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UPPER VISEAN CORALS FROM THE KIRIN FORMATION IN THE VICINITY OF MINCHENG, KIRIN PROVINCE, N. E. CHINA

By

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The name, "Kirin formation" was first introduced by M. KAWADA (1932) in the geology of Manchuria for the Palaeozoic strata which are widely distributed over Kirin province, Northeastern China (Manchuria), comprising a heavy bedded alternation of limestone, breccia and hornfels. This formation was estimated by him to be some 1,000 to 3,000 meters in thickness. The order of succession of major divisions in the Kirin formation was schematically established by him also, on the basis mainly of the lithological facies, suggested at that time that this formation may perhaps be a deposit, Permo-Carboniferous in age from the poorly known fossil evidences, such as coral remains etc., which were not named and described, however. Following this important work, numerous valuable discoveries have been made in connection with this formation for stratigraphical correlation.

From the upper part of the Kirin formation, the senior author of this paper found *Pseudoschwagerina* (1940) which was described later by him in collaboration with TORIYAMA (1943); from the middle part, OKADA (1940) reported the occurrence of coral at Mincheng and Panshi districts, both in Panshi-hsien, Kirin province. Next, SAITO (1940) discovered some brachiopods at the same places, and suggested their geological age to be probably Lower Carboniferous. The senior author visited the same district and made a collection of fossils such as *Millerella*, *Siphonodendron*, *Dibunophyllum*, "*Lonsdaleia*" and *Gigantella* in 1940; the results were published in a few short papers (1942, 1943, 1950) in preliminary form and the marine Lower Carboniferous was thus established in N. E. China.* Then from the lower part of this formation, *Pseudomphyma*, *Spongophyllum*, *Favosites* etc. were described by YABE and EGUCHI (1943, 1944, 1945). Besides these, OZAKI (1941) announced

* *Aulina manchuriensis* YABE et MINATO was also reported from the Kirin formation of Tosan, Panshi-hsien, Kirin Province. (YABE and MINATO, 1944)

the occurrence of *Fusulinella* from this formation at Ento-shan, although this fossil was not found in the bed *in situ*, but was collected from a huge boulder of limestone.

Thus it has become evident that the so-called Kirin formation may be divisible into a number of stratigraphical units ranging from Middle Gotlandian to Lower Permian in age, although the stratigraphical relationships of each unit are still left in open question.

Although the fauna of the Lower Carboniferous deposits in the vicinity of Mincheng, including its adjacent districts has already been outlined and reviewed by the senior author in the former papers, there still are left a number of corals to be described in detail. So, it is proposed to treat all of them here.

All the corals described herein were collected by the senior author himself from the roadside between Ron-ja-zu and Ton-ron-ja-zu, some 3 km southward from Mincheng.

As already stated in earlier papers, the Kirin formation develops comprising thick limestones and black slates and dark brown limestones in alternation, where several fossil zones were once recognized by the senior author.

In this paper these zones with their fossil contents are revised as follows in descending order: (Revised name of each zone is given in the parentheses.)

6. *Pseudoschwagerina* zone.
Pseudoschwagerina sp.
5. *Stylidophyllum manchuriense* zone (*Lonsdaleia floriformis floriformis* MARTIN zone)
Stylidophyllum manchuriense MINATO et KATO, sp. nov.
Siphonodendron asiatica var. *minor* MINATO
4. *Clisaxophyllum* sp. α zone. (*Auloclisia* sp. nov. (?) zone)
Clisaxophyllum sp. α
Clisaxophyllum sp. β
Caninia sp. α
3. *Siphonodendron* zone.
Siphonodendron asiatica (YABE et HAYASAKA)
Siphonodendron asiatica var. *minor* MINATO
2. *Productus (Gigantella) latissimus* zone. (*Gigantella* cfr. *latissimus* (SOWERBY) zone)
Productus (Gigantella) latissimus (SOWERBY)
Productus (Gigantella) manchuriensis MINATO
Siphonodendron asiatica var. *minor* MINATO
Cfr. *Caninia* sp. β
Koninckophyllum sp.

- Carcinophyllum* sp. α
Millerella sp.**
Endothyra sp.**
1. *Rhodophyllum fukudai* zone. (*Dibunophyllum* sp. nov. (?) zone)
Rhodophyllum fukudai MINATO et KATO, sp. nov.
Rhodophyllum ? sp.
Dibunophyllum sp.
Carcinophyllum ? sp. β
Clisaxophyllum sp. β
Clisaxophyllum ? sp. γ
Arachnolasma cfr. *cylindricum* YÜ
 Gen. et sp. indet.
Caminia sp. β
Caminia ? sp. γ
Siphonodendron asiatica (YABE et HAYASAKA)
Diphyphyllum (*Depasophyllum*) *hochangpingense* YÜ
Lonsdaleia ? sp.*
Palaeosmilia ? sp.*

It is quite worthy of note, that almost all the specimens collected at Mincheng had lost the most part of the peripheral part, and were found to be lying parallel to the bedding plane, which may show these fossils to have been transported and enrolled for some distance, even though it is not so far away. At least they may be not recognizable to have grown up originally at the places where they are now embedded in the matrix of rocks.

In discussing the geological age of this coral fauna, all the species derived from various fossil layers are treated in grouping as a single fauna, because they seem to the writers not to represent widely differing ages, although the fossils listed in the preceding table were really collected from the different horizons of the formation as enumerated before. That all these species show the Upper Viséan in age is far from doubtful, as claimed by the senior author on former opportunities, and no further discussion is needed.

However, for the consideration of palaeozoogeography, it seems wise to state briefly some affinities to those of other regions in the following paragraphs respecting the coral fauna of the Kirin formation.

For the first, *Stylidophyllum manchuriense* quite resembles *Stylido-*

* The corals marked with an asterisk are not described in this report because of the poor preservation of the material.

** Besides these species, many foraminifers occur in every horizon, but no fusulinid foraminifers are recognized other than *Millerella* sp., which indicates this zone.

phyllum japonica (YABE et HAYASAKA) and also shows some affinities with *Lonsdaleia* (*Stylidophyllum*) *floriformis abukumensis* SATO; both latter species are reported from the Onimaru series and its equivalent formation in Japan. *Stylidophyllum manchuriense* appears in the uppermost horizon in Manchuria, and *Stylidophyllum japonica* also appears in the upper part of the Onimaru series in the Kitakami mountain region, Northeast Japan. This fact shows that these exist some parallelism between the two regions, and seem to be worthy of note.

Siphonodendron asiatica var. *minor* frequently occurs in Manchuria and also was discovered in the Upper Viséan Tateishi formation of the Abukuma massif, Northeast Japan. *Carcinophyllum?* sp. β is a type having a rather reticulate axial column as in the genus *Setamainella* MINATO which has been known to occur from the Onimaru series and its equivalent formation in the Southern Abukuma massif. Then, the Manchurian coral fauna shows some intimate relation to the corals of the Japanese Onimaru series.

However, the Manchurian fauna seems, at least at the present moment, to lack *Kueichouphyllum*, while this coral genus is widely detected from the Upper Viséan formations throughout the Japanese islands.

Siphonodendron asiatica (YABE et HAYASAKA) is reported from several localities in China, and its allies such as *Siphonodendron irregulare* (PHILLIPS), *Siphonodendron pauciradiale* (M'COY) show rather wide distribution. Also *Caninia juddi* and its associate species, in which our *Caninia* sp. α may belong, are well known for their world wide distribution. Manchurian *Clisaxophyllum* spp. all resemble the Chinese *Clisaxophyllum* and "*Auloclisia*" formerly described by YÜ, although there is not yet known any species common to both regions. *Arachnolasma cylindricum* YÜ from Kansu and Kuangsi, China is a comparable species to the writers' *Arachnolasma* cfr. *cylindricum*, while the latter somewhat resembles in columnar structure the coral called by the senior author under the name of *Arachnolasma* cfr. *sinense* (YABE et HAYASAKA) from the Kwanto mountain region, Japan.

Diphyphyllum (*Depasophyllum*) *hochangpingense* YÜ described from Hunan and Kueichou provinces of Southern China is also found in the collection at hand. The large simple coral, the generic and specific name of which was unfortunately indeterminable, is now believed to be a form quite akin to the holotype of *Yuanophyllum kansuense* YÜ from Kansu province of North China.

From the corals above mentioned, the Manchurian fauna seems also to have some remarkable relationship with that of Upper Viséan (Upper

Fengningian) of Central and Southern China from the view point of palaeozoogeography, especially the former shows strong affinity to the coral fauna of Kansu province. Perhaps the sea at that time might have continued directly as far as Kansu province.

The relationship between this sea and the one of Western Siberia is not yet correctly known to the present writers.

