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AN INTERESTING CORAL FROM THE LOWER CARBONIFEROUS OF THE KITAKAMI DISTRICT, JAPAN

By

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With 1 Plate

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The so-called "Coral Limestone" of Lower Carboniferous age in the Kitakami district of Northeast Japan is renowned for its rich fossil coralline fauna. Some of these fossils were described as early as 1915 by Professors YABE and HAYASAKA. One of the present writers (MINATO) who has devoted himself for these three years to the study of the geology and palaeontology of the Palaeozoic deposits developed in the Setamai district in the southern part of Kitakami, collected abundant specimens of coral from this limestone. Among them is contained an interesting simple coral described in the present paper, which is, the writers believe, very near to *Yuanophyllum* established by YÜ from the Lower Carboniferous of China, but distinct therefrom in some important features.

Genus *Yuanophyllum* YÜ, 1931

Subgenus *Kesenella* nov.

Yuanophyllum (Kesenella) yabei nov.

Pl. XXVIII.

EXTERNAL CHARACTERS

Corallum. Simple, ceratoid, slightly curved, conical in the proximal half and almost cylindrical in the mature stage. Although both extremities are lost, it probably a little exceeds 70 mm. in total length and over 25 mm. in maximum diameter. Calyx unknown.

Epitheca. Epitheca smooth; fine longitudinal ridges present, but not much pronounced.

INTERNAL CHARACTERS

Eight succeeding thin sections have been made, of which a longitudinal one was prepared from the distal portion and seven transverse ones from the proximal two-thirds. None of the sections is complete due to bad preservation of the specimen, the marginal part of the corallite being always lost before or in preparation of the slices. Consequently no definite feature of the wall or marginal part is ascertained.

Horizontal sections

Septa. Major and minor septa are present. The major septa are essentially quite the same in all quadrants, but the minor septa show some important differences in the cardinal quadrants and the counter ones; they are almost as long as the major ones in the cardinal quadrants, being always extended far beyond the theca, but extremely short in the counter quadrants. The number of major septa reaches 62 in the adult stage, the cardinal and counter septa included. A few major septa adjacent to the cardinal fossula surround the fossula with their distal ends, a feature well observable even in the earlier stage of growth (fig. 7). Both alar septa are clearly recognizable. The right alar one is represented by a septum (fig. 2) slightly shorter than the other ones and situated close to the counter side of the right cardinal quadrant in which the prolongation of the minor septa is clearly observable.

In the last neanic stage (fig. 7), some of the major septa of the counter quadrants extend almost to the center with a tendency to join with each other, and especially all the three primary septa, two alar septa and counter one, nearly reach the center. In the section (of this stage), the cardinal septum is not shown, but apparently it is very short and it must have been lost in the preparation together with the periferal portion of the corallum; the major septa of the cardinal quadrants do not reach the center. In the sections of the ephebic stages (figs. 2-6), the major septa of all quadrants extend to the outer margin of the columellar area.

All the major septa are thickened in the intrathecal area by a stereoplasmic deposit, more strengthened with age, and especially those of the cardinal quadrants are completely fused with each other by the deposit. A very fine lamellar structure perpendicular to the septa, not shown in the figures, is present in the deposit. The septa are often sinuous in the extrathecal area where they are not thickened.

The minor septa in the counter quadrants do not reach the theca. In the earlier stage of growth (fig. 5), they do not penetrate into the dissepimental tissues, but cross only a small part of the peripheral rings.

The number of major septa

	Left cardinal quadrant	Cardinal septum	Right cardinal quadrant	Counter quadrants including counter septum and two alar septa
Neanic stage fig. 1	8	1	8	19+
Ephebic stage fig. 2	9	1	9	26+
fig. 3	10	1	10	28+
fig. 4	12	1	11	30+
fig. 5	14	1	14	34+
fig. 6	14	1	14	34+

Fossula. The cardinal fossula is large and clearly recognizable in all stages of growth; it extends from the margin to the central area. In fig. 6, it is not so clearly shown probably due to crushing. The alar fossula may also be discernible in the neanic stage, but it certainly disappears soon with the completion of the septal arrangement.

Tabulae. The tabular intersections vary greatly in outline; in the central portion they are concave and in the cardinal fossula convex, towards the center. In the intrathecal area of the counter quadrants, only a few out-edges of tabellae are scattered.

