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RESEARCH ARTICLE

# Early Silurian (Telychian) rugose coral fauna of Daguan area, northeast Yunnan Province, China

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**Abstract** Study on rugose coral fauna of the Sifengya Formation (early Telychian) and Daluzhai Formation (mid-late Telychian) in Daguan area, northeast Yunnan Province, China was carried out. Rugose coral fauna of the Sifengya Formation included 18 genera and 34 species, while Daluzhai Formation with nine genera, ten species. We described rugose coral fauna (12 genera, 19 species) including one new genus and five new species, *i.e. Protoketophyllum daguanense* gen. *et* sp. nov., *Crassilasma huanggexiense* sp. nov., *Pseudophaulactis heae* sp. nov., *P. convolutus* sp. nov., and *Shensiphyllum minor* sp. nov.. The characteristics and geological significance of rugose coral fauna of Sifengya Formation and Daluzhai Formation were analyzed. Particularly, rugose coral fauna of the Sifengya Formation represent early Telychian rugosan fauna in the Upper Yangtze region and improve the sequences of early Silurian (Llandovery) rugose coral assemblages in Yangtze region. It is therefore very meaningful to further analyze radiation period of rugose coral fauna in such epoch.

**Keywords** rugose coral fauna, Telychian, Silurian, Daguan, northeast Yunnan Province, China

## 1 Introduction

Stratum of early Silurian (Telychian) in Daguan area and northeast Yunnan Province yielded rich fossils. From the base to the top, there were Longmaxi Formation (Rhuddanian-early Aeronian), Huanggexi Formation (mid-late Aeronian), Sifengya Formation (early Telychian), Daluzhai Formation (mid-late Telychian), and Caidiwan Formation (late Telychian). Rugose coral fauna were richest in the middle and lower part of the Sifengya Formation. Daluzhai Formation also included rich rugose coral and Tabulata, but only few corals yielded in Huanghexi Formation (Ye et al., 1983). Some researchers in China usually named the above formations as Daguan Group or Daguan Formation and their adscription on epoch were also different. Wang Hongzhen reported that rugose corals belonged to Daguan Formation found in Huize, Daguan area, northeast Yunnan Province, China, but the detailed geographical position was not provided (Wang, 1944;1947). According as recent study by Rong Jiayu (Rong et al., 1996), Daguan Group can be divided into Huanggexi Formation (the lower part) and Sifengya Formation (the upper part) which belongs to Lower Silurian. According as recent information provided by Rong Jiayu 2004 (MS) (Fig. 1) based on the biostratigraphic research, the Sifengya Formation might belong to early Telychian, and the Daluzhai Formation assigned to middle-late Telychian. In this paper, all the study coral samples came from 2 resources. On the one hand, the one of the authors (Chen Jianqiang) collected the samples from the Huanggexi Formation (corresponding Sifengya Formation) in Daguan County, northeast Yunnan Province, China in the 1980s of the last century. The late He Yuanxiang, a Professor in former Chengdu Institute of Geology and Mineral Resources, gave us coral slices, most of which were collected from the Sifengya Formation and Daluzhai Formation of Huanggexi section in Daguan County, northeast Yunnan Province, China, and few from the Daluzhai Formation beside the road in the Huangjingba, Qaguan County (Fig. 2).

## 2 Rugose coral fauna of Sifengya Formation (early Telychian)

In Daguan area, the lower-middle part of the Sifengya Formation from the Huanggexi and Huangjinba sections

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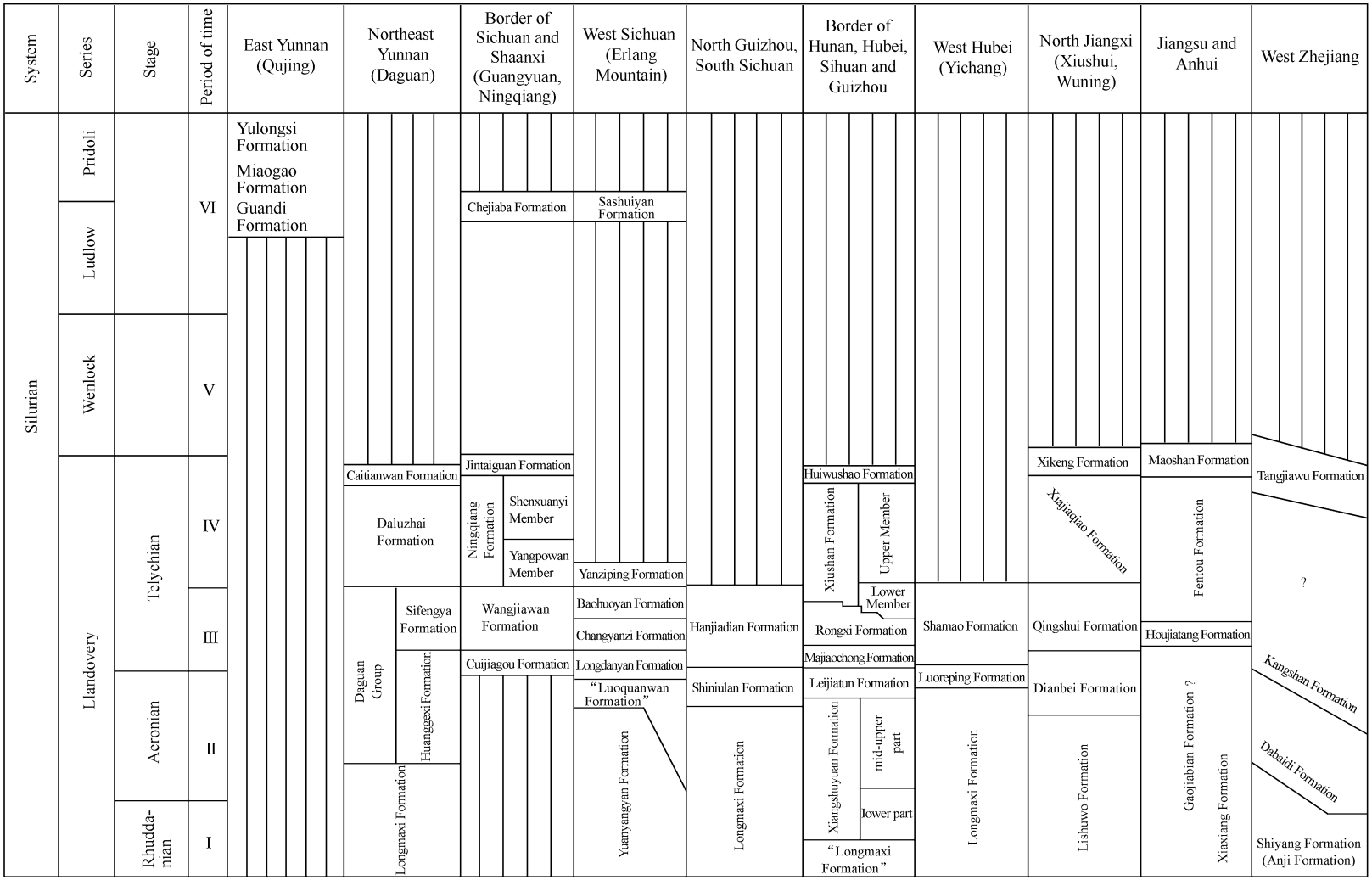
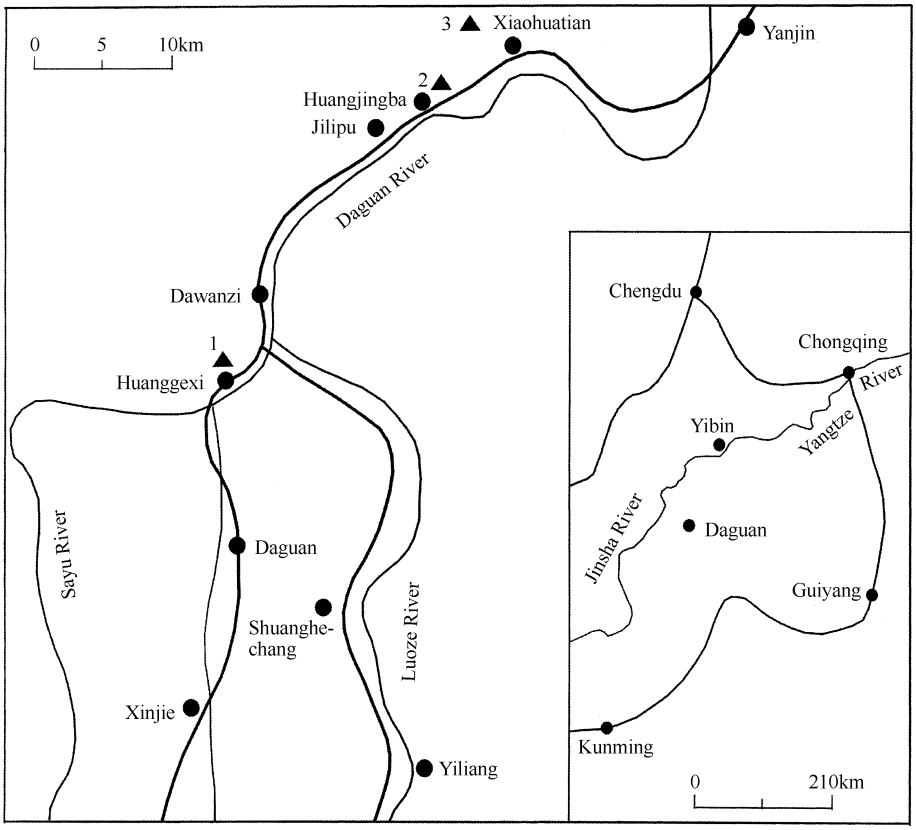