But *Caninia* ? sp. γ in the collection at hand is a large form which resembles such European species as *Caninia rossica* STUCKENBERG, and *Caninia samsonensis* SALÉE, although the minor septa are not developed in the Manchurian species. Also the specimens called by the writers under the name of *Koninekophyllum* sp. and *Caninia* spp. show some resemblance to some European forms. Further, such brachiopod species as *Gigantella latissimus* (SOWERBY) and *Gigantella manchuriensis* MINATO described from the Kirin formation may be recognizable as elements to indicate the isotopical facies between the sea of Manchuria and that of Europe through the Siberian sea. (MINATO, 1956)

DESCRIPTION OF SPECIES

Family *Zaphrentidae* EDWARDS et HAIME, 1850

Genus *Caninia* MICHELIN, 1840

Caninia sp. α

Pl. III, fig. 1.

1942. *Caninia* sp., MINATO: p. 39, pl. 1, fig. 3.

Corallum simple. Corallite attaining 16 mm in the diameter of the tabularium. Epithecal region is weathered away. Major septa counted as many as 34, straight but short, intrathecally thickened, especially in the cardinal quadrants. The central area well spaced in the cross section. Cardinal fossula inconspicuous but present with certainty, where the cardinal septum is situated, which is slightly shorter than the other major septa. Minor septa are not recognized in the section at hand. Dissepiments arranged in typical herringbone pattern, tabulae almost flat, gently bending downwards at their peripheral margin.

Remarks: Having typical herringbone dissepiments, the present form strictly belongs to *Caninia juddi* group. *Caninia juddi* and its allied species are distributed widely in time and space. Among them, *Caninia juddi* var. *dawsoni* (LAMBE) described by LEWIS (1935) from the Upper Viséan of Nova Scotia and *Caninia veryi* (GREENE) described by EASTON (1944) from the Chesterian of the Southern States of the U.S.A. are closely

allied to the form now in consideration, but both of them are specifically distinct from the Manchurian form in having larger corallites with more numerous septa than the latter.

Horizon: *Clisaxophyllum* sp. α zone.

Reg. No.: 9736.

Caninia sp. β

Pl. III, fig. 2.

Corallum simple. Corallite attaining 24 mm in calicular diameter so far as it is preserved. Epitheca not preserved. Major septa straight, moderately thick, not especially dilated at any part, short, numbering 34, not very much projected into the tabularium. Minor septa present, absolutely confined within the dissepimentarium. Cardinal fossula present, in which the cardinal septum is a little shorter than the others and surrounded by the neighbouring two major septa. Broad open space occupies the central portion of the corallite, where only the columellar prolongation of the counter septum is observable which is very weakly developed and shows amplexoid nature. Tabulae nearly horizontal. Dissepimentarium rather broad.

Remarks: As the present form has some clisiophylloid features, it may be grouped under *Caninia subibicina* group. From the mode of cardinal fossula, central broad open space, and inosculating dissepiments, it seems preferable to place the present form under the genus *Caninia* MICHELIN, although some collumellar feature is really recognizable, and this feature shows some resemblance to *Koninckophyllum interruptum* THOMSON and NICHOLSON (1876).

Horizon: *Rhodophyllum fukudai* zone.

Reg. No.: 9907.

Cfr. *Caninia* sp. β

Pl. III, fig. 3.

Remarks: Another specimen collected from a different horizon may be conspecific with the specimen above described. It has, however, smaller corallite, fewer septa than the specimen above described; besides, this small specimen possesses well developed minor septa, which prolong far into the intrathecal area and bear dissepiments of a definite "clisiophylloid" feature, although it wholly lacks columella and has distinct cardinal fossula. This small type of corallite may also resemble *Caninia subibicina* M'COY described by GARWOOD (1912) as well as *Caninia lonsdalei* KEY-

SERLING described by HERITSCH (1936); however, the present form has smaller corallite, fewer septa and coarser dissepiments than the latter two.

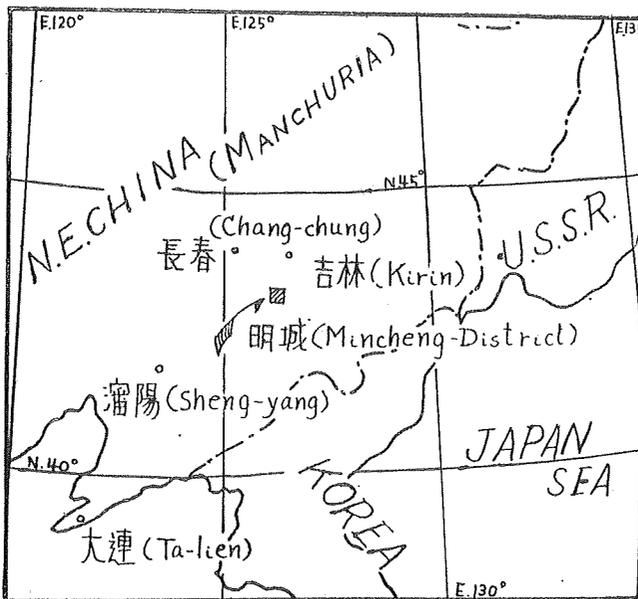
Horizon: *Productus (Gigantella) latissimus* zone.

Reg. No.: 9896.

Caninia ? sp. γ

Pl. III, fig. 4.

Large simple coral, although it is in fragmental state of preservation. Major septa numerous, straight, thick, but somewhat flexuous near the center. Minor septa unobservable. Epithecal parts weathered away, but the dissepimentarium rather wide, where many rows of dissepiments are arranged in herringbone pattern. Tabulae almost flat, often inosculating, and their outer margins gently bending downwards. Tabulae depression seems to be located at one side of the corallite.



Text-fig. 1.

Remarks: It is beyond doubt that the present form bears some resemblance to *Caninia samsonensis* SALÉE (1912) and to *Caninia rossica* STUCKENBERG (1904), but exact comparison of this coral to the latter is almost impossible from the poor preservation of the material.

Horizon: *Rhodophyllum fukudai* zone.

Reg. No.: 15012.

Family *Lithostrotiontidae* GRABAU, 1927

Genus *Siphonodendron* M'COY, 1849

Siphonodendron asiatica (YABE et HAYASAKA)

Pl. III, fig. 14

1916. *Lithostrotion irregulare* var. *asiatica*, YABE and HAYASAKA. pp. 57-60.
1920. *Lithostrotion irregulare* var. *asiatica*, YABE and HAYASAKA. pl. X, figs. 2a-2b; pl. XI, figs. 7a-7b.
1934. *Lithostrotion (Siphonodendron) irregulare* var. *asiatica*, YÜ. pp. 95-96, pl. XIX, figs. 3, 4a-d; pl. XX, figs. 1a-c.
1935. *Lithostrotion (Siphonodendron) irregulare* var. *asiatica*, CHI. pp. 30-31, pl. I, fig. 5.

Corallum compound, phaceloid. Corallites round in cross section, separated from each other by a distance nearly equal to their diameter, but occasionally in contact with connecting process. Diameter of the corallites usually attains 3 to 4 mm in mature stage. Septa in two orders; of them, the major septa are straight, thin, numbering 15 or 16 and they rarely reach the columella; the minor septa alternating with the former, attain a half or one-third the length of the former.

The cut edges of the flat domed tabulae appear as if forming an inner wall in the cross section encircling the columella. The major septa are rarely extruded beyond this ring like edges of tabulae, except for the counter and cardinal septum. Usually these two septa are observed to be directly united with the ends of the columella.

Dissepimentarium narrow, where dissepiments are arranged concentrically in one row.

In the longitudinal section, there are two kinds of tabulae, one is complete, conical, and rather steeply ascending towards the columella, while the other is incomplete and flat-domed; these two types of tabulae usually occur in alternation, although in some part of the corallites they are not so regularly alternating. Density of the tabulae is 4 to 5 in a space of 2 mm.

Dissepimental vesicles somewhat regular in size, arranged generally in one row, with their convex sides faced upwards as well as inwards. But as an exceptional case the vesicles are observed in two rows in a few of the corallites.

Remarks: The present form belongs doubtlessly to the genus *Siphonodendron*. Of the numerous species of this genus, the specimens

here treated may be assignable into the group of *Siphonodendron pauciradiale*, and they are recognized to be correctly conspecific with *Siphonodendron asiatica* (YABE et HAYASAKA) in every respect, especially in having smaller-sized corallites, less numerous septa, dissepiments mostly arranged in one row and flat-domed tabulae, besides the conical tabulae.

Siphonodendron asiatica was first described by YABE and HAYASAKA under the name of *Lithostrotion irregulare* var. *asiatica* from Hunan and Tibet; the geological range of this species was clearly ascertained by the efforts of Chinese palaeontologists to be Middle to later Fengninian in age.

