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THE RUGOSE CORAL FAUNA FROM THE UPPER PART OF THE HEYUANZHAI FORMATION IN WESTERN YUNNAN, CHINA

by

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(with 18 text-figures, 4 tables and 62 plates)

Contents

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Abstract

The material studied here is from the Malutang-Heyuanzhai region of Shidian County, Yunnan Province, China. In this region Devonian is well developed and may be divided into eight formations. They include the Lower Devonian Xiangyangsi Formation, the Wangjiacun Formation, the Shabajiao Formation, the Middle Devonian Xibiantang Formation and Malutang Formation, the upper Middle to lower Upper Devonian Heyuanzhai Formation and the Upper Devonian Dujiacun

Formation. Rugose corals are known from the Malutang Formation and the Heyuanzhai Formation. The Malutang Formation yields abundant brachiopods and a few rugose corals, while the Heyuanzhai Formation is rich in both rugose corals and brachiopods. This paper only deals with the rugose corals of the Heyuanzhai Formation.

Among the coral species from the Heyuanzhai Formation, except those discovered only in western Yunnan, one species, *Altaiophyllum sagsayicum*, is known from the Eifelian of the Urals, 10 species are restricted to Givetian, and 13 species to Frasnian or show some resemblance to Frasnian forms.

The rocks yielding the rugose corals are of different kinds of clastic limestones, including more than one bed of conglomeratic limestone. The phaceloid and dendroid corals are usually preserved in fragments, and the outer wall and even parts of dissepimentarium are destroyed in most of the specimens. Some of the corals are probably redeposited fossils. However, some typical Upper Devonian brachiopods, such as *Spinatrypa, Pugnoides* and *Devonoproductus*, were reported by Hou and others (1988, p. 218) from the Heyuanzhai Formation. Therefore the Heyuanzhai Formation seems to be Early Frasnian in age.

In the fauna, rugose corals, mostly of medium or large size, are abundant, forming small biostromes in part. So the corals must have lived in a warm shallow sea advantageous to their growth. Massive forms are usually small, and rare in individuals. These features show that the coral fauna lived in an environment not advantageous to the formation of coral reefs.

Almost all the solitary corals in the fauna are incompletely preserved, especially their proximal parts which are usullay destroyed. In some forms of *Macgeea*, the walls and outer dissepiments are usually destroyed, and even the horseshoe dissepiments are not preserved entirely. Growth direction of fragmentary preserved corallites of both phaceloid and dendroid coral is often in reverse direction. The rugose corals are usually encrusted by other fossils. Some had been destroyed before they were enclosed, some were destroyed after they had been enclosed. Moreover, the associated brachiopods are large in size, and with thick radiations on their shells. The broken fossil fragments are common in beds. On this basis, it is inferred that the coral fauna lived in a high wave energy environment.

A comparison of the known occurrences of the rugose coral species in the Heyuanzhai Formation with these in other areas indicates that the fauna is a mixed one of Frasnian and Givetian.

The state of preservation and the age of the rugose corals under discussion show that this fauna had partly undergone transportation before they were buried.

The components of the Heyuanzhai fauna are highly similar to the Beiliu coral fauna in Middle Devonian of South China. The fauna may have lived on the margin of the carbonate platform adjacent to deep water basin as did the Beiliu coral fauna.

The Heyuanzhai Formation consists mainly of marls and different kinds of limestones, including conglomeratic limestones and bioclastics. In the conglomer-

atic limestones and bioclastics, limestone gravels and fossil fragments are variable in size, irregular in shape and not rounded, but the matrix is very fine.

As noted above, the rugose corals in the Heyuanzhai Formation were destroyed to various degrees, but most of them were preserved well enough to be identified, and in most cases they are randomly oriented.

The state of the preservation of fossils and the lithology of the rocks in the Heyuanzhai Formation indicate that they were formed in a calm water, and the fossils and gravels as well as other coarse grains had been transported for only a short distance, and quickly deposited. So it may be inferred that the fauna was preserved in a slope environment of deposition.

In summary, the rugose corals under discussion may have lived in a warm high wave energy shallow water probably situated on the margins of a carbonate platform adjacent to deep water basin. After death they had been transported and quickly deposited in a calm water environment on the continental slope.

Three Devonian rugose coral biogeographical realms have been recognized by Hill (1957, 1981), Oliver and Pedder (1975-1984). They are the Eastern Americas Realm, the Old World Realm and the Malvinokaffric Realm. In 1989 Wang Hongzhen and others recognized four Devonian rugose coral biogeographic realms in the world: the Boreal, the West Tethyan, the East Tethyan and the Malvinokaffric Realm. The West Tethyan corresponds to the Eastern Americas Realm of Oliver et al.. Although different opinions exist with respect to the division of Devonian rugose coral biogeographic provinces, all agree that the difference between the Devonian coral fauna in eastern North America and that in the other regions of the world is the most striking.

At generic level the coral fauna from the Heyuanzhai Formation of western Yunnan is very close to eastern North America. More than 90 percent of the individuals are same as or similar to that of the eastern North America. However, Very common Devonian forms like *Disphyllum*, *Cyathophyllum*, *Temnophyllum* and *Endophyllum* in the so-called Old World Realm have not been discovered so far in eastern Yunnan.

Brachiopods are also very abundant in the Heyuanzhai Formation. *Stringocephalus*, a Givetian index fossil in the Old World Realm, has not been found in western Yunnan. This may also indicate that the Heyuanzhai fauna of western Yunnan was more closely related to Eastern Americas Realm than to the Old World Realm.

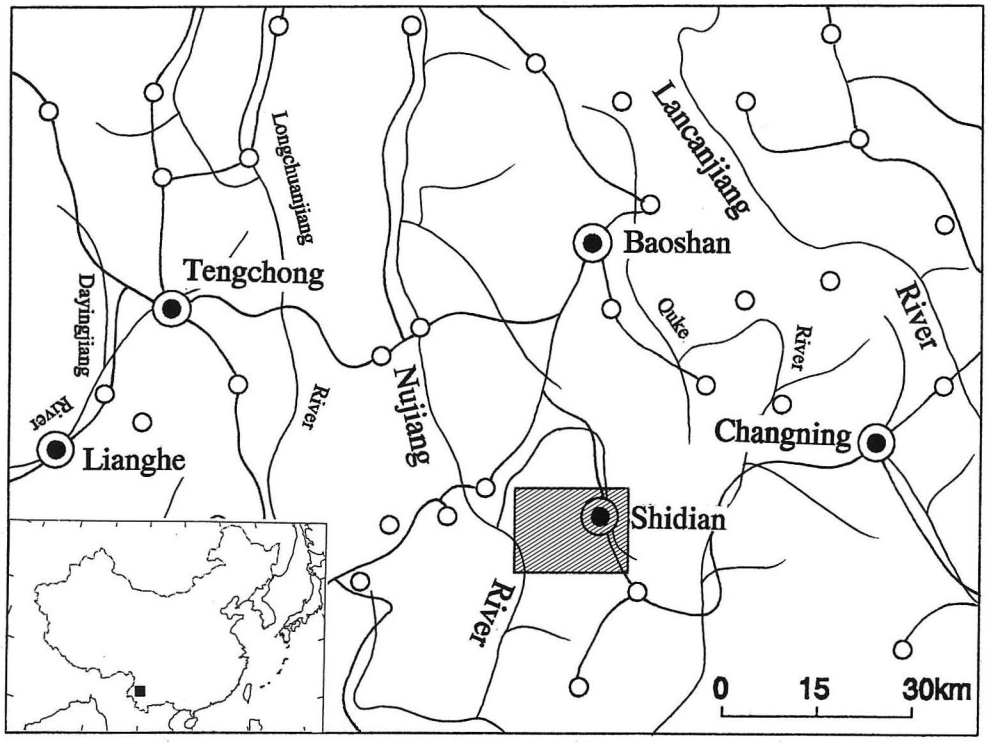
The Middle and Upper Devonian coral faunas in western Yunnan are quite different from those in the Yangtze region, and probably were separated from the Yangtze Platform by wide seas.

Altogether 13 genera and 37 species of rugose corals are described in the present paper from the upper part of the Heyuanzhai Formation. Among them 2 genera and 7 species are new and 4 species are indeterminable.

Introduction

Chinese geologists have long been studying the boundary between the Gondwana and the Eurasia continents. This boundary problems involve the tectonic province, sedimentary province and so on in China. Ten years ago, Chinese geologists paid more attention to the geological study of the Tibet; and in recent years they focus on the geology of western Yunnan.

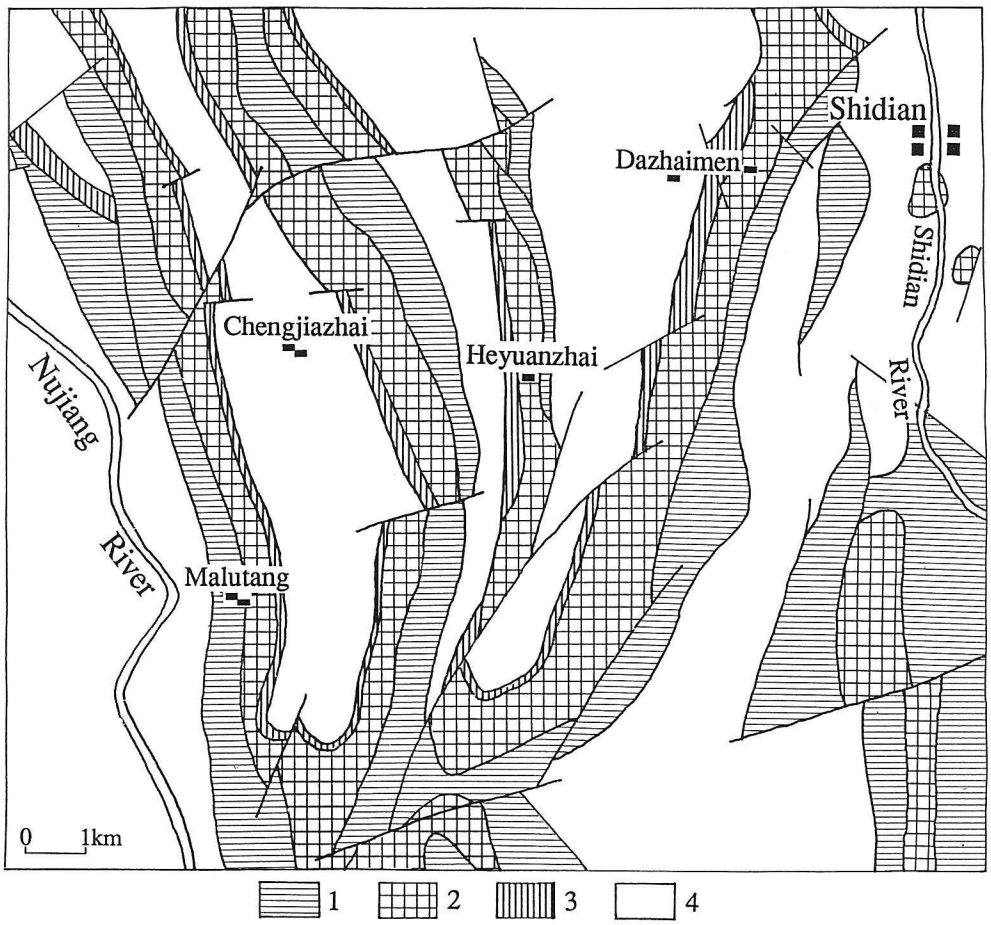
In 1987, a joint working team consisting of members of the China University of Geosciences (Beijing) and Institute of Geology, Academia Sinica began to study the tectonic evolution of the lithosphere of western Yunnan with the support of the China Natural Science Foundation. I was lucky to get an opportunity to participate in the study, and during the field work from November, 1987 to February, 1988 in Heyuanzhai, Malutang and Dazhaimen of Shidian County, Yunnan Province, measured the Devonian and Carboniferous sections, and collected a vast number of rugose corals of Middle to Late Devonian and Early Carboniferous age. From the Summer, 1988 to the Spring, 1989, enough specimens of the rugose corals, including about 420 Devonian individuals and 760 Carboniferous ones, were sectioned in Peking University, China. The fossils sectioned were provisionally classified at generic level in an interim report to the China Natural Science Foundation in the Summer,



Text-fig. 1 Index map showing the location of the study area

1990. At the same time Professor Wang Hongzhen of the China University of Geosciences (Beijing) suggested me to study more in detail the Devonian rugose corals from western Yunnan for my doctoral thesis.

According to the agreement of cultural exchange between China and Japan, I was permitted to study in Japan for two years starting from October, 1991. The present work was completed at the Department of Geology and Mineralogy, Faculty of Science, Hokkaido University under the joint direction of Professor Makoto Kato of Hokkaido University, Japan and Professor Wang Hongzhen of China University of Geosciences (Beijing), China.



Text-fig. 2 The distribution of Devonian in the study area
1-Lower Devonian (the Xiangyangsi Formation; the Wangjiacun Formation; the Shabajiao Formation);
2-Middle-Upper Devonian (the Xibiantang Formation; the Malutang Formation; the Heyuanzhai Formation);
3-Upper Devonian (the Dujiacun Formation);
4-non Devonian.

The materials, studied here were collected from the Malutang-Heyuanzhai region of Shidian County, Yunnan Province, China (Text-figure 1). In this region Devonian is well developed and may be divided into eight formations. They include the Lower Devonian Xiangyangsi, the Wangjiacun, and the Shabajiao Formations, the Middle Devonian Xibiantang and the Malutang Formations, the upper Middle to lower Upper Devonian Heyuanzhai Formation and the Upper Devonian Dujiacun Formation (Text-figure 2). Rugose corals are known from the Malutang Formation and the Heyuanzhai Formation. The Malutang Formation yields abundant brachiopods and a few rugose corals, while the Heyuanzhai Formation in rich in both rugose corals and brachiopods. This paper only deals with the rugose corals of the Heyuanzhai Formation.

A brief historical review

The history of study on Devonian corals of western Yunnan can be traced back to the 1920's. F. R. C. Reed was the first to study Devonian corals of western Yunnan, and described only one species, *Campophyllum yunnanense* in his "Paleozoic and Mesozoic Fossils from Yunnan". His specimen, probably from the Heyuanzhai Formation, resembles closely the forms described under *Siphonophrentis gigantea* in the present paper.

Song Xueliang (1982) described 7 genera and 11 species of rugose corals from the upper part of the Heyuanzhai Formation, condidering them as being Givetian in age and comparing them with the fauna of Europe, North America and South China. They are:

Baoshanophyllum cylindricum Sung
Amplexiphyllum yunnanense Sung
A. minor Sung
A. acanthoseptum Sung
Barrandeophyllum regulare Sung
Keriophyllum giganteum Sung
Cylindrophyllum malutangense Sung
C. planotabulatum Sung
Macgeea bathycalyx yunnanensis Sung
M. symmetrica Sung
Pexiphyllum shidianense Sung

Wang Zengji (1986) described rugose corals from both the Malutang Formation and the Heyuanzhai Formation. The Malutang Formation has yielded: *Metriophyllum gracile* Schlüter, *Metrionaxon yunnanense* Wang, *M. sinense* Wang, *Neaxon inopinatum* (Prantl), *N.* sp. and *Barrandeophyllum*? sp, all being small, solitary corals without dissepiments. Only 1 subspecies, the cerioid coral *Peripaedium planum planum* Birenheide was described from the Heyuanzhai Formation.

Altogether 13 genera and 37 species of rugose corals are described in the pres-

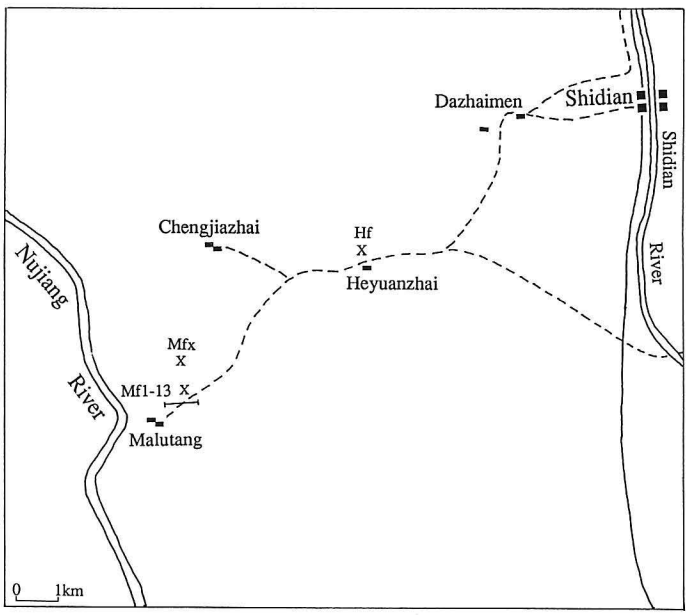
ent paper from the upper part of the Heyuanzhai Formation. Among them 2 genera and 7 species are new and 4 species are indeterminable. They are as follows:

Class Anthozoa Ehrenberg, 1834
Subclass Rugosa Milne-Edwards et Haime, 1850
Order Stauriida Verrill, 1865
Suborder Stauriina, Verrill, 1865
Family Amplexidae Chapman, 1893
Siphonophrentis gigantea (Lesueur)
S. cantabrica Birenheide
S. minor (Sung)
Altaiophyllum sagsayicum (Spasskiy)
A. yunnanense sp. nov.
A. shidianense sp. nov.
Suborder Metriophyllina, Spasskiy, 1965
Family Metriophyllidae Hill, 1939
Metriophyllum cf. *carinatum* (Simpsom)
Suborder Ketophyllina Zhavoronkova, 1972
Family Endophyllidae Torley, 1933
Tabulophyllum aff. *gracile* (Walther)
Suborder Ptenophyllina Wedekind, 1927
FamilyPtenophyllidae Wedekind, 1923
Subfamily Ptenophyllinae Wedekind, 1923
Acanthophyllum concavum (Walther)
A. looghense (Wedekind)
Grypophyllum sp.
Suborder Columnariina Soshkina, 1941
Family Disphyllidae Hill, 1939
Subfamily Disphyllinae Hill, 1939
Temnophyllum (*Truncicarinulum*) *altevogti* (Oliver et Sorauf)
Family Phillipsastreidae Hill, 1954
Phillipsastrea hennahii (Lonsdale)
P. liujingensis Yu et Kuang
P. goldfussi (de Verneuil et Haime)
Macgeea solitaria (Hall et Whifield)
M. bathycalyx (Frech)
M. berdensis Soshkina
M. symmetrica Sung
M. dubia (de Blainville)
M. rozkowskae Coen-Aubert
M. multizonata (Reed)
M. giganted Brice et Rohart
M. caucasica Soshkina
M. recta (Walther)

M. shidianensis (Sung)
M. yunnanensis sp. nov.
M. multiseptata sp. nov.
Peneckiella fascicularis (*Soshkina*)
P. yunnanensis sp. nov.
Parapeneckiella shidianensis gen. et sp. nov.
Suborder Cyathophyllina Nicholson, 1889
Family Eridophyllidae de Fromentel, 1861
Subfamily Cylindrophyllinae Oliver, 1874
Acinophyllum rectiseptatum (Rominger)
Neoacinophyllum canopotabulatum gen. et sp. nov.
N. malutangense (Sung)
N. planotabulatum (Sung)
N. crassiseptatum (Ehlers et Stumm)
N. sp.

Age of the fauna

The Heyuanzhai Formation was named by Professor Sun Yunzhu (1947), but without a strict definition. This caused a lot of confusion. Fang Runsen and others (1976) divided it into the Lower Heyuanzhai Formation consisting of dolomites, and the Upper Heyuanzhai Formation composed of limestones and marls. Hou Hongfei and others (1988) confined the Heyuanzhai Formation to the

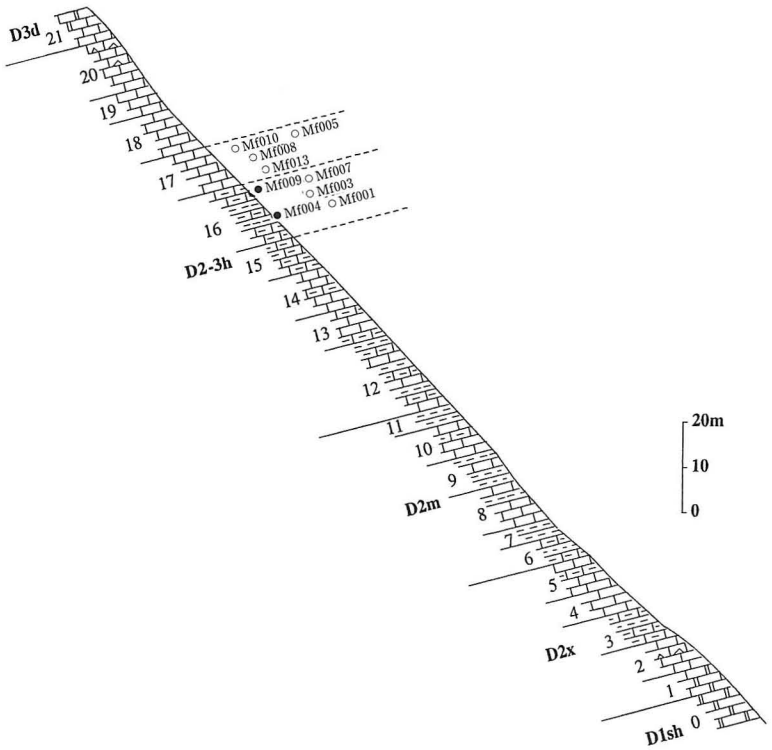


Text-fig. 3 Index map showing the sampling localities

limestones with abundant brachiopods and corals. Here the present author follows Hou Hongfei and others (1988) in the usage of the Heyuanzhai Formation.

The Heyuanzhai Formation was regarded as being Givetian in age (Song Xueliang, 1982; Wang Zengji, 1986). Hou Hongfei and others (1988, p. 218) pointed out that the Heyuanzhai Formation includes both the Middle and the Upper Devonian.

The material under study was collected from the upper part of the Heyuanzhai Formation in the Malutang-Heyuanzhai region of Shidian, Yunnan Province (Text-figure 3). In Heyuanzhai all the corals are from one bed of marl and labeled "Hf". In Malutang a Devonian section was measured (Text-figures 4, 5), which is situated on the right bank of the Nujiang River, a very deep and steep canyon. The fossils labeled "Mf001 to Mf013" were collected from one locality around the section. Among them only the corals labeled "Mf004" and "Mf009" were all discovered in the section, the others in loose stones near the section (Text-figure 4), and the labels mark only the locality where they are collected. All the fossils occur in the upper part of the Heyuanzhai Formation, above the bed 16 in the measured section. "Mf00x" indicates another locality about 1 Km away from



Text-fig. 4 Natural section of Middle and Upper Devonian in Malutang, Shidian, western Yunnan

●-fossils from the section; ○-fossils from loose stones.

			Lithology	Fs*	Fl
D3d	21		thick-bedded limestones, dolomitic limestones and dolomitites		
D2-3h	20		finely crystalline limestones with breccis,containing tabulate corals and rugose corals		
	19		thick-beded bioclastics, containing tabulate and rugose corals		
	18		thick-beded crystalline limestones containing rugose corals		Mf005
	17		crystalline limestones and bioclastic limestones		Mf008 Mf010 Mf013
	16		argillaceous limestones with calcareous shales and sandy limestones, containing tabulate corals, stromatoporoids and a few brachiopods and rugose corals	Mf009 Mf004	Mf001 Mf003 Mf007
	15		argillaceous limestones with micrites in thelower part		
	14		thick-bedded crystalline limestones with argillaceous limestones in the middle part and bioclastics in the uppermost part		
	13		medium-bedded crystalline limestones and argillaceous limestones		
	12		three cycles consisting of micrites, argillaceous limestones and calcareous shales, containg abundant brachiopods and a few small rugose corals and crinoid stems		
	11		calcareous shales		
D2m	10		micrites and argillaceous limestones		
	9		thin-bedded calcareous shales with medium-bedded argillaceous limestones in the upper part		
	8		micrites with calcareous shales in the upper part		
	7		thin-bedded calcareous shales		
	6		argillaceous limestones and interbedded calcareous shales		
D2x	5		crystalline limestones with micrites and argillaceous limestones		
	4		crystalline limestones		
	3		argillaceous limestones with micrites and calcareous shales, containing a few small brachiopods		
	2		micrites with breccis		
	1		thick-bedded dolomitic crystalline limestones		
D1sh	0		thick-bedded dolomicrites		

30m
15
0

* Fs-fossils from the section; Fl-fossils from the loose stones.

Text-fig. 5 Columnar section of the Middle and Upper Devonian in Malutang, Shidian, western Yunnan

the measured section. Some coral species, for example, *Siphonophrentis gigantea, Macgeea berdensis, and M. symmetrica*, occur at the three localities labeled " Hf ", " Mf001-013 " and " Mf00x " respectively (Table 1). As it is impossible to deter-

Table 1 The distribution of the rugose corals in the upper part of the Heyuanzhai Formation in western Yunnan

Species	M1*	M3	M4	M5	M7	M8	M9	M10	M13	Mx	H1
Siphonophrentis gigantea		6**	1	8	3	17	1	7		2	1
S. cantabrica		4		1	1		1	2		36	2
S. minor	1		1	3	5	17	1	1	4	1	
Altaiophyllum sagsayicum										1	
A. yunnanense										1	
A. shidianense										2	
Metriophyllum cf. carinatum						1					
Temnophyllum(Truncicarinulum) altevogti											1
Acanthophyllum concavum										1	1
A. looghense							2				1
Grypophyllum sp.										1	
Tabulophyllum aff. gracile		1	1								
Phillipsastrea hennahii			1								
Ph. liujingense	1				1						
Ph. goldfussi										1	
Macgeea solitaria						1	1	1	5	3	
M. bathycalyx	1				3	2	3	5	6	2	
M. berdensis		1			1		1	1	1	2	11
M. symmetrica	3				2	1	2	2	2	4	10
M. dibum	1				1					1	
M. multizonata					1						
M. gigantea										1	
M. caucasica					1						
M. rozkowskae						3			1	2	
M. recta										2	2
M. shidianensis				1		1		3		1	
M. multiseptata							1				
M. yunnanensis				1							
Peneckiella fascicularis					2						1
P. yunnanensis											9
Parapeneckiella shidianensis											1
Neoacinophyllum malutangensis	1	4	3	2	6		6	8	2	2	
N. planotabulatum				9							
N. crassiseptatum				1							
N. canopotabulatum			1								
N. sp.			1								
Acinophyllum rectiseptatum			1					2		3	1

* M1-Mf001; M3-Mf003; M4-Mf004; M5-Mf005; M7-Mf007; M8-Mf008; M9-Mf009; M10-Mf010; M13-Mf013; Mx--Mf00x; H1-Mf001.

** number of the specimen

Table 2 The known stratigraphical and geographical distribution of the rugose corals in the upper part of the Heyuanzhai Formation

Species	Eifelian	Givetian	Frasnian	Famennian
Phillipsastrea hennahii		England(Uppermost)	England; Belgium(F2i); Germany; Mackenzie	
Ph. goldfussi			Belgium(F2i-j); England; Poland.	
Ph. liujingense		Guangxi	South-Central New Mexico	
Macgeea soliaria			Iowa; Altai; Chitral.	
M. bathycalyx		Germany		
M. berdensis			Ural; Russian Platform; Holy Cross Mountains	Holy Cross Mountains
M. dubia			France	
M. multizonata			Chitral; Ural; Taimyr; Kuznetsk Basin; Poland; Belgium(F2ab)	
M. gigantea			France; Belgium(F2i-h)	
M. rozkowskae			Belgium(F2ad)	
M. caucasica			Armenia	
M. recta			Europe	
Peneckiella fasicicularis			Russian Platorm; Ural; Belgium(F2e-i); Timan; Poland.	
P. yunnanense			Mackcnzie; Chitral.	
Neoacinophyllum crassiseptata		Michigan		
N. planotabulatum			Mackenzie	
Acinophyllum rectiseptatum		Michigan		
Tabulophyllum cf. gracile			Germany	
Acanthophyllum concavum		Germany(Uppermost) Nepal		
A. looghense		France; Kuznetsk Basin (Uppermost)		
Grypophyllum sp.		western Canada		
Temnophyllum(Truncicarinulum) altevogti		Spain		
Siphonophrentis gigantea		Britain; Guizhou; Yunnan; Laos; North America.		
S. cantabrica		Spain(Upper)		
Metriophyllum cf. carinatum		U. S. A.		
Altaiophyllum sagsayium	Altai			

mine the sequence of the coral horizons, the age of the coral fauna can be only discussed as a whole.

Some species of the coral fauna are known only from the Middle Devonian, while some others are restricted to the Upper Devonian (Table 2). The association of Upper Devonian forms with Middle Devonian elements in the Heyuanzhai Formation may suggest that the faunal horizon in not far from the boundary between the Middle and the Upper Devonian.

The traditional boundary between the Middle and Upper Devonian in China has been placed between the *Stringocephalus* and *Cyrtospirifer* zones. Both genera are absent in western Yunnan, and the index fossils of conodonts have not been discovered in the region. Because of the absence of more precise zone fossils, the rugose corals and brachiopods are necessary relied upon for determination of the age of the fauna.

Phillipsastrea is the only one massive genus described here. This genus is widely distributed all over the world in Middle and Late Devonian. Three species of the genus are known in western Yunnan, *Ph. hennahii*, *Ph. goldfussi* and *Ph. liujingensis*. *Phillipsastrea hennahii* is widespread throughout Europe and is usually considered as an excellent indicator of Frasnian age. In Belgium this species is limited to the F2i level of the Dinant Basin, near the top of Middle Frasnian (Sorauf, 1967; Coen-Aubert, 1974; Sorauf and Pedder, 1986), corresponding to the conodont *Polygnathus asymmetricu triangularis* zone, above the upper *Polygnathus asymmetricus* zone (Tsien, 1977). In Germany *Ph. hennahii* occurs in Frasnian (Frech, 1885), which is also present in the Frasnian of Devonshire, England (Pickett, 1967), and is also occasionally known in the uppermost Givetian (Middleton, 1959; Scrutton, 1968). In North America *Ph. hennahii* is restricted to the Upper Devonian of the Mackenzie River Region (Smith, 1945; Stumm, 1949). The forms assigned to *Phillipsastrea monticola* by Reed (1922, p. 17, pl. 3, fig. 8-10) from the Upper Devonian of Chitral, northwest India maybe conspecific with *Ph. hennahii*. *Phillipsastrea goldfussi* is widely distributed over the Upper Devonian of Europe. In Belgium this species ranges from F2i and F2j in the Dinant Basin and from F2II in the Namur Basin (Sorauf, 1967), corresponding to the conodont *Polygnathus asymmetricus triangularis* zone (Tsien, 1977). It occurs also in the Frasnian of Devonshire, England, and Poland (Rozkowska, 1953; Middleton, 1959; Scrutton, 1968). *Ph. liujingensis* occurs in the late Middle Devonian of Guangxi, China (Yü and Kuang, 1982b). *Ph. confluensis* of Sorauf (1988a) from the Frasnian of South-Central New Mexico may be conspecific with *Ph. liujingense*.

Macgeea is one of the most abundant corals with the highest diversity in western Yunnan, of which 13 species have been recognized. *M. solitaria*, the type species, was described under *Pachyphyllum* by Hall and Whitfield (1873) based on the material from the Upper Devonian of Rockford, Iowa. This species has been repeatedly described and illustrated from this horizon and locality (Lang and Smith, 1935; Smith, 1945; Stainbrook, 1946; Pickett, 1967). *Macgeea solitaria* occurs also in the Frasnian of Altai, Siberia (Spasskiy, 1977). Some forms refer-

red to as *M. multizonata* by Reed (1922) from the Upper Devonian of Chitral, northwest India should belong to *M. solitaria*. Tsien (1969) described *M. solitaria* from the Co2c horizon of Belgium. The characteristics shown in the three transverse sections by Tsien is very close to *M. solitaria*, but as there is no longitudinal section, the longitudinal features remain unknown. So it is not certain whether Tsien's specimen represents *M. solitaria* or not. *M. bathycalyx* with different characters has been reported from a few localities. The present author prefers to confine this species to those forms with well developed horseshoe dissepiments forming complete pipes and with short cardinal septum and long counter septum. This species is only known from the Middle Devonian Crinoidal shale, near Gerolstein, Eifel, Germany (Frech, 1886) and the upper part of the Heyuanzhai Formation in western Yunnan (Song, 1982). *M. berdensis* is limited to the Frasnian of the Urals and the Russian Platform (Soshkina, 1939, 1952, 1954; Ivanovskiy and Shurygina, 1980). It ranges from Frasnian to Famennian in the Holy Cross Mountains (Rozkowska, 1953; 1969). *M. dubia* was erected on the basis of material from "Middle Devonian, Eifel", but its exact age remains to be confirmed. In France this species was discovered in the Frasnian (Brice and Rohart, 1974). *M. multizonata* is restricted to Frasnian, with its holotype from Chitral, northwest India (Reed, 1922; Schouppe, 1965). This species occurs in the Kuznetsk Basin, the Urals and Taimyr in Siberia (Bulvanker, 1958; Besprozvannykh and others, 1975; Tsyganko, 1981), in conodont *Polygnathus asymmmetricus* zone and *Palmatolepis gigas* zone of Poland (Rozkowska, 1979), and is also present in the F2ab horizon of Belgium (Coen-Aubert, 1982). *M. gigantea* is also limited to Frasnian, its holotype occurring in Ferques, France (Brice and Rohart, 1974), from the bioherms of F2i and F2h in the Dinant Basin, Belgium (Coen-Aubert, 1982). *M. rozkowskae* is so far only known from the F2ab horizon in Belgium (Coen-Aubert, 1982). *M. caucasica* was discovered from the Frasnian of Armenia (Soshkina, 1952), and *M. recta* from the UpperDevonian of Europe (Walther, 1982; Schouppé, 1958; Birenheide, 1978).

Peneckiella is well-known in the Middle and Upper Devonian all over the world. This genus contains two species in western Yunnan. *P. fascicularis* is widespread in the Frasnian of the Russian Platform, the Urals and the Timan (Soshkina, 1939, 1951, 1952, 1954; Tsyganko, 1981), in the conodont *Polygnathus asymmetricus* zone in Poland (Rozkowska, 1972, 1979), and from the F2e and F2i horizons in Belgium (Tsien, 1970). The new species *P. yunnanensis* described here is very close to the forms described under *Disphyllum* (*Synaptophyllum*) *densum* Smith (1945) from the Upper Devonian of Mackenzie River region, Canada. The Upper Devonian forms of Chitral, northwest India, assigned to *Cyathophyllum* (*Thamnophyllum*?) sp. by Reed (1922, p. 14, pl. 2, fig. 12, pl. 3, fig. 1,2) seem to belong to the new species.

Neoacinophyllum is common in the Middle and Upper Devonian of eastern North America, and is very abundant in western Yunnan. Five species have been recognized. *N. crassiseptatum* is known from the Middle Devonian of Michigan (Ehlers and Stumm, 1949; Mclaren, 1959). *N. planotabulatum* appears to be close

to *Disphyllum* (*Synaptophyllum*) *camselli* Smith from the Upper Devonian of the Mackenzie River region, Canada.

Acinophyllum is limited to the Middle Devonian. *A. rectiseptatum* was described from the Middle Devonian of Michigan (McLaren, 1959; Oliver, 1976a).

Tabulophyllum is widely distributed all over the world in Middle and Upper Devonian. *T. gracile* is known from the Frasnian of western Germany (Walther, 1928; Birenheide, 1978, 1990). *T.* aff. *gracile* described here is very close to *T. gracile*, especially to the specimen from the Middle/Upper Devonian beds of the Rheinisches Schiefergebirge, Germany, recently illustrated by Birenheide (1990, pl. 4, fig. 10).

Two species of *Acanthophyllum* were discovered from western Yunnan. *A. concavum* is known in the Givetian in Germany (Walther, 1928; Birenheide, 1961, 1978; Webby, 1964) and Nepal (Flügel, 1966), and may occur in the Middle/Upper Devonian boundary beds (Birenheide, 1990), but does not occur in the Frasnian. *A. looghense* is common in the Givetian of Eifel (Wedekind, 1925; Birenheide, 1961, 1962), and occurs in the uppermost Givetian in the Kusnetsk Basin (Bulvanker, 1958).

Only one specimen of *Grypophyllum* has been found from western Yunnan, which is similar to *G. aquilonium* Pedder from the Givetian of western Canada (Pedder, 1973).

Temnophyllum (*Truncicarinulum*) is very common in the upper Middle and Upper Devonian all over the world. *T.* (*T.*) *altevogti* occurs in the Givetian of Spain (Oliver and Sorauf, 1987).

Solitary nondissepimented corals, especially *Siphonophrentis*, are very abundant in the fauna discussed here. So far *Siphonophrentis* is known only in the Lower and Middle Devonian. The type species, *S. gigantea*, is restricted to the Givetian of British (Champernowne, 1884; Smith and Thomas, 1963), is common in the Middle Devonian of North America (Lesueur, 1921; O'Connell, 1914; Stumm, 1949), and also is present in the Middle Devonian of Laos (Fontaine, 1961) and in Yunnan and Guizhou, China (Reed, 1927; Wang Z. P., 1983). Beside western Yunnan, *S. cantabrica* is also known from the upper Givetian of Spain.

Altaiophyllum sagsayicum is from the Eifelian of Altai (Spasskiy, 1960; 1977). Only one small nondissepimented solitary coral described here as *Metriophyllum* cf. *carinatum* is exactly alike to the forms from the Middle Devonian of U. S. A. in longitudinal section, although its characters in transverse section is not known well.

Among the coral species from the Heyuanzhai Formation, except those discovered only in western Yunnan, one species, *Altaiophyllum sagsayicum*, is known from the Eifelian of the Ulals, 10 species are restricted to Givetian, and 13 species to Frasnian or show some resemblance to Frasnian forms (Table 2).

The rocks yielding the rugose corals are of different kinds of clastic limestones, including more than one bed of conglomeratic limestone. The phaceloid and dendroid corals are usually preserved in fragments, and the outer wall and even parts of dissepimentarium were destroyed in most of the specimens. These features indi-

cate that the fauna lived in a high wave energy environment and had partly undergone transportation before they were buried. Some of the corals are probably redeposited fossils. Moreover, some typical Upper Devonian brachiopods, such as *Spinatrypa*, *Pugnoides* and *Devonoproductus*, were reported by Hou Hongfei and others (1988, p. 218) from the Heyuanzhai Formation. Therefore the upper part of Heyuanzhai Formation seems to be Early Frasnian in age.

Paleobiogeographical significance

Almost all geologists agree that the boundary between Gondwana and Eurasia continents cut through western Yunnan. However, the opinions widely vary with respect to the concrete position of the boundary. Nujiang, Lancangjiang, Jinshajiang and others have been regarded as being the boundary between Gondwana and Eurasia continents.

The Baoshan-Shidian region where the rugose corals under discussion were collected was probably situated near the boundary between the Gondwasa and Eurasian continents. Its tectonic and palaeogeographical position, the affinity of paleobiogeographical significance have received much attention. The idea that the Baoshan-Shidian region with abundant Paleozoic marine fossils represents a separate massif has been adopted by all geologists. But, for a long time no agreement has been achieved with regard to its tectonic position during the Late Paleozoic. Three different opinions are being held, (1) the Baoshan Massif was near the margin of Eurasia and therefore closely related to the Yangtze Platform (Wang Hongzhen, 1986; Cao Renguan, 1986); (2) it was near the margin of Gondwana land, and not closely related to the Yangtze Platform (Wang Kaiyuan, 1985; Chen Bingwei and others, 1991; Liu Benpei and others, 1991); and (3) it was separated from both Eurasia and Gondwana by open seas (Wang Xunlian, 1988; Zhu Hong and Wan Tianfeng, 1991). The analysis based on geographical distribution of the rugose corals from the Heyuanzhai Formation does not answer the above question directly, but can give some important clue to clear the question.

It is well known that three rugose coral biogeographical realms have been recognized by Hill (1957, 1981), Oliver (1976a, 1976b, 1977, 1980, 1987, 1990, 1992), Oliver and Pedder (1979a, 1979b, 1984, 1989). They are the Eastern Americas Realm, the Old World Realm and the Malvinokaffric Realm. The Eastern Americas Realm was relatively small, including eastern North America and northern South America (Venezuela, Colombia). The Old World Realm included western and Arctic North America, Eurasia, Northern Africa, and Australia. The Malvinokaffric Realm included central and southern South America, South Africa, and Antarctica. Wang Hongzhen and others (1985) and Wang Zhiping (1985) considered that in the Devonian there may be four biogeographic realms: the Boreal, the Tethyan, the Australo-Pacific and the Gondwana Realms. In 1989 Wang Hongzhen and others recognized four Devonian rugose coral biogeographic realms in the world: the Boreal, the West Tethyan, the East Tethyan and the Malvinokaffric

Realm. The Boreal Realm included Siberia and western North America, the West Tethyan corresponds to the Eastern Americas Realm of Oliver and Pedder, the East Tethyan Realm to the Old World Realm, the Malvinokaffric Realm is all the same. Although different opinions exist with respect to the division of Devonian rugose coral biogeographic provinces, all agree that the difference between the Devonian coral fauna in eastern North America and that in the other regions of the world is the most striking.

The Eastern North Americas Realm contained many endemic elements, such as *Heliophyllum*, *Siphonophrentis, Cylindrophyllum, Prismatophyllum* and so on, and was characterized mainly by two endemic families, Eridophyllidae and Zaphrentidae. The eridophyllids bear some resemblance to disphyllids, but differs from the latter in having strongly attenuate septa formed of fine monacanths with well developed zigzag carinae. In contrast the disphyllids have thicker septa formed of coarse monacanths and generally lack remarkable carinae. These characters are variable within genera and species, but it seems very significant that the eridophyllid structure overwhelmingly predominated in eastern North American species and genera, whereas the disphyllid structure predominated in other parts of the world.

As discussed above the coral fauna from the Heyuanzhai Formation includes Givetian and Frasnian elements probably due to redeposition. Now it is not easy to distinguish the Givetian forms from Frasnian ones. Moreover, by Late Devonian the coral faunas were cosmopolitan and biogeographic provincialism was not distinct. Therefore the present author will attempt to study the world distribution of rugose coral genera known to occur in the Heyuanzhai Formation, with the purpose to determine the biogeographical affinity of the coral fauna.

Siphonophrentis is regarded as one of the most typical genus of the Eastern Americas Realm, although it was also found in China, and in Europe occasionally. Oliver (1992, p. B2) believed that the Family Siphonophrentidae Merriam (1974, p. 41) including *Siphonophrentis* and *Breviphrentis* seems to be endemic to the Eastern Arericas Realm. Some important genera in the Eastern Americas Realm, *Amplexiphyllum*, *Breviphrentis* and *Breviphyllum*, are considered as the synonym of *Siphonophrentis* in the present paper. The individuals of the genus is the most abundant, amounting to more than 40 percent of the total number of the specimens identified. Of the three species of *Siphonophrentis* known from the western Yunnan, *S. minor* is an endemic species, *S. cantabrica* was described from Spain where another typical Eastern Americas Realm genus *Heliophyllum* was also reported. *S. gigantea* is distributed over a wider area, including North America, Great Britain, Laos of Indochina and South China.

Altaiophllum was known from the Middle and Upper Devonian of Altai, China and Spain. This genus is very close to *Siphonophrentis* in morphological characters and septal microstructures. Although *Altaiophyllum* has not been recorded from North America, it certainly occurs there. The forms from the Middle Devonian of Ohio described as *Siphonophrentis gigantea* (Lesueur) by Wang Hongzhen and Chen

Jiangqiang (1989, p. 23, pl. 2, fig. 8, pl. 20, fig. 7-12) and as *Siphonophrentis elongata* (Rafinesque and Clifford) by Oliver (1992, p. B20, pl. 20, fig. 1-4; pl. 21, fig. 1-4; pl. 22, fig. 1-7) show typical septal characters of *Altaiophyllum*.

Both *Acinophyllum* and *Cylindrophyllum* are important representatives of the endemic family Eridophyllidae of the Eastern Americas Realm. Although only one questionable species of *Acinophyllum, A. rectiseptatum*, represented by 7 corallites in western Yunnan, has been recognized, the new genus *Neoacinophyllum* is very close to both *Acinophyllum* and *Cylindrophyllum*, and belong, beyond doubt, to the Family Eridophyllidae. Some species of the new genus occur in the Middle Devonian of the Eastern Northern American. *Neoacinophyllum* is one of the most abundant coral genera in western Yunnan, 46 individuals having been sectioned. The total number of individuals of *Neoacinophyllum* and *Acinophyllum* amounts to about 17 percent of the coral fauna under discussion.

Heliophyllum has been considered as the typical genus of the Eastern Americas Realm. Hill (1957) called the Emsian to Givetian coral fauna of the eastern North American the *Heliophyllum* fauna. So far no *Heliophyllum* has been found in western Yunnan, however, the form described as *Temnophyllum* (*Truncicarinulum*) *altevogti* (Oliver et Sorauf) in the present paper is very similar to *Heliophyllum* in the yardarm carinae, which is the most important character of *Heliophyllum*. The holotype of *Temnophyllum* (*Truncicarinulum*) *altevogti* was collected from the Givetian of the Cantabrica Mountains, NW Spain, where the Devonian coral fauna including *Heliophyllum* and *Siphonophrentis* is very similar to the Devonian rugose corals of the Appalachian region of North America (Altevogt, 1967).

The analogous genus *Hexagonaria* of the Old World Realm is identical to *Prismatophyllum* (Oliver, 1976a, p. 82) in the Eastern Northern America. Wang Zengji (1986, p. 599, pl. 2, fig. 1-2) described a subspecies *Peripaedium planum planum* Birenheide from the Middle Devonian of the Malutang. The form bears well developed long uniformly attenuate septa with thin zigzag to subyardarm, closely spaced carinae within dissepimentarium. These characters agree well with *Prismatophyllum*. The present author prefers to put the form illustrated as figure 1-2, Plate 2 by Wang Zengji (1986) under *Prismatophyllum* rather than *Peripaedium*.

Of the coral fauna studied *Macgeea* is second in number of individuals, 101 individuals having been sectioned, about 32 percent of the whole fauna. The genus has the highest diversity in western Yunnan, 13 species being recognized. *Macgeea* is dintributed almost all over the world except Australia. Oliver and Sorauf (1981) established the *Pachyllum-Macgeea* Assemblage zone in the Frasnian of New York and the adjacent areas. In the present paper *Pachyphyllum* is regarded as a synonym of *Phillipsastrea*, three species of the latter having been discovered from the Heyuanzhai Formation of western Yunnan.

Tabulophyllum, *Grypophyllum* and *Metriophyllum* are widespread in the world, including eastern North America (Oliver and Pedder, 1979b, p. 240) in Middle and Late Devonian, and have little biogeographic value.

Acanthophyllum and *Peneckiella* have not been reported from the Eastern Amer-

Table 3 The components of the genera in the rugose coral fauna of the Heyuanzhai Formation

Genera	Number
Siphonophrentis	126
Altaiophyllum	4
Acinophyllum	7
Neoacinophyllum	46
Temnophyllum (*Truncicarinulum*) *altevogti*	1
Prismatophyllum	1
Macgeea	101
Phillipsastrea	4
Tabulophyllum, Grypophyllum, Metriophyllum	4
Acanthophyllum, Peneckiella	17
Parapeneckiella	1

icas Realm, but were common in the other regions of the world in the Devonian. The both genera are rare in individuals in the fauna studied, totally numbering only 17, less than 5 percent of the fauna in number of individuals.

In summary, at generic level the coral fauna from the Heyuanzhai Formation of western Yunnan is very close to eastern North America. More than 90 percent of the individuals are same as or similar to those of the eastern North America, and only a few of them are known in other regions (Table 3). The very common Devonian forms like *Disphyllum*, *Cyathophyllum*, *Temnophyllum* and *Endophyllum*, in the so-called Old World Realm have not been discovered in western Yunnan so far.

Brachiopods are also very abundant in the Heyuanzhai Formation. Hou Hongfei and others (1988) studied the brachiopods, but did not find *Stringocephalus* which is a Givetian index fossil in the Old World Realm. This may also indicate that the Heyuanzhai fauna of western Yunnan was more closely related to Eastern Americas Realm than to the Old World Realm.

It may be pointed out that in the Givetian the endemism of Eastern Americas Realm strikingly decreased, and some typical genera of the Eastern Americans Realm, including *Heliophyllum* and *Siphonophrentis*, were also discovered in some areas of the Old World Realm. In the Frasnian the endemism tended to disappear, and cosmopolitan genera, such as *Macgeea, Phillipsastrea, Tabulophyllum*, were widely distributed over all world, and no distinct provincialism was recognized. Although rugose coral provincialism in Givetian and Frasnian become less distinct than in Early Devonian and Eifelian, the Heyuanzhai coral fauna still shows closer relation to the eastern Northern America.

Table 4 Comparison of the Givetian-Frasnian rugose coral faunas in Yangtze Region and western Yunnan

	Yangtze Region		western Yunnan
	Givetian	Frasnian	Givetian-Frasnian
Diversity	52	20	14
Prosperous families	Disphyllidae Phacellophyllidae Endophyllidae	Disphyllidae Phacellophyllidae Cyathophyllidae	Eridophyllidae Phacellophyllidae Amplexoidae
Assemblages	*Dendrostella trigemme* *Endophyllum yunnanense-Temnophyllum waltheri*	*Pseudozaphrentis*	
Prosperous genera	*Disphyllum* *Dendrostella* *Temnophyllum* *Endophyllum* *Hexagonaria*	*Pseudozaphrentis* *Sinodisphyllum* *Disphyllum*	*Siphonophrentis* *Neoaciophyllum* *Macgeea*
Brachiopods	*Stringocephalus*		

Now I will discuss the faunal differences between western Yunnan and the Yangtze region during Givetian and Frasnian time (Table 4). Many authors (Yü Changmin and others 1979; Wang Hongzhen and others, 1985; Wang Zhiping, 1985; Wang Xunlian and Wang Hongzhen, 1987) considered that the coral fauna under discussion is distinctly different from that of the Yangtze region. Song (1982) thought that the Devonian coral fauna in Baoshan-Shidian region in related to North America and Europe, and also close to eastern Yunnan and South China because of the commen occurence of *Temnophyllum* in these regions.

Unitil now the known material of the Devonian rugose corals of western Yunnan was not enough to clear the relationship between the fauna in Baoshan and Yangtze regions. The abundant rugose corals described here probably can answer this question.

In the Givetian, the Yangtze region was very rich in rugose corals. The coral fauna has a rather high diversity, containing up to 52 genera. Among them Disphyllidae, Phacellophyllidae, Endophyllidae, Stringophyllidae and Grypophyllidae are the most prosperous. Endemism was strong, and endemic genera such as *Jipaolasma*, *Jiangzhaiphyllum*, *Hunanophrentis* and *Neogrypophyllum*, amount to about 20 percent of the total number of genera. Two rugose coral assemblages, the *Dendrostella trigemme* Assemblage and the *Endophyllum yunnanense-Temnophyllum waltheri* Assemblage, have been established. The Frasnian rugose corals are also abundant in the Yangtze region, and Disphyllidae is the most prosperous family, which amount to 55 percent of the fauna, Cyathophyllidae and Phacellophyllidae are common. *Pseudozaphrentis* Assemblage zone was widespread.

The coral fauna of the Heyuanzhai Formation containing both Givetian and Frasnian forms, in very abundant in individuals, but is low in diversity. Only 14

genera are known. Eridophyllidae, which is a endemic family in the Eastern Americas Realm and unknown in the Yangtze region, Phacellophyllidae and Amplexidae are the most prosperous families, while Disphyllidae, the most prosperous family in Yangtze region, is not represented. There are only two endemic genera, *Parapeneckiella* and *Neoacinophyllum*. The latter is very close to *Acinophyllum* and *Cylindrophyllum*. *Dendrostella*, *Temnophllum*, *Endophyllum*, *Pseudozaphrentis* and *Sinodisphyllum*, which are widespread in the Yangtze region, are absent in the Baoshan-Shidian region. Three rugose coral genera, *Siphonophrentis*, *Macgeea* and *Neoacinophyllum* are the most abundant in individuals in the Heyuanzhai Formation, amounting to 88 percent of the whole fauna. *Neoacinophyllum* and its related genera *Acinophyllum* and *Cylindrophyllum* have not been reported from the Yangtze region. Some species of *Macgeea* and *Siphonophrentis* have been described from the Yangtze region, but their abundance and diversity are much lower than in the Baoshan-Shidian region.

At the species level, out of the more than 40 species of rugose corals known from the Baoshan-Shidian region, there are only two species, *Phillipsastrea liujingense* and *Siphonophrentis gigantea* are common to the Yangtze region and the Baoshan-Shidian region. Some authors would like to compare the Devonian coral fauna with Australia, but actually no Australian species are known in the Heyuanzhai Formation.

Song Xueliang (1982) illustrated two species of *Temnophyllum* from the Heyuanzhai Formation, *T. poshiense* Wang and *T. waltheri* Yoh, both common in the Givetian of the Yangtze region. From the investigation of my material collected from the Heyuanzhai Formation and of the figures of Song (pl. 2, fig. 5, 6), I have come to the opinion that the forms put under *Temnophyllum* by Song should belong to *Pexiphyllum*. *Pexiphyllum* shows some resemblance with *Temnophyllum*. Stumm (1949, p. 36) has regarded *Pexiphyllum* as a synonym of *Temnophyllum*. However, the dissepiments of *Pexiphyllum* are arranged in fans, and in the median part of the dissepimentarium, a complete or incomplete row of horseshoe dissepiments surrounded by globose dissepiments is present. *Temnophyllum* has no horseshoe dissepiments, and the dissepiments are arranged in halffans. The difference of the dissepimentarium in the two genera has lead me to put them under different families. In the present work *Pexiphyllum* is considered to be congeneric with *Macgeea*. Therefore it seems that no true *Temnophyllum* has been found in western Yunnan, and the Middle and Upper Devonian coral faunas in western Yunnan is quite different from those in the Yangtze region.

The Upper Devonian rugose corals of the Chitral, northwestern India described by Reed (1922) and Schouppé (1965) are not abundant in genera and species. Most of them are widespread forms, such as *Macgeea* and *Phillipsastrea*. No typical elements of the Eastern Americas Realm has been found in the Devonian of the Chitral. So it is difficult to judge whether the Heyuanzhai fauna is closely related to that in the Chitral or not. However most of forms being present in the Chitral show some resemblance to those found in the Heyuanzhai Formation. Maybe this

indicates that the Devonian coral fauna in western Yunnan has a closer affinity with Chitral than with the Yangtze region. The Middle and Late Devonian corals of Baoshan-Shidian and Chitral belonged probably to one continental platform, which was separated from the Yangtze Platform by wide seas.

Systematic description

The classification adapted here is that proposed by Hill (1981). All specimens described here were collected from the upper part of the Heyuanzhai Formation of Malutang and Heyuanzhai, Shidian County, Yunnan Province, China.

The definition of some symbols used in the present paper for the measurements of features of rugose corals:

No : number of specimen.
D : shortest diameter of corallite in solitary and fasciculate corals or dintance between two adjacent corallites in massive corals (mm).
Dc : distance between two adjacent corallites in fasciculate corals (mm).
N : number of septa.
Dt : diameter of tabularium (mm).
Ds : diameter of axial space (mm).
Lf : length of major septa (mm).
Ls : length of minor septa (mm).
Nt : number of axial tabulae within the vertical distance of 5 mm.
Nd : number of normal dissepiments within the vertical distance of 2 mm.
Nh : number of horseshoe dissepiments within the vertical distance of 2 mm.
Nf : number of flanges within the vertical distance 5 mm.
Tw: thickness of exterior wall (mm).

Class Anthozoa Ehrenberg, 1834
Subclass Rugosa Milne-Edwards et Haime, 1850
Suborder Stauriina, Verrill, 1865
Order Stauriida Verrill, 1865
Family Amplexidae Chapman, 1893

Genus *Siphonophrentis* O'Connell, 1914

1914 *Siphonophrentis* O'Connell, p. 187.
1949 *Breviphrentis* Stumm, p. 13.
1949 *Breviphyllum* Stumm, p. 25.
1949 *Amplexiphyllum* Stumm, p. 9.
1982 *Baoshanophyllum* Sung, p. 21.
1983 *Puanophyllum* Wang, Z. P., p. 66.

Type species: *Caryophyllia gigantea* Lesueur, 1821, p. 296.
Diagnosis: Solitary, cylindrical to ceratoid coral. Septa amplexoid. Major

septa unequal in length, minor septa well or poorly developed, with peripheral ends thickened and contiguous with the major septa to form stereozone. Fossulae distinct or poorly developed. Tabulae commonly complete, slightly convex, flat or depressed axially, with downward turn in the periphery. Dissepiments absent.

Discussion: This kind of corals with amplexoid septa, a stereozone and complete tabulae are common in Devonian. Different generic names, *Siphonophrentis* O'Connell, *Heterophrentis* Billings, *Breviphrentis* Stumm, *Amplexiphyllum* Stumm, *Puanophyllum* Wang, Z. P., *Baoshanophyllum* Sung, *Altaiophyllum* Ivaniya, *Zmeinogorskia* Spasskiy, and *Zelophyllia* Soshkina, especially the first two generic names, have been usually used for them. There is no agreement on the subdivision of this kind of corals among coral palaeontologists.

1. *Siphonophrentis* and *Heterophrentis*

(1) The divergence on the difference between *Siphonophrentis* and *Heterophrentis*

The opinions as to the difference between *Siphonophrentis* and *Heterophrentis* are varying widely. Most authors have used the genus *Siphonophrentis* for those rugose corals with typical amplexoid septa. Up to now, almost all species described under *Siphonophrentis* have typical amplexoid septa. In *Heterophrentis*, most species bear continuous septa. A few species with amplexoid septa have also been referred to *Heterophrentis*.

Different opinion exists with respect to the septal character of *Heterophrentis*. In describing *Siphonophrentis* sp. aff. *S. halli* (Edwards et Haime), Oliver (1987, p. D3) stated that "The Coles County specimen has relatively short, amplexoid septa that suggest *Siphonophrentis* (or *Breviphrentis*) rather than the closely related *Heterophrentis*." Although Oliver did not discuss the difference between the both genera, he evidently believed that the presence or absence of amplexoid septa is the key used to distinguish *Heterophrentis* from *Siphonophrentis*. Recently, Oliver (1992) used *Siphonophrentis* for the nondissepimented solitary corals with amplexoid major septa and restricted *Heterophrentis* to the forms with continuous major septa reaching the axis to form a boss. Cao and others (1983, p. 61, 62) also considered that *Heterophrentis* has long major septa extending to the axis, and *Siphonophrentis* has amplexoid septa.

Stumm (1949, p. 12) pointed out that *Siphonophrentis* bears amplexoid septa. In a series of important papers dealing with the Devonian rugose coral fauna of Michigan and Ohio by Stumm (1937-1968), all species included in *Siphonophrentis* have amplexoid septa. Moreover, in a lot of species referred to *Heterophrentis* by Stumm septa continuous and major septa long and almost extend to the axis. However, some forms with amplexoid septa, for example, *Heterophrentis nevadense* Stumm (1937, p. 426, pl. 54, fig. 1) and *Heterophrentis simplex* (Hall) (Stumm, 1968a, p. 38, pl. 1, fig. 6, 7; 1968b, p. 62, pl. 4, fig. 1-4), were also put under *Heterophrentis*. Even some forms of *H. prolifica* (Billings), the type species of *Heterophrentis*, described by Stumm (1949, p. 11, pl. 5, fig. 9. 10) possesses amplexoid septa.

Hill (1956, p. 270) considered that the septa with sparse axial lobes occur in both *Heterophrentis* and *Siphonophrentis*. In 1981 Hill (p. 147) believed that the septa of the two genera are amplexoid, although she doubted the validity of both *Heterophrentis* and *Siphonophrentis*.

Merriam (1973, p. 41) included *Siphonophrentis* and *Hererophrentis* in Subfamily Siphonophrentinae with amplexoid septa, and suggested to distinguish the both genera from each other by the following: (1) *Heterophrentis* has a curved ceratoid to trochoid or almost turbinate mature corallum with larger and better defined fossula on the convex side and a narrow septal stereozone; a very elongated cylindrical growth habit of *Siphonophrentis* is lacking. (2) *Heterophrentis*, unlike *Siphonophrentis*, has major septa extending to the axis, in which they may be loosely twisted and pervaded by stereome, but not to the extent of forming a discrete axial structure. (3) Tabulae of *Heterophrentis* are commonly more irregularly arched, less uniform, and more widely placed than are those of *Siphonophrentis*.

Kong and Huang (1978, p. 48) suggested to use the shape of the tabulae to divide *Heterophrentis* and *Siphonophrentis*. They believed that *Heterophrentis* has mesa-shaped tabulae, with horizontal axial area and downward turning peripheral area, and placed *Siphonophrentis* as the synonym of *Zelophyllia* Soshkina, 1952, and thought that the latter has nearly horizontal tabulae.

(2) A brief review of the original definition of *Siphonophrentis* and *Heterophrentis*

In order to make clear about the difference and relation between *Siphonophrentis* and *Heterophrentis*, it is necessary to look over the original definition of the both genera, especially the original definition of their type species.

Heterophrentis was proposed by Billings (1872, p. 235) for some species, including *H. spatiosa*, *H. excellens* and *H. prolifica* and others, previously placed under the genus *Zaphrentis*. At first, Billings regarded *Zaphrentis spatiosa* Billings, 1858 as the type species, and noted that "Septa below the calice sharp-edged, often with their inner edges twisted together; above the floor of the calice they are usually rounded especially on approaching the margin." Although Billings considered *Z. spatiosa* as the type species, he was not certain of the specific distinction of the species and the other species referred to this genus, and considered it as a probable form of *H. prolifica*. So the latter has been synonymized with *Zaphrentis spatiosa*.

In 1874 Billings emended the description and stated that "Septa from about 100 to 120 at the margin (Where they are all rounded), must common number from 100 to 120. In general they alternate in size at the margin; the small ones becoming obsolete on approaching the bottom of the calice; the large ones more elevated and sharp-edged. The septal fossette in large and deep, of a pyriform shape, gradually enlarging from the outer wall inwards for one third, or a little more of diameter of the coral, at the bottom of the calice. Its inner extremity is usually broadly rounded or, sometimes, straitish, in the middle."

O'Connell (1914, p. 189) stated that *Heterophrentis* "having at most a single tabulae at the base of the calyx, a marked fossula, fraquently a columella or a low

rounded elevation,".

The above descriptions clearly show that *Heterophrentis* has a marked fossulae and well developed major septum which usually twisted together in their inner edges to form a columella. Those characters well developed in a lot of species of Heterophrentis of Michigan and Ohio, illustrated by Stumm from 1937 to 1968, also present in the someforms assigned to *Heterophrentis* from China, for example, *Heterophrentis zhongguoensis* Jia (1977, p. 135), and H. *undulata* Yü in Jia et al. (1977, p. 135). Oliver (1992) reviewed the Family Siphonophrentidae of Eastern North America. He considered that the *Zaphrentis prolifica* is not congeneric with *Zaphrentis spatiosa*, and restricted *Heterophrentis* to two syntype specimens of its original type species *Zaphrentis spatiosa* Billing, 1858, and erected a genus *Metaxyphrentis* on the basis of *Zaphrentis prolifica* Billings, 1858. Oliver's Illustrations and description clearly show that the major septa in both *Zaphrentis saptiosa* and *Z. prolifica* are continuous. It seems to be evident that the septa in *Heterophrentis* is continuous rather than amplexoid as in *Siphonophrentis*.

O'Connell (1914) found *Siphonophrentis* with *Caryophyllia gigantea* Lesueur, 1820 as the type species after reviewing the genus *Zaphrentis* in detail. According to O'Connell's statement, *Caryophyllia gigantea* " have numerous, well-developed tabulae extending entirely across the visceral chamber and bending down marginally, and, on either side of the cardinal septum, forming a series of invaginated funnels giving a siphonofossula.

There is no external vesicular zone. In page 187 O'Connell explained the meaning of " siphonofossula " : this kind of fossula " is formed not by the meeting of the septa and the abortion of the cardinal septum, but rather by the down-bending of the successive tabulae to form a series of invaginated funnels," ; " this down-bending of the tabulae forms not a true fossula, which is due to the abortion of the cardinal septum, but a peculiar type which may be designated a ' Siphonofossula ', and which may or may not be accompanied by an abortion of the cardinal septum,". O'Connel did not mentioned the septal nature of *Siphonophrentis*, only emphasized the presence of siphonofossula in the genus.

O'Connell did not show any picture or drawhng as to this genus in 1914, so no one exactly knew the characters of the holotype of the type species. Stumm is probably the first to show the picture of *Siphonophrentis gigantea*, in which amplexoid septa can be seen, and to suggest that *Siphonophrentis* bears amplexoid septa in 1949 (p. 12). Stumm's picture was used in " Treatise on Invertebrate Palaeontology " by Hill (1956, p. 270, fig. 183, 7). Stumm (1964, p. 23) placed *Caryophyllia gigantea*, the type species of the genus, as the synonym of *Siphonophrentis elongata* (Rafinesque et Clifford), and pointed out that its major septa are amplexoid. The illustration by Stumm clearly shows the amplexoid septa in the genus again, and was cited by Hill (1981, p. 147, fig. 79, 4) in " Treatise on Invertebrate Palaeontology ". Now most authors have accepted that *Siphonophrentis* has amplexoid septa. And most species assigned to *Siphonophrentis* are found on the basis of comparison with the specimens illustrated by Stumm (1949, 1964).

(3) Conclusion

The discussion above and abundant material from western Yunnan available to me lead me to agree with Cao and others (1983, p. 61, 62) and Oliver (1987, p. D3; 1992, p. B6, B26) and confine *Heterophrentis* to those solitary corals with continuous septa and complete or nearly complete mesa-shaped tabulae without dissepiments, and use *Siphonophrentis* for only those solitary corals with amplexoid septa, complete and nearly complete mesa-shaped tabulae, and without dissepiments.

2. The morphological range of *Siphonophrentis*

Stumm (1949, p. 13) erected the genus *Breviphrentis* for Devonian corals with fossula and amplexoid septa and believed it differs from *Heterophrentis* mainly in the very short septa. Merriam (1973, p. 42; 1974, p. 21) regarded *Breviphrentis* as a subgenus of *Siphonophrentis*, and believed that *Siphonophrentis* (*Breviphrentis*) differs from *S.* (*Siphonophrentis*) in its more slender and markedly segmented growth habit with evident rejuvenescence flanges, while typical *Siphonophrentis* is a larger coral lacking pronounced rejuvenescence flanges. Oliver (1960b, p. 87; 1987, p. D3) regarded *Breviphrentis* as a synonym of *Siphonophrentis* because of the presence of relatively short, amplexoid septa in both genera, and separated *Breviphrentis* from *Siphonophrentis* in 1992 (p. B18). Hill (1956, p. 270, 271; 1981, p. 147, 166) considered *Siphonophrentis* and *Breviphrentis* different enough to recognize as two genera. Birenheide (1978, p. 69) noted the question on the similarity of *Siphonophrentis* and *Breviphrentis*, but used both names. According to Stumm's original description, *Breviphrentis* has amplexoid septa as in *Siphonophrentis*, so the only difference between the two in the presence or absence of a fossula. A distinct fossula may also be present in some species of *Siphonophrentis*, for example, *S. elongata* (Rafinesque et Clifford), usually considered as a typical species of that genus, has a clear cardinal fossula distinguished by short cardinal septa. Therefore the fossula does not appear to have generic siginificance in this group of corals. Moreover, the size of this kind of corals varies widely, usually a continuous change in length and diameter occurs even within a species. The material from western Yunnan indicates that *Siphonophrentis gigantea*, the type species, is extremely variable in size, with diameter ranging from 12.0 to 21.4 mm. In addition, the weakly developed rejuvenescence flanges as an external feature probably vary with the environments, and have only a value in distinguishing different species. It may be better to regard *Breviphrentis* as congeneric with *Siphonophrentis*.

Breviphyllum was founded by Stumm (1949, p. 25) to include Devonian corals that had been placed previously in *Campophyllum*. In the original definition, Stumm believed that *Breviphyllum* has pronounced amplexoid septa and narrow dissepimentarium composed of a few rows of inclined dissepiments. Stumm (1937, p. 428, pl. 53, fig. 4; pl. 5, fig. 4; 1949, p. 25, pl. 12, fig. 5) did not illustrate the longitudinal section of the holotype of the type species *Amplexus lonensis*, so the longitudinal skeletal feature had been relatively unknown. Merriam (1974, p. 41, pl. 17, fig. 12, 13) showed both transverse and longitudinal sections of the holotype of *Amplexus lonensis*, the type species of *Breviphyllum* Stumm, and pointed out that

the holotype of the type species lacks in fact dissepiment and synonymized *Breviphyllum* with *Siphonophrentis* (*Breviphrentis*). *Amplexiphyllum* Stumm (1949, p. 9) bears amplexoid septa and complete tabulae in late stages, and its major septa are fused at axial ends to form a stereocolumella in early stages. Up to now the septal characters of *Siphonophrentis* in early stages is not well known, but in a few ceratoid *Siphonophrentis cantabrica* Birenheide (Plate 10, fig. 3), the major septa may reach the axis and join to each other as in *Amplexiphyllum*. At least the characters of *Amplexiphyllum* in late stages are very close to *Siphonophrentis*. Wang, Z. P. (1983, p. 66) erected *Puanophyllum*, type species *P. gigantum*, and believed that it differs from *Heterophrentis* in having amplexoid septa, and the main difference between *Siphonophrentis* and *Puanophyllum* is the nearly horizontal and rather widely spaced tabulae in the former. In fact, in most species described under *Siphonophrentis* the tabulae are almost complate, horizontal in the wide axial part and turned downward in the periphery. Only a few species have nearly horizontal tabulae. The abundant material in western Yunnan shows that the number of tabulae within a limited distance is variable within a species, even within different parts of one specimen. Song (1982, p. 21) erected a genus *Baoshanophyllum* with amplexoid septa. The type species *B. cylindricum* Sung (1982, p. 21, pl. 1, fig. 4) is very close to *Amplexiphyllum minor* Sung (1982, p. 22, p. 1, fig. 5). and they may belong to the same species.

In summary, *Breviphrentis*, *Breviphyllum*, *Amplexiphyllum*, *Puanophyllum*, and *Baoshanophyllum* are regarded as the synonym of *Siphonophrentis* in the present paper.

3. *Siphonophrentis* and its related genera

Siphonophrentis is similar to *Altaiophyllum* (including *Zmeinogorskia*) in having amplexoid septa and complete tabulae, but differs in that *Altaiophyllum* has dilated septa in cardinal quadrant. *Siphonophrentis* resembles *Zelophyllia* Soshkina (1952, p. 74, text fig. 103) in having well developed stereozone and complete tabulae as well as shorter septa, but can be easily distinguished from the latter by having amplexoid septa and mesashaped complete tabulae rather than continuous septa and concave tabulae as in *Zelophyllia*. In *Metaxyphrentis* Oliver (1992, p. B9) and *Enallophrentis* Oliver (1992, p. 12), the septa are continuous, which can serve to differentiate the both genera from *Siphonophrentis*.

Assigned forms:

Siphonophrentis acanthosepta (Sung) (=*Amplexiphyllum acanthoseptum*), 1982, p. 22.
Siphonophrentis alenpchuensis Yü et Liao, 1978b, p. 250.
Siphonophrentis angusta (Yü) (=*Heterophrentis angusta*), 1974, p. 29.
Siphonophrentis asgeretus Yü et Kuang, 1982a, p. 55.
Siphonophrentis bifurcata (Ivaniya) (=*Heterophrentis bifurcata*), 1965, p. 14.
Siphonophrentis cantabrica Birenheide, 1978, p. 69.
Siphonophrentis cista (Oliver) (=*Breviphrentis cista*), 1992, p. B21.
Siphonophrentis cylindrica (Sung) (=*Baoshanophyllum cylindricum*), 1982, p. 21.
Siphonophrentis dongujumqinensis Guo, 1976, p. 78.
Siphonophrentis elongata (Rafinesque et Clifford) (=*Turbinolia buceros* var. *elongata*), 1820, p. 233.

see Stumm, 1964, p. 23.
Siphonophrentis giganta (Wang, Z. P.) (=*Puanophyllum gigantum*), 1983, p. 67.
Siphonophrentis gigantea (Lesueur) (=*Caryophyllia gigantea*), 1821, p. 296.
Siphonophrentis guizhouensis (Kong) (=*Heterophrentis guizhouensis*), 1978, p. 48.
Siphonophrentis halli (Edwards et Haime) (=*Zaphrentis halli*), 1851, p. 341. see Stumm, 1964, p. 24.
Siphonophrentis hamiltonae (Hall) (=*Amplexus hamiltonae*), p. 19. see Busch, 1941, p. 397; Stumm, 1949, p. 9.
Siphonophrentis interrupta (Ivaniya) (=*Heterophrentis interruptum*), 1965, p. 15.
Siphonophrentis invaginata (Stumm) (=*Amplexus invaginantus*), 1937, p. 427. see Spasskiy, 1977, p. 78; Merriam, 1974, p. 42.
Siphonophrentis involuta (Kong) (=*Heterophrentis involuta*), 1978, p. 49.
Siphonophrentis (*Breviphrentis*) *kobehensis* Merriam, 1974, p. 43.
Siphonophrentis kullmanni (Birenheide) (=*Breviphrentis kullmanni*), 1978, p. 69.
Siphonophrentis lijiawanensis (Wang, Z. P.) (=*Puanophyllum lijiawanense*), p. 1983, p. 67.
Siphonophrentis lonensis (Stumm) (=*Amplexus lonensis*), 1937, p. 428.
Siphonophrentis minor (Sung) (=*Amplexiphyllum minor*), 1982, p. 22.
Siphonophrentis minor (Wang, Z. P.) (=*Puanophyllum minor*), 1983, p. 68.
Siphonophrentis mirabilis (Billings) (=*Breviphrentis mirabilis*=*Amplexus mirabilis*), 1874, p. 232. see Stumm, 1949, p. 14.
Siphonophrentis multitabulata Guo, 1976, p. 78.
Siphonophrentis nandanensis (Jia in Jia et al.) (=*Breviphrentis nadanense*), 1977, p. 135.
Siphonophrentis nevadensis (Stumm) (=*Heterophrentis nevadensis*), 1937, p. 426.
Siphonophrentis percevali (Webby) (=*Heterophrentis percevali*), 1964, p. 7, text-fig. 2a-f.
Siphonophrentis planima (Hall) (=*Zaphrentis planima*), 1882. p. 29. see Stumm, 1964, p. 24.
Siphonophrentis pumilla (Oliver) (=Breviphrentis pumilla), 1992, p. B24.
Siphonophrentis regularis (Jia in Jia et al.) (=*Breviphrentis regularis*), 1977, p. 135.
Siphonophrentis salairica Ivaniya, 1957, p. 56. see Ivaniya, 1965, p. 37.
Siphonophrentis simplex (Hall) (=*Strombodes simplex*), 1843, p. 209. see Stumm, 1968a, p. 38; 1968b, p. 62.
Siphonophrentis variabilis Oliver, 1960b, p. 87.
Siphonophrentis subgigantea (Champernowne) (=*Zaphrentis subgigantea*), 1884, p. 501.
Siphonophrentis sublatitabulata (Jia in Jia et al.) (=*Breviphrentis sublatitabulata*), 1977, p. 136.
Siphonophrentis yandelli (Edwards et Haime) (=*Amplexus yardelli*), 1851, p. 344. See Stumm, 1964, p. 24; Guo, 1976, p.77.
Siphonophrentis yunnanensis (Reed) (=*Campophyllum yunnanense*), 1920, p. 10. see Fontaine, 1961, p. 91.
Siphonophrentis yunnanensis (Sung) (=*Amplexiphyllum yunnanense*), 1982, p. 22.

Rejected forms:

Breviphyllum concavum Altevogt, 1963, p. 28.
Amplexiphyllum cruciforme (Hall) (=*Zaphrentis cruciformis*), 1883, p. 315. see Stumm, 1964, p. 13.
Breviphyllum dilatatum Tsien, 1948, p. 50.
Breviphyllum flexuosum (Edwards et Haime) (=*Campophyllum flexuosum*), 1851, p. 395.
Breviphyllum lindstroemi (Frech) (=*Cyathophyllum lindstroemi*), 1886, p. 697.
Breviphyllum longiseptatum Tsien, 1969, p. 49.
Siphonophrentis longiseptata (Yu et Liao in Wang et al.) (=*Zelophyllia longiseptata*), 1974, p. 34. see Yu and Kuang, 1982a, p. 54.
Amplexiphyllum nanum Oliver, 1960a, p. 5.
Breviphyllum occidentale Altevogt, 1963, p. 26.
Breviphyllum planitabulatum Tsien, 1969, p. 49.
Siphonophrentis ponderosa (Hall) (=*Zaphrentis ponderosa*), 1884, p. 431. see Stewart, 1938, p. 26.
Breviphyllum richardsoni (Meek) (=*Aulophyllum richardsoni*), 1867, p. 81.
Amplexiphyllum simplex (Hall) (=*Streptelasma simplex*), 1882, p.18. see Stumm, 1949, p. 14.
Amplexiphyllum tabulatum (Busch) (=*Caninia tabulata*), 1941, p. 401. see Stumm, 1949, p. 9.

Amplexiphyllum tenue (Hall) (=*Streptelasma tenue*), 1882, p. 17. see Stumm, 1964, p. 14.
Breviphyllum tenuistriatum (Kelus) (=*Campophyllum tenuistriatum*), p. 41. see Tsien, 1969, p. 48.
Siphonophrentis torta (Hall) (=*Zaphrentis torta*), 1884, p. 434. see Stewart, 1938, p. 27.
Breviphyllum waskasense (Whiteaves) (=*Cyathophyllum waskasense*), 1892, p. 264.
Siphonophrentis ? xinjiangensis Cai in Zeng et Cai, 1983, p. 136.

Not examined forms:

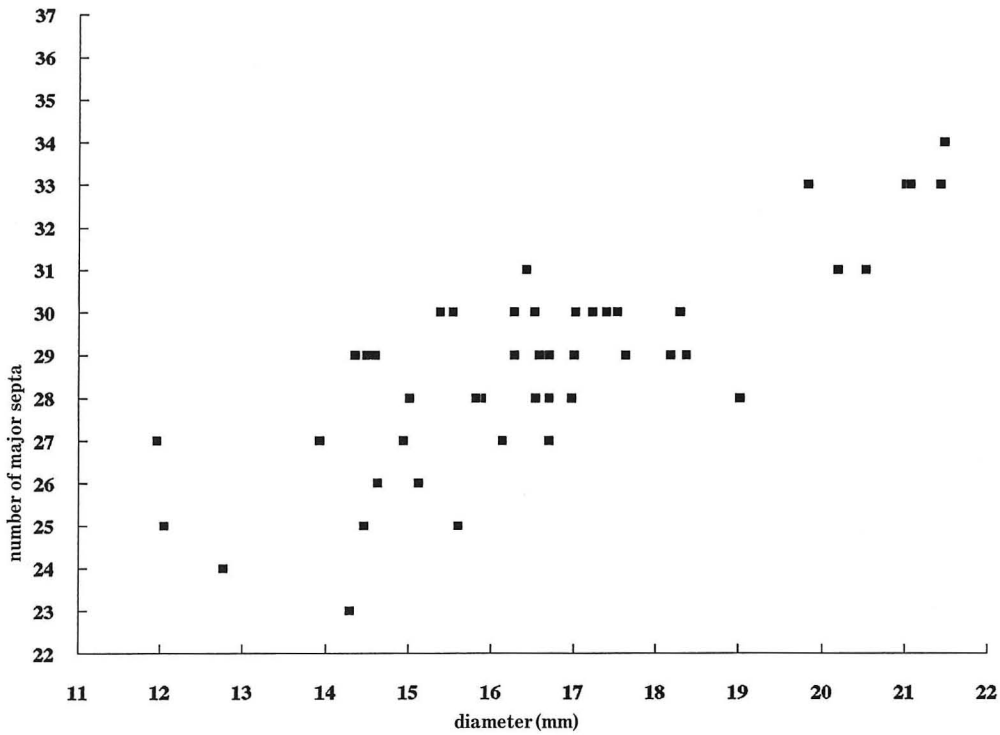
Breviphrentis multiseptata (Gürich) (=*Amplexus multiseptatus*), 1896, p. 186. see Roy, 1956.
Amplexiphyllum salinense McCammon, 1960, p. 30.

Geological distribution: Early and Middle Devonian.
Geographical distribution: China, North America, Europe, Altai.

Siphonophrentis gigantea (Lesueur), 1821

(Plate 17-22, text-figure 6)

1821 *Caryophyllia gigantea* Lesueur, p. 296.
1851 *Zaphrentis gigantea* (Lesueur). Milne-Edwards and Haime, p. 340, pl. 4, fig. 1a-c.
1884 *Zaphrentis subgigantea* Champernowne, p. 501, pl. 22, fig. 2-5.
1914 *Siphonophrentis gigantea* (Lesueur). O'Connell, p. 187.
1927 *Campophyllum yunnanense* Reed, p. 10, pl. 1, fig. 6-11.



Text-fig. 6 Scatter diagram of number of major septa versus diameter in *Siphonophrentis gigantea*

non 1938 *Siphonophrentis gigantea* (Lesueur). Stewart, p. 25, pl. 4, fig. 1.
1949 *Siphonophrentis gigantea* (Lesueur). Stumm, (in part) p. 12, pl. 5, fig. 1-3. non pl. 5, fig. 4.
?1950 *Siphonophrenits gigantea* (Lesueur). Wang, pl. 5, fig. 26; pl. 9, fig. 7.
1956 *Tabulophyllum yunnanense* (Reed). Ma, p. 57.
?1956 *Siphonophrentis gigantea* (Lesueur). Hill, p. 270, fig. 183, 7a-b.
?1961 *Siphonophrentis gigantea* (Lesueur). Fagerstrom, p. 12, pl. 4, fig. 5.
1961 *Breviphrentis yunnanense* (Reed). Fontaine, p. 91, pl. 19, fig. 14, 15.
1963 *Siphonophrentis subgigantea* (Champernowne). Smith and Thomas, p. 167, pl. 8 fig. 3-5.
non 1967 *Siphonophrentis gigantea* (Lesueur). Altevogt, p. 763, pl. 2, fig. 1, 2.
1983 *Puanophyllum lijiawanense* Wang, Z. P., p. 67, pl. 1, fig. 2-4.
non 1989 *Siphonophrentis gigantea* (Lesueur). Wang and Chen, p. 23, pl. 2, fig. 8; pl. 20, fig. 7-12.

Measurement:

No	D	N	Nt	Lf	Ls	Tw
Mf003016	21.4	33×2	3	2.9	0.7	1.1
Mf003010	21.0	33×2	5	3.3	0.6	1.1
Mf003003	21.1	33×2	3	3.2	0.5	1.0
Mf004001	19.8	33×2	3	3.4	0.5	1.0
Mf005007	15.0	28×2	4	2.9	0.6	1.1
Mf005026	17.6	29×2	6	2.2	0.6	0.7
Mf005009	15.9	28×2	5	2.4	0.6	0.9
Mf005019	19.0	28×2	4	2.7	0.6	0.8
Mf008025	20.2	31×2	4	2.5	0.5	0.8
Mf008034	17.5	30×2	5	2.8	0.5	0.8
Mf008013	16.3	30×2	4	2.3	0.4	0.6
Mf008002	15.4	30×2	5	2.3	0.6	0.7
Mf008007	17.4	30×2	4	2.5	0.5	0.6
Mf008023	17.0	28×2	4	2.6	0.5	0.5
Mf008025	16.6	29×2	4	2.4	0.6	0.9
Mf008037	18.2	29×2	4	3.4	0.6	0.6
Mf009014	18.3	30×2	5	3.9	0.9	0.8
Mf010044	14.3	23×2	5	2.6	0.5	0.7
Mf00x037	12.0	27×2	6	1.6	0.5	0.9
Mf00x041	14.5	29×2	5	1.9	0.6	0.9
Mf010026	17.0	29×2	4	2.5	0.5	1.1
Mf003004	16.4	31×2	4	2.9	0.9	0.9
Mf005004	15.1	26×2	3	2.4	0.5	0.8
Mf005016	14.6	26×2	6	2.8	0.7	1.0
Mf005001	14.5	25×2	8	3.4	0.7	0.8
Mf007024	12.8	24×2	6	2.3	0.5	1.0
Mf007001	14.0	27×2	4	4.3	0.7	0.9
Mf007027	21.5	34×2	6	3.7	0.7	1.0
Mf003006	12.1	25×2	5	2.2	0.3	0.8
Mf008033	18.4	29×2	4	2.7	0.5	0.6
Mf008031	20.5	31×2	5	3.9	0.6	0.8
Mf008048	16.5	28×2	4	2.3	0.4	0.6
Mf008005	17.0	30×2	3	3.1	0.7	0.6
Mf008030	16.5	30×2	4	3.1	0.5	0.6
Mf008010	16.7	29×2	5	3.3	0.5	0.7
Mf008018	15.8	28×2	5	2.3	0.5	0.8
M1008047	15.5	30×2	6	1.9	0.6	0.5
Mf008022	14.4	29×2	4	2.3	0.5	0.7
Mf010027	17.2	30×2	5	2.7	0.5	0.9
Mf010015	16.1	27×2	8	3.0	0.7	0.9
Mf010023	16.7	27×2	8	2.4	0.6	1.4

Mf005012	15.6	25×2	5	3.5	0.7	1.0
Mf010013	16.7	28×2	6	2.0	0.4	0.5
Mf008022	14.4	29×2	4	2.3	0.5	0.7
Mf010027	17.2	30×2	5	2.7	0.5	0.9
Mf010015	16.1	27×2	8	3.0	0.7	0.9
Mf010023	16.7	27×2	8	2.4	0.6	1.4
Mf005012	15.6	25×2	5	3.5	0.7	1.0
Mf010013	16.7	28×2	6	2.0	0.4	0.5
Mf010028	14.9	27×2	8	2.3	0.6	1.2
Hf1019	14.6	29×2	5	1.9	0.6	0.7

Diagnosis: Solitary, small to medium sized cylindrical or scolecoid coral. Septa in two orders, radially arranged. Major septa amplexoid, minor ones short, usually appear as septal ridges. No dissepiments. Tabulae complete, horizontal in wide axial region and turn downward in peripheral region.

