue. $\times 25$. – Fig. 4.4, *Actinostromella vaiverensis* NESTOR. Pridoli, Kaugatuma Stage; Estonia, loc. Vaivere. Holotype Co 3159 showing orthoreticular tissue, pierced by vertical tubules. – Fig. 4.5, *Pseudolabechia granulata* YABE et SUGIYAMA. Ludlow, Hemse Beds; Gotland, loc. Ardre. Specimen Kt 13D in Stockholm University showing stout pillars, grouped into columns and fine irregular structure in intercolumnal space. $\times 10$. Photo K. MORI. – Fig. 4.6, *Parallelostroma typicum* (ROSEN). Ludlow, Paadla Stage; Estonia, Island Saaremaa, loc. Pilguse. Lectotype Co 300g IGEAS showing orthoreticular microstructure of horizontal coenostroms. – Fig. 4.7., *Vikingia tenuis* (NESTOR). Wenlock, Jaagarahu Stage; Estonia, Saaremaa, loc. Jaagarahu. Holotype Co 3148 showing clinoreticular microstructure of vertical coenosteles. – Fig. 4.8, *Syringostromella borealis* (NICHOLSON). Ludlow, Paadla, Saaremaa, cliff Katri. Specimen Co 3176 showing akosmoreticular or cellular microstructure of coenosteles.

pillars connected with regular colliculi (Fig. 4.5). By this conception later evolution was directed to unification of the skeleton structure in the columns and intercolumnal space. In the Wenlock genus *Desmostroma* BOLSHAKOVA a part of the pillars occurs in bundles, whereas in *Densastroma* (Fig. 4.2) the whole skeletal network became unified. A similar opinion about the origin of fine-reticulate stromatoporoids has recently been expressed also by CARL STOCK (pers. comm.).

Microreticulate microstructure in other stromatoporoids

The problem of the origin of microreticulate stromatoporoids is complicated by the presence in the skeletal elements in several forms, customarily assigned to the order Stromatoporida, of microreticulate microstructure. This was already mentioned by ROSEN (1867), PARKS (1909), ST. JEAN (1967) and recently more thoroughly discussed by STOCK (1989).

Three different types of the microreticulate microstructure, orthoreticular, clinoreticular and akosmoreticular, have been distinguished (NESTOR, 1974; STOCK, 1989). In the first type the meshes of the network are rectangular (e.g. genus *Parallelostroma* NESTOR, Fig. 4.6). In the second, the microreticulate skeletal tissue consists of clinogonally arranged bundles of micro-pillars and more or less developed microcolliculi (e.g. *Vikingia* BOGOYAVLENSKAYA, Fig. 4.7). In the third case the microreticulate microstructure has very irregular meshes (e.g. *Plumatalinia* NESTOR, Fig. 4.1, *Syringostromella* NESTOR, Fig. 4.8).

The forms with similar microreticulate microstructure have also certain common mesostructural features. For instance, in the forms with a clinoreticular skeletal tissue (family Syringostromatidae) the vertical skeletal elements have very diffuse outlines; the horizontal elements are mostly represented by fine dissepiments. The skeletal tissue of the forms with the orthoreticular tissue (families Actinostromellidae and Pseudotrumpetostromatidae) is, as a rule, penetrated by tubuli with a round cross-section ("autotubes" – NESTOR, 1966). This suggests the common origin of the forms with similar microreticulate tissue. Particularly this concerns the stromatoporoids with the ortho- and clinoreticular microstructures (NESTOR, 1974: 34, Fig. 5).

More complicated is the situation with the akosmoreticulate forms which probably arose recurrently in the geological past.

In the geological record stromatoporoids with differ-

ent types of microreticulate microstructure appeared during a rather short period and by Wenlock time there existed representatives of all types. This complicates establishing of mutual relationships of forms with a different microstructure. Taking into consideration all the above, it seems most likely that clinoreticular microstructure has derived from the akosmoreticular one but the orthoreticular microstructure has developed independently.

The present author does not share the opinion of STOCK (1989: 154) that all the representatives of the order Stromatoporida had primarily a microreticulate microstructure and descended from actinostromatids, particularly from *Densastroma*. Examination of some early representatives of the genus *Stromatopora* (*S. baillargensis* PETRYK, 1967; *S. ringerikensis* MORI, 1971, *S. impexa* NESTOR, 1966) from the Late Llandovery and Early Wenlock has demonstrated that the tissue of their stout skeletal elements was compact and homogeneous. The typical Devonian representatives of *Stromatopora* bear no traces of microreticulation either. Therefore it is very likely that the order Stromatoporida is a polyphyletic grouping.

Conclusions

The Silurian was a period of the most intensive diversification of the Paleozoic stromatoporoid fauna. Progressive folding of the basal surface of the soft body, increasing the skeleton-secreting ability of the pinacoderm, was the most general tendency in stromatoporoid evolution. Other remarkable trends in stromatoporoid evolution during the Silurian were as follows: 1. Decay of labechiids and intense radiation in the order Clathrodictyida. 2. Development of stromatoporoids with well-differentiated regular continuous laminae and pillars (order Stromatoporellida). 3. Appearance of stromatoporoids with loose skeleton lattice (order Actinostromatida) and irregularly amalgamated structure (order Stromatoporida). 4. Origination of stromatoporoids with different kinds of a microreticulate microstructure and their parallel evolution.

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Appendix

Stratigraphic distribution of stromatoporoid families and genera during the Silurian.