Horizons: *Rhodophyllum fukudai* zone and *Shiphonodendron* zone.

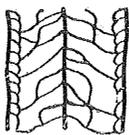
Reg. Nos.: 9868-i, 9870, 9872-i, 10054, 15017.

Siphonodendron asiatica var. *minor* MINATO

Pl. II, figs. 2-3.

1942. *Siphonodendron irregulare* var. *asiatica*, MINATO. pp. 34-35, pl. III, figs. 2a-2b; pl. IV, fig. 2; pl. V, fig. 3.
 1943. *Siphonodendron asiatica* var. *minor*, MINATO. pp. 63-65, pl. VII, figs. 3-6.
 1956. *Lithostrotion (Siphonodendron) asiatica* var. *minor*, SATO. p. 248, pl. IX, figs. 1a-1c.

Remarks: The present variety was fully described and discussed by the senior author in former papers. It may be needless to repeat the previously given description; the variety is fully accepted by us at present. It was mentioned on the former occasions that the variety belongs to the group of *Siphonodendron irregulare* (PHILLIPS), as well as *pauciradiale* (M'COY), *asiatica* (YABE et HAYASAKA) and so forth; specimens possess flat domed tabulae in central axial portion besides the conical tabulae, as shown in text-fig. 3.



Text-fig. 3.

Of course, the present specimens show close similarity to the preceding species in every respect, except for the smaller sized corallites and relatively less numerous septa possessed by the former.

Indeed there are also a number of corallites in the corallum of the preceding species which are almost indistinguishable from the corallites of this variety in respect to size and septal number; these smaller corallites with less numerous septa in the former species, however, should be

regarded to represent the corallites in young stage and most corallites in mature stage of the preceding species are more large in size than those of the present variety.

On the contrary, the corallites of the present variety are smaller and have less numerous septa, and individual variations seems to be rather smaller in respect to the size of the corallites and the number of septa in comparison with the preceding species.

Horizons: *Stylidophyllum manchuriense* zone, *Siphonodendron* zone and *Productus (Gigantella) latissimus* zone.

Reg. Nos.: 9868-ii, 9869-i, ii, 9867-i-iv, 9872-ii, 9873-i, ii, 9874-i, ii, 9878, 15003, 15010, 15101.

Genus *Diphyphyllum* LONSDALE, 1845

Subgenus *Depasophyllum* YÜ

Depasophyllum, YÜ, 1934: Pal. Sin., ser. B, vol. XII, fasc. 3, pp. 85-86.

MINATO, 1955: Jour. Fac. Sci. Hokkaido Univ., ser. IV, vol. IX, no. 2, pp. 80-81, 84.

Diphyphyllum β , SMITH, 1928: Ann. Mag. Nat. Hist., ser. 10, vol. I, p. 114.

non *Depasophyllum*, GRABAU, 1936: Pal. Sin., ser. B, vol. VIII, fasc. 4, pp. 43-44.

STUMM, 1949; Geol. Soc. America, Mem. no. 40, p. 30.

In 1934 YÜ introduced GRABAU's manuscript name of genus *Depasophyllum* for such corals as *Diphyphyllum* β type of SMITH (1928) and recognized this as a subgenus of *Diphyphyllum*. This type of coral is quite characteristic in having strongly arched inner tabulae to rest upon the preceding ones. One of the writers (M.M.) has also employed this subgeneric name in this sense.

Meanwhile, GRABAU later designated *Depasophyllum adnetum* GRABAU as a genotype of the genus *Depasophyllum*, which is a Devonian species. According to STUMM (1949), this species has neither dissepiments nor arched inner tabulae, and accordingly cannot be regarded to be intimate relation with the genus *Diphyphyllum* or *Depasophyllum* of YÜ's definition.*

Diphyphyllum (Depasophyllum) hochangpingense YÜ

Pl. III, figs. 8-12.

1934. *Diphyphyllum (Depasophyllum) hochangpingense*, YÜ. pp. 86-87, pl. XVI, figs. 5a-d, 6a-b.

Corallum compound, probably fasciculate, although most corallites

* Very recently, THOMAS (1956) stated that the genus *Depasophyllum* was validated by YÜ and, furthermore, *Depasophyllum* GRABAU is considered by THOMAS to be synonymous with the genus *Amplexocarinia* SUSHKINA.

are fragmental in preservation, and show dichotomous fission.

Corallites slender, cylindrical, sometimes closely disposed with each other, almost round in cross section, attain 5 mm in their calicular diameter (minimum 3.5 mm and maximum 6.5 mm). Epitheca thin. Septa in two orders, major and minor respectively; both arranged radially and moderately thick, counting as many as 22 to 24 in each order. Major septa rather short, attaining a half the length of the radius of the corallite, their distal ends rarely prolonged into the inner tabularium, while the minor septa grow beyond the dissepimentarium, being almost half the length of the former. Columella absolutely absent. Tabularium differentiated into two zones. The wide inner zone is occupied by moderately arched inner tabulae which are regularly spaced with a density of 6 to 8 in a space of 5 mm. They completely touch the preceding ones at their bending margins. The outer zone is narrow and is occupied by slightly concave tabulae. The density of the outer tabulae is almost equal to that of the inner ones. Dissepimentarium very narrow, where concentric dissepiments are arranged in one row.

Remarks: The present specimens show remarkable similarity to the Chinese form described by YÜ under the name of *Diphyphyllum* (*Depasophyllum*) *hochangpingense* in every respect, except that weak columella rarely appeared in the Chinese form, although most corallites of Chinese specimens are still completely diphyomorphic.

Comparing the present form with *Diphyphyllum* (*Depasophyllum*) *convexum* YÜ (1934), however, the former is specifically different from the latter in having large corallites, more numerous septa and less arched tabulae.

From *Diphyphyllum platiforme* YÜ (1934) the present form is also distinguishable in having more numerous septa, more highly arched tabulae and longer minor septa. The convexity of the inner tabulae of the present form seems to be almost intermediate between that of the two Chinese species above stated.

Horizon: *Rhodophyllum fukudai* zone.

Reg. Nos.: 9899, 9900, 9901, 9903, 9904, 15007.

Family *Clisiophyllidae* NICHOLSON et THOMSON, 1883

Genus *Rhodophyllum* THOMSON, 1874

Rodophyllum (sic) THOMSON, 1874; Geol. Mag., dec. 2, vol. I, pp. 556-557.

Rhodophyllum THOMSON, 1875; Ibid., dec. 2, vol. II, p. 273.

THOMSON and NICHOLSON, 1876; Ann. Mag. Nat. Hist., ser. 4, vol. XVIII, pp. 68-72.

As is well known, THOMSON (1874-1880) and THOMSON in collaboration with NICHOLSON (1875-1876) divided the so-called "dibunophylloid corals" into several closely allied genera, such as *Rhodophyllum*, *Aspidophyllum*, *Kurnatiophyllum*, *Centrophyllum*, *Histiophyllum*, *Dibunophyllum*, etc. .

Since then until the present there have been presented numerous diverse opinions upon the generic status of these genera by many palaeontologists.

It is quite true that THOMSON (1874), THOMSON and NICHOLSON (1876) and HILL (1938) claimed to be recognizable the gradual changes between them in respect to their axial structure. Accordingly, it seems to the present writers, to be quite reasonable that HILL (1938) grouped all these allied genera into one genus, *Dibunophyllum* NICHOLSON et THOMSON.

As she stated on that occasion, *Rhodophyllum*, *Aspidophyllum* and *Kurnatiophyllum*, etc., were all proposed prior to the establishment of the genus *Dibunophyllum*, but the latter is so well familiar and so commonly used in literature to denote the upper zone of the Lower Carboniferous, that it seemed to her best to select this generic name of *Dibunophyllum* to represent all the corals above enumerated, despite of the Rule of Nomenclature. The present writers wish to follow her in this regard.

However, in the typical form of the genus *Rhodophyllum* THOMSON, it is quite evident that no trace of median plate is recognizable in the axial structure, even though there develop numerous septal lamellae in the columella. As was emphasized by THOMSON, the septal lamellae of this genus show a sub-convolute trend and in fact he established this genus regarding this peculiar feature as a distinguishing character from the allied genera. This may be also accepted in one sense, but in some species which are assignable into genus *Dibunophyllum* with certainty, the convolute trend of septal lamellae is also recognizable, for instance in some corallites of *Dibunophyllum bipartitum* described by HILL (1938, pl. I, fig. 19). The septal lamellae of the axial structure in this specimen show a somewhat convoluted form, although this trend of this species is not so conspicuous as in the typical form of *Rhodophyllum*.