Description: Solitary, small or medium sized cylindrical, scolecoid or ceratoid coral, from 12.0 to 21.4 mm in diameter. Exterior wall variable in thickness, ranging from 0.5 to 1.4 mm. Septa in two orders, somewhat radially arranged, number from 23×2 to 34×2. In early stage minor septa absent, major septa well developed, a few of them nearly reach the axial center (pl. 17, fig. 2b). In late stage, major septa amplexoid, unequal in length, discontinuous in transverse section. Minor septa poorly developed, usually appear as septal ridges. Cardinal fossula not distinct.

In longitudinal section no dissepiments, tabulae complete, horizontal in wide axial region and downward turn in periaxial region, usually widely placed, only3-5 can be counted in the vertical distance of 5 mn, in a few specimens tabulae closely placed so that the number of tabulae in 5 mm may amount to 12. The one specimen shown as figure 5 of plate 17 has tabulae tend to be horizontal, but the other characters exactly agree with *S. gigantea*. So place it in this species.

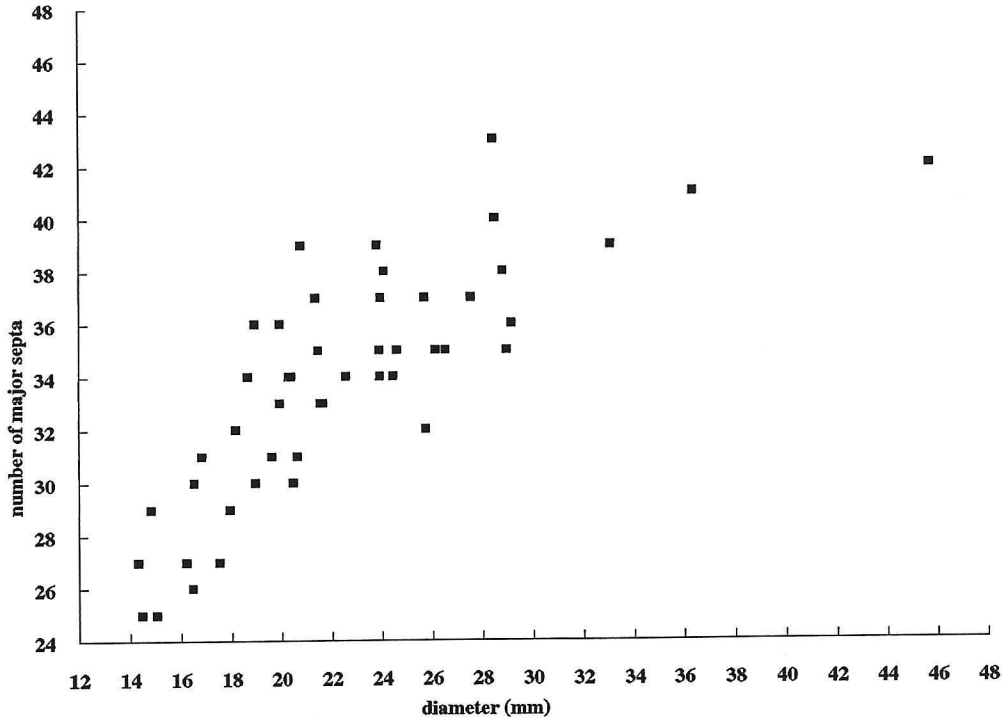
Discussion: *Siphonophrentis gigantea* is the type species of the genus, characterized by well developed amplexoid major septa and poorly developed minor as well as the absence of distinct cardinal fossula. The specimens collected from western Yunnan agree with *S. gigantea* (Lesueur) illustrated by Stumm (1949, p. 12, pl. 5, fig. 1-4) in main characters, but differ in having small and medium-sized corallites and less number of septa. For a long time *Siphonophrentis* is considered to be large in size. The material from western Yunnan shows that the forms of the genus, even within a single species, vary (from large to small) in size. Therefore the genus on the basis of *S. gigantea* should include small to medium sized corals.

Locality: Malutang and Heyuanzhai.

Siphonophrentis cantabrica Birenheide, 1978

(Plate 7-13, text-figure 7)

1978 *Siphonophrentis cantabrica* Birenheide, p. 69, pl. 9, fig. 2.
1982 *Amplexiphyllum yunnanense* Sung, 1982, p. 22, pl. 1, fig. 2,3.



Text-fig. 7 Scatter diagram of number of major septa versus diameter in *Siphonophrentis cantabrica*

Measurement:

No	D	N	Nt	Lf	Ls	Tw
Mf00x002	36.3	41×2	3	6.1	2.3	1.7
Mf00x005	33.1	39×2	4	4.3	2.2	1.2
Mf00x007	28.5	40×2	5	4.1	1.6	0.7
Mf00x012	28.9	35×2	3	4.1	2.0	1.0
Mf00x059	27.5	37×2	5	4.0	2.1	1.5
Mf00x046	26.5	35×2		3.1	1.7	1.2
Mf00x050	24.5	34×2	5	3.5	1.4	0.7
Mf00x046	24.6	35×2	5	2.3	1.1	1.3
Mf00x016	20.3	34×2	5	3.2	1.4	1.3
Mf00x039	16.5	30×2	4	3.6	1.6	1.0
Mf00x019	16.8	31×2	5	1.9	1.3	0.8
Mf00x015	29.1	36×2	3	5.2	2.0	1.2
Mf00x003	28.4	43×2	4	4.0	2.3	1.0
Mf00x064	25.7	32×2	4	3.6	2.3	0.9
Mf00x061	22.6	34×2	4	3.4	1.9	1.1
Mf00x013	24.1	38×2	3	2.9	1.6	1.2
Mf00x057	25.7	37×2	3	4.5	1.8	1.0
Mf00x062	21.6	33×2	4	3.4	1.1	1.0
Mf00x033	21.5	33×2	3	4.4	2.1	0.8
Mf00x003	21.3	37×2		3.2	1.8	1.0
Mf00x012	26.1	35×2		4.0	2.0	1.1
Mf00x038	18.9	36×2	3	3.0	1.0	0.9

Mf00x051	20.8	39×2	4	2.2	1.3	0.
Mf010014	17.5	27×2	4	2.4	1.1	0.9
Mf00x029	19.6	31×2	3	2.1	1.6	0.9
Mf00x034	20.4	34×2	4	3.0	1.0	1.0
Mf00x043	19.9	36×2	8	3.4	1.6	1.4
Mf00x011	23.8	39×2	8	3.0	2.2	1.5
Mf00x060	20.5	30×2	7	3.2	1.7	1.1
Mf00x017	23.9	35×2	5	4.1	1.7	1.1
Mf00x010	19.0	30×2	6	3.4	1.3	1.5
Mf00x016	19.9	33×2	6	3.1	1.2	1.3
Mf00x067	23.9	34×2	7	3.1	1.5	1.7
Mf00x045	23.9	37×2	5	2.9	1.5	1.1
Mf00x035	18.7	34×2	6	2.7	1.3	1.1
Mf00x066	28.8	38×2	4	4.9	3.5	1.2
Mf003002	16.2	27×2	16	3.9	1.7	1.3
003008	14.5	25×2	6	2.9	1.3	1.0
Mf003015	14.3	27×2	7	3.0	0.9	1.2
Mf003009	16.5	26×2	11	3.4	1.4	1.2
Mf005002	15.0	25×2	7	4.3	1.0	1.0
Mf007028	17.9	29×2	6	3.2	1.0	1.1
Mf009016	21.4	35×2	5	5.2	1.4	1.0
Hf1036	18.2	32×2	7	2.7	1.3	0.4
Hf1022	20.6	31×2	3	2.3	1.4	0.9

Diagnosis: Solitary, large to medium-sized subcylindrical coral. Septa in two orders, somewhat radially arranged, amplexoid. Major septa short, minor septa as long as the half of the major ones. The periphral edges of all septa dilated to form a narrow stereozone. No dissepiments. Tabulae complete, horizontal or slightly concave in wide axial region and turn downward in peripheral region.

Description: A lot of specimens of this species have been sectioned. Solitary, large to medium-sized subcylindrical coral. A few specimens show ceratoid or trochoid, from 14.3 to 45.7 mm in diameter. Septa of two orders, radial in arrangement, from 25×2to 43×2 in number. In early stages minor septa absent (pl. 7, fig. 3b; pl. 8, fig. 2b; pl. 10, fig. 3b), major ones long, may reach the axis and joined to each other to form a pseudocolumella (pl. 10, fig. 3b) like that in *Amplexiphyllum* described and illustrated by Stumm (1941, p. 9, pl. 3 fig. 33: 1961, p. 446, pl. 58 fig. 41). In late stages major septa amplexoid, vary in the length with the section, even unequal in same section (pl. 9, fig. 1a; pl. 10, fig. 1a), discontinuous, commonly disrupted by tabulae and appear as septal ridges with variable length on the surfaces of tabulae (pl. 11, fig. 3a; pl. 12, 1, 2a). Minor septa well developed, usually as long as, or longer than the one third of the majors. No dintinct fossula. The peripheral edges of all septa dilated to form narrow stereozone ranging from 0.6 to 1.7 mm in thickness.

In longitudinal section no dissepiments, tabularium usually composed of complete tabulae, in a few specimens tabulae slightly incomplete (pl. 7, fig. 2b; pl. 11, fig. 4b; pl. 12, fig. 2b). Tabulae horizontal or slightly concave in wide axial region and turn downward in peripheral region, usually widely placed so that only 3 to 5 can be counted over the vertical distance of 5 mm. In a few specimens, tabulae

closely placed, up to 16 in 5 mm, tend to be arranged in groups, and septal ridges well developed on the surface of tabulae (pl. 11, fig. 3b; pl. 12, fig. 2b).

Discussion: The specimens of this species described here agree exactly with the holotype of *S. cantabrica* from Late Givetian of Spain described and illustrated by Biredheide (1978, p. 69, pl. 9, fig. 12) in main characters, but the holotype of this species is very large, with 50 mm in maximum diameter and 50×2 in number of septa. Many specimens referred to *S. cantabrica* here show that the species seems to be large and medium in size, and the diameters gradually change. So that the species include medium sized coral, besides large individuals, as the original definition given by Birenheide.

This species is similar to *S. gigantea* in the form of tabulae, but differs from the latter in having well developed minor septa as long as about half of the majors. This species bears some resemblance to *S. elongata* (Rafinesque et Clifford), but can be distinguished from the latter by having well developed minor septa and by the absence of distinct cardinal fossula.

Locality: Malutang and Heyuanzhai.

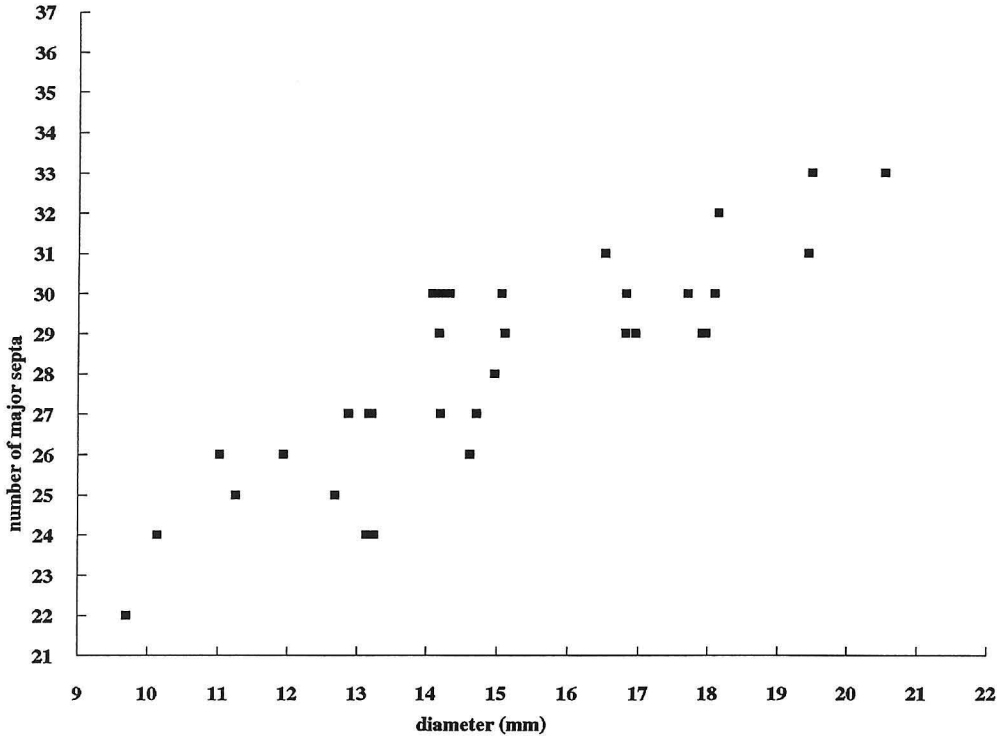
Siphonophrentis minor (Sung), 1982

(Plate 14-16, text-figure 8)

1982 *Amplexiphyllum minor* Sung, p. 22, pl. 1, fig. 5.
1982 *Baoshanophyllum cylindricum* Sung, p. 21, pl. 1, fig. 4.

Measurement:

No.	D	N	Nt	Lf	Tw
Mf008031	19.4	31	6	2.7	0.8
Mf008023	19.5	33	4	3.1	0.9
Mf008004	16.8	29	4	2.3	0.8
Mf008020	18.1	30	4	2.7	0.9
Mf008029	14.2	29	3	2.3	0.6
Mf008036	14.3	30	3	2.3	0.6
Mf008039	14.2	30	4	2.3	0.5
Mf008014	18.0	29	3	3.1	0.7
Mf008043	11.3	25	5	2.4	0.7
Mf008026	14.3	30	5	2.1	0.7
Mf008011	17.0	29	3	2.9	0.7
Mf008008	15.1	30	5	2.9	0.6
Mf008012	14.1	30	4	2.6	0.7
Mf005017	15.0	28	7	2.4	0.9
Mf005011	13.3	24	6	2.2	0.7
Mf005003	14.2	27	4	2.9	0.7
Mf007005	14.6	26	5	2.7	0.9
Mf007021	10.1	24	7	1.9	0.8
Mf013010	15.1	29	6	2.3	1.0
Mf013003	14.7	27	5	2.6	0.6
Mf013006	12.9	27	5	2.2	0.8
Mf010022	12.7	25	4	1.9	0.7
Mf001013	9.7	22	4	1.9	0.8



Text-fig. 8 Scatter diagram of number of major septa versus diameter in *Siphonophrentis minor*

Mf009017	20.5	33	5	4.2	1.2
Mf004003	17.7	30	4	4.2	1.1
Mf007004	18.1	32	7	3.3	1.3
Mf008038	16.8	30	3	2.3	0.8
Mf008041	13.2	27	5	3.0	1.0
Mf008016	16.5	31	5	2.8	0.7
Mf007025	11.0	26	4	2.7	1.0
Mf008006	11.9	26	4	2.5	0.6
	4.1	18		1.2	0.6
Mf007019	13.1	24	5	5.5	1.5
Mf013005	13.2	27	5	1.8	0.5

Diagnosis: Solitary, small to medium-sized cylindrical and scolecoid coral. Septa radially arranged. Major septa amplexoid, minor septa almost absent. No dissepiments and fossula. Tabulae complete, horizontal in wide axial region and turn downward in periaxial region.

Description: Solitary, small to medium-sized cylindrical, scolecoid or ceratoid coral, with diameter ranging from 9.7 to 20.5 mm in late stage. Septa amplexoid, radially arranged. Major septa unequal in length, discontinuous in transverse section (pl. 14, fig. 1a, 3a; pl. 16, fig. 7), number from 22 to 33, usually retreated from

the axial center. Only in few specimens major septa may reach the axis and joined to each other (pl. 16, fig. 6a), but not to the extent of forming a discrete axial structure. Minor septa nearly absent, only restricted to stereozone formed by the dilation of peripheral edges of all septa. The stereozone ranges from 0.5 to 1.5 mm in thickness.

In longitudinal section no dissepiments, tabulae complete, usually widely spaced, so that 3 to 5 can be counted over the vertical distance of 5 mm. Tabulae are horizontal in wide axial region which occupies about 80 percent of tabularium, and turn downwardly in periaxial region. Septal ridges usually are present on the surface of tabulae.

Discussion: These forms described under *S. minor* here include those assigned to *Baoshanophyllum cylindricum* and *Amplexiphyllum minor* by Song (1982). The first type, i. e. *B. cylindricum*, has long septa which may reach and meet at the axis, represented by the form shown as figure 6 of plate 16. The second type, namely *Amplexiphyllum minor*, bears short septa which usually retreated from the axis and leave a wide axial place. As stated by Song (1982), in the both types of coral, septa are all amplexoid. The excellent figure of *Baoshanophyllum cylindricumm* illustrated by Song (1982, pl. 1, fig. 4) clearly shows that the septa are disrupted by tabulae. This kind of septa vary in length with the position of transverse section, therefore the septal length in transverse section probably have no specific significance. Among the forms referred to this species, the specimens with short septa are more common than those with long septa which may reach the axial center, so that *Siphonophrentis minor* rather than *S. cylindricum* is selected to represent this kind of corals.

This species has some resemblance with *Siphonophrentis elongata* (Rafinesque et Clifford) in having almost no minor septa, but differs in the lack of distinct cardinal fossula distinguished by short cardinal septum, and having less diameter in individuals. This species can be easily distinguished from *S. gigantea* (Lesueur) by nearly complete lack of minor septa. Comparing with *S. cantabrica*, *S. minor* is small in size and lack minor septa.

Locality: Malutang.

Genus *Altaiophyllum* Ivaniya, 1955

1955 *Altaiophyllum* Ivaniya, p. 85.
1960 *Zmeinogorskia* Spasskiy, p. 100.

Type species: *Altaiophyllum belgebaschicum* Ivaniya, 1955, p. 85.

Diagnosis: Solitary, subcylindrical or ceratoid coral. Septa of two orders, amplexoid. Septa in cardinal quadrants thicher and pinnate in arrangement, the axial ends curved around the inner edge of cardinal fossula. Cardinal septum short in mature stage. The septa in counter quadrants thinner than those in cardinal

quadrants. Minor septa well developed. Tabulae commonly complete, flat or somewhat sagging with downturned edges in some species accessory tabellae present. No dissepiments.

Discussion: *Altaiophyllum* is very similar to *Siphonophrentis* O'Connell (1914, p. 187) in having amplexoid septa and complete tabulae, but can be easily distinguished from the latter by having pinnately arranged thicker septa in the cardinal quadrants. This genus resembles *Heterophrentis* Billings (1875, p. 235) in their features of tabulae, but differs from the latter in its amplexoid septa. *Kobeha* Merriam (1974, p. 47), with *Kobeha walcotti* Merriam (1974, p. 48) as the type species, has amplexoid septa which stronger dilated in cardinal quadrants than in counter quadrants, and agrees with *Altaiophyllum*. However, the presence of dissepiments in *Kobeha* can serve to distinguish it from *Altaiophyllum*.

Altaiophyllum has been reported from the Middle Devonian of Altai, the Urals, Kazakhstan, China and Spain. It is certain that *Altaiophyllum* was also distributed in the North America. The form described as *Siphonophrentis gigantea* (Lesueur) by Wang Hongzhen and Chen Jiangqiang (1989, p. 23, pl. 2, fig. 8, pl. 20, fig. 7-12), being collected from the Middle Devonian of Ohio, bears markedly dilated septa in the cardinal quadrants. Therefore it belongs to a form of *Altaiophyllum*.

Assigned forms:

Altaiophyllum altaicum Levaschov in Ivaniya, p. 103.
Altaiophyllum belgebaschicum Ivaniya, 1955, p. 85. see Ivaniya, 1965, p. 12
Altaiophyllum bublichenkoi (Spasskiy) (=*Zmeinogorskia bublichenkoi*) 1960, p. 32.
Altaiophyllum corgonicum Polyanski in Ivaniya, 1958, p. 105, pl. 3, fig. 11. See Ivaniya, 1965, p. 12.
Altaiophyllum elongata sensu Oliver, 1989, non *Siphonophrentis elongata* (Rafinesque and Clifford), 1820. Oliver, 1992, (in part), p. B27, pl. 20, fig. 1-4; pl. 21, fig. 1-4; pl. 22, 1-4. non pl. 21, fig. 5, 6.
Altaiophyllum giganteum sensu Altevogt, 1967, non *Siphonophrentis gigantea* (*Lesueur*), 1821. Altevogt, 1967, p. 763, pl. 2, fig. 1, 2.
Altaiophyllum giganteum sensu Wang and Chen, 1989, non *Siphonophrentis gigantea* (Lesueur), 1821. Wang and Hhen, 1989, p. 23, pl. 2, fig. 8; pl. 20, fig. 7-12.
Altaiophyllum prolificum sensu Altevogt, 1967, non *Heterophrentis prolifica* (Billings), 1858. Altevogt, 1967, p. 762, pl. 1, fig. 8.
Altaiophyllum sagsayicum (Spasskiy) (=*Zmeinogorskia sagsayica*), 1960, p. 120. see Spasskiy, 1977, p. 116.
Altaiophyllum tareicum (Kravtsov) (=*Tabulophyllum tareicum*), 1963. see Ivanovskiy, 1975, p. 80.
Altaiophyllum tenue Yu et Kuang, 1982b, p. 252.

Not examined forms:

Zmeinogorskia crassiseptata Gorianov, 1967, p. 8.
Altaiophyllum flexuosum Kaplan, 1977, p. 29.
Zmeinogorskia zaisanica Spasskiy, 1960, p. 121.

Geological distribution: Middle Devonian.

Geographical distribution: Altai, Kazakhstan, the Urals, China, Spain, North American.

Altaiophyllum sagsayicum (Spasskiy), 1960

(Plate 23, fig. 1)

1960 *Zmeinogorskia sagsayica* Spasskiy, p. 120.
1977 *Zmeinogorskia sagsayica* Spasskiy. Spasskiy, pl. 24, fig. 2.

Measurement:

No	D	N	Nt	Lf	Ls	Tw
(Early stage)	29.1	39×2		11.9	3.7	1.0
Mf00×014			3			
(Late stage)	39.3	42×2		10.2	4.0	1.2

Diagnosis: Solitary, ceratoid coral. Septa of two orders, bilateral in arrangement. Major septa long, dilated strongly to connect with each other laterally in early stage. Cardinal and counter septa slightly shorter than the other majors. The axial ends of septa in cardinal and counter quadrants curved respectively around the inner edge of cardinal and counter fossulae. In late stages septa become amplexoid, only the septa in cardinal quadrants dilated. Minor septa well developed. Tabulae complete, concave in wide axial region and turn downward in periaxial region. No dissepiments.

Description: Only two transverse sections and one longitudinal section have been prepared from one specimen of this species from western Yunnan. Solitary, ceratoid coral, septa of two orders. In early stage (pl. 23, fig. 1b) septa bilateral in arrangement, 32×2 in the section with diameter of 19.1 mm. Major septa long, somewhat withdraw from the axis. Cardinal and counter septa shorter than the other majors. The axial ends of major septa in cardinal and counter quadrants curved respectively around the inner edges of the cardinal and counter fossulae. All major septa strongly dilated and connected to each other laterally except their periaxial ends which are thinner than the other parts. Minor septa well developed, about one third of the major ones in length, markedly thinner than the major septa. In the late stage (pl. 23, fig. 1a) septa become amplexid, about half of the radius of the corallum, 42×2 in number at the diameter of 39.3 mm, bilateral in arrangement. Major septa variably dilated. The major septa near cardinal septum markedly thicker than the other majors. Cerdinal septum short, cardinal fossulae distinct. The axial ends of the major septa curved around the inner edges of cardinal fossula. Septa in counter quadrants slightly thin. Minor septa well developed, thinner than the majors. The stereozone in late stage is slightly thinner than that in the early stage.

In longitudinal section no dissepiments. Tabulae complete, strongly concave in wide axial region occupying 70 percent of the diameter of the corallum and turn downward in periaxial region, in the shape of a saddle as a whole, distantly arranged so that only 3 can be counted over the vertical distance of 5 mm.

Discussion: This kind of rugose corals are simple in their skeletal structure, the characters used for classification are less numerous, mainly being their septal and tabulae features. This species is similar to *A. belgebaschicum* Ivaniya, the type species of *Altaiophyllum*, in septal characters, but differs from the latter in having strongly concave tabulae in wide axial region, and strongly dilated major septa in early stages.

The specimen of this species is very close to the holotype of same species from the Eifelian of Altai. Comparing with the latter, the form from western Yunnan bears more strongly concave and more distant tabulae.

Locality: Malutang.

Altaiophyllum yunnanense sp. nov.
(Plate 23, fig. 2)

Measurement:

No	D	N	Dt	Lf	Ls	Tw
Mf00×058 (Holotype)	33.9	40×2	3	9.6	3.0	0.9

Diagnosis: Solitary, large ceratoid coral. Septa of two orders, amplexoid, bilateral in arrangement. Septa in cardinal quadrants thicker than that in the counter quadrants. Minor septa well developed. Tabulae nearly complete, strongly concave, without turndown edge and rare accessory tabellae.

Description: Only one specimen of this species from western Yunnan has been sectioned. Solitary, ceratoid coral, corallum large, up to 33.9 mm in diameter. Septa of two orders, amplexoid, bilaterally arranged, 42×2 in the number at the diameter above. Major septa short, only about half of the radius of corallum in length. The major septa in cardinal quadrants strongly dilated and are in contact with each other laterally in their inner ends, the minor septa markedly thinner than the neighboring major ones. Septa in counter quadrant thin. Minor septa distinct, about one third as long as the major ones. No distinct cardinal fossula.

In longitudinal section no dissepiments, tabulae complete, very strongly concave in axial region, distantly arranged, spaced of 3 in 5 mm, without turndown edge in periaxial region. Rare accessory tabulae may be present.

Discussion: This species in close to *A. sagsayicum* (Spasskiy), but differs from the latter in having very strongly concave tabulae without turndown edge in periaxial region and having rare accessory tabulae.

This species can be distinguished from *A. belgebaschicum* in bearing strongly concave tabulae without turndown edge in periaxial region.

Locality: Malutang.

Altaiophyllum shidianense sp. nov.
(Plate 23, fig. 3)

Measurement:

No	D	N	Dt	Lf	Ls	Tw
Mf00×063 (Holotype)	26.0	27×2	2	6.8	3.2	1.2
	14.8	27×2		2.2	1.7	1.1
Mf00×004			3			
	24.3	33×2		5.7	3.9	0.9

Diagnosis: Solitary, ceratoid coral. Septa of two orders, bilateral in arrangement. The septa in cardinal quadrants thicker than those in counter quadrants. Minor septa well developed. No distinct fossulae. Tabulae complete, horizontal in wide axial region, and turn downward in the periaxial region on one side, and turn upward on another side. Rare accessory tabellae may be present.

Description: Solitary, ceratoid coral, medium sized. Septa of two orders, bilateral in arrangement. In early stage major septa short, about one third of the radius of the corallum, slightly dilated. Minor septa well developed, as long as, or longer than the half of the major ones, and thinner than the majors. In the section with a diameter of 14.8 mm, the number of septa is 27×2. Exterior wall thick, about 1.1 mm in thickness. In late stage number of septa is from 27×2 to 33×2 at the diameter ranging from 24.1 to 26.0 mm. Septa amplexoid, the length of the major septa vary from section to section. The septa of cardinal quadrants markedly thicker than those of counter quadrants. Minor septa usually as long as, or longer than the half of the major ones. Exterior wall thick, from 0.9 to 1.2 mm thick.

In longitudinal section tabulae complete, horizontal or inclined to one direction in wide axial region occupying 70 percent of the tabularium, and turn downward in the periaxial region on one side and turn upward on the another side.

Discussion: The forms described here bear dilated septa only in the cardinal quadrants, and their septa are amplexoid, so they should belong to *Altaiophyllum*. This new species differs from all species previously assigned to *Altaiophyllum* in having partihular type of tabulae which are horizontal in wide axial region, and turn downward in the periaxial region on one side and turn upward on the another side.

Locality: Malutang.

Suborder Metriophyllina, Spasskiy, 1965
Family Metriophyllidae Hill, 1939

Genus *Metriophyllum* Edwards et Haime, 1850

1850 *Metriophyllum* Edwards et Haime, p. 69.
1900 *Lopholasma* Simpson, p. 206.

1959 *Asserculinia* Schouppé et Stacul, p. 284.
1967 *Haptophyllum* Pedder, p. 110.

Type species: *Metriophyllum bouchardi* Edwards et Haime, 1850, p. 69.

Diagnosis: Small solitary, turbinate to ceratoid corals. Calice deep and steep with very narrow calicular platform. Floor of calice flat or slightly concave. Septa two orders with marked flanges. Major septa thick and long, reaching the axis to form a pseudocolumella. Minor septa variably developed. Tabulae complete, usually convex. Dissepiments absent.

Discussion: *Metriophyllum* is characterized by the presence of flanges on sides of septa and the absence of dissepiments . Simpson (1900, p. 206) proposed a genus *Lopholasma*, on the basis of *Streptelasma recta* (Hall), with strong essentially horizontal flanges on the sides of septa. But he did not figure the type species, and figured another species assigned by him to *Lopholasma*, namely *L. carinatum*. According to Simpson's original description, there are dissepiments in *L. carinatum*, but the figures given by him clearly show there is any trace of dissepiments. The dissepiments described by Simpson are in fact the steeply sloping tabulae cut by transverse section. Many palaeontologists, including Smith (1945), Stainbrook (1946), Stumm (1949), Hill (1956), Holwill (1964), regarded *Lopholasma* as congeneric with *Metriophyllum*.

Asserculinia was established by Schouppé and Stacul (1959, p. 285) with *A. prima* as the type species. In erecting this genus, Schouppé and Stacul did not name the morphological difference between it and *Metriophyllum*. Therefore Rozkowska (1969, p. 34) regarded *Asserculinia* as a junior synonym of *Metriophyllum*. Weyer (1970, p. 58) considered that " important features of the type species, *Asserculinia prima* Schouppé et Stacul 1959, are the rather long and free minor septa, developed in subtabular regions too, and the probable presence of a true cardinal fossula. The two counter minor septa are not prominent." He concluded that *Asserculinia* is distinct from *Metriophylluum* and *Lopholasma*. Since *Asserculinia* was founded, except type species, four species, *A. elegans* Wu et Wang (1974, p. 298), *A. orbiculata* Wu et Wang (1974, p. 298), *A. arbiculata* Wu in Zhao (1976, p. 219) and *A. liuzhiensis* Zhao (1976, p. 219), have been described within the genus. All the four stecies bear well developed columella formed by the dilatation of the counter septum in axial end as in *Lophophyllidium*. The illustration of the holotype of *A. prima*, given by Schouppé and Stacul (1959, pl. 11, fig. 33-35), shows that the axial structure seems to be pseudocolumella made up of the fused axial ends of major septa rather than columella formed by the dilatation of counter septum in axial end. In this kind of coral like *Metriophyllum*, minor septa usually are variable, cardinal fossula is not stable. Therefore, the present author agrees with Rozkowska (1969, p. 34) in considering *Asserculinia* as congeneric with *Metriophyllum*.

Pedder (1967b, p. 110) proposed *Haptophyllum* with flanges on the basis of *Metriophyllum erisma* Hill, 1950. Pedder considered that *Haptophyllum* is distinguished from *Metriophllum* by possession of paired septa enclosing axially sloping

plates. In the transverse section of *H. erisma*, most septa occur in pairs, that is, the minor septa commonly contratingent with the majors. The paired septa also occur in *Metriophyllum carinatum* (Simpson, 1900, p. 206, fig. 19; Holwill, 1964, pl. 16, fig. 2). On the basis of this I prefer to regard *Haptophyllum* as a synonym of *Metriophyllum*.

Stereolasma Simpson (1900, p. 205) was regarded as a synonym of *Metriophyllum* by Smith (1945, p. 28). Smith also considered *Strombodes rectum* Hall, 1843 to be conspecific with *Metriophyllum carinatum* (Simpson). Busch (1941, p. 395) studied *Strombodes rectum* in detail. The excellent drawing of serial sections given by Busch (1941, p. 396, fig. 7-16) clearly indicate that there are no septal flanges in the species. The same conclusion was also reached by Stainbrook (1946, p. 410). On the basis of this difference mentioned above, most authors including Stumm (1949), Hill (1956; 1981), Holwill (1964) suggested to separate *Stereolasma* from *Metriophyllum*. The strong flanges appear to be a well marked and persistent character in the genus *Metriophyllum*, the absence of flanges in *Stereolasma* makes it easy to distinguish *Stereolasma* from *Metriophyllum*.

Assigned forms:

Metriophyllum album Soto, 1975, p. 51.
Metriophyllum bouchardi Edwards et Haime, 1850, p. 69.
Metriophyllum carbonarium (Grabau) (=*Lopholasma carbonaria*), 1922, p. 43.
Metriophyllum carinatum (Simpson) (=*Lopholasma carinatum*), 1900, p. 206. see Holwill, 1964, p. 119.
Metriophyllum delawarense (Baker) (=*Lopholasma delawarensis*), 1942, p. 141.
Metriophyllum devexicarinatum Pedder, 1967b, p. 119.
Metriophyllum erisma Hill, 1950, p. 142.
Metriophyllum gracile Schluter, 1884, p. 82. see Holwill, 1964, p. 114.
Metriophyllum gracile (Soshkina) (=*Lopholasma gracile*), 1928, p. 368.
Metriophyllum ilitschense (Soshkina) (=*Lopholasma ilitschense*), 1928, p. 369.
Metriophyllum iowense Stainbrook, 1946, p. 410.
Metriophyllum lituum Holwill, 1964, p. 116.
Metriophyllum primum (Schouppé et Stacul) (=*Asserculinia prima*), 1959, p. 285.
Metriophyllum qaganqulutense Guo, 1980, p. 106.
Metriophyllum rectum (Hall) (=*Stereptelasma recta*), 1876, p. 19. see Simpson, 1900, p. 206.
Metriophyllum skalense Fedorowski, 1965, p. 336.
Metriophyllum solidum solidum Pedder, 1967b, p. 120.
Metriophyllum solidum murrindalense Pedder, 1967b, p. 121.
Metriophyllum soshkinae, Rozkowska, 1969, p. 34.
Metriophyllum trochoides Hill et Jell, 1971, p. 15.
Metriophyllum tullium Williams in Cooper et Williams, 1935, p. 837.
Metriophyllum volki Weissermel, 1939, p. 361.
Metriophyllum xinjiangense Zeng in Zeng et Cai, 1983, p. 113.

Rejected forms:

Asserculinia arbiculata Wu in Zhao, 1976, p. 219.
Metriophyllum battersbyi Edwards et Haime, 1850, p. 318. see Edwards and Haime, 1853, p. 222
Metriophyllum bouchardi qitaiense Cai in Zeng et Cai, 1983, p. 113.
Asserculinia elegans Wu et Wang, 1974, p. 298.
Metriophyllum elsii Whidborne, 1901, p. 538.

Metriophyllum exiguum (Billings) (=*Heliophyllum exiguum*), 1860, p. 261. see Oliver, 1958, p. 822.
Metriophyllum exiguum elongatum (Davis) (=*Cyathophyllum exiguum elongatum*), 1887, pl. 133. see Oliver, 1958, p. 824.
Metriophyllum irregulare Paeckelmann, 1922, p. 143.
Asserculinia liuzhiensis Zhao, 1976, p. 219.
Asserculinia orbiculata Wu et Wang, 1974, p. 298.
Metriophyllum poshiense Mansuy, 1912, p. 47. see Yu and others, 1963, p. 324.

Not examined forms:

Lopholasma acanthiseptum Fomitchev, 1953.
Metriophyllum cruciferum Wessermel, 1941, p. 170.
Metriophyllum deminutivum Easton, 1944, p. 31.
Metriophyllum laeve Schlüter, 1889, p. 278. (no figures)
Metriophyllum minus Spriestersbach, 1942, p. 204.
Metriophyllum siluriense (M'Coy) (=*Cyathaxonia siluriensis*), 1850, p. 281. see Lindstrom, 1868.
Metriophyllum smithi Le Maitre, 1952, p. 50.

Geological distribution: Middle Devonian-Lower Permian.
Geographical distribution: Europe, Asia, Australia and North America.

Metriophyllum cf. *carinatum* (Simpson), 1900

(Plate 59, fig. 3)

Compare with:

1900 *Lopholasma carinatum* Simpson, p. 206.
1964 *Metriophyllum carinatum* (Simpson). Holwill, p. 119.

Measurement:

No	D	N	Nt	Nf	Tw
Mf008046	7.8	19×2	6	6	1.0

Diagnosis: Small solitary, ceratoid coral with a deep calyx. Exterior wall thick. Major septa long, reach and meet at the axis to form a pseudocolumella, with strong flanges. The flanges horizontal or gently upward and inwardly inclined. Tabulae complete, gently upwardly and inwardly inclined in peripheral area, and sharply become steep near axis and nearly vertical.

Description: Only one specimen of this species has been sectioned among the fossils from western Yunnan. Small solitary, ceratoid coral. Calyx deep, with steeply sloping wall and very narrow platform. Exterior wall thick, up to 1.0 mm in thickness, consists of lamellae. Septa 19×2 in number at the section with diameter of 7.8 mm. Major septa long, extending to the axis where they fuse to form a pseudocolumella. Septal flanges strongly developed. The further septal characters are not well known due to the section cut through the deep calyx.

In the longitudinal section, flanges thick, horizontal or gently inclined inwardly or upwardly, placed of 6 in 5 mm. Tabulae complete, markedly thinner than the flanges, gently inclined inwardly and upwardly in peripheral part, and sharply

become steep to be nearly vertical in axis, 6 can be counted over the vertical distance of 5 mm.

Discussion: The transverse section of the material described here was prepared through the deep calyx, so the septal characters can not be known very well. However the longitudinal section clearly shows the presence of flanges and pseudocolumella composed of fused axial ends of long major septa. Therefore this species should belong to *Metriophyllum* without doubt. The longitudinal section of the specimen agrees exactly with that of *M. carinatum* (Simpson) figured and illustrated by Simpson (1900, p. 206, fig. 20) and Holwill (1964, pl. 16, fig. 1). The present author believes that the specimen described here probably is conspecific with *M. carinatum*. Because of the absence of excellent transverse section, this specimen is described as *M.* cf. *carinatum*.

Locality: Malutang.

Suborder Ketophyllina Zhavoronkova, 1972
Family Endophyllidae Torley, 1933

Genus *Tabulophyllum* Fenton et Fenton, 1924

1924 *Tabulophyllum* Fenton et Fenton, p. 30.
1928 *Apolythophyllum* Walter, p. 135.
1937 *Sinospongophyllum* Yoh, p. 56.
1939 *Diversophyllum* Sloss, p. 65.
1967 *Tanjilasma* Pedder, p. 115.

Type species: *Tabulophyllum rectum* Fenton et Fenton, 1924, p. 31.

Diagnosis: Solitary coral with septa of two orders. Major septa reach or retreat from the axis, minor septa poorly developed, usually reduced to low septal ridges on exterior wall or dissepiments. No fossula. Tabularium wide, tabulae complete or incomplete. Axial tabulae convex or flatly domed with down-turned edges. Dissepimentarium narrow, dissepiments steeply inclined and elongated.

Discussion: The solitary corals with lonsdaleoid dissepimental zone and convex to flatly domed axial tabulae are widespread in the world in the Middle and Upper Devonian, and are often high in diversity. *Tabulophyllum* Fenton et Fenton, 1924 is a widely accepted generic name. *Apolythophyllum* Walther (1928) was described from the Frasnian of Germany, and the type species *A. normale* Walther (1928, p. 144, fig. 33, 34) was chosen by Lang, Smith and Thomas (1940, p. 18). Later Bulvanker (1940, 1947) described some species under *Apolythophyllum*. Nearly all authors including Bulvanker (1958, p. 162) now regard *Apolythophyllum* as a synonym of *Tabulophyllum*.

Sinospongophyllum Yoh with type species of *S. planotabulatum* Yoh (1937, pl. 6, fig. 2-5) are often used by Chinese paleontologists, but opinions differ widely with

regard to the difference between *Sinospongophyllum* and *Tabulophyllum*. Yoh and Wu (1964, p. 153) maintained that the shorter and involute major septa and the almost complete and regular tabulae in *Sinospongophyllum* may serve to distinguish it from *Tabulophyllum*. Kong and Huang (1978, p. 121) emphasized the continuous and carinate septa in *Sinospongophyllum* by which it differs from *Tabulophyllum*. Jia and others (1977, p. 155) used *Sinospongophyllum* for the solitary corals of *Endophyllum*. He (1978, p. 157) amended the definition of *Sinospongophyllum* on the basis of the material from Longmenshan, Shchuan Province, China and pointed out that the tabulae may be divided into a convex axial series and a concave periaxial series. Merriam (1974, p. 38) regarded the less developed lonsdaleoid zone and clear septal stereozone as the important characters of *Sinospongophyllum*. Yü and Kuang (1984, p. 139) regard the narrow lonsdaleoid zone as typical for *Tabulophyllum*. In short, there is no complete agreement on the definition of *Sinospongophyllum*. Many species examined here give the impression that it may be difficult to distinguish *Sinospongophyllum* from *Tabulophyllum*. In fact, except for the complete tabulae, the holotype of *S. planotabulatum*, type species of *Sinospongophyllum*, is similar to holotype of *T. rectum*, type species of *Tabulophyllum*.

When erecting *Diversophyllum*, Sloss (1939, p. 66) considered that the "genus differs from *Tabulophyllum* Fenton et Fenton (1924, p. 30) in exhibiting definite and persistent minor septa". *Diversophyllum* is rarely used, its type species *Zaphrentis traversensis* Winchell 1866, as restudied and illustrated by Sorauf (1987b, 1988b), appears to be a typical species of *Tabulophyllum*.

Pedder (1967b, p. 115) set up the genus *Tanjilasma* on the basis of *Tabulophyllum meridionale* Phillips, 1962, and stated that *Tanjilasma* is different from *Tabulophyllum* in having a better developed aulos. However, the longitudinal section of the type species given by Pedder (1967b, p. 117, fig. 4b) shows that the aulos in the species is not stable, and therefore does not have a generic siginificance. In the present paper I have regarded *Apolythophyllum, Sinosphyllum, Diversophyllum and Tanjilasma* as synonymous with *Tabulophyllum*.

Soshkina (1951, 1952, 1954) thought that only astreoid species like the type species *Endophyllum bowerbanki* Edwards et Haime (1851, p. 168, figured by Edwards and Haime,1853, as pl. 53, fig. 1) should be retained in *Endophyllum* Edwards et Haime (1851), and that cerioid species with a strong wall should be included within *Tabulophyllum*, which also include some fasciculate forms. It is evident that the scope of *Tabulophyllum* given by Soshkina is quite wide. It would seem better to confine *Tabulophyllum* to solitary forms.

The genera easily confused with *Tabulophyllum* are *Endophyllum*, *Blothrophyllum* and *Ketophyllum*. As noted above, *Tabulophyllum* is restricted to solitary corals, by which it differs from *Endophyllum*. *Blothrophyllum* Billings, 1859, with type species *B. decorticatum* Billings (1859, p. 130, fig. 25), closely resembles *Tabulophyllum*, but the transverse section shows a distinct cardinal fossula, which is absent in *Tabulophyllum*. *Ketophyllum* Wedekind, 1927 on the basis of *Ketophyllum incurvatum* Wedekind, 1927, is a Silurian genus with well developed lonsdalloid

dissepimentarium and flat domed tabulae, but has a well developed cardinal fossula not possessed by *Tabulophyllum*. *Siphonophyllia* (type species *S. cylindrica*) is also similar to *Tabulophyllum* in some aspects, but the distinct cardinal fossula, the dilated septa as well as the septal microstructures of *Siphonophyllia* are quite distinct from *Tabulophyllum*.

Assigned forms:

Tabulophyllum abrogatum (Hill) (=*Sinospongophyllum abrogatum*), 1942a, p. 20.
Tabulophyllum akqiense (Cai in Zeng et Cai) (=*Sinospongophyllum akqiense*), 1983, p. 194
Tabulophyllum altaicum Spasskiy, 1960, p. 28.
Tabulophyllum annulatum (Wang) (=*Endophyllum annulatum*), 1948, p. 31.
Tabulophyllum antelopense Merriam, 1973, p. 38.
Tabulophyllum aulacophyllum Ivaniya, 1960, p. 389. see Ivaniya, 1965, p. 30.
Tabulophyllum baiyangdongense (He) (=*Sinospongophyllum baiyangdongense*), 1978, p. 158.
Tabulophyllum bilaterale. see Sorauf, 1988b, p. 404.
Tabulophyllum brevissimum (Walther) (=*Apolythophyllum brevissimum*), 1928, p. 142.
Tabulophyllum chernyshevi Bulvanker 1958, p. 172.
Tabulophyllum clinatum Stainbrook, 1946, p. 418.
Tabulophyllum conicum (Wang) (=*Endophyllum conicum*), *1948, p. 32.*
Tabulophyllum conspectum Tsien 1976, p. 273.
Tabulophyllum contortum Stumm, 1940, p. 60.
Tabulophyllum curtum Stumm, 1962b, p. 293.
Tabulophyllum cylindricum (Walther) (=*Apolythophyllum cylindricum*), 1928, p. 140.
Tabulophyllum densum Rozkowska, 1979, p. 42.
Tabulophyllum dushanense Kong in Kong et Huang, 1978, p. 121.
Tabulophyllum dux Stainbrook 1956, p. 416.
Tabulophyllum ehlersi Fenton et Fenton, 1924, p. 34. see Sorauf, 1988b, p. 410.
Tabulophyllum elongatum Stumm, 1962b, p. 294.
Tabulophyllum erraticum Fenton et Fenton, 1924, p. 36.
? Tabulophyllum exiguum Fenton et Fenton, 1924, p. 37. (no section)
?Tabulophyllum expansum Fenton et Fenton, 1924, p. 39. (no section)
Tabulophyllum firmatum Tsien, 1969, p. 41.
Tabulophyllum flexitabulatum Kong in Kong et Huang, 1978, p. 123.
Tabulophyllum formosum Tsien, 1969, p. 40.
Tabulophyllum gorskyi Bulvanker in Soshkina, 1951, p. 39.
Tabulophyllum gracile (Walther) (=*Apolythophyllum gracile*), 1928, p. 139.
Tabulophyllum grandiversiculosum Soshkina, 1952, p. 71.
Tabulophyllum heckeri Bulvanker in Soshkina, 1952, p. 72.
Tabulophyllum heckeri giveticum Ferrari, 1968, p. 571.
Tabulophyllum implicatum Tsien, 1976, p. 271.
Tabulophyllum irregulare Rozkowska, 1979, p. 43.
Tabulophyllum irregulare (He) (=*Sinospongophyllum irregulare*), 1978, p. 157.
Tabulophyllum keyserlingi (Lebedew) (=*Campophyllum keyserlingi*) 1902, p. 152. see Ma 1956, p. 54.
Tabulophyllum latilimbatum (Kong in Kong et Huang) (=*Sinospongophyllum latilimtabum*), 1978, 127.
Tabulophyllum longiseptatum Bulvanker in Soshkina, 1951, p. 38.
Tabulophyllum longmenshanense (He) (=*Sinospongophyllum longmenshanense*), 1978, p. 158.
Tabulophyllum longmenshanense minor (*He*) (=*Sinospongophyllum longmenshanense minor*), 1978, p. 158.
Tabulophyllum longum Fenton et Fenton, 1924, p. 39. see Sorauf et Pedder, 1986, p. 1267.
Tabulophyllum lowryi Hill et Jell, 1970, p. 65.
Tabulophyllum magnum Fenton et Fenton, 1924, p. 38. see Sorauf, 1988b, p. 404.

Tabulophyllum major Bulvanker, 1958, p. 175.
Tabulophyllum manifestum Spasskiy, 1971, p. 106. see Ivanovskiy, 1975, p. 80.
Tabulophyllum mcconnelli (Whiteaves) (=*Cyathophyllum mcconnelli*), 1098, p. 422. see Smith, 1945, p. 59; McLean, 1985, p. 472.
Tabulophyllum meridionale Philip, 1962, p. 184.
Tabulophyllum multiseptatum Tsien, 1969, p. 39.
Tabulophyllum normale (Walther) (=*Apolythophyllum normale*), 1928, p. 134.
Tabulophyllum normale platetabulatum Cai in Zeng et Cai, 1983, p. 194.
Tabulophyllum orientale (Stumm) (=*Mictophyllum orientale*), 1960, p. 162. see Sorauf, 1987b, p. 678.
Tabulophyllum planotabulatum (Yoh) (=*Sinospongophyllum plantotabulatum*), 1937, p. 56.
Tabulophyllum pondarosum Fenton et Fenton, 1924, p. 40.
Tabulophyllum priscum (Munster) (=*Cyathophyllum priscum*), 1841, p. 26. see Rozkowska, p. 42.
Tabulophyllum quadratum Stainbrook, 1946, p. 418.
Tabulophyllum rectum Fenton et Fenton, 1924, p. 31.
Tabulophyllum regulare Fenton et Fenton, 1924, p. 33.
Tabulophyllum robustum Fenton et Fenton, 1924, p. 37.
Tabulophyllum rudiseptatum (Kong in Kong et Huang) (=*Sinospongophyllum rudiseptatum*), 1978, p. 127.
Tabulophyllum rotundum Fenton et Fenton, 1924, p. 35. see Sorauf, 1988b, p. 402.
Tabulophyllum rotundum Spasskiy, 1960, p. 26.
Tabulophyllum shuimogouense (He) (=*Sinospongophyllum shuimogouense*), 1978, p. 156.
Tabulophyllum smithi Tsien, 1976, p. 270.
Tabulophyllum subgracile Yü et Kuang, 1984, p. 139.
Tabulophyllum subnormale Yü et Kuang, 1984, p. 140.
Tabulophyllum tabulatum Tsien, 1969, p. 41.
Tabulophyllum tenuissimum (Walther) (=*Apolythophyllum tenussimum*), 1928, p. 143.
Tabulophyllum traversense (Winchell) (=*Zaphrentis traversensis*), 1866, p. 90. see Sorauf, 1987b: 1988b, p. 410.
Tabulophyllum traversense slossi Pitrat, 1962, p. 1161.
Tabulophyllum verum Spasskiy in Dubatolov et Spasskiy, 1971, p. 106.
Tabulophyllum vorticum (Wang et Tu in Wang et al.) (=*Endophyllum vorticum*), 1955, p. 30.
Tabulophyllum weberi sibisicum Ivaniya, 1965, p. 32.
Tabulophyllum xinjiangense (Cai in Zeng et Cai) (=*Sinospongophyllum xinjiangense*), 1983, p. 195.
Tabulophyllum zonatum. see Sorauf, 1988b, p. 404.

Rejected forms:

Tabulophyllum abditum (Edwards et Haime) (=*Endophyllum abditum*), 1851, p. 394. see Bulvanker, 1958, p. 166.
Tabulophyllum andulosum Spasskiy in Dubatolov et Spasskiy, 1971, p. 106.
Tabulophyllum bifurcatum Soshkina, 1939, p. 41, 57.
Tabulophyllum birmanicum (Reed) (=*Cyathophyllum birmanicum*), 1908, p. 6. see Ma, 1956, p. 57.
Tabulophyllum butovi Bulvanker, 1958, p. 171.
Tabulophyllum complicatum Soshkina, 1939, p. 42, 57.
Tabulophyllum curtoseptatum Bulvanker, 1958, p. 174.
Tabulophyllum butovi diseptatum Ivaniya, 1965, p. 35.
Tabulophyllum concinnum Onoprienko, 1979, p. 54.
Tabulophyllum compositium Onoprienko, 1979, p. 54.
Diversophyllum compressum Stumm, 1940, p. 58.
Tabulophyllum crotaliforme (Stewart) (=*Cyathophyllum crotaliforme*), 1938, p. 32. see Ma, 1956, p. 55.
Tabulophyllum curvatum Sun, 1958, p. 2, 10.
Tabulophyllum cylindricum Sun, 1958, p. 2, 10.
Tabulophyllum cysticum (Winchell) (=*Zaphrentis cystica*), 1866, p. 20. see Sloss, 1939, p. 54; Ma,

1956, p. 57.
Tabulophyllum delicatum Soshkina, 1951, p. 70
Tabulophyllum directum Onoprienko, 1979, p. 55.
Tabulophyllum gigantum Sun, 1958, p. 3, 11.
Tabulophyllum hispanicum Altevogt, 1963, p. 32.
Tabulophyllum ignotum Onoprienko, 1979, p. 55.
Tabulophyllum inclarum Onoprienko, 1979, p. 55.
Tabulophyllum incognitum Onoprienko, 1979, p. 56.
Tabulophyllum jielingense Wu, 1964, p. 70.
Tabulophyllum lacus (Stewart) (=*Cythophyllum lacus*), 1938, p. 33. see Ma, 1956, p. 55.
Tabulophyllum latetbulatum, 1979, p. 56.
Tabulophyllum lonsdaleoides Onoprienko, 1979, p. 57.
Tabulophyllum magnum Onoprienko, 1979, p. 57.
Tabulophyllum nevadense Stumm, 1937, p. 434.
Diversophyllum nevadense Stumm, 1940, p. 58.
Tabulophyllum novum Onoprienko, 1979, p. 56.
Tabulophyllum omulevskiense Spasskiy et Kravtsov in Ivanovskiy, 1975, p. 81.
Tabulophyllum pseudosociale Soshkina, 1951, p. 71.
Tabulophyllum schluteri (Peetz) (=*Cyathopaedium schluteri*), 1901, p. 225. see Bulvanker, 1958, p. 176.
Tabulophyllum sibiricum Bulvanker, 1958, p. 168.
Tabulophyllum simakovi Poty et Onoprienko, 1984, p. 200.
Tabulophyllum simplex Onoprienko, 1979, p. 57.
Tabulophyllum solidum Onoprienko, 1979, p. 55.
Tabulophyllum tareicum Kravtsov, 1963, p. 5. see lvanovskiy, 1975, p. 80.
Tabulophyllum tenuiseptatum Onoprienko, 1979, p. 56.
Tabulophyllum uralicum Vaganova, 1959, p. 77.
Tabulophyllum varium Onoprienko, 1979, p. 57.
Tabulophyllum verrucosum (Soshkina) (=*Schlueteria verrucosa*), 1952, p. 100. see Soshkina, 1954, p. 49.
Tabulophyllum weberi (Lebedew) (=*Cyathophyllum weberi*), 1902, p. 133. see Soshkina, 1951, p. 41.
Tabulophyllum yunnanense (Reed) (=*Campophyllum yunnanense*), 1927, p. 10. see Ma, 1956, p. 57.

Not examined forms

Tabulophyllum allophyllum Ivaniya, 1958, p. 199.
Tabulophyllum amurense Spasskiy, 1968, p. 31.
Tabulophyllum amurense Modzalevskaya, 1969.
Tabulophyllum athabascense (*Whiteaves*) (=*Cyathophyllum athabascense*), 1891, p. 202. see Ma, 1956, p. 55.
Tabulophyllum bakanasense Kaplan, 1969, p. 19.
Tabulophyllum balapanense Kaplan, 1977, p. 32.
Tabulophyllum bartini (Charles) (=*Glossophyllum bartini*), 1933, p. 119. see Ma, 1937, p. 25.
Tabulophyllum biaxis Dobrolyubova, 1966, p. 107.
Tabulophyllum callawayense (Branson) (=*Diplophyllum callawayense*), 1923, p. 50. see Ma, 1937, p. 24.
Tabulophyllum caninoforme Zolkina, 1962, p. 14.
Tabulophyllum carnosum Spasskiy, 1971, p. 60.
Tabulophyllum clisiophylloides Dobrolyubova, 1966, p. 105.
Tabulophyllum ellipticum (Hall et Whitfield) (=*Campophyllum ellipticum*), 1873, p. 202. see Ma, 1937, p. 24.
Tabulophyllum fasciculatum Ivaniya, 1980, p. 47.
Tabulophyllum gallina McCammon, 1960, p. 35.
Tabulophyllum grande Rogozov, 1963, p. 71.
Tabulophyllum houghtoni (Rominger) (=*Cyathophyllum houghtoni*), 1876, p. 104. see Fenton and

Fenton, 1924.
Tabulophyllum karatouense Zolkina, 1962.
Tabulophyllum limbatum Ivaniya, 1962, p. 156.
Tabulophyllum nicolaimichaelidis (Frech) (=*Endophyllum nicolaimichaelidis*), 1900, p. 185. see Ma, 1937, p. 25.
Tabulophyllum paranormale Bulvanker, 1960a, p. 242.
Tabulophyllum paraschlueteri Zhavoronkova, 1972, p. 104.
Tabulophyllum priscoides (Gürich) (=*Endophyllum priscoides*), 1896, p. 185. see Brice and others, 1977.
Tabulophyllum pseudodelicatum Ermakov, 1957, p. 165.
Apolythophyllum rectum Walther, 1928, p. 143. (no figure)
Apolythophyllum sibiricum Bulvanker, 1940.
Tabulophyllum siluriense Ivanovstiy, 1962, p. 120.
Tabulophyllum spiraleseptatum Ivaniya, 1968.
Tabulophyllum strelinaense Besprozvannykh, 1964, p. 60.
Apolythophyllum timanicum Bulvanker, 1947, p. 52.
Tabulophyllum uimense Spasskiy, 1960a.
Tabulophyllum waskasense (Whiteaves) (=*Cyathophyllum waskasense*), 1892, p. 264. see Ma, 1956, p. 55.

Geological distribution: Middle and Late Devonian.
Geographical distribution: Asia, Europe, North America, Australia.

Tabulophyllum aff. *gracile* (Walther), 1928

(Plate 59, fig. 1, 2)

Compare with:

1928 *Apolythophyllum gracile* Walther, p. 139, text-fig. 27.
1978 *Tabulophyllum gracile* (Walther). Birenheide, p. 66, pl. 8, fig. 3.
1990 *Tabulophyllum gracile* (Walther). Birenheide, pl. 4, fig. 10.

Measurement:

No	D	N	Dt	Nt	Lf	Ls	Tw
Mf004005	18.3	26×2	14.7	6	3.5	1.0	0.4
Mf003007	10.2	22×2	8.5	5	1.9	0.8	0.5
	13.1	24×2	11.7		2.0	0.7	0.3

Diagnosis: Solitary, cylindrical coral. Septa of two orders, radially arranged. Major septa short and continuous, minor septa appear as septal ridges, discontinuous in narrow dissepimentarium consisting of 2 to 3 rows of elongated lonsdaleioid dissepiments. Tabularium wide, composed of complete tabulae, which are in flat-topped dome with turndown edges.

Description: Solitary, cylindrical or ceratoid coral. Septa of two orders, somewhat radially arranged. In early stage both major and minor septa continuous (pl. 59, fig. 2b), number 22×2 in the section with diameter of 10.1 mm. Major septa short, only 1.9 mm long, minor septa as long as, or shorter than the half length of the majors. All septa are thickened and wedge-shaped, distinct inner wall formed by dissepiments is present. Dissepiments normal, in only one row. In late stage,

septa thin, number from 22×2 to 24×2 in the section with diameter ranging from 13.1 to 18.3 mm. Major septa usually continuous, 2.0 to 3.5 mm long, straight or curved, only a few of them are disrupted by lonsdaleioid dissepiments (pl. 59, fig. 1a). Minor septa short, unequal, discontinuous, appear as septal ridges. Dissepimentarium narrow, consists of irregular lonsdaleioid dissepiments disrupting minor septa. Herringbone dissepiments are usually present in the inner part of dissepimentarium.

In longitudinal section dissepimentarium narrow, composed of 2 to 3 rows of lonsdaleioid dissepiments. Dissepiments large, elongated, vertically arranged, variable in size. A few small dissepiments may be present in the innermost part of dissepimentarium. The trabeculae forming septa is coarse (pl. 59, fig. b), as shown by Sorauf (1988, pl. 3, fig. 4), about 0.4 mm in diameter. Tabularium wide, with diameter ranging from 11.7 to 14.7 mm, consist of complete tabulae. Tabulae slightly convex or flat-topped dome with turndown edges, 5 to 6 tabulae in 5 mm.

Discussion: The species described here is very close to *T. gracile* (Walther), especially to specimen illustrated by Birenheide (1990, pl. 4, fig. 10) in the characters of septa of the late stage, but differs in the complete tabulae. Maybe the specimens from western Yunnan represent a new species. Only two specimens of this kind of coral have been sectioned, and are not preserved very well, so they are regarded as a affinis of *T. gracile*.

Locality: Malutang.

Suborder Ptenophyllina Wedekind, 1927
Family Ptenophyllidae Wedekind, 1923
Subfamily Ptenophyllinae Wedekind, 1923
Genus *Acanthophyllum* Dybowski, 1873

1873 *Acanthophyllum* Dybowski, p. 339.
1922 *Mesophylloides* Wedekind, p. 51.
1924 *Ptenophyllum* Wedekind, p. 36.
1924 *Astrophyllum* Wedekind, p. 46.
1924 *Rhopalophyllum* Wedekind p. 52.
1925 *Leptoinophyllum* Wedekind, p. 4.
1925 *Stenophyllum* Amanshauser in Wedekind, p. 9.

Type species: *Cyathophyllum heterophyllum* Edwards et Haime, 1851, p. 367.

Diagnosis: Solitary, subcylindrical or ceratoid coral with inversely conical calice or bell-shaped conical calice, moderately large. Septa in two orders. Major septa long, often reach the axis and twist to form a vortex, but sometimes straight, characteristically spindle-shaped and generally more or less modified, usually dilated, sometimes carinate, and often appear to form a loose-plaited strand with break up peripherally. Minor septa well developed, markedly thinner than the majors. Dissepimentarium wide, typically consisting of small, globose to elongate dissepiments, lonsdaleoid dissepiments and lateral dissepiments may be developed. Tabularium

composed of incomplete tabulae, tabularial floors concave, commonly close together.

Discussion: *Acanthophyllum* is a common rugose coral genus in Middle Devonian all over the world. The opinions differ widely with respect to the definition and the morphological range of the genus. Birenheide (1961) discussed the genus *Acanthophyllum* and includes the three subgenera *Acanthophyllum*, *Neostringophyllum* and *Grypophyllum* within it. They differ primarily in the calical shape, degree of septal dilatation, and to a lesser extent degree of development of lonsdaleoid dissepiments. Some authors including Strusz (1966) follow Birenheide in subdividing *Acanthophyllum* into three subgenera, but most palaentologists, for example, McLaren (1964) and Jia (1984), consider the differences among the three taxa of generic importance taxonomically. Pedder (1973) merges *Neostringophyllum* in *Grypophyllum*, and separate the both from *Acanthophyllum*. Birenheide (1978) and Hill (1981) consider *Neostringophyllum* synonymous with *Acanthophyllum*, and give *Grypophyllum* a generic rank. For the presest I follow Birenheide (1978) and Hill (1981) in the assignment of *Neostringophyllum* to synonymy with *Acanthophyllum,* and in regarding *Grypophyllum* as an independent genus.

In Birenheide's revision (1961) of *Acanthophyllum* and related genera, *Grypophyllum* was differentiated from *Acanthophyllum* primarily on the basis of calicular form, which is bell-shaped in *Acanthophyllum* and inversely conical in *Grypophyllum*. Some species of *Acanthophyllum*, previously referred to the subgenus *Neostringophyllum*, also bear inversely conical calice. Generally speaking, in *Grypophyllum* septa are usually radial to weakly pinnate in arrangement, and are typically smooth and thin throughout their length. Dissepiments are relatively large, elongated, inclined inwardly, variable in size. Tabulae large, usually deeply concave. In *Acanthophyllum* septa are commonly bilateral in arrangement, dilated in the form of spindle to variable degrees. Cardinal and counter septa or a few protosepta are longer than the others and reach the axis and twist to form a vortex. Septa are unually carinated, especially in tabularium. Dissepiments small and regular in size, tabulae commonly small.

Neostringophyllum ultimum Wedekind, the type species of *Neostringophyllum*, has been regarded as a species of *Acanthophyllum* (Birenheide, 1961, p. 80; 1978, p. 150) and as a species of *Grypophyllum* (Pedder, 1971, p. 101). The present author prefers to agree with Birenheide on the basis of the degree of septal dilation in the holotype of *Neostringophyllum ultimum* Wedekind which can be distinguished from *Grypophyllum denckmanni* Wedekind, 1922, the type species of *Grypophyllum*, by having dilated septa as in *Acanthophyllum*.

Acanthophyllum is very close to *Dohmophyllum* in some characters, for example, both of them bear spindle-shaped long septa and wide dissepimentarium and so on. So there is no agreement on the division between the two common genera among coral paleotologists. In the past some authors had proposed a few standards to divide the two genera. Because the shape of skeleton in this kind of corals is extremely variable, however, it is very difficult to use a stable feature to

differentiate one from the other . So Wang (1950, p. 218) regarded *Dohmophyllum* as the synonym of *Acanthophyllum*. Pedder (1971, p. 40) suggested to use the ratio of the width of the tabularium to that of the entire corallite (Dt/Dc) as the standard to distinguish them. This is very useful in determining of species in this kind of coral, but is not easily used in generic division in practical identification. According to the characters shown in *A. heterophyllum*, the type species of *Acanthophyllum* and *D. involutum* Wedekind, 1923, the type species of *Dohmophyllum*, the most obvious difference between *Acanthophyllum* and *Dohmophyllum*is to be found in tabularium. *Acanthophyllum* bears slightly concave tabulae, and *Dohmophyllum* has relatively wide tabularium composed of slightly covex tabulae.

Assigned forms :

Acanthophyllum (*Acanthophyllum*) *aeneae* Strusz, 1966, p. 550.
Acanthophyllum aequiseptatum Hill, 1940a, p. 251.
Acanthophyllum angustum (Jin et He) (=*Leptoinophyllum angustum*), 1982, p. 134.
Acanthophyllum baculoides (Pocta) (=*Cyathophyllum baculoides*), 1902, p. 101. see Hill, 1939b, p. 223 ; Birenheide, 1978, p. 147.
Acanthophyllum bulvankerae (Spasskiy) (=*Ptenophyllum bulvankerae*), 1960, p. 61.
Acanthophyllum butovi (Bulvanker) (=*Ptenophyllyum butovi*), 1958, p. 98.
Acanthophyllum caiquum (Wedekind) (=*Stenophyllum caiquum*), 1925, p. 12.
Acanthophyllum carinatum (Soshkina) (=*Astrophyllum carinatum*), 1936, p. 60.
Acanthophyllum carinatum Goryanov in Bulvanker et al., 1968, p. 34.
Acanthophyllum celechovicense (Kettnerovā) (=*Ptenophyllum celechovicense*), 1932, p. 24.
Acanthophyllum cicatricosum (*Wedekind*) (=*Ptenophyllum cicatricosum*), 1922a, p. 34. p. 56 ; Birenheide, 1962, p. 103.
Acanthophyllum clermontense (Etheridge) (=*Cyathophyllum clermontense*), 1911, p. 5. see Hill, 1939a, p. 57 ; Pedder, 1965b, p. 215.
Acanthophyllum complicatum (Walther) (=*Neostringophyllum complicatum*), *1928, p. 115.*
Acanthophyllum concavum (Walther) (=*Neostringophyllum concavum*), 1928, p. 114.
Acanthophyllum conicum Wandg, 1948, p. 6.
Acanthophyllum coniforme (Wedekind) (=*Ptenophyllum coniforme*), 1924, p. 44. see Birenheide, 1962, p. 104.
Acanthophyllum contextum Goryanov, 1969, p. 135.
Acanthophyllum craigi (McLaren in McLaren et Norris) (=*Neostringophyllum craigi*), 1964, p. 11.
Acanthophyllum devonicum (Besprozvannych) (=*Ptenophyllum devonicum*), 1964, p. 64.
Acanthophyllum diluvianum (Amanshauser in Wedekind) (=*Stenophyllum dillvianum*), 1925, p. 12. see Tsien, 1969, p. 118.
Acanthophyllum entovallum (Jin et He) (=*Leptoinophyllum entovallum*), 1982, p. 134.
Acanthophyllum fibratum (Wedekind) (=*Rhopalophyllum fibratum*), 1924, p. 52.
Acanthophyllum filosum (Wedekind) (=*Ptenophyllum filosum*), 1924, p. 43.
Acanthophyllum frasniense Rozkowska, 1979, p. 44.
Acanthophyllum furcansum (Kong in Kong et Huang) (=*Leptoinophyllum furcansum*), 1978, p. 127.
Acanthophyllum gerolsteinense (Wedekind) (=*Astrophyllum gerolsteinense*), 1924, p. 48. see Stumm, 1949, p. 21.
Acanthophyllum gerolsteinense crassum (Wedekind) (=*Astrophyllum gerolsteinense crassum*), 1924, p. 48. see Yu, Liao and Deng, 1974, p. 225.
Acanthophyllum graniferum Bulvanker, Spasskiy et Kravtsov in Ivanovskiy, 1975, p. 68.
Acanthophyllum hallioides (Frech) (=*Cyathophyllum hallioides*), 1886, p. 63. see Ma, 1956, p. 62.
Acanthophyllum hedstroemi (Wedekind) (=*Stenophyllum hedstroemi*), 1925, p. 10.
Acanthophyllum heterophyllum (Edwards et Haime) (=*Cyathophyllum heterophyllum*), 1851, p. 367.
Acanthophyllum implicatum (Borchers in Wedekind) (=*Stenophyllum implicatum*), 1925, p. 12.

Acanthophyllum (*Neostringophyllum*) *implicatum*, Strusz, 1966, p. 554.
Acanthophyllum inchoatum (Walther) (=*Neostringophyllum inchoatum*), 1928, p. 112.
Acanthophyllum intermedium (Borchers in Wedekind) (=*Stenophyllum intermedium*), 1925, p. 12.
Acanthophyllum intortum (Wedekind) (=*Ptenophyllum intortum*), 1922a, p. 30.
Acanthophyllum intortum (Wedekind) (=*Astrophyllum intortum*), 1924, p. 64.
Acanthophyllum intratum (Wedekind) (=*Rhopalophyllum intratum*), 1924, p. 63.
Acanthophyllum involutum (Wedekind) (*Ptenophyllum involutum*), 1924, p.44.
Acanthophyllum involutum Yü et Kuang, 1982b, p. 265.
Acanthophyllum irgislense (*Soshkina*) (=*Astrokhyllum irgislense*), 1949, p. 73. see Soshkina, 1952, p. 83.
Acanthophyllum lacinatum (Wedekind) (=*Rhopalophyllum lacinatum*), 1924, p. 63.
Acanthophyllum looghense (Wedekind) (=*Leptoinophyllum looghense*), 1925, p. 8. see Birenheide, p. 1962, p. 110.
Acanthophyllum lyrielasmaeforme (Goryanov) (=*Ptenophyllum lyrielasmaeforme*), 1969, p. 133.
Acanthophyllum mansfieldense (Dun) (=*Cyathophyllum mansfieldense*), 1898, p. 87. see Hill, 1939b, p. 223.
Acanthophyllum maximum (Wedekind) (=*Stenophyllum maximum*), 1925, p. 13. see Birenheide, 1962, p. 110.
Acanthophyllum mirabile Tcherepnina in Astrova et Chudinova, 1970, p. 113.
Acanthophyllum mutabile Tsien, 1969, p. 118.
Acanthophyllum nohnense (Wedekind) (=*Ptenophyllum nohnense*), 1924, p. 21.
Acanthophyllum paraultimum (Kong in Kong et Huang) (=*Neostringophyllum paraultimum*), 1978, p. 115.
Acanthophyllum planum (Walther) (=*Neostringophyllum planum*), 1928, p. 113.
Acanthophyllum praecursor (Walther) (=*Neostringophyllum praecursor*), 1928, p. 112.
Acanthophyllum praeematurum (Wedekind) (=*Ptenophyllum praematurum*), 1922a, p. 29. see Stumm, 1949, p. 21.
Acanthophyllum primum (Wedekind) (=*Ptenophyllum primum*), 1922a, p. 33. see Birenheide, 1962, p. 112.
Acanthophyllum princeps (Wedekind) (=*Ptenophyllum princeps*), 1922a, p.33. see Wedekind, 1924, p. 43; Birenheide, 1962, p. 112.
Acanthophyllum pseudofibratum (Wedekind) (=*Rhopalophyllum pseudofibratum*), 1924, p. 63.
Acanthophyllum psevdofibrosum (Wedekind) (=*Ptenophyllum pseudofibrosum*), 19922a, p. 34. see Birenheide, 1962, p. 112.
Acanthophyllum pulchrum (Goryanov) (=*Ptenophyllum pulchrum*), 1969, p. 134.
Acanthophyllum quadripartitum (Wedekind) (=*Ptenophyllum quadripartitum*), 1922a, p. 34. see Birenheide, 1962, p. 113.
Acanthophyllum radiatum (Wedekind) (=*Ptenophyllum radiatum*), 1924, p. 43.
Acanthophyllum regressum (Walther) (=*Neostringophyllum regressum*), 1928, p. 116.
Acanthophyllum roemeri (Edwards et Haime) (=*Cyathophyllum roemeri*), 1853, p. 224.
Acanthophyllum richteri Wedekind (=*Mesophylloides richteri*), 1922b, p. 55.
Acanthophyllum salairicum (Bulvanker) (=*Grypophyllum salairicum*), 1958, p. 145. see Peder, 1973, p. 100.
Acanthophyllum scissum (Wedekind) (=*Ptenophyllum scissum*), 1922, p. 24. see Wedekind, 1924, p. 63; Birenheide, 1962, p. 115.
Acanthophyllum shaanxiense (Cao in Cao et al.) (=*Leptoinophyllum shaanxiense*), 1983, p. 145.
Acanthophyllum simplex (Wedekind) (=*Ptenophyllum simplex*), 1924, p. 39.
Acanthophyllum simplex (Walther) (=*Neostringophyllum simplex*), 1928, p. 113.
Acanthophyllum smyckai (Kettnerova) (=*Leptoinophyllum smyckai*), 1932, p. 42.
Acanthophyllum soshkinae (Spasskiy) (=*Ptenophyllum soshkinae*), 1977, p.102.
Acanthophyllum spinosum (Wedekind) (=*Rhopalophyllum spinosum*), 1924, p. 64.
Acanthophyllum tenuiseptatum Bulvanker, 1958, p. 97.
Acanthophyllum tornatum (Wedekind) (=*Ptenophyllum tornatum*), 1922a, p. 34. see Wedekind, 1924, p. 44; Birenheide, 1962, p. 117.
Acanthophyllum torquatum (Schlüter) (=*Cyathophyllum torquatum*) , 1884, p. 83. see Ma, 1956, p.

58; Birenheide, 1962, p. 112; 1978, p. 147.
Acanthophyllum torquatum orientale (Reed) (=*Cyathophyllum toquatum orientale*), 1922, p. 9.
Acanthophyllum (*Neostringophyllum*) *turni* Strusz, 1966, p. 559.
Acanthophyllum ultimum (Wedekind) (=*Neostringophyllum ultimum*), 1921, p. 16.
Acanthophyllum vermiculare (Goldguss) (=*Cyathophyllum vermiculare*), 1826, p. 58. see Ma, 1956, p. 59.
Acanthophyllum vermiculare minor Ma, 1956, p. 61.
Acanthophyllum wedekindi (Ivaniya) (=*Grypophyllum wedekindi*), 1960, p. 377. see Ivaniya, 1965, p. 150.
Acanthophyllum zhonggouense Jia (=*Neostringophyllum zhonggouense*), 1984, p. 30.
Acanthophyllum zintchenkae (Ivaniya)(=*Neostringophyllum zintchenkae*), 1957, p. 61. see Ivaniya, 1965, p. 89.

Rejected forms:

Stenophyllum altum Soshkina, 1949, p. 128. see Soshkina, 1952, p. 94.
Leptoinophyllum angustifossulatum Spasskiy et Kravtsov in Ivanovskiy, 1975, p. 70.
Mesophylloides auburgensis Wedekind, 1922b, p. 53. 9ee Birenheide, 1978, p. 174.
Acanthophyllum asperum Hill, 1940a, p. 252.
Neostringophyllum autiquum (Soshkina) (=*Charactophyllum autiquum*), 1949, p. 91. see Ivanova and Soshkina, 1980.
Neostringophyllum baculiferum Spasskiy et Kravtsov in Ivanovskiy, 1975, p. 75.
Leptoinophyllum conjunctivum Jin et He, 1982, p. 134.
Stenophyllum convolutum Amanshauser in Wedekind, 1925, p. 11.
Stenophyllum devonicum Bulvanker, 1955, p. 211. see Spasskiy, 1960, p. 58.
Neostringophyllum difficile (Soshkina) (=*Temnophyllum difficile*), 1951, p. 66. see Soshkina, 1952, p. 90.
Acanthophyllum figuratum Spasskiy, 1964, p. 135. see Spasskiy, 1977, p. 322.
Neostringophyllum fameniense Ivaniya, 1965, p. 91.
Neostringophyllum guangxiense Jia, 1984, p. 30.
Stenophyllum giganteum Spasskiy, 1960, p. 60.
Stenophyllum gorskii Bulvanker, 1955, p. 211. see Spasskiy, 1960, p. 58.
Acanthophyllum guitangense Yū et Liao in Wang et al., 1974, p. 33.
Neostringophyllum heterophylloides (Frech) (=*Cyathophyllum heterophylloides*), 1885, p. 30. see Spasskiy and Kravtsov, 1975, p. 74.
Ptenophyllum irrebulare Kettnerovā, 1932, p. 26.
Neostringophyllum isetense Soshkina, 1951, p. 53.
Neostringophyllum jenkinsi (Strusz) (=*Acanthophyllum* (*Grypophyllum*) *jenkinsi*), 1966, p. 562. see Pedder, 1973, p. 100.
Neostringophyllum jiwozhaiense (Yü, Liao et Deng) (=*Grypophyllum jiwozhaiense*), 1974, p. 230. see Kong and Huang, 1978, p. 114.
Mesophylloides kirki Stumm, 1937, p. 441.
Acanthophyllum kumuxiense Zeng et Cai, 1983, p. 195.
Neostringophyllum litvinovitschae (Soshkina) (=*Campophyllum litvinovitschae*), 1949, p. 86. see Ivanovskiy and Shurygina, 1980.
Mesophylloides maximus (Schlüter) (=*Actinocystis maximus*), 1882, p. 207. see Birenheide, 1978, p. 168.
Neostringphyllum mirabile (Birenheide) (=*Grypophyllum mirabile*), 1972, p. 72. see Pedder, 1973, p. 100.
Neostringophyllum mirabilism Jia in Jia et al., 1977, p. 162.
Neostringophyllum mistusum Kong in Kong et Huang, 1978, p. 114.
Acanthophyllum modicum (Smith) (=*Mictophyllum modicum*), 1945, p. 32. see Ma, 1956, p. 62.
Neostringophyllum modicum (Smith) (=*Mictophyllum modicum*), 1945, p. 32. see Soshkina, 1952, p. 90; Spasskiy and Kravtsov in Ivanovskiy, 1975, p. 75.
Leptoinophyllum moravicum Kettnerova, 1932, p. 42.

Leptoinophyllum multiseptatum Amanshauser in Wedekind, 1925, p. 9.
Neostringophyllum normale (Wedekind) (=*Grypophyllum normale*), 1925, p. 21. see Kong and Huang, 1978, p. 115.
Astrophyllum philocrinum (Frech) (=*Cyathophyllum helianthoides philocrina*), 1886, p. 56. see Soshkina, 1949, p. 73; 1952, p. 83.
Neostringophyllum pronini Soshkina, 1951, p. 61.
Acanthophyllum robertsense Merriam, 1973, p. 30.
Stenophyllum salairicum Kraevskaya in Khalfin, 1955, p. 211.
Stenophyllum soshkinae Zhmaev in Khalfin, 1955, p. 212.
Stenophyllum spinulosum Soshkina, 1952, p. 93.
Acanthophyllum sweeti (Ethridge) (=*Cyathophyllum sweeti*), 1895, p. 521. see Hill, 1942c, p. 235.
Stenophyllum taimyricum Kravtsov, 1963, p. 40.
Neostringophyllum tenue (Wedekind) (=*Grypophyllum tenue*), 1925, p. 22. see Kong and Huang, 1978, p. 115.
Stenophyllum uralicum Soshkina, 1949, p. 129. see Soshkina, 1952, p. 94.
Neostringophyllum vermiculare (Paeckelmann). see Kong and Huang, 1978, p. 116.
Acanthophyllum vermiculare praecursor (Frech) (=*Cyathophyllum vermiculare praecursor*), 1886, p. 63. see Ma, 1956, p. 60.
Acanthyllum vermiculare versiculosum (Sloss) (=*Hallia versiculosa*), 1939, p. 62. see Ma, 1956, p. 60.
Stenophyllum vogulicum (Bulvanker) (=*Cyathophyllum vogulicum*), 1934, p. 17. see Soshkina, 1941.
Neostringophyllum waltheri (Yoh) (=*Temnophyllum waltheri*), 1937, p. 58. see Soshkina, 1952, p. 90; Spasskiy and Kravtson, 1975, p. 74.
Acanthophyllum xintianense Jiang, 1982, p. 102.

Not examined forms:

Acanthophyllum atomatum Spasskiy, 1964, p. 134.
Acanthophyllum battersbyi (Edwards et Haime) (=*Metriophyllum battersbyi*), 1851, p. 318. see Holwill, 1964, p.119.
Acanthophyllum breviforme Zheltonogova, 1961, p. 405.
Acanthophyllum coniforme (Walther) (=*Neostringophyllum coniforme*), 1928, p. 116. see Birenheide, 1972. (no figure)
Acanthophyllum cornutum (Kelus) (=*Leptoinophyllum cornutum*), 1939, p. 43.
Ptenophyllum crassum Wedekind, 1922, p. 29.
Acanthophyllum cresswelli (Chapman) (=*Cyathophyllum cresswelli*), 1925, p. 111. see Ma, 1965, p. 59.
Acanthophyllum daedaleum Spasskiy, 1964, p. 136.
Ptenophyllum deciduum (Kravtson) (=*Phaulactis deciduum*), 1966, p. 30. see Spasskiy, 1977, p. 102.
Neostringophyllum devonicum Soshkina. see Spasskiy, 1977, p. 110.
Acanthophyllum dianthus (Goldfuss) (=*Cyathophyllum dianthus*), 1826, p. 54. see Mironova, 1966.
Acanthophyllum dunkani Dybowski, 1873, p. 271.
Neostringophyllum finale Kettnerovā, 1971, p. 57.
Ptenophyllum (Rhopalolasma) hudsoni Weyer, 1973, p. 679.
Neostringophyllum lacerum Goryanov, 1967, p. 8.
Acanthophyllum linarssenii Dybowski, 1874, p. 493.
Neostringophyllum litvinovitchi Soshkina, 1941, p. 37.
Acanthophyllum nikolaievi Bulvanker, 1965, p. 56.
Leptoinophyllum perneri Le Maitre, 1934.
Neostringophyllum posterum Zheltonogova, 1961.
Acanthophyllum pseudohelianthoides (Sherzer) (=*Chonophyllum pseudohelianthoides*), 1892, p. 275. see Goryanov, 1967.
Acanthophyllum radicans Dybowski, 1873, p. 319.

Acanthophyllum schischkaticum Lavrusevich, 1971, p. 47.
Neostringophyllum vilvense (Spasskiy) (=*Grypophyllum vilvense*), 1955, p. 131. see Pedder, 1973, p. 100.
Acanthophyllum weeekindi (Kettnerova) (*Rhopalophyllum* =*wedekindi*), 1932, p. 32.

Geological distribution: Devonian
Geographical distribution: China, Australia, North America, Europe.

Acanthophyllum concavum (Walther), 1928

(Plate 5, fig. 3, 4)

1925 *Neostringophyllum* sp. Wedekind, p. 45, pl. 11, fig. 68, 69.
1928 *Neostringophyllum concavum* Walther, p. 114, text-fig, 8.
1961 *Acanthophyllum* (*Neostringophyllum*) *concavum* (Walther). Birenheide, p. 125, p. 7, fig. 23, 24.
1964 *Acanthophyllum* (*Neostringophyllum*) *concavum* (Walther). Webby, p. 12, text-fig. 4.
1966 *Acanthophyllum* (*Neostringophyllum*) aff. *concavum* (Walther). Flugel, p. 102, pl. 1, fig. 1.
1978 *Acanthophyllum concavum* (Walther). Birenheide, p. 150, text-fig. 94.
1990 *Acanthophyllum concavum* (Walther). Birenheide, pl. 4, fig. 12.
non 1992 *Acanthophyllum concavum* (Walther). Oekentorp-Kuster and Oekentorp, p. 238, pl. 2, fig. 1.

Measurement:

No	D	N	Dt	Nt	Nd	Lf	Ls
Mf00x054	35.3	38×2	10.5	12	15	17.1	12.6
Hf1039	28.6	34×2	9.4	11	13	13.0	9.9

Diagnosis: Solitary, subcylindrical or ceratoid coral. Septa of two orders, bilateral or pinnate in arrangement. Major septa long, reach the axis, commonly straight, may be slightly curved in the axial space. Cardinal and counter septa markedly longer than the other septa, exceed beyond the axial center to form a symmetry plane of septal arrangement. Major septa spindle-shaped. Minor septa well developed, about two thirds of the major ones in length, thinner than the majors. Dissepimentarium consists of numerous rows of dissepiments, lonsdaleoid dissepiment occasionally prenent in the periphery. Tabularium composed of incomplete tabulae, tabularial floors concave.