**Fig. 1** Correlation of Silurian in South China [after Rong *et al.*, 1996; Rong, 2004 (MS)]




▲: showing coral localites; 1: Huanggexi; 2: Huangjinba; 3: Xiaohuatian

**Fig. 2** Sketch map showing the localities of the Early Silurian rugose coral in Daguan County, Yunnan Province, China

yield abundant rugose corals. Based on numerous rugosan sample study and identification collected from the Sifengya Formation and including He Yuanxiang has provided coral samples (vague statement). Altogether, 18 rugosan genera and 34 species (Table 1) were found from the Sifengya Formation. Among them the streptelasmatid corals are dominating with eight genera. The second is columnariid corals with six genera, while the cystiphyllid generic number is the least. Individual genus of cystiphyllid corals such as *Protoketophyllum* has higher diversity and numerous fossils. It should be pointed out that in the Sifengya Formation (early Telychian), the streptelasmatids *crassilasma* and *Pseudophaulactis* are most abundant including some Llandovery Siberian elements such as *Crassilasma simplex* and *C. completum*, while last two species are found for the first time in the Yangtze region. In addition, the Sifengya Formation showed larger solitary coral; namely, *Schlotheimophyllum* sp. which has been found from the Xiangshuyuan and Leijiatun formations (Aeronian) in northeastern Guizhou (He and Chen, 2003). However, the latter only has small to medium-sized corallite. The authors proposed that the large solitary *Schlotheimophyllum* occurred in the Sifengya Formation in Daguan is likely to have originated from a certain species of the medium-sized *Schlotheimophyllum* which yielded from the Aeronian strata in northeastern Guizhou, since the large form *Schlotheimophyllum* found in the Sifengya Formation (early Telychian) possess relatively complex skeletal structures. The columnariid corals of the Sifengya Formation are mainly composed of *Palaeophyllum* and *Strombodes*. In this formation, only few *Cystiphyllum* and *Dentilasma honorabilis* occurred and are usually found in Siberia (late Llandovery), and a few species of ketophyllids, belonging to Cystiphyllida. Since these ketophyllids in which septa are developed weakly and short without tabula fossula, usually with 1~2 affsets in the calical margin, the characteristics mentioned above proved to be significantly different from those of genus *Ketophyllum*. Therefore, the authors regarded these corals as a new genus *Protoketophyllum*.

In summary, rugose coral fauna of the Sifengya Formation (early Telychian) in Daguan area, northeast Yunnan Province, has relationship with those in Leijiatun Formation (middle-late Aeronian) in Shiqian area, Guizhou Province, China. All the 18 genera were gradually derived from middle-late Aeronian and showed significantly difference with rugose coral fauna mainly from the Ningqiang Formation (middle-late Telychian) in south Shaanxi Province and north Sichuan Province, China. But the Daluzhai Formation in Daguan area covered nine rugosan genera, eight of which were found in homochronous Ningqiang Formation (middle-late Telychian) in southern Shaanxi Province.

Stratum with coral fossils in Early Silurian Aeronian-

**Table 1** Rugosan genera and species of the Sifengya and Daluzhai formations from Daguan area, Yunnan Province

| Epoch | Formation | Genera and species |
|---|---|---|
| Middle and late Telychian | Daluzhai Formation | *Gyalophylloides huanggensis*(Y.X.He)<br>*Pseudophaulactis* sp., P. *convolutus* sp. nov.<br>*Pilophyllia intermedium* Cao., P. sp.<br>*Nanshanophyllum* sp., *Oliveria huanggeensis* Y. X. He<br>*Rhabdocyclus* sp., *Tabularia* sp.<br>*Shensiphyllum minor* sp. nov., *Zelophyllum daluzhaiense* Y. X. He |
| Early Telychian | Sifengya Formation | *Brachyelasma* sp., *B. sibiricucm* Nikolaeva, *Briantelasma desum* He *et* Chen, *B.* cf. *involutum* He *et* Chen, *Crasssilasma roboriseptatum* (Y. X. He), C. *simplex* Ivanovsky, C. *completum* (Nikolaeva), C. cf. *leijiatunense* He *et* Chen, *C. daguanease* Y. X. He, *C. huanggexiense* sp. nov., *C.* cf. *completum, Cystiphyllum* sp., *Dentilasma honorabilis* Ivanovsky, *D.* sp., *Eostauria minor* (Chen), *Entelophyllum* sp., *Kodonophyllum* sp., *Microplasma* sp., *Palaeophyllum* sp., *P.* sp. A, *P.* sp. B., *Protoketophyllum daguanense* gen. et sp. nov., *P. shiniulanense* (Y. X. He), *P. yanjinense* (Y. X. He), *Pseudophaulactis heae* sp. nov., *P. convolutus* sp. nov., *P.* sp., *Pycnactis* cf. *mitratus* (Schlotheim), *P.* sp., *Pycnostylus longiseptatus* Y. X. He, *Rhegmaphyllum* sp., *Schlotheimophyllum* sp., *Strombodes irregularis* Y. X. He, *S. socialis* (Soshkina), *Tabularia* sp. |