Accordingly present writers wish to distinguish the genus *Rhodophyllum* from the genus *Dibunophyllum*, taking as the criterion only whether a median plate is present or absent in the axial column.

According to HILL (1948), so-called *Rhodophyllum dubium* GORSKY reported from the Tournaisian of the U.S.S.R. is a form like to the genus *Kueichouphyllum*, although we are unable to refer to the original descrip-

tion of this species, while there is known such a Pennsylvanian species as *Rodophyllum texanum* MOORE et JEFFORDS. However, most species of genus *Rodophyllum* seem to be derived from the Lower Carboniferous deposits, so far as the present writers are aware.

The Manchurian species is characteristic in having well developed minor septa but has a cardinal fossula that is somewhat indistinct.

Rhodophyllum fukudai MINATO et KATO, sp. nov.

Pl. I, figs. 1-9; Pl. III, fig. 5.

1942. *Dibunophyllum* spp. MINATO. p. 37, pl. I, fig. 4b; pl. II, figs. 2-3; 6; pl. V, figs. 2,5.

Corallum simple, corallite large, probably cylindrical in form, so far as it is preserved, and somewhat laterally compressed. Calyx unobservable. Epithecal part completely destroyed. Corallite elliptical in cross section, although it may not be the original form. The longer diameter of the tabularium attains as much as 2.1 cm. The axial columella also elliptical in cross section about 1.2 cm. in its longer diameter, well bounded from the septate area, constructed loosely of 7 to 9 short septal lamellae and a few rings of somewhat flexuous axial tabellae. The septal lamellae of the columella are observed to be discontinuous with the major septa. Median plate completely lacking.

Septa in two orders, major and minor respectively; all of them are quite thick not only in the intrathecal region but also in the extrathecal area. Major septa almost straight, radially arranged, nearly reaching the axial column but not directly uniting with the septal lamellae as above stated, numbering as many as 36 in a large corallite in the full grown stage.

Minor septa are also well developed, alternating with the former, and a little prolonged beyond the theca.

Width of the dissepimentarium undeterminable. Dissepiments arranged in herringbone pattern, but more closely disposed near the theca, where the dissepiments seem to be somewhat in angulo-concentric pattern. Fossula indistinct.

In the longitudinal section, triareal arrangement is clearly shown. The axial column is composed of flexuous, discontinuous septal lamellae and rather flat tabellae. Tabulae almost flat or only slightly concave upwards, but rarely rather steeply inclined outwards. Density of the tabulae, 6 in a space of 5 mm. Dissepiments are unequal in size, arranged in oblique row, with their convex sides faced upward and inward.

Remarks: The present specimens now under consideration, are quite characteristic in having well developed minor septa and loosely constructed axial structure.

From the similarity in type of axial structure, the present form is somewhat comparable with *Rhodophyllum distans* GARWOOD and GOOD-YEAR (1924) but is distinguishable from the latter in the following points; (1) the latter has quite short minor septa confined only in the dissepimentarium, (2) has major septa only thickened in the intrathecal zone and (3) possesses a well-marked cardinal fossula.

From the other species hitherto known, the present form is quite distinct in the axial structure, rather distant tabulae and relatively long minor septa; therefore the writers wish to propose a new name for the Manchurian specimens now under consideration. The specific name is dedicated to Dr. Ren FUKUDA to whom the senior author was much obliged in visiting Mincheng for collecting the corals.

From careful observations of a number of specimens in thin sections, this species seems to show considerable variation in respect to the number of septal lamellae and mode of axial tabellae of the columella. There are specimens, though rarely found which lack the septal lamellae wholly (Reg. Nos. 9888, 9894); the axial structure of these specimens is composed of only very flexuous axial tabellae.

Meanwhile, in the other specimen (Reg. No. 9892), the septal lamellae are strongly developed in the center of the corallite but no median plate is present.

Horizon: *Rhodophyllum fukudai* zone.

Reg. Nos.: Holotype (9711, 9905, 9911, 9913); 9716, 9717, 9887, 9888, 9891, 9892, 9894, 9910.

Rhodophyllum ? sp. indet.

Pl. I, fig. 20.

Single longitudinal section only, in which triareal arrangement is clearly observable. Central axial column 8.0 mm in diameter, composed of dome-like, loosely arranged tabellae and a few, weak septal lamellae. Tabulae incomplete, convex upwards as well as outwards, numbering 4 to 6 in a space of 5 mm. Tabularium attaining 2.3 mm in diameter. Dissepimentarium incompletely preserved, where two series of steeply inclined small dissepiments are developed.

Remarks: Judging from the structure of the axial column, the present form is specifically different from the preceding species, but may be

stated to belong perhaps to the genus *Rhodophyllum*, although further precise investigation of this coral is almost impossible. From the superficial similarity, this form seems to the writers to be somewhat comparable with *Rhodophyllum craigianum* THOMSON (1874).

Horizon: *Rhodophyllum fukudai* zone.

Reg. No.: 9908.

Genus *Dibunophyllum* NICHOLSON et THOMSON, 1876

Dibunophyllum sp. indet.

1942. *Dibunophyllum* sp. b. nov. ?. MINATO: p. 37, pl. I, fig. 4a. non pl. I, fig. 4b; pl. II, fig. 2; pl. V, fig. 2.

Corallum simple. Epitheca unpreserved. Axial column polygonal in form in cross section, which is separated from the septate area by a sharp boundary, composed of short but distinct median plate, several septal lamellae and axial tabellae. The median plate of this form is discontinuous with the cardinal and counter septum, giving an appearance of the columella of so-called aspidophylloid type. Fossula indistinct.

Septa in two orders, major and minor respectively, counted as many as 30, both of them strongly thickened, although their peripheral parts are mostly unobservable. The major septa nearly reach the central area but do not directly unite with any septal lamellae of the columella. Minor septa well developed, fairly protruded beyond the margin of the dissepimentarium. The nature of the dissepiments unknown.

Remarks: The present form is somewhat similar to *Aspidophyllum tushanense* described by YÜ (1934) from the Lower Carboniferous of Kueichou, in respect to the similarity of the axial structure, however the latter has quite thin major septa, besides less long minor septa.

Horizon: *Rhodophyllum fukudai* zone.

Reg. No.: 9912.

Genus *Carcinophyllum* THOMSON et NICHOLSON, 1876

Carcinophyllum sp. α

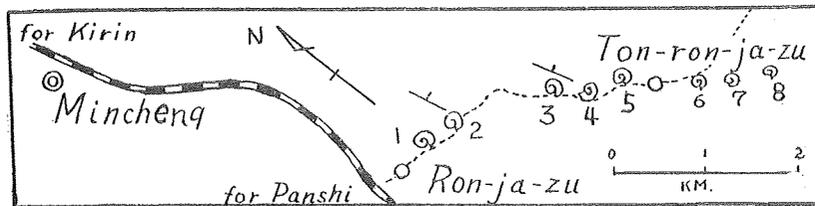
Pl. I, fig. 16.

Corallum simple, corallite cylindrical. Main part of the dissepimentarium is lost; the width of the tabularium attains 16 mm.

Major septa straight, and thick, stop their growth shortly before the columella. Minor septa also present, often slightly extruded beyond the dissepimentarium. Axial column relatively large, its diameter reach-

ing half the length of the diameter of tabularium, composed of a very short median plate, several sinuous, curved septal lamellae and axial tabellae; all these structures are much dilated by stereoplasmic deposits.

Remarks: From the structure of the axial column composed of much dilated, irregularly sinuous septal lamellae, much dilated short median plate and dilated, irregularly curved tabellae, the present form is assignable into genus *Carcinophyllum* with certainty. Of hitherto known species of this genus, *Carcinophyllum parkinsoni* RYDER illustrated by PARKINSON (1926) somewhat resembles the present form; especially the early corallite figured by him as 2a in pl. XIII, shows much similarity to the specimen at hand, although *Carcinophyllum parkinsoni* in the mature stage reveals quite different aspect to the Manchurian specimen.



Text-fig. 2. Map showing the localities and horizons.

- Loc. 1, *Rhodophyllum fukudai* zone.
- Loc. 2, *Productus (Gigantella) latissimus* zone.
- Loc. 3, *Siphonodendron* zone.
- Loc. 4, *Clisaxophyllum* sp. α zone.
- Loc. 5, *Stylidophyllum manchuriense* zone.
- Loc. 6-8, *Pseudoschwagerina* zone.

Dibunophyllum tushanense CHI (1931) (non *Aspidophyllum tushanense* YÜ) described by CHI from the Weiningian of China was once suggested by HILL (1940) to be assignable into genus *Carcinophyllum*. This species is also resemblant to the present specimen, especially in respect to the axial structure, although the lamellae of the Weiningian form are thinner than those of our specimen. Further, the present writers are of opinion that *Dibunophyllum tushanense* CHI may possibly belong to the genus *Lonsdaleia* since it has some lonsdaleoid cystosepiments at the periphery.