Description: Solitary, subcylindrical and ceratoid coral. Only two specimens of this species have been sectioned. In the individuals measured the diameter are 35.3 and 28.6 mm respectively, and septa 38×2 and 34×2 in number, bilateral or pinnate in arrangement. Major septa long, reach the axis, straight or slightly curved in axial area, smooth or with weakly developed carinae. Major septa are attenuated near periphery, then dilated across the inner part of dissepimentarium in spindle, then attenuate in tabularium. Cardinal and counter septa longer than the others and form a symmetry plane of septal arrangement. Minor septa well developed, as long as, or longer than the two thirds of the major ones, markedly thinner than the majors . Dissepimentarium wide, composed mainly of normal dissepiments. There

are commonly herringbone dissepiments in the loculi between adjacent major and minor septa, lonsdaleoid dissepiments disrupting major and minor septa may occur in the periphery.

In longitudinal section dissepimentarium consists of 11 to 12 rows of dissepiments. Dissepiments incline inwardly, the inclination increases from outer to inner part. The inner rows of dissepiments slightly elongated, nearly vertically arranged. Tabularium is less than one third of entire corallum in diameter, made up of axial tabulae and periaxial tabulae. The periaxial tabulae are variable in size and incline inwardly. Axial tabulae commonly small, closely spaced so that 13 to 15 may be counted over a vertical distance of 5 mm. The tabularial floors concave.

Discussion: This species is characterized by the long major septa, reaching the axis, straight or slightly curved in inner end, bilateral or somewhat pinnate in arrangement. Cardinal and counter septa are longer than the others and forming a symmetry plane of septal arrangement, and by the well developed minor septa,

Of the two specimens of the species available to me, one shown as fig. 4 in plate 5 is very close to the holotype of *A. concavum* from Givetian of Germany illustrated by Walther (1928) and Birenheide (1961; 1978; 1990). Another one shown as fig. 3 in plate 5 is larger in diameter and more in number of septa than the holotype of *A. concavum*.

Locality: Malutang and Heyuanzhai.

Acanthophyllum looghense (Wedekind), 1925

(Plate 5, fig. 1, 2)

1925 *Leptoinophyllum looghense* Wedekind, p. 98.
1962 *Leptoinophyllum looghense* Wedekind, Birenheide, p. 110, pl. 14, fig. 2.
1958 *Ptenophyllum butovi* Bulvanker, p. 98, pl. 48, fig. 1.
1961 *Acanthophyllum* (*Grypophyllum*) *vermiculare* (Goldfuss), Birenheide, (in part) p. 117, pl. pl. 6, fig. 20.
1965 *Grypophyllum* (*Leptoinophyllum*) *vermiculare* (Goldfuss). Schouppé, 1965, p. 17, pl. 1, fig. 1-4.

Measurement:

No	D	N	Dt	Nt	Nd	Lf	Ls
Mf009015	29.1	32×2	12.3	9	11	15.6	13.6
Hf1038	30.6	31×2	12.2	9	8	16.3	11.4
Mf009002	34.1	35×2	14.8	8	14	16.1	13.1

Diagnosis: Solitary, cylindrical coral with septa of two orders, bilateral in arrangenent. Major septa long, rotated in axial area in groups. Minor septa well developed. Cardinal septum and the major septa near to the cardinal septum slightly short than the other major ones. One or a few protosepta longer than the others. Dissepimentarium composed of numerous rows of dissepiments, including herringbone dissepiments and lonsdaleoid dissepiments. Tabularium consists of incomplete tabulae, tabularial floor concave.

Description: Three specimens referred to this species have been sectioned from

western Yunnan. Corallum cylindrical, with diameter ranging from 29.1 to 34.1 mm. Septa in two orders, bilateral or pinnate in arrangenent, from 31×2 to 35×2 in number. Major septa long reach the axis, rotated in axial area in groups, attenuate near periphery, then dilated in spindle across the inner part of dissepimentarium, thinner in tabularium. Cardinal septum and the septa around cordinal ones commonly slightly shorter than the other majors. One or a few major septa longer than the others, and the septa pinnately arranged around the longer major septa. Septa commonly smooth in dissepimentarium, carinated in tabularium. In transverse section normal dissepiments are dominant, herringbone dissepiments often occur in the loculi between adjacent major and minor septa, occasionally lateral dissepiments on the sides of septa and lonsdaleoid dissepiments in periphery disrupting minor septa are present.

In longitudinal section dissepimentarium composed of 8 to 14 rows of dissepiments, from the outer to inner part dissepiments gradually increase in size and inclined inwardly. Inner dissepiments elongated, nearly vertically arranged. Tabularium wide, with diameter ranging from 12.2 to 14.8 mm, consists of incomplete tabulae. Tabulae small in size, periaxial tabulae gently inclined, and axial tabulae concave, closely placed so that 8 to 9 can be counted over a vertical distance of 5 mm.

Discussion: The forms described here agree closely with the holotype of *A. looghense* illustrated by Birenheide (1962, pl. 14, fig. 2) in characters of septa, but differs in having small diameter and less number of septa.

Locality: Malutang and Heyuanzhai.

Genus *Grypophyllum* Wedekind, 1921

1921 *Grypophyllum* Wedekind, p. 13
1951 *Hooeiphyllum* Taylor, p. 173

Type species: *Grypophyllum denckmanni* Wedekind, 1921, p. 13.

Diagnosis: Solitary, ceratoid to subcylindrical coral with an inversely conical calice. Septa of two orders, radial to weakly pinnate in arrangement, smooth and thin throughout their length. Carinae exceedingly rare, and if present are invariably fine. Major septa long, and may be slightly rotated about the axis. Minor septa well or poorly developed. The adult dissepimentarium consisting of more than one to numerous rows of relatively large and inclined dissepiments, some of them may be lonsdaleoid. Tabulae incomplete to vesicular, usually closely spaced, and commonly forming axially depressed tabularial surfaces.

Discussion: My opinion on the relationship among *Acanthophyllum*, *Grypophyllum* and *Neostringophyllum* has been noted in the discussion on the genus *Acanthophyllum*. Here only the differences between *Grypophyllum* and the other related genera are given.

Lyrielasma Hill, 1939 has some resemblance to *Grypophyllum*, but the growth

shape is fasciculate; and strongly flanged septa of *Lyrielasma* in tabularium can serve to distinguish it from the latter. Pedder (1967a, p. 10) erected a genus *Embolophyllum* on the basis of *Acanthophyllum asper* Hill, 1940. Although there is no agreement on the difference between *Embolophyllum* and *Lyrielasma* so far, it is considered that the well developed septal flanges are present in the tabularium in *Embolophyllum* as in *Lyrielasma*. Moreover, in the holotype of *Acanthophyllum asper* Hill, septa are markedly dilated as in *Acanthophyllum*, minor septa well developed. So *Grypophyllum* can be easily distinguished from both *Lyrielasma* and *Embolophyllum* by its solitary growth shape, smooth and thin septa as well as usually poorly developed minor septa which may be replaced by herringbone dissepiment.

Assigned forms:

Grypophyllum aquilonium Pedder, 1973, p. 103.
Grypophyllum clarifundatum Ivaniya, 1965, p. 156.
Grypophyllum convolutum (Amanshauser in Wedekind) (=*Stenophyllum convolutum*), 1925, p. 2.
Grypophyllum cornus McLaren in Mclaren et Norris, 1964, p. 10.
Grypophyllum denckmanni Wedekind, 1921, p. 13.
Grypophyllum distinctum Kong in Kong et Huang, 1978, p. 113.
Grypophyllum gracile (McCoy) (=*Strephodes gracile*), 1850, p. 378. see Pedder, 1964, p. 440.
Grypophyllum gracile Wedekind, 1925, p. 22.
Grypophyllum jenkinsi Strusz (=*Acanthophyllum* (*Grypophyllum*) *jenkinsi*), 1966, p. 562.
Grypophyllum guangxiense Jia (=*Neostringophyllum guangxiense*), 1984, p. 30.
Grypophyllum jiwozhaiense Yü, Liao et Deng, 1974, p. 230.
Grypophyllum longiseptatum Jia, 1984, p. 92.
Grypophyllum mirabile Birenheide, 1972, p. 417.
Grypophyllum multiseptatum (Amanshauser in Wedekind) (=*Leptoinophyllum multiseptatum*), 1925, p. 9.
Grypophyllum normale Wedekind, 1925, p. 21.
Grypophyllum praecursor (Frech) (=*Cyathophyllum vermiculare praecursor*), 1886, p. 63. see Birenheide, 1961.
Grypophyllum regressum Wedekind, 1925, p. 22.
Grypophyllum shaoyangense Jiang, 1982, p. 105.
Grypophyllum striatum (Soshkina) (=*Neomphyma striatum*), 1937, p. 78, 99. see Soshkina, 1952, p. 96; Spasskiy, 1977, p. 326.
Grypophyllum stummi (Taylor) (=*Hooeiphyllum stummi*), 1951, p, 176. see Engel and Schouppé, 1958, p. 108.
Grypophyllum subnormale Yü et Kuang, 1982, p. 266.
Grypophyllum subtile Pedder, 1973, p. 105.
Grypophyllum tenus Wedekind, 1925, p. 22.
Grypophyllum tortum Tsien, 1969, p. 123.
Grypophyllum unduliseptatum Ivaniya, 1965, p. 152.
Grypophyllum vesiculosum Guo, 1980, p. 144.
Grypophyllum wedekindi Middleton, 1959, p. 146.

Rejected forms:

Grypophyllum aggregatum Hill, 1940a, p. 268.
Grypophyllum beichuanense He, 1978, p. 151.
Grypophyllum butovi (Bulvanker) (=*Ptenophyllum butovi*), 1958, p. 98. seePedder, 1973, p. 100.
Grypophyllum caiquum (Wedekind) (=*Stenophyllum caiquum*), 1925, p. 11. see Pedder, 1973, p. 100.

Grypophyllum carinatum (Soshkina) (=*Astrophyllum carinatum*), 1936, p. 60.
Grypophyllum ceriosum Ivaniya, 1965, p. 151.
Grypophyllum compactum Hill, 1942c, p. 255.
Grypophyllum crickmayi Pedder, 1973, p. 106.
Grypophyllum curviseptatum Stumm, 1937, p. 433.
Grypophyllum cynacanthinum Soshkina, 1949, p. 139. see, Soshkina, 1952, p, 96.
Grypophyllum diluxianum (Amanshauser in Wedekind) (=*Stenophyllum diluvianum*), 1925, p. 9. see Pedder, 1973, p, 100.
Grypophyllum elongatum (Kettnerovā) (=*Atelophyllum elongatum*), 1932, p. 19. see Ma, 1956, p. 52.
Grypophyllum fasciculus Kraevskaya in Khalfin, 1955, p. 210.
Grypophyllum gansuense Cao in Cao et al. 1983, p. 145.
Grypophyllum giganteum Stumm, 1937, p. 433.
Grypophyllum gracile kuznetskiense Bulvanker, 1958, p. 145.
Grypophyllum graciliseptatum Pedder, 1964, p. 441.
Grypophyllum graciliseptatum hejingense Cai in Zeng et Cai, 1983, p. 198.
Grypophyllum hedstroemi (Wedekind) (=*Stenophyllum hedstroemi*), 1925, p. 12. see Pedder, 1973, p. 100.
Grypophyllum isactis (Frech) (=*Cyathophyllum isactis*), 1886, p. 76. see Wedekind, 1921, p. 15.
Grypophyllum lebedewi Ma, 1956, p. 52.
Grypophyllum liuyangense Jiang, 1982, p. 104.
Grypophyllum longmenshanense He, 1978, p. 152.
Grypophyllum lonsdaleioides Tsien, 1969, p. 123.
Grypophyllum looghense (Wedekind) (=*Leptoinophyllum looghense*), 1925, p. 8.
Grypophyllum minimum Ivaniya, 1965, p. 154.
Grypophyllum nevadense Stumm, 1937, p. 432.
Grypophyllum paraagreratum Bulvanker, 1968, p. 37.
Grypophyllum pestereviense Zhmaev, 1955, p. 209.
Grypophyllum primum (Wedekind) (=*Ptenophyllum primum*), 1922a, p. 33. see Birenheide, 1962, p. 112; 1972, p. 414.
Grypophyllum psilatum Yü et Kuang, 1982a, p. 70.
Grypophyllum salairicum Bulvanker, 1958, p. 145.
Grypophyllum smyckai (Kettnerová) (=*Leptoinophyllum smyckai*), 1932, p. 42. see Pedder, 1973, p. 100.
Grypophyllum torquatum orientale (Reed) (=*Cyathophyllum torquatum orientale*), 1922, p. 9. see Pedder, 1973, p. 100.
Grypophyllum schwelmense Wedekind, 1925, p. 17.
Grypophyllum ultimum (Wedekind) (=*Neostringophyllum ultimum*), 1921, p. 16. see, Pedder, 1973, p. 101.
Grypophyllum vermiculare (Goldfuss) (=*Cyathophyllum vermiculare*), 1826, p. 28. see Birenheide, 1961, p. 117; Ma, 1956, p. 59.
Grypophyllum xiangzhouense Jia, 1984, p. 29.
Grypophyllum wedekindi Ivaniya, 1960, p. 377. see Ivaniya, 1965, p. 150.

Not examined forms:

Grypophyllum arcticum Bulvanker, 1968, p. 38.
Grypophyllum asiaticum Goryanov, 1967, p. 8.
Grypophyllum glukovense Tcherepnina in Zheltonogova, 1961.
Grypophyllum gorskii Soshkina. see Spasskiy, 1977, p. 106.
Grypophyllum mirabile Suitova, 1968, p. 65.
Grypophyllum rectum (Meek) (=*Zaphrentis rectum*), 1867, p. 82. see Warren and Stelck, 1956.
Grypophyllum reimani Lavrusevich, 1968.
Grypophyllum robustum (Maurer) (=*Cyathophyllum robustum*), 1885, p. 95.
Grypophyllum timanicum (Lebedev) (=*Cyathophyllum timanicum*), 1902, p. 179. see Ma, 1937.
Grypophyllum vilvense Spasskiy, 1955, p. 131.

Geological distribution: Devonian
Geographical distribution: China, the Urals, Altai, America, Europe, Australia.

Grypophyllum sp.
(Plate 6, fig. 2)

Description: Only one specimen of this species has been sectioned. The transverse and longitudinal sections cut through the calice due to the very deep inversely conical calice. Solitary, cylindrical coral. Septa of two orders, pinnate in arrangement, 32×2 in the section with a diameter of 33.3 mm. Major septa long, nearly extended to the axis. Minor septa well developed, longer than two thirds of the majors. All the septa dilated in periphery in delta, then attenuate in dissepimentarium, then slightly thickened again in tabularium or calice. Septa are wavy throughout their length, smooth in dissepimentarium, and are very poorly carinated in tabularium. In periphery both major and minor septa are commonly disrupted by lonsdaleoid dissepiments. Dissepimentarium composed of numerous rows of dissepiments, most dissepiments are concentrated, herringbone dissepiments may be present where minor septa absent.

In longitudinal section about 7 rows of dissepiments can be counted, the more peripherally situated dissepiments tend to be larger and less steeply inclined than the interior ones. Tabulae incomplete, periaxial tabulae large, elongated, steeply inclined inwardly or nearly vertically arranged; axially tabulae would be small and strongly concave.

Discussion: Of the forms assigned to *Grypophyllum*, the species with septa pinnately arranging are not very much. The specimen described here is similar to *G. aquilonium* Pedder (1973, p. 103, pl. 12, fig. 1, 4, 6) in its septa which are pinnate in arrangement, attenuate in dissepimentarium and slightly thickened in tabularium, but differs from *G. aquilonium* in a few characters as follows: (1) The specimen from western Yunnan bears larger diameter and more septa than *G. aquilonium* which has maximum diameter of 14.5 mm in which septa are 26×2 in number in its holotype; (2) The outer wall of *G. aquilonium*, is well developed at all stages, especially in early stages when it may attain a thickness of 1.5 mm, in late stages it is 0.7 to 1.0 mm thick, The outer wall of my specimen is only 0.2 mm thick; (3) The dissepiments of the specimen situated in periphery tend to be larger and less steeply inclined than the interior ones, but the more peripherally situated dissepiments tend to be smaller than the interior ones in *G. aquilonium*; (4) *G. aquilonium* has elongated cardinal and counter septa and gently inclined tabulae, however in the specimen described here has no obviously longer cardinal and counter septa and the periaxial tabulae very steeply inclined inwardly to nearly vertically arranged. In summary, the specimen collected from western Yunnan probably represents a species which is different from *G. aquilonium*, although it has some resemblance to the latter, should be a new species. At present only one specimen of this kind of coral is collected, and its transverse section just cuts

through the calyx. So it is described as *Grypophyllum* sp. here.

Locality: Heyuanzhai.

Suborder Columnariina Soshpina, 1941
Family Disphyllidae Hill, 1939
Subfamily Disphyllinae Hill, 1939

Genus *Temnophyllum* Walther, 1928
Subgenus *Temnophyllum* (*Truncicarinulum*) Yü et Kuang, 1982

1978 *Temnophyllum* (*Temnocarinia*) Yü et Liao in Kong et Huang, p. 98.
1982b *Temnophyllum* (*Truncicarinulum*) Yü et Kuang, p. 253.
1987 *Chasisphyllum* Oliver et Sorauf, p. 9.
1987 *Ningxiaphyllum* Wang X. L.,p. 102.

Type species: *Temnophyllum* (*Truncicarinulum*) *involutum* Yü et Kuang, 1982b, p. 253.

Diagnosis: Solitary, subcylindrical, ceratoid or trochoid coral. Septa of two orders, radial in arrangement, composed of charactophylloid trabeculae which inclined upward near the corallite wall, bend toward the axis within the outer dissepimentarium (becoming horizontal or inwardly inclined in some forms), then bend sharply upwards at the margin of the tabularium. Carinae well developed on the sides of the septa. Major septa long, reach the axis or slightly withdraw from the axis. Minor septa well developed. Septa dilated more than one times, may be connected to each other laterally to form numerous inner wall. Dissepimentarium wide, including numerous rows of concentric dissepiments. Herringbone dissepiments may be present in the inner margin of the dissepimentarium. Tabulae incomplete, consisting of axial tabulae and periaxial tabulae.

Discussion: Kong and Huang (1978, p. 98) described *Temnophyllum* (*Temnocarinia*) Yü et Liao on the basis of the manuscript, and designated *T.* (*T.*) *involuta* Yü et Liao as the type species of the subgenus, but did not describe the species. According to the "International Code of Zoological Nomenclature", without describing the type species, the genus or subgenus is invalid. It is very pity that this subgenus name had been used by some authors (Jiang, 1982, p. 97; Jin and He, 1982, p. 123). Yü and Kuang (1982b, p. 253) erected a subgenus *Temnophyllum* (*Truncicarinulum*) with the type species of *T.* (*T.*) *involutum* Yü et Kuang (1982b, p. 253, p. 1, fig. 2, 3, text-fig. 6) to replace *Temnophyllum* (*Temnocarinia*).

Of the rugose corals from the Late Middle Devonian of South China, some forms have been described under *Keriophyllum* Wedekind, 1923. *Keriophyllum* has been regarded as the synonym of *Cyathophyllum*. Its type species *K. heiligensteini* Wedekind is considered to be the synonym of *Cyathophyllum* (*Peripaedium*) *turbinatum* Goldfuss, 1926 (Birenheide, 1963, p. 390). *Temnophyllum* (*Truncicarinulum*) includes nearly all species described as *Keriophyllum* with septa formed of

charactophylloid trabeculae which intermittently expend to form well developed carinae.

Both *Charisphyllum*, erected by Oliver and Sorauf (1987, p, 9), and *Ningxiaphyllum*, found by Wang, X. L. (1987, p. 102) have septa made up of charactophylloid trabeculae which intermittently expanded to form obvious carinae. So they are regarded as the synonym of *Temnophyllum* (*Truncicarinulum*) here.

Temnophyllum (*Truncicarinulum*) is close to *Temnophyllum* Walther, 1928 in microstructure of septa and other skeletal characters, but differs in the trabeculae forming septa which intermittently expand to form well developed carinae, and may be connected to each other laterally to form numerous rows of inner wall and in having no distinct stereozone. *Temnophyllum* (*Truncicarinulum*) is similar to *Pseudozaphrentis* Sun, 1958 in some aspects, but can be distinguished from the latter by having septa which are radial in arrangement and intermittently expanded to form carinae. The subgenus resembles *Charactophyllum* Simpson, 1900, however the intermittent dilations of septa which may be connected to each other laterally to form numerous inner wall can serve to distinguish it from the latter.

Yardarm carinae are present in some spcies of *Temnophyllum* (*Truncicarinulum*), for example, *T.* (*T.*) *altevogti* (Oliver et Sorauf), 1987 and *T.* (*T.*) *aiense* (Soshkina), 1952. This character is similar to that in *Heliophyllum* Hall, 1846. However it differs from *Heliophyllum* in having charactophylloid trabeculae in the septa and in lacking a cardinal fossula.

Assigned forms:

Temnophyllum (*Truncicarinulum*) *abnormis* Kong, 1978, p. 99.
Temnophyllum (*Truncicarinulum*) *aiense* (Soshkina) (=*Heliophyllum aiense*), 1949, p. 89.
Temnophyllum (*Truncicarinulum*) altevogti (Oliver et Sorauf) (=*Charisphyllum altevogti*), 1987, p. 11.
Temnophyllum (*Truncicarinulum*) *aplata* (Jin et He) (=*Temnophyllum* (*Temnocarinia*) *aplata*), 1982, p. 124.
Temnophyllum (*Trucicarinulum*) *beichuanensis* (He) (=*Temnophyllum* (*Temnocarinia*) *beichuanensis*), 1978, p. 129.
Temnophyllum (*Truncicarinulum*) *coeletabulatum* (Wang, X. L.) (=*Ningxiaphyllum coeletabulatum*), 1987, p. 103.
Temnophyllum (*Truncicarinulum*) *complicatum* (Wang) (=*Temnophyllum complicatum*), 1948, p. 15.
Temnophyllum (*Truncicarinulum*) *conicum* (Wang) (=*Acanthophyllum conicum*), 1948, p. 12.
Temnophyllum (*Truncicarinulum*) *decaeni* (Pedder) (=*Temnophyllum decaeni*) 1972, p. 703.
Temnophyllum (*Truncicarinulum*) *floriforme* (Hill) (=*Temnophyllum ? floriforme*), 1954a, p. 24.
Temnophyllum (*Truncicarinulum*) *heiligensteini* (Wedekind) (sensu *Ceriophyllum heiligensteini* Wedekind, Wang, 1948, p. 12, non *Keriophyllum heiligensteini* Wedekind, 1923)
Temnophyllum (*Truncicarinulum*) *heterophylloides* (Frech) (sensu *Temnophyllum* (*Temnocarinia*) *heterophylloides* (Frech), Kong and Huang, 1978, p. 100, non *Cyathophyllum hereophylloides* Frech, 1886).
Temnophyllum (*Truncicarinulum*) *involutum* Yü et Kuang, 1982b, p. 253.
Temnophyllum (*Truncicarinulum*) *isetense* (*Soshkina*) (=*Neostringophyllum isetense*), 1951, p. 53.
Temnophyllum (*Truncicarinulum*) *lantenoisi* (Mansuy) (=*Cyathophyllum lantenoisi*), 1912, p. 71.
Temnophyllum (*Truncicarinulum*) *lenzi* (Pedder) (=*Temnophyllum lenzi*), 1972, p. 706.
Temnophyllum (*Truncicarinulum*) *liujingense* Yü et Kuang, 1984, p. 141.

Temnophyllum (*Truncicarinulum*) *macconnelli* (*Pedder*) (=*Temnophyllum macconnelli*), 1972, p. 705.
Temnophyllum (*Truncicarinulum*) *menyouense* (Hill et Jell) (=*Temnophyllum menyouense*), 1970, p. 60.
Temnophyllum (*Truncicarinulum*) *modicum* (Smith) (=*Mictophyllum modicum*, pl. 5, fig. 3), 1945, p. 28.
Temnophyllum (*Truncicarinulum*) *occidentale* (Hill et Jell) (=*Temnophyllum occidentale*), 1970, p. 59.
Temnophyllum (*Truncicarinulum*) *rugosa* (Jin et He) (=*Temnophyllum* (*Temnocarinia*) *rugosa*), 1982, p. 124.
Temnophyllum (*Truncicarinulum*) *shaodongensis* (*Jiang*) (=*Temnophyllum* (*Temnocarinia*) *shaodongensis*), 1982, p. 98.
Temnophyllum (*Truncicarinulum*) shiziyaensis (He) (=*Temnophyllum* (*Temnocarinia*) *shiziyaensis*), 1978, p. 130.
Temnophyllum (*Truncicarinulum*) *temeniophylloides* (Wang) (=*Temnophyllum temeniophylloides*), 1948, p. 13.
Temnophyllum (*Truncicarinulum*) *turbinatum* (Hill et Jell) (=*Temnophyllum turbinatum*), 1954, p. 23.
Temnophyllum (*Truncicarinulum*) *ultimum* (Walther) (sensu *Temnophyllum ultimum* (Walther), Wang, 1948, p. 15, non *Pexiphyllum ultimum* Walther, 1928)
Temnophyllum (*Truncicarinulum*) *xintianense* (Jiang) (=*Acanthophyllum xintianense*), 1982, p. 102.
Temnophyllum (*Truncicarinulum*) *xipingshanense* (Wang, X. L.) (=*Ningxiaphyllum xipingshanense*), 1987, p. 103.

Rejected forms:
Temnophyllum (*Truncicarinulum*) *ningxiangense* (Jiang) (=*Temnophyllum* (*Temnocarinia*) *ningxiangensis*), 1982, p. 97.

Geological distribution: late Middle Devonian to Late Devonian.
Geographical distribution: Asia, Europe, North America and Australia.

Temnophyllum (*Truncicarinulum*) *altevogti* (Oliver et Sorauf), 1987
(Plate 6, fig. 1)

1987 *Charisphyllum altevogti* Oliver et Sorauf, p. 9, fig. 5-7.

Diagnosis: Solitary, trochoid coral, axial increase. Septa of two orders, somewhat bilaterally arranged, composed of charactophylloid trabeculae, thickened and yardarm carinated in dissepimentarium and thin in tabularium. Dissepimentarium wide, composed of numerous rows of globose dissepiments. Tabulae incomplete, axial tabulae horizontal in axial part and turn downward in axial part.

Description: Only one specimen of this species from western Yunnan has been sectioned. Solitary, trochoid coral. Offsets increase from tabularium. At early stage septa radially arranged, 33×2 in number at the diameter of 14.2 mm. Major septa retreated from the axis, and leave a central area with diameter of 6.6 mm, weekly dilated and have rare carinae within narrow dissepimentarium, thin in tabularium. Minor septa short, about or less than one third of the major ones in

length, usually restricted to narrow dissepimentarium composed of 1 to 3 rows of concentric dissepiments. No stereozone. Exterior wall only 0.4 mm thick. In late stage septa somewhat bilateral in arrangement, up to 36×2 in the section with a diameter of 34.2 mm. Major septa withdraw from the axis, minor septa well developed, almost as long as the majors, but markedly thinner than the major ones. All septa thickened, the maximum thickness at the boundary between dissepimentarium and tabularium. Yardarm carinae well developed within dissepimentarium comprised of numerous rows of concentric and herringbone dissepiments, lateral dissepiments also present.

In longitudinal section septa are formed by typical charactophylloid trabeculae. Numerous rows of globose dissepiments occupy the outer one third of the corallite, outer 3 to 4 rows of dissepiments large, nearly horizontally arranged, inner dissepiments small, steeply inclined inward or nearly vertically arranged. Tabularium wide, composed of incomplete tabulae. Axial tabulae with wide flat axial parts and downturned edges, closely spaced so that 14 can be counted in the vertical distance of 5 mm. Periaxial tabulae small, globose, of numerous rows, gently incline inwardly or nearly horizontal. The boundary between dissepimentarium and tabularium in not distinct.

Discussion: The form described here agrees exactly with that from Givetian of Spain illustrated and described by Oliver and Sorauf (1987). This species is similar to *Temnophyllum* (*Truncicarinulum*) *liujingense* Yü et Kuang (1984, p. 141, pl. 1, fig. 1-7), occurring in the boundary beds between the Middle and Upper Devonian in Guangxi, China, but differs from the latter in having large corallum and well developed minor septa which almost as long as the major ones in the mature stage. This species is also close to *Temnophyllum* (*Truncicarinulum*) *aiense* (Soshkina), whose holotype is from the Givetian of Ural. But the wide dissepimentarium composed of about 20 rows of small globose dissepiments and the incomplete axial tabulae broken into tabellae of the latter can serve to distinguish it from the present species. This species resembles some species belonging to *Heliophyllum* in the yardarm carinae, but distinct from them in having charactophylloid trabeculae in the septa.

Locality: Heyuanzhai.

Family Phillipsastreidae Hill, 1954

Genus *Phillipsastrea* d'Orbigny, 1849

1849 *Phillipsastrea* d'Orbigny, p. 12.
1850 *Pachyphyllum* Edwards et Haime, p. 168.
1851 *Smithia* Edwards et Haime, p. 171.
1855 *Medusaephyllum* Roemer, p. 33.
1856 *Streptastrea* Sandberger et Sandberger, p. 416.
1881 *Pseudoacervularia* Schlüter, p. 84.
1951 *Keriophylloides* Soshkina, p. 102.

Type species: *Astrea hennahii* Lonsdale, 1840, p. 697.

Diagnosis: Astreoid, thamasterioid or in part cerioid astreoid or aphroid corals. Septa of two orders, extending variably into tabularium, showing fusiform dilatation in the boundary between dissepimentarium and tabularium just over the locus of horseshoe dissepiments. In dissepimentarium, horseshoe dissepiments vary from weakly and intermittent development to a continuous pipe completely surrounding the tabularium, several series of normal dissepiments also present. Tabulae complete or incomplete.

Discussion: The opinion differs widely on the definition of *Phillipsastrea* among coral paleontologist so far, resulting primarily from the divergence of view on the feature of the dissepimentarium in the genus.

Early authors used this genus for those corals with or without horseshoe dissepiments. Schouppé (1958, p. 234) restudied the holotype of *Astrea hennahii* Lonsdale, 1840, the type species of *Phillipsastrea*, and pointed out that there are horseshoe dissepiments in the specimen, and on this basis of the character included within *Phillipsastrea* those species with horseshoe dissepiments, and put those without horseshoes under *Billingsastraea*, and regarded *Pachyphyllum* as a synonym of *Phillipsastrea*. Oliver (1964, p. B2) further divide this kind of corals into three groups: (1) *Phillipsastrea* has horseshoe dissepiments and dilated septa in tabularium; (2) *Billingsastraea* has uniform attenuate septa and lack horseshoe dissepiments; (3) "*Billingsastraea*" possesses a zone of septal thickening just outside the tabularium and no horseshoe dissepiments. The last has been put into *Frechastraea*.

So far three generic names, *Phillipsastrea*, *Pachyphyllum* and *Medusaephyllum*, are used for those forms with horseshoe dissepiments. Smith (1945, p. 37), Scrutton (1968, p. 210), Coen-Aubert (1974, p. 9), He (1978, p. 137), Jin and He (1982, p. 119) believed that *Pachyphyllum* is best regarded as a synonym of *Phillipsastrea*. Jell (1969, p. 65) recognized three groups within Phillipsastraeinae. Of them one group, including *Pachyphyllum*, is those with the horseshoe dissepiments arranged in a pipe or cylinder at the tabularial boundary, and another group, including *Phillipsastrea*, is those in which the horseshoes are arranged irregularly in incomplete series in the inner dissepimentarium. Soshkina (1952, 1954), Rozkowska (1953), Bulvanker (1958), Ivaniya (1965), Sorauf (1978), Cao and others (1983) separated *Pachyphyllum* from *Phillipsastrea*. Sorauf (1978) proposed six criteria occurring in *Pachyphyllum* to differentiate species of *Pachyphyllum* and *Phillipsastrea*. They are as follows: (1) The presence of a uniform row of horseshoe dissepiments; (2) The deposition of stereome as a secondary biogenic coating on the horseshoe dissepiments; (3) Species from North America show the tendency to develop a small axial structure which often resembles and sometimes actually is an aulos, formed by the periaxial deflection of septa; (4) Some species are large, with tabularium from 7-9 mm in diameter, and with 50 or more septa; (5) In some species there is a strong tendency to develop an aphroid colony form by the nonconfluence of septa between corallites. Conversely, there is little or no tendency toward development of a pseudocerioid form, as commonly noted in species

of *Phillipsastrea*; (6) there is a marked tendency toward a flatsided, exaggerated dilation of septa in the area of the horseshoe dissepiments. Birenheide (1978), Sorauf and Pedder (1986), McLean (1986), Sorauf (1988a), McLean and Sorauf (1989) used *Medusaephyllum* for those species having a well developed pipe of horseshoe dissepiments on the basis of which to distinguish *Pachyphyllum* and *Medusaephyllum* from *Phillipsastrea*. Sorauf (1988a), McLean (1988) confined *Pachyphyllum* to those species characterized by some colonies with very large founder corallites. McLean (1988) considered *Medusaephyllum* as a synonym of *Phillipsastrea* on the basis of the study of many massive Pillipsastreidae from the Frasnian of western Canada, in which variability in development of horseshoe dissepiments is great both in a species and even within a corallum. Maybe the key divergence on the difference between *Pachyphyllum* and *Phillipsastrea* focuses on the presence or absence of a uniform pipe of horseshoe dissepiments in *Phillipsastrea*. In the material described here in a single specimen, even within a corallum the feature of development of horseshoe dissepiment is variable. Well developed pipes of horseshoe dissepiment and poorly developed horseshoe pipes may be present in different parts, the feature of horseshoe dissepiments seen in longitudinal vary with the position of sections. Therefore this character seems to be difficultly applied to warrant division between *Pachyphyllum* and *Phillipsastrea*. *Phillipsastrea* should probably include those phillipsastreid species in which the pipe of horseshoe dissepiments variably developed.

Edwards and Haime (1851, p. 171) proposed a genus *Smithia* and took *Astrea hennahii* Lonsdale as the type species of their genus. *A. hennahii* had been chosen as the type species of *Phillipsastrea* d'Orbigny. So *Smithia* is an objective synonym of *Phillipsastrea*. When establishing *Streptastrea*, with *S. longiradiata* as the type species, Sandberger and Sandberger (1856, p. 416) stated that the genus is "*Smithia* Milne-Edwards et Haime", and identified the *Streptastrea longiradiata* with "*Astrea hennahii* Lonsdale". *Smithia* is a synonym of *Phillipsastrea*, *Streptastrea* is thus also a synonym of *Phillipsastrea*. *Pseudoacervularia* was erected by Schlüter (1881, p. 84), but its type species was not selected until Lang, Smith and Thomas (1940, p. 108) choose *Acervularia coronata* Edwards et Haime (1851, p. 416) as the type species. Edwards and Haime did not illustrate and figure this species, Scrutton (1968, p. 213) and Birenheide (1978, p. 99) have merged the species to *Phillipsastrea hennahii*. So it is best to regard *Pseudoacervularia* as a synonym of *Phillipsastrea*. *Keriophyllum astreiforme* (Soshkina, 1936, p. 62), the type species of *Keriophylloides*, bears well developed horseshoe dissepiments as illustrated by Soshkina (1951, p. 102, pl. 19, fig. 1). *Keriophylloides* is almost certainly congeneric with *Phillipsastrea*.

He (1978, p. 138) founded a genus *Chuanbeiphyllum*, with *C. hongyansiense* He (1978, p. 138) as the type species. According to He's opinion *Chuanbeiphyllum* is primarily different from *Phillipsastrea* in having aphroid in the growth form.

Rozkowska (1979, p. 18) proposed the genus *Smithicyathus* and included *Phillipsastrea cincta* Smith, 1945, *Pachyphyllum lacunosum* Gürich, 1896 and *Smithicyathus*

lubliniensis sp. nov. within it. Rozkowska (1979, p. 18) believed that the genus *Smithicyathus* is distinguished from all genera of Phillipsastraeinae by its epithecate wall (Sorauf, 1967, p. 5-7; Jell, 1969, p. 62), surrounding corallites within the corallum.

Assigned forms:

Phillipsastrea ananas (Goldfuss) (=*Cyathophyllum ananas*), 1826, p. 60. see Rozkowska, 1953, p. 52; Scrutton, 1968, p. 228; Tsien, 1977, p. 203.
Phillipsastrea ananas veserensis Coen-Aubert, 1974, p. 21.
Phillipsastrea astraeiformis (Soshkina) (=*Keriophyllum astraeiforme*), 1936, p. 62. see Soshkina, 1951, p. 102.
Phillipsastrea beneharnica Joseph et Tsien, 1975, p. 195.
Phillipsastrea bethunei Tsien, 1977, p. 207.
Phillipsastrea bouchardi (Edwards et Haime) (=*Pachyphyllum bouchardi*), 1851, p. 397.
Phillipsastrea breviseptata Stumm, 1940, p. 65.
Phillipsastrea carinata Jia in Jia et al., 1977, p. 152.
Phillipsastrea chenouensis (Semenoff) (=*Pachyphyllum chenouensis*), 1961, p. 304.
Phillipsastrea confluens (Sorauf) (=*Medusaephyllum confluens*), 1988a, p. 180.
Phillipsastrea conili Tsien, 1977, p. 208.
Phillipsastrea coronata (Edwards et Haime) (=*Acervularia coronata*), 1851, p. 416.
Phillipsastrea crassicostata (Webster) (=*Pachyphyllum crassicostatum*), 1889, p. 623. see Sorauf, p. 827.
Phillipsastrea crassiseptata Tsien, 1977, p. 207.
Phillipsastrea crassicostatum nanum (Webster) (=*Pachyphyllum crassicostatum nanum*), 1889, p. 623. see Fenton and Fenton, 1924, p. 52.
Phillipsastrea currani iaspiculensis Pedder in Pedder et al., 1970, p. 243.
Phillipsastrea devoniensis (Edwards et Haime) (=*Pachyllum devoniense*), 1851, p. 397. see Frech, 1885, p. 67; Scrutton. 1968, p. 226.
Phillipsastrea dybowskii (Rozkowska) (=*Pseudoacervularia dybowskii*), 1953, p. 56.
Phillipsastrea emendata Spasskiy et Kravtsov in Ivanovskiy, 1975, p. 61.
Phillipsastrea enbyskae Sorant, 1972, p. 432.
Phillipsastrea exigua (Lambe) (=*Phillipsastrea verrilli exiguum*), 1901, p. 168. see Smith, 1945, p. 41; McLean, 1985, p. 472.
Phillipsastrea focantiensis Tsien, 1977, p. 206.
Phillipsastrea friedbergi (Rozkowska) (=*Pachyphyllum friedbergi*), 1953, p. 43.
Phillipsastrea ganxiensis He, 1978, p. 137.
Phillipsastrea givetica (Ivaniya) (=*Pachyphyllum giveticum*), 1960, p. 407. see Ivaniya, 1965, p. 119.
Phillipsastrea goldfussi (de Verneuil et Haime) (=*Acervularia goldfussi*), 1850, p. 161. see Sorauf, 1967, p. 27.
Phillipsastrea hennahii (Lonsdale) (=*Astrea hennahii*), 1840, p. 697.
Phillipsastrea hennahii ussheri Scrutton, 1968, p. 221.
Phillipsastrea hunanensis Jiang, 1982, p. 101. (=*Ph. carinata* Jia in Jia et al., 1977, p. 152).
Phillipsastrea ibergenseformis (Spasskiy) (=*Pachyphyllum ibergenseformis*), 1960, p. 125. see Spasskiy, 1977.
Phillipsastrea ibergensis (Roemer) (=*Medusaephyllum ibergense*), 1855, p. 33. see Frech, 1885, p. 66; Rozkowska, 1953, p. 47.
Phillipsastrea ibergensis progressa (Rozkowska) (=*Pachyphyllum ibergense progressa*), 1953, p. 48.
Phillipsastrea intercellulosa (Phillips) (=*Astrea intercellulosa*), 1841, p. 12. see Frech, 1885, p. 48; Pickett, 1967, p. 51.
Phillipsastrea iregularis (*Roemer*) (=*Acervularia irregularis*), p. 1855. see Frech, 1885, p. 84.
Phillipsastrea irregulare (Webster et Fenton in Fenton et Fenton) (=*Pachyphyllum irregulare*), 1924, p. 49.
Phillipsastrea kaisini Tsien, 1977, p. 206.
Phillipsastrea lacunosa (Gürich) (=*Pachyphyllum lacunosum*), 1896, p. 183. see Rozkowska, 1953,

p. 45.
Phillipsastrea levatum (Webster et Fenton in Fenton et Fenton) (=*Pachyphyllum levatum*), 1924, p. 48.
Phillipsastrea longiradiata (Sandberger et Sandberger) (=*Streptastrea longiradiata*), 1856, p. 416.
Phillipsastrea macouni Smith, 1945, p. 41.
Phillipsastrea macrommata (Roemer) (=*Acervularia macrommata*), 1885, p. 33. see Rozkowska, 1953, p. 49; Sorauf, 1967, p. 33, Tsien, 1977, p. 203.
Phillipsastrea massiva (Vaganova) (=*Keriophylloides massivum*), 1959, p. 82.
Phillipsastrea monticola Reed, 1922, p. 17.
Phillipsastrea nevadensis Stumm, 1939, p. 66.
Phillipsastrea nevadensis magna (Stumm) (=*Pachyphyllum nevadense magnum*) 1948, p. 45.
Phillipsastrea occidens Stumm, 1940, p. 67.
Phillipsastrea ordinatum (Webster) (=*Pachyphyllum ordinatum*), 1889, p. 624. see Fenton and Fenton, 1924, p. 47.
Phillipsastrea owenense (Webster et Fenton in Fenton et Fenton) (=*Pachyllum owenense*), 1924, p. 50.
Phillipsastrea pentagoniforme (Tsyganko) (=*Frechastraea pentagoniforme*), 1981, p. 79.
Phillipsastrea plantana Rozkowska, 1979, p. 19.
Phillipsastrea producta Jin et He, 1982, p. 119.
Phillipsastrea roemeri (Verneuil et Haime in Edwards et Haime) (=*Acervularia roemeri*), 1883, p. 237. see Frech, 1885, p. 57; Rozkowska, 1953, p. 53.
Phillipsastrea rozkowskae Scrutton, 1968, p. 230.
Phillipsastrea samsonowiczi (Rozkowska) (=*Pseudoacervularia samsonowiczi*), 1953, p. 54.
Phillipsastrea senceliae Tsien, 1977, p. 206.
Phillipsastrea smithi (Rozkowska) (=*Pachyphyllum smithi*), 1953, p. 40.
Phillipsastrea sobolewi (Rozkowska), 1965, p. 317.
Phillipsastrea speciosa Chapman, 1914, p. 306. see Hill, 1939b, p. 237.
Phillipsastrea variabile (Sorauf) (=*Medusaephyllum variabile*), 1988a, p. 177.
Phillipsastrea verneuili Edwards et Haime, 1881, p. 447.
Phillipsastrea woodmani (White) (=*Smithia woodmani*), 1870, p. 188. see Sorauf, 1978, p. 820.
Phillipsastrea woodmani avocaensis (Sorauf) (=*Pachyphyllum woodmasi avocaense*), 1978, p. 824.
Phillipsastrea xinhuaensis Jiang, 1982, p. 101.

Rejected forms:

Phillipsastrea affiniss Billings, 1874, p. 11. see Oliver, 1964, p. B3.
Phillipsastrea aperta Hill, 1942b, p. 154.
Phillipsastrea arachne (Stumm) (=*Radiastraea arachne*), 1937, p. 439. see Ma, 1956, p. 38.
Phillipsastrea astraeiformis Ivaniya, 1952, p. 137. see Ivaniya, 1965, p. 186.
Phillipsastrea boloniensis (Edwards et Haime) (=*Smithia boloniensis*), 1851, p. 423. see Edwards and Haime, 1853, p. 230; Coen-Aubert, 1979, p. 25; Smith, 1945, p. 44..
Phillipsastrea bowerbanki (Edwards et Haime) (=*Smithia bowerbanki*), 1851, p. 423. see Tsien, 1977, p. 206.
Phillipsastrea brandonensis (*Stainbrook*) (=*Prismatophyllum brandonense*), 1940, p. 279. see Soshkina, 1954, p. 47.
Keriophylloides caespitosus Vaganova, 1959, p. 81.
Phillipsastrea callosa Hill, 1942b, p. 154.
Phillipsastrea carinata Hill, 1942a, p.16.
Phillipsastrea carinata Bulvanker, 1958, p. 126.
Phillipsastrea cedarensis (Stainbrook) (=*Prismatophyllum cedarense*), 1940, p. 276. see Soshkina, 1954, p. 47.
Phillipsastrea cincta Smith, 1945, p. 43.
Phillipsastrea cordis Rozkowska, 1953, p. 61.
Phillipsastrea crassiseptata Ivaniya, 1965, p. 180.
Phillipsastrea crassiseptata Tsien, 1977, p. 207.

Phillipsastrea currani Etheridge, 1892, p. 166. see Hill, 1956, p. 280,
Phillipsastrea dangduogouensis Cao in Cao et al., 1983, p. 89.
Phillipsastrea davidsoni (Edwards et Haime) (=*Acervularia davidsoni*), 1851, p. 418.
Phillipsastrea filata (Schlotheim) (=*Madreporites filatus*), 1820, p. 359. see Pedder, 1965, p. 182.
Phillipsastrea frocapella Tsien, 1977, p. 207.
Phillipsastrea goldfussi minima Tsien, 1971, p. 158.
Keriophylloides grandis Tcherepnina, 1970, p. 116.
Phillipsastrea gropsicarina Ouyang in Cao et al., 1983, p. 89.
Phillipsastrea heckeri Ivaniya, 1965, p. 183.
Phillipsastrea hercynica (Weyer) (=*Marisastrum hercynicum*), 1971, p. 46. see Birenheide, 1978, p. 101.
Phillipsastrea ingens Davis, 1887, p. 118. see Stumm, 1964, p. 43.
Phillipsastrea kunthi Frech, 1885, p. 62.
Phillipsastrea lazutkini (Bulvanker in Ivaniya), 1948, p. 19. see Bulvanker, 1958, p. 125.
Phillipsastrea limitata (Edwards et Haime) (=*Acervularia limitata*), 1851, p. 419. see Ivaniya, 1965, p. 184.
Phillipsastrea linearis Hill, 1942b, p. 153.
Phillipsastrea maculosa Hill, 1942b, p. 153.
Phillipsastrea microastraea Penecke, 1903, p. 149. see Ivaniya, 1965, p. 185.
Phillipsastrea micrommata (Roemer) (=*Smithia micrommata*), 1852, p. 51. see Scrutton, 1968, p. 240; Tsien, 1977, p. 205.
Phillipsastrea nevadensis Stumm, 1940, p. 66.
Phillipsastrea oculoides Hill, 1942, p. 186. see Strusz, 1965, p. 547; Tsien, 1968, p. 606.
Phillipsastrea pengelli Edwards et Haime. see Soshkina, 1952, p. 102.
Phillipsastrea pentagona (Goldfuss) (=*Cyathophyllum pentagonum*), 1826, p. 60. see Sorauf, 1976, p. 29.
Phillipsastrea pentagona micrommata (Roemer in Frech) (=*Acervularia pentagona micrommata*), 1885, p. 56.
Phillipsastrea pentagona minima Rozkowska, 1953, p. 66.
Phillipsastrea primitive Jin et He, 1982, p. 119.
Phillipsastrea rugosa (Hall) (=*Astrea rugosa*), 1843, p. 159. see Frech, 1851, p. 387; Simpson, 1900, p. 219.
Phillipsastrea sanctacrucensis Rozkowska, 1953, p. 59.
Phillipsastrea schafferi Penecke, 1904, p. 147. see Bulvanker, 1958, p. 121.
Phillipsastrea sedgwicki (Edwards et Haime) (=*Cyathophyllum sedgwicki*), 1851, p. 378. see Edwards and Haime, 1853, p. 231; Soshkina, 1951, p. 96.
Keriophylloides simplex Vaganova, 1959, p. 80.
Pachyphyllum solitarium Hall et Whitfield, 1872, p. 13.
Phillipsastrea thomasi (Stainbrook) (=*Prismatophyllum thomasi*), 1940, p. 278. see Soshkina, 1952, p. 101.
Phillipsastrea verrilli (Meek) (=*Smithia verrilli*), 1867, p. 83. see Smith, 1945, p. 38, Pedder, 1980, p. 598.
Phillipsastrea vesiculosa Smith, 1945, p. 42.
Keriophylloides virgatus Tcherepnina, 1970, p. 115.
Phillipsastrea whittakeri Smith, 1945, p. 39.
Phillipsastrea yardelli Rominger, 1876, p. 130. see Stumm, 1964, p. 43.
Phillipsastrea zarubinskiensis Ivaniya, 1953, p. 13. see Besprozvannych, 1964, p. 69.
Phillipsastrea zickzack Ivaniya, 1952, p. 138. see Ivaniya, 1965, p. 186.

Not examined forms:

Phillipsastrea adanensis Unsalaner, 1951, p. 136.
Phillipsastrea billingsi, Calvin, 1893, p. 111.
Phillipsastrea cantabrica Verneuil, 1850, p. 162. (no figure)
Phillipsastrea carinata Ivaniya, 1958, p. 198.
Phillipsastrea circumvallata Spasskiy, 1972, p. 85.

Phillipsastrea clisiophylloides Thomson, 1898, p. 60.
Phillipsastrea clisiophylloides stellata Thomson. 1898, p. 623.
Pachyphyllum crassum Webster, 1889, p. 624.
Phillipsastrea cuncta Pocto in Barrande, 1902, p. 138.
Phillipsastrea delicatula Hill, 1936, p. 30.
Phillipsastrea fasciculata Thomson, 1901, p. 62.
Phillipsastrea freieslebeni (Fischer) (=*Hydnopora freieslebeni*), 1837, p. 157.
Pachyphyllum gibberosum (Eichwald) (=*Turbinolia gibberosum*), 1830, p. 187.
Phillipsastrea gigas Owen, 1844, p. 70.
Phillipsastrea grandin Dun in Benson, 1918, p. 18.
Phillipsastrea heckeri Ivaniya, 1958, p. 200.
Phillipsastrea humboldti (*Fischer*) (=*Hydnopora humboldti*), 1837, p. 158.
Pachyphyllum intermedium Ivaniya, 1953, p. 45. see Ivaniya. 1965, p. 117. (no figure)
Smithia johanni Hall et Whitfield, 1872, p. 234.
Phillipsastrea kotelnitchi Ermakov, 1957, p. 162.
Phillipsastrea lacunosum Gurich, 1896, p. 183.
Phillipsastrea lamellose Stuckenberg, 1895, p. 109.
Phillipsastrea lateseptata Ivaniya, 1953, p. 11.
Smithia longiradiata Hall et Whitfield, 1872, p. 234.
Phillipsastrea mammillaris Owen, 1844, p. 70.
Phillipsastrea microastraea Penecke, 1903, p. 149.
Pachyphyllum minutissimum Webster, 1905, p. 70.
Phillipsastrea molli (Fischer) (=*Hydnopora molli*), 1837, p. 157.
Smithia multiradiata Hall et Whitfield, 1872, p. 234.
Phillipsastrea orientalis Reed, 1929, p. 231.
Phillipsastrea padaukpinensis Reed, 1929, p. 234.
Phillipsastrea parallela (Roemer) (=*Astrea parallela*) 1843, p. 5.
Phillipsastrea placenta (M'Coy) (=*Sarcinula placenta*), 1849, p. 121.
Phillipsastrea radiata (Martin) (=*Ebismatolithus tubiporites radiatus*), 1809, p. 18.
Phillipsastrea roemeri polonica Gürich, 1896, p. 179.
Phillipsastrea rossica Stuckenberg, 1888, p. 26.
Phillipsastrea scheil Loewe, 1913, p. 13.
Phillipsastrea silurica Lahusen, 1868, p. 293.
Phillipsastrea torreana Verneuil, 1850, p. 162. (no figure)
Phillipsastrea torreana acicularis Bulvanker, 1940.
Phillipsastrea torreana minuta Almela et Revilla, 1950, p. 60.
Phillipsastrea tuberosa (M'Coy) (=*Sarcinula tuberosa*), 1849, p. 124.
Phillipsastrea uchtensis Stuckenberg, 1895, p. 24.
Phillipsastrea undulata Kuzn in Ivaniya, 1953, p. 24,
Pachyphyllum vagabundum Ehlers, 1949, p. 1.
Phillipsastrea walli Etheridge, 1892, p. 169.
Pachyphyllum websteri Belanski, 1928, p. 172.
Phillipsastrea wischeriana Stuckenberg, 1895, p. 108.
Pachyphyllum woodmani ruddi Webster, 1905, p. 70.
Pachyphyllum woodmani gregarium Webster, 1905, p. 70.

Geological distribution: Devonian.
Geographical distribution: Asia, Europe, North America.

Phillipsastrea hennahii (Lonsdale), 1840

(Plate 60)

1840 *Astrea hennahii* Lonsdale, p. 697, pl. 58, fig. 3a-b.

1849 *Phillipsastrea hennahii* (Lonsdale). d'Orbigny, p. 107.
1851 *Smithia hennahii* (Lonsdale). Edwards and Haime, p. 421.
1853 *Smithia hennahii* (Lonsdale). Edwards and Haime, p. 240, pl. 54, fig. 4, 4a-d.
1885 *Phillipsastrea hennahii* (Lonsdale).Frech, p. 59, pl. 5, fig. 1, 2, (non fig. 3, 4).
1922 *Phillipsastrea monticola* Reed, p. 17, pl. 3, fig. 8-10.
non 1939 *Phillipsastrea cf. hennahii* (Lonsdale). Weissermel, p. 367, pl. 14, fig. 18.
1945 *Phillipsastrea hennahii* (Lonsdale). Smith, p. 37, pl. 19, fig. 1a-b.
1949 *Phillipsastrea hennahii* (Lonsdale). Stumm, p. 73, pl. 16, fig. 12.
1952 *Pachyphyllum hennahii* (Lonsdale). Soshkina, p. 86.
1958 *Phillipsastrea hennahii* (Lonsdale). Schouppé, p. 235, pl. 5, fig. 1, text-fig. 20,21.
non 1958 *Phillipsastrea hennahii* (Lonsdale). Sun, p. 6, 18, pl. 11, fig. 1a-c.
? 1959 *Phillipsastrea hennahii* (Lonsdale). Middleton, p. 156. (no figure)
non 1963 *Phillipsastrea ? hennahii* (Lonsdale). Yü and others, p. 326, pl. 65, fig. 7a-c.
1964 *Phillipsastrea hennahii* (Lonsdale). Yoh and Wu, p. 94. text-fig, 80.
1967 *Phillipsastrea hennahii* (Lonsdale). Sorauf, p. 26, fig. 5, la-d, 2 ; fig. 7, 4 ; fig. 8, 1a-d.
1967 *Phillipsastrea hennahii* (Lonsdale). Pickett, p. 63, pl. 2, fig. 7.
1968 *Phillipsastrea hennahii* (Lonsdale). Scrutton, p. 214, pl. 1 fig. 1-6 ; pl. 2, fig.1-4.
1968b *Phillipsastrea hennahii hennahii* (Lonsdale). Tsien, fig. 2 ; pl. 3, fig. 1-9 ; non pl. 5, fig. 3.
1974 *Phillipsastrea hennahii* (Lonsdale). Coen-Aubert, p. 24, pl. 5, fig. 2, 3.
non 1977 *Phillipsastrea* cf. *hennahii* (Lonsdale). Tsien, p. 202, pl. 1, fig. 1, 2.
1978 *Phillipsastrea hennahii* (Lonsdale)., Birenheide. p. 99, pl. 15, fig. 1.
1981 *Phillipsastrea hennahii* (Lonsdale). Hill, p. 281, fig. 181, 3a-c.
1986 *Phillipsastrea hennahii* (Lonsdale). Sorauf and Pedder, 1986, pl. 5, fig. 3, 6.
non 1990 *Phillipsastrea hennahii* (Lonsdale). Fontaine, p. 74, pl. 4, fig. 1, 2.
1990 *Phillipsastrea hennahii* (Lonsdale). Birenheide, pl. 9, fig. 23 ; pl. 11, p. 27.

Measurement :

Material : Mf004006

Transverse section :		Longitudinal section :		
D	N	Dt	Nt	Nh
	12×2	2.5	22	8
11.5				
	11×2	2.5	19	8
8.6				
	10×2			
11.9				
	11×2			
11.1				
	12×2			
12.3				
	12×2			

Diagnosis : Astreoid or thamasterioid corals. Septa of two orders, radial in arrangement. Major septa extend to axis or retreat from the axis, minor septa restricted to dissepimentarium. All the septa dilated in fusiform in the inner dissepimentarium at the locus of horseshoe dissepiments. Few weakly developed carinae present on the sides of septa. The innermost row of dissepiments strongly convex, tend to form horseshoe dissepiments. The inner dissepiments incline outward, and the outer dissepiments tend to be horizontal. Tabulae incomplete.

Description : Only one specimen of this species has been sectioned. The specimen is large in size, its entire external form is unknown. Astreoid to thamaster-

ioid coral in which weak wall can bee seen at places. The distance between axes of adjacent corallites ranges from 8.6 to 12.3 mm. Septa of two orders, radially arranged, from 10×2 to 12×2 in number. Major septa slightly withdraw from the axis, leave an axial space with diameter ranging from 0.8 to 1.6 mm. Occasionally, however, the major septa may reach the axis. Minor septa do not enter the tabularium. The major and minor septa dilated in fusiform in the inner dissepimentarium at the locus of horseshoe dissepiments. Septal dilation results in maximum thickness of 0.3 mm in major septa and slightly thinner in the minor septa than in the majors. A few weakly developed carinae on the sides of septa. The inner dissepiments small and closely spaced, increase outwardly in size, lateral dissepiments may be present on sides of some septa.

In longitudinal section septa are formed of vertical asymmetrical fans of divergent septal trabeculae in the area of dilation of septa; the inner half fans are very narrow, and the outer usually wide. Dissepimentarium composed of 4-6 rows of normal dissepiments and a row of horseshoe dissepiments. The horseshoe dissepiments small, 10 can be counted over the vertical distance of 2 mm, form a discontinuous pipe of the horseshoe, but in most part the horseshoe are developed. The inner dissepiments small and incline outwardly at about 45 degree with the horizon. The dissepiments increase in size and decrease in the inclination. The outer dissepiments tend to be horizontal. Tabularium with diameter of 2.5 mm composed of incomplete tabulae. Axial tabulae wide, usually sightly convex or flat, occasionally concave, 19-22 counted in 5 mm.

Discussion: This species, the type species of the genus, is characterized by the presence of horseshoe dissepiments which tend to form a pipe at variable degree. Those forms without horseshoes previously put into the species are not included within this species.

Locality: Malutang.

Phillipsastrea liujingense Yü et Kuang, 1982
(Plate 61, Plate 62)

1982b *Phillipsastrea liujingense* Yü et Kuang, p. 258, pl. 2, fig. 4; pl. 3, fig. 1.
1988a *Medusaephyllum confluens* Sorauf, p. 180, fig. 24, 3-6.

Measurement:

Mf001011

Transverse section:			Longitudinal section:		
D	N	Ds	Dt	Nt	Nh
	12×2	1.0	2.0	13	8
7.1					
	13×2	1.2	1.8	11	8
6.6					
	12×2	1.0	1.8	12	8
7.1					
	11×2	1.2			

6.0		
	11×2	1.1
7.3		
	11×2	1.1
5.0		
	11×2	1.0

Mf007018

Transverse section:			Longitudinal section:		
D	N	Ds	Dt	Nt	Nh
	13×2	1.6	1.7	15	7
6.2					
	12×2	1.4	1.9	17	7
6.5					
	10×2	1.0			
6.8					
	13×2	1.0			
4.4					
	13×2	0.9			
6.8					
	11×2	1.5			
7.1					
	13×2	1.2			

Diagnosis: Thamasterioid corals. Septa in two orders, radially arranged, slightly dilated in fusiform, not to form an inner wall. Major septa retreat from the axial center, minor septa restricted to dissepiments. Small carinae may be present on the sides of septa. Dissepimentarium consists of innermost row of horseshoe dissepiments and normal dissepiments. Tabulae incomplete, composed of convex axial tabulae and inwardly inclined periaxial tabellae.

Description: Two specimens of this species have been sectioned. Corallum is larger than 20 cm in length and 20 cm in width and 14 cm in height. Its external form remains unknown. Thamasterioid corals. The distance between the axial centers of two adjacent corallites varies from 4.4 to 7.3 mm. Septa of two orders, from 11×2 to 13×2 in number. Major septa slightly withdraw from the axis, and leave an axial space with diameter ranging from 0.9 to 1.6 mm. Minor septa do not enter the tabularium. All the septa are slightly dilated in fusiform at the locus of the horseshoe dissepiments, not contact laterally to form an inner wall. The septal dilations in minor septa are slightly smaller than that in the majors. A few weakly developed carinae are present on the sides of the septa.

In longitudinal section, the dissepimentarium consists of 4 to 6 rows of normal dissepiments and an innermost row of horseshoe dissepiments. The horseshoe dissepiments small, form a almost complete pipe of horseshoes, placing 7 or 8 in 2 mm. In the inner margin of the horseshoes there are some vertically arranging elongated dissepiments forming a discontinuous row. The inner normal dissepiments incline outwardly, and decrease in the inclination outwardly. The outer dissepiments tend to be horizontal in arrangement. Tabularium are 1.8 to 2.0 mm in

diameter, composed of incomplete tabulae. The axial tabulae unually convex, a few of them concave, 11 to 17 can be counted over the vertical distance of 5 mm. Periaxial tabellae incline inwardly at variable angles, and vary in size.

Discussion: This species is similar to *P. hennahii* in septal characters and dissepimentarium, but in different from the latter in having more narrow tabularium and thinner septal dilatation which do not laterally contact to form inner wall over the locus of horseshoe dissepiments. The specimen described here agrees well with the holotype of the species (Yü and Kuang, 1982b, pl. 3, fig. 1) from Givetian of Guangxi, China in form of shape, the number of septa, the distance between the axial center of adjacent corallites and also in the character of the tabulae and of dissepiments.

Locality: Malutang.

Phillipsastrea goldfussi (de Verneuil et Haime), 1850

(Plate 63)

1850 *Acervularia goldfussi* Verneuil et Haime, p. 161.
1851 *Acervularia goldfussi* de Verneuil et Haime. Edwards and Haime, p. 417.
1853 *Acervularia goldfussi* de Veneuil et Haime. Edwards and Haime, p. 236, pl. 53, fig. 3, 3a.
1953 *Phillipsastrea goldfussi* Edwards et Haime. Rozkowska, p. 62, pl. 8, fig. 5, 6.
1958 *Billingsastraea goldfussi* (Edwards et Haime). Schouppé, p. 236, text-fig. 25, 26.
1959 *Phillipsastrea goldfussi* (Edwards et Haime). Middleton, p. 156, text-fig. 6d.
1967 *Phillipsastrea goldfussi* (de Verneuil et Haime). Sorauf, p. 27, fig. 10, 1a, 1b, 1f, non 1c, 1d, 1e; fig. 11, 1a, 1b.
1968 *Frechastraea goldfussi* (de Verneuil et Haime). Scrutton, p. 247, pl. 10, fig.1-5; pl. 11, fig. 1, 2.
1968b *Phillipsastrea goldfussi* (de Verneuil et Haime). Tsien, pl. 1, fig. 3, 4; pl. 3, fig. 10.
1977 *Phillipsastrea goldfussi* (de Verneuil et Haime). Tsien, p. 203, pl. 1, fig. 4a-b.

Measurement:

Mf00xttf

Transverse section:			Longitudinal section		
D	N	Ds	Dt	Nt	Nh
9.1					
	14×2	2.0	2.2	13	9
11.9					
	11×2	0.2	2.2	14	10
9.0					
	11×2	1.3			
7.3					
	11×2	1.4			
8.2					
	12×2	1.0			
9.2					
	11×2	1.0			

Diagnosis: Cerioid tending to cerioid astreoid corals. Wall thin, in part discon-

tinuous. Septa of two orders, radial in arrangement. Major septa reach or withdraw from the axis, minor septa restricted to dissepimentarium. All the septa dilated in spindle at the locus of horseshoe dissepiments. Dissepimentarium composed of the innermost row of herseshoe dissepiments and normal dissepiments. Tabulae incomplete.

Description: Only one specimen of the species has been sectioned in the material from western Yunnan. Corallum small, less than 15 cm in length, width and height respectively. Cerioid coral. Wall thin, usually zigzag. In part the wall absent to become cerioid astreoid in growth form. The distance between axes of two adjacent corallites varies from 7.3 to 11.9 mm Septa of two orders, radially arranged, with a few small carinae, from 11×2 to 14×2 in number. Major septa long, slightly withdraw from axis, leave axial spaces ranging from 1.0 to 2.0 mm in diameter, In one or two corallites major septa may almost reach axis, only small axial space of 0.2 mm in diameter is left. Minor septa well developed, but not enter the tabularium. Septa in dissepimentarium typically show fusiform dilation near the boundary between tabularium and dissepimentarium, where horseshoe dissepiments developed. The maximum thickness of septal dilation up to about 2.2 mm in major septa and slightly thinner in the minors. Septal dilations do not connect each other to form inner wall.

In longitudinal section the dissepimentarium composed of 7 or 8 rows of dissepiments. The innermost row of dissepiments are small, intermittently developed horseshoe dissepiments almost forming an uniform row, spaced of 12 or 13 in the vertical distance of 2 mm. The inner dissepiments gently incline outwardly, the outer dissepiments very large, horizontal in arrangement. The dissepiments increase outwardly in size, and decrease in the inclination. Tabularium is 2.0 to 2.4 mm in diameter, consists of incomplete tabulae. The axial tabulae large, irregular, convex, concave or flat, 11 to 14 may be counted over the vertical distance of 5 mm. The periaxial series of tabulae small, inclined inwardly.

Discussion: This species is similar to *Phillipsastrea liujingensis* in the thinner septal dilation not to be in contact laterally to form inner wall, but may be distinguished from the latter by having almost complete exterior wall and very large and horizontal outer dissepiments as well as irregular axial series of tabulae. *Phillipsastrea ananas* (Goldfuss) is another species of *Phillipsastrea* with well developed exterior wall, has been regarded as the synonym of *Ph. goldfussi* by some authors. The illustration of *Ph. ananas* by Rozkowska (1953, pl. 7, fig, 1, 2), Scrutton (1968, pl. 5, fig. 1-4) and Tsien (1977, pl. 1, fig. 3a-b) clearly show that the horseshoe dissepiments in *Ph. ananas* are developed in the median part of dissepimentarium. In the inner dissepimentarium there are more than two rows of normal dissepiments inclining inwardly. This can serve to dintinguish *Ph. ananas* from *Ph. goldfussi*.

The specimen from western Yunnan is very close to that from Frasnian unit F2i of Belgium, figured as fig. 11, 1a, 1b by Sorauf (1967, p. 30) in the main characters.

Locality: Malutang.

Genus *Macgeea* Webster, 1889

1889 *Macgeea* Webster, p. 710.
1834 *Pterorrhiza* Ehrenberg, p. 312.
1928 *Pexiphyllum* Walther, p. 128.
1979 *Trigonella* Rozkowska, p. 24.
1979 *Debnikiella* Rozkowska, p. 25.
1986 *Rozkowskaella* Wrzolek, p. 277.
1991 *Macgeea* (*Rozkowskaella*), Wrzolek. Coen-Aubert and Wrzolek, p. 10.

Type species: *Pachyphyllum solitarium* Hall et Whitfield, 1873, p. 232.

Diagnosis: Corallum solitary or rarely with small offsets developing near the mature calice. Septa of two orders, radial or bilateral in arrangement, composed of coarse rhipidacanths forming fans with their axis of divergence centered over a row of horseshoe dissepiments, and typically show fusiform dilation centered on the horseshoes which are often thickened by stereome. Dissepimentarium consists of three parts, outer, horseshoe and inner dissepiments. The outer dissepiments usually flat, concave, inclined outward, in some of species globose. The horseshoe dissepiments characteristically form a continuous pipe, in a few species the pipe of horseshoes not complete. The inner dissepiments globose or elongated. Tabularium wide, consisting of incomplete tabulae which are considerably vary.

Discussion: *Macgeea* is abundant and widely distributed all over the world in the Middle and Upper Devonian. The agreement has not been achieved on the proper nomenclature for the genus and the placement of species in the genus. Three genera, *Pterorrhiza* Ehrenberg 1834, *Macgeea* Webster 1889 and *Pexiphyllum* Walther 1928, have been used for this group. Sorauf (1987b, p. 646; 1988a, p. 172) and McLean (1989, p. 244, 245) noted the usage of the three genera mentioned above respectively in detail. Now there are three viewpoints on this problem: (1) use *Pterorrhiza, Macgeea, and Pexiphyllum* respectively for different species (Hill, 1956; Birenheide, 1978); (2) use *Pterorrhiza* for the entire group and regard *Macgeea* and *Pexiphyllum* as the synonyms (Hill, 1981; Pickett, 1967; Birenheide, 1969; Rozkowska, 1979); (3) use *Macgeea* and consider *Pterorrhiza* and *Pexiphyllum* as the synonyms (Sorauf, 1987b; 1988a; McLean, 1989).

The holotype of *Pachyphyllum solitarium*, the type species of *Macgeea*, has been considered as missing (Sorauf, 1988a; McLean, 1989), but its external and internal morphology is well known by the excellent photographs illustrated by Lang and Smith (1935, pl. 37, figs. 1-3), Stainbrook (1946, pl. 60, figs. 11, 14) and Pickett (1967, pi. 5, figs. 19-21). The holotype of *Cyathophyllum marginatum*, the type of *Pterorrhiza*, also has been lost, its lectotype was sectioned in the transverse direction only (Birenheide, 1969, pl. 3, fig. 10; pl. 5, figs. 7a, b). Some important skeletal features, especially the feature of dissepimentarium, are still not well known to date. The holotype of *Pexiphyllum rectum* Walther 1928, the type species

of *Pexiphyllum*, shows a more or less continuous pipe of horseshoe dissepiments with well developed globose outer dissepiments and variable inner dissepiments. Birenheide (1978), Yü and Kuang (1982b, p. 260) confined *Pexiphyllum* to those species with the horseshoes surrounded by globose outer dissepiments. The material from western Yunnan shows considerable variation in outer dissepiments of this kind of corals. Globose, flat and concave outer dissepiments can occur even within a single sample. In the longitudinal section of the holotype of *Pachyphyllum solitarium* illustrated by Pickett (1967, pl. 5, fig. 20a ; p. 66, text-fig. 18) a few globose outer dissepiments are present. It is evident that the shape of the outer dissepiment on this group is extremely variable and can not be used as the basis to distinguith *Pexiphyllum* from the others.

Rozkowska (1979, p. 24) established a genus *Trigonella* from the Frasnian of Poland. The genus name had been used for a bivalve by da Costa in 1778. Wrzolek (1987, p. 277) proposed a new name *Rozkowskaella* for the *Trigonella* Rozkowska 1977. Coen-Aubert and Wrzolek (1991, p. 10) discovered that the horseshoe dissepiments forming a continuous pipe are present in *Trigonella sandaliformis* Rozkowska 1980, the type species of *Rozkowskaella*, and regard it as a subgenus of *Macgeea* on the basis of the discovery of horseshoe dissepiments.

Debnikiella Rozkowska (1979, p. 25) with *D. formosa* Rozkowska (1979, p. 25, pl. 3, fig. 12 ; pl. 4, fig. 16 ; text-fig. 5) as type species is a genus of solitary coral with dissepimentarium composed of outer horizontal dissepiments, horseshoe dissepiments and inner globose dissepiments. Here I follow Coen-Aubert and Wrzolek (1990, p. 8) to consider *Debnikiella* as synonymous with *Macgeea*.

Schouppé (1949) divided *Macgeea* into three subgenera: *Macgeea*, *Thamnophyllum* and *Synaptophyllum*, and included those forms assigned to *Thamnophyllum*, *Macgeea, Peneckiella* and *Synaptophyllum* within the genus. *Thamnophyllum*, can be easily distinguished from *Macgeea* by its dendroid growth form and narrow dissepimentarium composed of only outer horseshoe dissepiments and inner globose dissepiments. McLaren (1959) cleared up many misconceptions regarding the genus *Synaptophyllum*, restricting the genus to those forms without dissepiments and with complete tabulae, commonly flat or concave axially, strongly downturn peripherally. *Peneckiella* bears particular peneckielloid and sigmoidal dissepiments. A few species with horseshoe dissepiments have been described under *Peneckiella*, in these species no outer dissepiments are present. Therefore *Thamnophyllum, Synaptophyllum* and *Peneckiella* have been regarded as independent genera for a long time.

Macgeea is similar to *Phacellophyllum* Gürich, 1909, with *Lithodendron caespitosum* Goldfuss, 1826 as the type species, in some features, but differs from the latter in its solitary or rarely with small offsets developing near the mature calices.

Assigned forms :

Macgeea arcuata (Walther) (=*Pexiphyllum arcuatum*), 1928, p. 133.
Macgeea bathycalyx amabilis Rozkowska, 1956, p. 301.
Macgeea araxis Frech. see Soshkina, 1952, p. 84.

Macgeea bathycalyx (Frech) (=*Cyathophyllum bathycalyx*), 1886, p. 181.
Macgeea bathycalyx josephi Rozkowska, 1956, p. 294.
Macgeea bathycalyx kasimiri Rozkowska, 1956, p. 289.
Macgeea bathycalys longiseptata Rozkowska, 1956, p. 299.
Macgeea bathycalys regularis Rozkowska, 1956, p. 298.
Macgeea bathycalyx yunnanensis Sung, 1982, p. 26.
Macgeea berdensis Soshkina, 1939, p. 18, 48.
Macgeea caucasica Soshkina, 1952, p. 84.
Macgeea crassa (Yü et Kuang) (=*Pexiphyllum crassum*), 1982b, p. 261.
Macgeea cylindrica (Yoh) (=*Campophyllum cylindricum*), 1937, p. 59.
Macgeea czarnockii Rozkowska, 1953, p. 24.
Macgeea czarnockii brevisepta (Pickett) (=*Pterorrhiza czarnockii brevisepta*), 1967, p. 49.
Macgeea densa (Fedorowski) (=*Pterorrhiza densa*), 1968, p. 226.
Macgeea (*Macgeea*) *desioi* Schouppé, 1965, p. 32.
Macgeea dubia (de Blainville) (=*Caryphyllia dubia*), 1830, p. 311.
Macgeea formosa (Rozkowska) (=*Debnikiella formosa*), 1979, p. 25.
Macgeea gallica Lang et Smith, 1935, p. 579.
Macgeea gallica gigantea Brice et Rohart, 1974, p. 55.
Macgeea gallica pauciseptata Coen-Aubert, 1982, p. 24.
Macgeea guangxiensis (Yü et Kuang) (=*Pexiphyllum guangxiense*), 1984, p. 154.
Macgeea heterophylloides (Frech, 1885) (sensu *Macgeea heterophylloides*, Birenheide, 1978, p. 113, non *Cyathophyllum heterophylloides* Frech, 1885, p. 30, pl. 1, fig. 2a-c).
Macgeea houeshanensis Yü et Liao, 1978, p. 129.
Macgeea inculta Jin et He, 1982, p. 118.
Macgeea kozlowskii Rozkowska, 1953, p. 19.
Macgeea lacroixi Coen-Aubert, 1982, p. 26.
Macgeea marginata (Goldfuss) (=*Gyathophyllum marginatum*), 1826, p. 55.
Macgeea multa (Yü et Kuang) (=*Pexiphyllum multum*), 1982b, p. 261.
Macgeea multitabulata Jia, 1977, p. 147.
Macgeea multizonata (Reed) (=*Cyathophyllum multizonatum*), 1922, p. 12.
Macgeea murchisoni (Penecke) (=*Thamnophyllum murchisoni*), 1894, p. 595. see Pedder, 1965; Soshkina 1952.
Macgeea parva Webster, 1889, p. 711. see Stainbrook, 1946.
Macgeea ponderosa Stumm 1960, p. 161.
Macgeea prima (Walther) (=*Pexiphyllum primum*), 1928, p. 130.
Macgeea proteus Smith, 1945, p. 27.
Macgeea recta (Walther) (=*Pexiphyllum tectum*), 1928, p. 130.
Macgeea richardsoni (Meek) (=*Aulophyllum richardsoni*), 1867, p. 81, see, Ma, 1956, p. 22.
Macgeea rozkowskae Coen-Aubert, 1982, p. 17.
Macgeea sandaliformis (Rozkowska) (=*Trigonella sandaliformis*), 1979, p. 24.
Macgeea shidianensis (Sung) (=*Pexiphyllum shidianense*), 1982, p. 27.
Macgeea siemiradzkii (Rozkowska) (=*Pexiphyllum siemiradzkii*), 1953, p. 36.
Macgeea socialis Soshkina, 1939, p. 22, 50.
Macgeea solitaria (Hall et Whitfield) (=*Pachyphyllum solitarium*), 1873, p. 232.
Macgeea supradevonica (Penecke) (=*Thamnophyllum supradevonica*), 1903, p. 144. see Ma, 1937, p. 13; Schouppé, 1949, p. 168.
Macgeea symmetrica Sung , 1982, p. 27.
Macgeea thomasi Stainbrook, 1946, p. 422.
Macgeea touti Pedder, 1965, p. 186.

Rejected forms:

Macgeea (*Thamnophyllum*) achanayensis (Soshkina) (=*Peneckiella achanayensis*), 1939, p. 25.
Pexiphyllum altum Walther, 1928, p. 132. see Liao and Li, 1991, p. 607.
Macgeea arundinacea (Billings) (=*Diphyphyllum arundinaceum*), 1859, p. 38. See Smith, 1945, p. 56.

Macgeea breviconus Soshkina, 1939, p. 20, 49.
Macgeea caespitosa (Goldfuss) (=*Lithostrotion caespitosum*), 1826, p. 60. see Lang and Smith, 1935; Ma, 1937; Flügel, 1958.
Macgeea (*Thamnophyllum*) *caespitosa minus* (Roemer) (=*Disphyllum minus*), 1855, p. 29. see Schouppé, 1949, p. 152.
Macgeea ? crassoseptata Wang, 1948, p. 18.
Macgeea dahekouensis Huang in Kong et Kuang, 1978, p. 91.
Disphyllum (or *Macgeea*) *excavatum* Hill, 1942, p. 250.
Pexiphyllum frechi Sun, 1958, p. 2, 8.
Macgeea (*Synaptophyllum*) *heritschi* Schouppé, 1949, pl. 12, fig. 66, 67.
Macgeea (Thamnophyllum) *hoernesi* (Penecke) (=*Thamnophyllum hoernesi*), 1893, p. 595. see Schouppé, 1949, p. 128.
Macgeea (*Thamnophyllum*) *hoernesi trigemme* (Quenstedt) (=*Cyathophyllum caespitosum trigemme*), 1881, p. 518. see Schouppé, 1949, p. 131.
Macgeea kunthi (Dames) (=*Cyathophyllum kunthi*), 1869, p. 699, see Flügel, 1958, p. 361; Ma, 1937, p. 12; Ma, 1956, p. 17; Frech, 1885, p. 36.
Macgeea langi Sun, 1958, p. 6, 20.
Macgeea magna Stumm, 1940, p. 61.
Macgeea (*Synaptophyllum*) *nalivkini* (Soshkina) (=*Peneckiella nalivkini*), 1939, p. 24. see Schouppé, 1945, p. 172.
Macgeea originata Soshkina, 1939, p. 21, 49.
Macgeea (*Thamnophyllum*) *peneckei* Schouppé, 1949, p. 159.
Macgeea pinguiseptata (Hill) (=*Heliophyllum pinguiseptata*), 1954b, p. 110. see Ma. 1956, p. 23.
Macgeea pulchra Spasskiy, 1960, p. 46.
Macgeea (*Synaptophyllum*) *spiralis* (Soshkina) (=*Peneckiella spiralis*), 1939, p. 28. see Schouppé, 1949, p. 171.
Macgeea (*Thamnophyllum*) *stachei* (Penecke) (=*Thamnophyllum stachei*), 1893, p. 265. see Schouppé, 1949, p. 135.
Macgeea subcylindrica Stumm, 1940, p. 61.
Macgeea ? symmmetrica (Frech) (=*Diphyphyllum symmetricum* Frech, 1896, p. 95), Ma, 1956, p. 24.
Disphyllum (or *Macgeea*) *trochoides* Hill, 1942c, p. 249.
Macgeea turbinata (Hill) (=*Temnophyllum turbinatum*), 1954a, p. 23. see Ma, 1956, p. 23.
Macgeea ultima (Walther) (*Pexiphyllum ultimum*), 1928, p. 134. see Liao and Li, 1991, p. 607.

Not examined forms:

Pexiphyllum bunthi Taylor, 1951, p. 191.
Macgeea calostrota Crickmay, 1962, p. 3.
Macgeea cumulus Webster, 1889, p. 712. (no figure)
Pterorrhiza excentrica (Goldfuss) (=*Cyathophyllum excentricum*), 1826, p. 55. see Ehrenberg, 1834.
Macgeea minima Brice, 1970, p. 286.
Macgeea minor (Gürich) (=*Ceratophyllum lindstroemi minor*), 1896, p. 165. see Ma, 1956, p. 24.
Pterorrhiza radicans (Goldfuss) (=*Cythophyllum radicans*), 1826, p. 55. see Ehrenberg, 1834.
Macgeea teleopea Crickmay, 1962, p. 4.

Geological distribution: Middle and Late Devonian
Geopraphical Distribution: Europe, Asia, North America and North Africa.

Macgeea solitaria (Hall et Whitfield), 1873

(Plate 24, 25, text-figure 9)

1873 *Pachyphyllum solitarium* Hall et Whifield, p. 232, pl. 9, fig. 6, 7.

1889 *Macgeea solitaria* (Hall et Whitfield). Webster, p. 711.
1922 *Cyathophyllum* (*Thamnophyllum*) *multizonatum* Reed (in part), p. 12, pl. 2, fig. 1-5. non pl. 1, fig. 10, 11; pl. 2, fig. 6, 7.
non 1924 *Macgeea solitaria* (Hall et Whitfield). Fenton and Fenton, p. 54, pl. 9, fig. 7-10.
1935 *Macgeea solitaria* (Hall et Whitfield). Lang and Smith, p. 552, text-figs. 10, 11; pl. 37, fig. 1-3.
1945 *Macgeea solitaria* (Hall et Whitfield). Smith, p. 28, pl. 24, fig. 1.
1946 *Macgeea solitaria* (Hall et Whitfield). Stainbrook, pl. 57, fig. 16; pl. 60, fig. 11, 14.
1949 *Macgeea solitaria* (Hall et Whitfield). Stumm, p. 35, pl. 17, fig. 1-4.
1949 *Macgeea* (*Macgeea*) *solitaria* (Hall et Whitfield). von Schouppé, p. 159, pl. 11, fig. 49, 50, pl. 14, fig. 81-85.
non 1951 *Macgeea solitaria* (Hall et Whitfield). Soshkina, p. 82, fig. 34, pl. 14, fig. 5-9.
non 1952 *Macgeea solitaria* (Hall et Whitfield). Soshkina, p. 84, pl. 19, fig. 66.
1956 *Macgeea solitaria* (Hall et Whitfield). Hill, fig. 192, 2.
1958 *Macgeea* (*Macgeea*) solitaria (Hall et Whitfield). von Schouppé, fig. 1, 2.
non 1960 *Macgeea solitaria* (Hall et Whitfield). Spasskiy, p. 44, pl. 19, fig. 1-5.
1963 *Macgeea* (*Macgeea*) *solitaria* (Hall et Whitfield). Schouppé., text-fig. 2a-b.
1964 *Macgeea solitaria* (Hall et Whitfield). Yoh and Wu, p. 99, text-fig. 90.
1967 *Pterorrhiza solitaria* (Hall et Whitfield). Pickett, p. 65, text-fig. 18, pl. 5, fig. 19-21.
? 1969 *Macgeea solitaria* (Hall et Whifield). Tsien, p. 70, pl. 48, fig. 7, 8, 16.
1977 *Macgeea solitaria* (Hall et Whitfield). Spasskiy, pl. 24, fig. 3.
non 1981 *Macgeea solitaria* (Hall et Whitfield), Tsyganko, p. 131, pl. 58, fig. 1, 2.
1991 *Macgeea* (*Macgeea*) *solitaria* (Hall et Whitfield), Coen-Aubert and Wrzolek, p. 8, pl. 1, fig. 1-3.