Telychian in Daguan area, Yunnan Province was continuous. Rugose coral fauna of the Sifengya Formation (early Telychian) not only possess rich species and are well-preserved but were also characterized with the combination of *Crassilasma-Protoketophyllum*. Such stratum and layer (Sifengya Formation) that yielded abundant rugose corals can mostly represent early Telychian rugose coral fauna of the Yangtze area in China. Rugose coral fauna of the Sifengya Formation were significantly different with those in Leijiatun Formation and Ningqiang Formation, but have some obviously transitional characteristics. Based on other evidences, we deduced that the rugose coral fauna of the Sifengya Formation in Daguan area should belong to early Telychian. We established the combination of *Crassilasma-Protoketphyllum* (gen. nov.) was different from the Leijiatun Formation (Aeronian) that contained *Kodonophyllum-Maikottia* assemblage and Ningqiang Formation (middle-late Telychian) with rugosan assemblage of *Gyalophylloides-Idiophyllum* (Wang and He, 1980; Wang and Chen, 1989; Chen and He, 1997).

## 3 Rugose coral fauna of Daluzhai Formation (middle-late Telychian)

Daluzhai Formation was approximately similar with the middle and upper part of the Ningqiang Formation in southern Shaanxi Province and Xiushan Formation in southeast Sichuan Province, China, and their age belonged to middle-late Telychian (Fig. 1). However, rugose coral fauna of the Daluzhai Formation was inferior compared to those of Ningqiang Formation. Rugose coral fauna in middle-late Telychian represented by Ningqiang Formation included 51 genera, but Daluzhai Formation only possessed nine genera (Table 1), eight of which can be found in Ningqiang Formation. It was possible that the epoch of Daluzhai Formation was earlier than that of Ningqiang Formation and that rugose coral fauna of the Sifengya Formation have close relationship with fauna of Aeronian in northern Guizhou Province. Another possible explanation was that the deposit layers of the two areas are different. Because the later (Ningqiang Formation) was the normal sea carbonate deposit environment and with some small coral reef distribution, coral fossils were rich and many kinds of solitary and compound corals were found characterized by combination of *Gyalophylloides Idiophyllum*. Now, we find qe genera and 11 species in the Daluzhai Formation, among them are some genera and species from the Sifengya Formation, such as *Pseudophaulactis convolatus* sp. nov. The majority of genera or species in Daluzhai Formation were new or immigrating such as *Pilophyllia intermedium, Shensiphyllum, Nanshanophyllum*, possibly originated from the Ningqiang Formation in south Shaanxi Province, China. The rugosan genera in Ningqiang Formation such as *Idiophyllum*, *Kodonophyllum*, *Ningqiangophyllum* were not found in the Daluzhai Formation implying that their stratum layers and ecological communities varied. Rugose coral fauna of the Daluzhai Formation in Daguan area were relatively simple and are characterized by small to middle-size solitary corals. Compared with *Shensiphyllum* from Ningqiang Formation in southern Shaanxi Province, the Daluzhai Formation yielding *Shensiphyllum* is characterized by small size, narrow dissepimentarium, and undifferentiated tabulae. In addition, *Shensiphyllum is* associated with *Nanshanophyllum* in the same bed. Therefore, the epoch of the Daluzhai Formation was obviously earlier than that of Ningqiang Formation. Such coral fauna of the Daluzhai Formation mainly included *Pilophyllia*, *Shensiphyllum*, *Pseudophaulactis*, etc.

**Description of new genus and new species:**

**Order Cystiphyllida Nicholson, 1889**

**Family Ketophyllidae Lecompte, 1952**

**Genus *Protoketophyllum* gen. nov.**

**Type species.** *Protoketophyllum daguanense* gen. *et* sp. nov., Lower Silurian, Sifengya Formation (early Telychian), Huanggexi, Daguan County, northeast Yunnan, China.

**Diagnosis.** Solitary coral, ceratoid-cylindrical with 1—2 affsets in calical margin or not, septa discontinuous forming short septal spines, but not continued into tabularium. Septa are composed of fibers trabecular; stereozone narrow, boundary of cystosepimentarium and tabularium is distinct,

without cardinal tabular fossula.

**Remarks**. This new genus is similar to *Dokophyllum* Wedekind (*Ketophyllum* Wedekind,1927), but main differences are that former has no tabular fossula, with short septal spines, and sometimes with 1~2 affsets in calical margin.

**Age and Distribution**. Early Silurian(late Aeronian-Telychian). Yunnan, Guizhou, Sichuan, Shaanxi provinces, China.

***Protoketophyllum daguanense* gen. *et* sp. nov.**

(pl.I, Figs. 1~3, 5)

**Material.** Nine specimens including 13 transverse and longitudinal sections.

**Holotype.** YDH-S 090-091.

**Paratype.** YDH-S 092-094, YDH-S 098.

**Diagnosis.** Solitary with medium conical-cylindrical corallum, with 1~2 affsets in the calical margin; tabulae wide, mostly complete and flat.

**Description.** Moderate conical-cylindrical solitary corallum, maximum diameter of corallum is 25mm. In ephebic stage, 1~2 affsets may appear in calical margin; septa are very short (subtriangle), they are merely developed in narrow stereozone and some marginal cysto-sepiment. Marginal zone consist of 4~6 rows cystose piment; generally, width of tabulae reaches to length of 1/2 of diameter of the corallite. Tabulae are most complete, flat or concave, tabular distribution is not regular, without tabular fossula.

**Comparison**. Type species *Protoketophyllum daguanense* is similar to *Protoketophyllum yanjinense* (He, 1978) in some respects but it differs from latter in having 1~2 affsets in calical margin in ephebic stage, with a larger corallum and wider marginal zone.

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation (early Telychian), Huanggexi and Liangfengya, Daguan County, Yunnan Province, China

***Dentilasma* Ivanovsky, 1962**

***Dentilasma honorabilis* Ivanovsky, 1962**

Pl.I,fig. 4

1962 *Dentilasma honorabilis* Ivanovsky, P.155, Pl.1, Fig. 2.

1963 *Dentilasma honorabilis* Ivanovsky, P.109, Pl.26, Fig. 3.

1974 *Dentilasma honorabilis*, Ge and Yu, P.168, Pl. 72, Fig. 1,2.

**Material**. Only one specimen with two transverse and longitudinal sections

**Description.** Solitary with small ceratoid corallum, diameter of corallite is 13mm during the ephebic stage. Marginal stereozone composed of short septal ridges in lateral contact. In the longitudinal section cystosepimentarium consisted of 1~3 rows larger cystosepiments, boundary of tabularium and cystosepimentarium was distinct. Tabulae were mostly complete, nearly flat, sometimes with tabellae. Spacing of tabula was generally 1~2 mm, a few of septal spines occasionally developed in cystosepiment especially in peripheral edges.