So far as the axial structure is concerned, the present form is also referable to *Carcinophyllum* ? sp. illustrated by SMYTH (1922), however the columella of SMYTH's species is still very small in cross section.

Horizon: *Productus (Gigantella) latissimus* zone.

Reg. No.: 9898.

Carcinophyllum ? sp. β

Pl. III, fig. 6.

1942. *Carcinophyllum* sp. MINATO, p. 39, pl. III, fig. 3.

Fragmental specimen only, from which one incomplete cross section was prepared. The most part of the dissepimentarium was unfortunately lost prior to the preparation of thin section. Corallum probably simple, corallite equal to or a little smaller than that of the preceding form in size. Major septa straight, moderately thick, radially in arrangement while the minor septa are also present, although they are only observable at their axial ends. Axial column rather large, showing irregular meshwork of somewhat reticulate appearance built of slightly thickened flexuous lamellae and irregularly arranged tabellae, but no distinct median plate is discernible in it.

Remarks: That the present form, though quite incomplete, belongs to the genus *Carcinophyllum* is almost doubtless from the characteristic feature of the axial structure, although the nature of the dissepimentarium of this species is by no means certain.

Meanwhile, it may be said that this specimen reminds one somewhat of *Setamainella hayasakai* MINATO (1943) described from the Lower Carboniferous of the Kitakami mountain region, Japan, in its peculiar feature of the columella, as has already been described. But the axial structure of this species is not so regular and not so finely constructed as in the case of *Setamainella*, and further, the lamellae and tabellae in this form are slightly thickened.

Horizon: *Rhodophyllum fukudai* zone.

Reg. No.: 9899.

Genus *Clisaxophyllum* GRABAU et YÜ, 1934

Clisaxophyllum, YÜ, 1934: Pal. Sin., ser. B, vol. XII, fasc. 3, pp. 103-107.

MINATO, 1955: Jour. Fac. Sci. Hokkaido Univ., ser. IV, vol. IX, no. 2, p. 136.

Clisiophyllum, THOMSON et NICHOLSON, 1876: Ann. Mag. Nat. Hist, ser. 4, vol. XVII, pp. 451-457.

non *Clisaxophyllum*, CHI, 1931: Pal. Sin., ser. B, vol. XII, fasc. 5, pp. 23-24.

The genus *Clisaxophyllum* is closely related to the genus *Clisiophyllum* in every respect, but is distinguishable from the latter on the basis of the axial structure in which the median plate is very short, and the central column is free from any septa. Notwithstanding this fact, HILL (1938) regarded *Clisaxophyllum* to be synonymous with *Clisiophyllum*. However

she also recognized the species of genus *Clisiophyllum* to be divisible into two groups: one is represented by the species such as *Clisiophyllum keyserlingi*, the genolectotype of *Clisiophyllum*, viz. it is a typical *Clisiophyllum*, while the other is represented by such species as *Clisiophyllum multi-septatum* which is nothing but the genus *Clisaxophyllum* in GRABAU and YÜ's definition.

There are a number of species described by YÜ under the generic name of *Auloclisia* from the Lower Carboniferous in South China: (1934) as follows: *Auloclisia multiplexum*, *multiplexum* var. *minor*, *densum*, and *A. tentatum*. The senior writer once accepted the view of YÜ in respect to the generic identification of these species, and he treated also one of his Manchurian species as a species of *Auloclisia* (1942).

However, according to LEWIS (1927), there is no median plate in the typical form of the genus *Auloclisia* at least in the mature stage, although there is stated to be a discernible distinct median plate in the columella of the Chinese species described by YÜ from South China under the genus *Auloclisia* and also in the Manchurian form. So the former view of the senior author on the generic identification of these species above enumerated must now be revised, and the specimens should be assigned to the genus *Clisaxophyllum*.

The present writers are of opinion that a series of such genera as *Clisaxophyllum*, *Clisiophyllum*, *Auloclisia* and *Aulophyllum* are quite like each other in having concentric dissepiments. Of them, genus *Clisaxophyllum* has a corallite with distinct median plate throughout its ontogeny, with relatively narrow axial column in cross section, in which the septal lamellae are not directly uniting with the major septa. Genus *Clisiophyllum* possesses also distinct median plate throughout its ontogeny and bears rather wide column in cross section, the septal lamellae of which are directly uniting with the major septa as usual, while the fossula is poorly developed.

Genera *Auloclisia* and *Aulophyllum* show almost similar aspect in the cross section, in which there is no median plate at least in the mature stage, and the fossula in these genera is rather distinct. Besides, the septa in these genera are usually more dilated in the cardinal quadrants than those of the counter side, although such peculiar dilation is not always observable in all species of these two genera above named.

The distinction between genera *Auloclisia** and *Aulophyllum* consists in only the presence or absence of the special central tabellae of the axial

* It is worthy of note that the genotype of the genus *Auloclisia* possesses the corallite with some lonsdaleoid cystosepiments in mature stage. (LEWIS, 1927)

column in the longitudinal section of the corallite. In the species assignable into genus *Aulophyllum*, there are recognizable special central tabellae quite distinct from the outer tabellae, especially in their curvature.

Clisaxophyllum sp. α

Pl. I, fig. 12; Pl. III, fig. 7.

1942. *Auloclisia* sp. MINATO: p. 35, pl. II, fig. 1.

1942. *Clisaxophyllum* sp. α , MINATO: p. 36, pl. II, fig. 4.

Corallum simple, corallite elliptical in outline in oblique section, moderate in size, attaining 12.5 mm in short diameter. Outer wall thick. Axial column fairly large, also elliptical and cuspidate in one end facing the shallow but distinct cardinal fossula, where a slightly shortened cardinal septum is positioned. Axial column is densely constructed of the following three skeletal elements: (1) distinct and rather long median plate, which completely bisects the column, (2) some 15 to 16 rings of thin axial tabellae and (3) about 30 thin septal lamellae. Of these lamellae, half of them reach the median plate, while the remaining ones are short and never reach the center of the column. Major septa straight, radially arranged, numbering as many as 42, which are relatively thin in the dissepimentarium, while very thick in the intrathecal area. Minor septa thin, alternating with the former, and a few of them are observed to be interrupted near the outer wall. Dissepimentarium rather narrow, consists of 8 to 9 rows of small dissepiments, which are arranged in concentric pattern and are more densely disposed near the theca to form an inner wall. No longitudinal section was obtainable.

Remarks: The present form is allied to the forms described by YÜ (1934) under the generic name of *Clisaxophyllum* and "*Auloclisia*" from the Upper Fengninian, namely *Clisaxophyllum yangtzeense* (YOH), *C. vesiculosum* YÜ, "*Auloclisia*" *densum* YÜ, "*A.*" *multiplexum* and its variety *minor* YÜ.

Clisaxophyllum yangtzeense (YOH, 1929; YÜ, 1934) resembles the Manchurian form in size of the corallite, and septal numbers, but differs from the latter in having very narrow dissepimentarium, thin epitheca; furthermore, the major septa of the former almost reach the axial column which is not well bounded in its outer margin.

Clisaxophyllum vesiculosum may be also comparable to the present form as a whole, but it has small, narrow cystosepiments in its outer margin, a feature which is completely unobservable in the Manchurian form.

"*Auloclisia*" *densum* has a distinct median plate, so it may be better put under the genus *Clisaxophyllum*, and also it resembles the form at hand but has larger corallites, numerous septa, wider dissepimentarium, and entirely round axial column in which the axial tabellae and septal lamellae construct a more dense reticulation than the present form. It is also expected to present a similar case when comparison is made between the present form and "*Auloclisia*" *multiplexum* and its variety *minor*.

Meanwhile, another small specimen (Reg. No. 9713) is at the writers disposal. This specimen has a round corallite in cross section, although most of its epithecal parts are lost, and attains 9.5 mm in diameter as far as it is preserved. In this specimen, there are observable 31 major septa, very thick median plate, 20 septal lamellae, 8 to 10 rings of axial tabellae, and narrow dissepimentarium where only three rows of dissepiments are concentrically arranged. Major septa dilated in the tabularium, minor septa also confined in the dissepimentarium; axial column well bounded, and remarkable cardinal fossula present. Except for the presence of much thickened median plate, this specimen (No. 9713) is indistinguishable from the specimen treated in the foregoing paragraphs (No. 9712) and may be a younger stage of the corallite of the latter.

Horizon: *Clisaxophyllum* sp. α zone.

Reg. Nos.: 9712, 9713.

Clisaxophyllum sp. β

Pl. I, figs. 13-14.