Measurement:

No	D	N	Dt	Lf	Ls.	Nt	Nh
Mf009009	20.5	35×2	12.3	7.2	2.8		4
Mf013019	17.8	31×2	12.5	7.4	3.1	13	6
Mf013015	16.7	30×2	11.4	6.1	2.6	12	5
Mf00x048	16.0	30×2	11.4	6.1	2.6	12	5
Mf013017	16.8	31×2	13.1	7.7	2.6	11	4
Mf013018	15.8	29×2	10.5	7.0	2.6	9	6
Mf013015	15.3	29×2	10.4	6.1	2.6	12	5
Mf00x008	16.7	29×2	10.7	6.6	3.1	11	4
Mf008003	16.6	33×2	13.1	6.8	2.9	7	5
Mf010031	13.1	28×2	7.9	5.8	2.0	11	5
Mf00x053	5.9	31×2	10.6	5.9	2.2	8	4

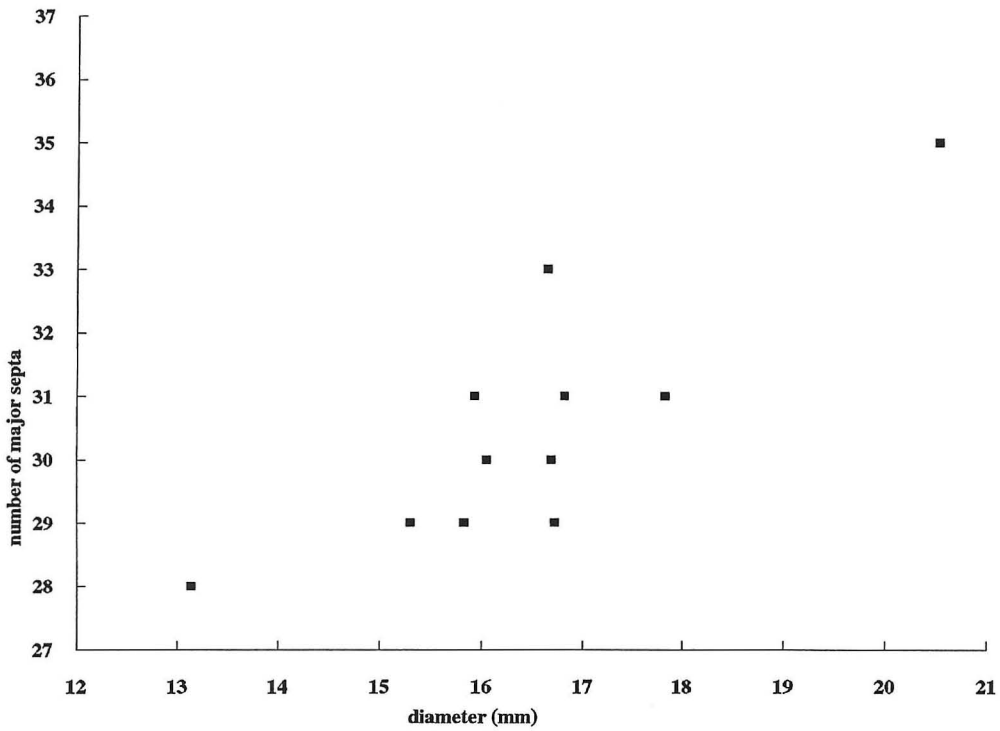
Diagnosis: Soliatary, sometimes with a few offsets developed near the mature calice, subcylindrical or trochoid coral. Septa in two orders, radially arranged. Major septa almost reach the axis, dilated in fusiform. In some individuals cardinal septa slightly shorter than the other majors, but no clear cardinal fossula. Dissepimentarium consists of outer, horseshoe and inner dissepiments. Tabulae incomplete.

Description: Solitary, subcylindrical or trochoid coral with diameter ranging from 12.8 to 20.5 mm. Exterior wall thin, usually has not been preserved. Cup-shaped calices deep, with vertically sloping wall and very narrow calical platform (pl. 24, fig. 3b; pl. 25, fig. 1b). Septa of two orders, radial in arrangement, from 26×2 to 42×2 in number. Major septa long, nearly reach the axis, dilated in fusiform, thickest at the inner margin of dissepimentarium, but thin, may be waved

in tabularium (pl. 24, fig. 3a ; pl. 25, fig. 2a, 3a). In some specimens cardinal septum is slightly shorter than the other majors (pl. 24, fig. 2a, 3a). Minor septa short, restricted to dissepimentarium or a little enter the tabularium, nearly one third of the major ones in length, markedly thinner than the majors. Lateral dissepiments may be present in the position of horseshoe dissepiments (pl. 24, fig. 1a).

In longitudinal section the coarse rhipidacanths forming septa arranged in fans with the axis of divergence centered over the horseshoes (pl. 24, fig. 1b ; pl. 25, fig. 2b). The dissepimentarium is composed of three kinds of dissepiments. The outer dissepiments are horizontal or concave or inclined outwardly, in a few specimens the outer dissepiments have been destroyed over the much parts. Horseshoe dissepiments are well developed to form a continuous pipe often coated by stereome, 4 to 6 can be counted over the vertical distance of 5 mm. The inner dissepimentarium consists of 1 to 4 rows of small globose dissepiments which are nearly vertically arranged. Tabularium wide, with diameter of 9.6 to 13.1 mm, occupied by incomplete tabellae, axially convex tabulae. The surface of tabulae is variable, flat, slightly convex or concave in the wide axial part and turn downwardly in peripheral part, spaced 5 to 6 over the vertical distance of 5 mm. Periaxial tabellae inclined inwardly at variable angle from horizon.

Discussion: The species is the type species of the genus, displays regular structure. The species is similar to *Macgeea bathycalyx regularis* Rozkowska (1956, p.



Text-fig. 9 Scatter diagram of number of major septa versus diameter in *Macgeea solitaria*

298, fig. 19, 29) from the Givetian of Poland, but the extremely numerous carinae on the sides of *M. bathycalyx regularis* can serve to distinguished it from *M. solitaria*.

Locality: Malutang and Heyuanzhai.

Macgeea bathycalyx (Frech), 1886

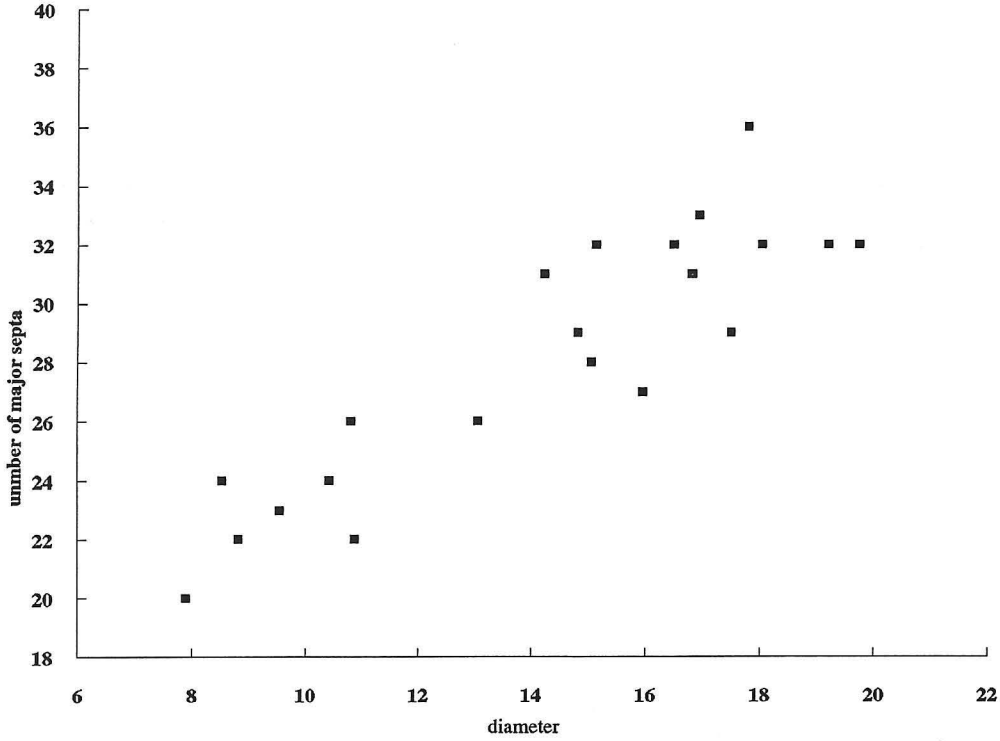
(Plate 26-29, text-figure 10)

1886 *Cyathophyllum bathycalyx* Frech, p. 181, pl. 7, fig. 8-10. (non pl. 5, fig. 17-24, pl. 7, fig. 11).
?1908 *Cyathophyllum bathycalyx* Frech. Reed, p. 3, pl. 1, fig. 2.
1949 *Macgeea bathycalyx* (Frech). Stumm, p. 35, pl. 17, fig. 5.
1949 *Cyathophyllum bathycalyx* Frech. Schouppé, p. 175.
non 1969 *Ceratophyllum bathycalyx* (Frech). Tsien, p. 52, pl. 7, fig. 1-7.
non 1956 *Macgeea bathycalyx bathycalyx* (Frech). Rozkowska, p. 288, text-fig. 9, 10.
non 1978 *Pterorrhiza bathycalyx* (Frech). Birenheide, p. 109, text-fig. 58.
1982 *Macgeea bathycalyx yunnanensis* Sung, p. 26, pl. 2, fig. 3, pl. 3, fig. 3.

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh
Mf013011	15.9	27×2	11.2	6.7	2.6	10	5
Mf010011	14.8	29×2	10.3	7.3	2.5	11	6
Mf013012	14.8	29×2	10.9	6.8	2.7	11	4
Mf010010	14.2	31×2	11.9	6.0	2.2	10	5
Mf009013	8.5	24×2	5.6	4.0	1.5	10	5
Mf013010	8.8	22×2	5.5	4.1	1.4	12	8
Mf013001	9.5	23×2	6.1	4.0	1.7	12	7
	8.3	20×2	5.1	3.2	1.6		
Mf010009	17.5	29×2	11.6	7.3	2.2	10	5
Mf007026	15.0	28×2	10.6	5.4	1.8	8	4
Mf013008	19.2	32×2	12.3	7.6	3.7		5
Mf010012	16.5	32×2	12.0	7.0	2.3	10	5
Mf007010	18.0	32×2	11.6	7.2	2.3	7	4
Mf008024	16.8	31×2	12.5	6.1	2.7	6	5
Mf008011	16.9	33×2	12.6	7.9	2.8	7	5
Mf001005	10.4	24×2	7.3	4.3	2.0	9	4
Mf009001	17.8	36×2	12.5	6.8	2.7	16	4
	13.1	27×2	8.9	5.2	2.4		
Mf010004	19.7	32×2	15.0	8.0	2.7	8	7
	13.3	29×2	9.8	6.5	2.2		
Mf00x020	10.8	26×2	5.6	4.6	2.3	9	6
	10.1	26×2	5.4	3.7	2.0		
Mf013015	7.9	20×2	4.1	3.4	1.3		8
Mf00x036	10.9	22×2	5.4	4.1	2.1	11	7
	7.1	19×2	4.9	2.4	1.3		
Mf009012	15.1	32×2	11.0	5.7	2.0	8	4
	9.5	25×2	6.8	4.1	1.6		
Mf007056	13.1	26×2	9.4	4.8	1.8	8	4

Diagnosis: Solitary, cylindrical or trochoid coral with septa of two orders, bilateral in arrangement. Counter septum markedly longer than the other majors and cardinal fossula can be easily distinguished by the short cardinal septum. Disse-



Text-fig. 10 Scatter diagram of number of major septa versus diameter in *Macgeea bathycalyx*

pimentarium composed of outer horizonsal, medium horseshoe and inner globose dissepiments. Tabulae incomplete.

Description: Solitary, cylindrical or trochoid coral, the size of the individuals considerably varies from 7.9 to 19.2 mm in diameter. Exterior wall very thin, usually has been destroyed. Septa of two orders, numerous, range from 19×2 to 36×2, bilaterallly arranged. Major septa usually retreated from the axis, in some specimens major septa nearly reach the axis (pl. 27, fig. 1a ; pl. 28, fig. 2a ; pl. 29, fig. 6a). Counter septum markedly longer than the others, usually extend beyond the center. This character is more obvious in the early stage (pl. 26, fig. 1b ; pl. 27, fig. 1b, 2b). Cardinal septum short and cardinal fossula distinct. Septa dilated within the dissepimentarium in fusiform and thin in tabularium, their maximum thickness just over the position of the horseshoe dissepiments. Minor septa short, restricted to the tabularium or a little enter tabularium, less than half of the majors in length. Weakly developed carinae may be present on the sides of septa. In transverse sections, besides horizontal, horseshoe and globose dissepiments, there are lateral dissepiments in the position of horseshoe dissepiments (pl. 26, fig. 1a ; pl. 27, fig. 1a).

In longitudinal section septal trabeculae are coarse rhipidacanths, arranged in fans with their axis of divergence over the horseshoes often coated by stereome (pl. 26, fig. 1c ; pl. 29, fig. 2b, 3c). Dissepimentarium consists of three parts. The

outer dissepiments horizontal or concave or gently inclined outwardly. Horseshoe dissepiments well developed to form a continuous pipe of horseshoes which are dilated to form two rows of inner walls. Inner dissepiments small, globose, nearly vertically arranged and in 1 to 4 rows. In some individuals the inner small globose dissepiments discontinuous or absent in parts (pl. 26, fig. 2b, 3b; pl. 29, fig. 1b; pl. 30, fig. 2b, 3b). Tabularium wide, with diameter of 4.1 to 12.5 mm, consists of incomplete tabulae. Axial convex tabulae, with flat, weekly convex or concave axial surfaces. Periaxial tabellae considerably vary in size, and incline in variable degree or nearly horizontal. In one or two individuals the tabulae arch in vesicular form (pl. 30, fig. 3b).

Discussion: In erecting this species, F. Frech (1886) put two kinds of specimens under the species. One kind is those with typical horseshoe dissepiments which form a continuous pipe as shown in pl. 7, fig. 8-10, and the text-figure on p. 67 (Frech, 1886). The another kind is those without any horseshoes as shown in pl. 5, fig. 17-24, pl. 7, fig. 11. Therefore some forms with different characters have been described under this species. It is very obvious that the corals without horseshoe dissepiments should not belong to *Macgeea*. As seen in the figures shown by Frech as fig. 8-10 in pl. 7, this species is characterized by these features that the septa bilaterally arrange, counter septum longer than the others and the cardinal fossula is distinguished by the shorter cardinal septum. All these charactehs mentioned above unually can be seen in the early stage of some species refereed to *Macgeea*. Maybe this species is a more ancestral one in the genus.

The material from the western Yunnan shows that the species is considerably variable in size.

Locality: Malutang.

Macgeea berdensis Soshkina, 1939

(Plate 37-41, text-figure 11)

1939 *Macgeea berdensis* Soshkina, p. 18, pl. 3, fig. 19-36; pl. 4, fig. 37, 38; pl. 13, fig. 108-111.
1949 *Macgeea* (*Macgeea*) *berdensis* Soshkina. Schouppé, p. 169, fig. 94-99.
1952 *Macgeea berdensis* Soshkina. Soshkina, p. 84, text-fig. 111.
1953 *Macgeea berdensis* Soshkina. Rozkowska, p. 22, pl. 4, fig. 7-11.
1954 *Macgeea multizonata* (Reed). Soshkina, p. 68, pl. 19, fig. 4.
1969 *Macgeea berdensis* Soshkina. Rozkowska, p. 148, text-fig. 61.

Explanation of Plate 1

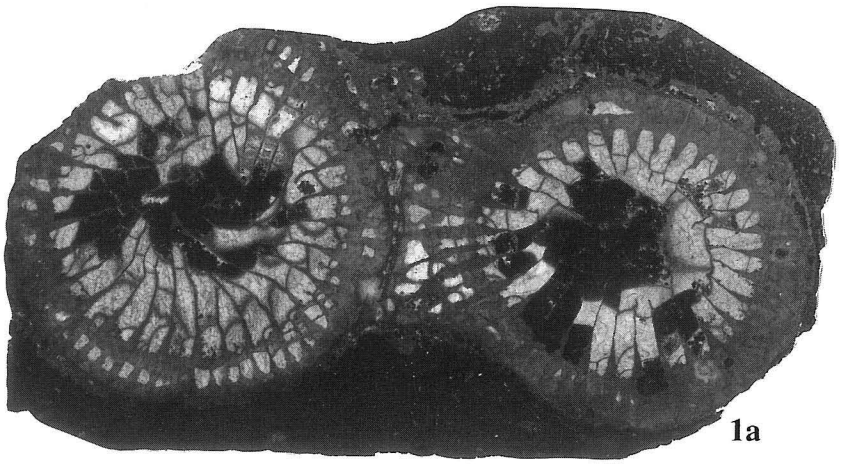
(All corals illustrated here were collected from the upper part of the Heyuanzhai Formation in Shidian County, Yunnan Province, China. The forms labeled "Mf" are from Malutang, and the others labeled "Hf" from Heyuanzhai. All specimens are stored in China University of Geosciences, Beijing, China).

(All figures are ×4)

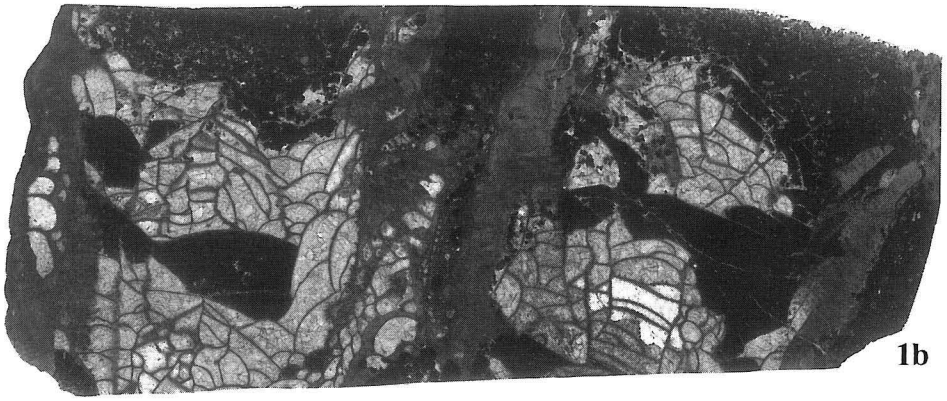
Fig. 1 *Peneckiella fascicularis* (Soshkina). Mf007012, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Peneckiella fascicularis* (Soshkina). Hf1002, 2a. transverse section; 2b. longitudinal section.

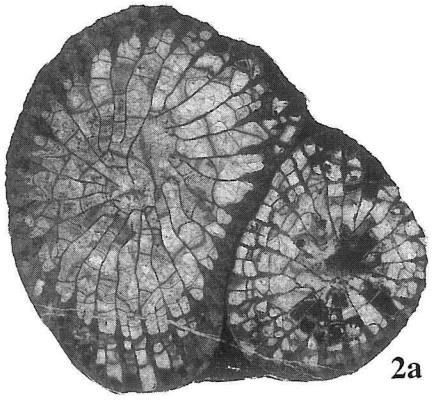
Plate 1



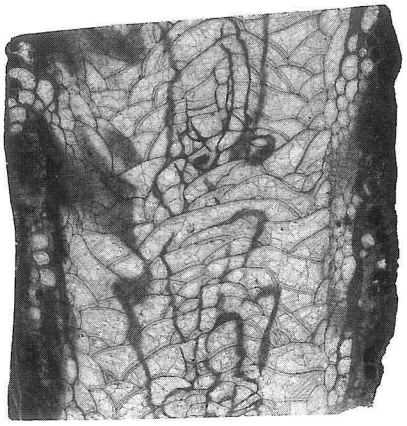
1a



1b



2a



2b

Peneckiella

1980 *Macgeea berdensis* Soshkina. Ivanovskiy and Shurygina, p. 22, pl. 6, fig. 2, 3.

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh
Mf010005	13.5	29×2	9.4	5.4	2.3	9	5
	12.0	28×2	9.2	4.3	1.7		
Hf1015	13.8	25×2	10.1	4.2	1.8	8	5
Mf013009	13.0	26×2	7.3	4.8	1.8	11	7
Hf1009	11.4	27×2	8.6	3.5	0.9	6	4
	10.8	27×2	8.4	4.0	1.6		
Hf1027	13.2	26×2	8.8	4.8	1.7	9	6
	10.2	20×2	7.9	3.5	1.4		
Hf1021	13.9	28×2	7.1	3.6	1.7	4	5
Hf1005	12.8	26×2	9.0	3.5	1.8	6	5
Hf1010	10.7	23×2	8.0	4.4	1.6	5	4
	8.5	16×2	6.5	2.9	1.0		
Hf1032	13.1	27×2	9.4	4.0	1.2	6	4
Hf1004	12.2	24×2	9.6	4.4	1.7	7	4
Mf1026	10.3	22×2	9.2	3.4	1.3	4	4
Hf1029	9.8	22×2	7.0	4.0	1.5	7	5
	9.0	21×2	6.6	3.7	1.3		
Mf00x040	12.1	26×2	8.7	4.0	2.1	8	5
Hf1008	11.0	23×2	8.3	4.1	1.5	6	5
	10.8	23×2	8.4	4.1	1.6		
Mf00x021	11.7	22×2	8.4	4.3	2.0	6	5
Mf009002	8.7	21×2	6.1	3.3	1.5	10	5
Mf003016	9.2	22×2	6.5	2.4	1.5	11	7
Mf007023	10.8	26×2	6.6	2.7	1.8		

Diagnosis: Small solitary, subcylindrical coral with short major septa which usually strongly dilated in dissepmentarium to form a well developed inner wall. Dissepimentarium composed of outer, horseshoe and poorly developed inner dissepiments. Tabulae incomplete.

Description: Solitary, small subcylindrical coral with diameter ranging from 8.7 to 13.9 mm. Exterior wall mostly had been destroyed, and in such cases septa projecting outside. Septa of two orders, number 21×2 to 29×2, nearly radially arranged. Major septa short, about three fifths of the radius in length, weakly or strongly dilated in outer margin of tabularium in wedge, and thin in tabularium. Their axial ends may be disrupted by tabulae (pl. 37, fig. 3a). The septal dilatation may be in contact laterally to form a well developed inner wall (pl. 39, fig. 1a, 1b, 2a, 2b. 3). The maximum thickness of septal dilation is variable. Minor septa

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Explanation of Plate 2

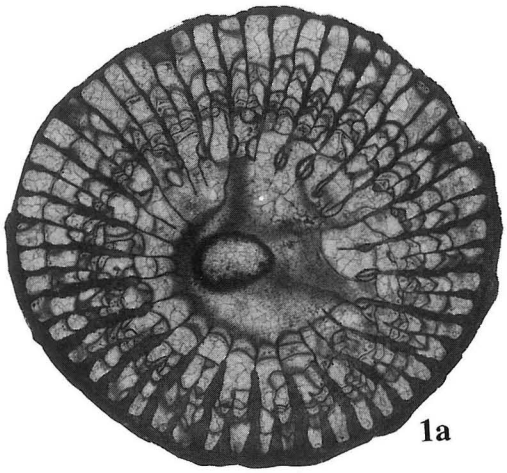
(All figures are ×4)

Fig. 1 *Peneckiella yunnanensis* sp. nov. Hf1034, 1a. transverse section; 1b. longitudinal section.

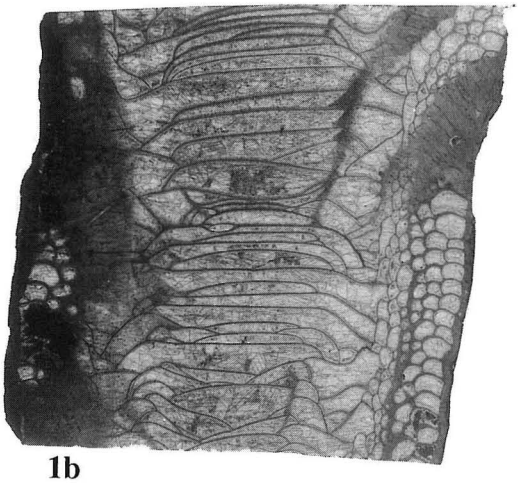
Fig. 2 *Peneckiella fascicularis* (Soshkina). Mf007003, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Peneckiella yunnanensis* sp. nov. Hf1024, 3a. transverse section; 3b. longitudinal section.

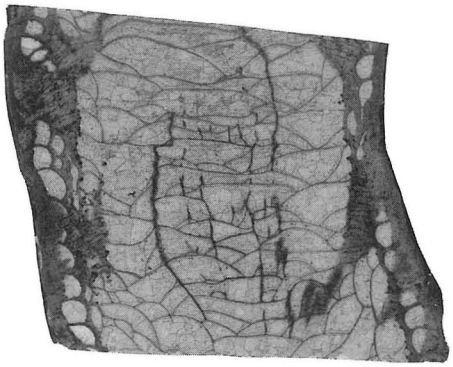
Plate 2



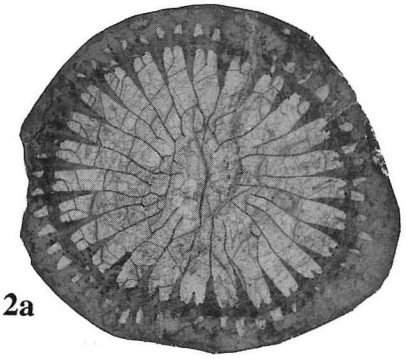
1a



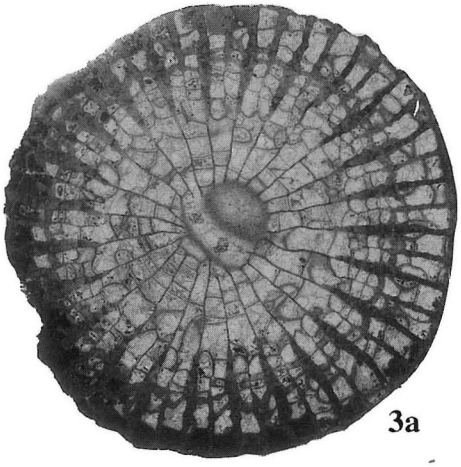
1b



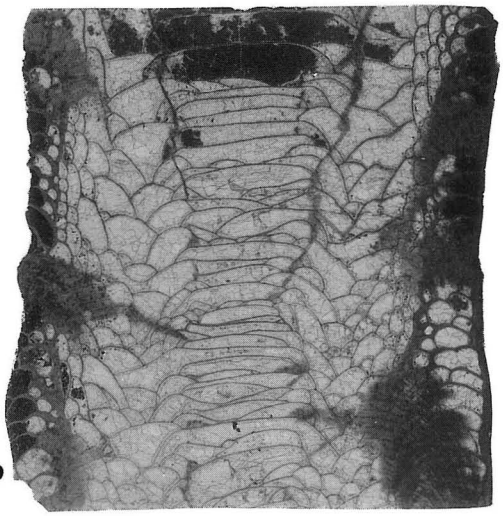
2b



2a



3a



3b

Peneckiella

short, usually restricted to the narrow dissepimentarium, shorter than the half of the majors. Lateral dissepiments are usually present in some specimens (pl. 38, fig 1a ; pl. 39, 1a). Weakly developed carinae may be seen in peripheral parts (pl. 38, fig. 2a).

In longitudinal section septal trabeculae in fans with their axis of divergence over the horseshoe dissepiments may coat the horseshoes (pl. 38, fig. 1b. 2b ; 41, fig. 1c, 2c). Dissepimentarium narrow. In most specimens, the outer dissepiments have been destroyed, in a few specimens horizontal and rare outer dissepiments can be seen (pl. 37, fig. 1c ; pl.39, fig. 2b ; pl. 40, fig. 3b). Large horseshoe dissepiments well developed and form a continuous pipe of horseshoe in which the top surface nearly globose. The inner dissepiments poorly developed, absent or only one row of small, globose dissepiments. Tabularium occupied by incomplete tabulae. Axial tabulae usually large, convex. In some specimens the axial tabulae irregular. Concave, convex, and flat axial tabulae can be present within a single specimen (pl. 37, fig. 2b, 3b). Periaxial tabellae vary from specimen to specimen, large or small, horizontal or inclined inwardly.

Discussion: *Macgeea berdensis* described by Soshkina (1939, 1952, 1954), Rozkowska (1953, 1969), Ivanovskiy and Shurygina (1980) from Frasnian and Famennian of Ural and Holy Cross Mountains shows short and strongly dilated septa. Of the material from western Yunnan the specimens resembling *Macgeea berdensis* may be divided into two groups. One group includes those specimens which have strongly dilated septa to form well developed inner wall (pl. 35, fig. 1a, 1b, 2a, 2b, 3), and more number of axial tabulae within limited vertical distance, more complex tabulae as well as a few inner dissepiments. The characters occurring in this group are identical with those seen in the material from Ural and Holy Cross Mountains. The another group of corals are those in which septal dilation is thinner, usually not being in contact laterally to form inner wall (Pl. 37, fig. 1a, 1b, 2a, 3a ; pl. 40, fig. 2a), are less numerous tabulea within limited distance, tabulae tend to be complete, and inner dissepiments rare or absent. It is very interesting that the strongly and weakly dilated septa may occur in one section (pl. 38, fig. 2a). Therefore the difference on the degree of septal dilation does not merit for the separation of species. It is inferred that the first group lived in a turbulent shallow water, and their skeleton in strongly dilated and more complicated so as to adapt themselves to the circumstances. The second group adapted to a calmer shallow water, their skeleton tends to be simple. In fact, these specimens assigned to

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Explanation of Plate 3

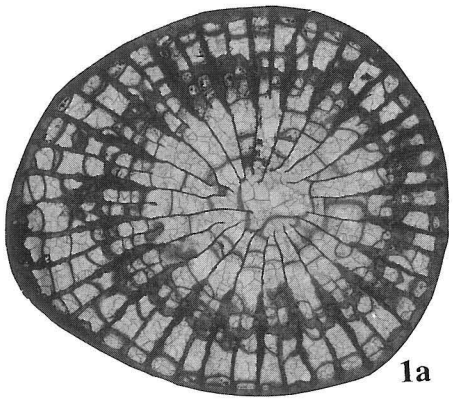
(All figures are ×4)

Fig. 1 *Peneckiella yunnanensis* sp. nov. Hf1033 (Holotype), 1a, ab, both transverse sections at two different diameters; 1c. longitudinal section.

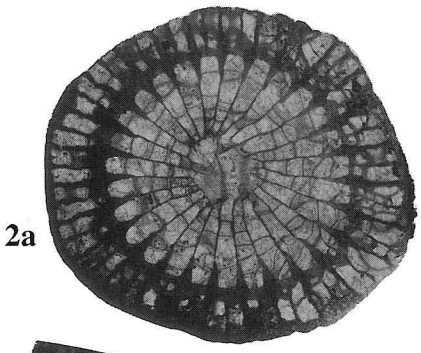
Fig. 2 *Peneckiella yunnanensis* sp. nov. Hf1014, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Peneckiella yunnanensis* sp. nov. Hf1017, 3a. transverse section; 3b. longitudinal section.

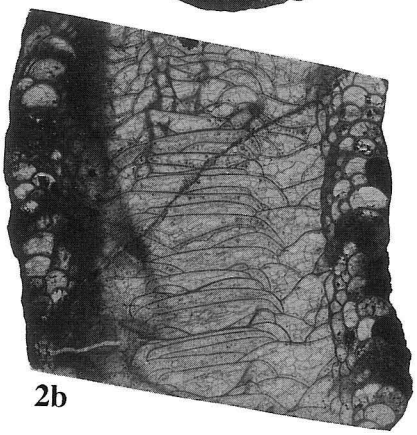
Plate 3



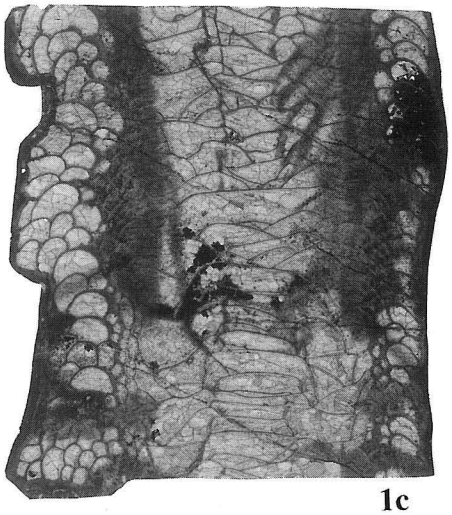
1a



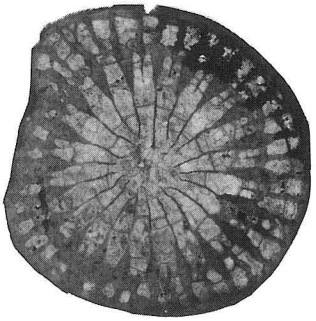
2a



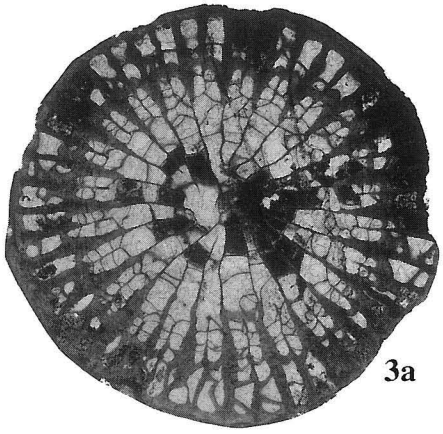
2b



1c



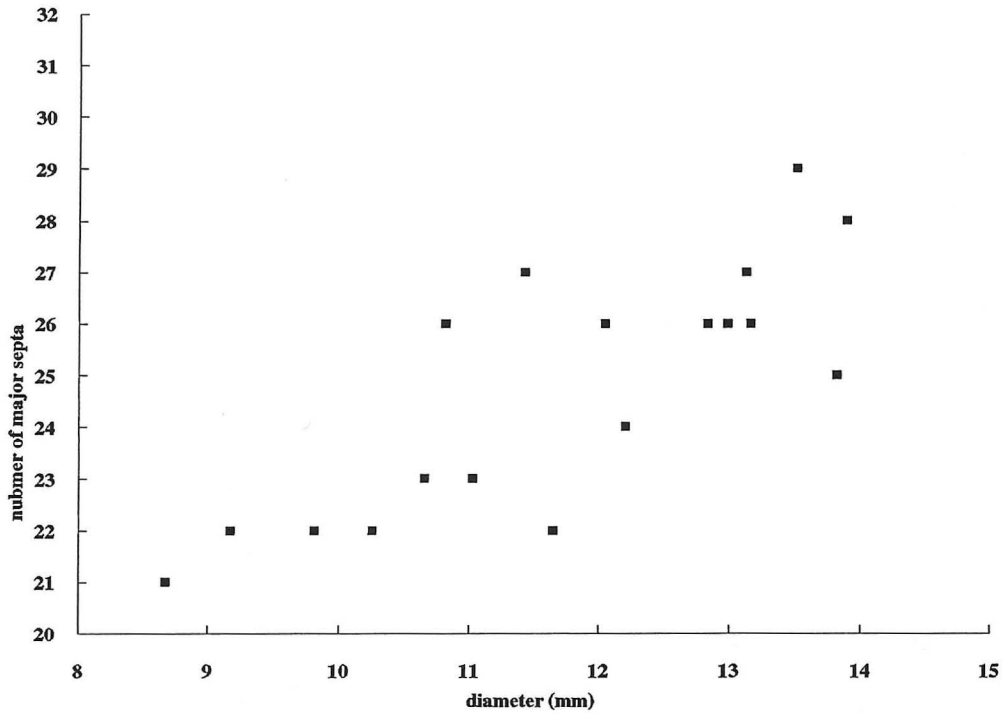
1b



3a

3b

Peneckiella



Text-fig. 11 Scatter diagram of number of major septa versus diameter in *Macgeea berdensis*

Macgeea berdensis were collected from Malutang and Heyuanzhai respectively. The first group in which the specimens labeled by Mf are mainly from Malutang, and the second group whose elements by Hf are mainly from Heyuanzhai. The strongly dilated septa and weekly dilated septa can be seen within one specimen, so that these two groups are assigned to *M. berdensis* although there are some differences between them. It is, however, still difficult to explain why there is difference in the degree of dilation in parts within the same transverse thin section.

The tabulae features in the specimen of *Macgeea berdensis* from Famennian of Holy Cross Mountain remain unknown because of the absence of longitudinal section. The axial tabulae of the specimen of *M. berdensis* from Frasnian of Ural and Holy Cross Mountain are slightly convex with horizontal surfaces and downturn edges. However, the axial tabulae of *M. berdensis* described here are slightly convex with horizontal surfaces and downturn edges in most individuals, they may

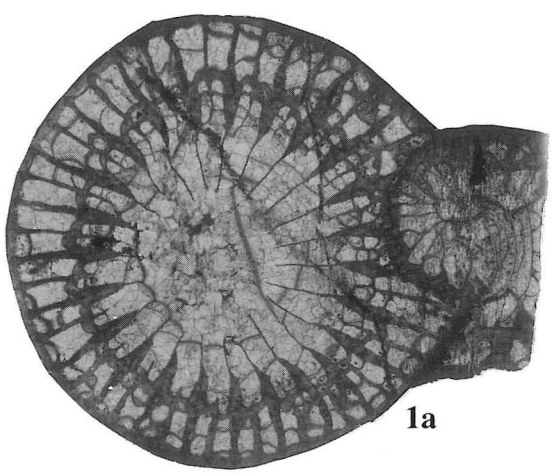
Explanation of Plate 4

Fig. 1 *Peneckiella yunnanensis* sp. nov. Hf1016, 1a. transverse section; 1b. longioudinal section, ×4.

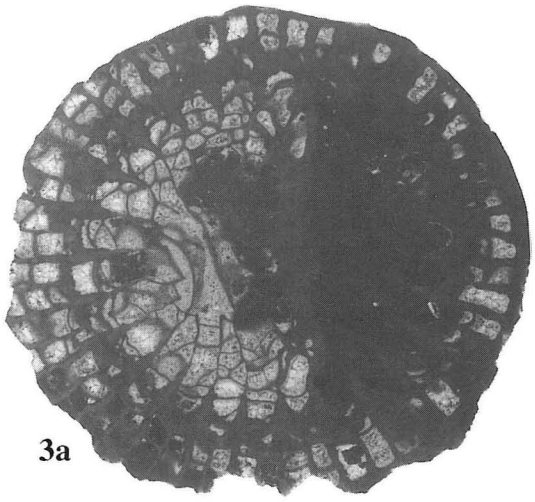
Fig. 2 *Peneckiella yunnanensis* sp. nov. Hf1011, 2a, 2b. both transverse sections at two different diameters; 2c. longitudinal section, ×4.

Fig. 3 *Parapeneckiella shidianensis* gen. et sp. nov. Hf1042 (Holotype), 3a. transverse section; 3b. longitudinal section, ×6.

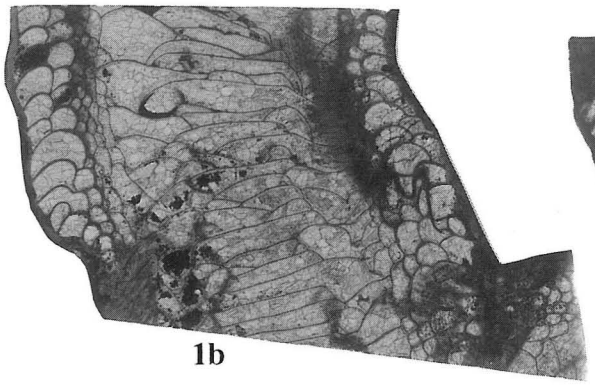
Plate 4



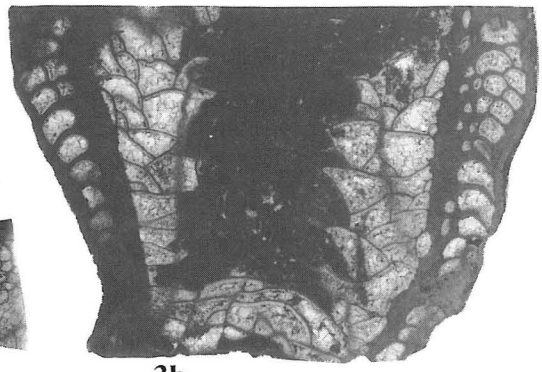
1a



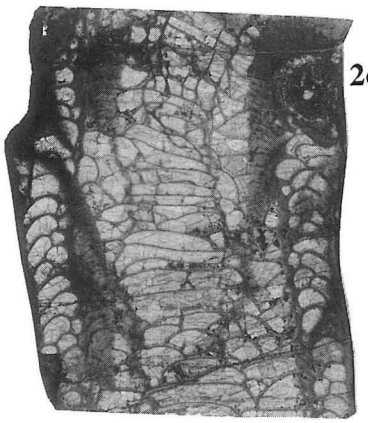
3a



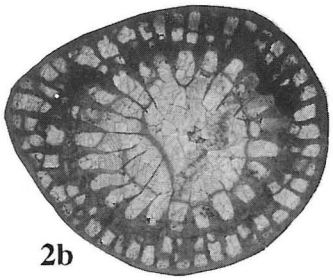
1b



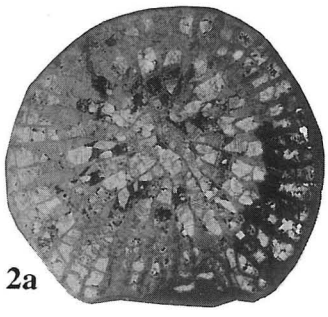
3b



2c



2b



2a

Peneckiella* and *Parapeneckiella

be irregular, convex, flat or concave in some specimens (pl. 37, pl. 2b, 3b; pl. 40, fig. 2b).

This species is similar to *M. solitaria* in some aspects, but differs from the latter in having small individuals and short major septa.

Locality: Malutang and Heyuanzhai.

Macgeea symmetrica Sung, 1982

(Plate 30-36, text-figure 12)

1982 *Macgeea symmetrica* Sung, p. 27, pl. 2, fig. 1.

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh
Hf1023	14.6	26×2	8.9	4.5	1.9	6	4
	12.5	23×2	8.8	4.5	2.6		
Hf1099	9.3	24×2	6.8	3.6	1.5	5	4
Mf007020	11.1	24×2	9.0	5.2	1.7	9	5
Mf010012	13.3	28×2	9.3	5.5	2.6	11	6
Hf1013	14.4	26×2	8.7	5.7	1.8	6	4
Mf010007	12.2	25×2	8.3	4.7	2.2	10	5
Mf001006	12.8	24×2	8.0	4.4	2.1	10	4
	9.7	21×2	6.9	3.2	1.3		
Hf1020	14.4	27×2	10.4	5.1	2.0	5	5
	13.6	25×2	11.2	5.0	1.3		
Mf008045	10.6	25×2	8.7	5.1	1.9	13	9
Mf001010	13.7	27×2	10.1	5.6	1.8	9	3
Hf1035	12.7	27×2	9.2	4.1	1.6	5	5
	10.9	27×2	8.3	3.5	1.3		
Hf1001	10.6	23×2	7.0	4.4	1.3	6	5
Mf001002	11.1	29×2	8.2	4.5	1.3	10	5
Hf1003	13.5	27×2	10.0	4.7	1.7	5	4
Mf00x023	12.6	27×2	8.6	5.9	2.1	12	4
Mf008003	10.4	26×2	7.6	3.9	1.5	10	4
Mf007002	11.6	24×2	8.8	5.1	1.7	10	4
Mf009004	10.0	27×2	7.0	4.0	1.4	10	5
Mf013014	11.7	29×2	8.5	5.1	1.8	9	6
Mf00x032	12.6	23×2	7.8	5.3	2.0	9	8
	7.9	17×2	5.0	3.1	1.6		
Hf1031	11.6	27×2	8.2	4.8	1.3	4	5
Mf00x021	12.2	23×2	8.4	4.4	1.7	9	5

Explanation of Plate 5

(All figures are ×2)

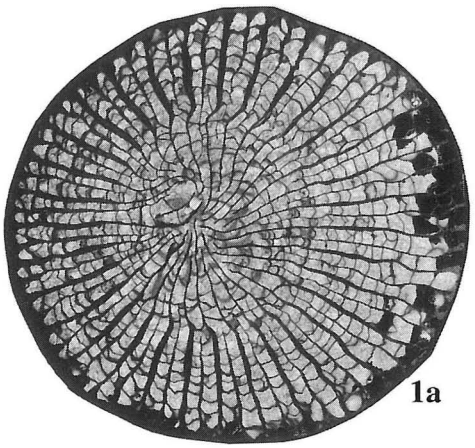
Fig. 1 *Acanthophyllum looghense* (Wedekind). Mfp009015, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Acanthophyllum looghense* (Wedekind). Hf1038, 2a. transverse section; 2b. longitudinal section.

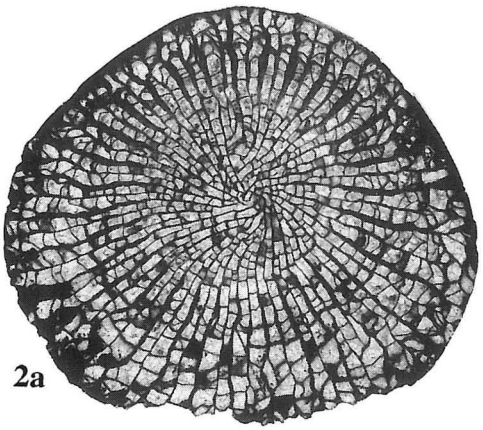
Fig. 3 *Acanthophyllum concavum* (Walther). Mf00x054, 3a. transverse section; 3b. longitudinal section.

Fig. 4 *Acanthophyllum concavum* (Walther). Hf1039, 4a. transverse section; 4b. longitudinal section.

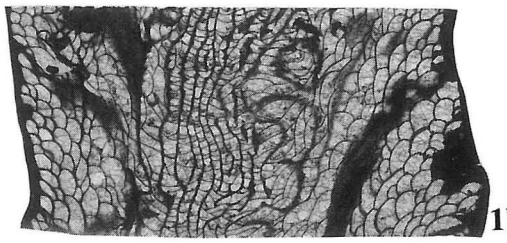
Plate 5



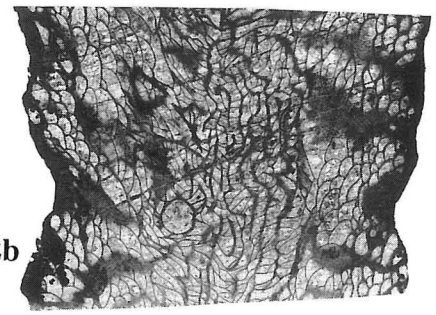
1a



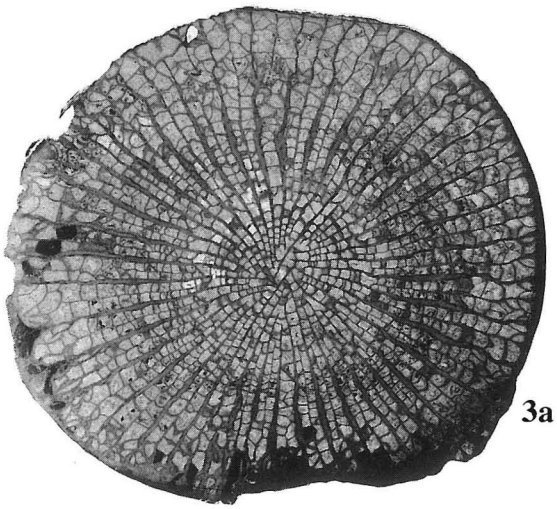
2a



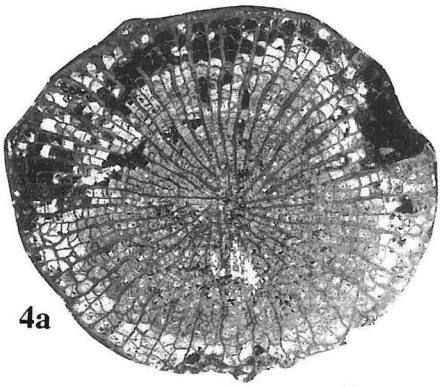
1b



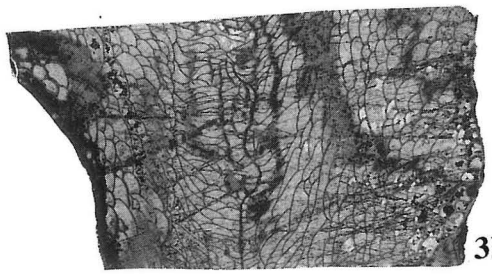
2b



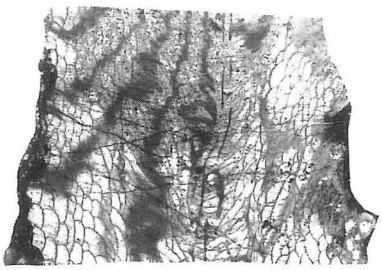
3a



4a



3b



4b

Acanthophyllum

Mf1007	13.4	24×2	8.3	4.4	1.2	4	5
	11.7	24×2	9.1	4.5	1.5		
Mf00x044	12.4	23×2	7.5	4.4	1.2	10	5
Mf013012	14.7	29×2	10.9	6.5	2.6	13	5
Hf1030	12.7	26×2	9.9	5.5	2.2	4	4

Diagnosis: Solitary, small subcylindrical or trochoid coral with markedly bilaterally arranged septa. Both distinct cardinal and counter fossulae can be easily distinguished by shorter cardinal and counter septa. Dissepimentarium including the outer, horseshoe and inner dissepiments. Tabularium composed of incomplete convex tabulae.

Description: Solitary, subcylindrical or trochoid coral, small sized, with diameter ranging from 9.3 to 14.6 mm. Calices are cup-shaped, with steeply sloping wall and very narrow calical platform (pl. 34, fig. 2b, 2c). Exterior wall thin, and is usuallg destroyed, and septa project outside. Septa in two orders, number 23×2 to 29×2, markedly bilateral in arrangement. Major septa usually retreated from the axis, may nearly reach axis in only rare individual (pl. 34, fig. 2a). Cardinal and counter septa shorter than the other majors, which make the cardinal and counter fossulae distinct. In the inner margin of dissepimentarium septa dilated in fusiform. The maximum dilated thickness variable, may be in contact laterally to form inner wall. Septa thin in tabularium. The axial ends of major septa may dilate in rhopaloid form (pl. 32, fig. 1b). In some specimens the axial ends of major septa may be disrupted by tabulae to appear as lonsdaleoid septa (pl. 31, fig. 1a, 1b). Minor septa short, usually restricted within narrow dissepimentarium, may enter a little into tabularium in a few individuals (pl. 33, fig. 3a; pl. 34, fig. 2a). On the sides of septa rare carinae present. Lateral dissepiments may be well developed in the position of the horseshoes (Pl. 36, fig. 2a).

In longitudinal section coarse trabeculae forming septa arrange in fans with their axis over the horseshoe dissepiments, often coating the horseshoes (pl. 31, fig. 1c; pl. 32, fig. 1c; pl. 33, fig. 1b. 4c). Dissepimentarium narrow, composed of three parts. In most specimens the outer dissepiments have been destroyed. In a few individuals the outer dissepiments rare, horizontal or concave. Horseshoe dissepiments well developed and form a uniform row of horseshoe dissepiments, which is often coated by stereome or coarse rhipidacanth trabeculae in fans forming the septa. The number of the horseshoes range from 4 to 9 within 2 mm. Inner dissepiments small, globose or somewhat elongated and inclined inwardly, grading into similarly inclined tabulae. The inner dissepimentarium usually is formed of 1 to 2 rows of dissepiments, may be absent in part. Tabularium wide, with diameter ran-

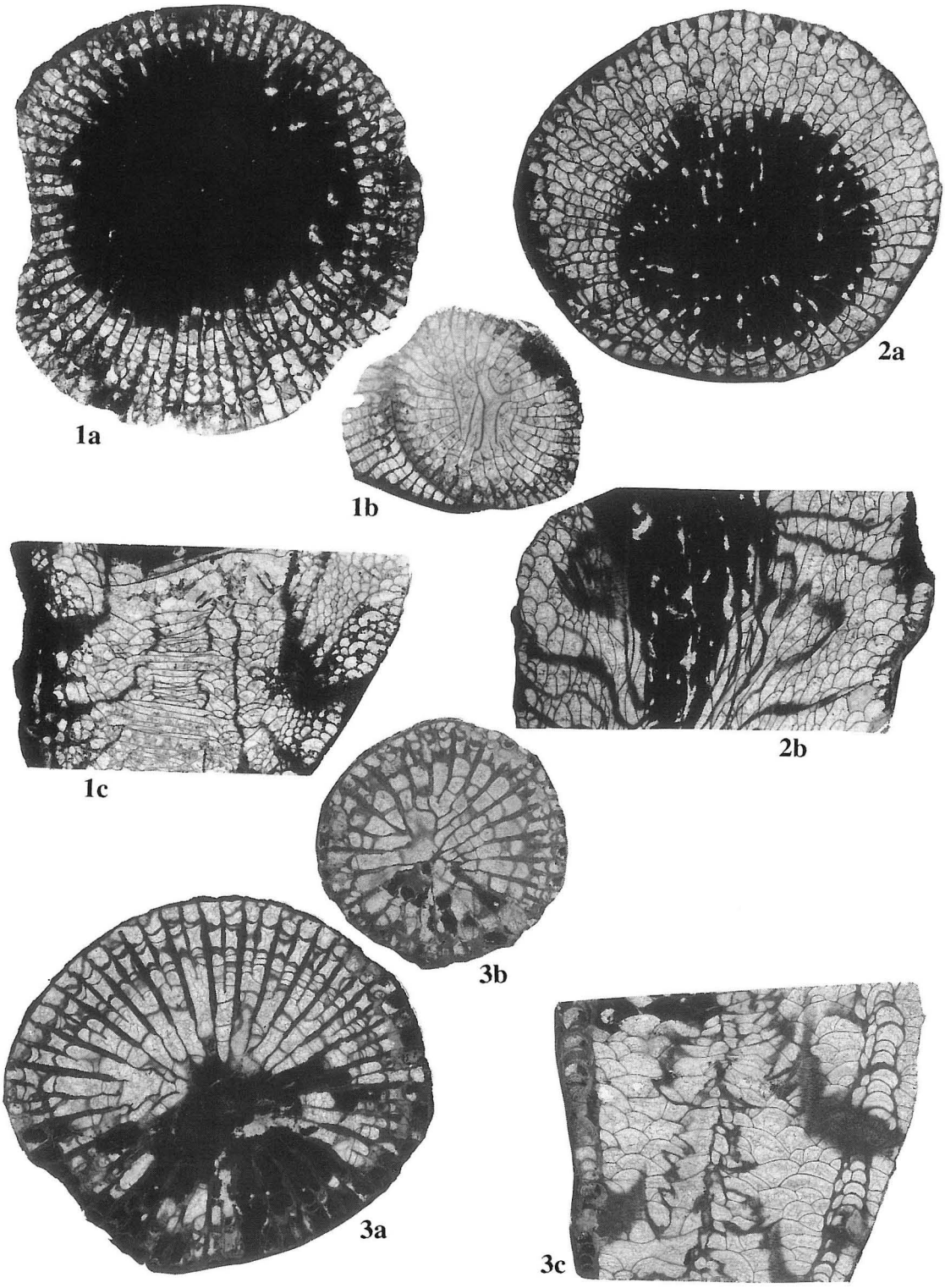
Explanation of Plate 6

Fig. 1 *Temnophyllum* (*Truncicarinulum*) *altevogti* (Oliver et Sorauf). Hf1039, 1a. transverse section of late stage; 1b. transverse section of early stage; 1c. Longitudinal section, ×2.

Fig. 2 *Grypophyllum* sp.. Hf1040, 2a. transverse section; 2b. longitudinal section, ×2.

Fig. 3 *Macgeea yunnanensis* sp. nov.. Mf005022 (Holotype), 3a. transverse section of late stage; 3b. transverse section of early stage; 3c. longitudinal section, ×4.

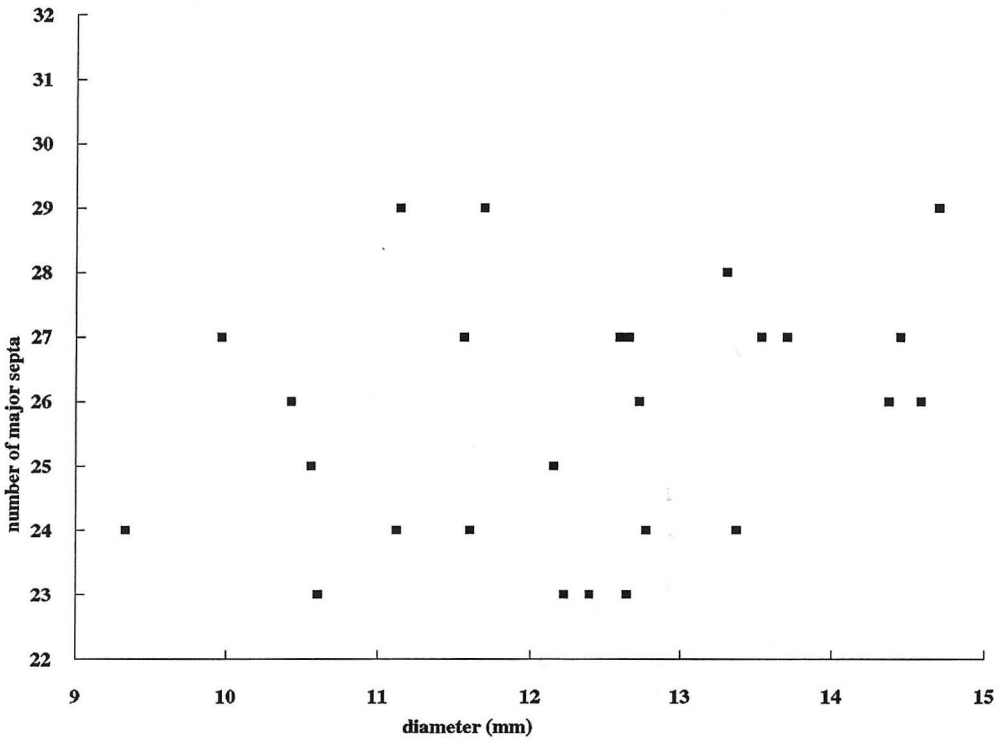
Plate 6



Temnophyllum (Truncicarinulum), Grypophyllum* and *Macgeea

ging from 6.9 to 10.1 mm, is composed of incomplete tabulae. The shape of the tabulae extremely variable. The tabulae usually differentiated into axial tabulae and periaxial tabellae. The axial tabulae commonly flat with downturned edges, axial surfaces convex or concave, 4 to 13 can be counted within the vertical distance of 5 mm. The periaxial tabulae inclined inwardly or nearly horizontal, large or differentiated into vesicles.

Discussion: This species is characterized by bilaterally arranged septa and clear cardinal and counter fossulae distinguished by shorter cardinal and counter septa. The septal dilation in these specimens assigned to *M. symmetrica* is extremely variable in the maximum thickness, and the number of tabulea and horseshoe within limited distance differ widely. As noted in the discussion on *M. berdensis*, the specimens belonging to *M. symmetrica* are also collected from two localities,



Text-fig. 12 Scatter diagram of number of major septa versus diameter in *Macgeea symmetrica*

Explanation of Plate 7

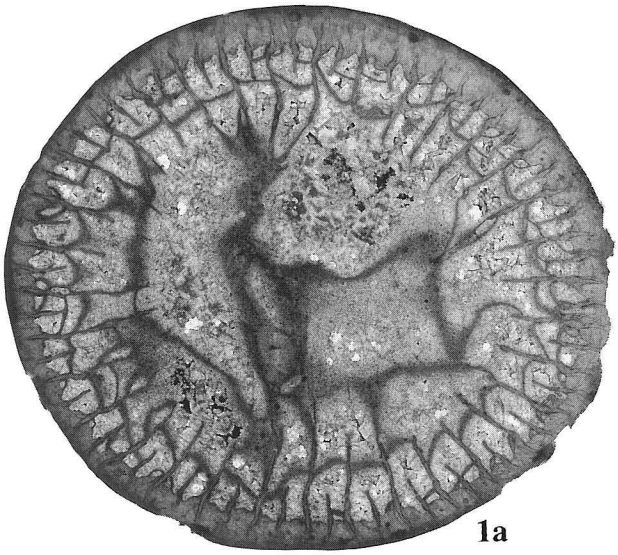
(All figures are ×3)

Fig. 1 *Siphonophrentis cantabrica* Birenheide. Mf00x067, 1a. transverse section; 1b. longitudinal section.

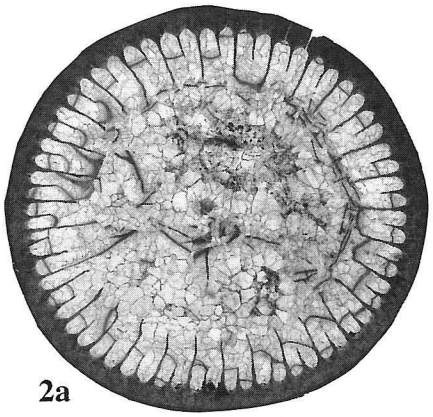
Fig. 2 *Siphonophrentis cantabrica* Birenheide. Mf1036, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Siphonophrentis cantabrica* Birenheide. Mf00x010, 3a. Transverse section of late stage; 3b. transverse section of early stage; 3c. longitudinal section.

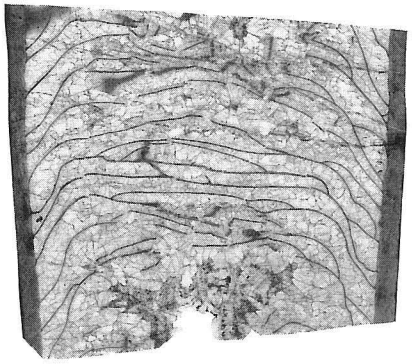
Plate 7



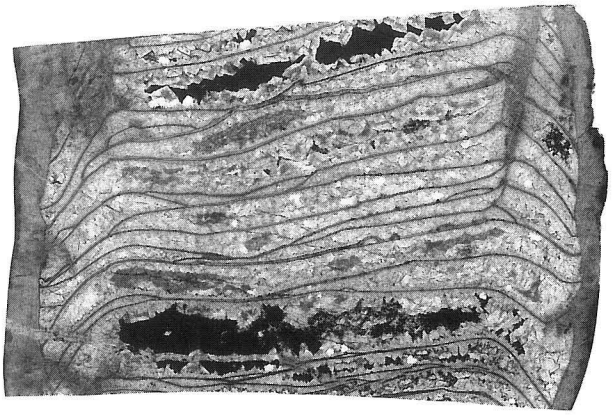
1a



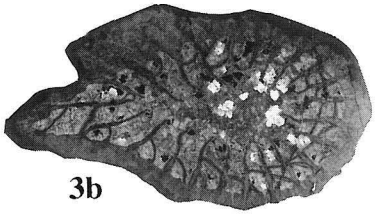
2a



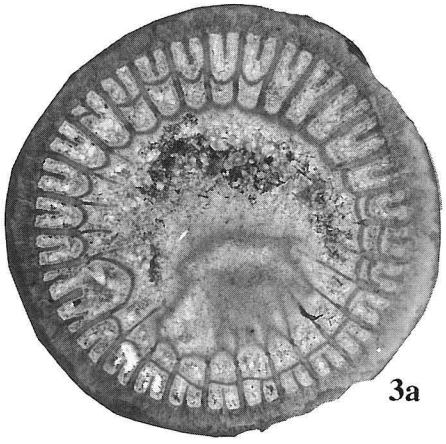
2b



1b



3b



3a

3c

Siphonophrentis

Malutang and Heyuanzhai. In the individuals from Malutang the skeleton tends to be reinforced, septa strongly dilated, number of tabulae within limited distance increases, more than 8 in 5 mm. Contrary, the skeleton of the specimen from Heyuanzhai seems to be simple, septa weekly dilated, number of tabulae decreases, less than 6 tabulae can be counted over the vertical distance of 5 mm.

This species is similar to *M. bathycalyx* and *M. berdensis* in some aspects, but dffers from *M. bathycalyx* in having clear cardinal and counter fossulae, and can be distinguished from *M. berdensis* by bilaterally arranged septa and pronounced cardinal and counter fossulae.

The form described under *M. bathycalyx bethycalyx* by Rozkowska (1956, p. 288, text-fig. 9, 10) bears bilaterally arranged septa and shorter cardinal and counter septa, But its long septa which almost reach the axis and the strong septal dilation in their axial ends as well as the very well developed carinae can serve to distinguish it from *M. symmetrica.*

Locality: Malutang and Heyuanzhai.

Macgeea dubia (de Blainville), 1830

(Plate 42)

1826 *Cyathophyllum hexagonum* Goldfuss, p. 61, pl. 19, fig. 5a-c.
1830 *Caryophyllia dubia* de Blainville, p. 311.
1935 *Disphyllum* (or *Macgeea*) *dubium* (de Blainville). Lang and Smith, p. 577, pl. 35, fig. 9-13, text-fig. 32, 33.
1949 *Macgeea* (*Macgeea*) *dubia* (de Blainville). Schouppé, p. 161, fig. 1, 53, 55, 56, 58, 86, 90.
non 1968a *Macgeea dubia* (de Blainville). Tsien, fig. 4, M.
1974 *Macgeea dubia* (de Blainville). Brice and Rohart, p. 58, pl. 9, fig. 1-7.

Measurement:

No	D	N	Dt	Lf	LS	Nt	Nh
Mf001012	16.0	31×2	10.4	5.7	1.9	8	4
Mf00x052	17.3	31×2	12.3	7.9	2.3	11	5
Mf007003	15.1	31×2	10.9	5.9	2.3	8	4

Diagnosis: Solitary, cylindrical coral with radially arranged septa. Major septa long, nearly reach the axis, markedly dilated in fusiform within dissepimentarium, most of them become involuted in their inner ends. Minor septa short and replaced by herringbone dissepiments in the inner margin of dissepimentarium. There are

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Explanation of Plate 8

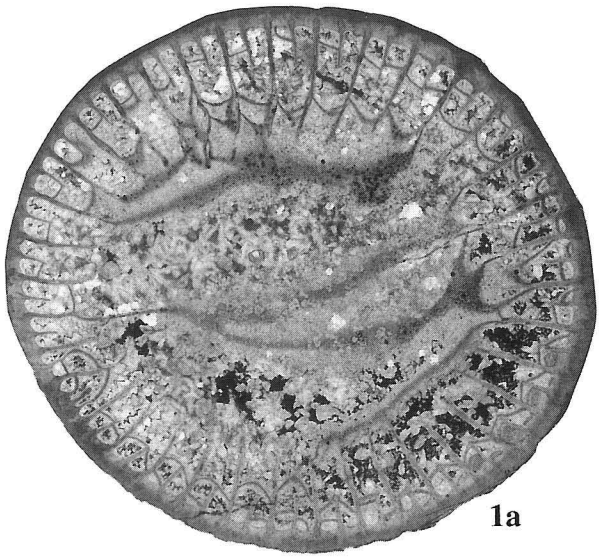
(All figures are ×3)

Fig. 1 *Siphonophrentis cantabrica* Birenheide. Mf00x057, 1a. transverse section; 1b. longitudinal section.

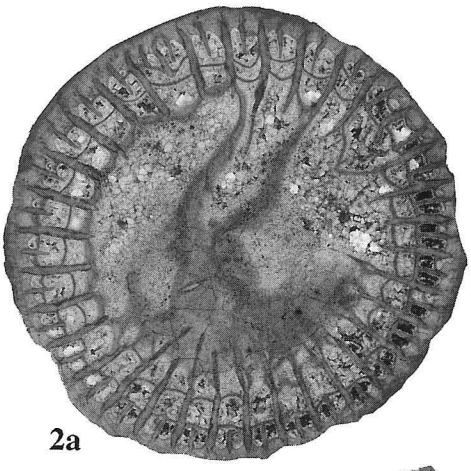
Fig. 2 *Siphonophrentis cantabrica* Birenheide. Mf007016, 2a, 2b. both transverse sections at two different diameters, 2c. longitudinal section.

Fig. 3 *Siphonophrentis cantabrica* Birenheide. Mf00x029, 3a. transverse section; 3b. longitudinal section.

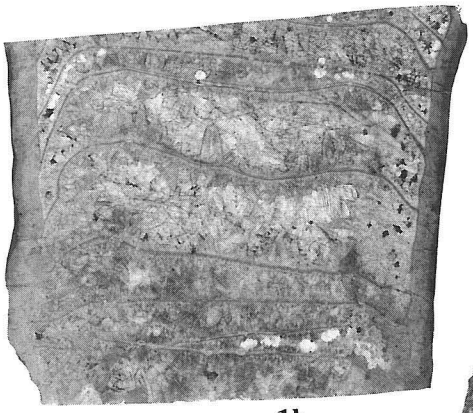
Plate 8



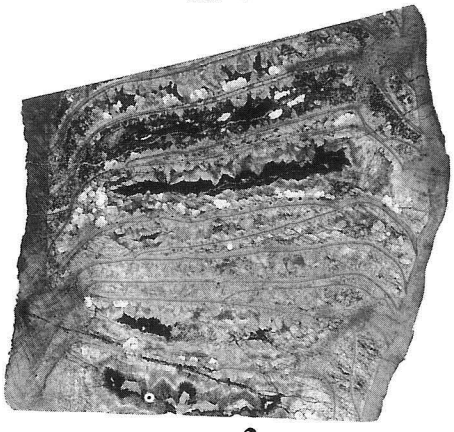
1a



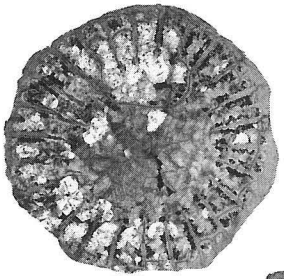
2a



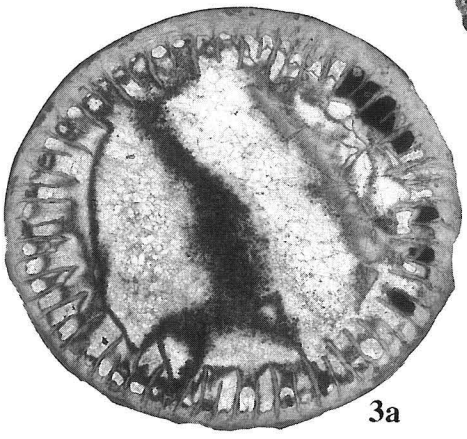
1b



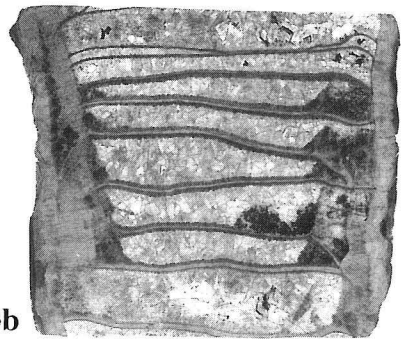
2c



2b



3a



3b

Siphonophrentis

outer, horseshoe and inner dissepiments in dissepimentarium. Tabulae incomplete.

Description: Solitary, cylindrical coral. In only three specimens sectioned the diameter ranges from 15.1 to 17.3 mm. Septa in two orders, radial in arrangement, 31×2 in number. In some individuals cardinal fossula can be distinguished by slightly short cardinal septum (pl. 42, fig. 1a). Major septa long, extend across about three fourths of the radius, strongly dilated in fusiform, the maximum at the boundary between dissepimentarium and tabularium. Most major septa become involuted in their inner ends, may be disrutped by tabulae in axial spaces (pl. 42, fig. 1a). Minor septa short, nearly one third as long as the major ones. The inner dissepiments tend to meet one another at an acute angle in the loculi between adjacent septa and form herringbone dissepiments. Lateral dissepiments also present.

In longitudinal section the trabeculae forming septa coarse, arranged in fans with their axis of divergence over the horseshoe dissepiments, and may coat the horseshoes (pl. 42, fig. 3b). Three parts of dissepiments can be seen. The outer dissepiments horizontal or concave. Horseshoe dissepiments well developed, 4 to 5 can be counted in the vertical distance of 2 mm, and form a continuous pipe of horseshoe, which usually dilated to form inner walls. Inner dissepiments small, globose,.nearly vertically arranged, 1 to 4 rows. Tabularium wide, with diameter ranging from 10.4 to 12.3 mm, composed of incomplete tabulae. The axial tabulae large, transverse, irregular in part become vesicles (pl. 42, fig. 3b), and surrounded by some more strongly curved, inwardly inclined periavial tabulae.

Discussion: In the species referred to *Macgeea*, some characters occurring in *M. dubia*, such as radially arranged, dilated major septa in fusiform, three kind of dissepiments, are common, but *M. dubia* differs from the other species assigned to *Macgeea* in having 2 to 4 rows of herringbone dissepiment.

These forms collected from western Yunnan agree exactly with those illustrated and described by Lang and Smith (1935) and Brice and Rohart (1974) in the shape and size of corallum, characters of dilated septa and also in the herringbone dissepiments. In the specimen shown as figure 1a of plate 42 the cardinal fossula is more pronounced. The tabulae in some specimens become vesicles in part (pl. 42, fig. 3b).

Locality: Malutang and Heyuanzhai.

Explanation of Plate 9

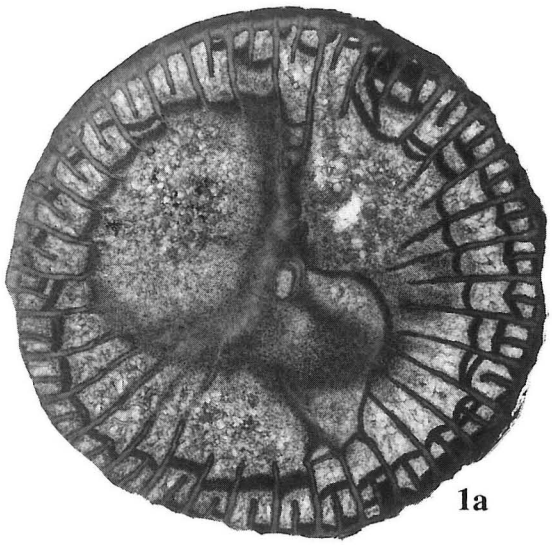
(All figures are ×3)

Fig. 1 *Siphonophrentis cantabrica* Birenheide. Mf00x017, 1a. transverse section; 1b. longitudinal section.

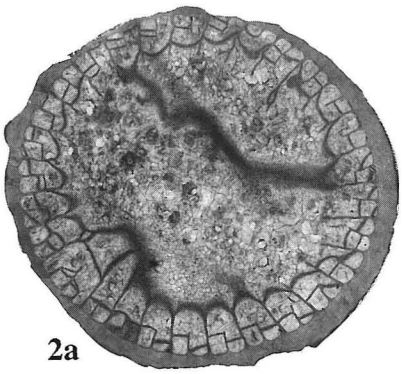
Fig. 2 *Siphonophrentis cantabrica* Birenheide. Hf1022, 2a transverse section; 2b. longitudinal section.

Fig. 3 *Siphonophrentis cantabrica* Birenheide. Mf00x003, 3a. transverse section; 3b. longitudinal section.

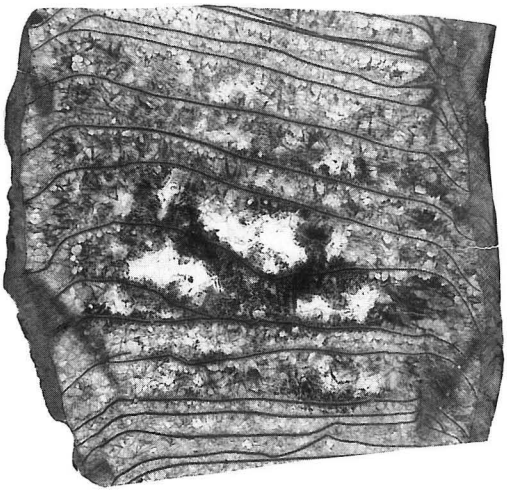
Plate 9



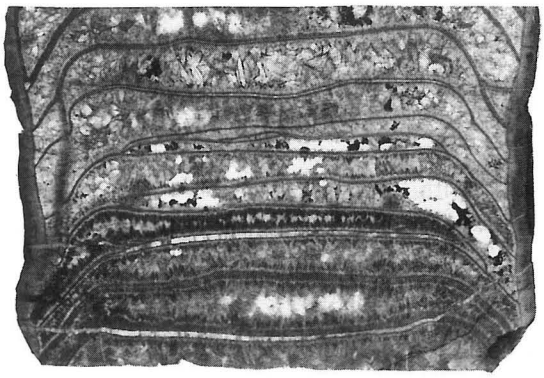
1a



2a

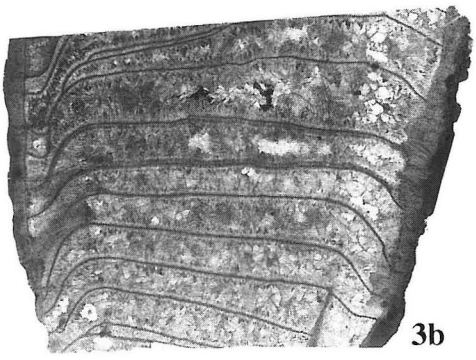


2b



1b

3a



3b

Siphonophrentis

Macgeea multizonata (Reed), 1922

(Plate 46, fig. 1)

1922 *Cyathophyllum* (*Thamnophyllum*) *multizonatum* (Reed) (in part), p. 12, pl. 1, fig. 10, 11; pl. 2, fig. 6, 7. non pl. 2, fig. 1-6.
1935 *Macgeea multizonata* (Reed). Lang and Smith, p. 580, pl. 37, fig. 3-15.
1937 *Macgeea mutizonata* (Reed). Ma, p. 14, pl. 4, fig, 1a, 1b.
1949 *Macgeea multizonata* (Reed). Schouppé, pl. 11, fig. 34.
non 1951 *Macgeea multizonata* (Reed). Soshkina, p. 80, pl. 14, fig. 1-4.
non 1952 *Macgeea multizonata* (Reed). Soshkina, p. 84, pl. 19, fig. 68.
non 1953 *Macgeea* cf. *multizonata* (Reed). Rozkowska, p. 27, pl. 3, fig. 1-7.
non 1954 *Macgeea multizonata* (Reed). Soshkina, p. 68, text-fig. 21, pl. 19, fig. 4, 5.
1958 *Macgeea multizonata* (Reed). Bulvanker, p. 88, pl. 42, fig. 1, 2.
non 1957 *Macgeea multizonata* (Reed). Rozkowska, p. 116, fig. 20.
non 1961 *Macgeea multizonata* (Reed). Spasskiy, p. 45, pl. 20, fig. 2, 3, pl. 24, fig. 5, 6.
non 1960 *Macgeea multizonata* (Reed). Semenoff-Tian-Chansky, Larfuste and Delga, p. 308, pl. 3, fig. 1-3.
1963 *Macgeea* (*Macgeea*) *multizonata* (Reed). Schouppé, text-fig. 6, 7.
1965 *Macgeea* (*Macgeea*) *multizonata* (Reed). Schouppé, p. 27, p. 2, fig. 1-10, text-fig. 1-10.
1966 *Macgeea* (*Macgeea*) *multizonata* (Reed). Schouppé and Stacul, text-fig. 55, 106.
non 1968 *Macgeea* cf. *multizonata* (Reed). Gunia, p. 149, pl. 4, fig. 11, 12.
1975 *Macgeea multizonata* (Reed). Besprozvannykh, Dubatolov, Kravtsov, Latypov, Spasskiy, p. 85, pl. 31, fig. 5.
1979 *Pterorrhiza multizonata* (Reed). Rozkowska, p. 20, pl. 1, fig. 5, 6.
1981 *Macgeea multizonata* (Reed). Tsyganko, p. 30, pl. 57, fig. 3, pl. 58, pl. 3, 4.
1982 *Macgeea multizonata* (Reed). Coen-Aubert, p. 15, pl. 1 fig. 1-3.

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh
Mf007029	21.4	32×2	15.6	8.1	3.4	3-5	3

Diagnosis: Solitary, large, cylindrical coral with septa in two orders, Major septa thick and fusiform in dissepimentarium and rapidly thin, curved in tabularium. Horseshoe dissepiments well developed and often coated by stereome. Tabularium broad, consisting of concave tabulae.

Description: Only one specimen of this species has been sectioned. Corallum solitary, large, with a diameter of 21.4 mm, at which 32×2 septa can be counted. Exterior wall thin, mostly destroyed, so the septa projected outside. Septa in two orders, radially arranged. Major septa retreated from the axis, about two thirds of the radius in length, strongly dilated in dissepimentarium, the maximum thickness at the outer margin of the horseshoe dissepiment, almost entirely connect each

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Explanation of Plate 10

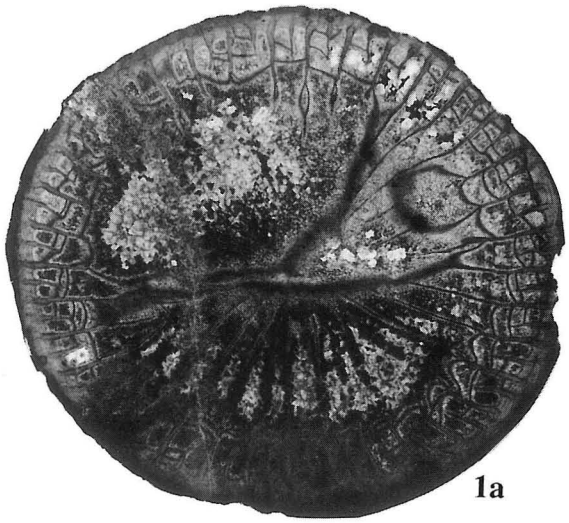
(All figures are ×3)

Fig. 1 *Siphonophrentis cantabrica* Birenheide. Mf00x067, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Siphonophrentis cantabrica* Birenheide. Mf00x038, 2a. transverse section; 2b. longitudinal section.

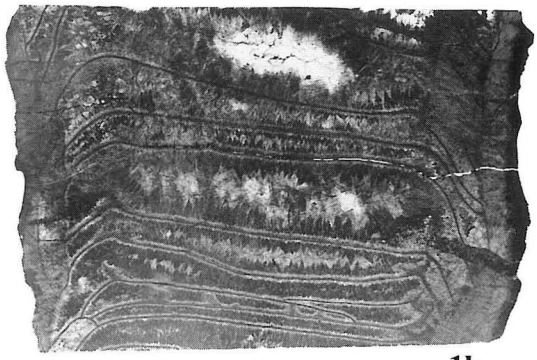
Fig. 3 *Siphonophrentis cantabrica* Birenheide. Mf009016, 3a. transverse section of late stage; 3b. transverse section of early stage; 3c. longitudinal section.

Plate 10

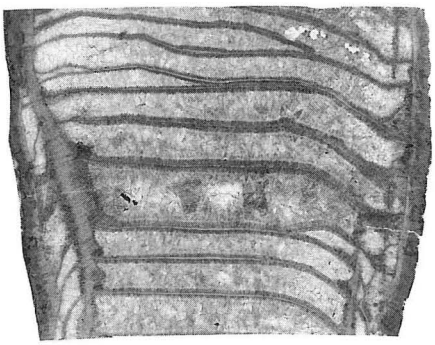


1a

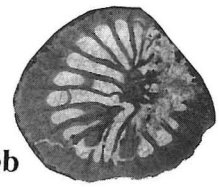
2a



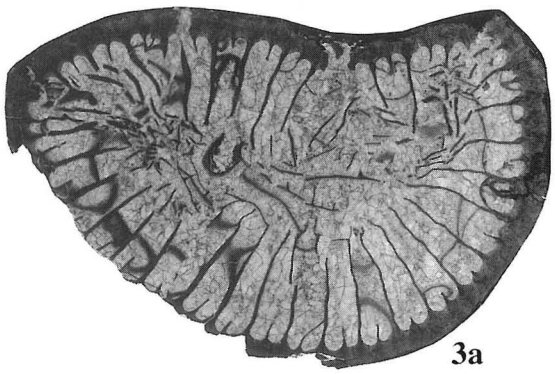
1b



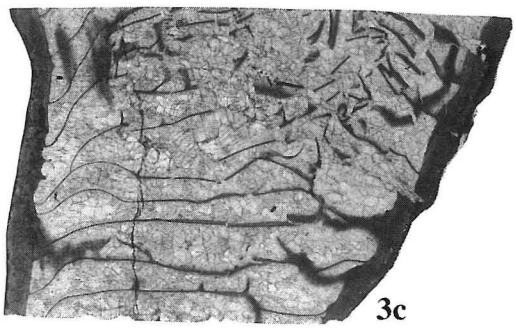
2b



3b



3a



3c

Siphonophrentis

other to form thick inner wall together with horseshoes. In inner margin of dissepimentarium major septa redilated to form a thinner wall, thin rapidly and slightly involved in tabularium. Minor septa short, less than half of the major ones in length, only little penetrate into the tabularium.

In longitudinal section the outer dissepiments have been destroyed. Horseshoe dissepiments regular, nearly globose, only one or two elongated, well developed to form a continuous pipe, spaced of 3 in 2 mm. Inner dissepiments small, rare, discontinuous, globose. Tabularium wide, with a diameter of 15.6 mm, more than two thirds of the diameter of the corallum. Tabulae incomplete, axial tabulae evidently concave, with turndown periaxial edges, widely disposed so that 2 to 5 can be counted within the vertical distance of 5 mm. Periaxial tabulae inclined inwardly, their size considerably variable.

Discussion: The striking features of this species is large corallum, curved thin major septa in wide tabularium which is occupied by rather widely apart concave tabulae.

In erecting this species Reed (1922, p. 12) considered that "the striking feature in longitudinal section is the differentiation of the peripheral vesicular tissue into several definite zones.", that is, the dissepimentarium consists of three parts, outer, horseshoe and inner dissepiments. The character stated above is, however, common in *Macgeea*. Reed (1922, p. 12) believed that the species bears large horizontal tabulae, flat or very gently arched, but he included those forms with variable tabulae, including flat, gently convex, and slightly concave tabulae (Reed, 1922, pl. 1, fig. 7-12, pl. 2, fig. 1-7) within the species. Lang and Smith (1935, pl. 37, fig. 13-15) first used the *M. multizonata* for the coral of North America and illustrated it (pl. 37, fig. 13-15). Although Lang and Smith (1935) did not gave a description of the species, in their specimen the tabulae evidently concave. Lang and Smith's concept on *M. multizonata* has been widely accepted. The forms from the Frasnian of the Holy Cross Mountain of Poland also have markedly concave axial tabulae. The forms with concave tabulae are very rare among known species assigned to *Macgeea*. Therefore the present author suggests to confine *M. multizonata* to those with concave tabulae, and places these forms which have been assigned to *M. multizonata* by Reed (1922, pl. 2, fig. 1-5), but bear convex tabulae in *M. solitaria*.