Dissepiments. As already remarked, the peripheral part being largely lost in most of the sections; the complete features of this part are not gained. The dissepiments appear in a very early stage of growth within the wall of the calice and the dissepimental area is gradually thickened with age. In fig. 7, a section of a neanic stage, the dissepiments are not represented, and in the cardinal quadrants in all stages they are also not clearly shown, certainly due to the missing of this part in the preparation, but not to want of them,

for in figs. 3, 4 they are partly represented in the cardinal quadrants. The dissepiments are arranged in a concentric pattern in the earlier stage (fig. 6) and take an angulo-concentric appearance in the mature stage.

Vertical sections

Fig. 1 shows a section prepared from the counter quadrants, so as to be parallel to the alar septa, and differs naturally from a section parallel to the counter septum, and also from that cut through the cardinal quadrants and parallel to the alar septa.

Counter septum. The counter septum is represented at the central part, somewhat sinuous, but not interrupted.

Tabularium. The tabularium is composed of the inner series of tabellae and the outer series of tabulae. The tabulae and tabellae are rather loosely arranged and ascend rapidly towards the counter septum. The tabellae are more crowded and slightly steeper in inclination than the tabulae.

Dissepimentarium. The dissepimental zone possesses very crowded, slightly convex dissepimental vesicles arranged vertically with convex surface facing inwards.

REMARKS

The genus *Yuanophyllum*⁽¹⁾ has been founded on a peculiar coral, *Y. kansuense* Yü, and its three varieties from the *Yuanophyllum* Zone of the Fengninian System of China. The original generic diagnosis runs as follows:

"Corallum simple, large, curved and slightly turbinate. In some specimens it is cornute proximally and cylindrical distally. The calyx is deep with a small projection at the center of its base. The major septa are commonly thickened within the intrathecal region, especially in the cardinal quadrants. The counter septum is always prolonged to the center to form a columella. It is usually flexuous,

(1) C. C. Yü: The Correlation of the Fengninian system, the Chinese Lower Carboniferous, as based on coral zones. Bull. Geol. Soc. China, vol. 10, 1931, p. 26.

C. C. Yü: Lower Carboniferous corals of China. Palaeontologia Sinica, Ser. B, Vol. 12, 1931, Fasc. 3, p. 46.

slightly thickened at the center and often twisted with some other septa. The minor septa are very short. The dissepiments are arranged mainly angulo-concentrically. The dissepimental zone is rather broad, attaining a thickness of about $\frac{1}{2}$ the major septa at the adult stage of some specimens. A very distinct fossula is present. The inner ends of the major septa often turn aside in one direction. The pseudocolumella in the longitudinal section is usually flexuous vertically and also discontinuous in some specimens. The central part of the visceral chamber is wholly filled with vesicular tabulae."

YÜ compared his genus with *Heterocarinia* YABE and HAYASAKA⁽¹⁾, *Koninckophyllum* THOMSON and NICHOLSON⁽²⁾, *Arachnolasma* GRABAU⁽³⁾, and also with *Lophophyllum tortuosum* (MICH.)⁽⁴⁾. The present coral is easily distinguished from all of these except *Yuanophyllum*. As will be seen from the description, the specimen at hand has many points in common with *Yuanophyllum*; general form of the corallum, a well developed thickening of the septa in the cardinal quadrants, a very distinct and large cardinal fossula and, furthermore, a large columellar area. Consequently the writers are warranted to regard the Japanese coral as congeneric with Chinese one. However, there are many other features, some of which are important, which separate it from YÜ's genotype as well as from the varieties. The former is far smaller in size and has far more numerous major septa, differences which are probably of specific importance. But it is characterized by the minor septa in the cardinal quadrants almost as long as the major ones, a feature quite peculiar not seen in many corals. In the genotype of *Yuanophyllum* and the varieties, this character is not described nor figured, except the variety in which these septa are somewhat longer than in the other forms of the genus, but do not much extend beyond a half of the width of the dissepimental

(1) H. YABE and I. HAYASAKA: Geographical research in China. Atlas of fossils, 1920, Pl. XI, Figs. 2a-d.

(2) J. THOMSON and A. NICHOLSON: Contribution to the chief generic types of the Palaeozoic corals. Ann. & Mag. Nat. Hist., Ser. 4th. vol. XVI, 1876, pp. 297-300.

(3) A. W. GRABAU: Palaeozoic corals of China. Palaeontologia Sinica, Ser. B, Vol. 2, 1922, Fasc. 1, p. 59.

(4) R. G. CARRUTHER: *Lophophyllum* and *Cyathaxonia*, note on two genera of Carboniferous corals. Geological Mag., vol. X, 1913, p. 49.