TAXA	Appearance	LLANDOVERY	WENLOCK	LUDLOW	PRI-DOLI	Disappearance
ORDER LOPHIOSTROMATIDA						
Fam Lophiostromatidae Nestor 1966	O2	<----->				? Tr
<i>Lophiostroma</i> Nicholson 1891	O2	<- - - - ->				? Tr
ORDER LABECHIIDA						
Fam Rosenellidae Yavorsky, 1973	O2	<----->				D3-C1
<i>Rosenella</i> Nicholson, 1886	O2	<----->				?D3-C1
<i>Pachystylostroma</i> Nestor, 1964	O2	<- - - - ->				D3-C1
? <i>Forolinia</i> Nestor, 1964		-----				
<i>Rosenellinella</i> Yavorsky, 1967		- -				
Fam Labechiidae Nicholson, 1879	O2	<----->				D3-C1
<i>Labechia</i> M -Edw et Haime 1851	O2	<----->				D3-C1
<i>Labechiella</i> Yabe et Sug 1930	O2	<- - - - ->				D2
<i>Cystocerium</i> Nestor 1976		----->				
Fam Aulaceridae Kühn 1927	O2	<= = ?				
<i>Ludictyon</i> Ozaki, 1938	O2	<- - ?				
Fam Plumataliniidae Bogoy , 1969	O3	<===== = = =				
<i>Plumatalinia</i> Nestor, 1960	O3	<- - - - - ?				
<i>Stromatodictyon</i> Khalifina, 1972		- - - -				
? <i>Hexastylotroma</i> Dong, 1984		- - - -				
ORDER CLATHRODICTYIDA						
Fam Clathrodictyidae Kühn, 1939	O2	<----->				? D3
<i>Clathrodictyon</i> Nich et Mur , 1978	O2	<- - - - ->				? D2
<i>Oslodictyon</i> Mori, 1978		----->				
? <i>Clavidictyon</i> Sugiyama, 1939		- - - - ->				D3-C1
<i>Stelodictyon</i> Bogoy , 1969		----->				
Fam Ecclimadictyidae Stearn, 1980	O2	<----->				?D1
<i>Ecclimadictyon</i> Nestor, 1964	O2	<----->				
<i>Neobeatricea</i> Rukhin 1938		----->				?D1
<i>Yabeodictyon</i> Mori 1968		----->				
<i>Actinodictyon</i> Parks, 1909		----->				
<i>Plexodictyon</i> Nestor 1966		? - - - - ->				
Fam Tienodictyidae Bogoy 1965		<----->				D3-C1
<i>Intexodictyon</i> Yavorsky 1963		----->				?D2
<i>Schistodictyon</i> Lessovaya 1970		----->				D3
Fam Amphiporidae Rukhin 1938		<=====>				D3
<i>Clathrodictyella</i> Bogoy 1965		----->				D2
<i>Paramphipora</i> Yavorsky 1955		----->				D3
? <i>Stellopora</i> Bogoy 1972		----->				D3

Appendix continued.

TAXA	Appea- rance	LLANDO VERY	WEN- LOCK	LUD- LOW	PRI- DOLI	Dis- appea- rance
ORDER STROMATOPORELLIDA						
Fam Synthetostromatidae Khrom 1969			=====			D3
? <i>Petridiostroma</i> Stearn gen n		-	-----			D3
<i>Simplexodictyon</i> Bogoy , 1969			-----			?D1
Fam Hermatostromatidae Nestor, 1964			=====			D3-C1
? <i>Gerronodictyon</i> Bogoy 1969			---	--		
<i>Gerronostroma</i> Yavorsky 1931				-----		D3-C1
? <i>Amnestostroma</i> Bogoy , 1969				-----		D1
<i>Praeidiostroma</i> Bogoy , 1971					-----	
ORDER ACTINOSTROMATIDA						
Fam Actinostromatidae Nich , 1886			=====			D3-C1
<i>Plectostroma</i> Nestor, 1964			-----			D3
? <i>Trigonostroma</i> Bogoy , 1969				-----		
<i>Crumplestroma</i> Khalfina, 1972					-----	
Fam Pseudolabechiidae Bogoy , 1969			=====			
<i>Pseudolabechia</i> Yabe et Sug , 1930			-----			
Fam Densastromatidae Bogoy , 1977			=====			?D2
<i>Densastroma</i> Flügel, 1959				-----		
? <i>Desmostroma</i> Bolshakova 1969				-----		
<i>Araneosustroma</i> Lessovaya, 1970				-----		D1
<i>Petschorostroma?</i> Bogoy , 1983				-----		
? Fam Actinostromellidae Nestor, 1966						
<i>Actinostromella</i> Boehnke 1914			-----			
ORDER STROMATOPORIDA						
Fam Stromatoporidae Winchell 1867			=====			D3
<i>Stromatopora</i> Goldfuss 1826			-----			D3
<i>Lineastroma?</i> Khalf et Yav 1973			-----			
Fam Yavorskiinidae Khalfina 1973			=====			D3
<i>Yavorskiina</i> Khalfina 1968			-----			
<i>Syringostromella</i> Nestor 1966			-----			D3
Fam Syringostromatidae Lecompte 1951			=====			D3
<i>Vikingia</i> Bogoy 1969			-----			
Fam Pseudotruperostromatidae Khalf et Yav 1973				=====		D3
<i>Parallelostroma</i> Nestor, 1966				-----		D2