The specimen described here closely resembles the form from Frasnian of Holy

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Explanation of Plate 11

(All figures are ×3)

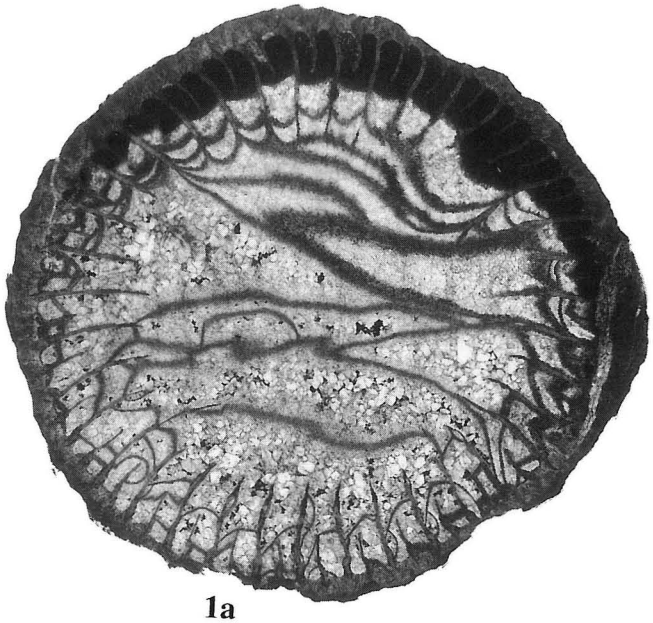
Fig. 1 *Siphonophrentis cantabrica* Birenheide. Mf00x059, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Siphonophrentis cantabrica* Birenheide. Mf010014, 2a. transverse section; 2b. longitudinal section.

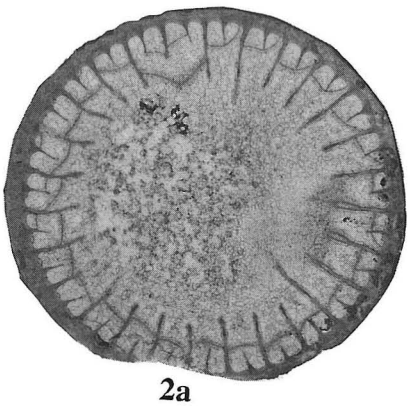
Fig. 3 *Siphonophrentis cantabrica* Birenheide. Mf003009, 3a. transverse section; 3b, longitudinal section.

Fig. 4 *Siphonophrentis cantabrica* Birenheide. Mf005002, 4a. transverse section; 4b. longitudinal section.

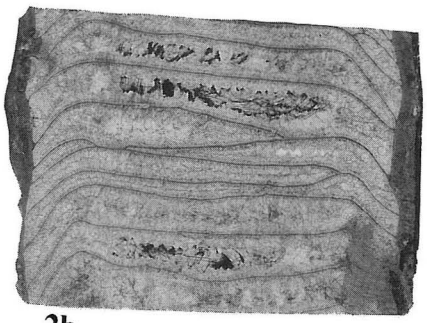
Plate 11



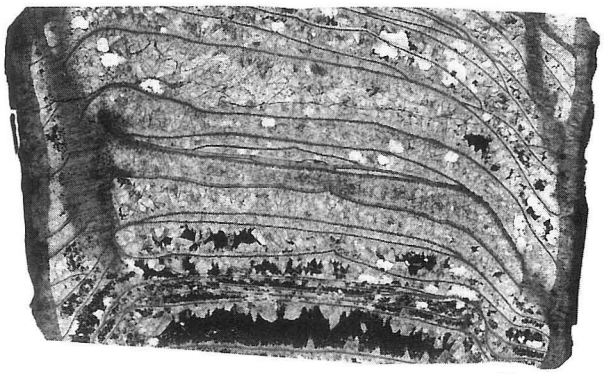
1a



2a

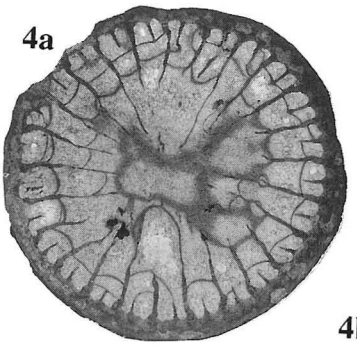


2b

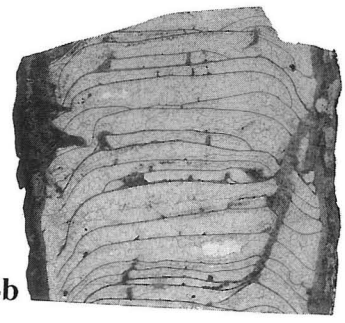


1b

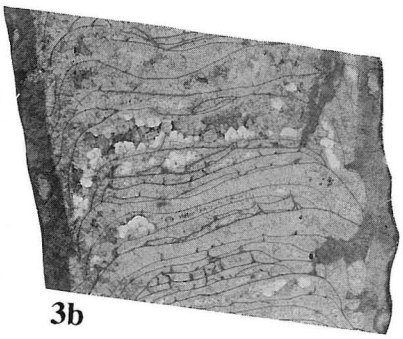
3a



4a



4b



3b

Siphonophrentis

Cross Mountain of Poland described and illustrated by Rozkowska (1979, p. 20, pl. 1, fig. 5, 6) in all morphological characters. Their septal index, that is the ratio of the number of septa to diameter, is also similar to each other. The septal index is (34×2)/22 in the specimen from Poland, and is (32×2)/21 in the corallum from western Yunnan. Comparing with the specimen illustrated by Lang and Smith (1937, pl. 37, fig. 13-15), the axial tabulae in the specimen described here are rare and with markebly sagging axial surfaces.

Locality: Malutang.

Macgeea gigantea Brice et Rohart, 1974
(Plate 46, fig 2)

1974 *Macgeea galica gigantea* Brice et Rohart, p. 55, pl. 8, fig. 1-5, pl. 9 fig8, 9
1982 *Macgeea galica gigantea* Brice et Rohart, Coen-Aubert, p. 22, pl. 2, fig. 9, 10.

Measurement:

No	D	N	Dt	Lf	Ls	Tw
Mf00x056	26.7	32×2	8.7	9.3	8.2	0.3

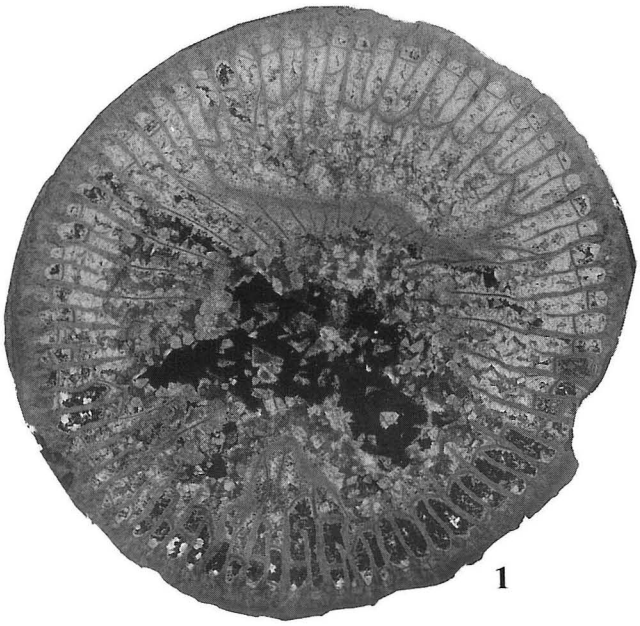
Diagnosis: Solitary coral with large corallum. Septa numerous, both major and minor septa long, dilated in spindle. Dissepimentarium wide, composed of outer dissepiments, horseshoe dissepiments and numerous rows of inner dissepiments.

Description: Large solitary coral. Only one specimen of this species from western Yunnan has been sectioned in transverse direction, so that the shape of the corallum remains unknown. Exterior wall thin, only 0.3 mm thick. Septa in two orders, number 32×2 in the section with a diameter of 26.7 mm, radially arranged. Major septa withdraw from axis, maximum length 9.4 mm, leave a wide axial space, dilated and spindle-shaped in dissepimentarium, gradually thin inwardly, the inner ends may be disrupted by tabulae. Minor septa almost as long as the majors, the maximum length up to 8.2 mm, enter the tabularium. Weak carinae develop on the sides of the septa. Dissepimentarium wide, about two thirds of the radius of the corallum, consists of horizontal outer dissepiments, a row of horseshoe disse-

Explanation of Plate 12
(All figures are ×3)

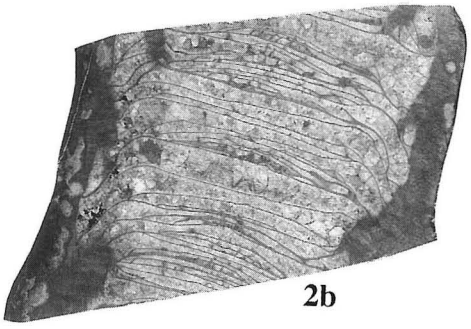
Fig. 1 *Siphonophrentis cantabrica* Birenheide. Mf00x066, 1. transverse section.
Fig. 2 *Siphonophrentis cantabrica* Birenheide. Mf003002, 2a. transverse section; 2b. longitudinal section.
Fig. 3 *Siphonophrentis cantabrica* Birenheide. Mf00x035, 3a. transverse section; 3b. longitudinal section.
Fig. 4 *Siphonophrentis cantabrica* Birenheide. Mf003015, 4a. transverse section; 4b. longitudinal section.
Fig. 5 *Siphonophrentis cantabrica* Birenheide. Mf003008, 5a. transverse section; 5b. longitudinal section.

Plate 12

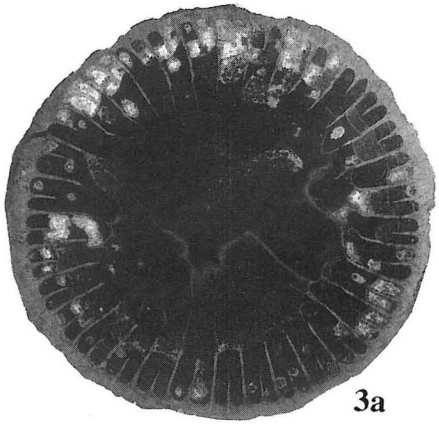


1

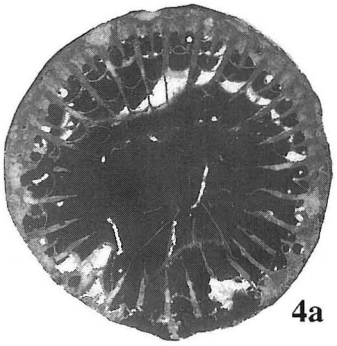
2a



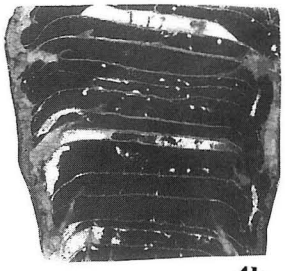
2b



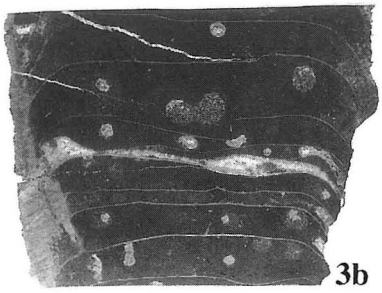
3a



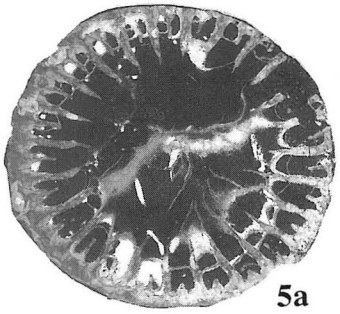
4a



4b

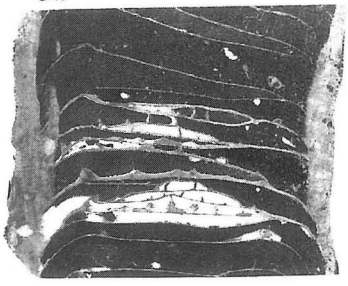


3b



5a

5b



Siphonophrentis

piments and 8 to 10 rows of concentric inner dissepiments.

Discussion: Brice and Rohart (1974) proposed a new subspecies *M. galica gigantea*, which is different from *M. galica* Lang et Smith (1935. p. 579, pl. 37, fig. 4-11) in having large corallum, longer minor septa and wide dissepimentarium including numerous rows of concentric inner dissepiments. Up to now except *M. galica gigantea* all species assigned to *Macgeea* have small to medium-size corallum, more narrow dissepimentarium usually containing 1 to 4 rows of concentric inner dissepiments, as well as shorter minor septa commonly restricted to narrow dissepimentarium. The main difference between *M. galica gigantea* and other species of the genus is very evident and appears to have siginificance to erect a species. Thus *M. gigantea* is regarded as an independent species here.

This form described here agrees exactly with the French specimen (Brice and Rohart, 1974, pl. 8, fig. 1-4) and Belgian form illustrated by Coen-Aubert (1982, pl. 2, fig. 8, 9) in the main characters of septa and dissepimentarium, but the specimen from western Yunnan bears slightly small diameter and less septa in number.

Locality: Malutang.

Macgeea rozkowskae Coen-Aubert, 1982
(Plate 43, 44, text-figure 13)

1982 *Macgeea rozkowskae* Coen-Aubert, p. 17, pl. 1, fig. 4-7, pl. 3, fig. 14.

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh
Mf00x047	20.7	34×2	15.4	9.0	4.0	6	5
Mf008019	19.0	34×2	13.2	7.6	2.9	12	9
Mf00x009	17.0	30×2	10.9	5.8	2.0	12	5
Mf008032	15.3	30×2	10.6	6.6	2.8	10	6
Mf013004	14.1	29×2	9.6	6.0	2.1	11	9
Mf008015	18.8	28×2	13.1	6.7	3.1	3	8

Diagnosis: Solitary, cylindrical coral. Septa in two orders, somewhat radially arranged, dilated in elongated fusiform. Dissepimentarium composed of three parts. The outer dissepiments globose, inclined outwardly. Horseshoe dissepiments irregular, wide and flat, crowded, considerably vary in size and morphology. Inner dissepiments small, vertically arranged. Tabulae incomplete. Lateral dissepiments well developed in the position of the horseshoe.

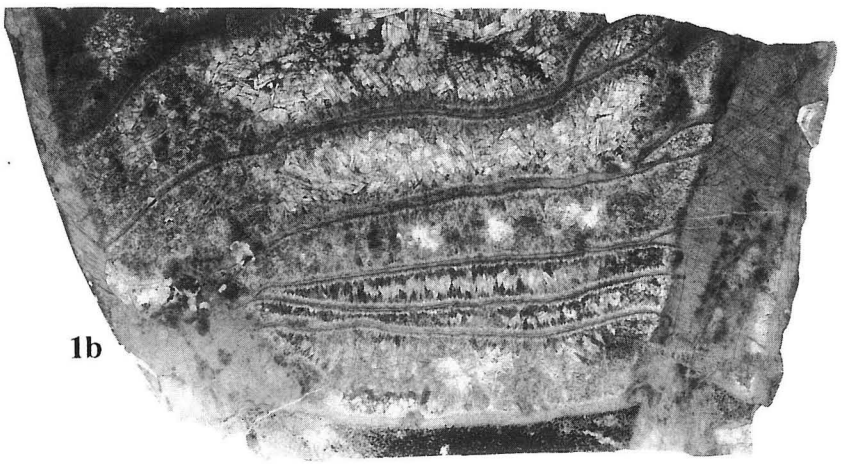
Description: This species is characterized by the presence of irregular horseshoe dissepiments and bearing outer globose dissepiments. Solitary, corallum subcylindrical or trochoid, medium-sized. In the six specimens available, diameter ranges

Explanation of Plate 13

Fig. 1 *Siphonophrentis cantabrica* Birenheide. Mf00x022, 1a. transverse section; 1b. longitudinal section, ×3.

Plate 13

1a



1b

Siphonophrentis

from 14.1 to 20.7 mm. Septa in two orders, number from 28×2 to 34×2, somewhat radially arranged. Major septa usually retreated from axis, the length considerably variable. Cardinal septum slightly shorter than the other majors, cardinal fossula not pronounced. Major septa dilated in fusiform, the maximum dilation at the inner margin of dissepimentarium, and thin in the tabularium. Minor septa well developed, usually enter tabularium (pl. 43, fig. 1a; 1a; pl. 44, fig. 1a, 2a), as long as long as or slightly shorter than half of the major ones in length. In one specimen shown as figure 3a of plate 43, minor septa short and are replaced by herringbone dissepiments in the inner margin of dissepiments. Lateral dissepiments well developed in the position of horseshoe dissepiments.

In longitudinal sections trebecular fans forming septa well developed, composed of coarse trabeculae. Dissepimentarium contains outer and inner dissepiments and horseshoe dissepiments. The horseshoe dissepiments vary considerably in size and morphology, flat or elongated, and irregular in arrangement, no well developed pipe of horseshoe forms, 5 to 9 are disposed in 2 mm. The outer dissepiments globose, in part inclined outwardly. 1 to 4 rows of inner dissepiments small, globose or elongated, nearly vertically arranged. Tabularium wide, with diameter ranging from 9.6 to 15.4 mm, occupied by incomplete tabulae. The axial tabulae convex, large, quite variable in number within a limited distance from specimen to specimen, even in different parts within a sigle specimen. Periaxial tabulae small, globose or elongated, inclined inwardly.

Locality: Malutang.

Macgeea caucasica Soshkina, 1952

(Plate 45)

1952 *Macgeea caucasica* Soshkina, p. 84, pl. 18, fig. 63.

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh
Mf007013	25.4	35×2	19.4	7.1	3.2	12	9

Diagnosis: Large solitary, trochoid coral with short strongly dilated septa. Dis-

Explanation of Plate 14

(All figures are ×3)

Fig. 1 *Siphonophrentis minor* (Sung). Mf009017, 1a. transverse section; 1b. longitudinal section.

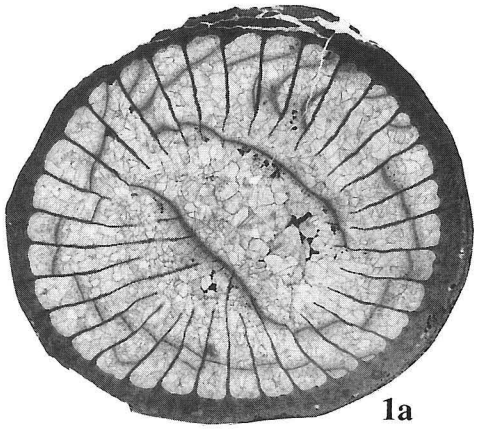
Fig. 2 *Siphonophrentis minor* (Sung). Mf008021, 2a. transverse section; 2b. longtudinal section.

Fig. 3 *Siphonophrentis minor* (Sung). Mf007009, 3a. transverse section; 3b. longitudinal section.

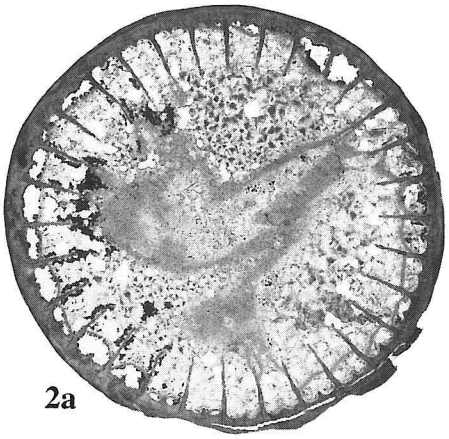
Fig. 4 *Siphonophrentis minor* (Sung). Mf005003, 4a. transverse section; 4b. longitudinal section.

Fig. 5 *Siphonophrentis minor* (Sung). Mf013006, 5. transverse section.

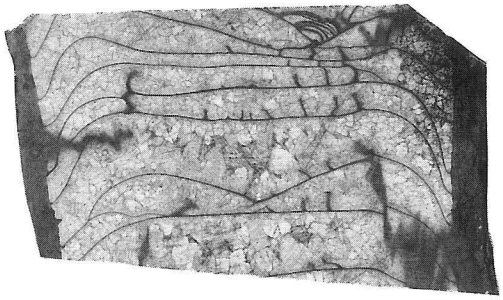
Plate 14



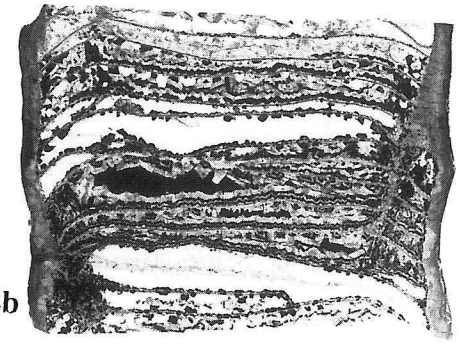
1a



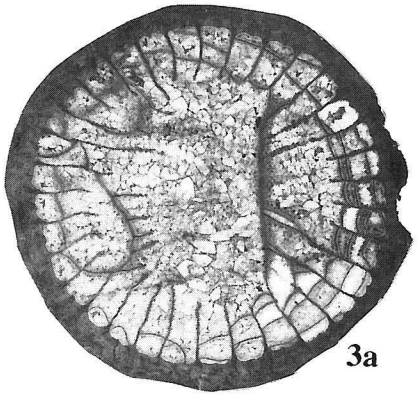
2a



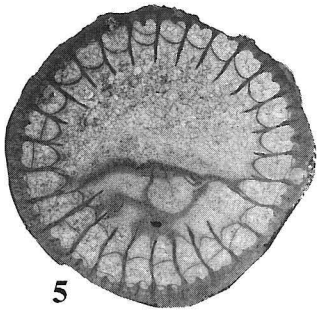
1b



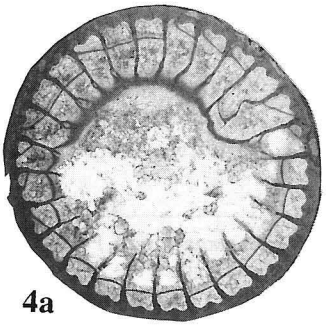
2b



3a

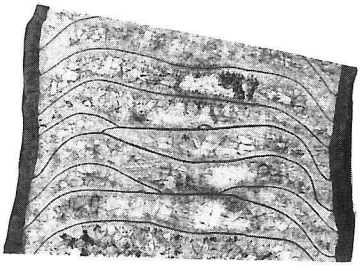


5



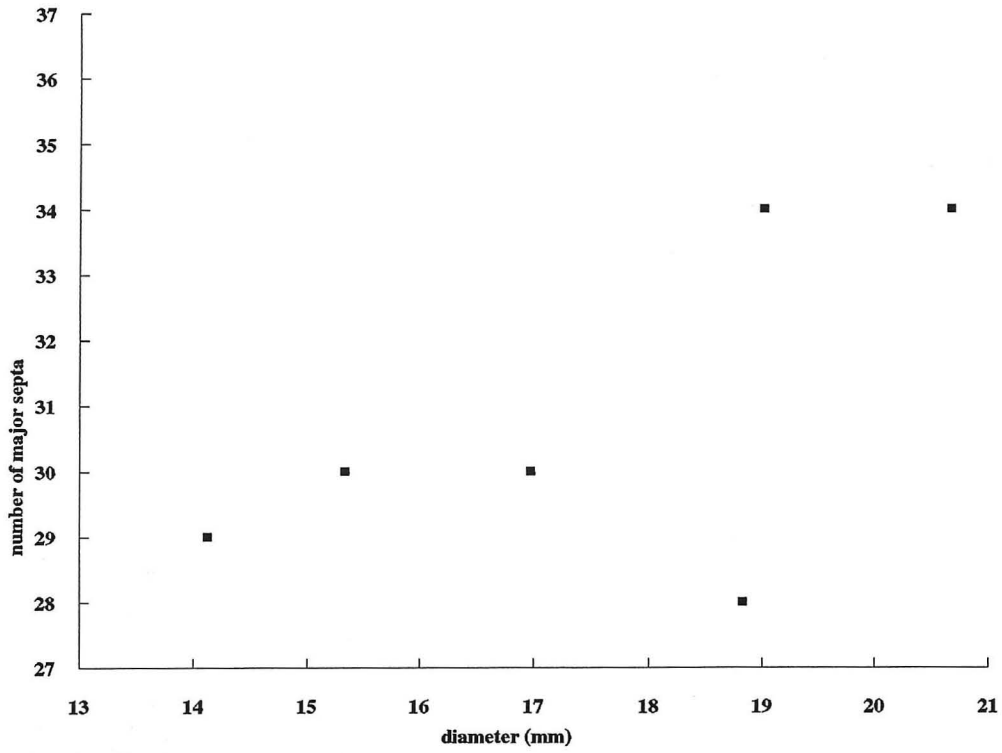
4a

3b



4b

Siphonophrentis



Text-fig. 13 Scatter diagram of number of major septa versus diameter in *Macgeea rozkowskae*

sepimentarium consists of three parts, outer, horseshoe and inner dissepiments. Tabulae markedly convex in the form of tent.

Description: Only one specimen of this species from western Yunnan has been sectioned. Corallum, solitary large, with diameter up to 25.4 mm. Septa of two orders, somewhat radially arranged, 35×2 in number at the diameter mentioned above, strongly dilated in elongated fusiform and laterally connected each other to form two rows of thick inner wall together with horseshoe dissepiments. Major

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Explanation of Plate 15

(All figures are ×3)

Fig. 1 *Siphonophrentis minor* (Sung). Mf007005, 1a, 1b. both transverse sections at two different diameters; 1c. longitudinal section.

Fig. 2 *Siphonophrentis minor* (Sung). Mf005011, 2a. transverse section; 2b. longitudinal section.

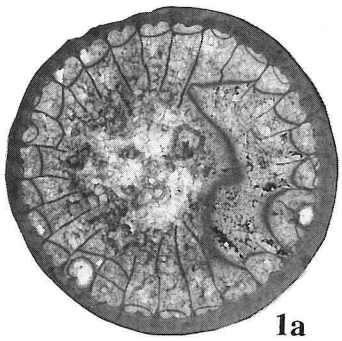
Fig. 3 *Siphonophrentis minor* (Sung). Mf007021, 3a, 3b. both transverse sections at two different diameters; 3c. longitudinal section.

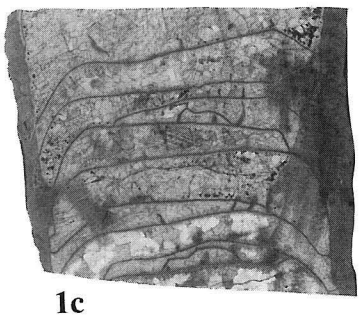
Fig. 4 *Siphonophrentis minor* (Sung). Mf013003, 4a. transverse section; 4b. longitudinal section.

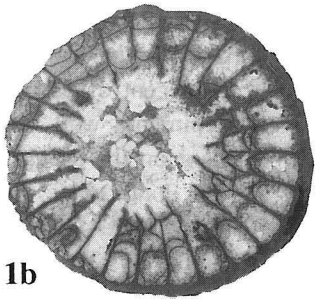
Fig. 5 *Siphonophrentis minor* (Sung). Mf008006, 5a. transverse section of late stage; 5b. transverse section of early stage; 5c. longitudinal section.

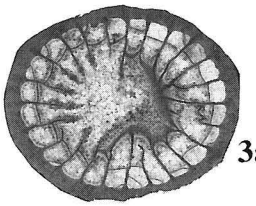
Fig. 6 *Siphonophrentis minor* (Sung). Mf010022, 6a. transverse section, 6b. longitudinal section.

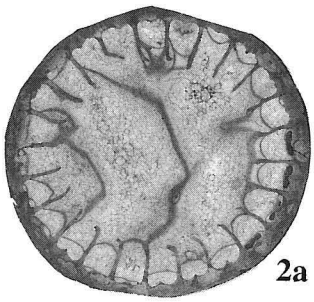
Plate 15

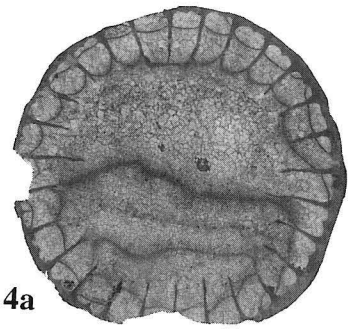

1a

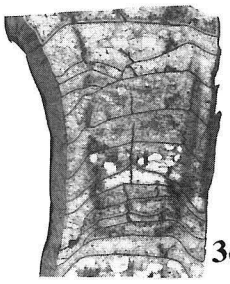

1c

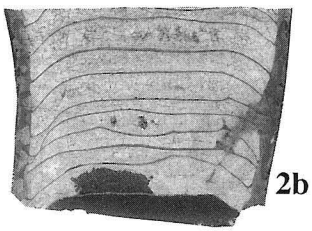

1b


3a


2a


4a


3c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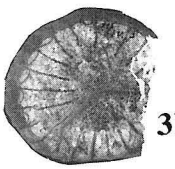
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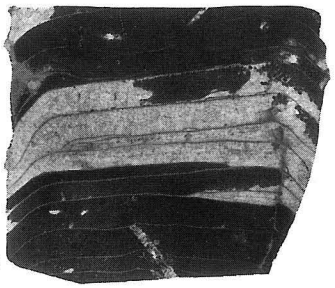
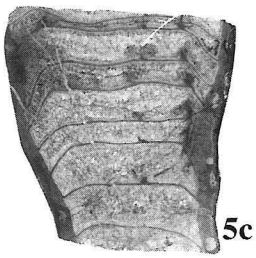
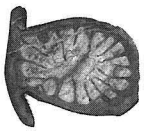
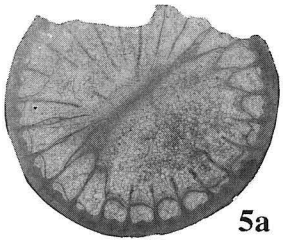
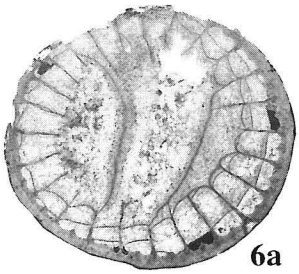
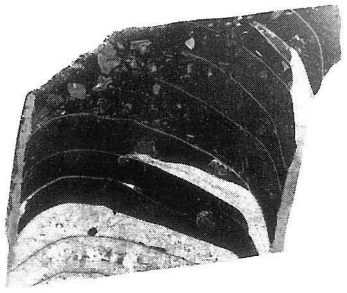

4b


5c


5b


5a


6a


6b

Siphonophrentis

septa withdraw from the axis, variable in the length, usually half of the radius of corallum, consequently a wide axial area is free of septa. Some major septa extend to the axis. Major septa attenuate in longwedge, the longer majors very thin in central parts. Minor septa short, restricted to dissepimentarium. Lateral dissepiments well developed in the position of the horseshoes. Septal ridges are present on the tabulae in axial space.

In longitudinal section dissepimentarium usually coated by septal trabeculae forming wide fans with their axis of divergence over the horseshoes consists of three parts. The outer dissepiments small, and flat, inclined outwardly and globose forms occur in the individual. The horseshoe dissepiments well developed to form a continuous pipe. Horseshoes wide and flat, shape and size being extremely irregular, crowded, number up to 9 within 2 mm. Inner dissepimentarium is usually formed of 1-2 rows of globose or elongated small dissepiments. Tabularium wide, reach to 19.4 mm in diameter, more than two thirds of the diameter of the corallum, occupied by incomplete tabulae. Axial tabulae strongly convex in the form of tent, variable in size and irregularly disposed, 12 can be counted in the vertical distance of 5 mm. Periaxial tabulae inclined inwardly, with their size considerably variable.

Discussion: This species is characterized by short, strongly dilated septa and markedly arched tabulae in the form of tent. The specimen from western Yunnan in very similar to that from the Frasnian of Armenia, illustrated by Soshkina (1952, pl. 18, fig. 63) in the morphological characters. Comparing with the holotype of *M. caucasica*, the form described here has a larger diameter and more numerous septa. The septal index in the holotype is larger ((29×2)/17=3.4) than that in the specimen from western Yunnan ((35×2)/26=2.8).

This species is similar to *M. rozkowskae* in the shape of horseshoe dissepiments, but is different from the latter in having short, strongly dilated septa and markedly arched tabulae as well as large corallum. This species also resembles *M. berdensis* in the shape of septa, but can be distinguished from the latter by its large corallum, irregular horseshoe dissepiments and strongly arched axial tabulae.

Explanation of Plate 16

(All figures are ×3)

Fig. 1 *Siphonophrentis minor* (Sung). Mf008020, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Siphonophrentis minor* (Sung). Mf008026, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Siphonophrentis minor* (Sung). Mf008039, 3a. transverse section; 3b. longitudinal section.

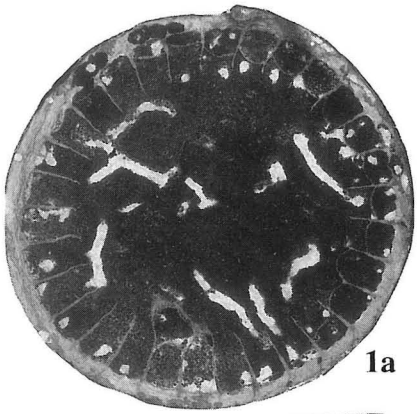
Fig. 4 *Siphonophrentis minor* (Sung). Mf007005, 4a. transverse section; 4b. longitudinal section; 4c. transverse section.

Fig. 5 *Siphonophrentis minor* (Sung). Mf001013, 5a, transverse section; 5b. longitudinal section.

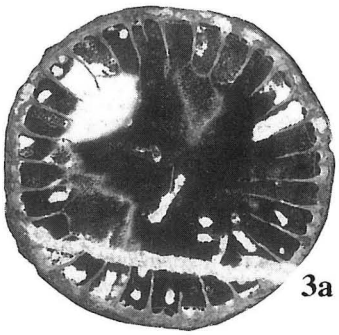
Fig. 6 *Siphonophrentis minor* (Sung). Mf004003, 6a. transverse section; 6b. longitudinal section.

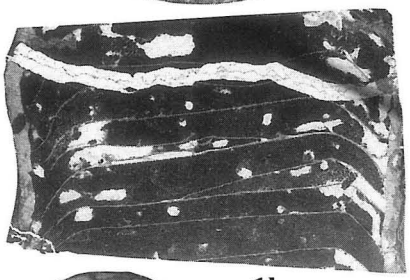
Fig. 7 *Siphonophrentis minor* (Sung). Mf008016, 7. transverse section.

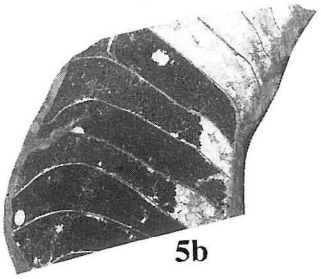
Plate 16


1a


2a


3a


1b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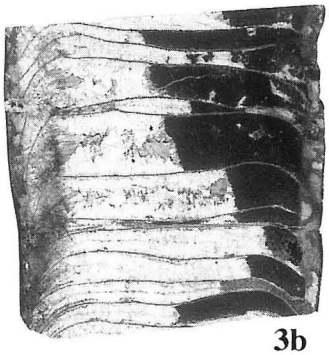
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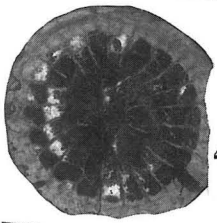
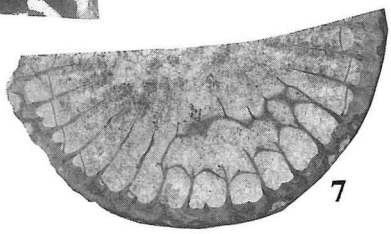
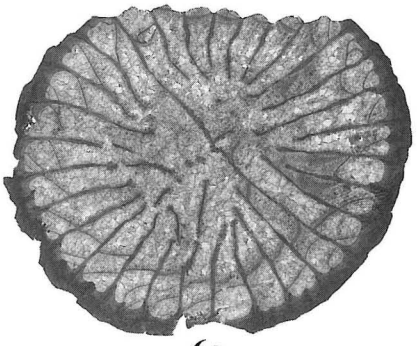
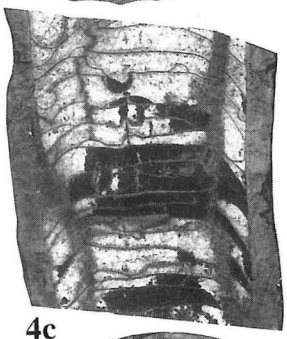
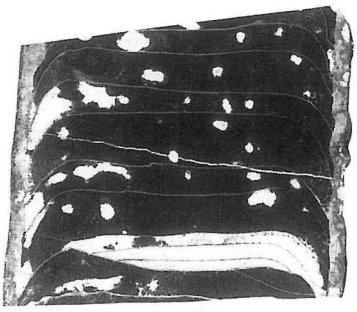
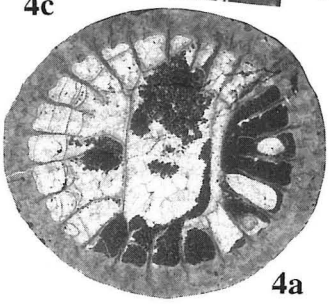

4b

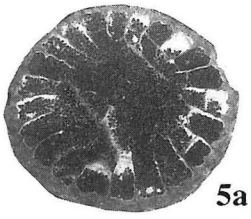

7

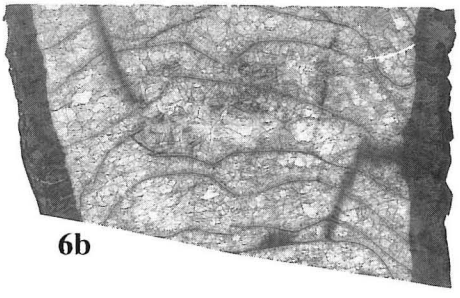

6a


4c


2b


4a


5a


6b

Siphonophrentis

Locality: Malutang.

Macgeea recta (Walther), 1928

(Plate 49, fig. 1-4)

1928 *Pexiphyllum rectum* Walther, p. 130, text-fig. 21, 22.
1949 *Temnophyllum rectum* (Walther). Stumm, pl. 17, fig. 9, 10.
1956 *Pexiphyllum rectum* Walther. Hill, p. 282, text-fig. 191, 12.
1958 *Macgeea (Macgeea) recta* (Walther). Schouppé, p. 224, text-fig. 3, 4, pl. 6, fig. 3, 4.
1964 *Pexiphyllum rectum* Walther. Yoh and Wu, p. 100, text-fig. 91.
1978 *Pexiphyllum rectum* Walther. Birenheide, p. 112, pl. 18, fig, 3.
1981 *Pterorrhiza recta* (Walther). Hill, p. 286, text-fig. 185, ad, 4e.

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh
Mf00x028	13.8	26×2	9.8	6.0	2.2	10	5
	9.7	18×2	6.6	2.6	1.4		
Mf00x049	14.5	26×2	9.7				
	6.7	15×2	4.3	2.7	1.5		
Hf1043	10.5	23×2	7.1			3	6
	7.0	18×2	4.4	2.2	1.5		
Hf1012	10.2	21×2	8.2	2.2	1.3	5	6

Diagnosis: Solitary, trochoid or subcylindrical coral. Septa of two orders, radial in arrangement. Major septa retreated from axis, cardinal septum shorter than the others. Outer dissepiments globose, tabulae variable.

Description: Solitary, all of the four specimens studied here are small trochoid corals, varying from 10.5 to 14.5 mm in diameter. Cup-shaped calice deep, with steeply sloping wall and narrow calical platform (pl. 49, fig. 2, fig. 3). Septa in two orders, radially arranged, from 23×2 to 26×2 in total number. Major septa withdraw from the axis, about two thirds of the radius in length, dilated in fusiform. The maximum septal thickness at the inner margin of dissepimentarium, gradually thin in tabularium, and slightly involuted. Cardinal septum is shorter than the

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Explanation of Plate 17

(All figures are ×3)

Fig. 1 *Siphonophrentis gigantea* (Lesueur). Mf010028, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Siphonophrentis gigantea* (Lesueur). Mf007004, 2a. transverse section of latestage; 2b. transverse section of early stage; 2c. longitudinal section.

Fig. 3 *Siphonophrentis gigantea* (Lesueur). Mf005016, 3a. transverse section; 3b. longitudinal section.

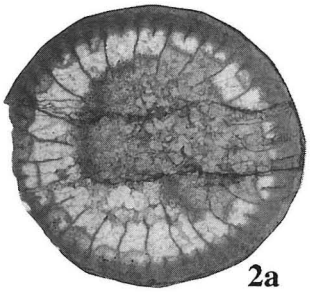
Fig. 4 *Siphonophrentis gigantea* (Lesueur). Mf005012, 4a. transverse section; 4b. longitudinal section.

Fig. 5 *Siphonophrentis gigantea* (Lesueur). Mf005004, 5a. transverse section; 5b. longitudinal section.

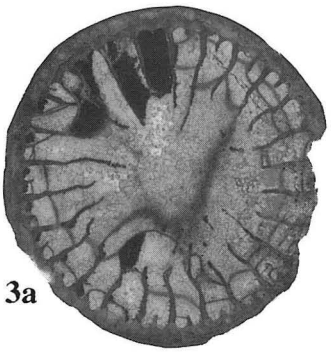
Fig. 6 *Siphonophrentis gigantea* (Lesueur). Mf005001, 6a. transverse section; 6b. longitudinal section.

Plate 17

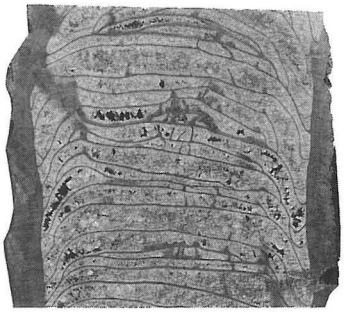
1a



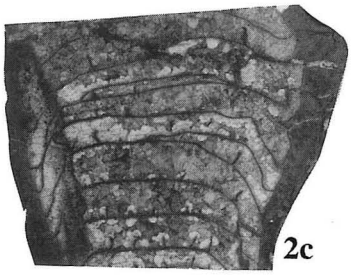
2a



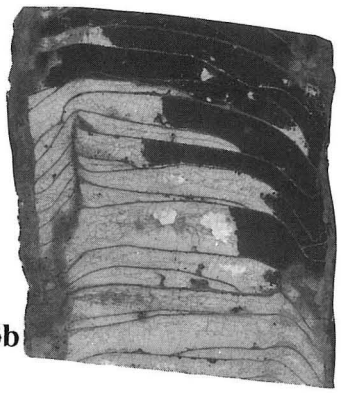
3a



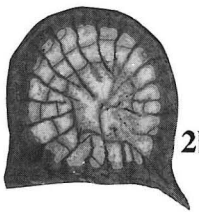
1b



2c



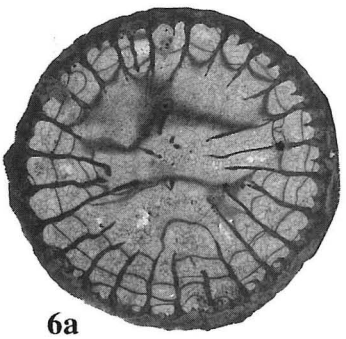
3b



2b

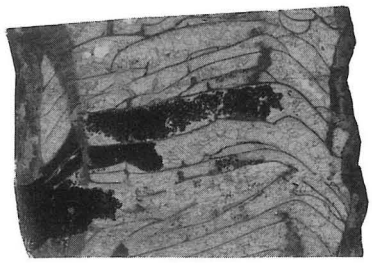
4a

5a

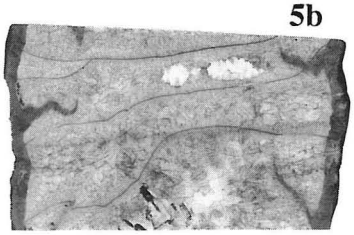


6a

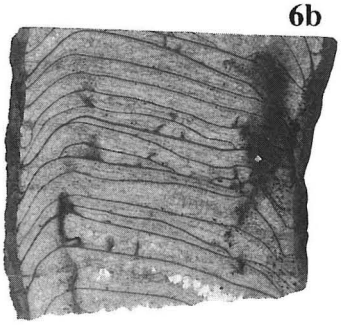
4b



5b



6b



Siphonophrentis

other majors, but no evident cardinal fossula present. Minor septa short, about half of the majors in length, not enter the tabularium. Lateral dissepiments occasionally presest in the position of horseshoe dissepiments (pl. 49, fig. 1a).

In longitudinal sections three parts of dissepiments can be seen. Outer dissepiments one or more than one row, globose or elongatad, inclined outwardly, with considerably variable size and shape. Horseshoe dissepiments usually developed well to form a pipe. In the specimen shown as figure 3 of plate 49, the horseshoes irregular and the pipe of horseshoe is not complete. This feature exactly agrees with that shown in the holotype of *M. recta* illustrated by Walther (1928, p. 130, text-fig. 20, 21). Inner dissepiments usually rare or absent; in parts 3 rows of inner dissepiments can be seen, their size and shape fairly vary, small globose or elongated. Tabularium wide from 7.1 to 9.8 mm in diameter, composed of incomplete tabulae. Axial tabulae convex, periaxial tabulae inclined inwardly. Tabulae can be broken into small vesicular tabellae (pl. 49, fig. 2c). The number of tabulae within a limited distance extremely variable. In the specimens from Heyuanzhai labeled " Hf ", the number of tabulae is only 3or5 within 5 mm, and almost complete (pl. 49, fig. 3,4). Contrary the tabulae are numerous, disposing of 10 to 11 within 5 mm in the specimens from Malutang labeled " Mf ", but the distance between the adjacent ones not uniform (pl. 49, fig. 1, 2).

Discussion: This species is the type species of *Pexiphyllum*, and characterized by outer globose dissepiments. By this character this species can be distinguished from *M. berdensis* and *M symmetrica*. All of the three species have small individuals and short major septa.

This species has resemblance to *M. rozkowskae* in the feature of outer dissepiments, but short major septa.

Locality: Malutang and Heyuanzhai.

Macgeea shidianensis (Sung), 1982

(Plate 47-48, text-figure 14)

1982 *Pexiphyllum shidianense* Sung, p. 27, pl. 1, fig. 9

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh

Explanation of Plate 18

(All figures are ×3)

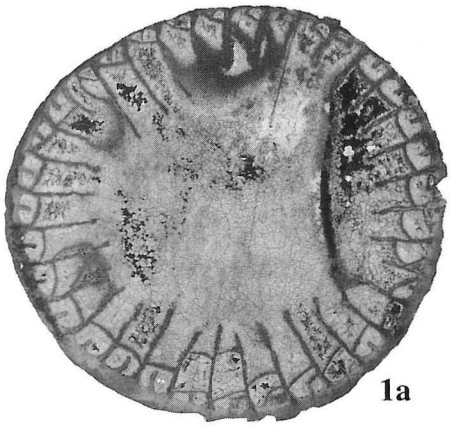
Fig. 1 *Siphonophrentis gigantea* (Lesueur). Mf004001, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Siphonophrentis gigantea* (Lesueur). Mf007027, 2a. transverse section; 2b. longitudinal section.

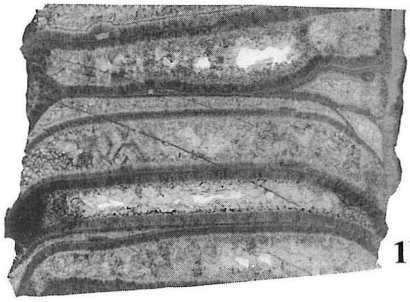
Fig. 3 *Siphonophrentis gigantea* (Lesueur). Mf10028, 3a. transverse section; 3b. longitudinal section.

Fig. 4 *Siphonophrentis gigantea* (Lesueur). Mf009014, 4a. transverse section; 4b. longitudinal section.

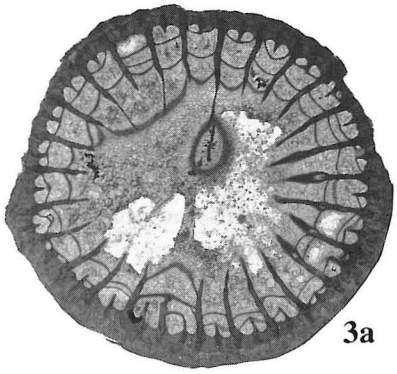
Plate 18



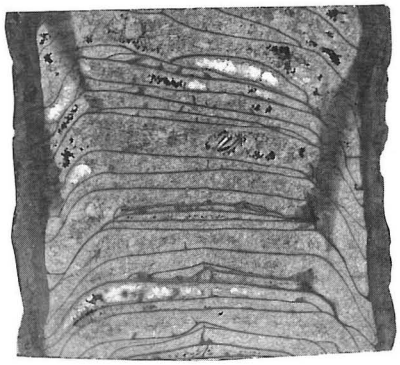
1a



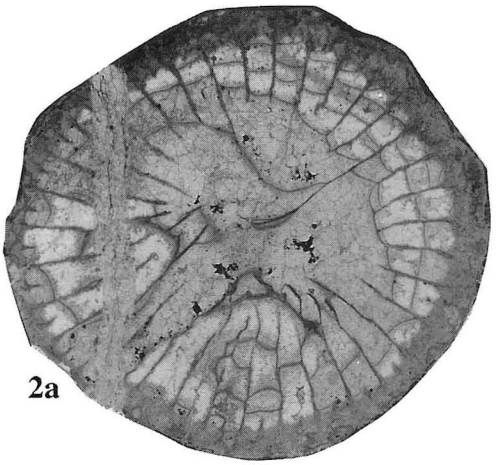
1b



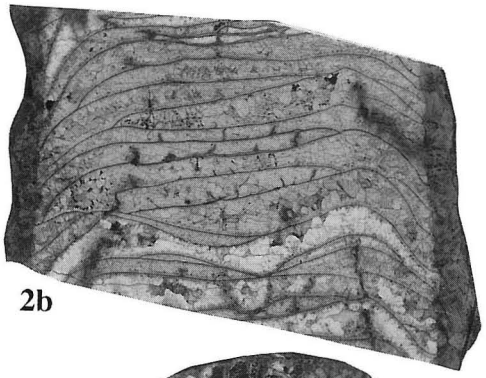
3a



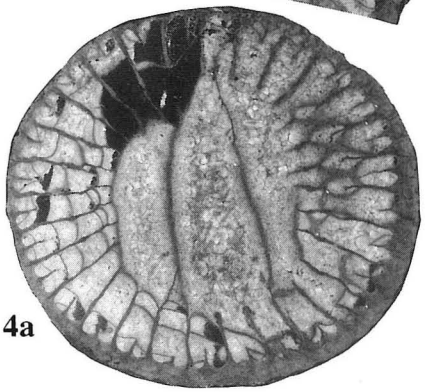
3b



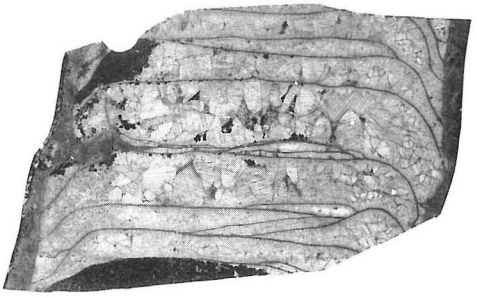
2a



2b



4a



4b

Siphonophrentis

Mf008035	14.5	31×2	9.9	6.5	3.4	11	5
Mf010008	14.7	29×2	9.7	5.9	2.5	13	6
	8.4	22×2	5.8	3.4	1.4		
Mf005005	12.6	28×2	10.6	5.9	2.0	12	6
Mf00x024	17.5	29×2	11.6	6.4	3.4	8	5
	9.7	21×2	6.0	4.1	1.7		
Mf010002	11.0	25×2	7.0	4.8	3.2	12	9
	8.3	25×2	5.4	3.1	1.5		
Mf010029	9.5	21×2	5.1	3.5	1.6	12	7

Diagnosis: Solitary, small and medium trochoid coral. Septa of two orders, markedly bilateral in arrangement. Major septa nearly reach the axis, a few major septa, especially the counter septum, longer than the others. may extend to the axis, even joining each other at the center. Outer dissepiments globose. Tabulae incomplete.

Description: Solitary, trochoid coral, small and medium sized, ranges from 8.1 to 17.5 mm in diameter. Septa of two orders, 21×2 to 31×2 in number, markedly bilateral in arengement. Major septa usually nearly reach the axis, a few of them, especially the counter septum, longer than the others, may join each other in axis (pl. 47, fig. 2a). Septal dilation is fusiform in dissepimentarium, the maximum thickness at the inner margin of dissepimentarium. Minor septa short, usually less than the one third of the majors in length, restricted to dissepimentarium. Lateral dissepiments may be present in the position of horseshoe dissepiments (pl. 47, fig. 1a). Weak carinae can be seen on the peripheral parts of septa in a few individuals (pl. 47, fig. 2a).

In longitudinal section septal trabeculae coarse, forming fans in arrangement, coating horseshoe dissepiments (pl. 47, fig. 1c; pl. 48, fig. 1c). Dissepimentarium composed of three parts. Outer dissepiments usually globose, inclined outwardly, and horizontal outer dissepiments also can be seen in parts. Horseshoe dissepiments commonly well developed to form a pipe, spachng 5 to 9 in 2 mm, in part the pipe of horseshoe dissepiments discontinuous. Horseshoe dissepiments variable in size and shape, regular or irregular in arrangement. Inner dissepiments only from

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Explanation of Plate 19

(All figures are ×3)

Fig. 1 *Siphonophrentis gigantea* (Lesueur). Mf008013, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Siphonophrentis gigantea* (Lesueur). Mf003006, 2a. transverse section; 2b. longitudinal section.

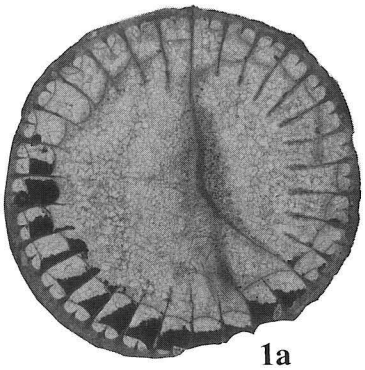
Fig. 3 *Siphonophrentis gigantea* (Lesueur). M1008047, 3a. transverse section; 3b. longitudinal section.

Fig. 4 *Siphonophrentis gigantea* (Lesueur). Mf003001, 4a. transverse section; 4b. longitudinal section.

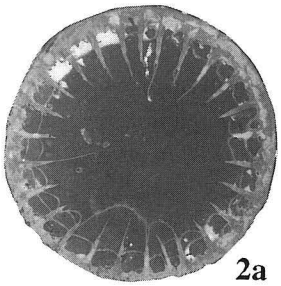
Fig. 5 *Siphonophrentis gigantea* (Lesueur). Mf010044, 5a. transverse section; 5b. longitudinal section.

Fig. 6 *Siphonophrentis gigantea* (Lesueur). Mf005007, 6a. transverse section; 6b. longitudinal section.

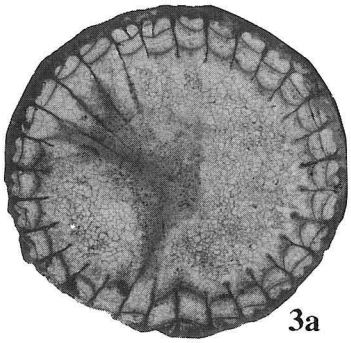
Plate 19



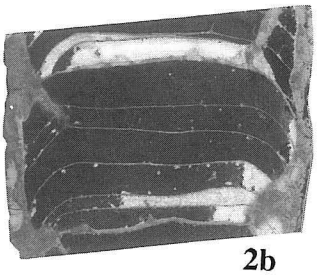
1a



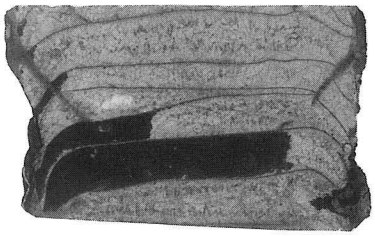
2a



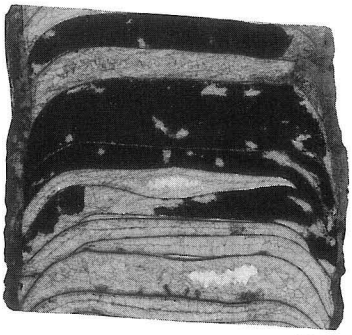
3a



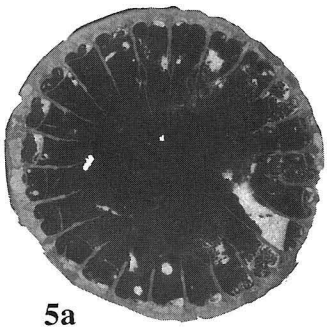
2b



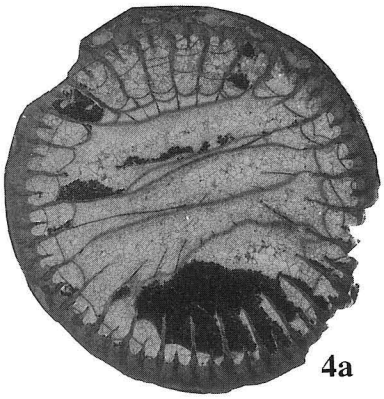
1b



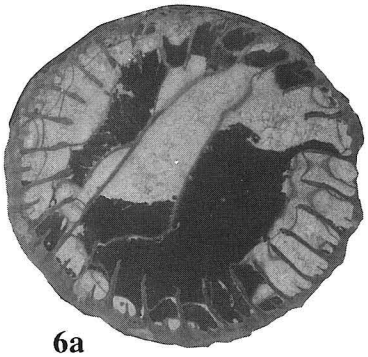
3b



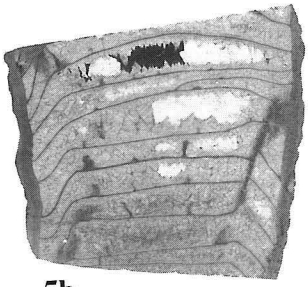
5a



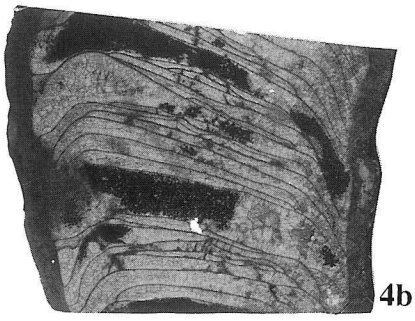
4a



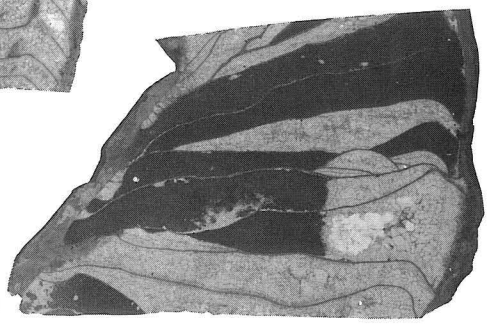
6a



5b



4b

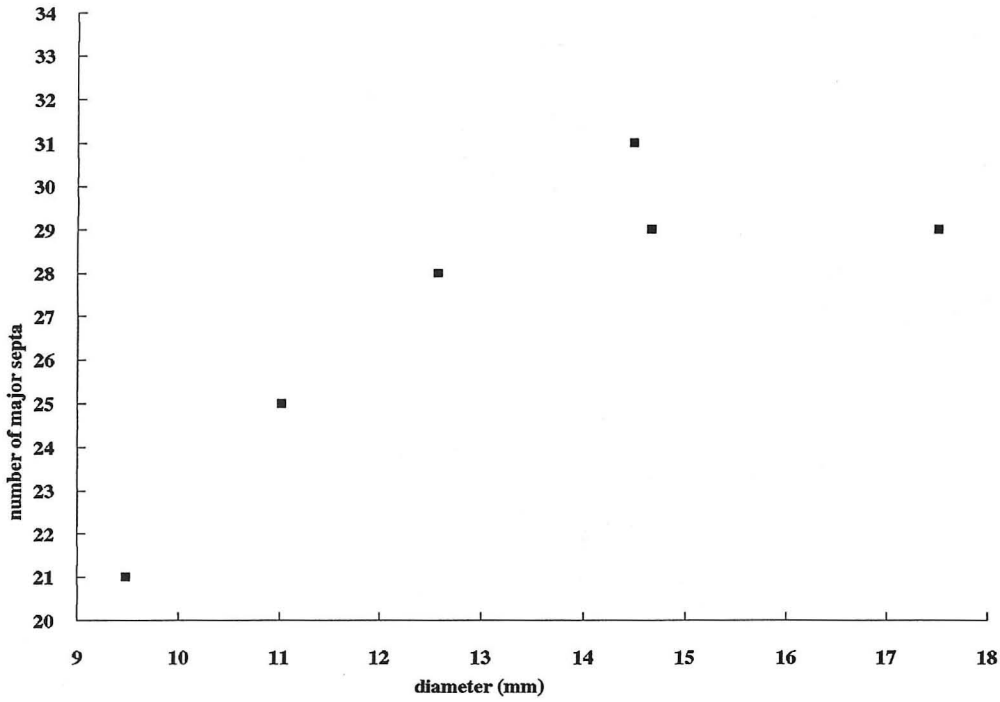


6b

Siphonophrentis

1 to 2 rows, small, globose or elongated, nearly vertically arranged. In some specimens the inner dissepiments absent. Tabularium wide, from 5.4 to 11.6 mm in diameter, consists of incomplete tabulae. Axial tabulae convex (pl. 47, fig. 1c, 2b, 3c) or flat (pl. 48, fig. 1c), variable in size, usually large, in a few individual small, only one third of the diameter of the tabularium in width, 8 to 13 can be counted within the vertical distance of 5 mm. Periaxial tabulae inclined inwardly or horizontal, their shape and size extremely variable.

Discussion: Song (1982, p. 27) erected this species and pointed out that the species is characterized by septa markebly bilateral in arrangement and having a



Text-fig. 14 Scatter diagram of number of major septa versus diameter in *Macgeea shidianensis*

Explanation of Plate 20

(All figures are ×3)

Fig. 1 *Siphonophrentis gigantea* (Lesueur). Mf005026, 1a. transverse section; 1b. transverse section through the calyx; 1c. longitudinal section.

Fig. 2 *Siphonophrentis gigantea* (Lesueur). Mf00x041, 2a, 2b. both transverse sections at two different diameters; 2c. longitudinal section.

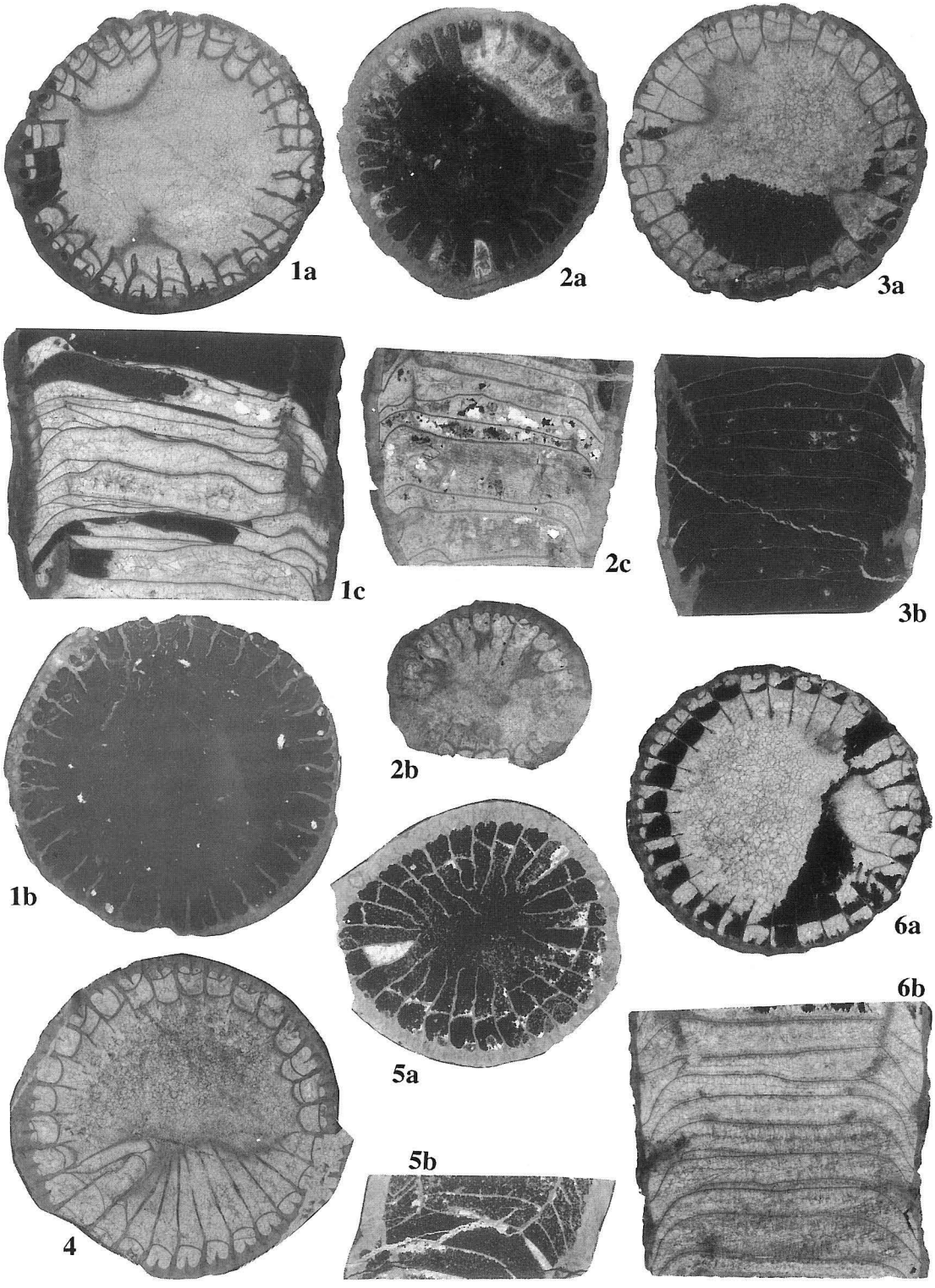
Fig. 3 *Siphonophrentis gigantea* (Lesueur). Mf008018, 3a. transverse section; 3b. longitudinal section.

Fig. 4 *Siphonophrentis gigantea* (Lesueur). Mf010026, 4. transverse section.

Fig. 5 *Siphonophrentis gigantea* (Lesueur). Mf007001, 5a. transverse section; 5b. longitudinal section.

Fig. 6 *Siphonophrentis gigantea* (Lesueur). Mf008002, 6a. transverse section; 6b. longitudinal section.

Plate 20



Siphonophrentis

longer counter septum and outer globose dissepiments on the basis of specimens from Heyuanzhai. The material collected from Malutang closely resembles the holotype of *M. shidianense* Sung (1982」pl. 1, fig. 9), but in some specimens besides the counter septum a few major septa longer than the others and may join each other in axial area (pl. 47, fig. 1a, 2a; pl. 48, fig. 3)

This species is similar to *M. bathycalyx* in having longer counter septum and resembles *M. solitaria* in features of septa, but can be distinguished from the latter two species by having outer globose dissepiments. This species has resemblance to *M. recta* (Walther) in the dissepimentarium, but differs from the latter in having the septa bilaterally arranged and a few major septa reaching the axis.

Locality: Malutang.

Macgeea multiseptata sp. nov.
(Plate 49, fig. 5)

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh
Mf009013(Holotype)	11.7	42×2	8.6	3.8	1.2	11	4

Diagnosis: Solitary, small cylindrical coral. Septa of two orders, radial in arrangement, numerous, dilated in fusiform. Dissepimentarium comprises of three parts, the outer, horseshoe and inner dissepiments. Tabulae incomplete.

Description: Only one specimen of this type of coral from western Yunnan has been sectioned. Solitary, small cylindrical coral, only 11.7 mm in diameter. Exterior wall very thin, destroyed ver much parts. Septa in two orders, radially arranged, numerous, up to 42×2 in number, being the most numerous in known species of *Macgeea* in western Yunnan. Major septa retreated from axis, shorter than two thirds of the radius of the corallum, leaving a wide axial space, dilated in the peripheral part; the maximum thickness at the outer margin of the horseshoe disse-

Explanation of Plate 21
(All figures are ×3)

Fig. 1 *Siphonophrentis gigantea* (Lesueur). Mf008025, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Siphonophrentis gigantea* (Lesueur). Mf003003, 2a. transverse section; 2b. longitudinal section.

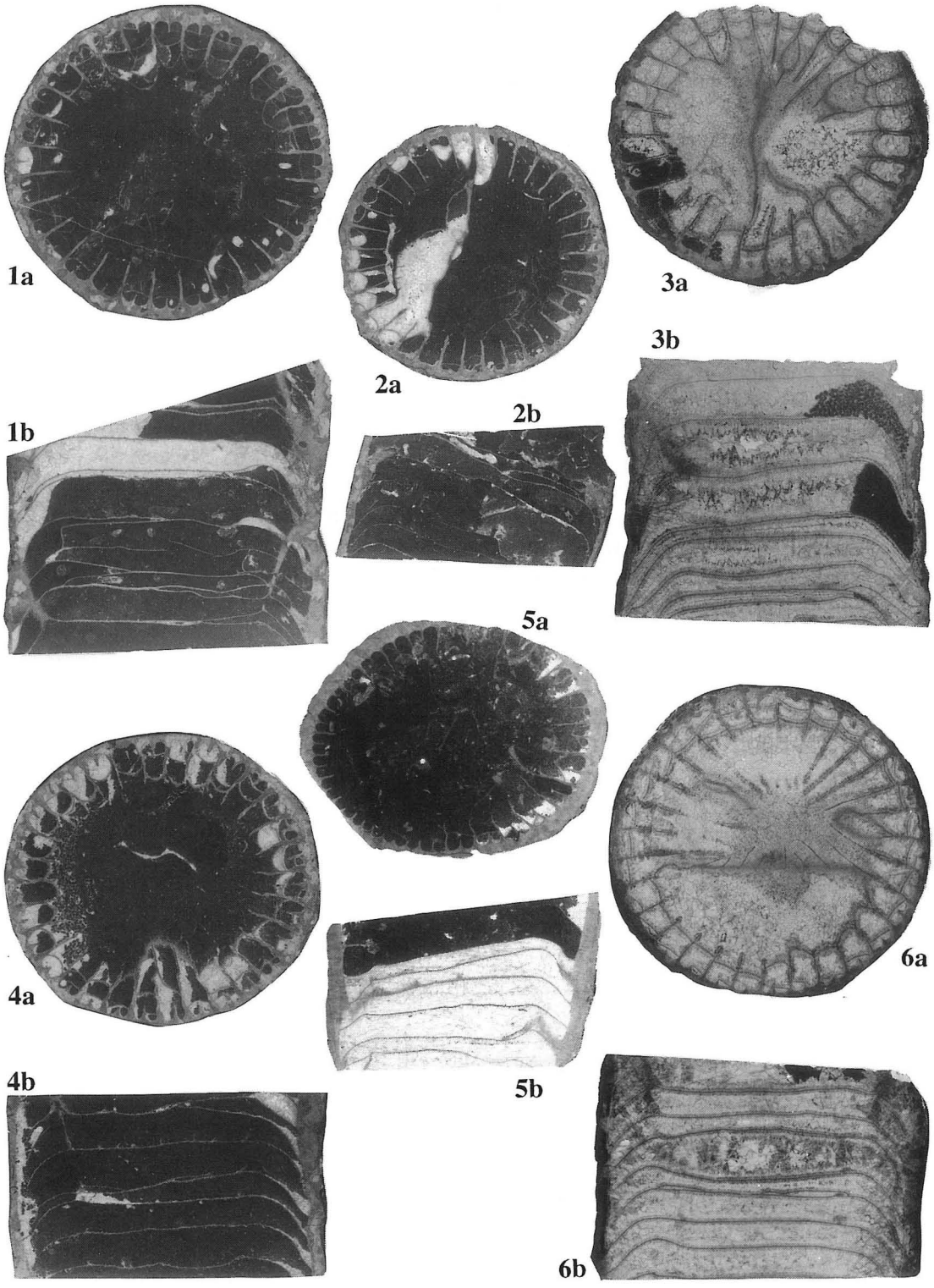
Fig. 3 *Siphonophrentis gigantea* (Lesueur). Mf008010, 3a transverse section; 3b. longitudinal section.

Fig. 4 *Siphonophrentis gigantea* (Lesueur). Mf003004, 4a. transverse section; 4b. kongitudinal section.

Fig. 5 *Siphonophrentis gigantea* (Lesueur). Mf1019, 5a. transverse section through the calyx; 5b. longitudinal section.

Fig. 6 *Siphonophrentis gigantea* (Lesueur). Mf008030, 6a. transverse section; 6b. longitudinal section.

Plate 21



Siphonophrentis

piments where the septal thickness form inner wall with the horseshoes, redilated at the boundary between dissepimentarium and tabularium in fusiform, do not form inner wall here. Minor short, less than one third of the majors in length, restricted to dissepimentarium, are usually replaced by herring bone dissepiments in inner dissepimentarium.

In longitudinal section the fans composed of septal trabeculae concentrated the axis of divergence over the horseshoes, may coat the horseshoes. The outer dissepiments have been destroyed over much parts, only a few outer globose dissepiments can be seen on the left part on figure 5b of plate 49. Horseshoe dissepiments well developed to form a continuous pipe, variable in size. Inner dissepiments small, globose or elongated, variable in size, nearly vertically arranged, usually only in one row, in parts more than one row of inner dissepiments may be present. Tabularium wide, with a diameter of 8.6 mm, more than 70 percent of the diameter of corallum in width, composed of incomplete tabulae. Axial tabulae small, about one third of the width of tabularium, flat, slightly convex, 11 can be counted over the vertical distance of 5 mm. Periaxial tabulae large, gently inclined inwardly at variable angles with horizon.

Discussion: The outer dissepiments of this form described here have been destroyed over much parts. but a few outer globose dissepiments still have been preserved. In this character the new species differs from *M. solitaria* and other species with horizontal outer dissepiments. Moreover, this species has small diameter but more septa. This makes it has much higher septal index, by which the new species may be easily distinguished from the other species assigned to *Macgeea*.

Locality: Malutang.

Macgeea yunnanensis sp. nov.

(Plate 6, fig. 3)

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh	Tw
Mf005022 (Holotype)	16.4	31×2	10.6	7.4	3.5	6	4	0.1
	10.1	24×2	7.1	3.8	1.4			

Explanation of Plate 22

(All figures are ×4)

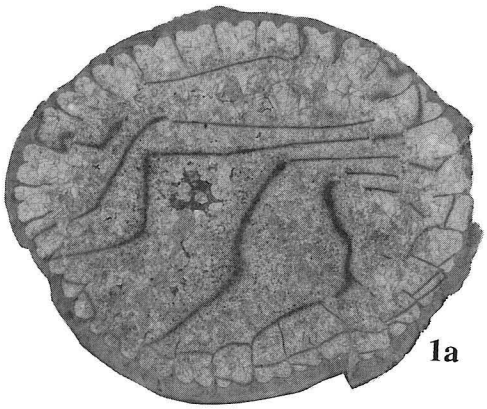
Fig. 1 *Siphonophrentis gigantea* (Lesueur). Mf00x031, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Siphonophrentis gigantea* (Lesueur). Mf010027, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Siphonophrentis gigantea* (Lesueur). Mf008025, 3a. transverse section; 3b. longitudinal section.

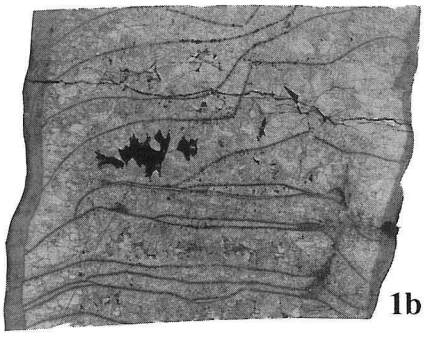
Fig. 4 *Siphonophrentis gigantea* (Lesueur). Mf010013, 4a. transverse section; 4b. longitudinal section.

Plate 22

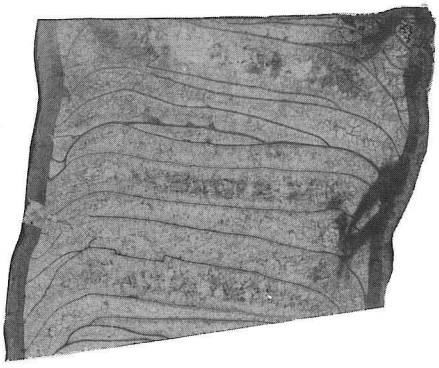


1a

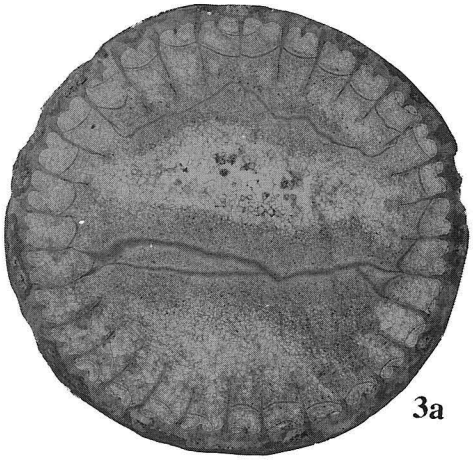
2a



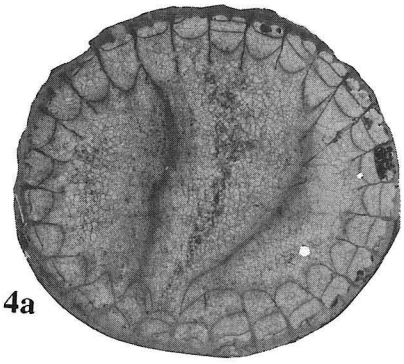
1b



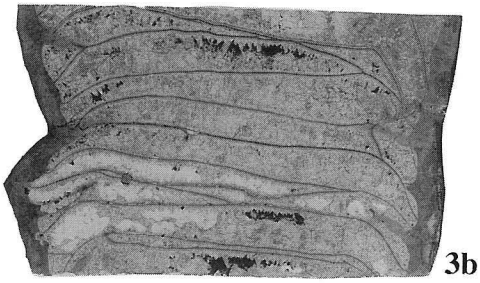
2b



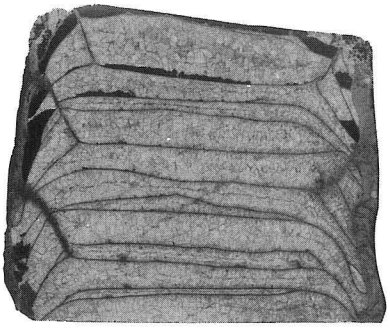
3a



4a



3b



4b

Siphonophrentis

10.1 24×2 7.1 3.8 1.4

Diagnosis: Solitary, turbinate coral. Septa of two orders, bilateral in arrangement, dilated in median parts. A few major septa longer than the others and extend to and meet at the axial place. Dissepimentarium composed of outer, horseshoe and inner dissepiments. Tabularium wide, consists of incomplete tabulae. Tabulae break into gently convex vesicles.

Description: Solitary, turbinate coral. Two transverse sections have been prepared from one specimen of this species. In the section with a diameter of 10.1 mm, septa of two orders, 24×2 in number, bilateral in arrangement. Major septa long, reach the axis, where they meet in four groups (pl. 6, fig. 3b), both peripheral and axial ends thin, and median parts thick; minor septa short, as long as one third of the majors, restricted to narrow dissepimentarium without inner dissepiments. In the section with diameter of 16.4 mm, septa amount to 31×2 in number, bilateral in arrangement. Major septa long, nearly reach the axis. A few major septa longer than the others and meet at the axis. Cardinal septum shorter than the others. Both peripheral and axial ends of major septa thin, the median parts in inner dissepimentarium and outer tabularium dilated. Minor septa well developed, enter the tabularium, as long as about half of the majors, dilated in fusiform, markedly thinner than the majors. In transverese section 2 to 4 rows of inner rows normal dissepiments occur.

In longitudinal section coarse trabeculae forming the septa arranged in fans concentrating their axis of divergence on horseshoes. Dissepimentarium narrow, composed of three parts. The outer dissepiments flat or slightly convex, no globose dissepiments. Horseshoe dissepiments well developed to form a continuous pipe, variable in size. In early stage there is no inner dissepiments, later 1 to 2 rows of inner dissepiments which are small, globose or elongated, nearly vertically arranged. Tabularium wide, with diameter more than two thirds of the diamerer of corallum in width. Tabulae incomplete, break into vesicles. Axial tabulae convex, slightly large, 6 can be counted over the vertical distance of 5 mm; the periaxial tabellae small, convex, gently inwardly or outwardly inclined.

Discussion: The new species is characterized by the tabulae breaking into vesicles and bilaterally arranging septa among which a few major septa extend to and meet at the axis. This species is similar to *M. solitaria* in septal dilatation and

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Explanation of Plate 23

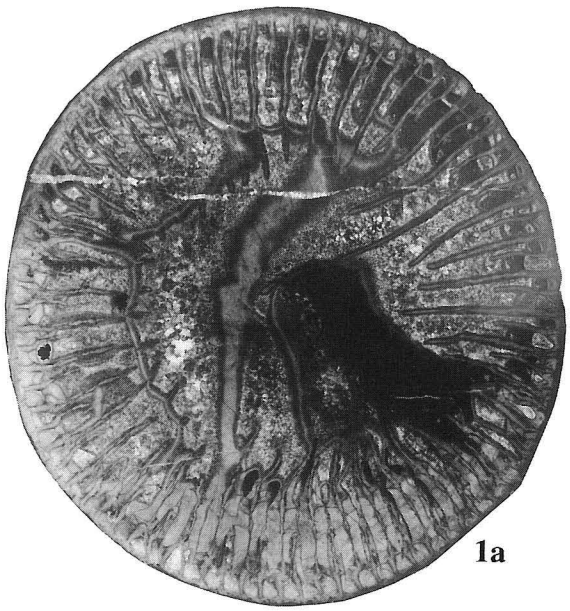
(All figures are ×2)

Fig. 1 *Altaiophyllum sagsayicum* (Spasskiy), 1960. Mf00x014, 1a. transverse section of late stage (probably through the calyx); 1b. transverse section of early stage; 1c. longitudinal section.

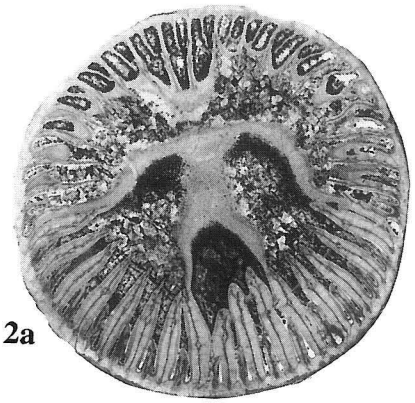
Fig. 2 *Altaiophyllum yunnanense* sp. nov.. Mf00x058 (Holotype), 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Altaiophyllum shidianense* sp. nov.. Mf00x063 (Holotype), 3a. transverse section; 3b. longitudinal section.

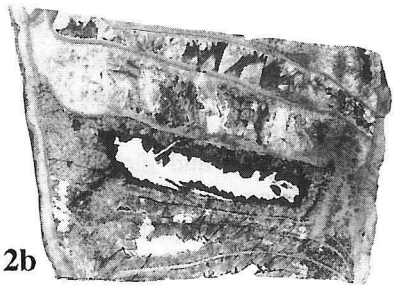
Plate 23



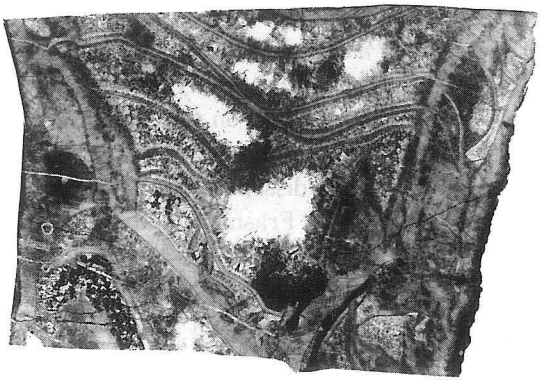
1a



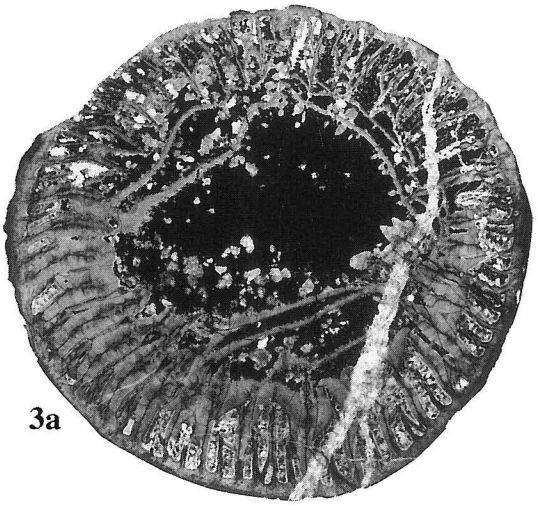
2a



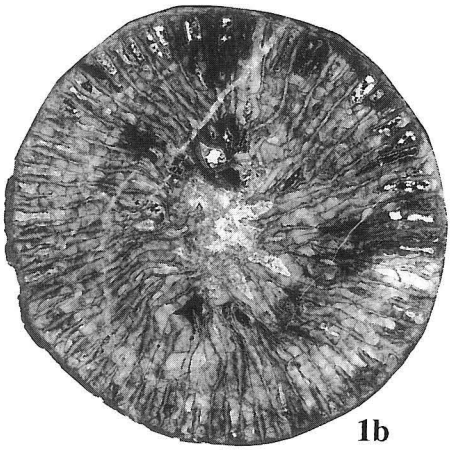
2b



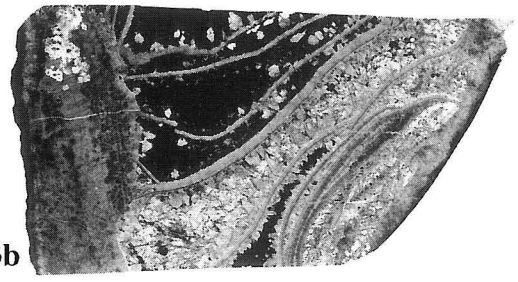
1c



3a



1b



3b

Altaiophyllum

dissepimentarium, but differs in the tabulae in vesicles and bilaterally arranging septa. In *M. shidiandnse* a few major septa are longer than the others, may reach and fuse at axis as in *M. yunnanense*, but the presence of globose outer dissepiments and large axial tabulae in *M. shidianense* can serve to distinguish it from the new species.