**Remarks**. In corallum size and form feature, this specimen was closely similar to *Dentilasma honorabilis* described by Ivanovsky (1963, P. 109, Pl. 26, Fig. 3) (Ivanovskiy 1963), main differences are that former marginal zone consisted of 1~3 rows cystosepiments while latter ones only developed 1~2 rows cystosepiments; in addition, in the former cystosepimentarium occasionally appeared septal spines. It should be pointed out that the species *Dentilasma honorabilis* described by Ge and Yu (1974) yielded from Xiangshuyuan Formation (middle Llandovery) in Yinjiang area, northeastern Guizhou was referred to type species *D.honorabilis* is problematic, because that specimen possessed a wide dissepimentarium composed of 4~5 rows cyscystosepimentarium and most of tabulae were incomplete as it may be a new species.

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation (early Telychian). Huanggexi, Daguan County, Yunnan Province, China.

**Order Streptelasmatida Verril, 1865**

**Family Streptelasmatidae Nichoson, 1889**

**Genus *Crassilasma* Ivanosky, 1962**

***Crassilasma simplex* Ivanovsky**

Pl. Ⅱ. Fig. 3

1962 *Crassilasma simplex* Ivanovsky, P.154, Pl.1, Fig. 1

1963 *Crassilasma simplex* Ivanovsky, P.217, Pl.4, Fig. 1

1997 *Crassilasma simplex* Ivanovsky, He xinyi *et al*., P.434, Pl. Ⅱ, Fig. 11

**Material**. Three specimens including six transverse and longitudinal sections

**Description**. Solitary with medium-sized corallum, maximum diameter of corallite is 16 mm. Major septa are strongly dilated in lateral contact in neanic stage, but they slightly thinned in ephebic stage and extended to center of corallite with convolute. Minor septa are very short, sometimes they poorly developed. Cardinal fossula is lacking. Number of major septa is 38 in corallum diameter of 16mm. Tabulae are rare, complete, convex in boders, and slightly cancave in middle part.

**Remarks**. Ivanovsky (1963) has described the type species *Crassilasma simplex* with long minor septa and a conspicuous cardinal fossula (Ivanovsky 1963). Based on observation of the illustration (Ivanovsky 1963, Pl.4, Fig. la). We believed that the type species actually has no minor septa or rudimental. In Ivanovsky's illustration which long septa are all to belong major septa in fact, and the cardinal fossula only developed in neanic stage. We believed that the present specimen characters are basically consistent with *Crassilasma simplex* Ivanovsky, beside the former corallite size is rather smaller, and the septal number is comparatively less.

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation, Huanggexi, Daguan County, Yunnan, Province, China.

***Crassilasma completum* (Nickolaieva)**

Pl.11, Fig. 2

1963 *Crassilasma completum* Ivanovsky, P.30, Pl.5, Fig. 2.

**Material** Five specimens including ten transverse sections and three longituginal sections.

**Description** Small to medium-sized ceratoid solitary corallum, Maximum diameter of corallite is 20 mm. Major septa are strongly dilated in ontogeny, only slightly thinned in late adult stage. Axial ends of major septa slightly broaden and contact with each other, but they did not form axial structure. Minor septa are very short or poorly develop. Microstructures of septal axial part composed of fibrous, but with lamellar tissue involved in both sides. In ephebic stage cardinal septum short, cardinal fossula is lacking, and distal ends of some major septa are whorled in one direction. Number of septa amounts to (32~33)×2 and (34~36)×2 in the corallum diameter 10~11mm and 12~13mm respectively. Tabulae are complete, convex in borders and the middle part is nearly flat.

**Comparison** This specimen is very similar to *Crassilasma completum* (Nickolaieva) described by Ivanovsky (1963) from Siberia, the only difference is that the former corallum diameter (20mm) is smaller than the latter ones (maximum diameter 34mm) and with some complete tabulae.

**Occurrence and Horizon** Same as the preceding species.

***Crassilasma roboriseptatum*** (Y. X. He)

Pl. Ⅱ, Figs. 6, 7.

1978 *Borelasma roboriseptatum* Y.X.He, He Yuan xiang, P.101, Pl.52, Fig. 6.

**Material**. 5 specimers with 10 transvers and longitudinal sections.

**Description.** Solitary with small to medium-sized ceratoid corallum. In neanic stage major septa are strongly thickened in lateral contact and majority of major septa reached to center of corallite but without forming axial structure. During ephebic stage major septa still dilated but became shortened, cardinal septum and cardinal fosula are inconspicuous in ontogeny, minor septa are very short. Number of septa is 34×2 and (35~36) ×2 in corallum diameter of 11mm and 15~17mm, respectively. Tabulae are mostly complete with domed-form convex, spacing of tabulae is regular, 7~8 in a space of 5 mm.

**Remarks**. He Yuan Xiang (1978) originally described this species from the Lower Silurian in northeastern Yunnan had identified as genus *Borelasma* (*Borelasma roboriseptatum* Y. X. He.) (He, 1978). Wang and He (1980) believed that the species should be assigned to genus *Crassilasma*, because its cardinal septum did not elongate in ontogeny. The authors agree with Wang's idea. The present specimen is very similar to *Crassilasma roboriseptatum*（Y. X. He）, the only difference is that the latter has a conspicuous cardinal fossula in the ephebic stage.

**Occurrence and Horizon**. Same as the preceding species.

***Crassilasma huanggexiense*** **sp. nov.**

(Pl. Ⅱ, Fig. 4, 5)

**Material**. 8 specimens including 17 transverse and longitudinal sections.

**Holotype**. YDH-S 028-031.

**Paratype**. YDH-S 032-033.

**Diagnosis**. Solitary with ceratoid corallum, major septa strongly dilated in neanic stage and then moderately thickened in ephebic stage; cardinal fossula not conspicuous, minor septa very short, tabulae sparse, most complete and flat.

**Description**. Solitary, small to medium ceratoid corallum, maximum diameter of corallite is 20mm. In neanic stage, major septa are long, strongly dilated in lateral contact, but in ephebic stage major septa become wedge-form, sometimes they are lateral contact in middle parts. Minor septa very short, generally they are confined in the marginal stereozone. Number of septa is (33~35) ×2 and 39×2 in the corallum diameter of 12mm and 19mm, respectively. Narrow cardinal fossula may appear in late ephebic stage. Tabulae are merely developed in late neanic and ephebic stage, sparse, most complete, flat convex or declining. Spacing of tabulae is 2~2.5mm, sometimes, tabulae are augmented by stereozone.

**Comparison**. This new species is similar to *Crassilasma simplex* Ivanovsky in some respects, the main differences are that the former has a narrow cardinal fossula in the ephebic stage and with flat convex, regular distribution tabula. The new species also resembles *Crasssilasma roboriseptatum* (He, 1978), but it differs from the latter by having sparse, flat tabulae, and with very short minor septa.

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation, Huanggexi, Daguan County, Yunnan Province, China.