1942. *Clisaxophyllum* sp. b, MINATO: p. 36, pl. IV, fig. 4.

The following is a description based on the specimen, Reg. No. 9715.

Corallum simple, corallite oval in cross section, attaining 10.5 mm in shorter diameter. Epithecal part is somewhat weathered, but the outer wall in preserved part is fairly thick. Axial column very narrow in cross section, in which there is recognizable a short, but thick median plate, 18 radiating septal lamellae, and 4 rings of axial tabellae.

The area between the axial column and the septal ends is well spaced. The major septa straight, numbering 38, especially thickened in the tabularium, growing until half way to the center from the outer wall, and alternating with the minor ones, which are a little extruded into the tabularium. Dissepimentarium narrow, includes 3 or 4 rows of concentrically arranged dissepiments. Fossula is indistinct.

Another specimen (Reg. No. 9719) collected from the same horizon

in association with the specimen above described shows much similarity in every respect and may perhaps be considered conspecific with the latter, except for the more reduced minor septa.

Remarks: There are a number of species which are comparable with the present form. Of them, such English "*Clisiophyllum*" as *Clisiophyllum delicatum* SMYTH, *Clisio. ingletonense* VAUGHAN, *Clisio. curkeenense* VAUGHAN, including *Clisio. multiseptatum* GARWOOD (1912) are all allied to the present form; but in the English species, the axial columns are not so well defined from the other parts of the corallite as in the Chinese forms described by YÜ. Similar case is also observable in the Manchurian forms. Furthermore, the septal lamellae of the English species are usually arising from the median plate, and a half number of them do not reach the outer margin of the axial column. (cfr. LEWIS, 1930, p. 270, fig. 3). On the contrary, in Chinese forms of YÜ as well as the Manchurian species, the septal lamellae arise from the outer margin of the axial column, although almost a half number of them do not reach the median plate.

Other allied forms reported from the Chinese Carboniferous are *Clisaxophyllum yangtzeense* (YOH) (1929), *Clisaxophyllum vesiculosum* YÜ (1934), but the present form is also distinguishable from them in having smaller corallite, less numerous septa, and more loosely constructed axial column than the latter. The present form also closely resembles the preceding form treated in the foregoing page (*Clisaxophyllum* sp. α), except for the character of minor septa which are always confined to the dissepimentarium in the latter. From the scantiness of the material, it was not possible to study further in detail or to identify the present form with any other species known at present.

Horizon: *Rhodophyllum fukudai* zone.

Reg. Nos.: 9715, 9719.

Clisaxophyllum ? sp. γ

Pl. I, fig. 15.

Corallum simple, corallite fairly large in size. Epitheca not preserved. Axial column round in cross section, very large, occupying half the diameter of the tabularium of about 20 mm, well-bounded from the septate area, and consists of several concentric, thin tabellae and many thin, radiating septal lamellae, giving a reticulate appearance, in which the median plate is not discernible with certainty because of the filling of calcite veinlets in the central part of the column. Septal lamellae do not

connect with any septa. Major septa straight, thick, fairly long but do not extend to the axial column, numbering about 40, and alternating with the minor septa. The minor septa slightly extended beyond the dissepimentarium, but they occasionally do not reach as far as the outer wall. Fossula unknown.

Dissepiments arranged in concentric pattern, more densely crowded near the margin of the dissepimentarium rather loosely and irregularly disposed near the outer wall in which part there develops large lonsdaleoid cystosepiments.

Remarks: Owing to the inadequate preservation of the material, it is not possible exactly to detect the character of the central column, especially it is not certain, whether there is a median plate or not, but if the median plate is truly absent, the present form should be classified into the genus *Auloclisia* LEWIS rather than into genus *Clisaxophyllum* GRABAU et YÜ.

However, the present form is quite characteristic in having lonsdaleoid cystosepiments, and the writers are now inclined to regard it as a representative of a species belonging to a new genus, putting aside for the time being the problem of the presence or absence of the median plate in the axial column.

However, such cystosepiments are also observable in the corallite of *Auloclisia mutatum* LEWIS (1927), the genotype of the genus *Auloclisia*, and similar cystosepiments are also found, according to YÜ (1934), in *Clisaxophyllum vesiculosum* YÜ described by him from the Lower Carboniferous of S. China.

Aside from the existence of cystosepiments, the Manchurian species may be quite distinct from those two species just mentioned, and should never be regarded as conspecific with either of them.

Horizon: *Rhodophyllum fukudai* zone.

Reg. No.: 9714.

Genus *Koninckophyllum* THOMSON et NICHOLSON, 1876

Koninckophyllum sp. indet.

Pl. I, figs. 17-18.

Corallum simple. Wall rather thin. Columella also thin and short in cross section; one end of the columella is firmly united with the counter septum and surrounded by a few rings of the cut edges of ascending tabulae. Major septa moderately thick, numbering as many as 32 in a

corallite of 12 mm calicular diameter, while 38 in the specimen of about 17 mm diameter. All of them fall short of the center. Minor septa also present but quite rudimentary. There are observable only three septal lamellae, of which two are disposed on the two sides of the columella and grow to the direction, almost perpendicular to the elongation of the columella, while the peripheral ends of these septal lamellae are firmly united with distal ends of the major septa. The other one septal lamella is developed at a position near the distal end of the cardinal septum, although the former does not unite with the latter.

Dissepimentarium is very narrow, a few rows of dissepiments are arranged in herringbone pattern. No longitudinal sections are obtainable.

Remarks: From the present material, it was impossible to prepare any longitudinal thin sections, and accordingly either generically or specifically, the specimens are quite difficult to determine. However from the simple structure of the axis, the present material should be preferably assigned into the genus *Koninckophyllum* rather than into the genus *Dibunophyllum*.

The median plate of these specimens, now under consideration, is united only with the counter septum and free from the cardinal one, and further, it is almost impossible to imagine the existence of axial tabellae in the axial column of the present specimens.

In the view of the present writers, the present specimens may be somewhat comparable to such species as *Lophophyllum meathopense* GARWOOD (1912), *Koninckophyllum clitheroense* PARKINSON (1926), and *Koninckophyllum divisum* LEWIS (1930), from the similarity of the axial column. All these species are known to occur in the Upper Viséan deposits.

Horizon: *Productus (Gigantella) latissimus* zone.

Ref. Nos.: 9897, 9909.

Genus *Arachnolasma* GRABAU, 1922

Arachnolasma cfr. *cylindricum* YÜ

Pl. I, fig. 10.

1942. *Dibunophyllum?* sp. MINATO: p. 37, pl. I fig. 2.

Compare with:

1934. *Lophophyllum (Arachnolasma) cylindricum*, YÜ: pp. 35-36, pl. II, figs. 1a-c, 2a-e, 3a-d.

For this species only one thin section is available, the peripheral part of which is mostly destroyed. Corallum simple. Axial column is large, consists of median plate, several axial tabellae and a few septal

lamellae. Median plate is strongly thickened by fibrous calcareous deposits and appeared fusiform as a whole in cross section; median plate is firmly united with the counter septum, although somewhat discontinuous with the cardinal one. Major septa mostly straight, but there are also somewhat sinuous septa, all of them slightly thickened by stereoplasmic deposits. Minor septa short and rudimentary, if any. Dissepimentarium perhaps narrow, and dissepiments arranged in herringbone pattern at least near the theca. Fossula unobservable.

Remarks: That the present form is assignable into genus *Arachnolasma* is almost doubtless. Of the known species of genus *Arachnolasma*, the present form seems to be much like or almost conspecific with *Arachnolasma cylindricum* YÜ in every respect, especially of the axial structure, arrangement of dissepiments, and less developed minor septa. The specimen now in concern may be perhaps a young corallite of YÜ's species, however the present material is unfortunately too imperfect for determination of its species.

Horizon: *Rhodophyllum fukudai* zone.

Reg. No.: 9906.

Gen. et sp. indet.

Pl. I, fig. 19.

Corallum simple, corallite large, attaining about 40 mm in cross diameter, and curved cylindrical in form as far as it is preserved. Epitheca unknown. Major septa straight, thickened in the tabularium, numbering 51, among them, cardinal septum rather more shorter than the other major septa, and its shortening makes a cardinal fossula. Septa usually do not reach the columella, but the counter septum directly unites with it. Minor septa are not observable and may perhaps be absent. Dissepimentarium broad, occupies a half the radius of the corallite, includes many rows of dissepiments arranged in herringbone pattern in cross section. Tabulae also incomplete, vesicular and gently ascending to the columella. Columella somewhat complicated, consists of a sinuous median lamella which is nothing but a prolongation of the counter septum, and a few, thin septal lamellae. Lamellae anastomose with the irregularly arched tabulae.