Locality: Malutang.

Genus *Peneckiella* Soshkina, 1939

1939 *Peneckiella* Soshkina, p. 32.
1939 *Pseudostringophyllum* Soshkina, p. 36, 54.
1960 *Sudetia* Rozkowska, P. 35.

Type species: *Diphyphyllum minus* Roemer, 1855, p. 29.

Diagnosis: Phaceloid or dendroid rugose corals. Septa of two orders, usually radial in arrangement, may be slightly carinated and dilated in dissepimentarium. Peneckielloid dissepiments in the outer part of the dissepimentarium. Horseshoe, sigmoidal and globose dissepiments may also be present. The coarse trabeculae forming the septa arranging in the form of asymmetrical fans or of half-fans. Tabulae complete or incomplete, frequently with flat-topped domes. Increase usually lateral, but may be axial.

Discussion: Many species have been described under *Peneckiella*, which vary considerably in morphology. Because the lonitudinal section of the holotype of the type species is not well illustrated, no agreement has been achieved on the arrangement of trabeculae in the septa. Soshkina (1939, p. 32) pointed out that *Peneckiella* has one row of particular dissepiments similar to horseshoe dissepiments. Flügel (1956, p. 355) restudied the holotype of the type species in the Frasnian of Ibergerkalk, Winterberg, Harz Mts., Germany, and illustrated a drawing of the longitudinal section of *Peneckiella*, which shows a row of horseshoe dissepiments. After the study of topotypes of the type species, Schouppé (1958) concluded that it is characterized basically by a single, rarely double rows of horseshoe dissepiments. Lang and Smith (1935, p. 576) and Pickett (1967, fig. 14) come to the same conclusion as did Flügel (1956) and Schouppé (1958) on the basis of the study of the topotype specimen of *Peneckiella minus* (Roemer), the type species of the genus.

Strusz (1965, p. 556) divided the dissepiments into 5 types in phacellophyllid

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Explanation of Plate 24

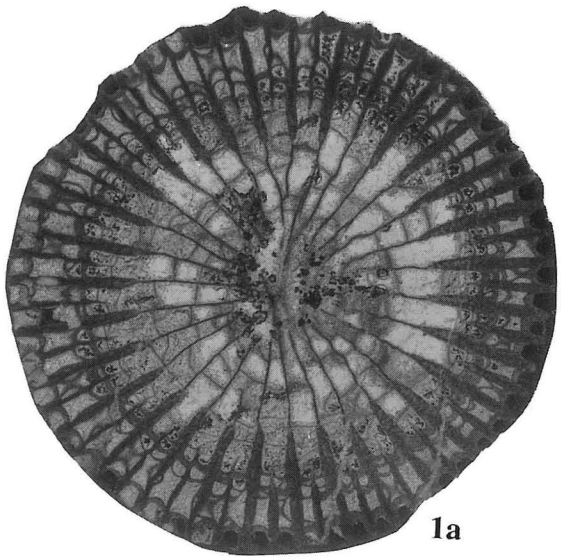
(All figures are ×4)

Fig. 1 *Macgeea solitaria* (Hall et Whitfield). Mf013029, 1a. transverse section; 1b. longitudinal section.

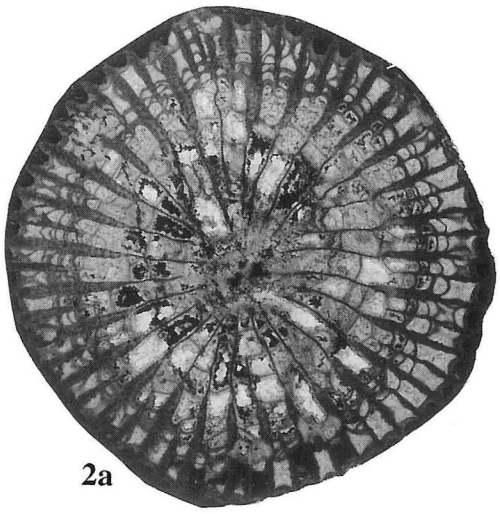
Fig. 2 *Macgeea solitaria* (Hall et Whitfield). Mf013015, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea solitaria* (Hall et Whitfield). Mf008003, 3a. transverse section.; 3b. longitudinal section.

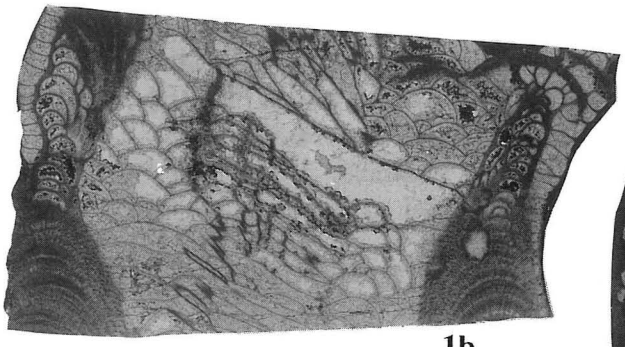
Plate 24



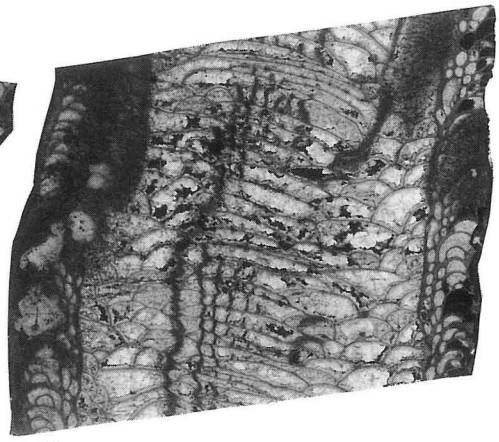
1a



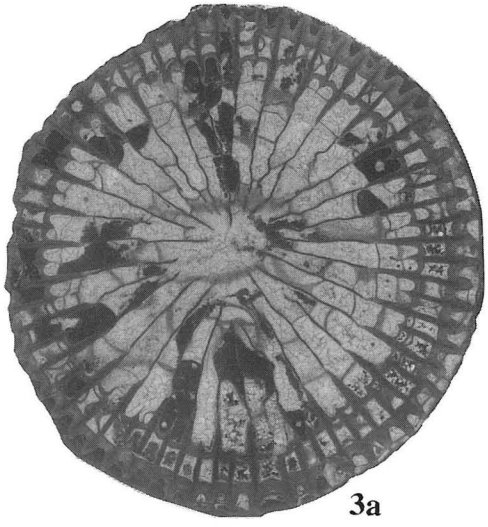
2a



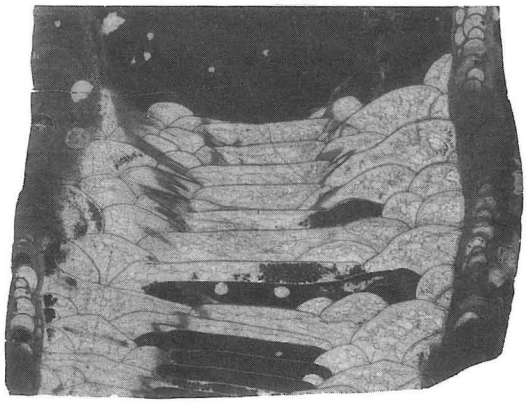
1b



2b



3a



3b

Macgeea

species. They are horseshoe dissepiments, peneckielloid dissepiments, sigmoidal dissepiments, horseshoe and horizontal dissepiments and horseshoe and accessory dissepiments. Sigmoidal dissepiments is a variant of peneckielloid ones, closely resembling a combination of horseshoe and horizontal dissepiments. Strusz believed that *Peneckiella* bears a peripheral series of horseshoe and peneckielloid dissepiments, supplemented by an inner, and occasionally outer row of accessory dissepiments. According to Strusz' opinion, except the horseshoe and horizontal dissepiments all the other four types of dissepiments may be presest in *Peneckiella*. Scrutton (1968, p. 272) considered that " it is peneckielloid and no true horseshoe dissepiments that are characteristic of the genus ". Yü and Kuang (1984, p. 149) confined *Peneckiella* to those forms with sigmoidal and peneckielloid dissepiments. In fact Yü and Kuang and Scrutton held the same opinion on the dissepimentarium of *Peneckiella*. The present author agrees with Yü and Kuang and Scrutton with regard to the chacters of the dissepimentarium of *Peneckiella*.

Soshkina (1939, p. 32) included both solitary and massive corals in *Peneckiella*. Now almost all palaeontologists use *Peneckiella* for only phaceloid and dendroid corals.

Almost all authors (Strusz, 1965, p. 557; Rozkowska, 1979, p. 22; Hill, 1981, p. 289; Yü and Kuang, 1984, p. 149) believed that the septal trabeculae in *Peneckiella* are arranged in asymmetrical fans. However, the material from western Yunnan shows that the trabeculae are arranged in two manners, asymmetrical fans and half-fans as in disphyllid coral (pl. 2, fig. 1b, 2b). In the asymmetrical trabeculae fans the outer half is very narrow, and the inner half is relatively wide. The trabeculae can be wavy as in charactophylloyid trabeculae in the inner part of asymmetric trabeculae fans and in the half-fans of symmetrical trabeculae of *Peneckiella* (pl. 3, fig. 1c).

Soshkina (1939, p. 36, 54) erected another genus *Pseudostringophyllum* and included three species within it. *P. caespitosum*, the type species, illustrated by Soshkina (1951, pl. 20 fig. 5; 1952, pl. 45, fig. 158) bears typical peneckielloid dissepiments. I prefer to put it under *Peneckiella* and to merge the genus *Pseudostringophyllum* into *Peneckiella*.

Rozkowska (1960, p. 35) proposed the genus *Sudetia* Rozkowska, with the type species *S. lateseptata* Rozkowska, 1960, from the Late Frasnian of the Sudetian Mountains, Poland. This genus has one series of peneckielloid dissepiments, asymmetrical trabeculae fans, with an axis of divergence near the wall, resting on the

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Explanation of Plate 25

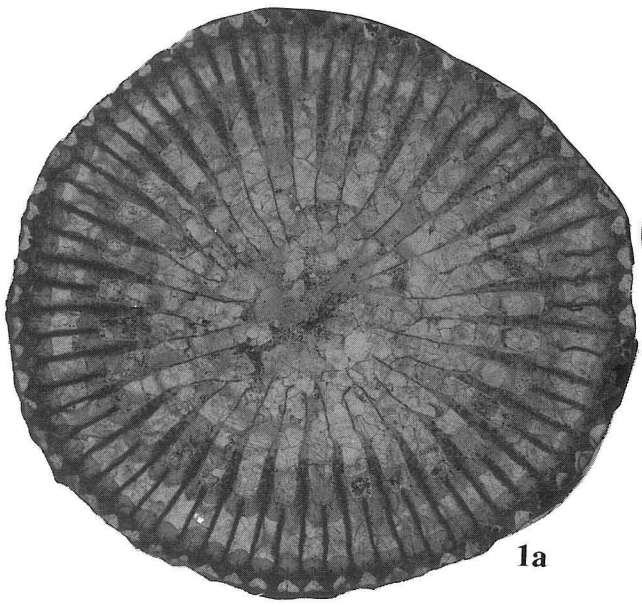
(All figures are ×4)

Fig. 1 *Macgeea solitaria* (Hall et Whitfield). Mf009009, 1a. transverse section; 1b. longitudinal section.

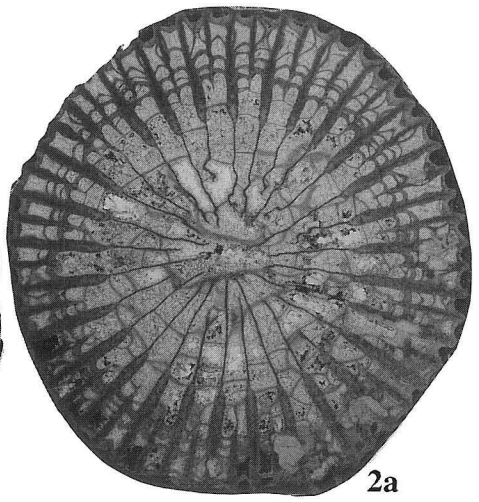
Fig. 2 *Macgeea solitaria* (Hall et Whitfield). Mf013018, 2a. transverse section, 2b. longitudinal section.

Fig. 3 *Macgeea solitaria* (Hall et Whitfield). Mf013017, 3a. transverse section; 3b. longitudinal section.

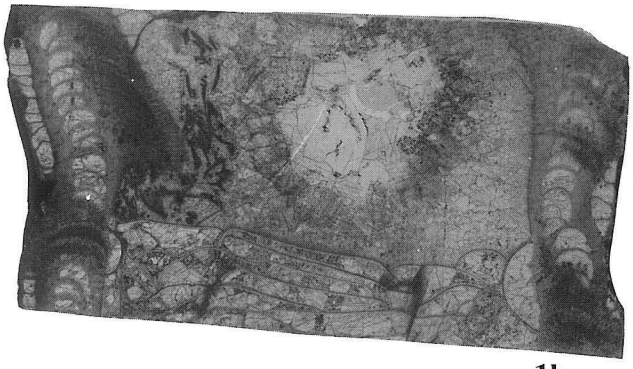
Plate 25



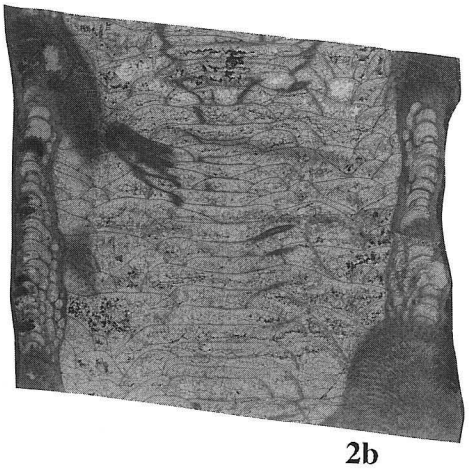
1a



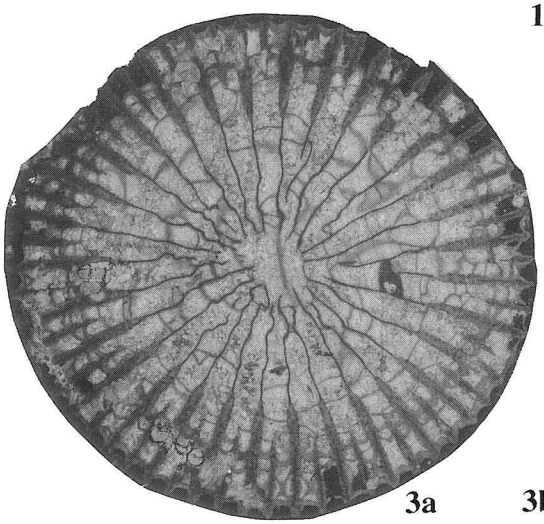
2a



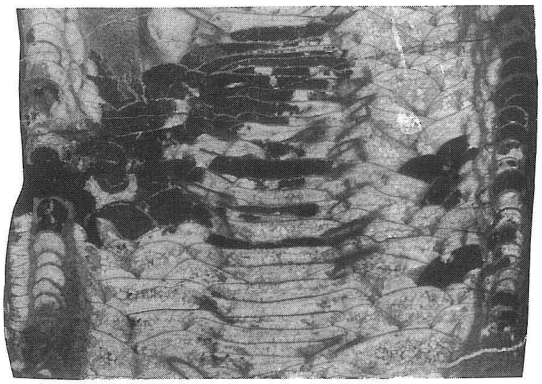
1b



2b



3a



3b

Macgeea

distal ends of peneckielloid dissepiments. These characters agree exactly with *Peneckiella*. Thus it may be better to regard *Sudetia* Rozkowska as a synonym of *Peneckiella*, as Scrutton (1968, p. 271) and McLaren (1989, p. 244) suggested.

Peneckiella appears closely related to *Thamnophyllum*, from which it may be distinguished by the presence of peneckielloid and sigmoidal dissepiments.

Assigned forms:

Peneckiella achanayensis Soshkina, 1939, p. 25, 51.
Peneckiella arundinacea (Billings) (=*Disphyllum arundinaceum*), 1859, p. 134; (=*Disphyllum* (*Synaptophyllum*) cf. *arundinaceum*). See Smith, 1945, p. 22.
Peneckiella belskayae Ivaniya, 1960, p. 385. see Ivaniya, 1965, p. 198.
Peneckiella boreensis boreensis Strusz, 1965, p. 562.
Peneckiella caespitosum (Soshkina) (=*Pseudostringophyllum caespitosum*), 1939, p. 36. see Soshkina, 1951, p. 110; 1952, p. 105.
Peneckiella caeskitosum tricyclicum (Schouppé) (=*Disphyllum caespitosum tricylicum*), 1965, p. 22.
Peneckiella catenata (Smith) (=*Disphyllum catenatum*), 1945, p. 21.
Peneckiella densa (Smith) (=*Disphyllum* (*Synaptophyllum*) *densum*), 1945, p. 22.
Peneckiella elegans Ivaniya, 1965, p. 198.
Peneckiella elegans Ivaniya, 1965, p. 198.
Peneckiella fascicularis (Soshkina) (=*Spinophyllum fasciculare*), 1939, p. 34.
Peneckiella guangxiensis Yü et Kuang, 1984, p. 150.
Peneckiella halysodes Ouyang in Cao, Ouyang et al., 1983, p. 91.
Peneckiella lateseptata (Rozkowska) (=*Sudetia lateseptata*), 1960, p. 35.
Peneckiella liujingensis Yü et Kuang, 1984, p. 153.
Peneckiella longiseptata He, 1978, p. 128.
Peneckiella mesa (Hill) (=*Disphyllum mesa*), 1942, p. 185.
Peneckiella metalinae Sorauf, 1972, p. 431.
Peneckiella minor (Roemer) (=*Diphyphyllum minus*), 1855, p. 29.
Peneckiella minor kunthi (Dames) (sensu *Peneckiella minor kunthi*, Rozkowska, 1960, p. 29, non *Cyathophyllum kunthi* Dames, 1869, p. 699.), see Strusz, 1965, p. 558.
Peneckiella monozonata Soshkina, 1939, p. 25, 52.
Peneckiella nalivkini Soshkina, 1939, p. 24, 51.
Peneckiella poculiformis Jin in Kong et Huang, 1977, p. 71.
Peneckiella praecox Hill, 1940b, p. 398.
Peneckiella pyrenaica Joseph et Tsien, 1975, p. 193.
Peneckiella ramondi Joseph et Tsien, 1975, p. 196.
Peneckiella raritabulata Jia, 1977, p. 142.
Peneckiella regularis Jia, 1977, p. 141
Peneckiella salternensis Scrutton, 1968, p. 273.
Peneckiella shawoziensis He, 1978, p. 128.
Peneckiella spiralis Soshkina, 1939, p. 28, 52.
Peneckiella szulczewskii Rozkowska, 1979, p. 21.
Peneckiella teicherti Hill, 1954a, p. 25.
Peneckiella tolstichinae Soshkina, 1952, p. 103.
Peneckiella tolstichinae Soshkina, 1952, p. 103.

Explanation of Plate 26

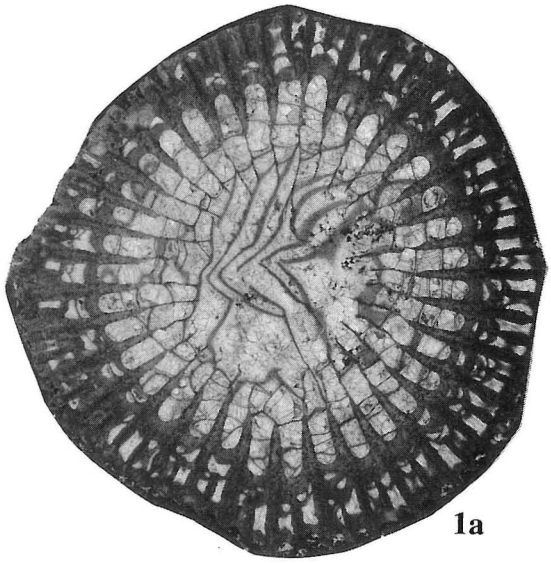
(All figures are ×4)

Fig. 1 *Macgeea bathycalyx* (Frech). Mf009001, 1a, 1b. both transverse sections at two different diameters; 1c. longitudinal section.

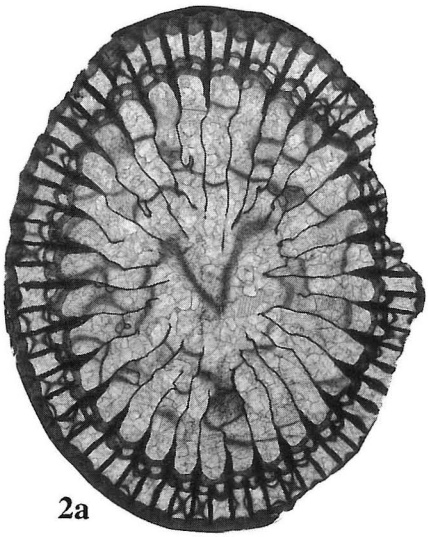
Fig. 2 *Macgeea bathycalyx* (Frech). Mf007011, 2a, transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea bathycalyx* (Frech). Mf001005, 3a. transverse section; 3b. longitudinal section.

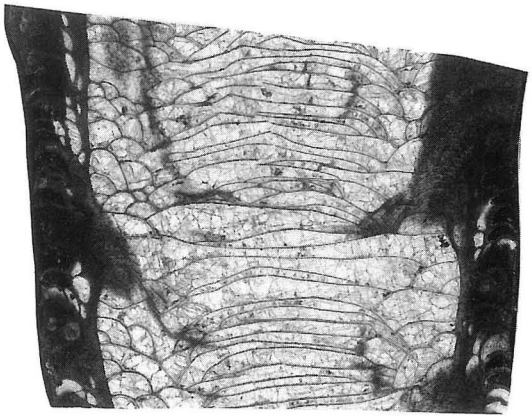
Plate 26



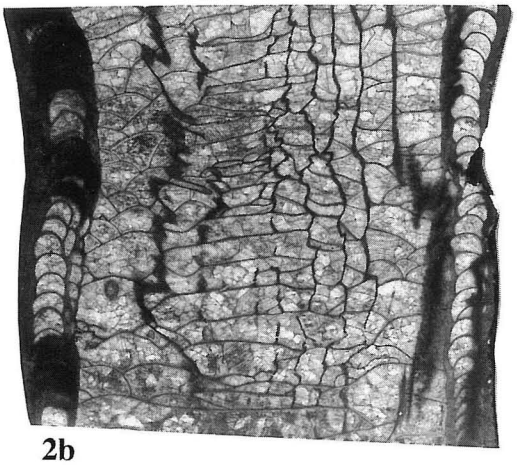
1a



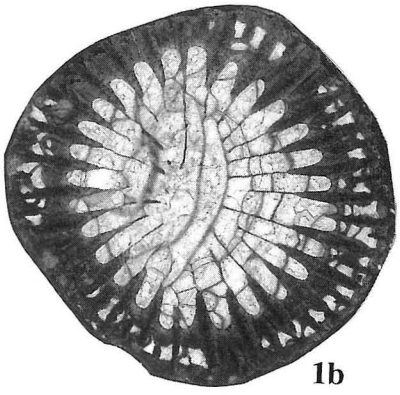
2a



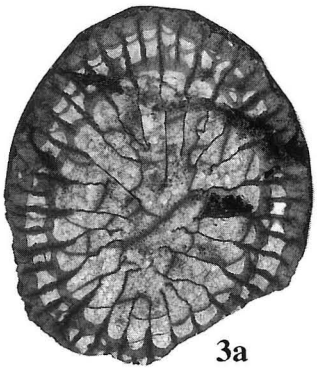
1c



2b

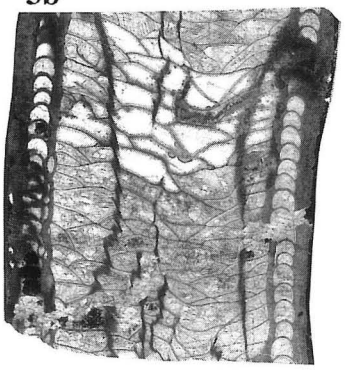


1b



3a

3b



Macgeea

Peneckiella xizangensis Liao in Wu, Liao et Zhao, 1982, p. 119.
Peneckiella yakoxlevi (Bulvanker) (=*Hexagonaria yakovlevi*), 1958, p. 183.
Peneckiella yunnanensis sp. nov.

Rejected forms:

Peneckiella breviseptata (Yoh) (=*Prismatophyllum hexagonum* var. nov. *breviseptatum*), 1937, p. 69. see Soshkina, 1949, p. 142.
Peneckiella carinata Ivaniya, 1965, p. 193.
Peneckiella darwini (Frech) (=*Cyathophyllum darwini*), 1885, p. 36. see Soshkina, 1952, p. 107.
Peneckiella glubokiensis Ivaniya, 1960, p. 386. see Ivaniya, 1965, p. 195.
Peneckiella irregularis Ivaniya, 1965, p. 194.
Peneckiella isylica」Bulvanker) (=*Hexagonaria isylica*) 1958, p. 185.
Peneckiella jevlanensis Bulvanker in Soshkina, 1952, p. 103.
Peneckiella juresanensis Soshkina, 1951, p. 104.
Peneckiella primitiva Sayutina, 1965, p. 7.
Peneckiella tabulata Ivaniya 1952, p. 131. see lvaniya, 1965, p. 197.
Peneckiella zhongguoensis Jia, 1977, p. 141.

Not examined forms:

Peneckiella evlanensis Bulvanker. see Soshkina, 1939, p. 25.
Peneckiella glubokiensis Ivaniya, 1958, p. 200.
Peneckiella originalis Bulvanker. see Tsyganko, p. 142.
Peneckiella yakovlavi Ivaniya, 1965, p. 199. (no description)

Geological distribution: Middle and Late Devonian.

Geographical distribution: Asia, Europe, North America and Australia

Peneckiella fascicularis (Soshkina), 1939

(Plate, 1; Plate 2, fig. 2)

1939 *Spinophyllum fasciculare* Soshkina, p. 34, pl. 7, fig. 61, 62.
1951 *Schlueteria fascicularis* (Soshkina). Soshkina, p. 94, pl. 17, fig. 1.
1952 *Schlueteria fascicularin* (Soshkina). Soshkina, p. 100, pl. 40, text-fig. 119.
1954 *Schlueteria fascicularis* (Soshkina). Soshkina, p. 44, pl. 9, fig. 1-4.
1970 *Disphyllum fasciculare* (Soshkina). Tsien, p. 171, fig. 13, 14.
1972 *Disphyllum wirbelauense bonae* Rozkowska et Fedorowski, p. 298, pl. 2, fig. 1-5; text-fig. 9-12.
1979 *Peneckiella fascicularis* (Soshkina). Rozkowska, p. 21, pl. 2, fig. 3, 4.
1981 *Peneckiella fascicularis* (Soshkina). Tsyganko, p. 78, pl. 24, fig. 2.

Measurements:

No	D	N	Dt	Nt	Lf	Ls	Tw

Explanation of Plate 27

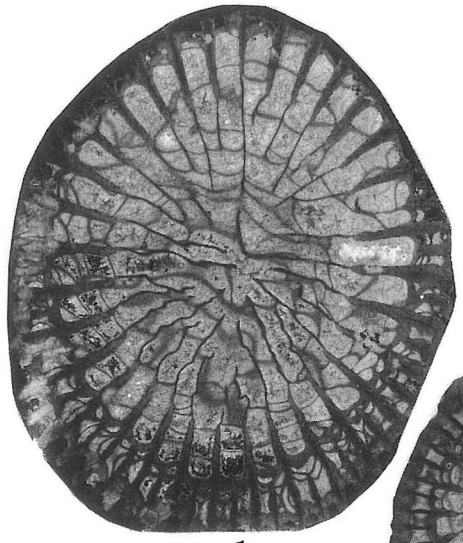
(All figures are ×4)

Fig. 1 *Macgeea bathycalyx* (Frech). Mf010004, 1a, 1b. both transverse sections at two different diameters; 1c. longitudinal section.

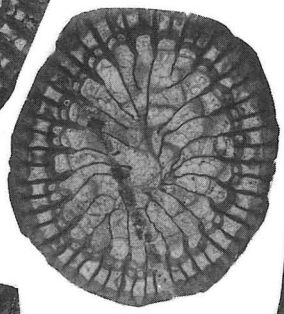
Fig. 2 *Macgeea bathycalyx* (Frech). Mf009012, 2a, 2b. both transverse section at two different diameters; 2c. longitudinal section.

Fig. 3 *Macgeea bathycalyx* (Frech). Mf009013, 3a. transverse section; 3b. longitudinal section.

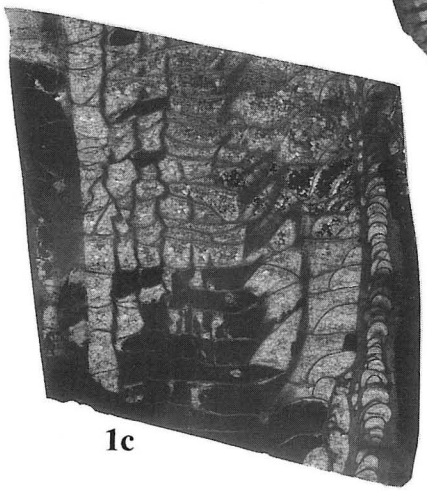
Plate 27



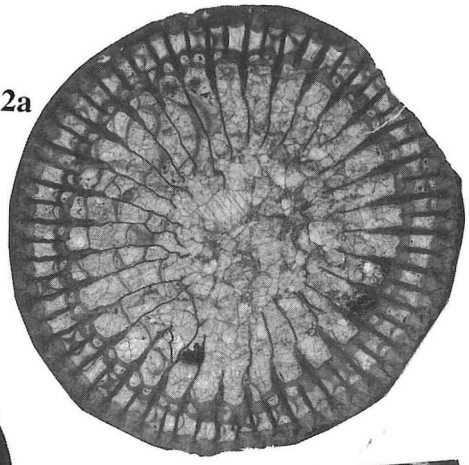
1a



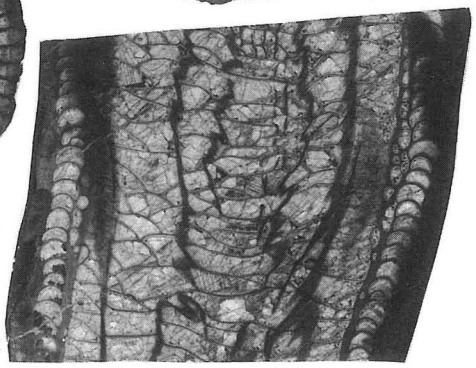
2b



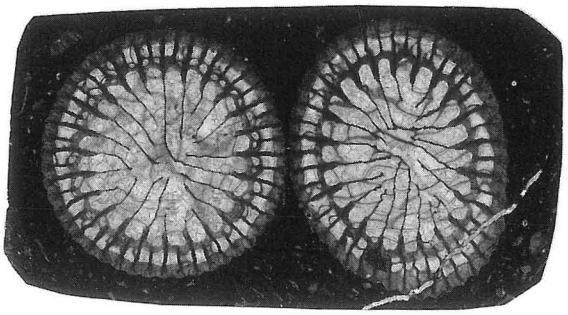
1c



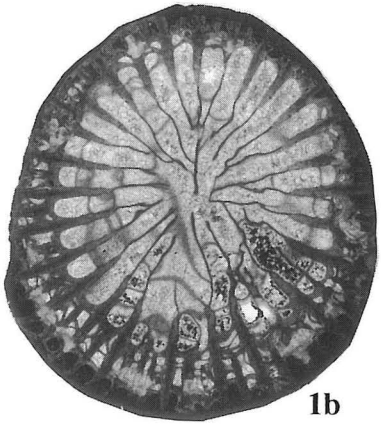
2a



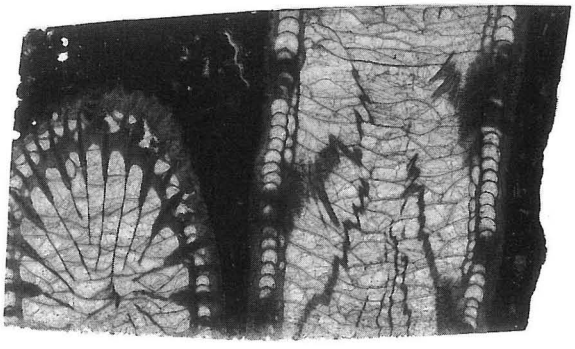
2c



3a



1b



3b

Macgeea

Mf007003	12.1	26×2	10.0	9	4.1	1.4	0.6
Mf007012	11.3	30×2	8.7		4.0	1.3	0.9
	13.6	29×2	10.5	10	5.2	1.6	0.5
Hf1002	13.2	26×2	9.6	9	5.7	1.6	0.8
	8.4	23×2	6.0		3.6	1.0	0.2

Diagnosis: Dendroid corals made up of cylindrical corallites, increase lateral or peripheral. Septa of two orders, radially arranged. Major septa nearly reach the axis, minor septa short. The peripheral ends of all septa dilated to form an exterior wall. Dissepimentarium narrow, consists of the outermost row of non-typical peneckielloid dissepiments and inner normal dissepiments. Tabularium wide, tabulae incomplete, convex.

Description : The sections of this species were prepared from three specimens from western Yunnan. Dendroid corals, composed of cylindrical corallites with diameter ranging from 11.3 to 13.6 mm in late stage, laterally offsetting (pl. 1, fig. 1a, 2a). Septa of two orders, somewhat radially arranged, 26×2 to 30×2 in number. Major septa long, nearly extend to the axis, may be involuted in axial area, one of protosepta longer than the others (pl. 1, fig. 1a, 2a). Occasionally one or two major septa are disrupted by tabulae only at their axial ends (pl. 2. fig. 2a). Minor septa short, less than one third of the majors in length. In early stage exterior wall thin, only 0.2 mm thick (pl. 1, 2a), in the late stage the peripheral ends of all septa dilated to form septal streozone up to 0.5 to 0.9 mm thick. Septa may be redilated at the boundary between dissepimentarium and tabularium and are in contact laterally to form an inner wall. Major septa rapidly attenuated in tabularium. Minor septa do not enter tabularium.

In longitudinal section, dissepimentarium narrow, composed of one or more than one row of dissepiments. The outermost dissepiments are large, non-typical peneckielloid dissepiments. 1 to 3 rows of inner dissepiments small, globose, vertically arranged. The inner dissepiments may be dincontinuous in part of some corallites (pl. 2, fig. 2b). The trabeculae forming septa coarse, about 0.3 mm in diameter, arranged in half fans, steeply upward in periphery, and gradually gently inclined inward in tabularium. Tabularium wide, with diameter ranginig from 8.7 to 10.5 mm, composed of incomplete tabulae. Axial tabulae large, with horizontal axial parts and turndown peripheral edges, 9 to 10 can be counted over the vertical distanee of 5 mm in part breaking into vesicles. Periaxial tabellae variable in size, usually inclined in ward.

Discussion: This species is characterized by dendroid corallum, narrow dissepimentarium and non-typical peneckielloid dissepimentarium. Because of the poor-

Explanation of Plate 28

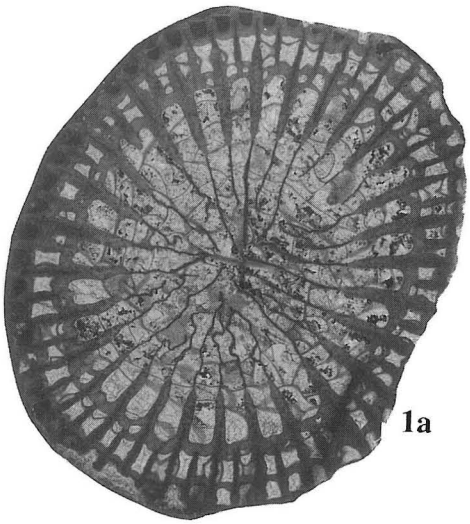
(All figures are ×4)

Fig. 1 *Macgeea bathycalyx* (Frech). Mf010009, 1a. transverse section; 1b. longitudinal section.

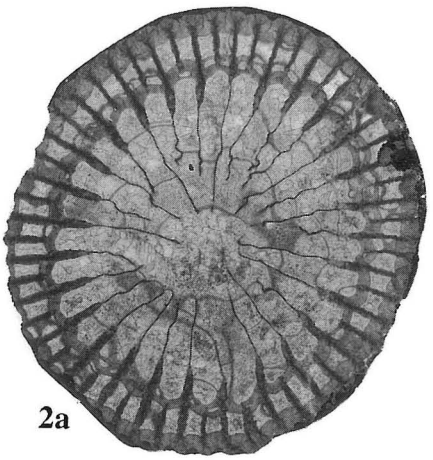
Fig. 2 *Macgeea bathycalyx* (Frech). Mf007026, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea bathycalyx* (Frech). Mf010011, 3a. transverse section; 3b. longitudinal section.

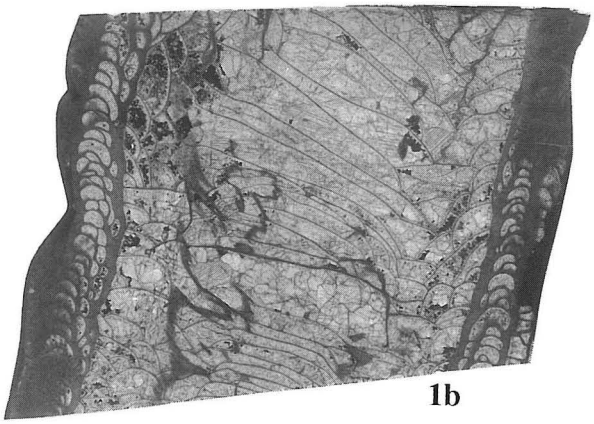
Plate 28



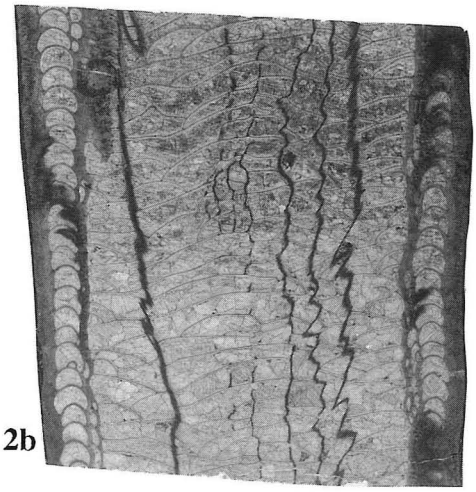
1a



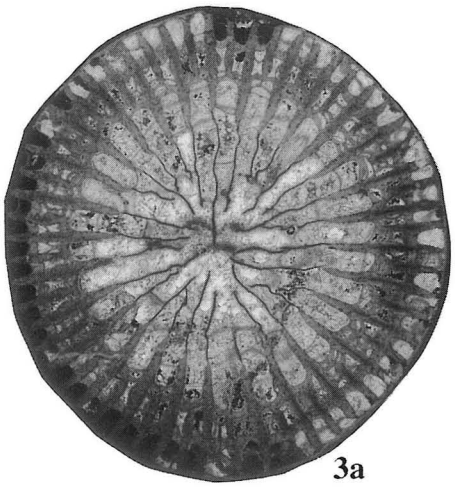
2a



1b



2b



3a

3b

Macgeea

ly developed peneckielloid dissepiments, this species had been placed in *Disphyllum* (*Schlueteria* has been regarded as a synonym of *Disphyllum*). Recently there is a tendency to put this species under *Peneckiella*. In view of that the presence and absence of peneckielloid dissepiments is the key difference between *Disphyllum* and *Peneckiella*, and that peneckielloid dissepiments are present in this species indeed, although they do not form a continuous row, I prefer to follow Rozkowska (1979) and Tsyganko (1981) and place this species in *Peneckiella*.

The material from western Yunnan exactly agrees with the *P. fascicularis* from the Frasnian of Ural, Timan, Armenia (Soshkina, 1951, 1952, 1954; Tsyganko, 1981) and that from the Givetian and Frasnian of Poland (Rozkowska and Fedorowski, 1972; Rozkowska, 1979) in main characters, but is slightly larger and has more septa than those assigned to the species mentioned above.

Locality: Malutang and Heyuanzhai.

Peneckiella yunnanensis sp. nov.

(Plate 2, fig. 1, 3; Plate, 3; Plate 4, fig. 1, 2; text-figure 15)

1922 *Cyathophyllum* (*Thamnophyllum*?) sp. Reed, p. 14, pl. 2, fig. 12; pl. 3, fig. 12; pl. 3, fig. 1, 2.

Measurement:

No	D	N	Dt	Lf	Nt	Nh	Tw	
Hf1033 (Holotype)	15.0	23×2	7.9	6.9	4.2	10	4	0.8
Hf1016	15.2	24×2	8.6	5.5	3.6	9	3	0.3
Hf1024	16.1	25×2	12.3	6.4	3.9	15	3	0.3
Hf1034	12.3	26×2	10.4	5.2	3.4	12	4	0.3
H11014	12.8	27×2	8.0	5.5	1.9	13	3	0.3
Hf1025	13.2	25×2	8.7	4.8	2.5	11	3	0.3
Hf1017	14.2	24×2	9.1	6.6	3.3	8	4	0.3
Hf1011	11.0	23×2	6.8	4.8	1.8	13	3	0.3
Hf1012	11.0	25×2	8.3	5.1	1.9	9	4	0.3

Diagnosis: Corallum dendroid, offsetting laterally. Septa of two orders, usually radial in arrangement. The major septa reach or not reach the axis, dilated in fusiform within dissepimentarium. The coarse trabeculae forming septa arranged in asymmetrical fans with very narrow outer half-fans or in half-fans, and may be

Explanation of Plate 29

(All figures are ×4)

Fig. 1 *Macgeea bathycalyx* (Frech). Mf007056, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Macgeea bathycalyx* (Frech). Mf010012, 2a. transverse section; 2b. longitudinal section.

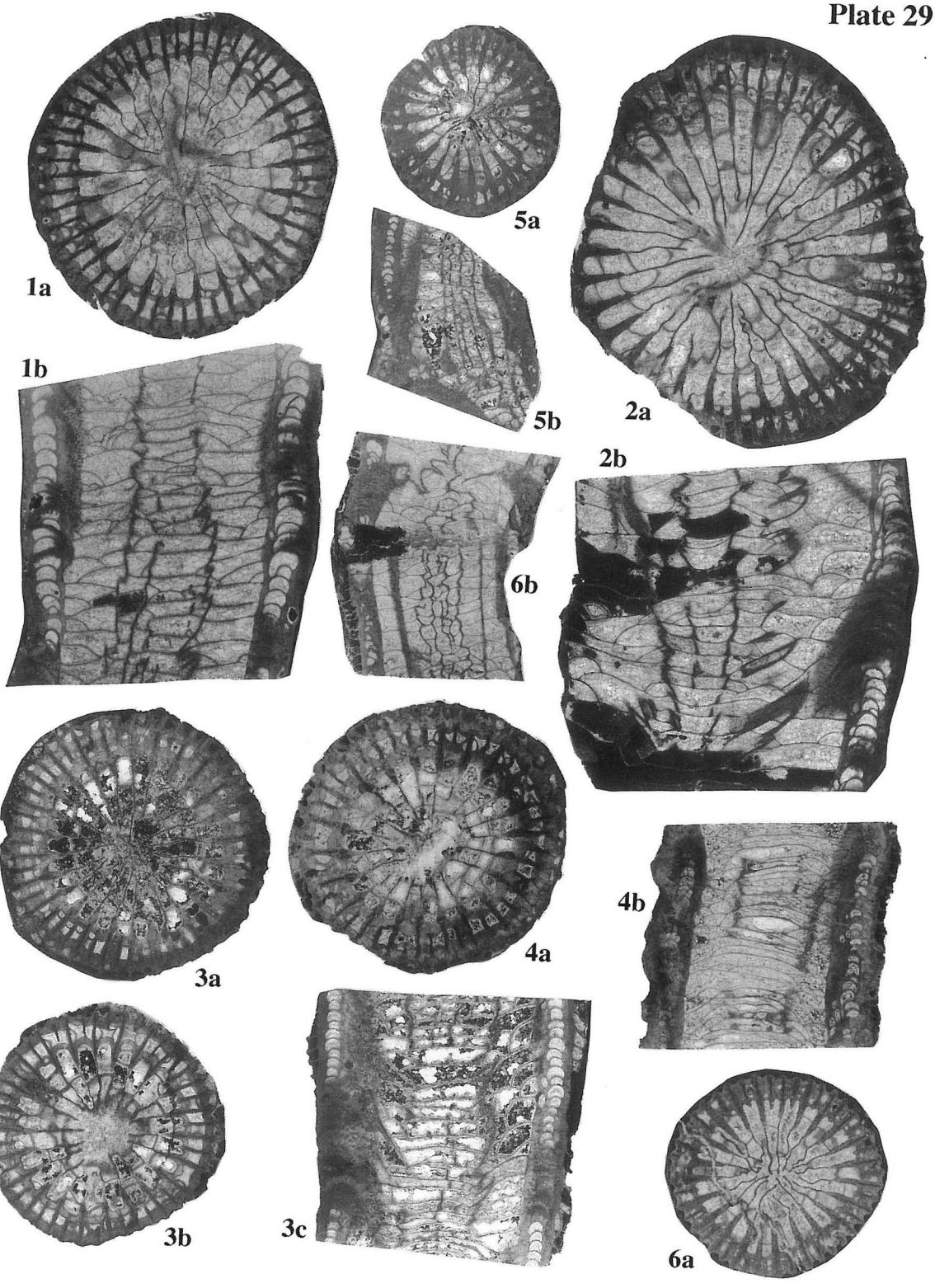
Fig. 3 *Macgeea bathycalyx* (Frech). Mf00x020, 3a, 3b. both transverse sections at two different diameters; 3c. longitudinal section.

Fig. 4 *Macgeea bathycalyx* (Frech). Mf00x036, 4a. transverse section; 4b. longitudinal section.

Fig. 5 *Macgeea bathycalyx* (Frech). Mf013015, 5a. transverse section; 5b. longitudinal section.

Fig. 6 *Macgeea bathycalyx* (Frech). Mf013010, 6a. transverse section; 6b. longitudinal section.

Plate 29



Macgeea

wave like charactophylloid trabeculae. Dissepimentarium consists of outer peneckielloid dissepiments and inner globose dissepiments. Tabulae complete or incomplete, commonly with flat-topped domes.

Description: Corallum dendroid. In the specimen numbered Hf1016 (pl. 4, fig. 1a, 1b) can be seen an offset which arises in the outer part of dissepimentarium. At first this offset grows parallel to the parent corallite which loses its own outer wall and the offset produced its own new outer wall. Then the offset diviated laterally with a large angle. Corallites subcylindrical, occasionally irregularly bent, rounded or elliptical in transverse section, with diameter ranging from 11.0 to 16.3 mm. The specimens of this species collected from western Yunnan in fragments of corallites, so the distances between two adjacent corallites is unknown. Septa of two orders, somewhat radially arranged, in few specimen counter septum longer than the other majors and septa are bilateral in arrangement (pl. 3, fig. 1a; pl. 4, fig. 2a). The sharp external ends of septa deeply penetrate into about 0.3 mm thick outer wall. Septa from 23×2 to 27×2 in number. The major septa retreated from the axis. Their length considerably variable, usually as long as, or longer than the two thirds of the radius, occasionally reach the axis (pl. 3, fig. 3a; pl. 4, fig. 2a). Septal dilation is fusiform, the maximum thickness at the inner margin of dissepimentarium. Septal dilations can laterally connect to each other to form an inner wall. In a few specimens (pl. 2, fig. 3a; pl. 3, fig. 1a, fig. 3a) one of protosepta slightly longer than the other majors. Minor septa well developed, usually as long as half of the major ones, markedly thinner than the majors. In a few specimens minor septa short, not entering the tabularium (pl. 3, fig. 2a; pl. 4 fig. 2a, 2b). Weakly developed carinae may be present on the sides of the septa. Inner dissepiments markedly closer spaced than the outer; lateral dissepiments may be present in the outer part of the dissepimentarium.

In longitudinal section dissepimentarium composed of peneckielloid dissepiments and inner dissepiments. The peneckielloid dissepiments large, located in the outer margin of dissepimentarium, only 1 or 2 rows, 3 to 4 disposed in 2 mm. Inner dissepiments small, globose, vertically arranged, usually 2 to 4 rows. The tabularium wide, with diameter ranging from 6.8 to 12.3 mm, consists of incomplete tabulae. Axial tabulae large, commonly with flat-topped domes, 8 to 15 can be counted over the vertical distance of 5 mm. Periaxial tabellae variable in size, and incline inwardly with different angles.

Discussion: In the species previously assigned to *Peneckiella* only one or two rows of dissepiments can usually be found. The specimens described here bear large corallites and wide dissepimentarium composed of more than 3 rows of disse-

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Explanation of Plate 30

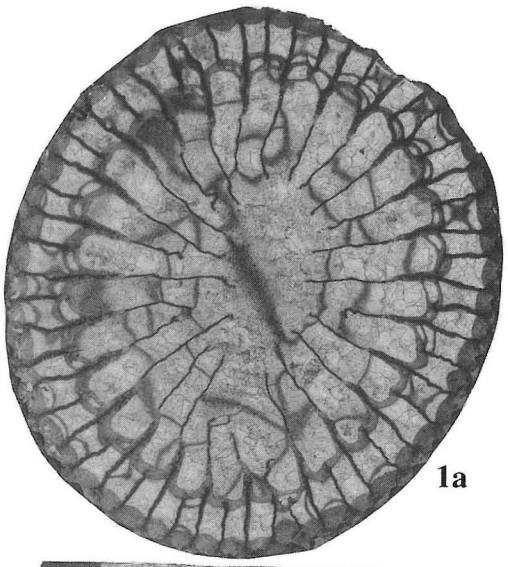
(All figures are ×5)

Fig. 1 *Macgeea symmetrica* Sung. Mf001010, 1a. transverse section; 1b. longitudinal section.

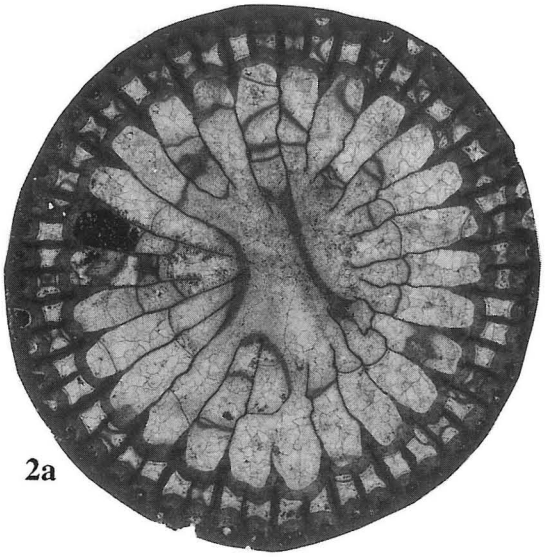
Fig. 2 *Macgeea symmetrica* Sung. Hf1013, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea symmetrica* Sung. Mf007002, 3a. transverse section; 3b. longitudinal section.

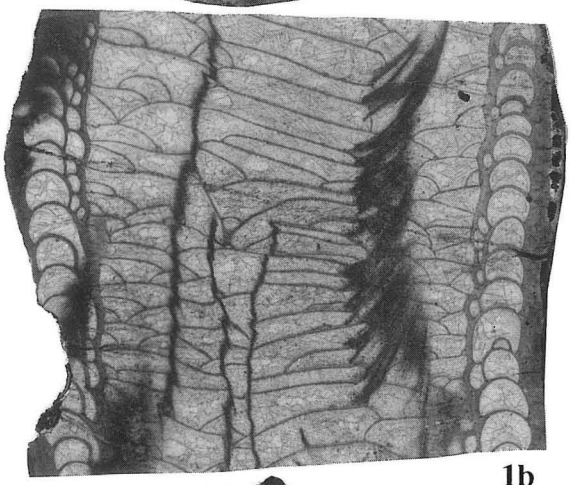
Plate 30



1a

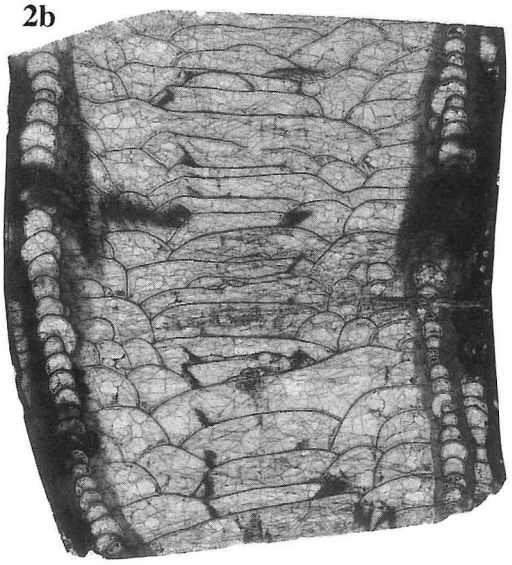


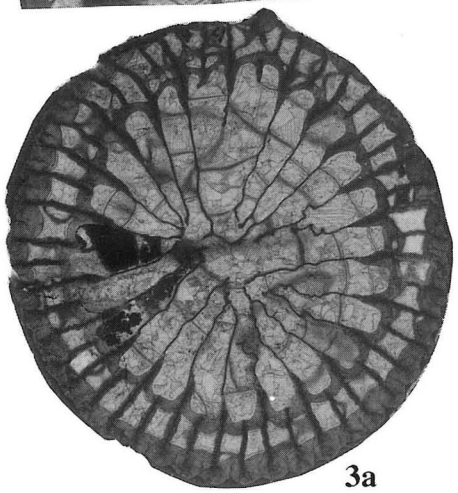
2a



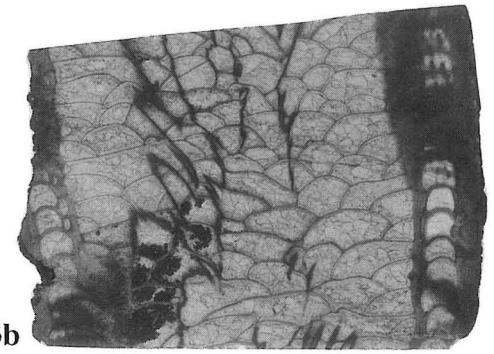
1b

2b





3a



3b

Macgeea

piments, by which the new species can be distinguished from the other species assigned to *Peneckiella* previously.

The new species has some resemblance to *Disphyllum* (*Synaptophyllum*) *densum* Smith (1945, p. 22, pl. 12, fig. 3a-c) with more than two rows of dissepiments including peneckielloid dissepiments, from the Upper Devonian of Mackenzie River Region, Canada. The specimens from western Yunnan have larger diameter and more septa than *Disphyllum* (*Synaptophyllum*) *densum*. According to Smith's original description, *D.* (*S.*) *densum* bears amplexoid septa on which carinae are strongly developed. However, the transverse section of the holotype of that species (Smith, 1949, pl. 12, fig. 3b) does not show the presence of amplexoid septa very well. Maybe the presence and absence of amplexoid septa is the most important difference between *D.* (*S.*) *densum* and *Peneckiella yunnanensis*. If the septa are continuous rather than amplexoid in Smith's species, the new species may be conspecific with *D.* (*S.*) *densum*.

The new species is similar to the form shown as *Disphyllum minus* (Roemer) by Ma (1937, pl. 2, fig. 1) in the dissepiments, but the latter has lonsdaleoid dissepiments disrupting septa, by which the both can be easily distinguished from each other. Joseph and Tsien (1975, p. 183, 184) described 2 species, *Peneckiella pyrenaica* and *P. ramondi*, from Givetian. The both species resemble the new species in having 2 to 3 rows of dissepiments, but they differ from the latter in having small diameter only about 5 mm and narrow dissepimentarium.

Locality: Heyuanzhai.

Genus *Parapeneckiella* gen. nov.

Type species: *Parapeneckiella shidianensis* gen. et sp. nov.

Diagnosis: Solitary coral. Septa of two orders, radial in arrangement. Major septa amplexoid in late stage as least. Dissepimentarium consisting of outer peneckielloid dissepiments and inner globose dissepiments. Tabularium wide, composed of incomplete, convex tabulae.

Discussion: The rugose corals with peneckielloid dissepiments are so far mostly known as compound corals. Among the abundant material collected, there is only one small solitary corallum with typical peneckielloid dissepiments. This specimen is contributed to erect a new genus, although the variation within the genus can not be discussed, as there is only one corallum. I would define the new genus as a solitary coral with peneckielloid dissepiments and amplexoid septa. Having

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Explanation of Plate 31

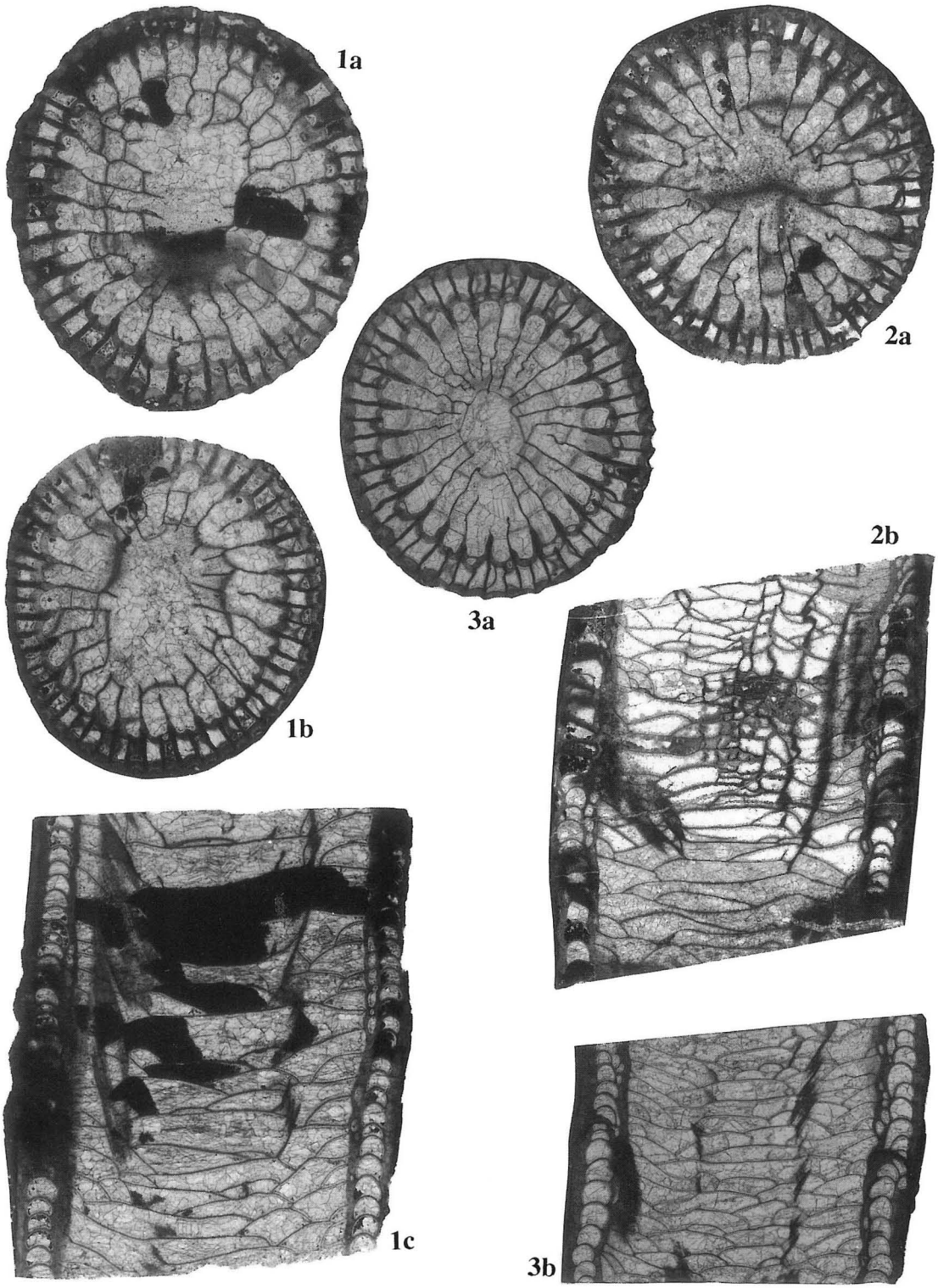
(All figures are ×5)

Fig. 1 *Macgeea symmetrica* Sung. Hf1035, 1a, 1b. both transverse sections at two different diameters; 1c. longitudinal section.

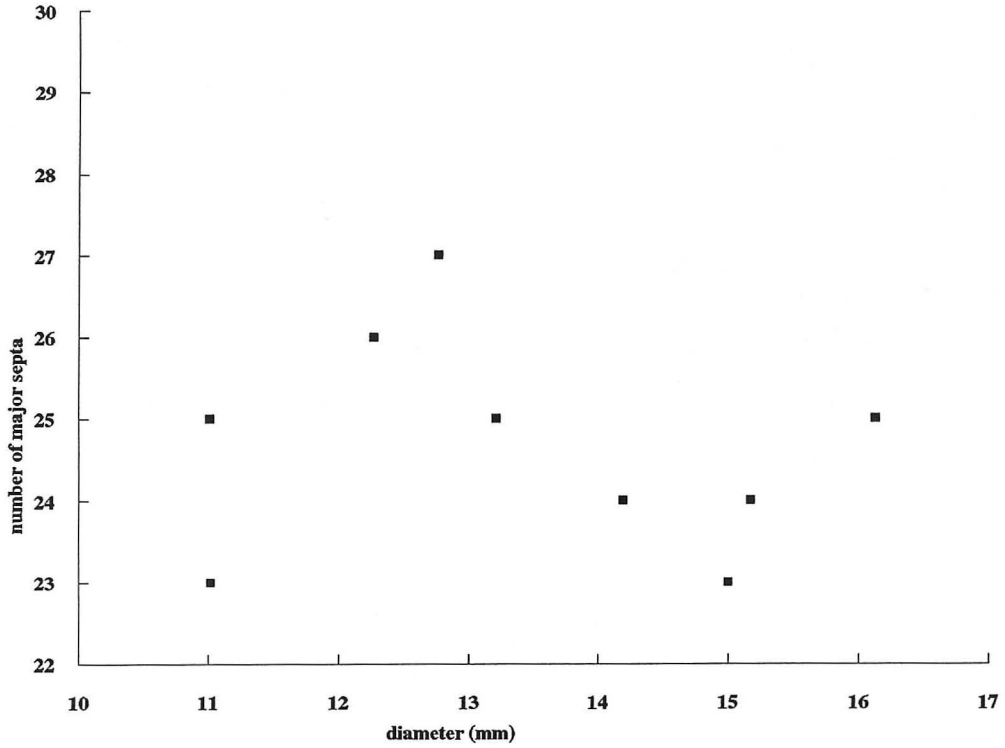
Fig. 2 *Macgeea symmetrica* Sung. Mf001002, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea symmetrica* Sung. Mf009003, 3a. transverse section; 3b. longitudinal section.

Plate 31



Macgeea



Text-fig. 15 Scatter diagram of number of major septa versus diameter in *Peneckiella yunnanensis* sp. nov.

peneckielloid dissepiments, therefore it should belong to Phacellophyllidae Wedekind. The new genus *Parapeneckiella* differs from *Peneckiella* and *Neoacinophyllum* in solitary growth form and in having amplexoid septa at least in late growth stage.

Geological distribution: Late Middle and early Late Devonian.

Geographical distribution: Western Yunnan, China.

Parapeneckiella shidianensis gen. et sp. nov.

(Plate 4, fig. 3)

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Nh	Tw

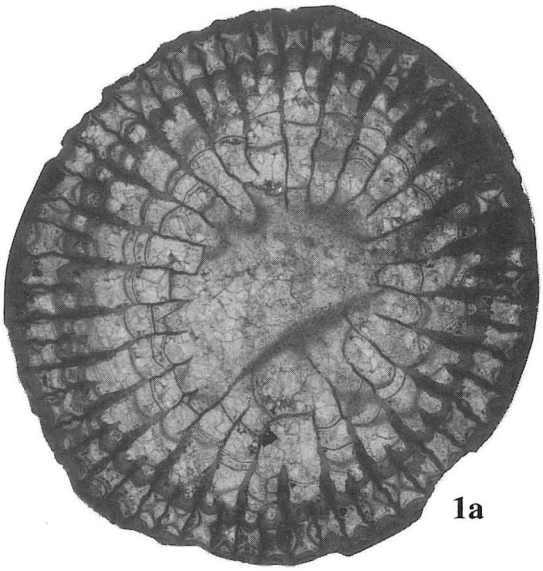
Explanation of Plate 32

(All figures are ×5)

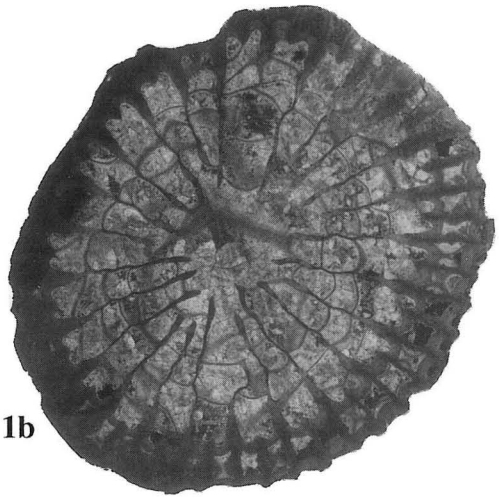
Fig. 1 *Macgeea symmetrica* Sung. Hf1020, 1a, transverse sectisection of late stage; 1b. transverse sections of early stage; 1c. longitudinal section.

Fig. 2 *Macgeea symmetrica* Sung. Mf001006, 2a, 2b. both transverse sections at two different diameters; 2c. longitudinal section.

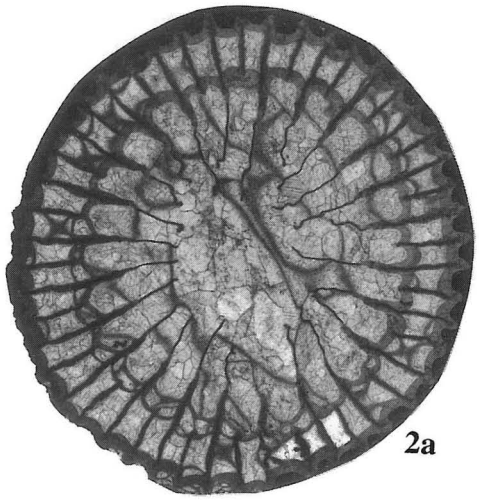
Plate 32



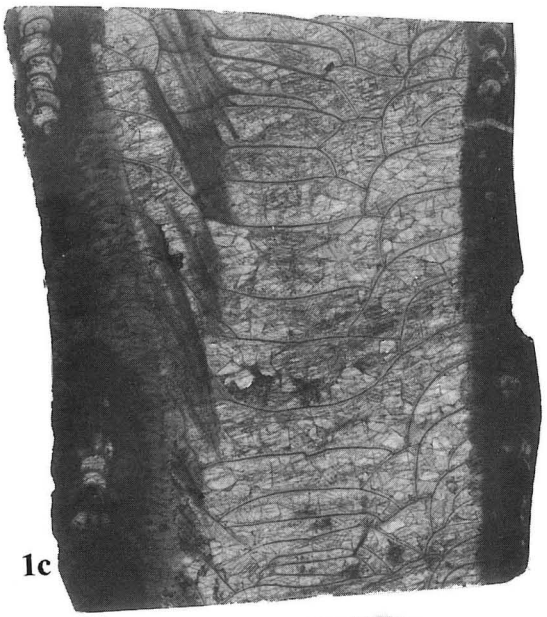
1a



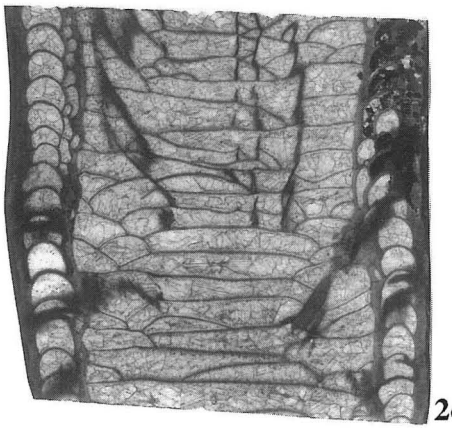
1b



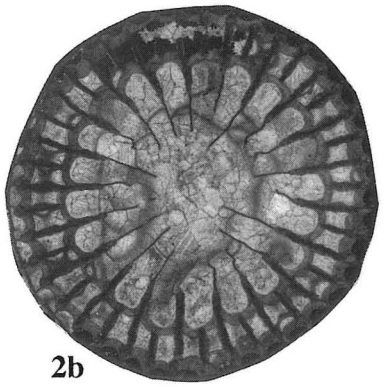
2a



1c



2c



2b

Macgeea

Hf1042(Holotype)	11.6	26×2	8.1	4.0	1.9	10	4	0.3

Diagnosis: Solitary, turbinate coral. Septa in two orders, radially arranged. Major septa retreated from the axis, dilated in fusiform with the maximum thickness at the boundary between dissepimentarium and tabularium, amplexoid at least in late stage. Minor septa not enter the tabularium. Dissepimentarium narrow, composed of outer peneckielloid dissepiments and inner normal dissepiments. Tabulae incomplete, axial tabulae markedly convex.

Description: Only one specimen of this species has been sectioned. Solitary, turbinate coral with a diameter of 11.6 mm. Septa of two orders, radial in arrangement, 26×2 in number. Major septa retreated from the axis, about two thirds of the radius of the corallum, are disrupted by tabulae in late stage, dilated in fusiform, the maximum thickness attained just at the boundary between dissepimentarium and tabularium. The septal dilation may lead them in contact laterally to form an inner wall. Minor septa are restricted to the dissepimentarium, about a half of the majors, thinner than the major septa. All septa are slightly zigzag in dissepimentarium. Carinae developed very weakly.

In longitudinal section dissepimentarium narrow, consists of outer peneckielloid dissepiments and inner globose dissepiments. In early stage there is only one row of peneckielleid dissepiments, but dissepiments increase in number later. One to two rows of peneckielloid dissepiments large, the inner dissepiments small, globose, vertically arranged, may be coated by stereome. Tabularium wide, with a diameter of 8.1 mm, more than two thirds of the diameter of the corallum. Tabulae incomplete, axial tabulae markedly convex, about 10 can be counted over the vertical distance of 5 mm. Periaxial tabulae variable in size, inclined inwardly.

Discussion: This species agrees well with *Peneckiella yunnanensis* sp. nov. in transverse section, but differs from the latter in having amplexoid septa and solitary growth form.

Locality: Heyuanzhai.

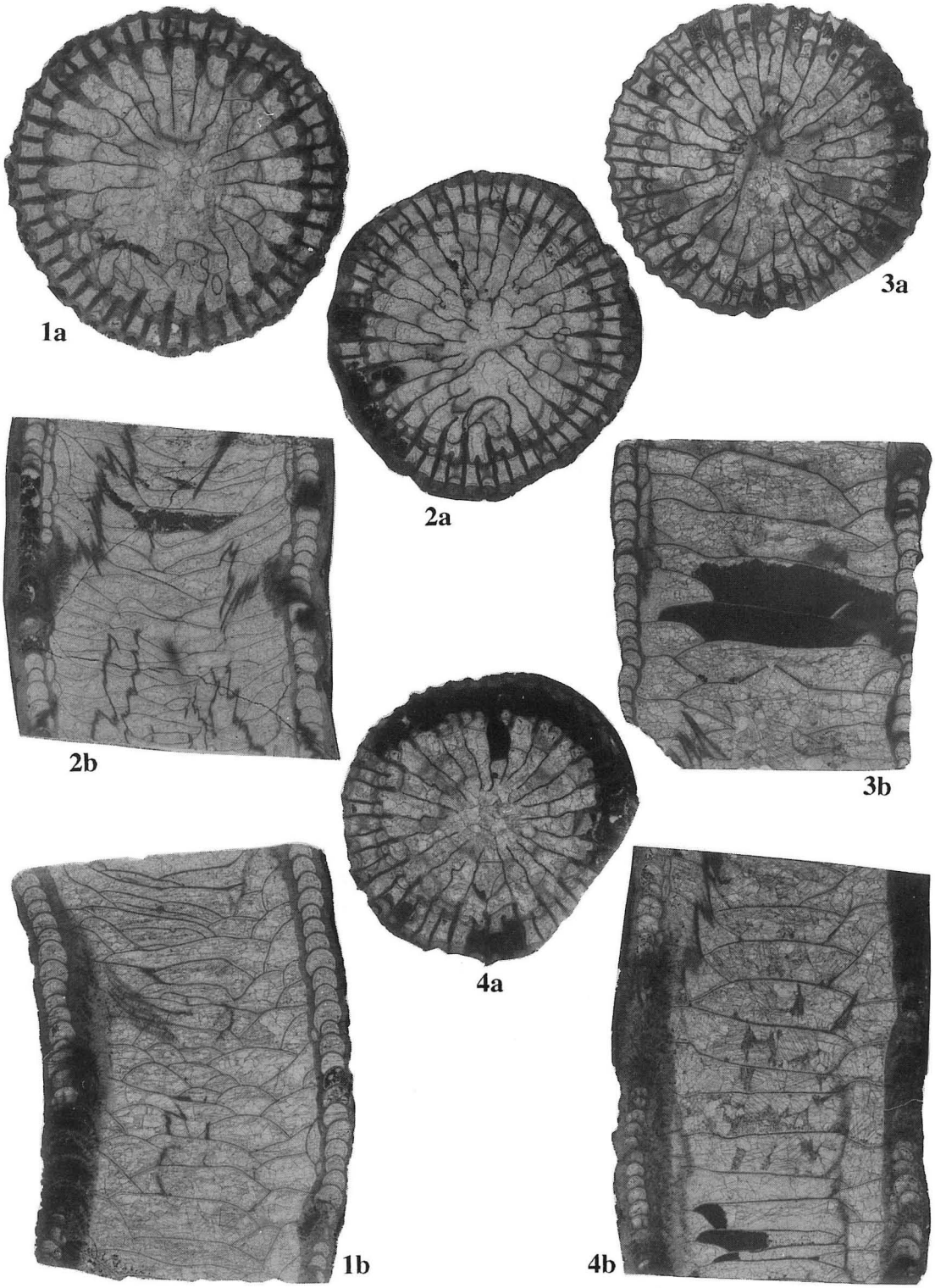
Suborder Cyathophyllina Nicholson, 1889
Family Eridophyllidae de Fromentel, 1861
Subfamily Cylindrophyllinae Oliver, 1874

Genus *Acinophyllum* McLaren, 1959

1959 *Acinophyllum* McLaren, p. 22

Explanation of Plate 33
(All figures are ×5)
Fig. 1 *Macgeea symmetrica* Sung. Hf1001, 1a. transverse section; 1b. longitudinal section.
Fig. 2 *Macgeea symmetrica* Sung. Mf009004, 2a. transverse section; 2b. longitudinal section.
Fig. 3 *Macgeea symmetrica* Sung. Hf1013, 3a. transverse section; 3b. longitudinal section.
Fig. 4 *Macgeea symmetrica* Sung. Hf1099, 4a. transverse section; 4b. longitudinal section.

Plate 33



Macgeea

Type species: *Eridophyllum simcoense* Billings, 1859, p. 132.

Diagnosis: Dendroid or phaceloid coral, usually consisting of slender corallites. Increase lateral and nonparricidal. Septa in two orders, radially arranged, and dilated, with weak to strong, commonly zigzag carinae in the peripheral zone. Major septa short, never extending to the axis. The trabeculae forming septa arranged in half fans. Dissepimentarium narrow, usually consisting of one row of normal globose dissepiments. Tabularium wide. Tabulae commonly complete but sometimes incomplete.

Discussion: *Acinophyllum* was established by McLaren (1959) to include some species previously assigned to *Synaptophyllum*. Before that time two different definitions of *Synaptophyllum* had been used. Simpson (1900, p. 213) grouped three species described by Billings (1859), *Eridophyllum simcoense*, *Diphyphyllum arundinaceum*and *D. stramineum*, into the genus *Synaptophyllum*, and regarded *D. arundinaceum* as the type species. But he did not give the figure of the type species, and only figured the other three species assigned by him to *Synaptophyllum*. All these three species figured by Simpson (1900, p. 214) bear dissepiments and are not congeneric with *Diphyphyllum arundinaceum*. For a long time paleontologists follow Simpson in using *Synaptophyllum*. Lang and Smith (1935, p. 561) put corals with horseshoe dissepiments under *Synaptophyllum arundinaceum* (Billings). Since 1935 the definition of *Synaptophyllum* was effected by Lang and Smith's paper. Most authors including Stumm (1948, p. 43; 1949, p. 37), Ehlers and Stumm (1949, p. 28), Rozkowska (1953, p. 16) and Schouppé (1949, p. 124; 1958, p. 230) agree with Lang and Smith in the presence of horseshoe dissepiments in *Synaptophyllum*. Hill (1965, p. 280) followed Simpson but used Lang and Smith's illustration. McLaren (1959) restudied the original material of *Diphyphyllum arundinaceum* Billings. The sections prepared from the original material show that this species has no dissepiments and bears strongly convex tabulae. McLaren placed the genus in the family Stauriidae Hill 1956, rather than Disphyllidae Hill, 1939, and divided the species previously referred to *Synaptophyllum* into three parts: *Synaptophyllum* without dissepiments, represented by *Diphyphyllum arundinaceum* Billings; *Phacellophyllum* based on Lang and Smith's material; and a new genus *Acinophyllum* with narrow dissepimentarium previously included within *Synaptopphyllum*.

McLaren (1959, p. 23) stated that *Acinophyllum* may be a junior synonym of *Peneckiella*. Scrutton (1968, p. 272) held the same opinion on the relationship of *Acinophyllum* to *Peneckiella*. Now there is a tendency to restrict *Peneckiella* to

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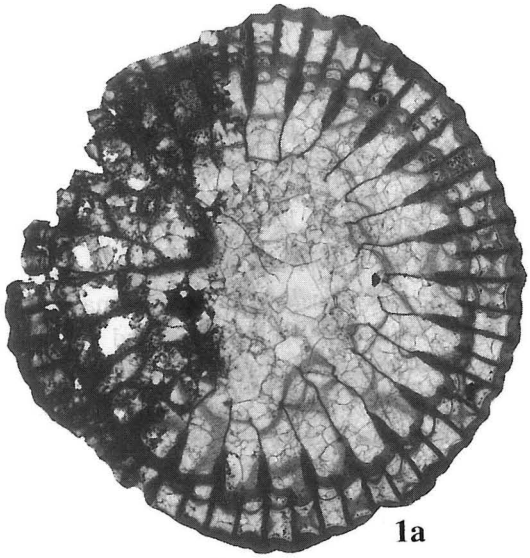
Explanation of Plate 34

(All figures are ×5)

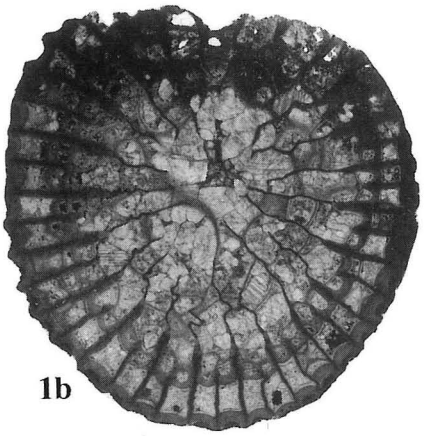
Fig. 1 *Macgeea symmetrica* Sung. Hf1023, 1a, 1b. both transverse sections at two different diameters, 1c. longitudinal section.

Fig. 2 *Macgeea symmetrica* Sung. Mf008045, 2a. transverse section; 2b. transverse section through the calyx; 2c. longitudinal section.

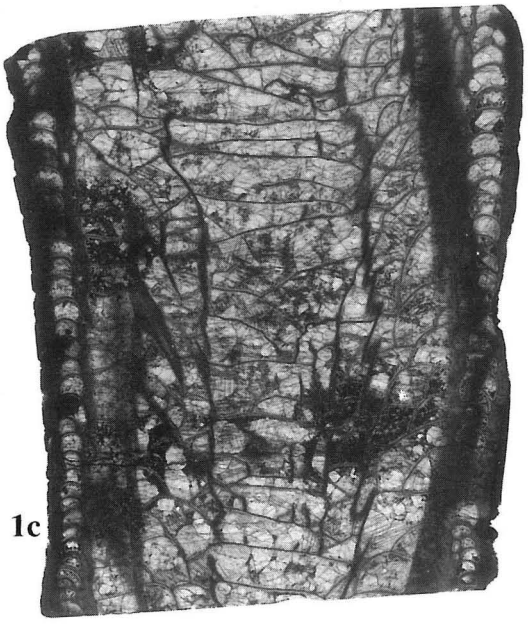
Plate 34



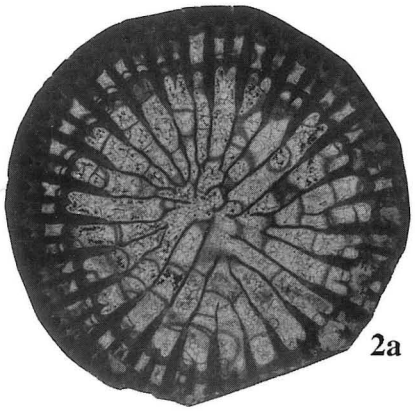
1a



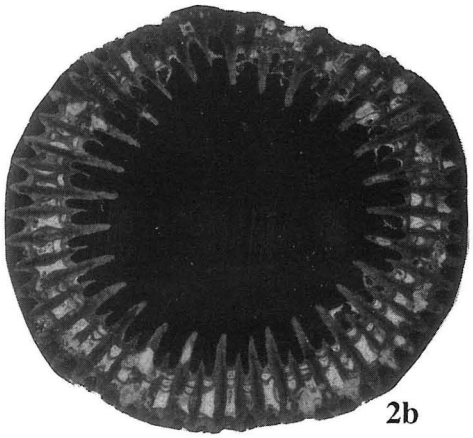
1b



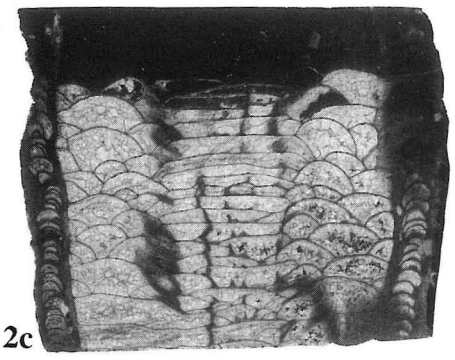
1c



2a



2b



2c

Macgeea

species with peneckielloid, sigmoidal and horseshoe dissepiments. Oliver (1974, p. 167; 1976a, p. 55) examined hundreds of longitudinal sections of species belonging to *Acinophyllum* and believed that there are no peneckielloid, sigmoidal, or horseshoe dissepiments in the genus. Thus *Acinophyllum* can be distinguished from *Peneckiella*. The material from western Yunnan shows that it is not easy to divide dissepiments into peneckielloid and nonpeneckielloid sometimes, especially in the species referred to the new genus *Neoacinophyllum*. However, it is true that there are no true peneckielloid, sigmoidal or horseshoe dissepiments in *Acinophyllum* from western Yunnan.

Acinophyllum bears a close resemblance with *Cylindrophyllum* in growth manner and carinate septa. But the long sepe nearly extending to the axis and the wide dissepimentarium consisting of numerous rows of dissepiments in *Cylindrophyllum* can serve to distinguish it from *Acinophyllum*.

Disphyllum is another genus to be easily confused with *Acinophyllum*. *Acinophyllum* differs from *Disphyllum* in its carinate septa and narrow dissepimentarium usually with one row of dissepiments. *Disphyllum* has a wide dissepimentarium, and smooth septa without obvious carinae. The disphylloid corals with carinate septa are generally placed in *Cylindrophyllum*.

Planetophyllum Crickmay (1960, p. 4), with *P. planetum* as type species, is another fasciculate coral with narrow dissepimentarium of only one row of dissepiments, and is similar to *Acinophyllum*. Up to now, only one species, the type species, has been described under *Planetophyllum*. This species bears very short, non-carinate septa, and may be distinguished from *Acinophyllum*.

The new genus *Neoacinophyllum* is very close to *Acinophyllum*, but differs from it in the mode of carinate septa and the dissepimentarium. In *Neoacinophyllum* the septal carinae are typically yardarm type, and not zigzag as in *Acinophyllum*, and the dissepimentarium consists of one or more than one row of peneckielloid and nonpeneckielloid dissepiments.