***Rhegmaphyllum*** **Wedekind, 1927**

***Rhegmaphyllum*** **sp.**

Pl.2, Fig. 9

**Material.** Two specimens including five transverse and longitadinal sections.

**Description**. Solitary, with small ceratoid corallum, in neanic stage major septa are strongly dilated, mostly reached to center of corallite and some of septal inner ends contact with each other. Microstructure of septa composed of fine trabeculae in which may elongate to form septal carinae. During early ephebic stage major septa slightly thinned and septal carinae became rare, but some of septa still dilated in lateral contact. In late ephebic stage major septa are thinned, most septa extended to center of the corallum, minor septa very short, which are generally confined to stereozone. During ephebic stage cardinal fossula is narrow, number of septa is 32×2 in the corallum diameter of 14mm. Tabulae are complete, rare, concave in middle part.

**Comparison**. This uncertain species is somewhat similar to *Rhegmaphyllum* sp. descriped by He (2003) (P.176, Pl.1, Figs.13~15) in some respects (He and Chen, 2003), such as the corallite form, very short minor septa and with narrow stereozone, but the main differences are that the latter possesses a marked cardinal fossula and with a wider stereozone.

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation, Huanggexi, Daguan County, Yunnan Province

China.

**Family Pycnactidae Hill, 1940**

**Genus *Pseudophaulactis* Zaprudskaya, 1963.**

***Pseudophaulactis convolutus* sp. nov.**

(Pl.Ⅲ, Fig. 3－9)

**Material**. 4 specimens with 9 transverse and longitudinal sections.

**Holotype**. YDH-S 060-062.

**Paratype.** YDH-S 063-064.

**Diagnosis**. Solitary, major septa reaching to axis and convoluting in distal ends in neanic to ephebic stage; cardinal fossula conspicuous, tabulae most complete of convex type.

**Description**. Solitary, with medium ceratoid corallum, major septa are long and convoluted in ontogeny. In ephebic stage, major septa of cardinal quadrant become shorter, while counter quadrant septa are still longer. Marked cardinal fossula and short cardinal septum are present in ephebic stage. When maximum diameter of corallite is 15 mm, number of major septa is about 40. Tabulae are merely developed in late neanic to ephebic stage, complete or incomplete, with numerous and close distribution, strongly convex, and spacing of tabulae is 0.5~1 mm.

**Comparison**. This new species differs from other species of the genus by having major septa convoluted in ontogeny, with a conspicuous cardinal fossula and tabulae are numerous, closely spaced.

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation and Daluzhai Formation, Huanggexi,Huangjinba, Daguan County, Yunnan Province, China.

***Pseudophaulactis heae* sp. nov.**

(Pl. Ⅲ, Figs. 4, 5)

**Derivation of name.** The species name is in memory of the rugose coral scholar He Yuanxiang.

**Material**. 10 specimens including 8 transverse and longitudinal sections.

**Holotype**. YDH-S 0171-0173.

**Paratype**. YDH-S 0175-0176.

**Diagnosis**. Solitary, major septa strongly dilated reaching to center in neanic stage and become shortened and thinned in ephebic stage especially in counter quadrant, without cardinal fossula, tabulae most complete, sparse.

**Description**. Solitary with ceratoid-cylindrical corallum, maximum diameter of corallite is 20 mm. Major septa are dilated in lateral contact in early neanic stage but shortened and thinned in late neanic stage. In ephebic stage, major septa have a length of 1/3~1/2 of the radius of corallite. Number of septa is 32×2 and 37×2 in the corallum diameter of 16mm and 20mm, respectively. Minor septa are longer, generally confined in stereozone (width about 2mm). Tabulae are most complete, nearly flat in middle part and convex in lateral parts. Spacing of tabulae is 1~1.5 mm, generally dilated with stereoplasm.

**Comparison.** This new species is similar to *Pseudophaulactis lasius* Ivanovsky (1963) in the early stages, but main differences are that former major septa become much shortened and with sparse tabulae. This new species also resembles *Shiqianophyllum breviseptatum* He and Chen (1997) in some respects, but it differs in having dilated major septa in cardinal quadrant during ephebic stage.

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation, Huanggexi, Daguan County, Yunnan Province, China.

**Family Kodonophyllidae Wedekind, 1927**

**Genus *Schlotheimophyllum* Smith, 1945**

***Schlotheimophyllum* sp.**

Pl.Ⅲ, Fig. 1

**Material.** Only one specimen with two transverse sections and one longitudinal section.

**Description**. Solitary, large trochoid corallum with a wide marginal stereozone. The maximum corallum diameter is 33mm. Septa are strongly dilated in lateral contact. Major septa mostly extended to center of corallite and with twisting in their distal ends. Septal microstructures which trabeculae are multiserially arranged in marginarium and embedded in lamellar tissues of septa. Number of septa is 45×2 in corallum diameter of 33 mm. Tabulae are mostly complete of convex type. Spacing of tubula is about 10 in a space of 5 mm.

**Comparison**. The present specimen is similar to *Schlotheimophyllum* sp. described by He and Chen (2003) (P. 180, Pl.1, Fig. 1,2.) yielding from Leijiatun Formation (Aeronian stage) in Shiqian area, Guizhou (He and Chen 2003), but it differs from the latter in having larger corallite and with sparser tabulae.

**Occurrence and Horizon**. Lower Silwrian, Sifengya Formation, Huanggexi, Daguan County, Yunnan Province, China.

**Order Columnariida Soshkina, 1941**

**Family Stauriidae Milne-Edwads *et* Haime**

**Genus *Palaeophyllum* Billings, 1858**

***Palaeophyllum* sp. A**

Pl.Ⅰ, Fig. 7

**Material**. One specimen including two transverse and longitudinal sections.

**Description**. Fasciculate compound corallum with larger corallite, maximum diameter of corallite reach to 14mm with 6~7 offsets in calical margin, most of major septa are extended to axis, minor septa are short, mariginal stereozone reach to 2~3 mm in width. Tabulae are complete, convex with shaped saddle-like, spacing of tabula is close, with spacing of 0.8－1mm.

**Remarks**. The present specimen is characterized by larger corallite having 6~7 offsets in the calice and with a wide stereozone. Consequently, this specimen may be a new species of genus *Palaeophyllum.* Owing to having only a few of specimens, we originally assigned this specimen to *Palaeophyllum* sp. A.

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation, Huanggexi, Daguan County, Yannan Province, China.

***Palaeophyllum* sp. B**

Pl. Ⅰ, Fig. 8

**Material.** One specimen including two transverse and longitudinal sections.

**Description**. Fasciculate compound corallum with lateral budding increases. Corallite diameter is usually 7~8mm in ephebic stage. Spacing of adjacent corallite is generally less 1 mm. Major septa mostly have a length of 1/2 of radius of corallite, a few of them extending to axis. Minor septa are very short. Septal number is (18~21) × 2 in ephebic stage. Wall of corallite is very thin. Tabulae are complete, slightly concave in borders. Number of tabula raise from five to six in space of 5mm.

**Comparison**. The present specimen is similar to *Palaeophyllum hubeiensis* Ge et Yu yielded from the Loureping Formation (Aeronian) in western Hubei, it differs from latter in having longer major septa and adjacent corallite space is closer (Ge and Yu, 1974).

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation, Huarggexi, Daguan County, Yunnan Province, China.