Remarks: The present form possesses large corallite, numerous septa, herringbone dissepiments, vesicular tabulae, cardinal fossula, and columella united with the counter septum. From those characters, the present form should be regarded to be in close relationship with the

species of the genus *Yuanophyllum* YÜ, especially with the genotype. But, in the present form, major septa are really dilated intrathecally but not especially in the cardinal quadrants as in the genotype of *Yuanophyllum*, furthermore, the axial structure of the present form is not a single "palcolumella" but forms a rather complicated structure, although the median plate of it appears to be united with the counter septum. The last mentioned feature indicates that some intimate relationship exists between the present form and "*Lophophyllum*" as well as *Koninckophyllum*. YÜ once described *Yuanophyllum kansuense* and its three varieties (1934). Of them, varieties β and γ do not have the intrathecal dilation even in the cardinal quadrants. So, MA (1954) regarded the genus *Yuanophyllum* to be wholly synonymous with *Koninckophyllum*. But at least, so far as the genotype is concerned, the genus *Yuanophyllum* is quite distinct from the genus *Koninckophyllum* although the former resembles rather genus *Heterocaninia* YABE et HAYASAKA (1924) in having major septa extraordinarily dilated in the cardinal quadrants.

Yuanophyllum yabei described by NAGAO in collaboration with the senior author from the Onimaru series in the Kitakami mountainland, Northeast Japan (1941) is also quite similar to the genotype of the genus *Yuanophyllum*, especially in having strongly thickened major setpa in the cardinal sides of the corallite.

From the scantiness and the imperfect preservation of the material the present writers unfortunately could not prepare any suitable thin section for the specific determination, and the further investigation of this specimen is almost impossible beyond the present point.

Horizon: *Rhodophyllum fukudai* zone.

Reg. Nos.: 9893, 9890, 15005, 15089?.

Genus *Stylidophyllum* FROMENTEL, 1861

Stylidophyllum manchuriense MINATO et KATO, sp. nov.

Pl. II, fig. 1; Pl. III, fig. 13.

1942. *Lonsdaleia floriformis floriformis*, MINATO: (non MARTIN). p. 38, pl. II, fig. 5; Pl. IV, fig. 3.

Corallum compound, massive, cerioid. Corallites prismatic, 4- to 7-sided, attaining the longest diameter of about 20 mm in cross section. Epitheca thin, upon which slight and inconspicuous calcareous accretion is observable. Dissepimentarium rather wide, includes large, irregular, compressed, and laterally flattened cystosepiments of several rows ex-

truding to the epitheca; cystosepiments not penetrated by any septa, although the septal elongation sometimes is prolonged slightly to the peripheral area. Tabularium circular in form in cross section, occupies a half the diameter of the corallites, distinctly separated from the area of the lonsdaleoid cystosepiments by well defined inner wall composed of the inner margin of the cystosepiments. Septa thick, but decreasing in thickness towards both the axial and the peripheral ends; septa in two orders, major and minor, alternating with each other and attaining 20 to 23 in each order in mature stage. Major septa nearly reach the axial column. Minor septa rather thin and unequal in length, but usually attain a third the length of the major ones, somewhat flexuous. Axial column ellipsoidal shape in cross section as a whole, rather densely constructed, quite free from any sort of septa, consists in thick, flexuous median lamella, thick, irregularly flexuous septal lamellae, and a few rings of axial tabellae. The mode of the axial column is not typical spider web structure but shows some resemblance to the column of *Carcinophyllum*.

In one specimen, new corallite is observed to be arising from the peripheral area of the older one. It should be quite worthy of note that the minor septa are already appearing in this new corallite, even though it represents an early stage of the ontogeny.

In the longitudinal section, peripheral vesicles are unequal in size, although most of them are elongate in form, very large in size; they are gently inclined towards the axial column and irregularly overlapping upon the preceding ones. The tabulae are rather complete, subhorizontal in the central portion but upturned in both their ends. Density of the tabulae is 4 to 5 in a space of 2 mm.

In the columella the median plate is not visible, septal lamellae are flexuous, while the axial tabellae are strongly arched; all these structural elements give an irregular appearance like the columella of the genus *Carcinophyllum*.

Remarks: The present form fairly resembles *Stylidophyllum japonica* (YABE et HAYASAKA) (1915), but the former specifically distinct from the latter in having less numerous septa, longer minor septa, more wide and flatter cystosepiments and more thin outer wall, besides the peculiar feature of the columella.

A Russian form, described and illustrated by SMITH (1915) under the name *Lonsdaleia floriformis floriformis* MARTIN also shows some similarity to the present form but the Russian form is wholly lacking in the minor septa, and should be regarded to be a different species, although the senior author once treated the Manchurian form as conspecific with

the latter.

Lonsdaleia (Stylidophyllum) floriformis abukumensis SATO (1956) described recently by SATO from the Abukuma Massif, Japan is more nearly allied to the present form than the preceding species, especially in having longer minor septa and a peculiar axial column which shows a carcinophylloid trend like the Manchurian form, although it is more loosely constructed than the Manchurian form; furthermore, the former has thinner epitheca than the latter. Such being the case, the writers wish to propose a new name for the Manchurian form.

Horizon: *Stylidophyllum manchuriense* zone.

Reg. Nos. 9720-i, ii, iii.

Repository

The above described corals are now stored in the Geological and Mineralogical Department, Faculty of Science, Hokkaido University, Sapporo, Japan.

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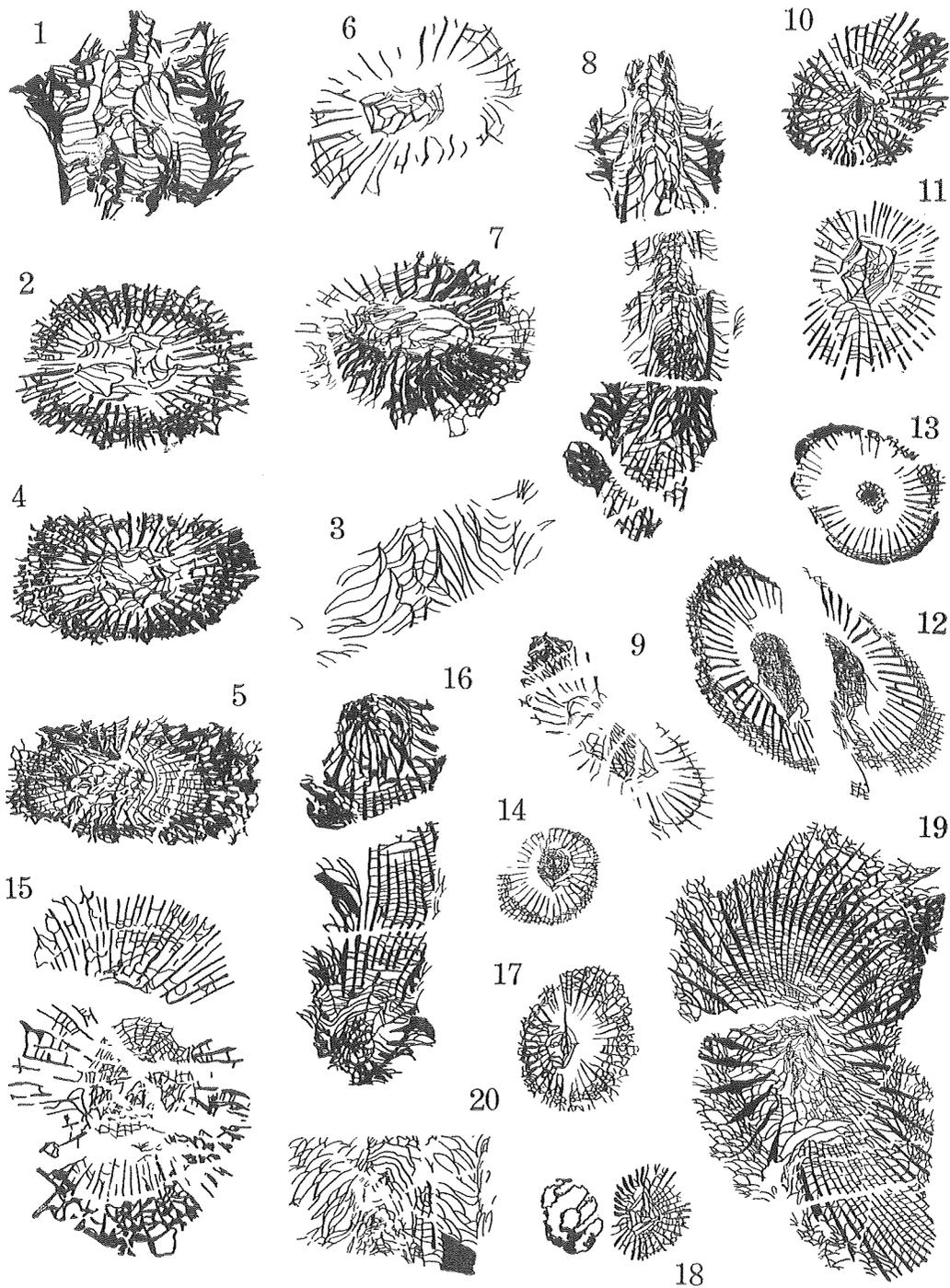
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Explanation of
Plate 1

Explanation of Plate I.