Assigned forms:

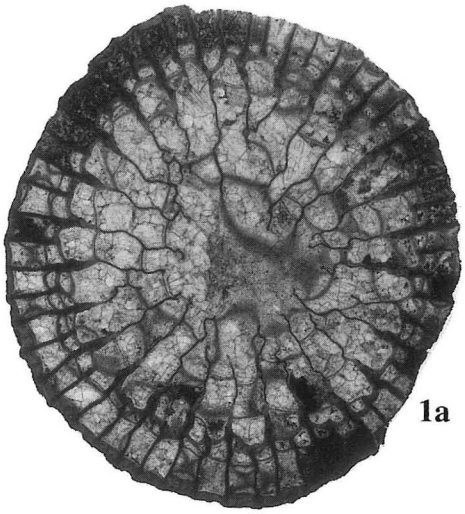
Acinophyllum baculoideum (Simpson) (=*Synaptophyllum baculoideum*), 1900, p. 213. seeMcLaren, 1959, p. 27.
Acinophyllum camselli (Smith) (=*Disphyllum* (*Synaptophyllum*) *camselli*), 1945, p. 23.
Acinophyllum davisi Stumm, 1964, p. 42.
Acinophyllum fasciculum (Meek) (=*Diphyphyllum fasciculum*), 1877, p. 29. see Stumm, 1948, p. 44.
Acinophyllum muclareni Fagerstrom, 1961, p. 14.
Acinophyllum occidens (Stumm) (=*Synaptophyllum occidens*), 1948, p. 44.
Acinophyllum rectiseptatum (Rominger) (=*Diphyphyllum rectiseptatum*), 1876, p. 124. see McLaren,

Explanation of Plate 35

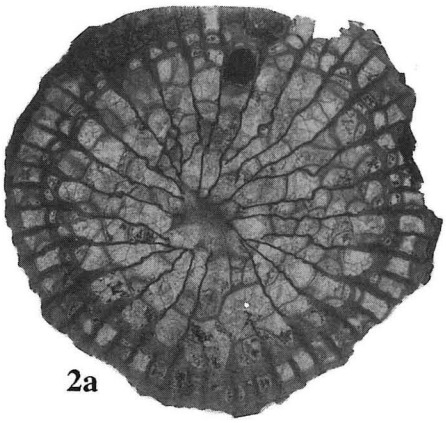
(All figures are ×5)

Fig. 1 *Macgeea symmetrica* Sung. Hf1003, 1a. transverse section; 1b. longitudinal section.
Fig. 2 *Macgeea symmetrica* Sung. Hf1031, 2a. transverse section; 2b. longitudinal section.
Fig. 3 *Macgeea symmetrica* Sung. Mf009020, 3a. transverse section; 3b. longitudinal section.

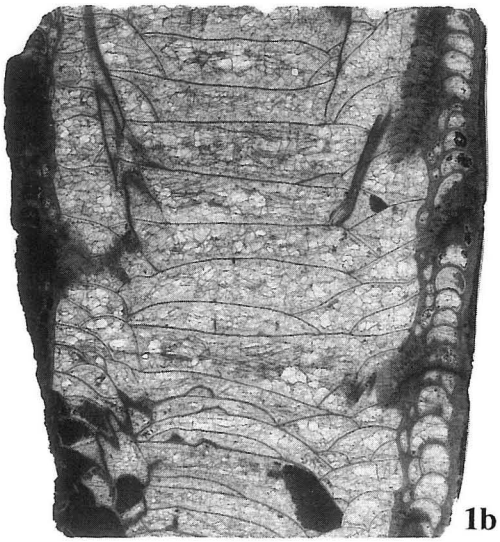
Plate 35



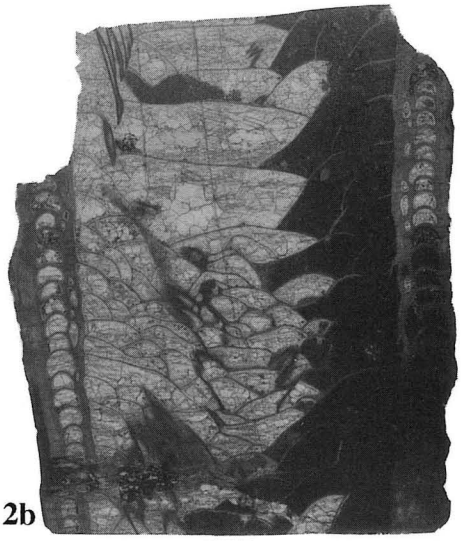
1a



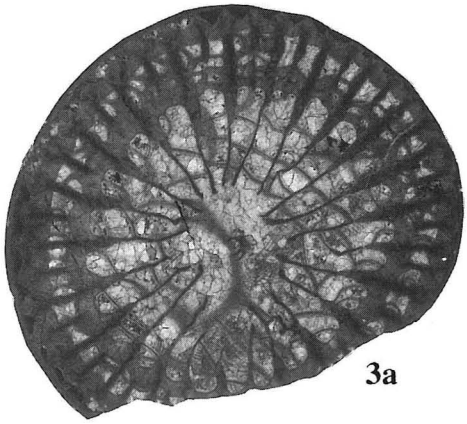
2a



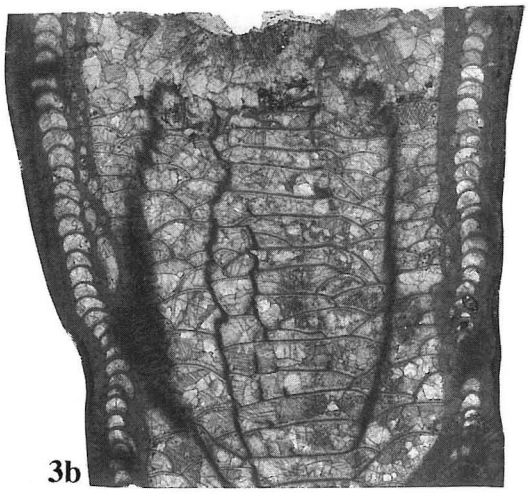
1b



2b



3a



3b

Macgeea

1959, p. 28.
Acinophyllum simcoense (Billings) (=*Eridophyllum simcoense*), 1859, p. 132. see McLaren, 1959, p. 24.
Acinophyllum stokesi (Edwards et Haime) (=*Lithostrotion stkesi*), 1851, p. 440. see Easton and Oliver, 1973, p. 916.
Acinophyllum stramineum (Billings) (=*Diphyphyllum stramineum*), 1859, p. 135. see McLaren, 1959, p. 25.
Acinophyllum tianchiense Cao in Cao et al. 1983, p. 95.
Acinophyllum yakovlevi (Bulvanker) (=*Hexagonaria yakovlevi*), 1958, p. 183. see Spasskiy, 1977, p. 63.

Rejected forms:
Acinophyllum Garinatum (Ivaniya) (=*Peneckiella carinata*), 1965, 6. 193. see Spasskiy, 1977, p. 63.
Acinophyllum crassiseptatum (Ehlers et Stumm) (=*Synaptophyllum crassiseptatum*), 1949, p. 28. see McLaren, 1959, p. 27.
Acinophyllum segregatum (Simpson) (=*Synaptophyllum segregatum*), 1900, 6. 213. see Oliver, 1974, p. 166.

Not examined forms:
Acinophyllum chermassanense Spasskiy, 1977, p. 63. (no figure)
Acinophyllum vermetum (Weisbord) (=*Diphyphyllum vermetum*), 1926, p. 5. see Scrutton, 1973, p. 230.

Geological distribution : Middle Devonian.
Geographical distribution : Eastern North America, Kuznetsk Basin and China.

Acinophyllum rectiseptatum (Rominger), 1876

(PLate 58, text-figure 16)

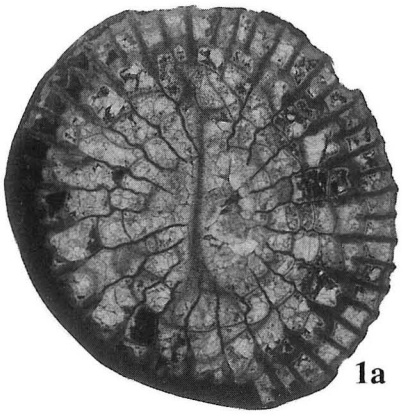
1876 *Diphyphyllum rectiseptatum* Rominger, p. 124.
1958 *Acinophyllum rectiseptatum* (Rominger). McLaren, p. 28.
1976a *? Disphyllum rectiseptatum* (Rominger). Oliver, p. 112, pl. 30.

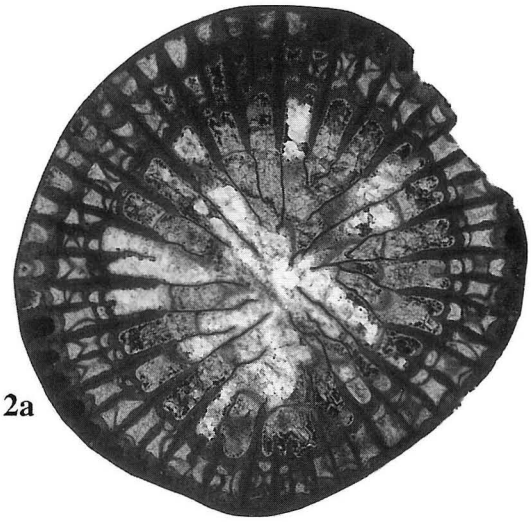
Measurement:

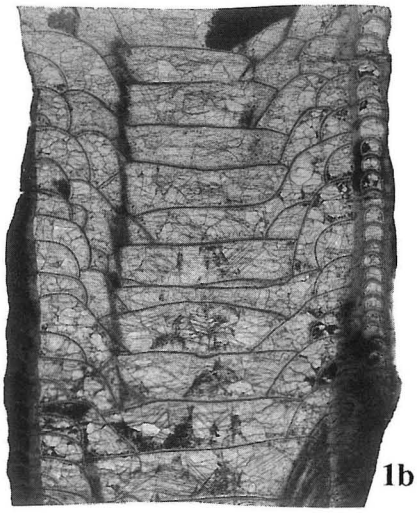
No	D	N	Dt	Nt	Lf	Ls	Tw
Mf00x042	9.1	20×2	5.9	6	1.8	1.5	0.3
Mf00x027	7.4	17×2	4.7	9	1.6	1.4	0.2
Mf010018	7.7	19×2	5.6	7	1.8	1.3	0.2
	4.5	18×2	3.5		1.2	0.5	0.2
Mf010025	7.6	20×2	5.4	6	1.8	1.2	0.2
Mf004011	9.1	20×2	6.0	7	2.6	2.0	0.2
Mf00×006	7.3	18×2	4.9	7	1.9	1.4	0.2
	7.5	18×2	4.8	7	1.8	1.2	0.2

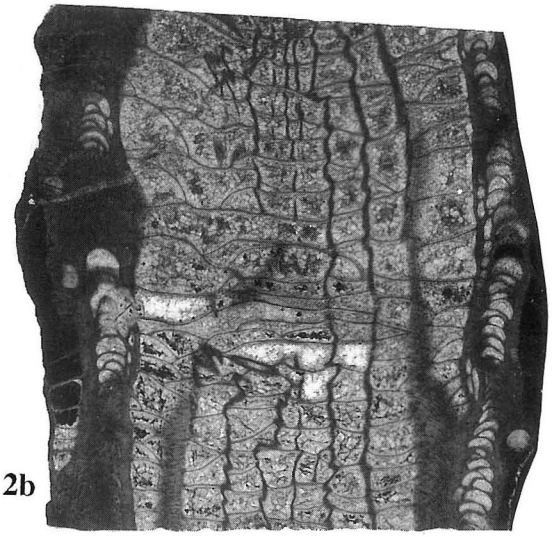
Explanation of Plate 36
(All figures are ×5)
Fig. 1 *Macgeea symmetrica* Sung. Hf1007, 1a. transverse section; 1b. longitudinal section.
Fig. 2 *Macgeea symmetrica* Sung. Mf010012, 2a. transverse section; 2b. longitudinal section.
Fig. 3 *Macgeea symmetrica* Sung. Hf1020, 3a. transverse section; 3b, longitudinal section.

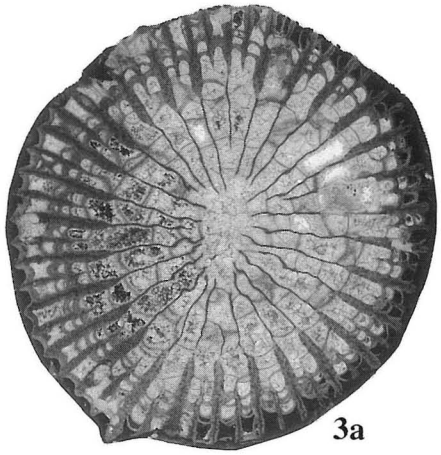
Plate 36

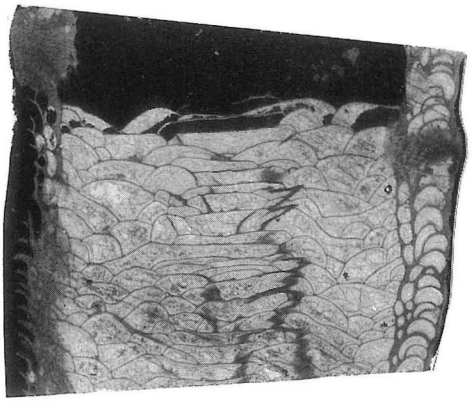

1a


2a


1b


2b


3a


3b

Macgeea

Hf1014	5.8	16×2	3.9	7	1.2	0.9	0.2

Diagnosis: Fasciculate coral made up of slender corallites. Increase lateral. Septa of two orders, radial in arrangement, with rare weakly developed zigzag carinae, occasionally rare yardarm carinae may be present. Major septa well developed. Dissepimentarium consists of one row of dissepiments. One or two rows of additional rows of small dissepiments may be present. Tabularium wide, usually ccomposed of complete tabulae.

Description: Fasciculate coral made up of slender corallites with diameter ranging from 5.8 to 9.1 mm. Calices are relatively deep, bell-shaped, with steeply sloping calical wall asd narrow calical platform and flat bottom (pl. 58, fig, 1b). The specimens are preserved in fragmental corallites, so the distances between adjacent two corallites and the size of corallum remain unknown. Increase lateral. Septa in two orders, radially arranged, from 16×2 to 22×2 in number. The peripheral ends of septa penetrate into about 2 mm thick exterior wall. Major septa short, from 1.2 to 2.6 mm in length, about half of the radius of corallites. Minor septa well developed, as long as, or longer than two thirds of the majors. All the septa thick. Zigzag carinae are present but very weak and rare. Few poorly developed yardarm carinae occasionally occur (pl. 58, fig. 3a). Septa dilated at the boundary between dissepimentarium and tabularium with variable degree. The median septal dilatation may lead them in contact laterally to form inner wall. Of the specimens the inner wall made up of septal dilatation is not stable, complete (pl. 58, fig. 4a), incomplete (pl. 58, fig. 6a), or tend to disappear (pl. 58, 1a).

In longitudinal section the trabeculae forming septa arranged in half fans, their thickness being about 0.2 mm. Dissepimentarium narrow, usually consists of one to three rows of dissepiments. The outermost row of dissepiments larger, globose, inner additional dissepiments small, globose or slightly elongated, vertically arranged. Tabularium wide, with diameter ranging from 3.9 to 6.0 mm, composed of complete or incomplete tabulae varying from horizontal to slightly convex or concave. Six to 10 tabulae can be counted over the vertical distance of 5 mm. There is nearly no peripheral tabulae.

Discussion: According to Oliver's revision (1976a, p. 112), this species was originally described but not illustrated by Rominger (1876). The first illustrations were given by Stumm (1955) as *Synaptophyllum rectiseptatum*. Stumm's illustrations are not available to me. But the specimens described here exactly agree with that forms from the Givetian of Dundee Limestone illustrated and described by Oliver (1976a, p. 112, pl. 30). Oliver (1976a) placed this species into *Disphyllum* due to

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Explanation of Plate 37

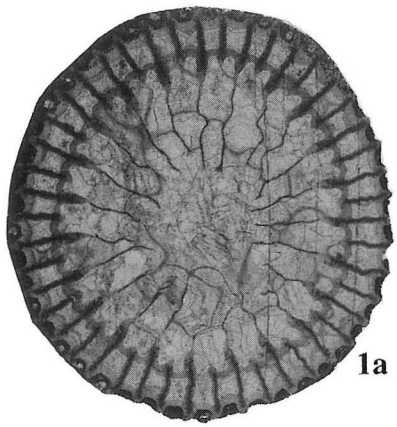
(All figures are ×5)

Fig. 1 *Macgeea berdensis* Soshkina. Hf1010, 1a. transverse section of late stage; 1b. transverse section of early stage; 1c. longitudinal section.

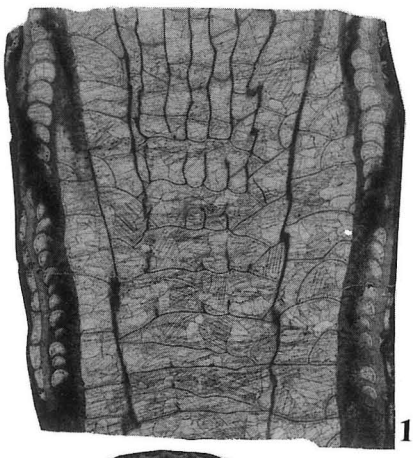
Fig. 2 *Macgeea berdensis* Soshkina. Mf1021, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea berdensis* Soshkina. Mf1026, 3a. transverse section; 3b. longitudinal section.

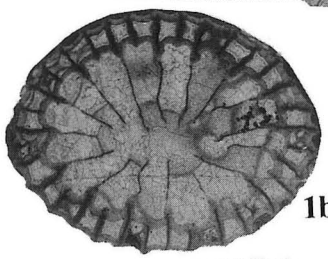
Plate 37



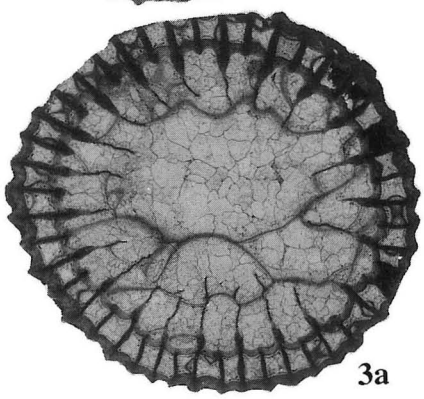
1a



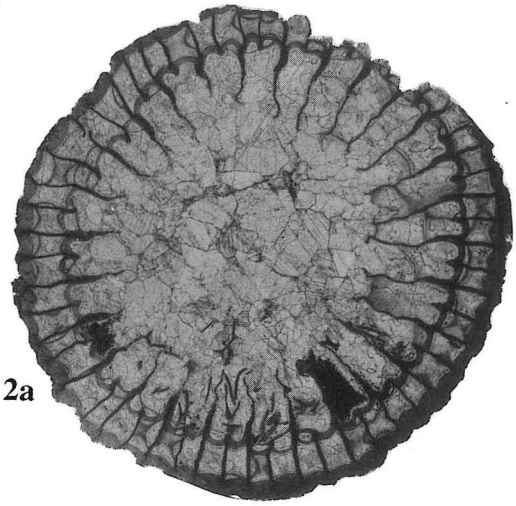
1c



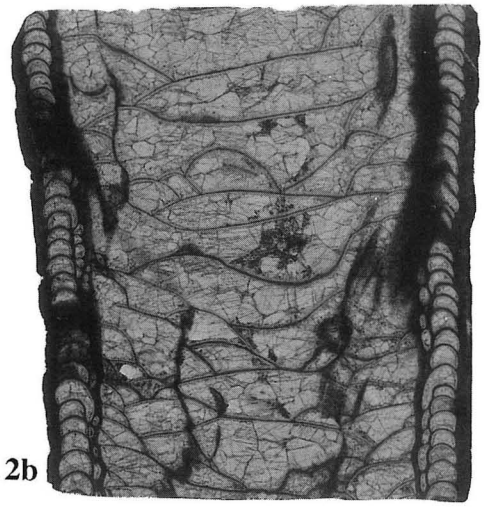
1b



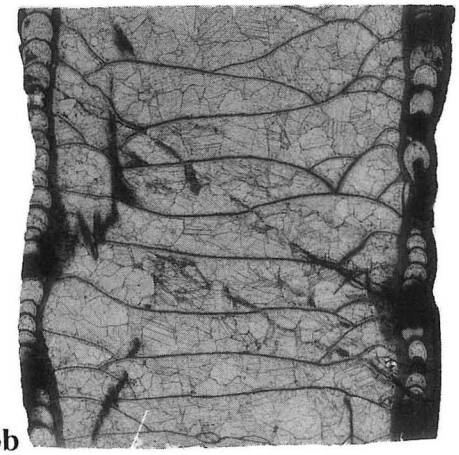
3a



2a

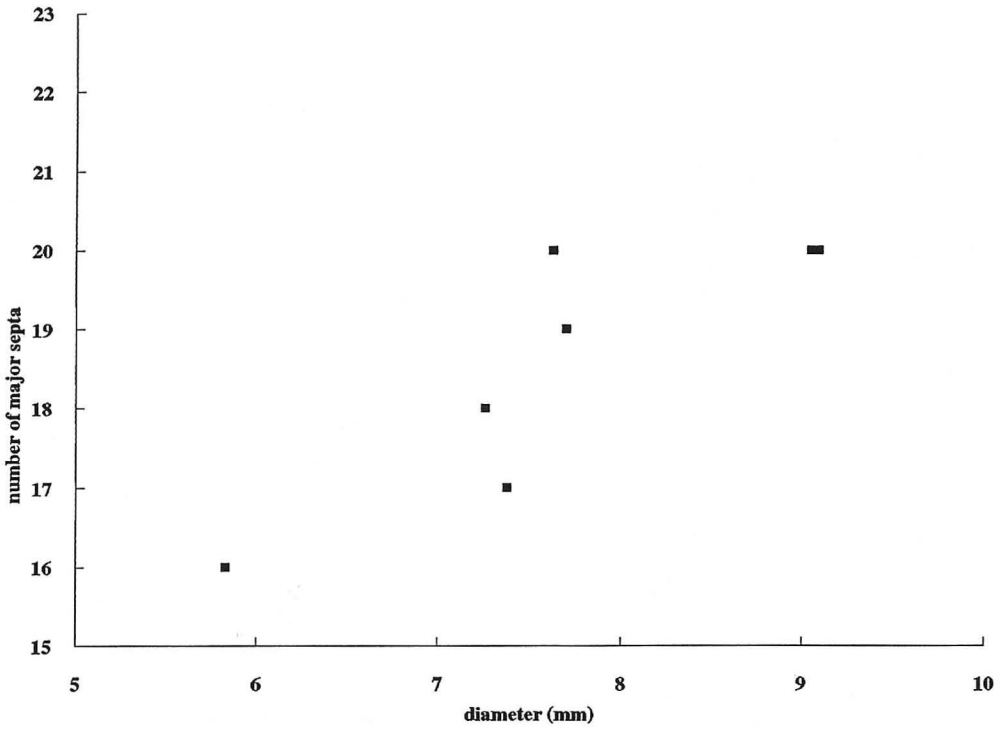


2b



3b

Macgeea



Text-fig. 16 Scatter diagram of major septa versus diameter in *Acinophyllum rectiseptatum*

the too weak carinae and thickened septa as well as the probable presence of disphylloid microstructure. This species is characterized by short major septa, narrow dissepimentarium usually composed of outermost row of large globose dissepiments and less than two rows of small additional dissepiments, well developed minor septa and poorly developed carinae. Those features shown in this species are the basic characters of *Acinophyllum* and the main difference between *Acinophyllum* and *Disphyllum*. So this species is assigned to *Acinophyllum* here.

Locality Malutang and Heyuanzhai.

Genus *Neoacinophyllum* gen. nov.

Type species: *Cylindrophyllum malutangense* Sung, 1982, p. 25.

Diagnosis: Dendroid or phaceloid corallum consisting of slender corallites.

Explanation of Plate 38

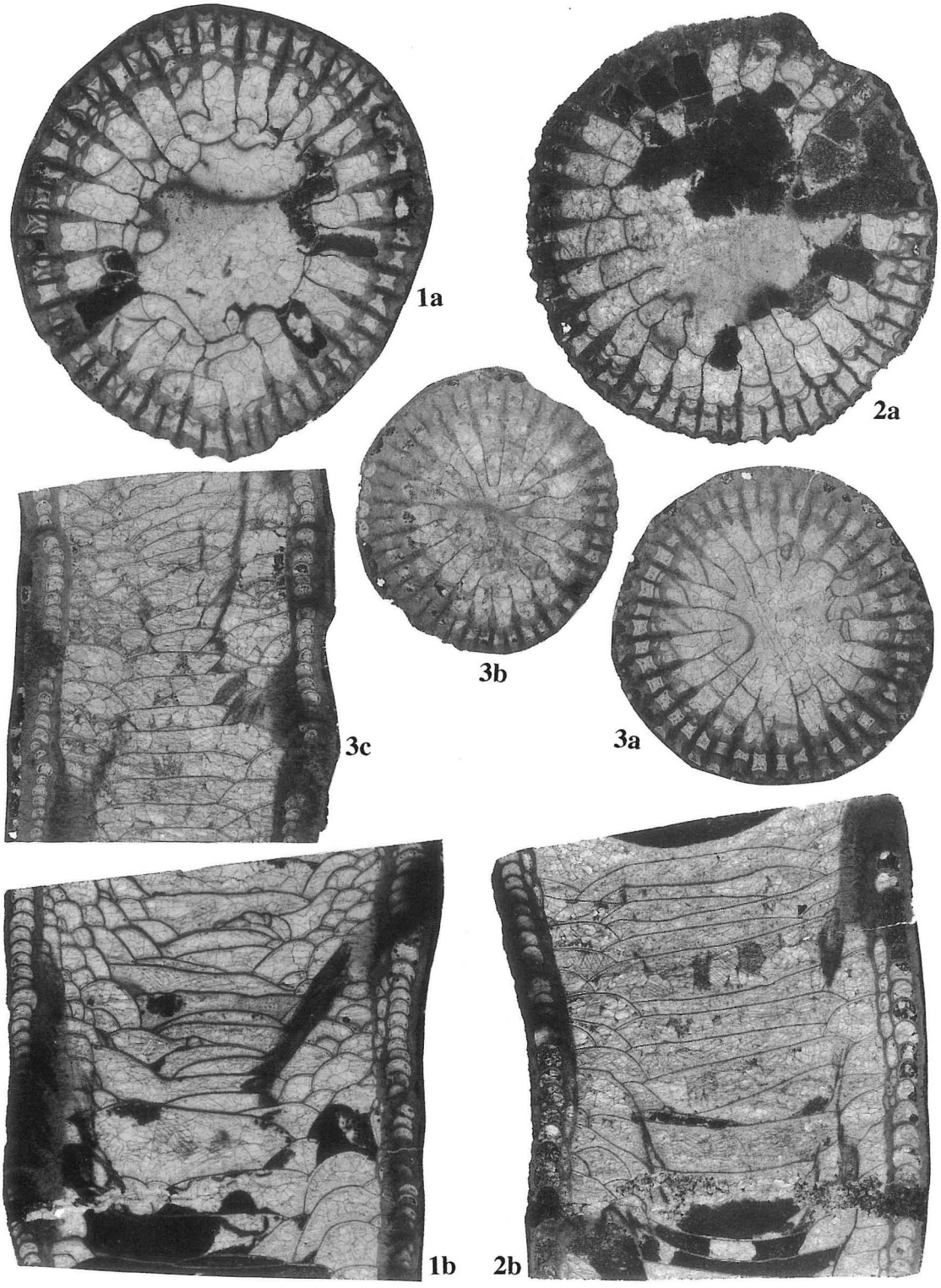
(All figures are ×5)

Fig. 1 *Macgeea berdensis* Soshkina. Mf1005, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Macgeea berdensis* Soshkina. Mf1032, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea berdensis* Soshkina. Mf1029, 3a. transverse section of late stage; 3b. transverse section of early stage; 3c. longitudinal section.

Plate 38



Macgeea

Increase lateral. Septa in two orders, radially arranged and dilated, with well developed typical yardarm carinae. Major septa variable in length, short or nearly extending to the axis. Septal trabeculae arranged in half fans. Dissepimentarium narrow or wide, usually consisting of a few rows of normal globose dissepiments. Non-typical peneckielloid dissepiments usually present in the periphery. Tabularium consisting of complete or incomplete tabulae.

Discussion: This newgenus is proposed here to include forms referred to *Heliophyllum* with dendroid or phaeloid growth manner and forms referred to *Cylindrophyllum* with strongly developed yardarm carinae.

Fasciculate rugose corals with typical yardarm carinae and relatively narrow dissepimentarium have been known from the Middle Devonian of western Yunnan for a few years. Song Xueliang (1982), the first to have described this kind of corals from western Yunnan, referred them to the genus *Cylindrophyllum*. Similar forms are also well known from the late Middle Devonian and early Upper Devonian of western Canada, and were previously assigned to *Heliophyllum*, *Cyathophyllum* or *Cylindrophyllum* according to their shape and the presence or absence of carinae. From a study of the abundant material from western Yunnan it is deemed necessary to establish a new genus.

Hall named the genus *Heliophyllum* in 1846, but without type species. Before that time Hall had described solitary corals with yardarm carinae from the Devonian of New York State as *Strombodes helianthoides ?* Phillips. This kind of corals corresponds well with *Heliophyllum* found by Hall. Thus Edwards and Haime considered *Strombodes helianthoides*? Phillips as the type species and renamed it as *Heliophyllum halli* (Edwards and Haime, 1851, p. 408, pl. 7, fig. 6, 6a, 6b). Oliver (1974, p. 174; 1976a, p. 123) pointed out that *Heliophyllum* needs revision as it is poorly understood. He put phaceloid, cerioid, and asteroid species characterized by long yardarm carinae and, in some cases, by septal dilation in *Heliophyllum*. It is clear that scope of *Heliophyllum* as defined by Oliver is very wide. In fact up to now few palaeontologists use *Heliophyllum* for compound rugose corals. The new genus is identical with *Heliophyllum* in the type carinae, but differs from the latter in having dendroid or phaceloid shape.

Cylindrophyllum was founded by Simpson (1900, p. 217), with *C. elongatum* Simpson (1900, p. 217, text-fig. 42) as the type species. In erecting this genus Simpson considered that the internal structure of this genus is essentially the same as in *Heliophyllum*, and the septa are carinated as in *Heliophyllum*. However, in the only one text-figure (p. 217, textfig. 42), showing the structure of *Cylindrophyl-*

Explanation of Plate 39

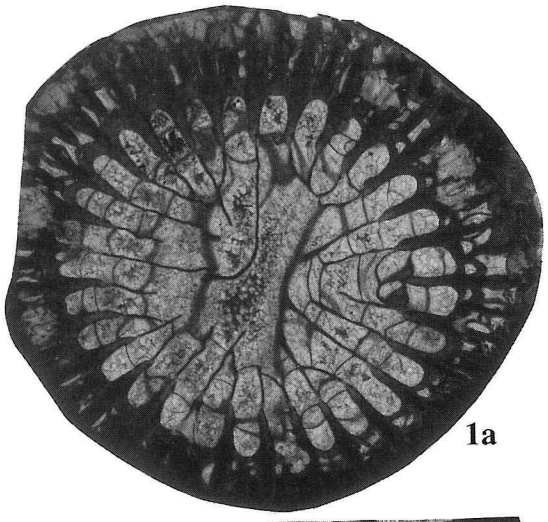
(All figures are ×5)

Fig. 1 *Macgeea berdensis* Soshkina. Mf010005, 1a. transverse section of late stage; 1b. transverse section of early stage; 1c. longitudinal section.

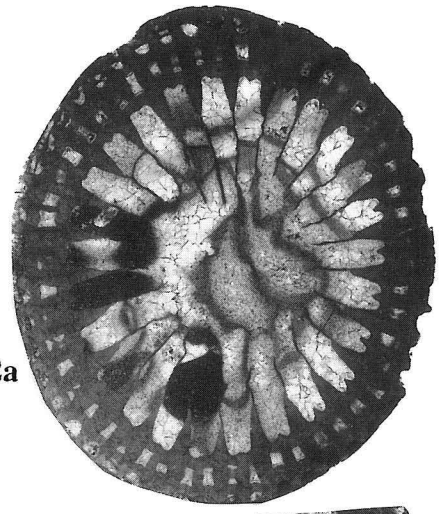
Fig. 2 *Macgeea berdensis* Soshkina. Hf1027, 2a, 2b. both transverse sections at two different diameters; 2c. longitudinal section.

Fig. 3 *Macgeea berdensis* Soshkina. Mf007023, 3. transverse section.

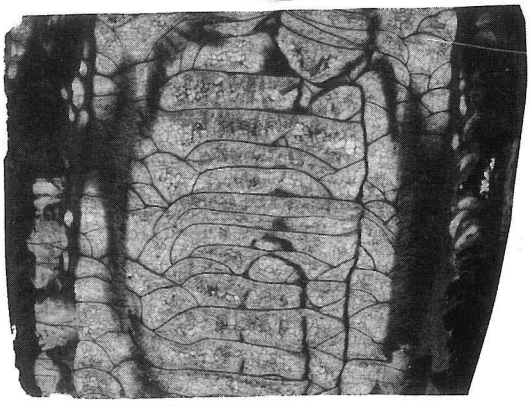
Plate 39



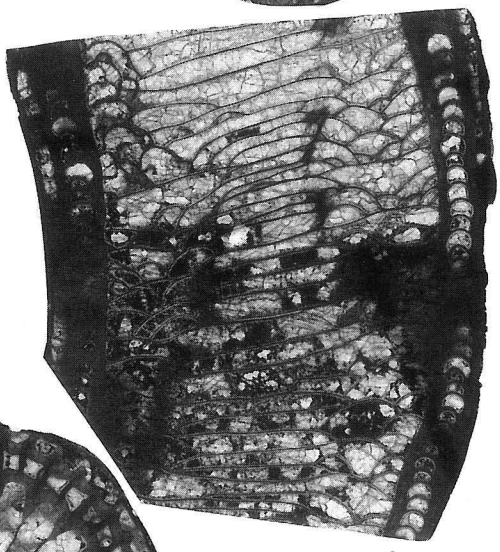
1a



2a

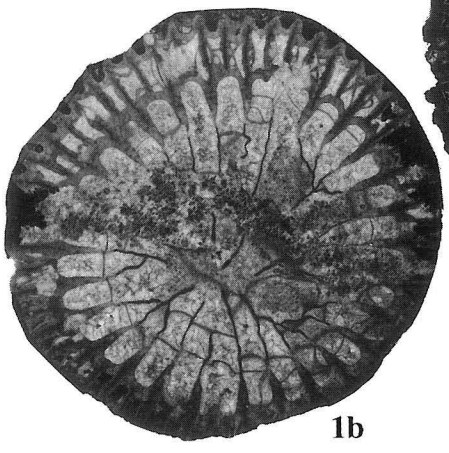


1c

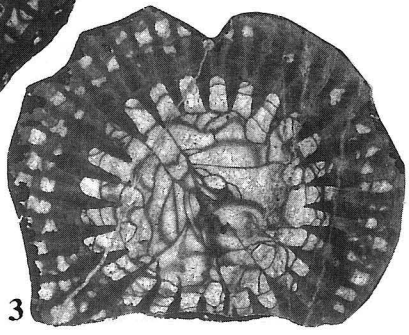


2c

2b



1b



3

Macgeea

lum, which is the drawing of the longitudinal section of *C. elongatum*, there is any trace of carinae. Oliver (1976a) studied *Cylindrophyllum* has commonly zigzag or subyardarm carinae, which refer to carinae that rise abruptly from the septal surface usually with only slight offset (Oliver, 1976a, p. 32), but not true yardarm carinae, and has a relatively wide dissepimentarium usually consisting of from 3 to 8 rows of normal globose dissepiments (Oliver, 1976a, p. 68). This opinion was accepted by Hill (1981, p. 292). *Neoacinophyllum* is very close to *Cylindrophyllum* in the corrallum growth manner and general appearance, as well as the pattern of increase. But it can be distinguished from the latter by the well developed typical yardarm carinae and the relatively narrow dissepimentarium commonly containing less than 3 rows of normal globose dissepiments.

Acinophyllum, with *Eridophyllum simcoense* Billings (1859, p. 132, text-fig. 27) as type species, was erected by McLaren (1959, p. 22) to include species previously assigned to *Synaptophyllum* Simpson (1900, p. 212). This genus has a dendroid or phaceloid shape, lateral increase, short septa and narrow dissepimentarium, and is very similar to *Neoacinophyllum*. But *Acinophyllum* has only zigzag carinae and no yardarm carinae. In all the species assigned to *Acinophyllum*, no true yardarm carinae have been described.

Another dendroid or phaceloid rugose coral genus with weekly or strongly developed carinae is *Cyathocylindrium* established by Oliver (1974, p. 172) based on *Cyathocylindrium opulens* Oliver (1974, p. 172, figures 5 a-e). The bilateral arrangement of septa, zigzag caminae and short cardinal and counter septa in *Cyathocylindrium* can be used to distinguish from *Neoacinophyllum*.

The new genus is also similar to *Disphyllum* Fromental, 1861 in the growth manner as well as the pattern of increase, but differes from it mainly in its strongly developed yardarm carinae.

The presence of peneckielloid dissepiments in the new genus gives it some resemblance to *Peneckiella*, but it can be easily distinguished from the latter by the well developed yardarm carinae.

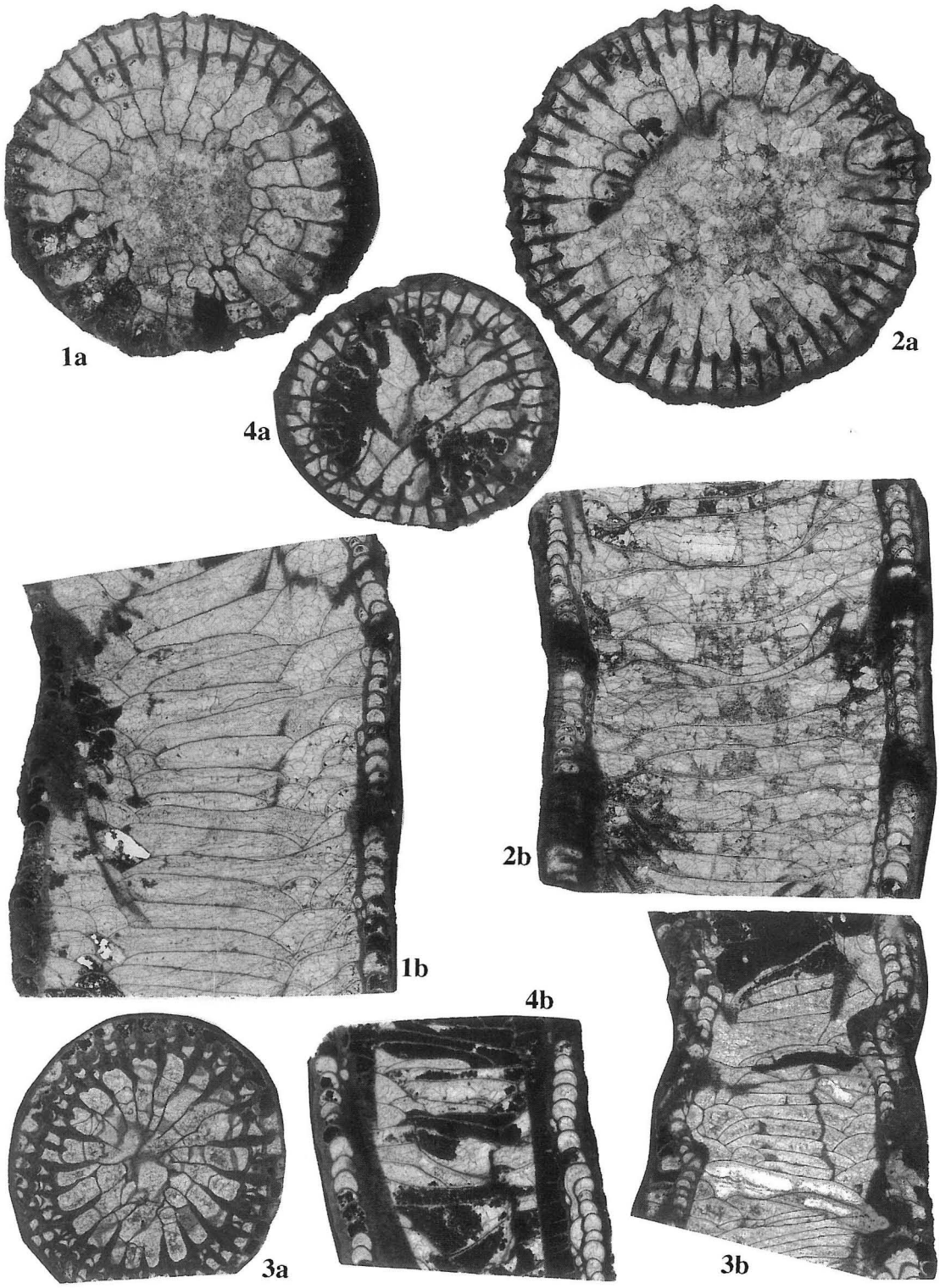
The species belonging to the new genus may be divided into two groups, one with long septa and wide dissepimentarium containing numerous rows of globese dissepiments mainly occurring in the Middle Devonian of North America, and another with narrow dissepimentarium composed of less than 3 rows of dissepiments and with variously withdrawn major septa from the axis, known only from western Yunnan. In view of the length of major septa, the width of dissepimentarium and the number of dissepiments, the species of the new genus from western Yunnan are more similar to *Acinophyllum* than to *Cylindrophyllum*. It may be

Explanation of Plate 40

(All figures are ×5)

Fig. 1 *Macgeea berdensis* Soshkina. Hf1004, 1a. transverse section; 1b. longitudinal section.
Fig. 2 *Macgeea berdensis* Soshkina. Mf1005, 2a. transverse section; 2b. longitudinal section.
Fig. 3 *Macgeea berdensis* Soshkina. Mf003016, 3a. transverse section; 3b. longitudinal section.
Fig. 4 *Macgeea berdensis* Soshkina. Mf009002, 4a. transverse section; 4b. longitudinal section.

Plate 40



Macgeea

pointed out that the relationship of the species assigned to *Neoacinophyllum* from western Yunnan to those from North Arerica is not certain.

Assigined forms:

Neoacinophyllum canopotabulatum gen. et sp. nov.
Neoacinophyllum compactum (Hall) (=*Heliophyllum compactum*), 1882, p. 48. see Stumm, 1964, p. 42.
Neoacinophyllum crassiseptatum (Ehlers et Stumm) (=*Synaptophyllum crassiseptatum*), 1949, p. 28
Neoacinophyllum delicatulum (Ehlers et Stumm) (=*Cylindrophyllum delicatulum*), 1949, p. 23
Neoacinophyllum grabaui (Ehlers et Stumm) (=*Cylindrophyllum grabaui*) 1949, p. 24.
Neoacinophyllum gruense (McLaren) (=*Cylindrophyllum gruense*), 1964, p. 9.
Neoacinophyllum hindshawi (Ehlers et White) (=*Cylindrophyllum hindshawi*), 1932, p. 97. see Ehlers and stumm, 1949, p. 25.
Neoacinophyllum magnum (Ehlers et Stumm) (=*Cylindrophyllum magnum*), 1949, p. 26.
Neoacinophyllum malutangense (Sung) (=*Cylindrophyllum malutangense*), 1982, p. 25.
Neoacinophyllum megaproliferum (Oliver) (=*Heliophyllum megaproliferum*), 1976a, p. 124.
Neoacinophyllum n. sp. C (Oliver) (=*Heliophyllum* n. sp. C), 1976a, p. 126.
Neoacinophyllum planotabulatum (Sung) (=*Cylindrophyllum planotabulatum*), 1982, p. 26.
Neoacinophyllum proliferum (Hall) (=*Heliophyllum proliferum*), 1877. see Oliver, 1971, p. 198.
Neoacinophyllum propinquum (Stewart) (=*Cylindrophyllum propinquum*), 1938, p. 45. see Fagerstrom, 1964, p. 14; Stumm, 1964, p. 42.

Geological distribution: Middle Devonian and early Late Devonian.
Geographical distribution: Eastern North America and western Yunnan of China.

Neoacinophyllum malutangense (Sung), 1982

(Plate 50-54; text-figure 17)

1982 *Cylindrophyllum malutangense* Sung, p. 25, pl. 1, fig. 8, pl. 2, fig. 2.

Measurenrent:

No	D	N	Dt	Nt	Nd	Lf	Ls	Tw	Dc
Mf010016	7.4	19×2	4.1	7	3	1.6	1.1	0.2	5.1
	7.6	19×2	4.5	8	3	1.7	1.4	0.2	10.5
	7.0	19×2	4.6			1.7	1.2		
Mf005024	7.3	19×2	4.7	9	3	1.9	1.3	0.2	1.8
	6.1	18×2	4.3			1.8	1.3		
Mf009006	8.2	20×2	5.2	7	3	2.1	1.6	0.2	
Mf007016	8.6	20×2	6.0	9	2	2.0	1.4	0.2	
Mf00502	9.2	21×2	7.0	2		1.7	1.0	0.2	
Mf007011	9.7	20×2	6.3	5	3	2.8	1.8	0.2	
Mf00x005	8.0	18×2	5.4	5	2	1.8	1.6	0.2	4.2
	5.9	17×2	4.2	6	2	1.7	1.2	0.2	

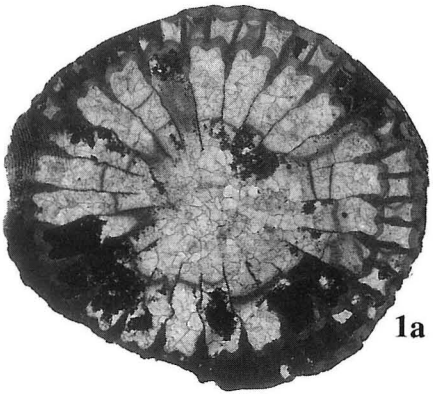
Explanation of Plate 41

(All figures are ×5)

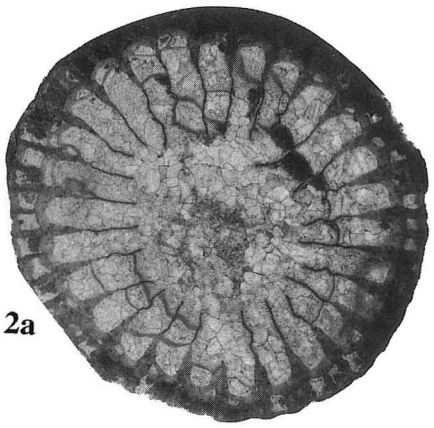
Fig. 1 *Macgeea berdensis* Soshkina. Hf1008, 1a, 1b. both transverse sections at two differest diameters; 1c. longitudinal section.

Fig. 2 *Macgeea berdensis* Soshkina. Hf1009, 2a, 2b, botth transverse section at two different diameters; 2c. longitudinal section.

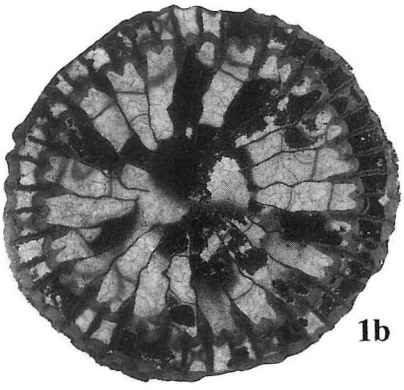
Plate 41



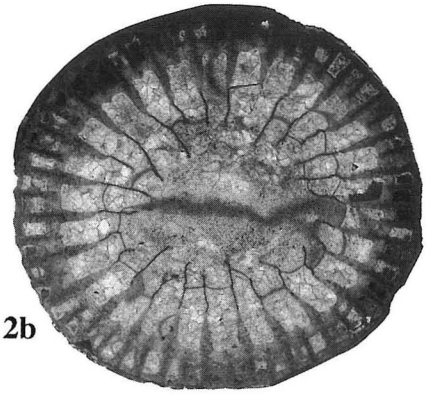
1a



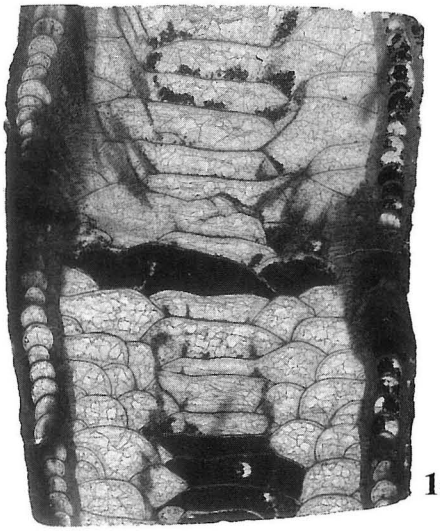
2a



1b



2b



1c

2c

Macgeea

Mf013013	9.0	19×2	5.6	8	3	2.3	1.6	0.2	
Mf004009	9.4	19×2	6.5	11	3	2.3	1.5	0.3	
Mf007017	6.9	20×2	4.4	12	3	1.4	1.0	0.2	
Mf003012	6.3	16×2	4.4		3	1.6	1.1	0.3	
Mf004007	7.3	21×2	6.3	10	2	2.2	1.7	0.3	
Mf009011	8.5	19×2	6.0		3	1.8	1.6	0.3	
Mf003015	9.5	21×2	6.5	8	4	2.3	1.6	0.1	
Mf010017	7.8	18×2	5.1	5	3	2.0	1.5	0.2	9.1
	7.3	18×2	5.2			1.7	1.2	0.2	
Mf003013	7.8	19×2	5.6	10	3	1.8	1.0	0.2	
Mf010032	8.2	19×2	5.4	5	4	2.2	1.4	0.2	
	8.5	19×2	5.8	5	2	2.0	1.2	0.2	
Mf010030	8.0	20×2	5.6	8	3	2.2	1.4	0.2	
Mf009005	8.1	19×2	5.2	8	2	2.0	1.4	0.2	
Mf004011	9.1	20×2	6.1	7	2	1.9	1.4	0.2	
Mf009010	8.0	19×2	5.5	6	3	1.8	1.5	0.2	
Mf010006	9.3	19×2	5.4	7	4	2.2	1.8	0.2	
Mf010025	9.3	19×2	6.3	5	2	2.1	1.5	0.3	
Mf001001	7.2	21×2	5.0	9	3	1.8	1.4	0.2	
Mf010020	10.9	20×2	6.0	8	2	3.0	1.8	0.2	
Mf007007	8.1	21×2	5.3	7	2	2.1	1.3	0.2	
Mf009008	7.6	19×2	5.1	9	3	1.9	1.4	0.1	
Mf009007	8.1	19×2	5.1	7	2	1.9	1.4	0.2	
Mf003011	7.0	16×2	4.8	9	2	1.8	1.5	0.2	
Mf013016	8.9	20×2	5.8	8	2	2.0	1.3	0.2	
Mf010001	7.9	20×2	4.8	7	3	2.0	1.6	0.2	
Mf007022	9.1	20×2	6.0	6		1.8	1.4	0.3	
Mf007015	8.2	19×2	5.9			2.0	1.5	0.2	
Mf00x006	7.5	18×2	5.2	7	3	1.9	1.3	0.2	
	7.7	18×2	4.8	7	3	1.8	1.2	0.2	

Diagnosis: Dendroid coral composed of slender corallites. Increase lateral. Septa in two orders, radially arranged. Major septa retreated from axis, thick and wedge-shaped at the inner margin of tabularium, may be in contact laterally each other to form inner wall. Minor septa well developed. Typical yardarm carinae well developed on the peripheral parts of all septa. Dissepimentarium consists of more than 2 rows of dissepiments. The outermost row of dissepiments large, peneckielloid. Tabularium wide, usually composed of incomplete tabulae.

Description: Dendroid coral made up of slender corallites with diameter ranging 5.9 to 10.9 mm. Increase lateral with large angle (pl. 52, fig. 1b, 2b, 3a). The distance between two adjacent corallites considerably variable, from 1.8 to 10.5 mm. Corallites cylindrical or scolecoid. Septa in two orders, radially arranged, from

Explanation of Plate 42

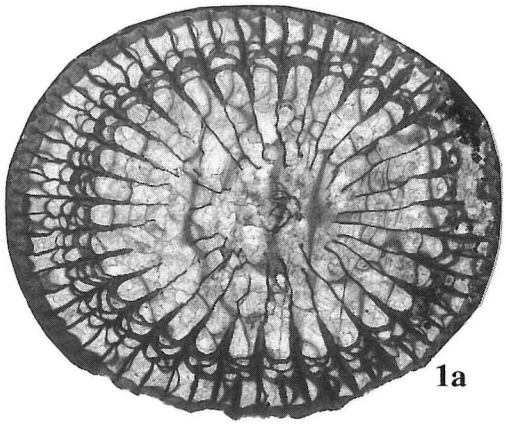
(All figures are ×4)

Fig. 1 *Macgeea dubia* (de Blainville). Mf001010,1a. transverse section; 1b. longitudinal section.

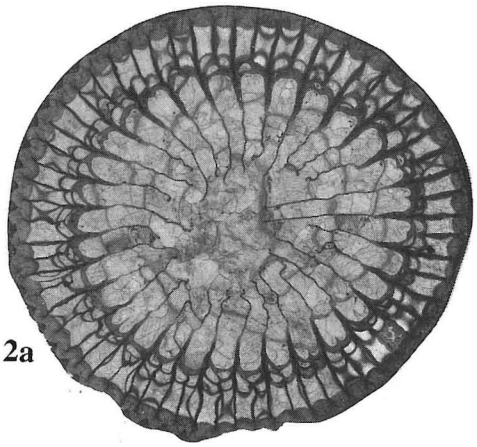
Fig. 2 *Macgeea dubia* (de Blainville). Mf007003, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea dubia* (de Blainville). Mf00x052, 3a. transverse section; 3b. longitudinal section.

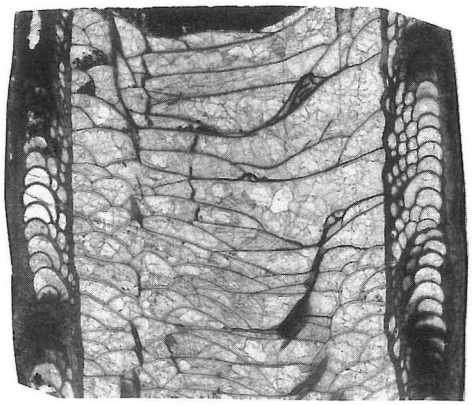
Plate 42



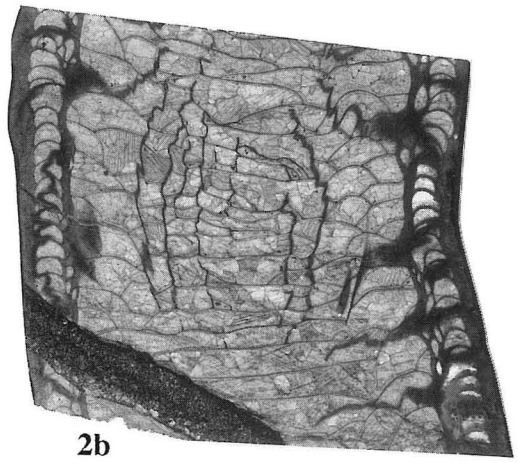
1a



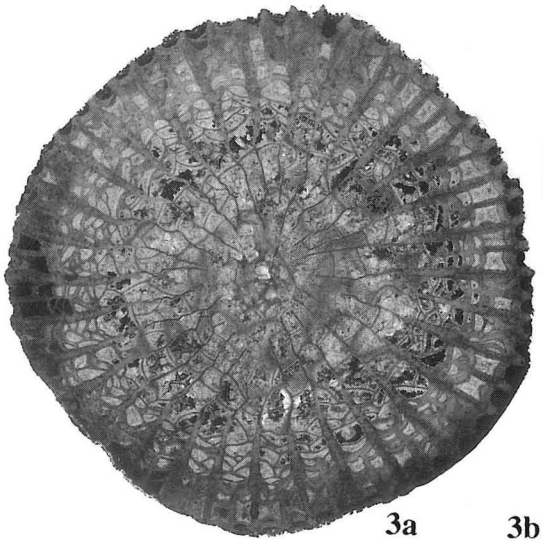
2a



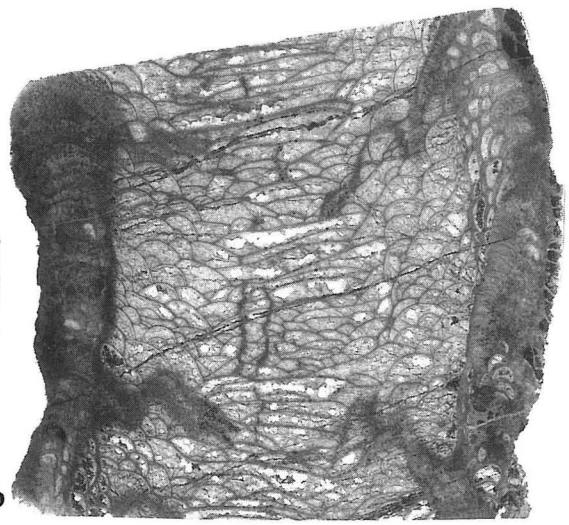
1b



2b



3a



3b

Macgeea

16×2 to 21×2 in number. Major septa usually less than half of the radius of corallites in length, from 1.4 to 3.0 mm, thick and wedge-shaped at the inner margin of the tabularium, may connect laterally with each other and form inner wall. Minor septa well developed and almost as long as the majors. Typical yadarm carinae strongly developed in the periphery of all septa, rare in tabularium.

In longitudinal section dissepimentarium usually composed of 2 to 3 rows of normal globose dissepiments. Only in three specimens (pl. 51, fig. 1; pl. 52, fig. 3; pl. 54, fig. 6) 4 rows of dissepiments can be seen. The outer row of dissepiments are commonly large and regular, usually appear as peneckielloid dissepiments, and the inner rows of dissepiments small, globose, a few of them elongated. Tabularium wide, with diameter ranging from 4.1 to 7.0 mm, usually comprised of incomplete tabulae. Tabulae considerably variable. Axial tabulae flat, convex, sometime concave, spacing of 5 to 13 in 5 mm. Periaxial tabellae inclined inward at various angle. In some specimen one or two complete tabulae can been seen occasionally.

Locality: Malutang.

Neoacinophyllum planotabulatum (Sung), 1982

(Plate 55-56; text-figure 18)

1982 *Cylindrophyllum planotabulatum* Sung, p. 26, fig. 7.

Measurement:

No	D	N	Dt	Nt	Nd	Lf	Ls	Tw	Dc
Mf005010	7.4	18×2	5.3	9	1	1.3	0.8	0.2	
Mf005020	5.5	17×2	4.2	8	2	1.1	0.5	0.2	
Mf005023	6.2	18×2	4.5	7	2	1.2	0.8	0.2	2.5
Mf005006	6.8		4.6	10	2	1.2	0.8		
Mf005013	5.5	16×2	3.8	9	1	1.0	0.6	0.2	2.5
Mf005008	6.4	20×2	5.1	13	1	1.0	0.4	0.2	
Mf005027	6.1	17×2	4.4	13	2	1.3	0.8	0.1	
Mf005014	6.2	16×2	4.0	7	2	1.0	0.6	0.2	
Mf005025	7.4	19×2	6.2	8	2	1.4	0.7	0.2	

Diagnosis: Dendroid or phaceloid corals made up of slender corallites. Increase lateral. Septa in two orders, somewhat radially arranged. Major septa very short, and strongly dilated at the inner margin of dissepimentarium to form an

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Explanation of Plate 43

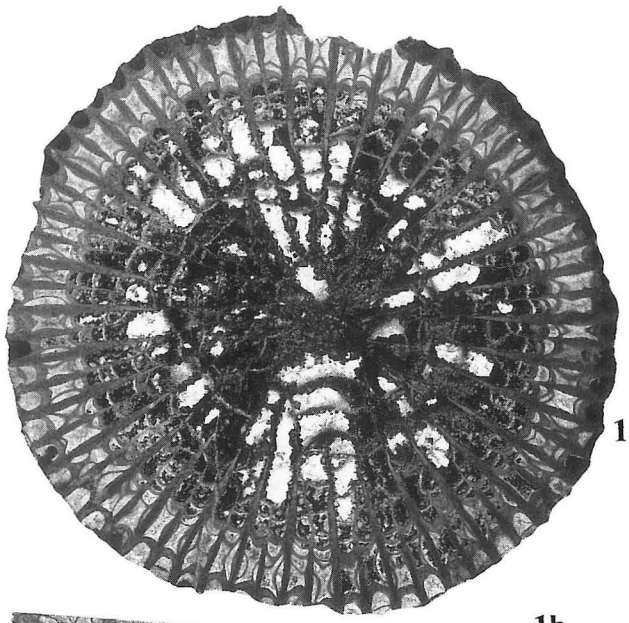
(All figures are ×4)

Fig. 1 *Macgeea rozkowskae* Coen-Aubert. Mf00x047, 1a. transverse section; 1b. longitudinal section.

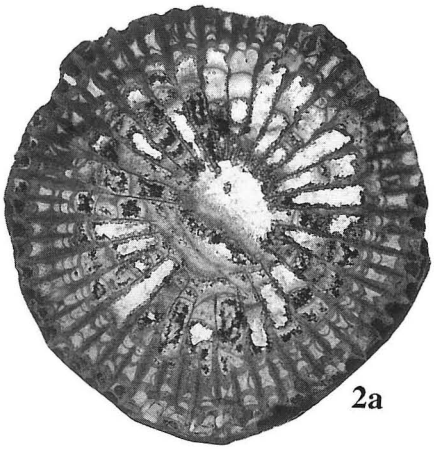
Fig. 2 *Macgeea rozkowskae* Coen-Aubert. Mf013004, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea rozkowskae* Coen-Aubert. Mf00x009, 3a. transverse section; 3b. longitudinal section.

Plate 43

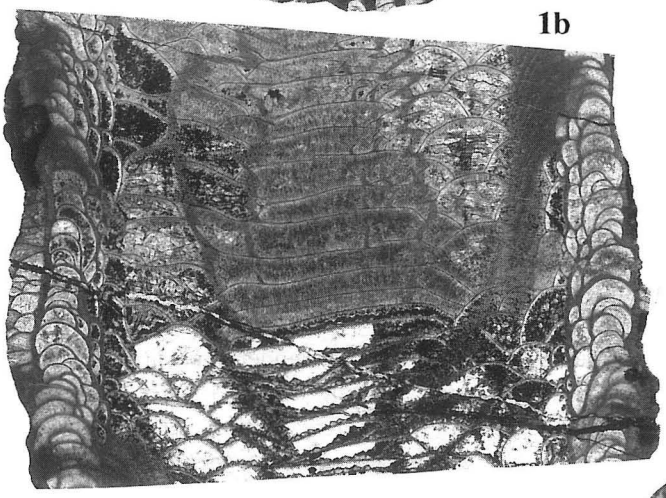


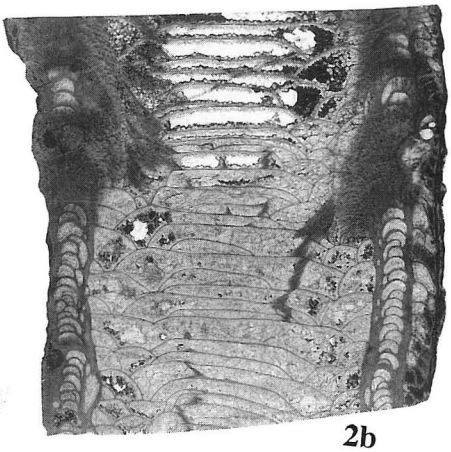
1a



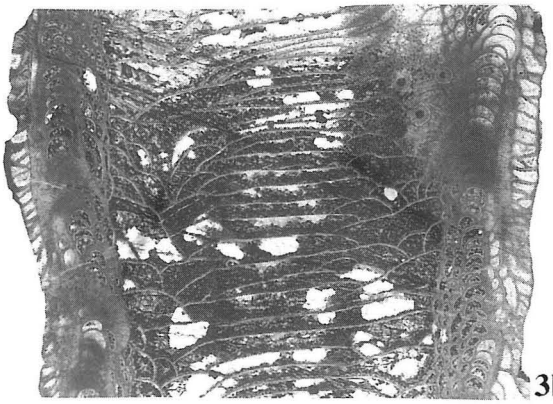
2a

1b

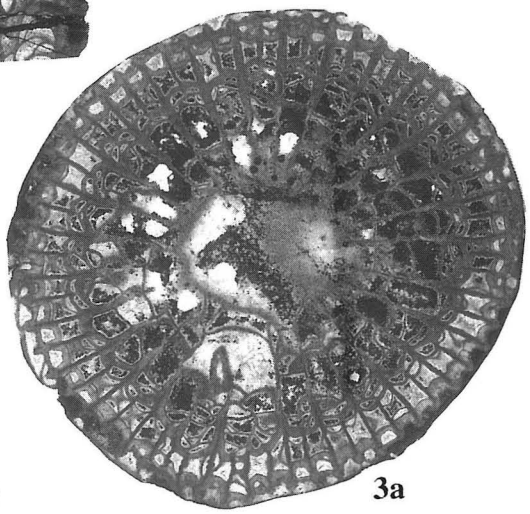




2b

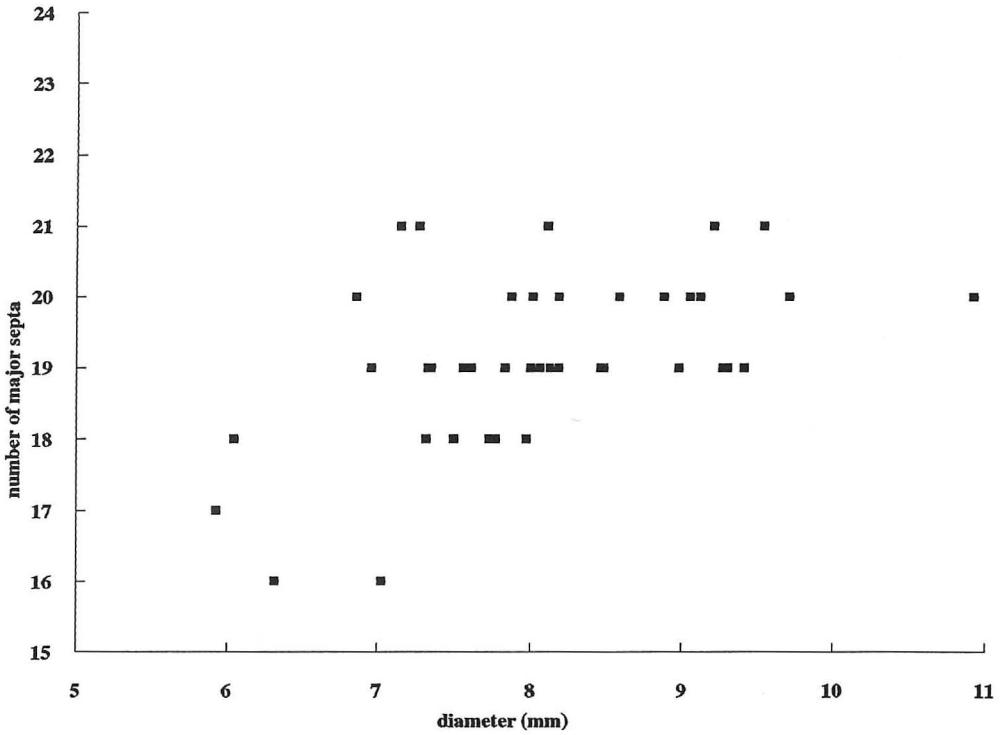


3b



3a

Macgeea



Text-fig. 17 Scatter diagram of number of major septa versus diameter in *Neoacinophyllum malutangense*

inner wall, gradually thin in tabularium. Minor septa short, usually restricted to narrow dissepimentarium. A few yardarm carinae on the sides of septa. Narrow dissepimentarium usually composed of only one row of dissepiments. Tabularium wide, consists of complete tabulae.

Description: Dendroid or phaceloid coral composed of slender corallites in the form of cylindrical or scolecoid, with diameter ranging from 5.5 to 7.4 mm. Increase lateral with large angle (pl. 56, fig. 1b). In a few sections are seen the distances ranging from 0.8 to 2.5 mm between the two adjacent corallites. Septa in two orders, somewhat radially arranged, from 16×2 to 20×2 in number, the peripheral ends penetrated into exterior wall with thickness ranging from 0.1 to 0.2. Major septa short, from 0.9 to 1.4 mm in length, about one third of the radius of corallites, thick and wedge-shaped at the outer margin of tabularium, usually connected to each other to form a thick inner wall. Minor septa short,

Explanation of Plate 44

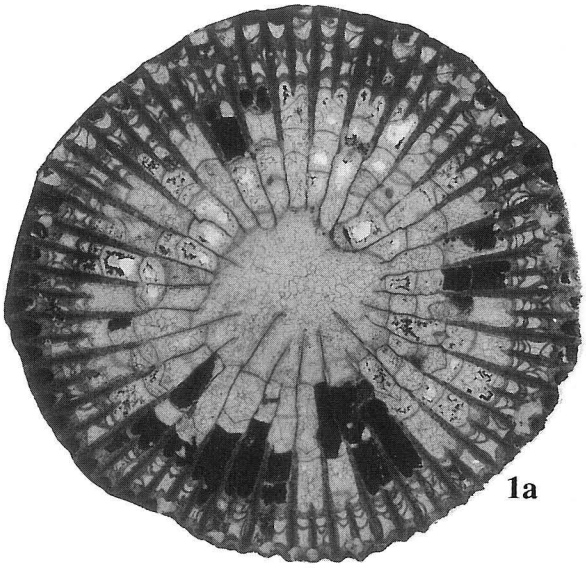
(All figures are ×4)

Fig. 1 *Macgeea rozkowskae* Coen-Aubert. Mf008019, 1a. transverse section; 1b. longitudinal section.

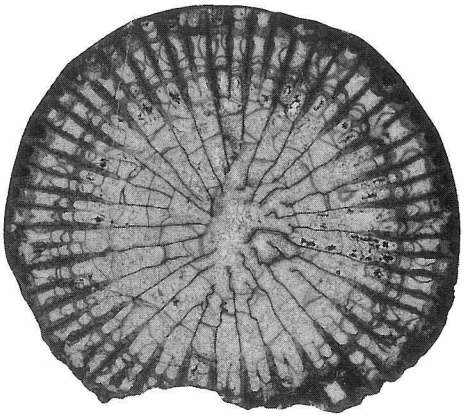
Fig. 2 *Macgeea rozkowskae* Coen-Aubert. Mf008032, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea rozkowskae* Coen-Aubert. Mf008015, 3a. transverse section; 3b. longitudinal section.

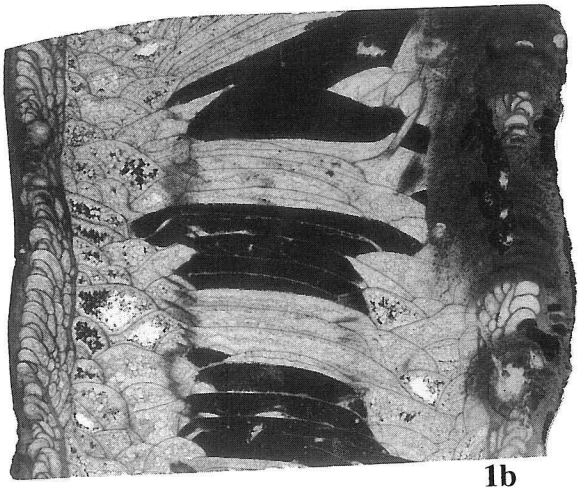
Plate 44



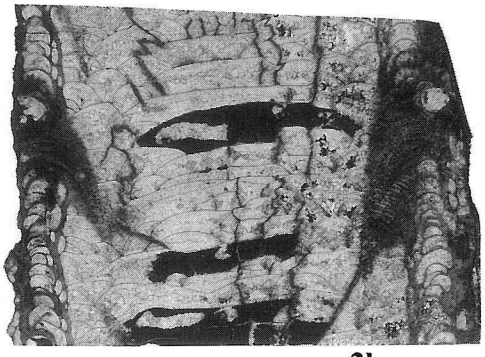
1a



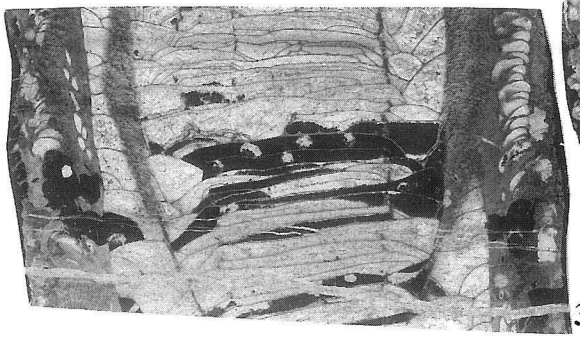
2a



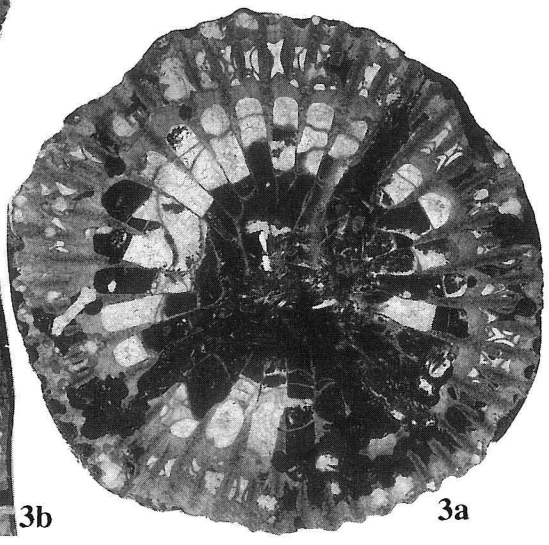
1b



2b



3b



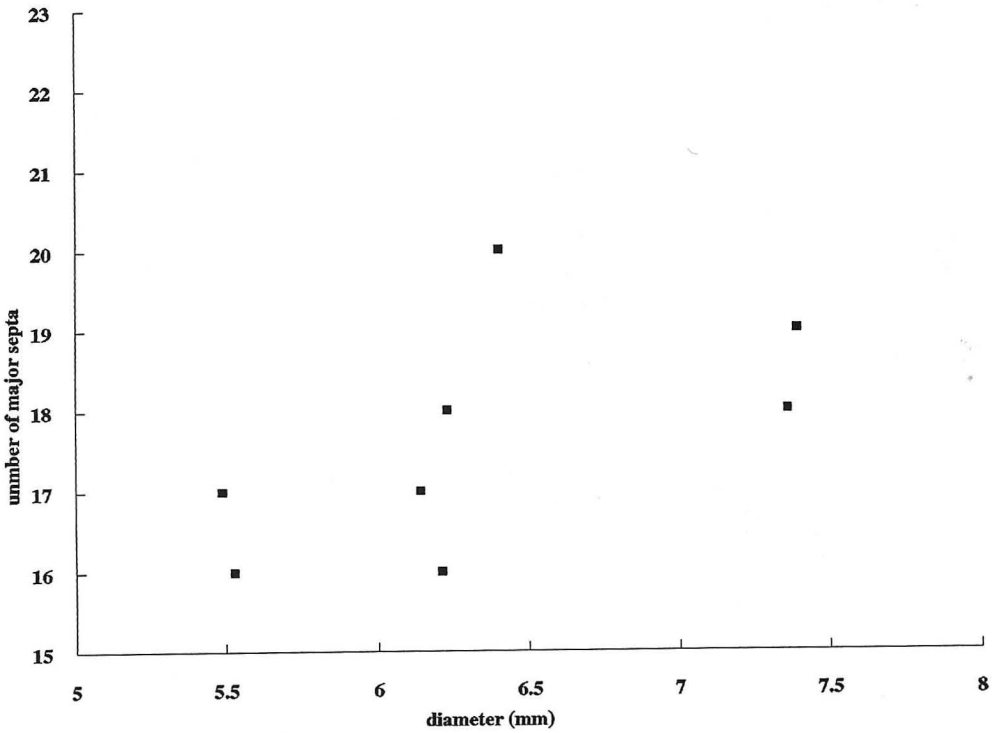
3a

Macgeea

commonly restricted to narrow dissepimentarium, as long as half of the majors. Typical yardarm carinae are present on the sides of septa.

In longitudinal section the coarse trabeculae forming septa arranged in half fans, the width of trabeculae about 0.3 mm. Dissepimentarium narrow, about one fourth of the radius of corallites in width, composed of only 1 or 2 rows of dissepiments. The outermost row of dissepiments large, non-typical peneckielleid. The inner dissepiments small, globose, absent in part. It is very scarce for more than one row of inner dissepiments to occur. Tabularium wide, from 3.1 to 6.2 mm in diameter, composed of complete tabulae. Tabulae flat, a few tabulae being slight convex or concave.

Discussion: This species has narrow dissepimentarium consisting of only 1 to 2 rows of dissepiments and typical yardarm carinae, so that it should belong to *Neoacinophyllum*. This species is similar to *N. malutangense* (Sung) in some aspects, but differs from the latter in having short septa, narrow dissepimentarium composed of only 1 to 2 rows of dissepiments and complete tabulae. The species

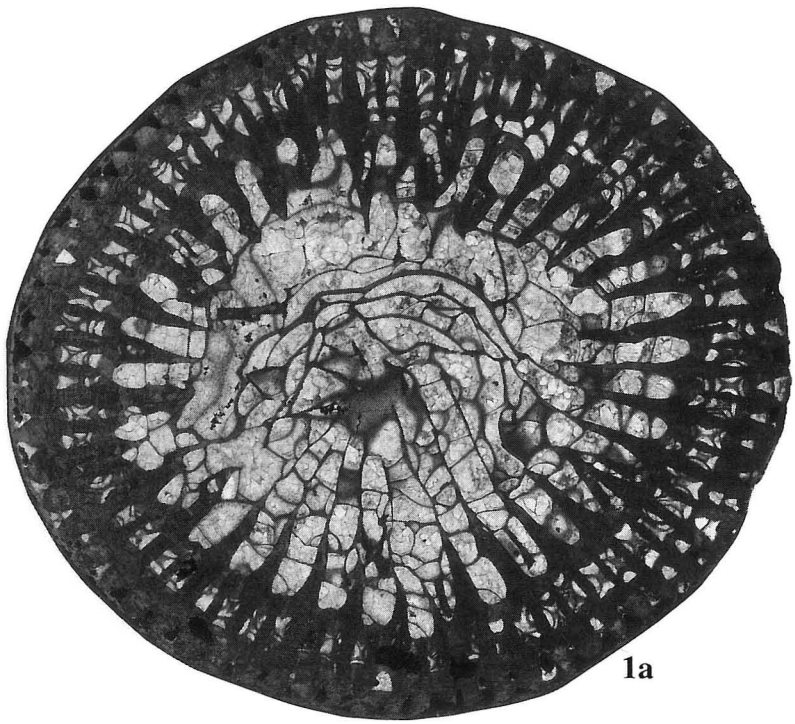


Text-fig. 18 Scatter diagram of number of major septa versus diameter in *Neoacinophyllum planotabulatum*

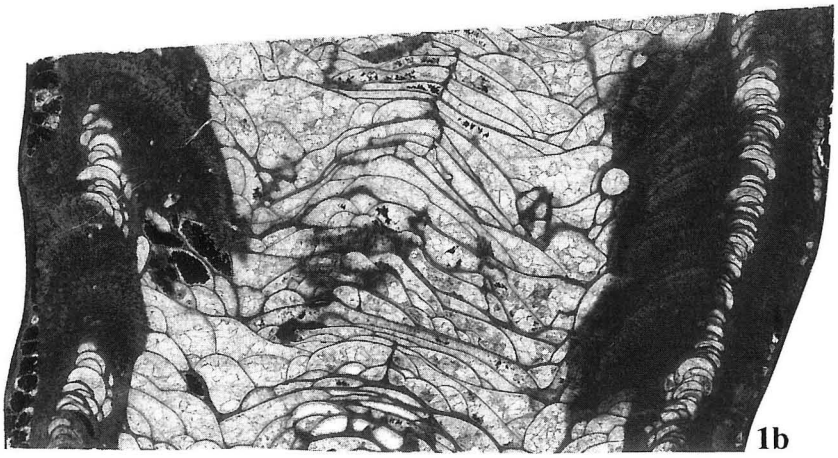
Explanation of Plate 45

Fig. 1 *Macgeea caucasica* Soshkina. Mf001013, 1a. transverse sectition; 1b. longitudinal section, ×4.

Plate 45



1a



1b

Macgeea

appears close to *Acinophyllum camselli* (Smith) (=*Disphyllum* (*Synaptophyllum*) *camselli* Smith) from Frasnian of Mackenzie River Region, Canada (Smith, 1945, p. 23, pl. 12, fig. 4) in the character of septa, but the presence of typical yardarm carinae can serve to distinguish it from the latter. This species resembles *Acinophyllum simcoense* (Billings), the type species of *Acinophyllum*, in having short septa, but the latter has abundant lateral supports and strongly developed zigzag carinae on the peripheral parts of all septa, and lacks inner well. *Neoacinophyllum crassiseptatum* (Ehlers et Stumm) (=*Synaptophyllum crassiseptatum* Ehlers et Stumm, 1949, p. 28, pl. 6, fig. 1-5) also has very short septa with yardarm carinae like as that in *N. planotabulatlm*, but can be easily distinguished from the latter in having well developed minor septa which nearly as long as the major ones and incomplete tabulae.

Locality: Malutang.

Neoacinophyllum crassiseptatum (Ehlers et Stumm), 1949
(Plate 57, fig. 3)

1949 *Synaptophyllum crassiseptata* Ehlers et Stumm, p. 28, pl. 2 fig. 3, pl. 5, fig. 1-6.
1959 *Acinophyllum crassiseptatum* (Ehlers et Stumm). McLaren, p. 27.

Measurement:

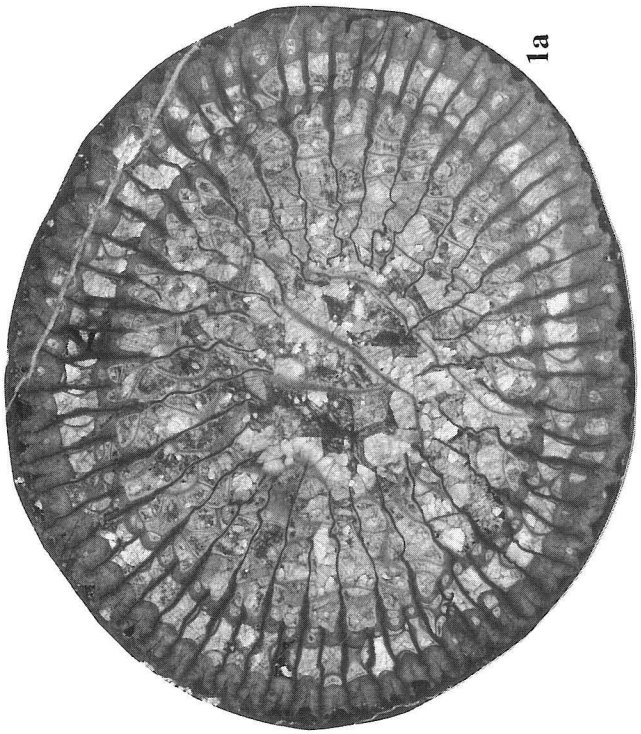
No	D	N	Dt	Nt	Nd	Lf	Ls	Tw	Dc
Mf005025	4.6	16×2	3.1	8	2	0.9	0.7	0.1	0.8

Diagnosis: Corallum dendroid or phaceloid, composed of slender corallites. Septa of two orders, radial in arrangement. Major septa short, dilated in the inner margin of dissepimentarium in wedge to form inner wall, with yardarm carinae within dissepimentarium. Minor septa nearly as long as the majors. Dissepimentarium narrow, consists of 1 to 2 rows of dissepiments. Outer dissepiments tending to be peneckielloid, and the inner one strongly inclined inward or nearly vertically arranged. Tabularium wide, composed of incomplete tabulae, flat or concave, periaxial tabellae steeply inclined, variable in size.

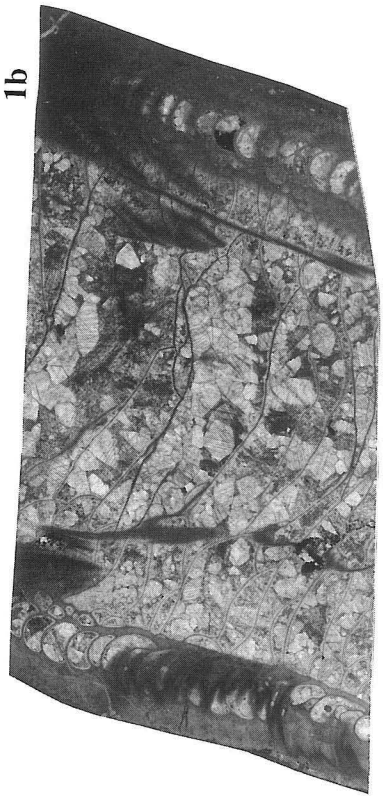
Description: Phaceloid or dendroid coral made up of closely spaced cylindrical and scolecoid corallites. In the section described here the distance between the two adjacent corallites is 0.8 mm. Corallite slender, only 4.6 mm in diameter. Septa of two orders, radially arranged, 16×2 in number. Major septa short, about two fifths of the radius of the corallite. Minor septa nearly as long as the majors. All septa wedge-shaped at the boundary between dissepimentarium and tabularium to

Explanation of Plate 46
(All figures are ×4)
Fig. 1 *Macgeea multizonata* (Reed). Mf007029, 1b. transverse section; 1b. longitudinal section.
Fig. 2 *Macgeea gigantea* Brice et Rohart. Mf00x056, 2. transverse section.