**Family Amplexidae Chapman, 1893**

**Genus *Tabularia* Soshkina,1937**

***Tabularia turiensis* Soshkina**

Pl.Ⅲ, Fig. 6

**Material**. 3 specimens with 5 transverse and longitudinal sections.

**Description**. Solitary with medium-sized cylindrical-conical corallum, in ephebic stage maximum diameter of corallite is 17mm. During early stages, corallum wall is relatively thin, but it will be augmented in later stages. In inner side of wall are developed numerous septal crest or spines, which may observe in transverse and longitudinal sections(P1. Ⅲ.fig. 6b). Number of septal crest reach to 45 in corallum diameter of 16 mm. Tabulae are complete, nearly flat or slightly concave, spacing of tabula is of 1~2 mm.

**Comparison**. This specimen is close similar to *Tabularia turiensis* Soshkina described by Ivanovsky (1963) from the Middle Silurian (Wenlock) in Ural, but it differs from the latter in having more septal number and with irregular space of the tabulae.

**Occurrence and Horizon**. Lower Silurian, Sifengya Formation, Huanggexi, Daguan County, Yunnan Province, China.

**Family Paliphyllidae Soshkina,1955**

**Genus *Nanshanophyllum* Yu,1956**

***Nanshanophyllum* sp.**

Pl.Ⅲ, Fig. 7

**Material:** One specimen with 2 transverse and longitudinal sections.

**Description:** Solitary, with small trochoid corallum, major septa are extended to center of corallite, minor septa are also long. Septal in dissepimentarium are moderately dilated, and they developed septal carinae. In transverse section, dissepiments appeared as hemicircle or herringbone form. Cardinal fossula is lacking. Number of septa is about 35 × 2 in corallum diameter of 12 mm. Tabulae are divided into two parts: middle part is of convex type, while borders are concave.

**Comparison:** This species is somewhat similar to *Nanshanophyllum typicus* Yu C M, 1956, but it differs from latter in having smaller corallite, and having convex axial tabulae.

**Occurrence and Horizon:** Lower Silurian, Daluzhai Formation, Huanggexi, Daguan County, Yunnan Province, China.

**Family Acervulariidae de Fromentel, 1861**

**Genus *Shensiphyllum* Ge *et* Yu, 1974**

***Shensiphyllum minor* sp. nov.**

(Pl.Ⅲ, Fig. 8)

**Material:** Several specimens with 10 transverse and longitudinal sections.

**Holotype:** YDJ-S 202-203.

**Paratype:** YDJ-S 204.

**Diagnosis:** Fasciculate compound corallum, with small corallite, dissepimentarium is narrow having 1 row horseshoe dissepiments, and 1~2 rows of global dissepiments. Tabulae are complete and convex.

**Description:** Compound corallum is fasciculate, with increase in lateral budding. Corallite is very small as most of them did not reach 2 mm in diameter. Major septa are generally extended to center. Minor septa reach a length of 1/3~1/2, as compared with that major septa. Dissepimentarium consisted of 1 row horseshoe dissepiments, and 1 or 2 rows of global dissepiments in ephebic stage. Tabulae are complete with width reaching half of corallum radius. Central part is convex, with concave borders. Number of tabulae is about 25 in a space of 5mm.

**Comparison:** This new species differs from other species of same genus by having very small corallites, a narrow dissepimentarium, complete tabulae, and closed spacing.

**Occurrence and Horizon:** Lower Silurian, Daluzhai Formation, Huanggexi, Daguan County, Yunnan Province, China.

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**Explanation of plates**

The samples were saved in China University of Geosciences (Beijing).

**Plate Ⅰ**

1－3. *Protoketophyllum daguanense* gen. *et* sp.nov.

1a.1b. same corallum transverse and longitudinal sections, ×2,All seen 1－2 offsets. register no.:YDH-S 090-091 (holotype); 2. calical longitudinal section of another corallite. ×2; register no.: YDH-S 093 (paratype); 3a, 3b. same corallum transverse and longitudinal sections,×2, 3a. calical margin with one offset. Register no.: YDH-S 092-S 094 (paratype). upper Llandovery. Sifengya Formation, Huanggexi, Daguan, Yunnan Province.

4. *Dentilasma honorabilis* Ivanovsky

4a, 4b. corallum transverse and longitudinal sections, all×2, register no.: YDH-S 097. upper Llandovery, Sifengya Formation, Huangjingba, Dagun,Yunnan Province.

5.*Protoketophyllum daguanense* gen.*et* sp. nov.

5a. 5b. same corallum transverse and longitudinal sections, ×2; register no.: YDH-S 098 (paratype). upper Llandovery, Sifengya Formation, Huanggexi, Daguan, Yunnan Province.

6.*Dentilasma* sp.

6a.early stage transverse section of corallite, ×2; 6b. corallum transverse section, ×2; 6c.longitudinal section, ×2; register no.: YDH-S 100. Occurrence and Horizon are same as preceding species.

7. *Palaeophyllum* sp. A

7a. ephebic stage corallite with 7 offsets in calical margin,×3; 7b. same specimen showing the longitudinal section, ×3; register no.: YDH-S 084-085. Occurrence and Horizon are same as preceding species.

8.*Palaeophyllum* sp. B

8a.8b. fasciculate compound transverse and longitudinal sections, ×3; register no.: YDH-S 086-087; Occurrence and Horizon are. same as preceding species.

**Plate Ⅱ**

1.*Crassilasma* sp.

1a,1b. transverse and longitudinal sections, ×2; register no.:YDH-S 057-058. upper Llandovery, Sifengya Formation, Huanggexi, Daguan, Yunnan Province.

2.*Crassilasma complectum* (Nikolaieva)

2a, 2b, 2c. neanic and ephebic stages transverse section, ×2.5; register no.: YDH-S 007-S009.2d.same corallum longitudinal section, ×2.5; register no.: YDH-S 010. Occurrence and Horizon are same as the preceding species.

3. *Crassilasma simplex* Ivanovsky

3a.neanic stage transverse section, ×2.5; 3b, 3c. ephebic stages transverse section, ×2.5; register no.: YDH-S 001-S 003; 3d.same corallum longitudinal section, ×2.5; register No.:YDH-S 004. Occurrence and Horizon are same as the preceding species.

4, 5.*Crassilasma huanggexiense* sp. nov.

4a. neanic stage transverse sectuon, ×2; 4b, 4c. ephebic stage transverse section, ×2 (holotype); 4d. same specimen longitudinal section, ×2; register no.: YDH-S 031 (holotype); register no.: YDH-S 028-S 030;5a,5b.another corallum transverse and longitudinal sections, ×2; register no.: YDH-S 032-33 (paratype). Occurrence and Horizon are same as preceding species.

6,7.*Crassilasma roboriseptatum*(Y. X. He)

6a. neanic stages transverse, ×2; 6b.longitudinal section, ×2; register no.:YDH-S 045;

7a,7b. another corallum neanic and ephebic stages transverse sections, ×2; 7c. same corallum longitudinal section, ×2; register no.:YDH-S 046-047. Occurrence and Horizon are same as the preceding species.

8.*Brachyelasma* sp.

8a, 8b. neanic and ephebic stages transverse sections, ×2.5; 8c. same corallum longitudinal section, ×2.5; register no.:YDH-S 052. upper Llandovery, Sifengya Formation, Huangjingba, Daguan County, Yunnan Province.