- Figs. 1-9. *Rhodophyllum fukudai* MINATO et KATO, sp. nov.
- 1-4. Serial sections from the Holotype.
 1. Longitudinal section. ($\times 1$) Reg. No. 9711.
 2. Transverse section. ($\times 1$) Reg. No. 9911.
 3. Longitudinal section. ($\times 1.8$) Reg. No. 9905.
 4. Transverse section. ($\times 1$) Reg. No. 9913.
 5. Transverse section. ($\times 1$) Reg. No. 9910.
 6. Transverse section; septal lamellae irregularly meet in the axial column. ($\times 1.6$) Reg. No. 9716.
 7. Transverse section; septal lamellae scarcely present in the axial column. ($\times 1.1$) Reg. No. 9894.
 8. Longitudinal section. ($\times 1$) Reg. No. 9891.
 9. Transverse section. ($\times 1.2$) Reg. No. 9717.
- Fig. 10. *Arachnolasma* cfr. *cylindricum* YÜ; Transverse section. ($\times 1.2$) Reg. No. 9906.
- Fig. 11. *Dibunophyllum* sp. indet.; Transverse section. ($\times 1.3$) Reg. No. 9912.
- Fig. 12. *Clisaxophyllum* sp. α ; Transverse section. ($\times 1.6$) Reg. No. 9712.
- Figs. 13-14. *Clisaxophyllum* sp. β
13. Transverse section. ($\times 1.7$) Reg. No. 9715.
 14. Transverse section. ($\times 1$) Reg. No. 9719.
- Fig. 15. *Clisaxophyllum* ? sp. γ ; Transverse section. ($\times 1.2$) Reg. No. 9714.
- Fig. 16. *Carcinophyllum* sp. α ; Oblique section. ($\times 1.1$) Reg. No. 9898.
- Figs. 17-18. *Kovincekophyllum* sp. indet.
17. Transverse section. ($\times 1$) Reg. No. 9909.
 18. Transverse section. ($\times 1$) Reg. No. 9897.
- Fig. 19. Gen. et sp. indet.; Transverse section, slightly oblique. ($\times 0.9$) Reg. No. 9893.
- Fig. 20. *Rhodophyllum* ? sp. indet.; Longitudinal section. ($\times 1.2$) Reg. No. 9908.



Explanation of
Plate 2

Explanation of Plate II.

(All figures 3 times natural size)

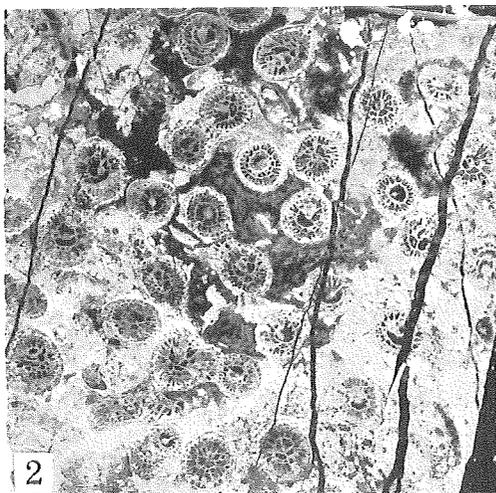
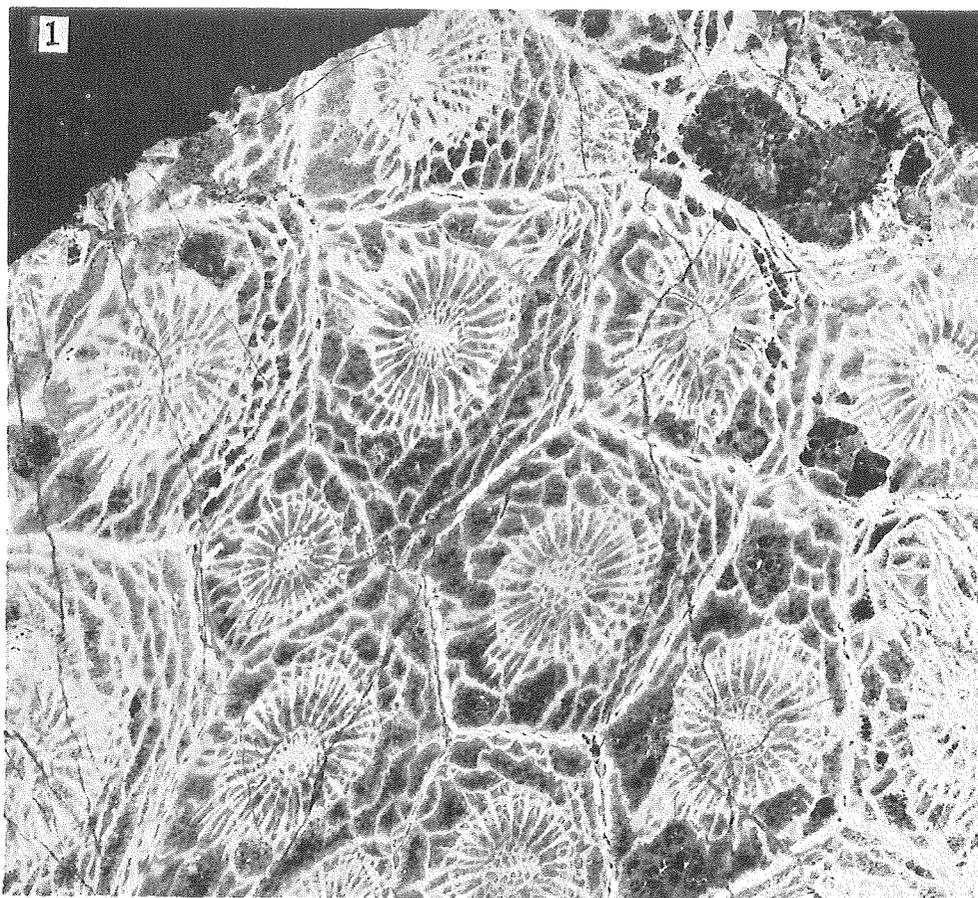
Fig. 1. *Stylidophyllum manchuriense* MINATO et KATO, sp. nov.

Transverse section. Reg. No. 9720-i.

Figs. 2-3. *Siphonodendron asiatica* var. *minor* MINATO.

2. Transverse section. Reg. No. 9874-i.

3. Longitudinal section. Reg. No. 9874-ii.



Explanation of
Plate 3

Explanation of Plate III.

- Fig. 1. *Caninia* sp. α ; Transverse section. ($\times 2.1$) Reg. No. 9736.
Fig. 2. *Caninia* sp. β ; Transverse section, showing the columellate feature ($\times 1.1$) Reg. No. 9907.
Fig. 3. Cfr. *Caninia* sp. β ; Transverse section. ($\times 2$) Reg. No. 9896.
Fig. 4. *Caninia* ? sp. γ ; Transverse section. ($\times 2$) Reg. No. 15012.
Fig. 5. *Rhodophyllum fukudai* MINATO et KATO, sp. nov.; Transverse section, showing the well-developed septal lamellae. ($\times 2$) Reg. No. 9892.
Fig. 6. *Carcinophyllum* ? sp. β ; Transverse section. ($\times 2$) Reg. No. 9889.
Fig. 7. *Clisaxophyllum* sp. α ; Transverse section. ($\times 3$) Reg. No. 9713.
Figs. 8-12. *Diphyphyllum* (*Depasophyllum*) *hochangpingense* Yü;
8. Transverse section. ($\times 1.2$) Reg. No. 9903.
9. Transverse section. ($\times 2$) Reg. No. 9904.
10-11. Longitudinal section. ($\times 1.1$) delineated from Fig. 12.
12. Longitudinal section. ($\times 1$) Reg. No. 9899.
Fig. 13. *Stylidophyllum manchuriense* MINATO et KATO, sp. nov.; Longitudinal section. ($\times 2$) Reg. No. 9720-ii.
Fig. 14. *Siphonodendron asiatica* (YABE et HAYASAKA); Longitudinal section. ($\times 2$) Reg. No. 9868-i.
Fig. 15. *Lonsdaleia* ? sp. indet.; Transverse section. ($\times 1.5$) Reg. No. 9883.