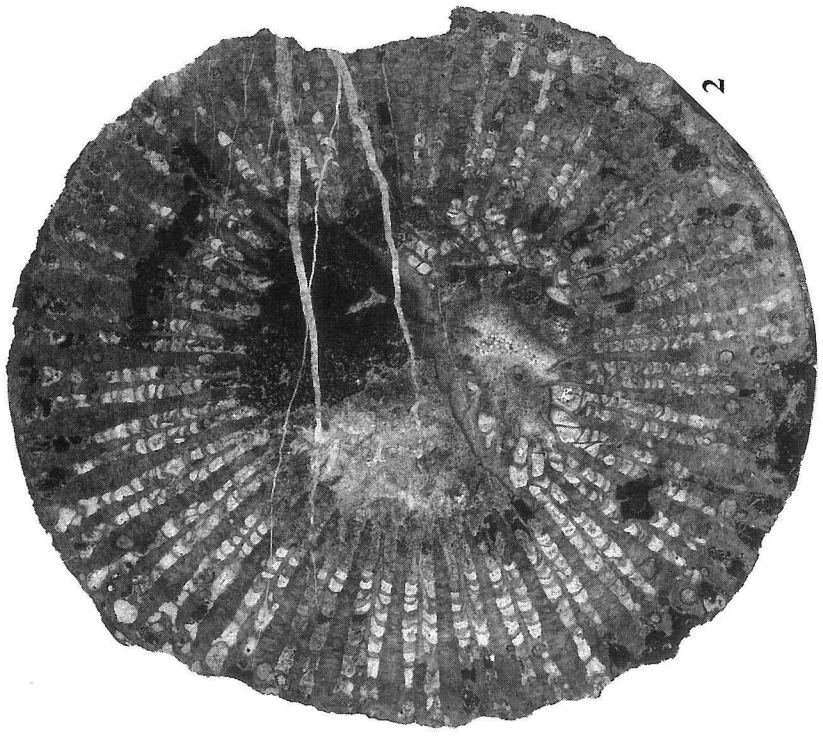
Plate 46



1a



1b



2

Macgeea

form an inner wall. Strongly diveloped yardarm carinae present on most the septa, 1 to 3 carinae to per septum. Dissepimentarium narrow, only 0.6 mm wide.

In longitudinal section dissepimentarium consists of 1 to 2 rows of dissepiments. The outer dissepiments gently inclined or flatly arranged, a few of them tend to be peneckielloid, the inner ones steeply inclined inward and nearly vertically arranged. Tabularium wide, with diameter of 3.1 mm, about two thirds of the diameter of corallite, composed of incomplete tabulae. Tabulae flat or concave, 8 can be counted over vertical distance of 5 mm. Periaxial tabulae variable in size, and inclined inward at different angles. The boundary between dissepimentarium and tabularium distinct.

Discussion: This species is most closely related to *Neoacinophyllum planotabulatum* (Sung) in the characters of transverse section, differs from the latter only in its incomplete and concave tabulae. This species agrees with *Acinophyllum camselli* (Smith), 1945, but can easily be differentiated from the latter by having incomplete tabulae and numerous yardarm carinae.

Locality: Malutang.

Neoacinophyllum canopotabulatum gen. et sp. nov.
(Plate 57, fig. 2)

Measurement:

No		D	N	Dt	Nt	Nd	Lf	Ls	Tw
Mf004010(Holotype)*		6.3	18×2	4.1		3	1.8	1.5	0.3
	**	10.3	22×2	7.2	8	3	3.5	1.7	0.4

* Early stage; ** Late stabe.

Diagnosis: Dendroid or phaceloid corals made up of slender corallites. Septa of two orders, radial in arrangement. Major septa retreated from the axis. Minor septa are limited to dissepimentarium. All of the septa strongly dilated in wedge and in lateral contact to form an inner wall at the outer margin of tabularium. Typical yardarm carinae strongly developed not only within the dissepimentarium but also in tabularium in late stage. Dissepimentarium narrow, consists of 2 to 3 rows of normal globose dissepiments. Tabularium wide, composed of incomplete tabulae. Axial tabulae strongly convex in the form of tent, and form a loose axial structure in early stage. Periaxial tabellae gently inclined inward.

Description: Only one corallite of this species from western Yunnan has been

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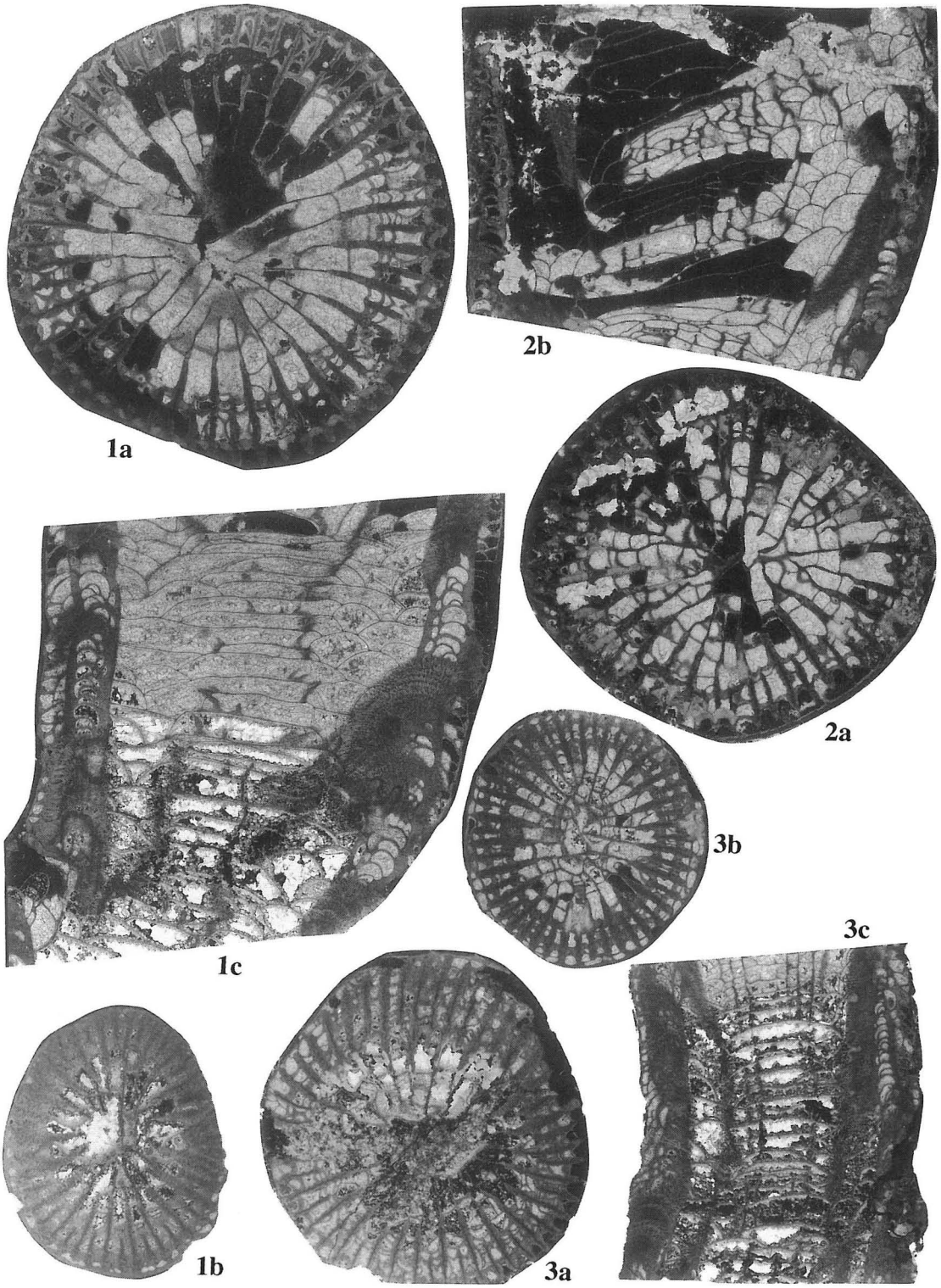
Explanation of Plate 47
(All figures are ×4)

Fig. 1 *Macgeea shidianensis* (Sung). Mf010008, 1a. transverse section of late stage; 1b. transverse section of early stage; 1c. longitudinal section.

Fig. 2 *Macgeea shidianensis* (Sung). Mf005005, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea shidianensis* (Sung). Mf010002, 3a, 3b. both transverse sections at two different diameters; 3c. longitudinal section.

Plate 47



Macgeea

sectioned. So its exact shape and increase pattern have remained unknown. Corallite slender, subcylindrical. Septa of two orders, radial in arrmangement. In early stage septa 18×2 in number in the section with a diameter of 6.3 mm. Major septa withdrawn from the axis, about half of the radius of the corallite or more. Minor septa nearly as long as the majors. Septa thin and strongly yardarm carinated within dinssepimentarium and dilated near the inner margin of dissepimentarium in wedge to form an inner wall. In late stage septa up to 22×2 in number in the section with a diameter of 10.3 mm, major septa longer than two thirds of the radius of corallite, minor septa half as long as the majors. Within dissepimentarium septa thin, and with typical yardarm carinae, dilated at the boundary between dissepimentarium and tabularium, and form a discontinuous inner wall. In tabularium major septa abruptly attenuated and with a few yardarm carinae, slightly curved in their axial ends. Minor septa not or little enter the tabularium. Dissepimentarium narrow, composed of 2 to h rows of dissepiments, 1.4 mm wide.

In longitudinal section dissepimentarium composed of 2 to 3 rows of dissepiments. The outer dissepiments peneckielloid, larger than the inner ones. The inner dissepiments globose. Tabularium wide, from 4.1 to 7.1 mm in diameter from early to late stages, about two thirds of the diameter of the corallite, composed of incomplete tabulae. Axial tabulae strongly convex in the form of tent, may form an axial structure in the early stage, 8 can be counted over the vertical distance of 5 mm. Periaxial gently inclined inward, variable in size. The boundary between dissepimentarium and tabularium very distinct. From early to late stages the exterior wall veried from 0.3 to 0.4 mm in thickness.

Discussion: This species is very close to *N. malutangense* (Sung) in the characters of septa and dissepiments, but can be easily differentiated from the latter by having strongly convex axial tabulae in the form of tent and long major septa with carinae in both dissepimentarium and tabularium.

Locality: Malutang.

Neoacinophyllum sp.

(Plate 57, fig. 1)

Measurement:

No	D	N	Dt	Lf	Ls	Nt	Tw
Mf004004	13.5	26×2	8.7	3.2	2.6	3	0.3

Diagunosis: Fasciculate corallum made up of large cylindrical corallites. Septa

Explanation of Plate 48

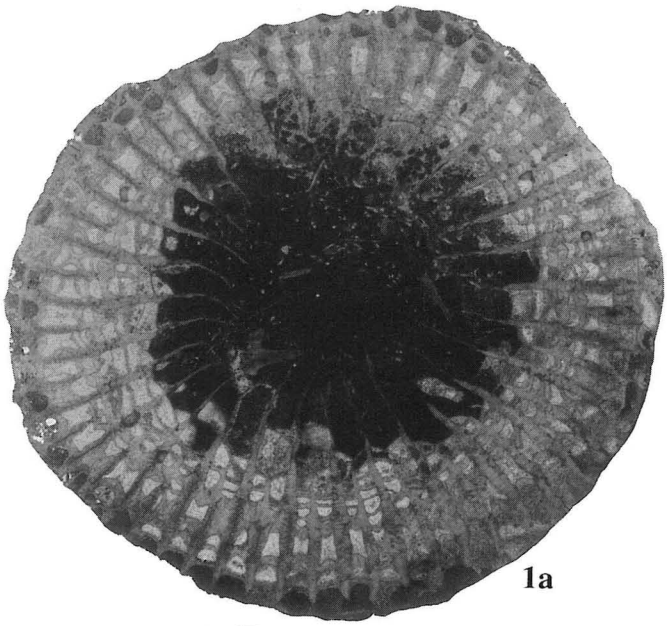
(All figures are ×4)

Fig. 1 *Macgeea shidianensis* (Sung). Mf00x024, 1a. transverse section of late stage (maybe through the calyx; 1b. transverse section of early stage; 1c. longitudinal section.

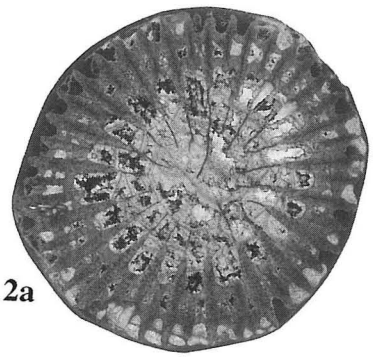
Fig. 2 *Macgeea shidianensis* (Sung). Mf005029, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Macgeea shidianensis* (Sung). Mf008035, 3. transverse section.

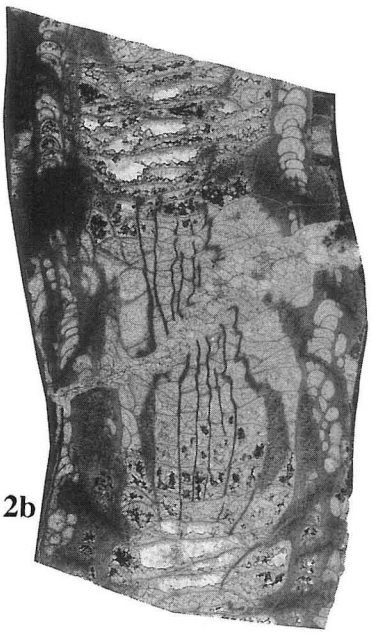
Plate 48



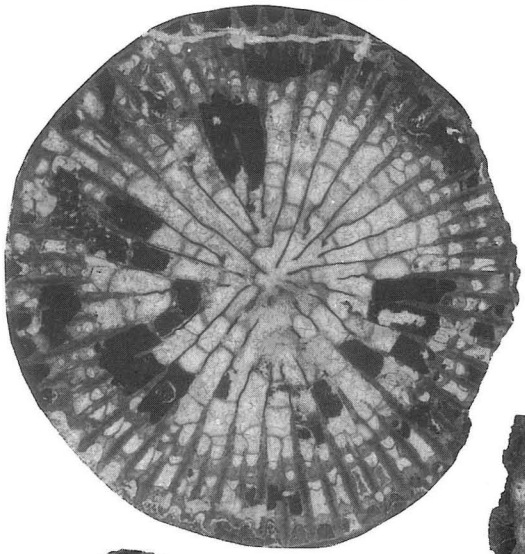
1a



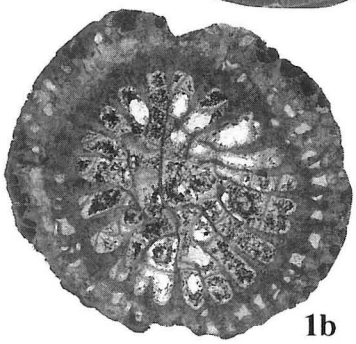
2a



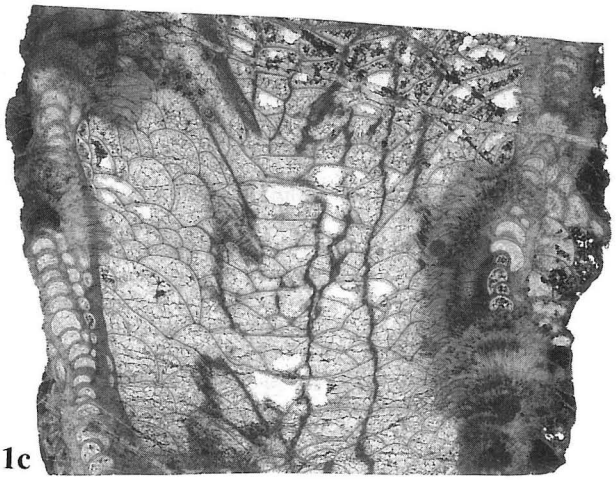
2b



3



1b



1c

Macgeea

of two orders, radial in arrangement. Rare zigzag and yardarm carinae are present on the sides of septa. Dissepimentarium narrow, composed of 1 to 2 rows of dissepiments. Dissepiments globose and non-typical peneckielloid. Tabularium wide, tabulae complete, widely placed.

Description: The sections of this species were prepared from only one specimen of western Yunnan. So the exact shape of the corallum is not certain. It is inferred that the species takes the fasciculate manner of growth. The corallites forming corallum cylindrical, large, up to 13.5 mm in diameter. Exterior wall thin. 0.3 mm in thickness. Septa of two orders, radial in arrangement, 26×2 in number. In the transverse section cut through the calyx major septa retreated from the axis, minor septa nearly as long as the majors. All septa slightly dilated in peripheral ends, gradually thin inwardly. Rare zigzag and yardarm carinae on the sides of the septa.

In longitudinal section dissepimentarium narrow, composed of 1 to 2 rows of dissepiments. Dissepiments globose or non-typical peneckielloid, large, few small dissepiments among them. Well developed carinae are shown very clearly in longitudinal section. Tabularium wide, 8.7 mm in diameter, about two thirds of the diameter of the corallite. Tabulae tend to be complete, irregular, flat, convex or concave, widely spaced so that only 3 can be counted over the vertical distance of 5 mm.

Discussion: The menner of growth and septal character of the species have not been known clearly because only one transverse section cut through calyx and a longitudinal section available to me. The narrow dissepimentarium with non-typical peneckielloid dissepiments and carinae are present in the form, so it is probably a species of *Neoacinophyllum*. Known species assigned to *Neoacinophyllum* are all made up of slender corallites, with dilated septa in the inner margin of dissepimentarium, and with strong yardarm carinae. The form described here bears large diameter, septa thin gradually inwardly, rare zigzag and yardarm carinae present on the sides of the septa, in which the form clearly differs from all the other species assigned to *Neoacinophyllum*, probably represents a new species. Because only one corallite of this type of coral has been sectioned, and the transverse section was cut through the calyx, some of important characters, especially the septal character remains to be unknown. It is described here as a *Neoacino-*

Explanation of Plate 49

(All figures are ×4)

Fig. 1 *Macgeea recta* (Walther). Mf00x028, 1a. transverse section of late stage; 1b. transverse section of early stage; 1c. longitudinal section.

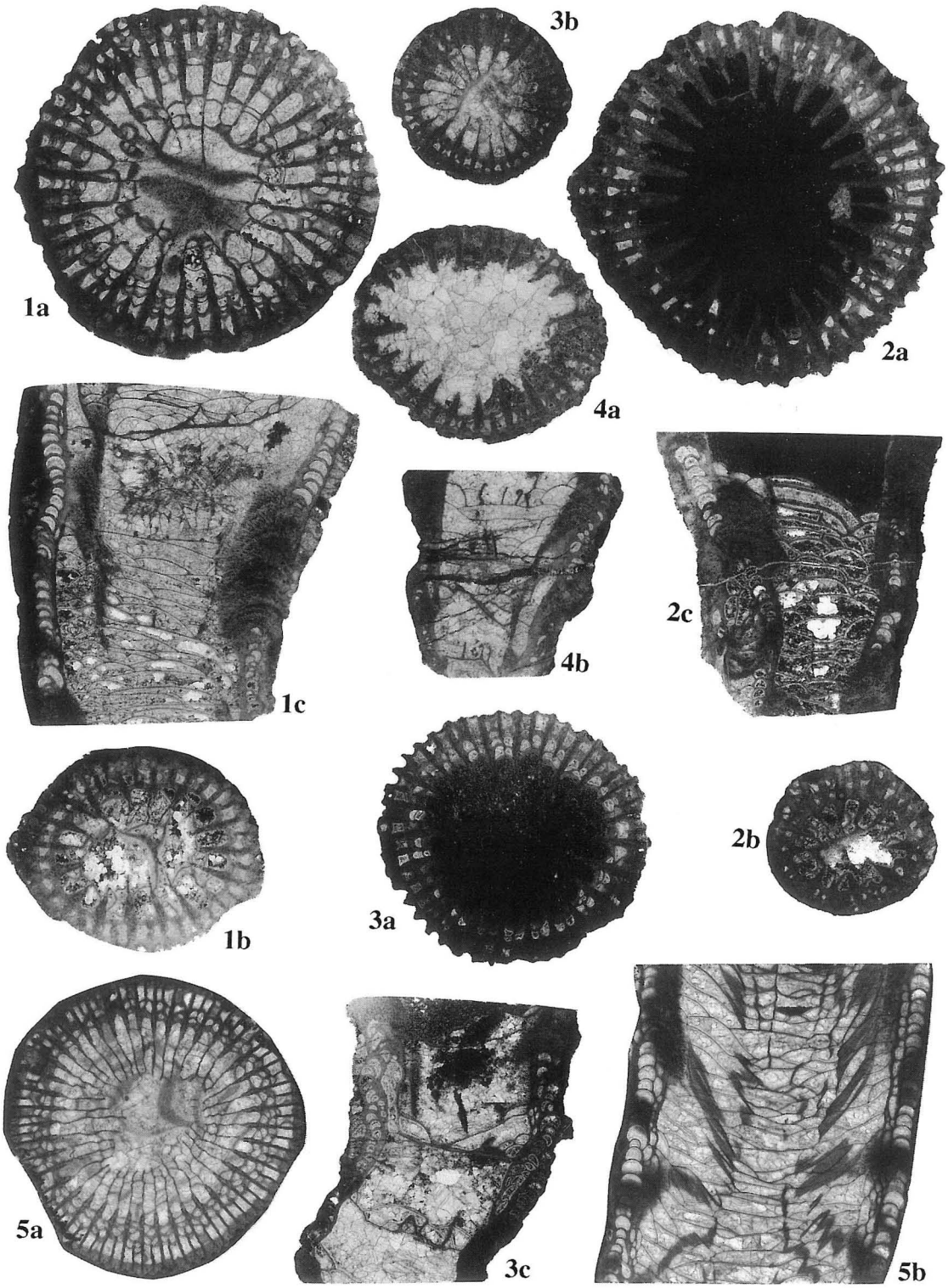
Fig. 2 *Macgeea recta* (Walther). Mf00×049, 2a. transverse section through the calyx; 2b. transverse section of early stage; 2c. longitudinal section.

Fig. 3 *Macgeea recta* (Walther). Hf1043, 3a. transverse section through the calyx; 3b. transverse section; 3c. longitudinal section.

Fig. 4 *Macgeea recta* (Walther). Mf1012, 4a. transverse section; 4b. longitudinal section.

Fig. 5 *Macgeea multiseptata* sp. nov.. Mf009013 (Holotype), 5a. transverse section; 5b. longitudinal section.

Plate 49



Macgeea

phyllum sp..

The presence of zigzag carinae and uncommon yardarm carinae on the side of this form make it possible that this type of coral is a species of *Acinophyllum*. The large corallites can serve to differentiate this form from all known species of *Acinophyllum*. The presence of non-typical peneckielloid dissepimentarium in the form discussed here leads me to place it in *Neoacinophyllum* rather than *Acinophyllum*, but the proper classification position of this form can not be determined until further studying much related material.

Locality: Malutang.

Acknowledegments:

I am most deeply indebted to Professor Makoto Kato of Hokkaido University, Japan and Professor Wang Hongzhen of China University of Geosciences (Beijing), China for guidance throughout this study in various ways, not only concerning the study on rugose corals, but also including my daily life. Without their guide, I would certainly not finish this dissertation in a short time.

I gratefully acknowledge the China Natural Science Foundation and the Ministry of Education of Japan for supporting my work on this study in China and Japan, respectively. Sincere thanks go to the Research Group of Stratigraphy, Hokkaido University for providing me with the most excellent working condition. The Research Group of Tectonics, China Univesity of Geosciences (Beijing) deserves many thanks for encouragement and help in many aspects.

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I am much obliged to Mr. Jia Kehua of Peking University, China for making the thin sections for study.

I wish to express special gratitude to Dr. N. Minoura and Miss Y. Kamada of Hokkaido University who aided me with the photographical work.

I am grateful to Dr. M. Kawamura and Mr. T. Kanamatsu of Hokkaido University for helping draw the text-figures using the cmputer.

I would like to express my cordial thanks to Associate Professor Chen Jianqiang and Mr. Wu Zhiguo of China University of Geosciences (Beijing), who pro-

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Explanation of Plate 50

(All figures are ×5)

Fig. 1 *Neoacinophyllum malutangense* (Sung). Mf010020, 1a, 1b. both transverse sections at two different diameters; 1c. longitudinal section.

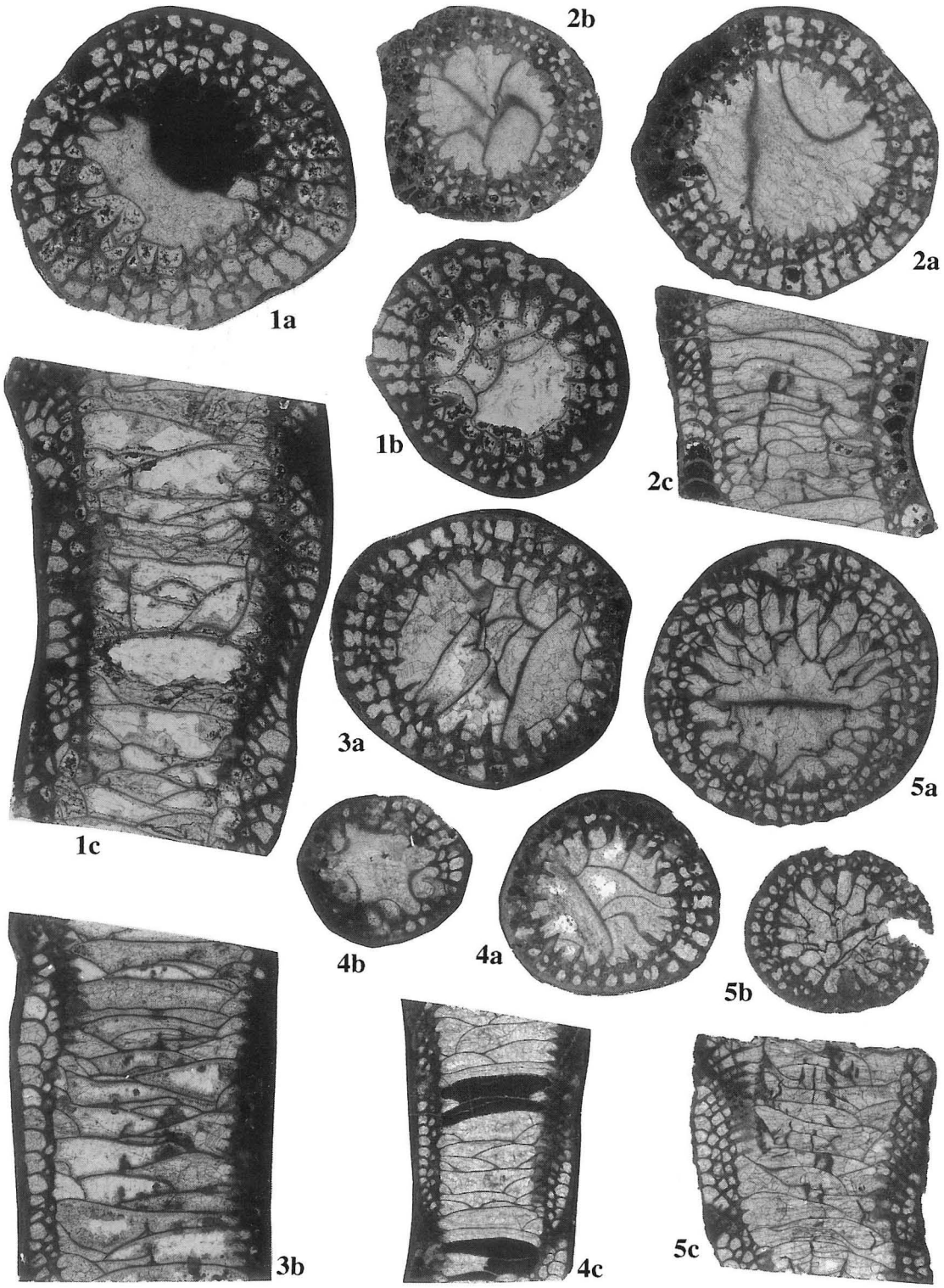
Fig. 2 *Neoacinophyllum malutangense* (Sung). Mf004007, 2a, 2b. both transverse sections at two different diameters; 2c. longitudinal section.

Fig. 3 *Neoacinophyllum malutangense* (Sung). Mf007016, 3a. transverse section; 3b. longitudinal section.

Fig. 4 *Neoacinophyllum malutangense* (Sung). Mf003011, 4a, 4b. both transverse sections at two different diameters; 4c. longitudinal section.

Fig. 5 *Neoacinophyllum malutangense* (Sung). Mf004009, 5a. transverse section of late stage; 5b. transverse section of early stage; 5c. longitudinal section.

Plate 50



Neoacinophyllum

vided me with many important literatures.

I very much acknowledge Messrs T. Terada, K. Nakamoto and N. Yasuda for helping the author in various ways.

All workers and graduate students of the Research Group of Stratigraphy, Hokkaido University, including Dr. Y. Fujiwara, Dr. F. Nanayama, Mr. K. Yoshida, Mr. E. Machiyama and Mr. H. Ueda, also give me great help and encouragement during the course of this study, to whom thanks are also due.

I particularly wish to thank my dear wife for her generous support during my education at home and abroad.

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Explanation of Plate 51

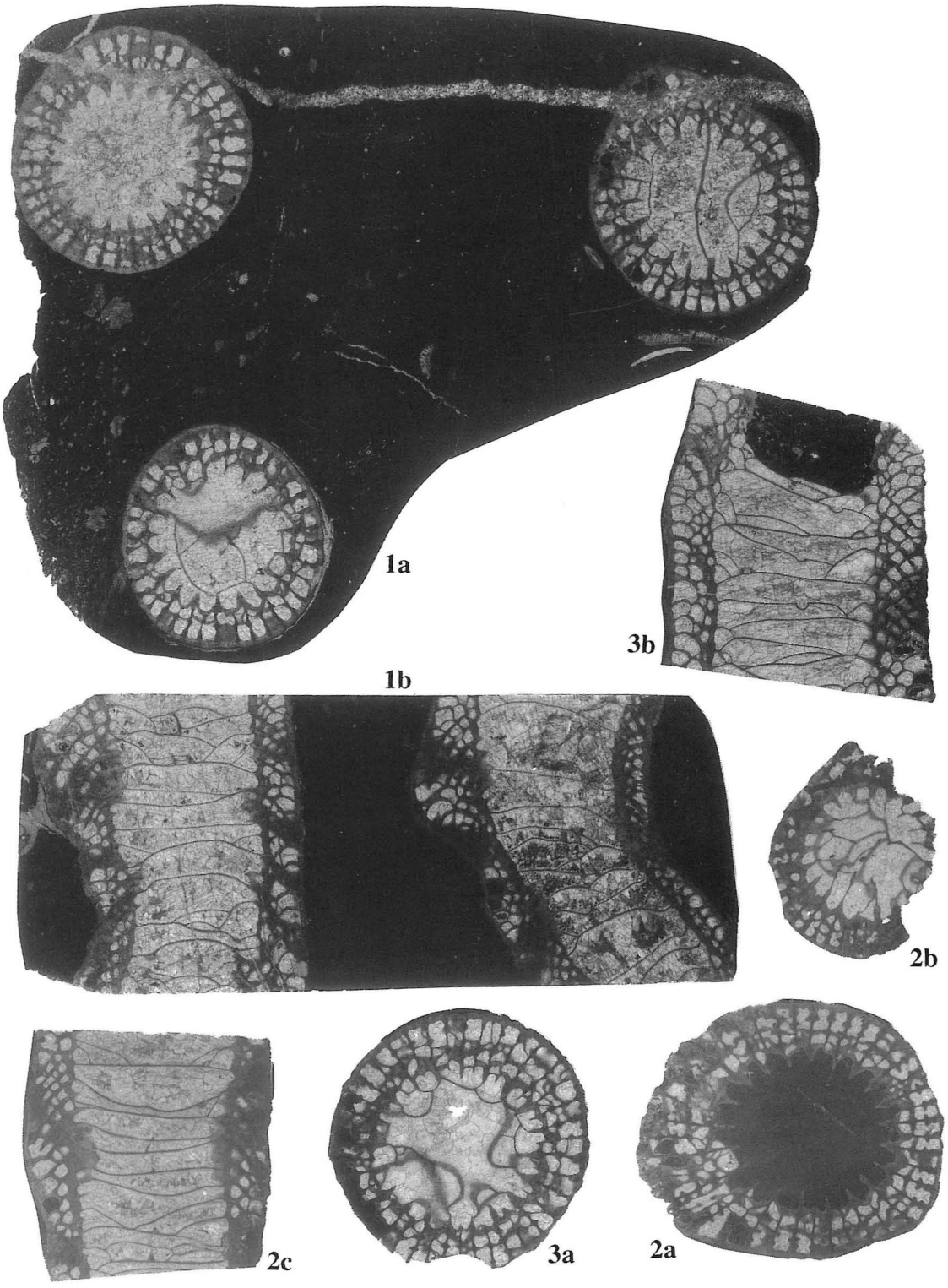
(All figures are ×5)

Fig. 1 *Neoacinophyllum malutangense* (Sung). Mf010016, 1a. transverse section of late stage (Maybe through the calyx) ; 1b. transverse section of early stage ; 1c. longitudinal section.

Fig. 2 *Neoacinophyllum malutangense* (Sung). Mf013016, 2a. transverse section of late stage (Maybe through the calyx) ; 2b. transverse section of early stage ; 2c. longitudinal section.

Fig. 3 *Neoacinophyllum malutangense* (Sung). Mf009006, 3a. transverse section ; 3b longitudinal section.

Plate 51



Neoacinophyllum

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Explanation of Plate 52

(All figures are ×5)

Fig. 1 *Neoacinophyllum malutangense* (Sung). Mf003012, 1a. transverse section; 1b. longitudinal section, showing lateral increase.

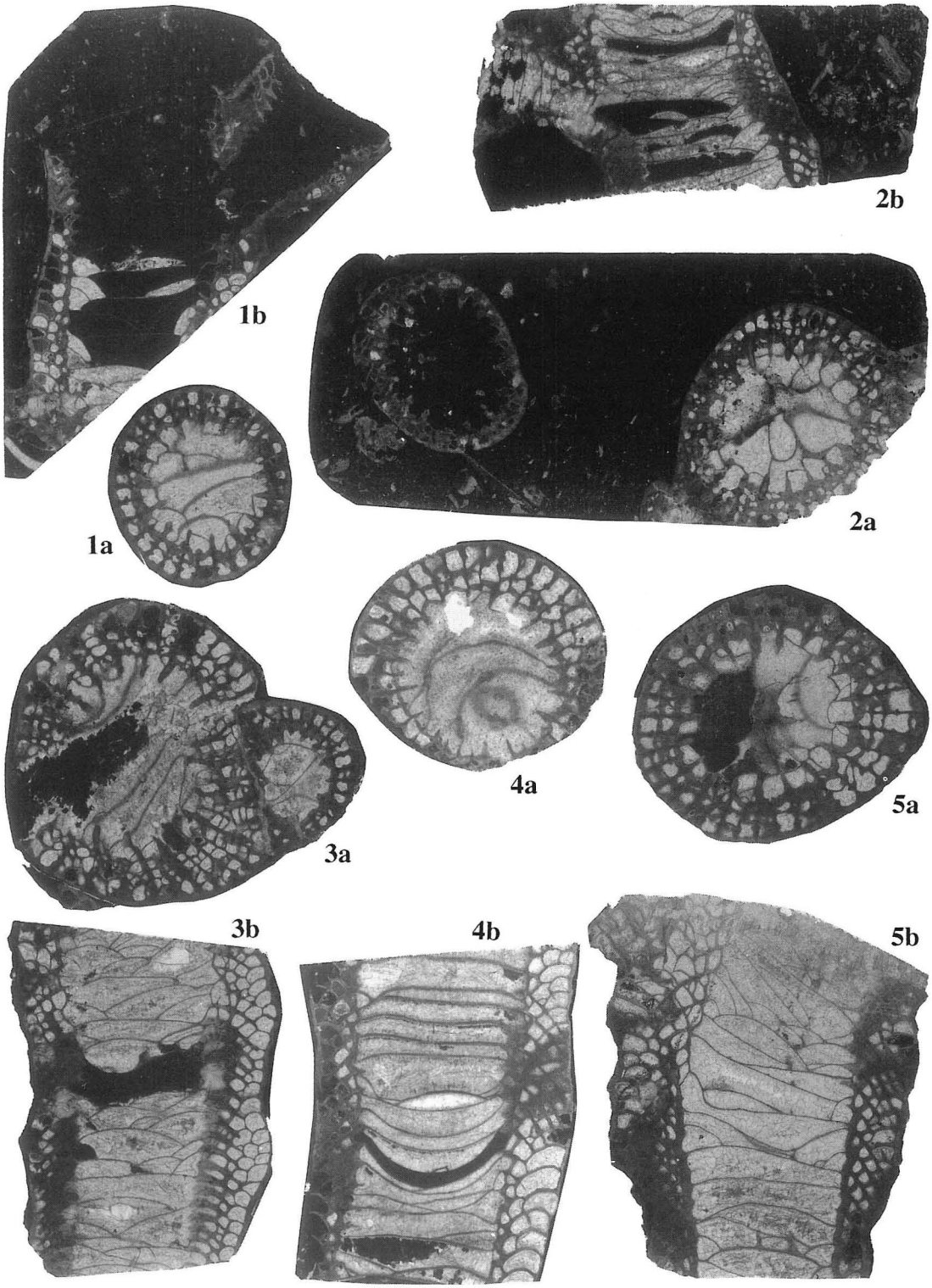
Fig. 2 *Neoacinophyllum malutangense* (Sung). Mf003013, 2a. transverse section, 2b. longitudinal section, showing lateral increase.

Fig. 3 *Neoacinophyllum malutangense* (Sung). Mf003015, 3a. transverse section, showing marginal increase; 3b. longitudinal section.

Fig. 4 *Neoacinophyllum malutangense* (Sung). Mf009005, 4a. transverse section; 4b. longitudinal section.

Fig. 5 *Neoacinophyllum malutangense* (Sung). Mf010006, 5a. transverse sectisection; 5b. longitudinal section.

Plate 52



Neoacinophyllum

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Explanation of Plate 53

(All figures are ×5)

Fig. 1 *Neoacinophyllum malutangense* (Sung). Mf005024, 1a. transverse section; 1b. longitudinal section.

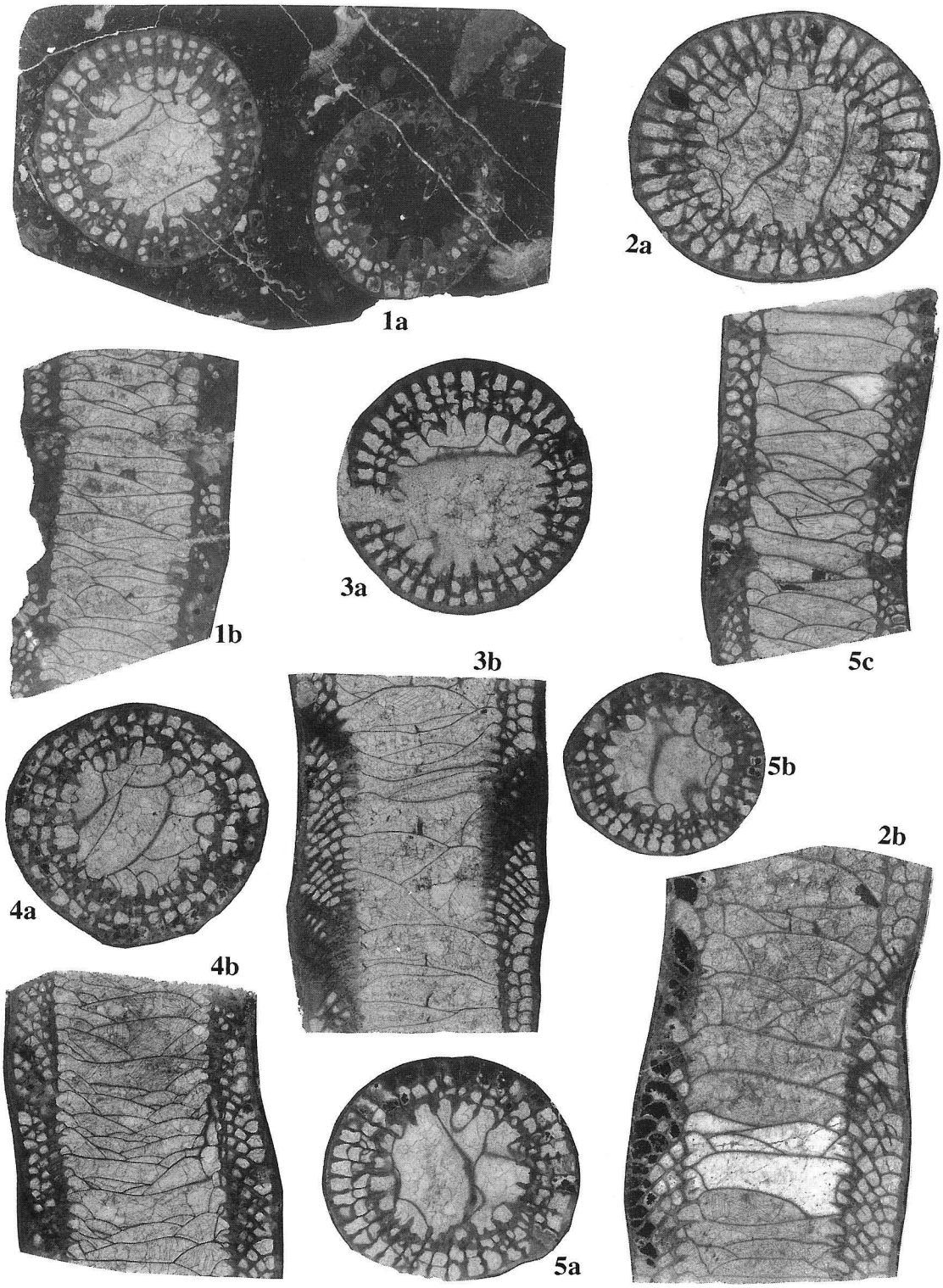
Fig. 2 *Neoacinophyllum malutangense* (Sung). Mf007001, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Neoacinophyllum malutangense* (Sung). Mf010030, 3a. transverse section; 3b. longitudinal section.

Fig. 4 *Neoacinophyllum malutangense* (Sung). Mf009008, 4a. transverse section; 4b. longitudinal section.

Fig. 5 *Neoacinophyllum malutangense* (Sung). Mf009007, 5a, 5b. both transverse sections at two different diameters; 5c. longitudinal section.

Plate 53



Neoacinophyllum

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Explanation of Plate 54

(All figures are ×3)

Fig. 1 *Neoacinophyllum malutangense* (Sung). Mf009010, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Neoacinophyllum malutangense* (Sung). Mf010025, 2a. transverse section; 2b.longitudinal section.

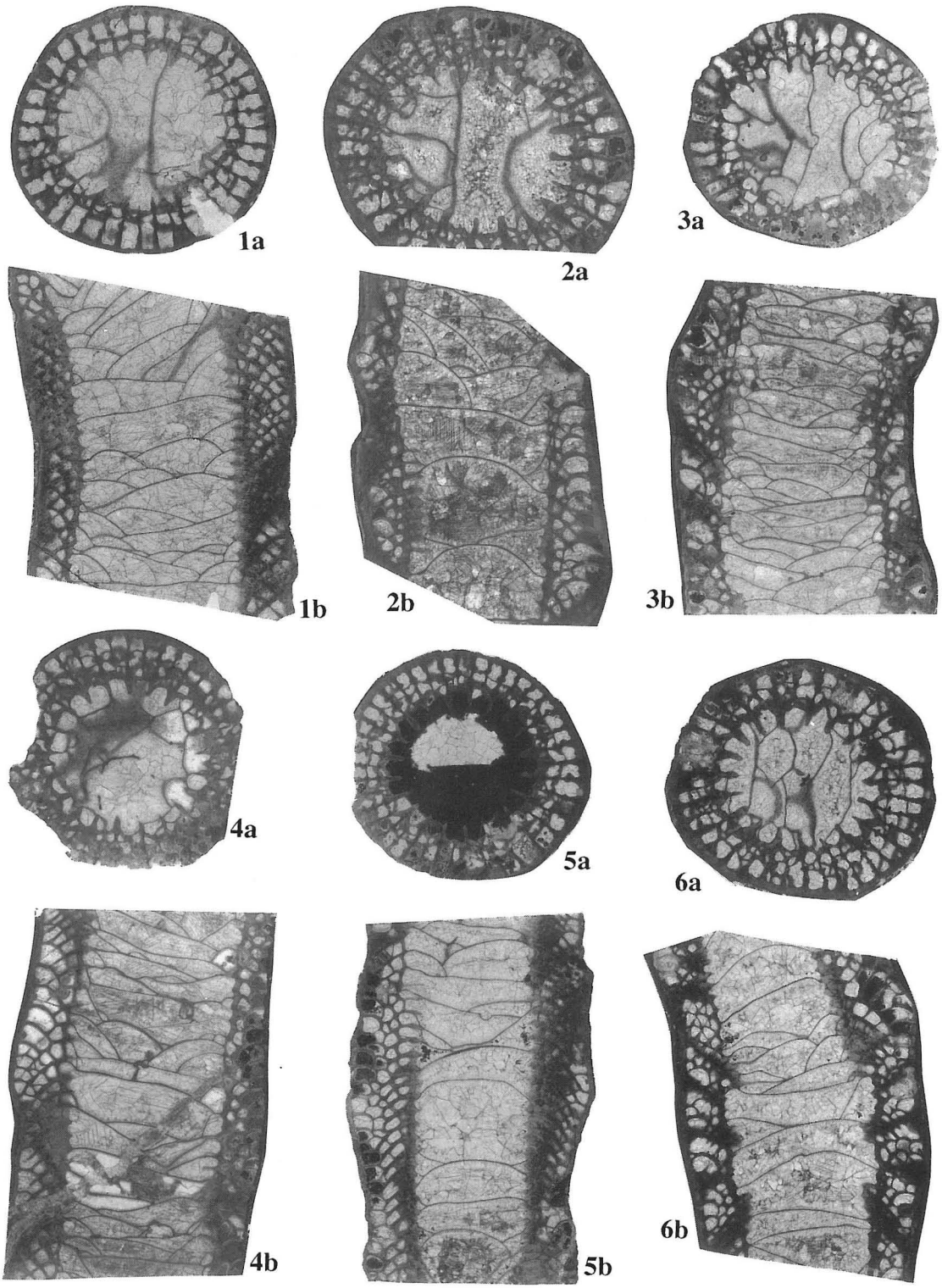
Fig. 3 *Neoacinophyllum malutangense* (Sung). Mf001001, 3a, transverse section; 3b. longitudinal section.

Fig. 4 *Neoacinophyllum malutangense* (Sung). Mf007007, 4a. transverse section; 4b. longitudinal section.

Fig. 5 *Neoacinophyllum malutangense* (Sung). Mf010001, 5a. transverse section; 5b. longitudinal section.

Fig. 6. *Neoacinophyllum malutangense* (Sung). Mf010032, 6a. transverse section; 6b. longitudinal section.

Plate 54



Neoacinophyllum

Univ., Tr., p. 1-399, pl. 1-103.
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Explanation of Plate 55

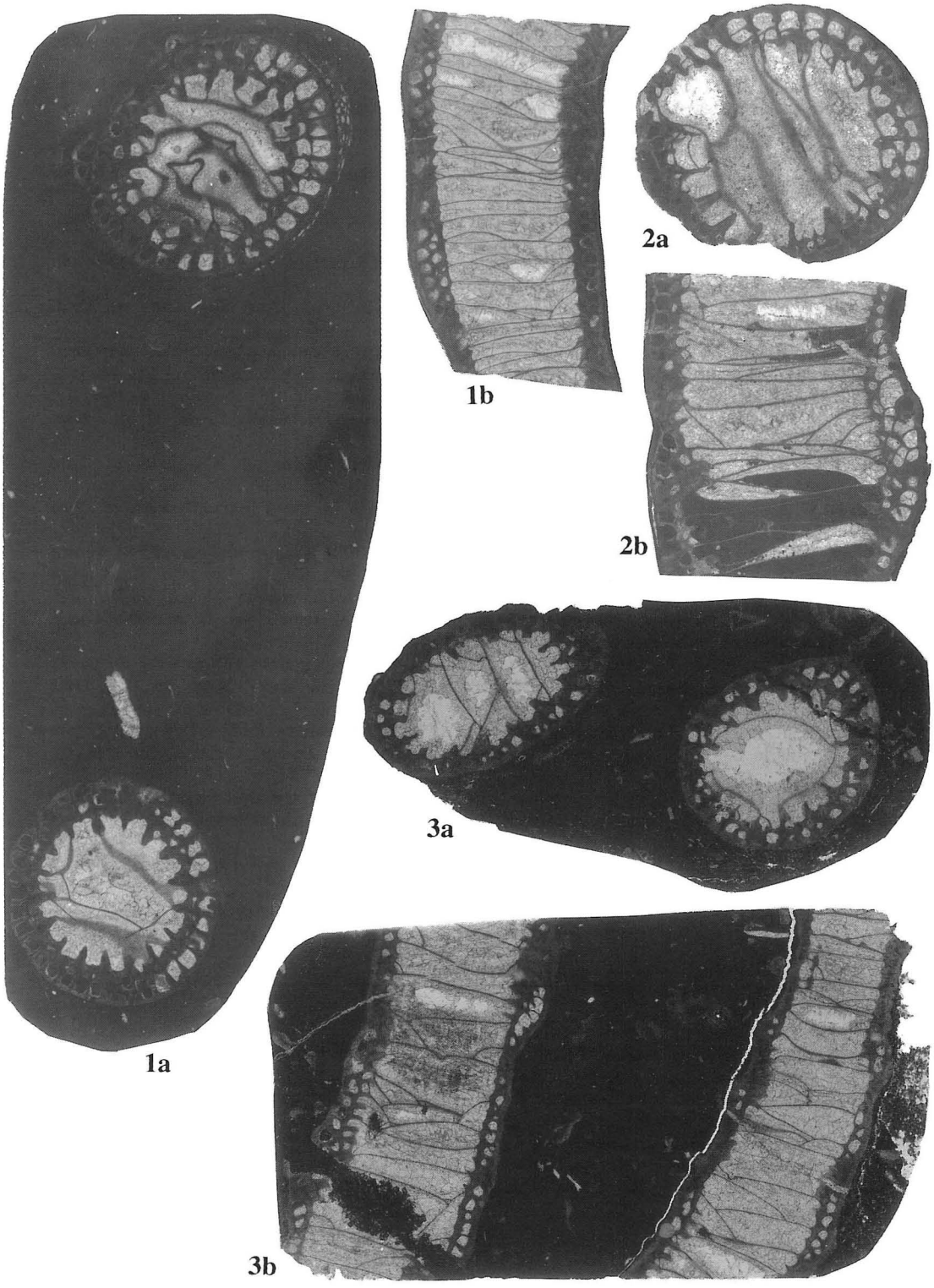
(All figures are ×6)

Fig. 1 *Neoacinophyllum planotabulatum* (Sung). Mf005027, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Neoacinophyllum planotabulatum* (Sung). Mf005010, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Neoacinophyllum planotabulatum* (Sung). Mf005013, 3a. transverse section; 2b. longitudinal section.

Plate 55



Neoacinophyllum

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Explanation of Plate 56

(All figures are ×6)

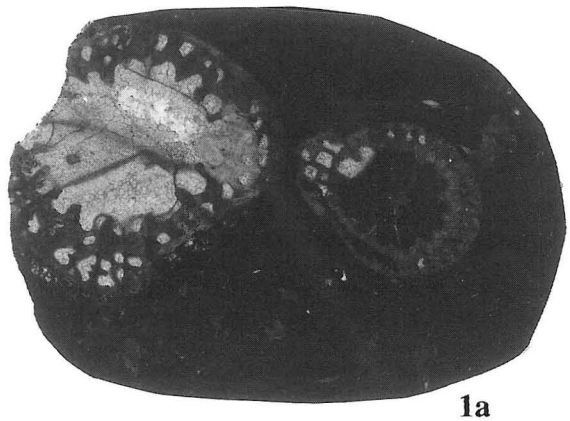
Fig. 1 *Neoacinophyllum planotabulatum* (Sung). Mf005014, 1a. transverse section; 1b. longitudinal section, showing lateral increase.

Fig. 2 *Neoacinophyllum planotabulatum* (Sung). Mf005020, 2a. transverse section; 2b. longitudinal section.

Fig. 3 *Neoacinophyllum planotabulatum* (Sung). Mf005025, 3a, 3b. both transverse sections at two different diameters; 3c. longitudinal section.

Fig. 4 *Neoacinophyllum planotabulatum* (Sung). Mf005008, 4a. transverse section; 4b. longitudinal section.

Plate 56



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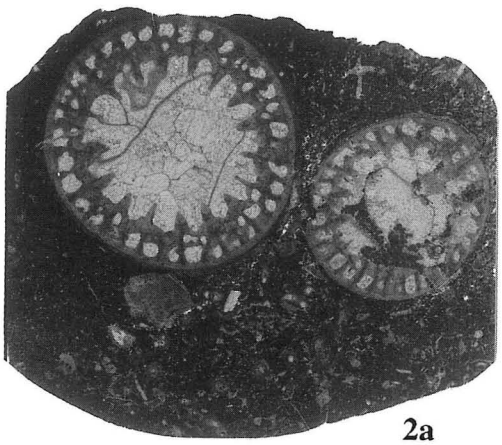
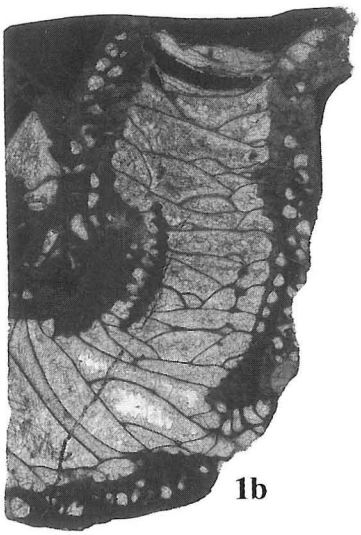
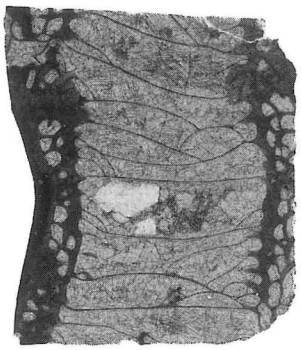


2a



1b

3a



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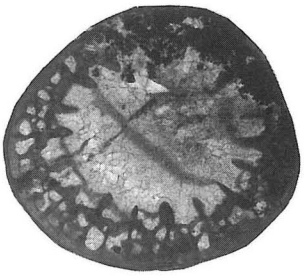

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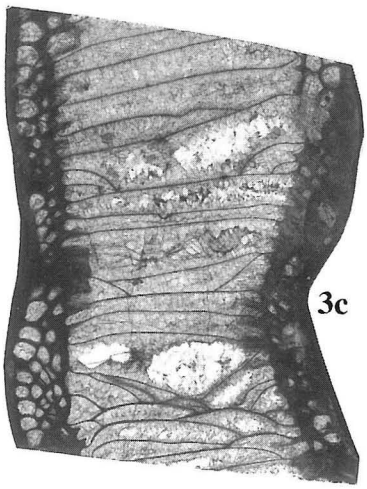
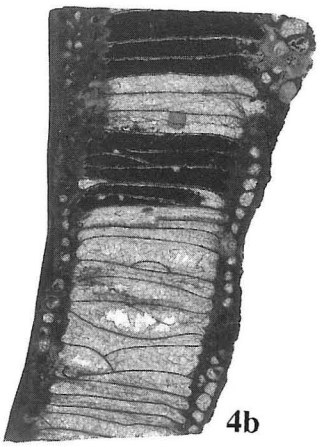


3c

4a



4b

Neoacinophyllum

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Explanation of Plate 57

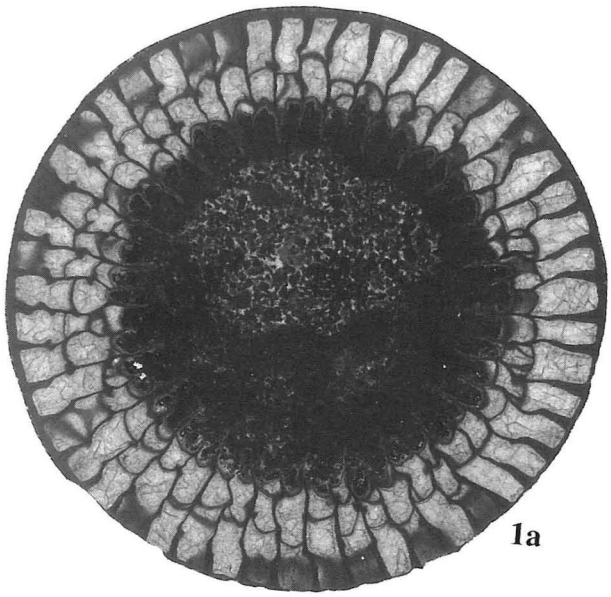
(All figures are ×6)

Fig. 1 *Neoacinophyllum sp.* Mf004004, 1a. transverse section; 1b. longitudinal section.

Fig. 2 *Neoacinophyllum canopotabulatum* gen. et sp. nov. Mf004010 (Holotype), 2a. transverse section of late stage; 2b. transverse section of early stage; 2c. longitudinal section.

Fig. 3 *Neoacinophyllum crassiseptatum* (Ehlers et Stumm). Mf005002, 3a. transverse section; 3b. longitudinal section.

Plate 57



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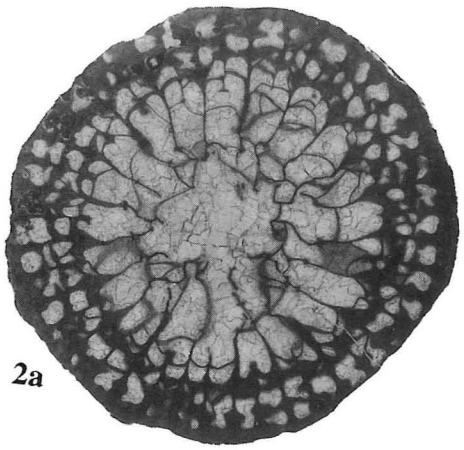

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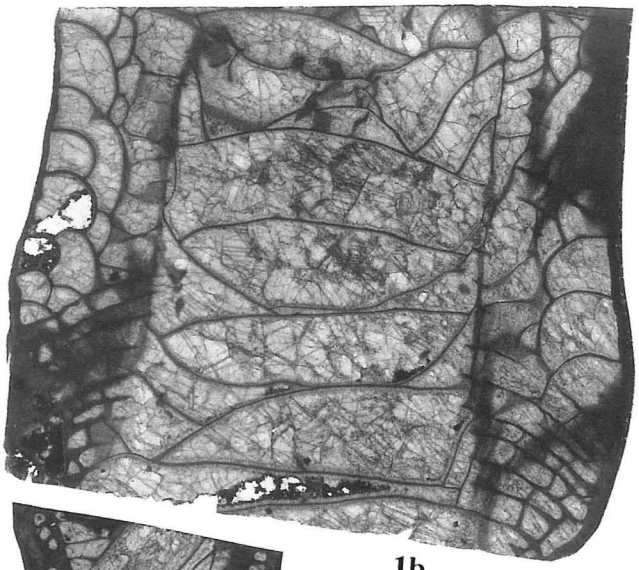

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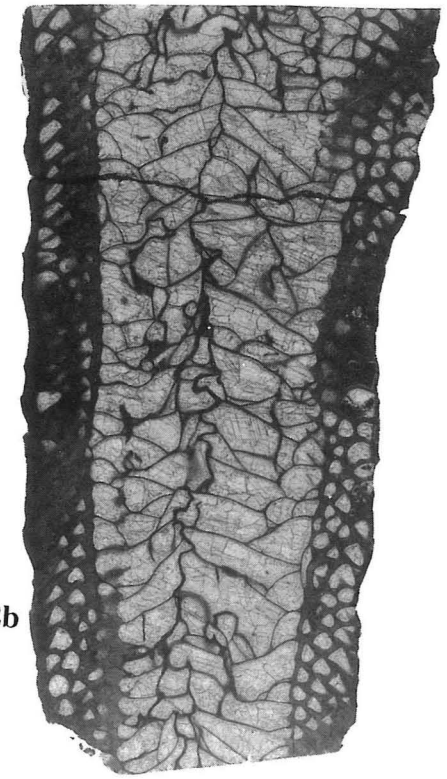

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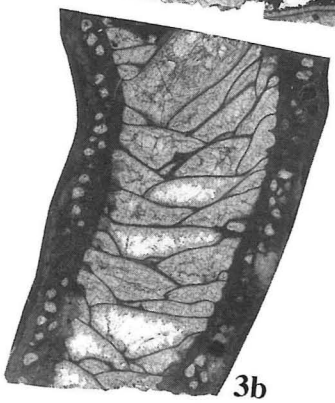

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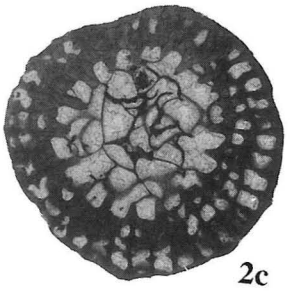

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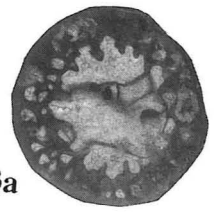

3a

Neoacinophyllum

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Explanation of Plate 58

(All figures are ×4)

Fig. 1 *Acinophyllum rectiseptatum* (Rominger). Mf00x042, 1a. transverse section, 1b. longitudinal section.

Fig. 2 *Acinophyllum rectiseptatum* (Rominger). Mf004011, 2a. transverse section; 2b. longitudinal section.

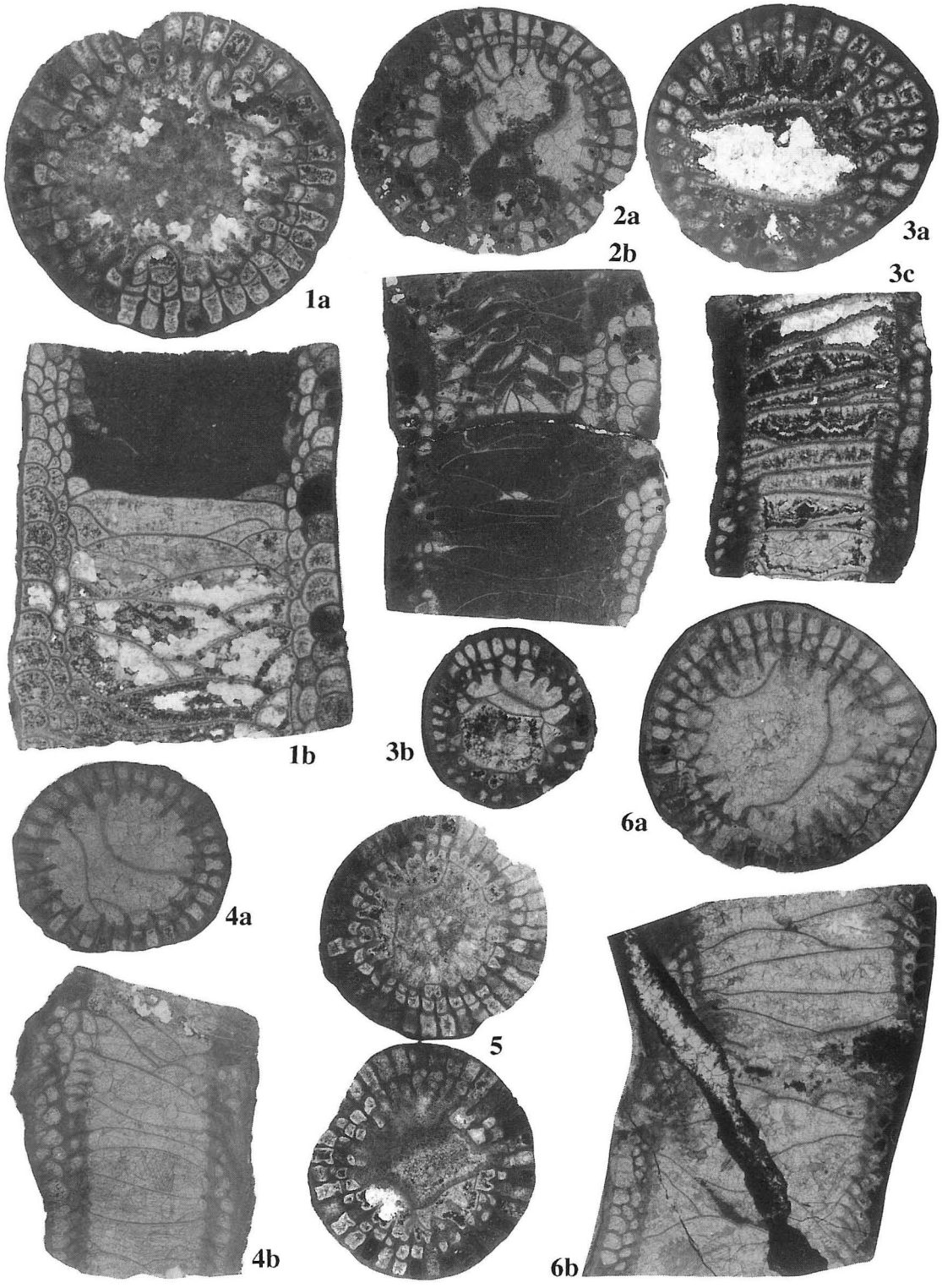
Fig. 3 *Acinophyllum rectiseptatum* (Rominger). Mf010018, 3a, 3b. both transverse sections at two different diameters; 3c. longitudinal section.

Fig. 4 *Acinophyllum rectiseptatum* (Rominger). Hf1046, 4a. transverse section; 4b. longitudinal section.

Fig. 5 *Acinophyllum rectiseptatum* (Rominger). Mf00x006, 5. transverse section.

Fig. 6 *Acinophyllum rectiseptatum* (Rominger). Mf010025, 6a. transverse section; 6b. longitudinal section.

Plate 58



Acinophyllum

Rozkowska, M., 1969, Famennian tetracoralloid and heterocoralloid fauna from the Holy Cross Mountains (Poland). *Acta Palaeontol. Polonica*, vol. 14, no. 1, p. 3-187, pl. 1-8.

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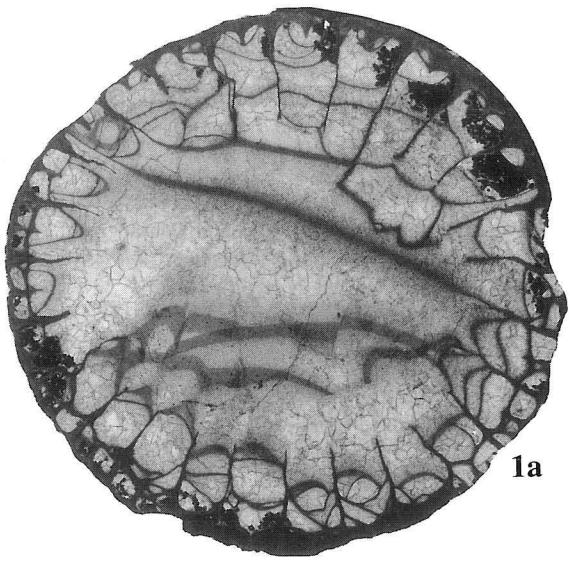
Explanation of Plate 59

Fig. 1 *Tabulophyllum* aff. *gracile* (Walther). Mf004005, 1a. transverse section ; 1b. longitudinal section., ×4.

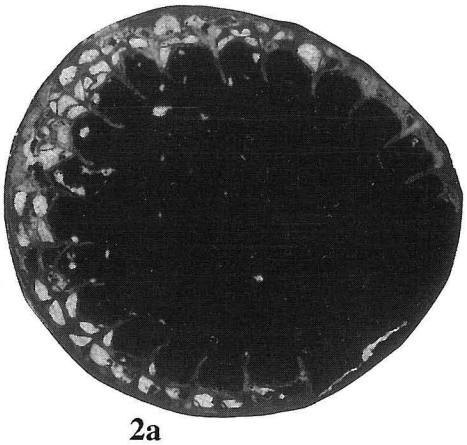
Fig. 2 *Tabulophyllum* aff. *gracile* (Walther). Mf003007, 2a. transverse section through the calyx ; 2b. transverse section of early stage ; 2c. longitudinal section, ×4.

Fig. 3 *Metriophyllum* cf. *carinatum* (Simpson). Mf008046, 3a. transverse section through the calyx ; 3b. longitudinal section, ×5.

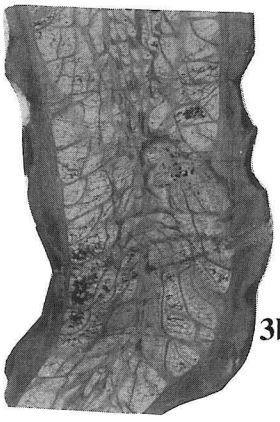
Plate 59



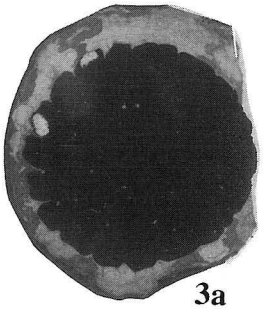
1a



2a



3b



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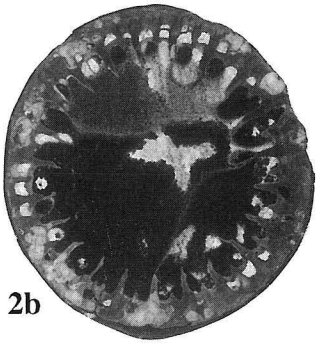
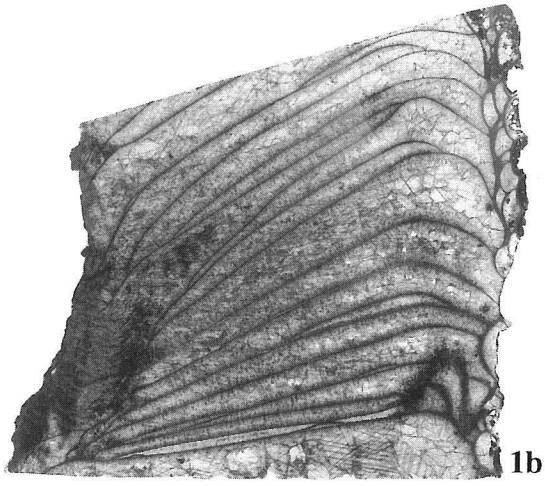
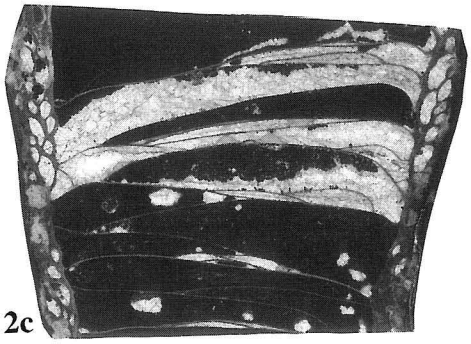


2b



1b



2c

Tabulophyllum* and *Metriophyllum

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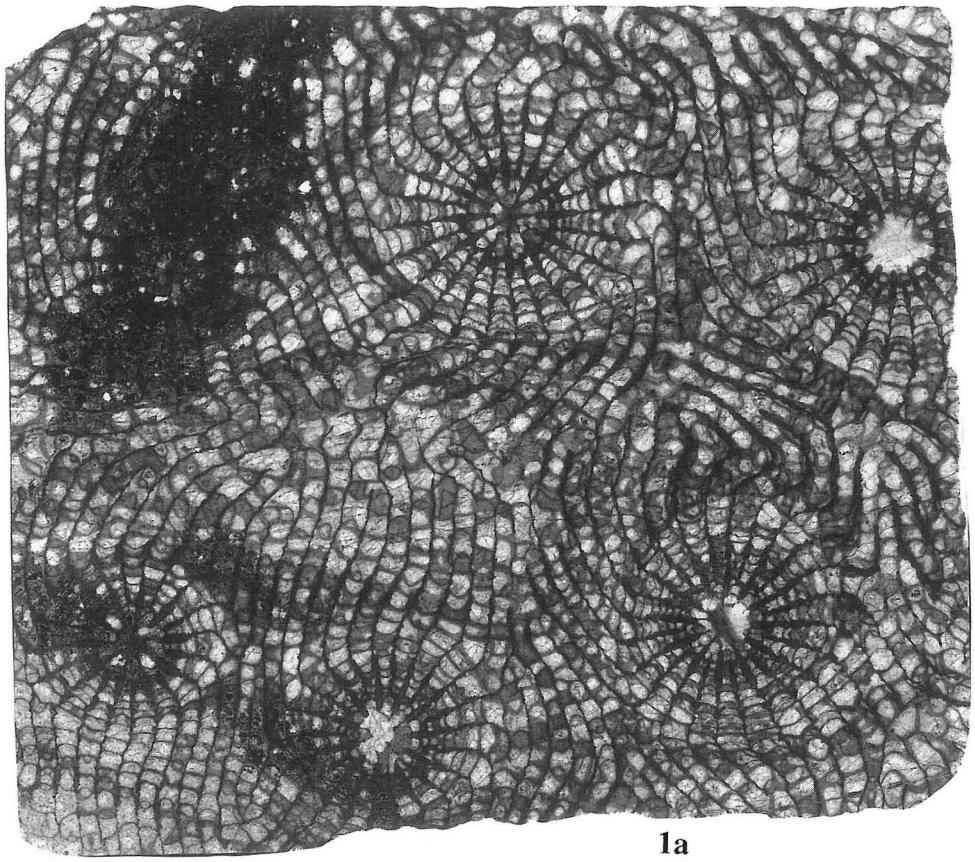
Explanation of Plate 60

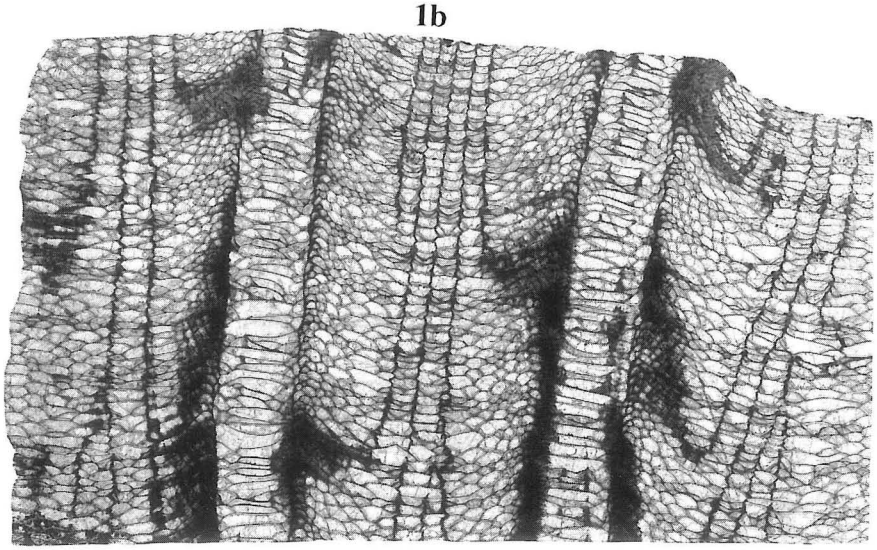
Fig. 1 *Phillipsastrea hennahii* (Lonsdale). Mf004006, 1a. transverse section; 1b. longitudinal section, ×4.

Plate 60



1a

1b



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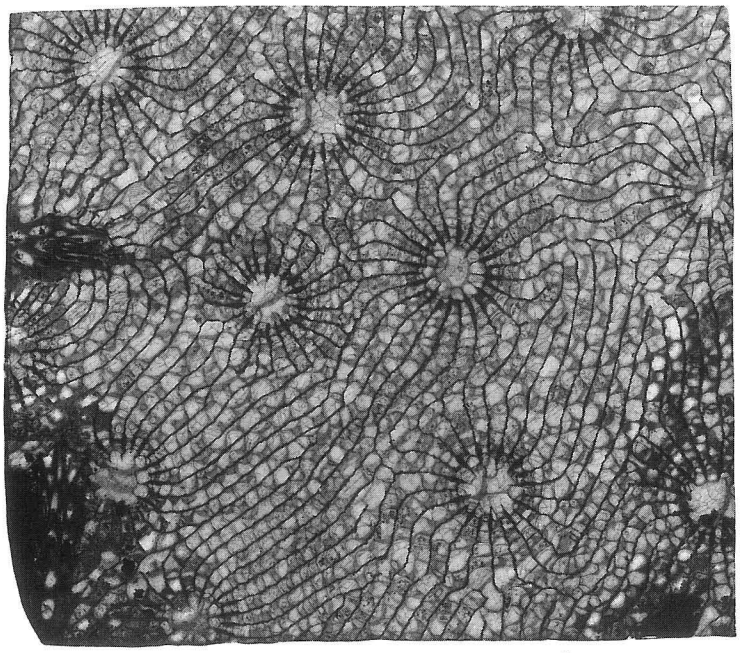
Explanation of Plate 61

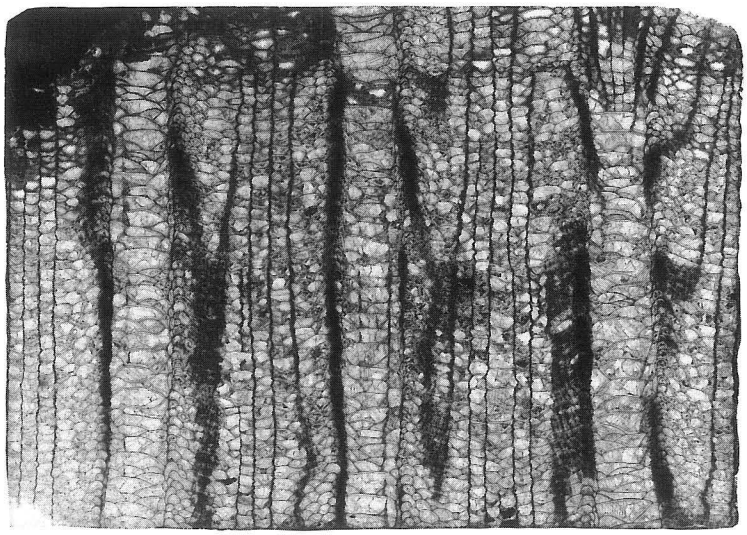
Fig. 1 *Phillipsastrea liujingense* Yü et Kuang. Mf001011, 1a. transverse section ; 1b. longitudinal section, ×4.

Plate 61



1a

1b



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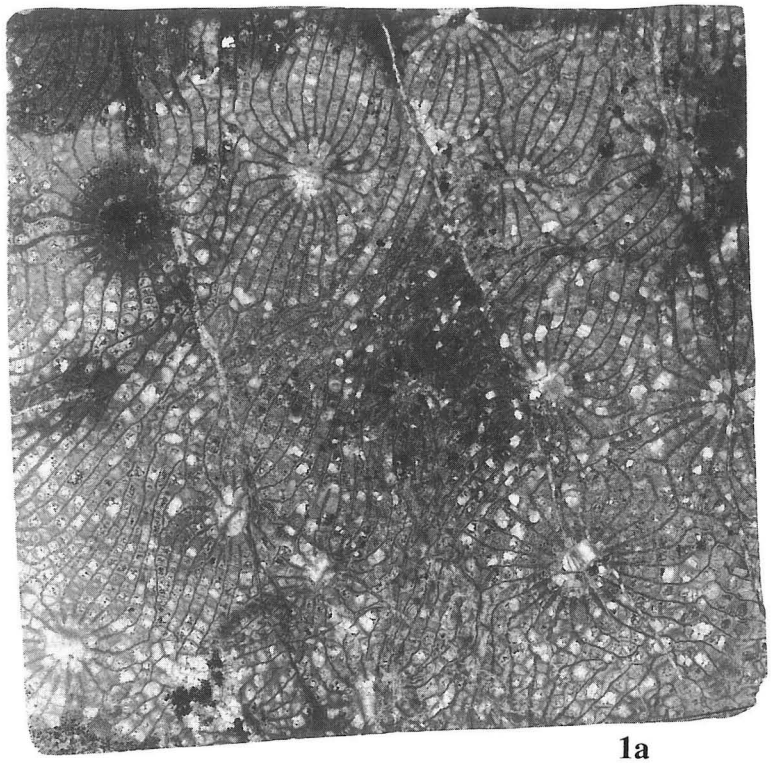
Explanation of Plate 62

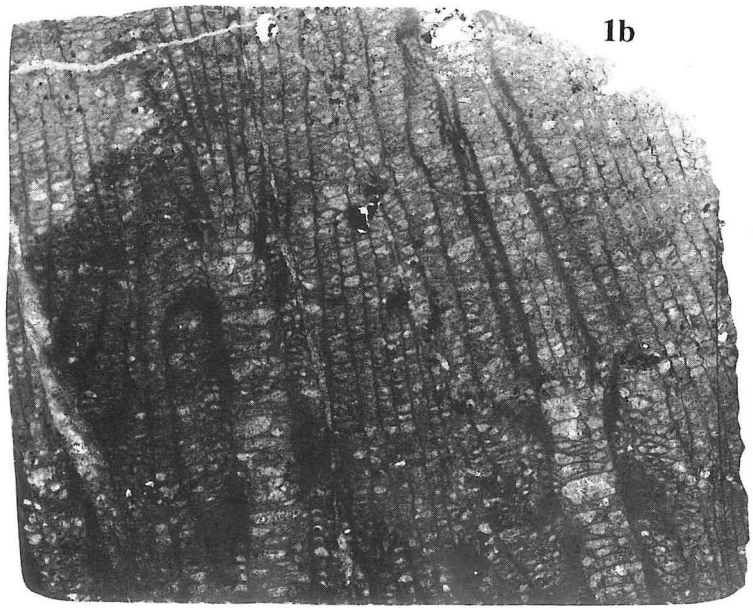
Fig. 1 *Phillipsastrea liujingense* Yü et Kuang. Mf001011, 1a. transverse section ; 1b. longitudinal section, ×4.

Plate 62



1a

1b



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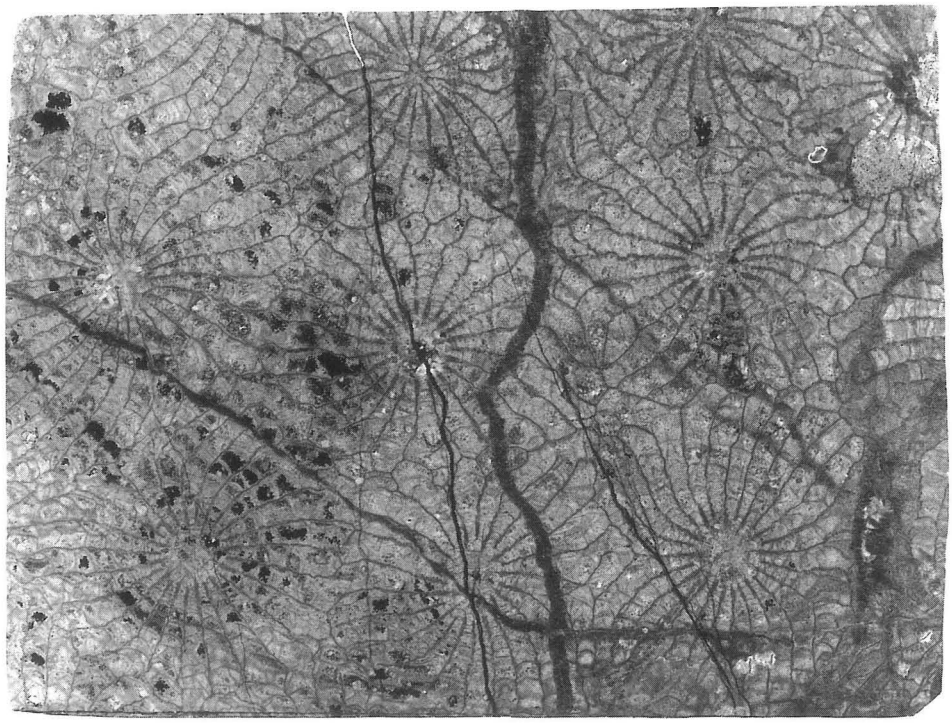
(Manuscript received on April 1, 1993: and accepted on September 20, 1993)

Explanation of Plate 63

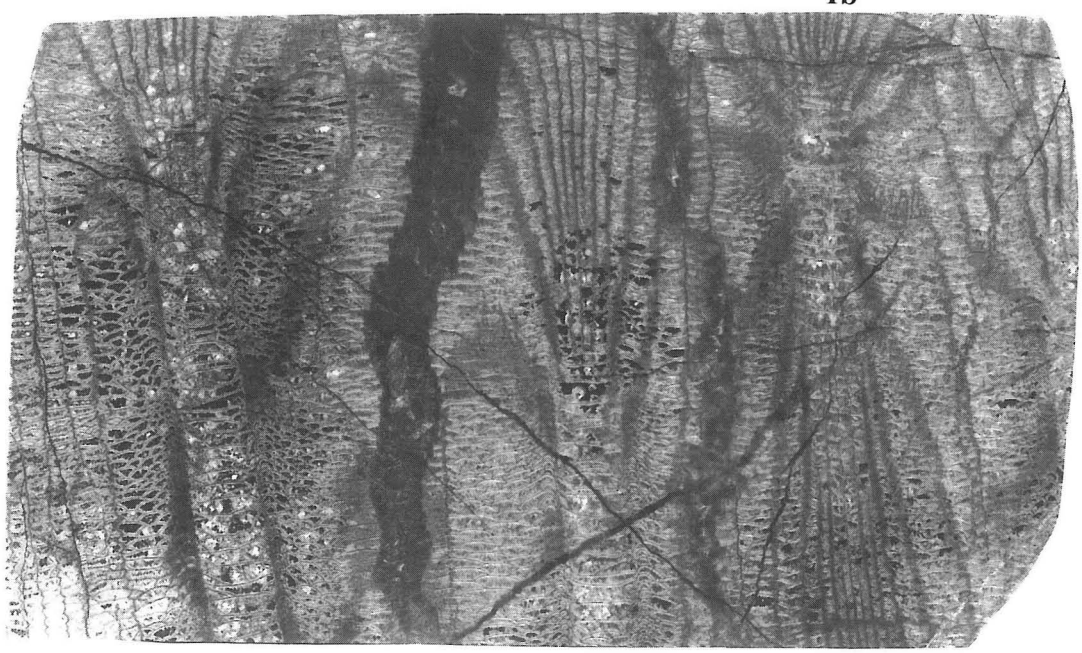
Fig. 1 *Phillipsastrea goldfussi* (de Verneuil et Haime). Mf00x001, 1a. transverse section, 1b. longitudinal section, ×4.

Plate 63



1a

1b



Phillipsastrea