9.*Rhegmaphyllum* sp.

9a, 9b. ephebic stages transverse sections, ×2.5; 9c.same

corallum longitudinal section, ×2.5; register no.:YDH-S 0524-056. upper Llandovery, Sifengya Formation, Huangjingba, Daguan,Yunnan Province.

**Plate Ⅲ**

1. *Schlotheimophyllum* sp.
1a, 1c. early and late ephebic stage transverse sections, ×2; 1b.longitudinal sections, ×2; register no.: YDH-S 081-083. upper Llandovery, Sifengya Formation, Huanggexi, Daguan, Yunnan Province.
2. *Kodonophyllum* sp.
2a. neanic stage transverse section, ×2; 2b. calical transverse section, ×2; 2c.same corallum longitudinal section, ×2; register no.: YDH-S 079-081, Occurrence and Horizon are same as preceding species.
3,9. *Pseudophaulactis convolutus* sp.nov.
3a,3b. neanic and ephebic stages transverse sections, ×2.5; 3c.longitudinal section, ×2.5;
register no.: YDH-S 060-062 (holotype); Occurrence and Horizon are same as preceding species. 9. another corallite ephebic stage transverse section, ×2.5, register no.: YDH-S064. upper Llandovery, Sifengya Formation and Daluzhai Formation Huangjingba, Daguan, Yunnan Province.
4,5. *Pseudophaulactis heae* sp.nov.
4a,4b. same corallum neanic and ephebic stages transverse sections, ×2; 4c.longitudinal section, ×2; register no.: YDH-S 071-073 (holotype). 5a, 5b. another corallum transverse and longitudinal sections, ×2; register no.: YDH-S 075-076 (paratype). upper Llandovery, Sifengya Formation, Huanggexi, Daguan, Yunnan Province.
6.*Tabularia turiensis* Soshkina
6a,6b. same corallum transverse and longitudinal sections, ×2; register no.: YDH-S 101; Occurrence and Horizon are same as preceding species.
7. *Nanshanophyllum* sp.
7a,7b. same corallum transverse and longitudinal sections; register no.: YDJ-S 200-201. upper Llandovery, Daluzhai Formation, Huanggexi, Daguan, Yunnan Province.
8. *Shensiphyllum minor* sp. nov.
8a,8b. transverse sections, ×6; register no.: YDJ-S 200-202 (holotype). upper Llandovery, Daluzhai Formation, Huanggexi, Daguan, Yunnan Province. 8c. longitudinal section, ×6; register no.: YDJ-S 204 (paratype) Occurrence and Horizon aresame as preceding species.

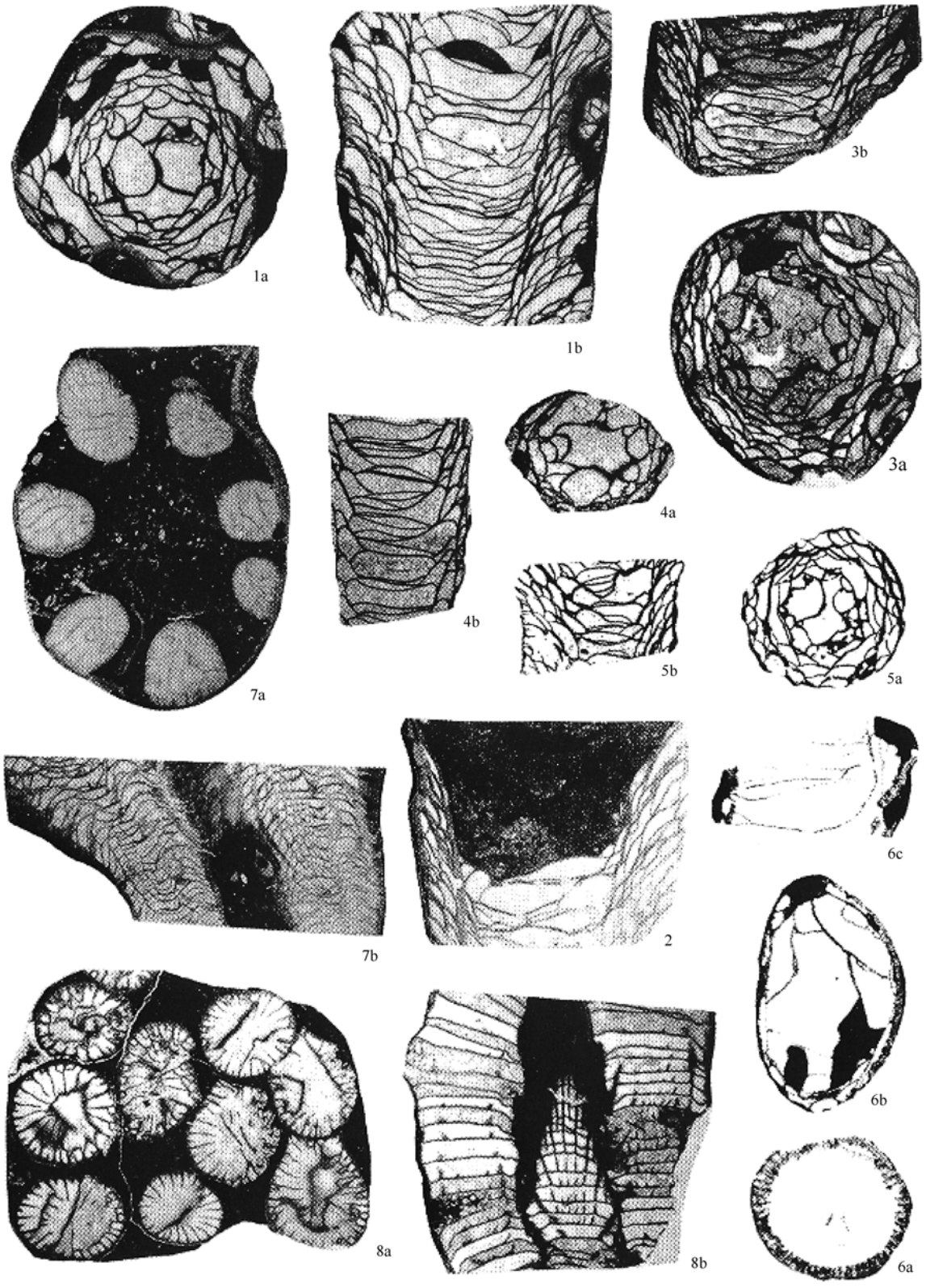


Plate-I

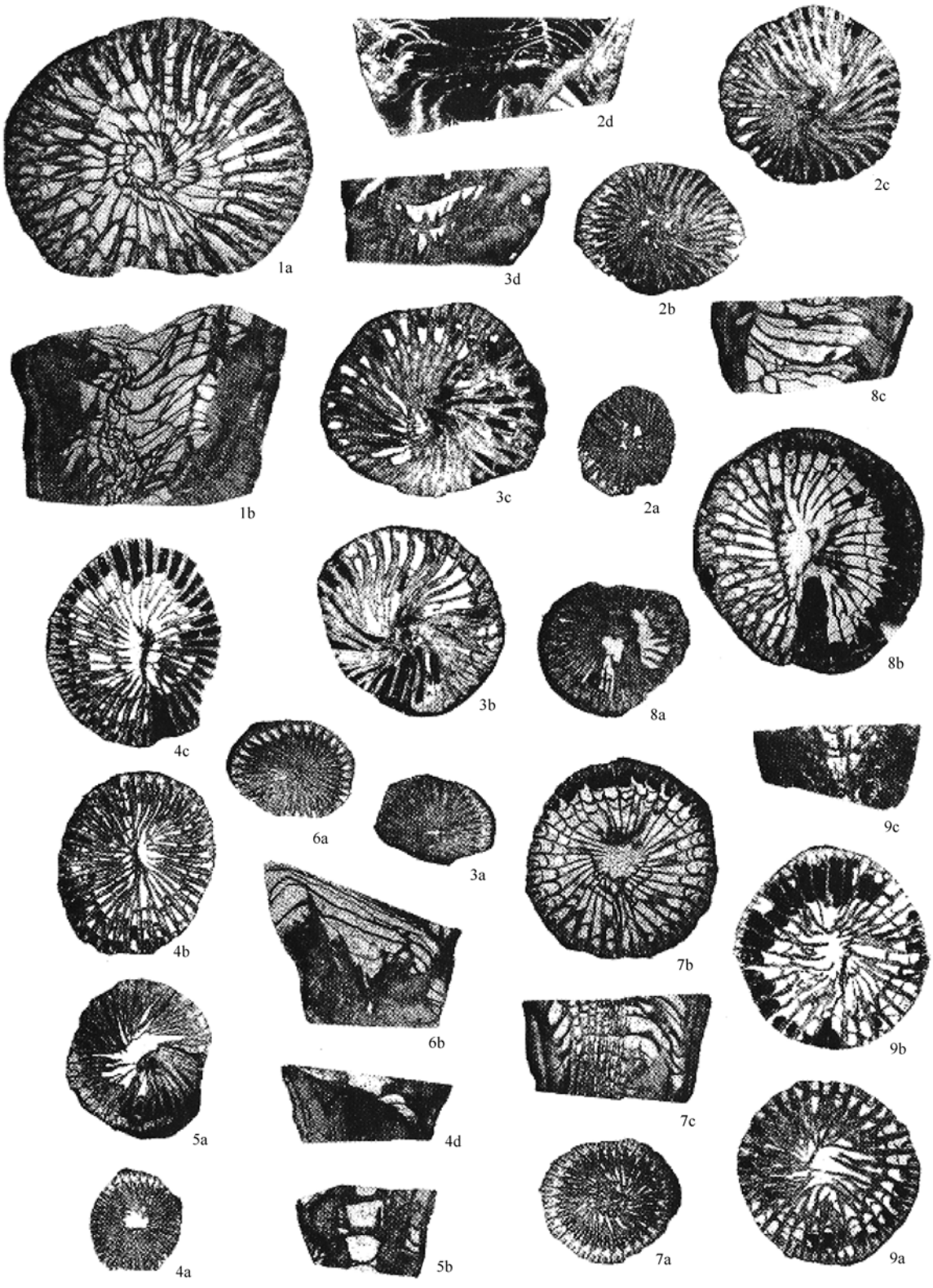
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Plate-II

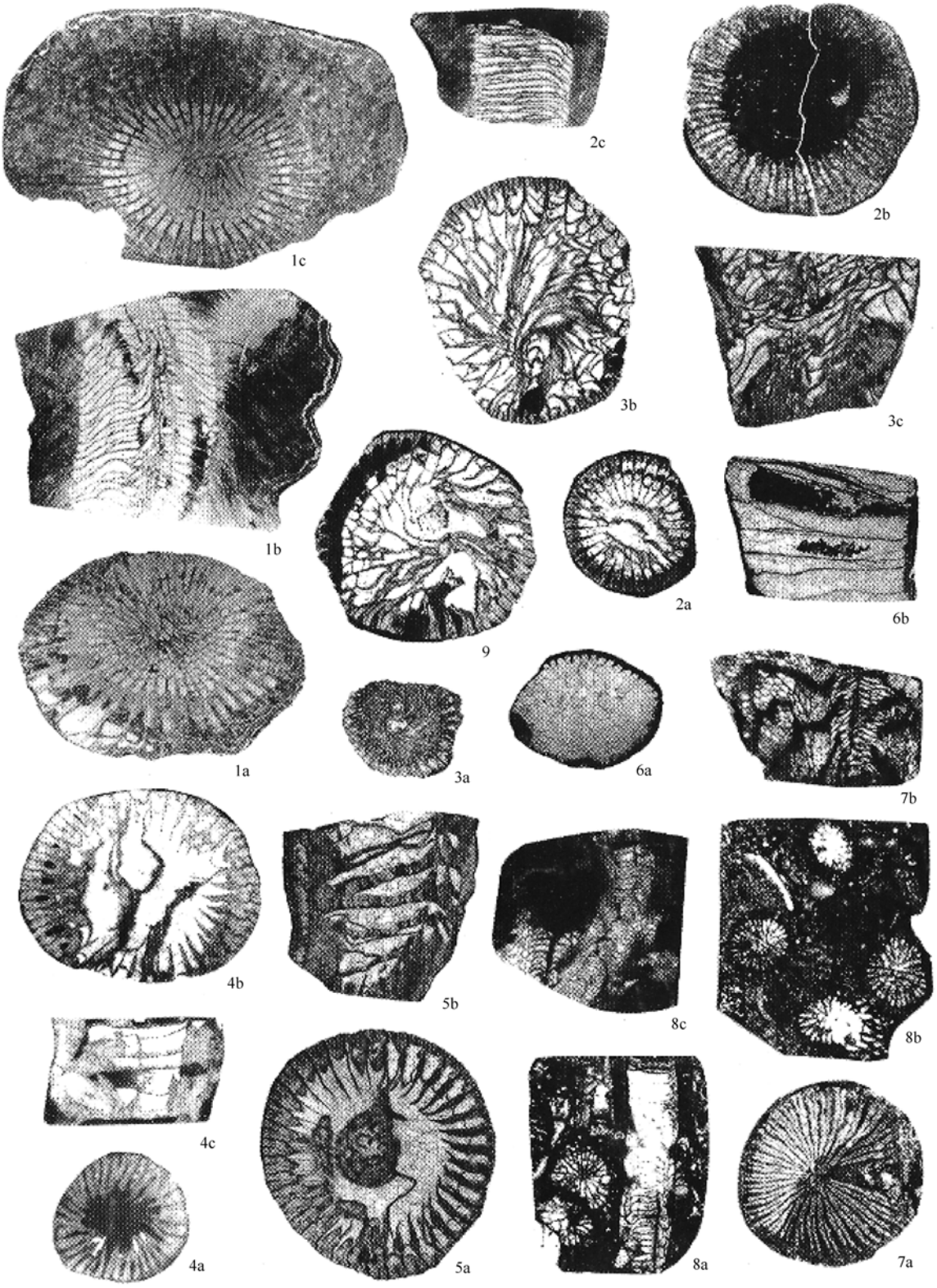


Plate-III