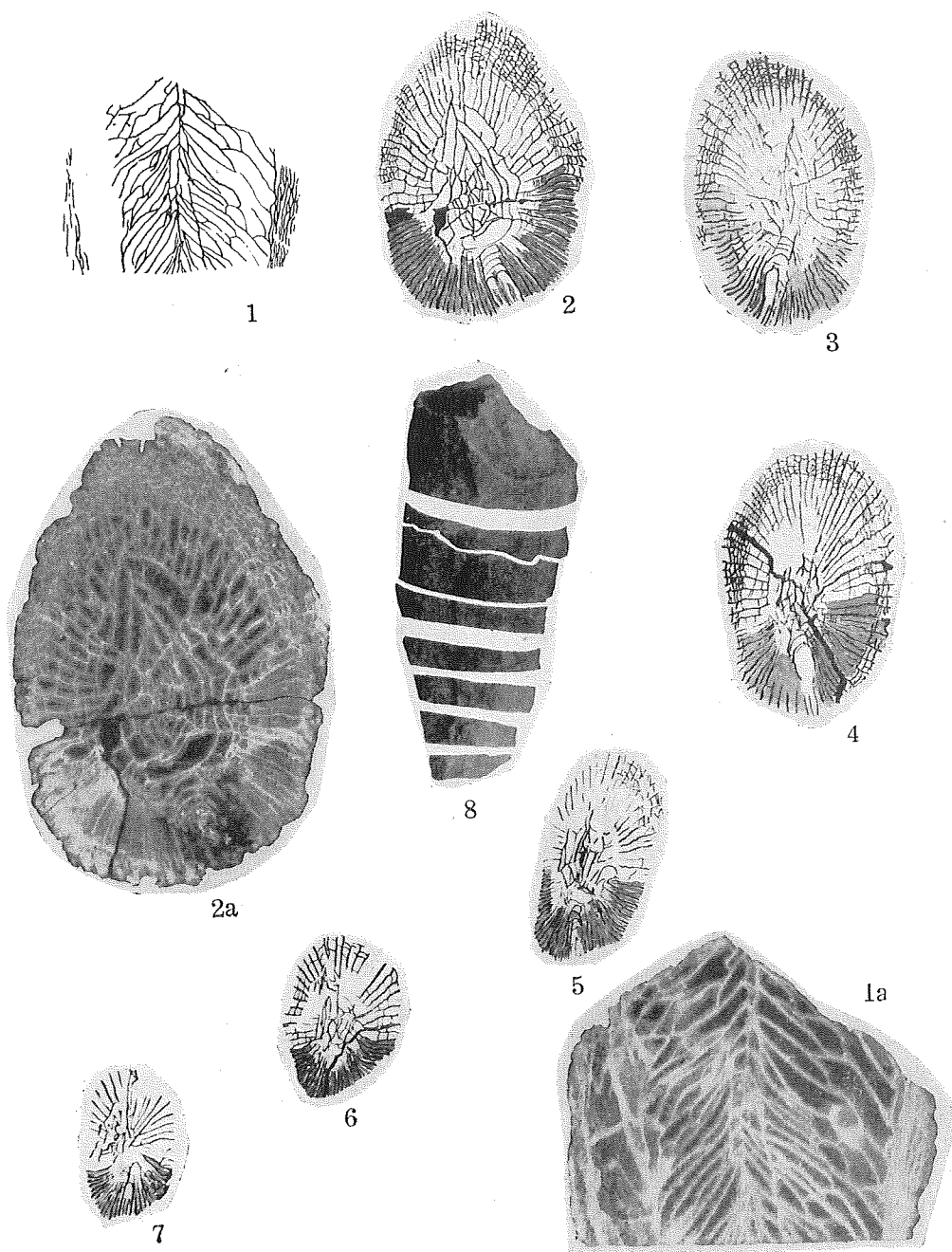
area. As shown in the vertical sections, the inner tabulae of the columellar area are loosely arranged and very steeply inclined outward and downward from the counter septum, while they are very crowded with a slow inclination in all forms of YÜ's genus. Such being the circumstances, the writers wish to propose a new sub-generic name, *Kesenella* nov., to receive the present coral from Japan.

Yuanophyllum kansuense and its varieties are restricted in China to the *Yuanophyllum* zone of the uppermost part (Upper Viséan) of the Lower Carboniferous Fengninian System. This zone is, based on its coral fauna, believed by YÜ to be parallel with the *Dibunophyllum* zone of Europe. It is remarkable that the present coral, *Y. (Kesenella) yabei*, occurs with *Dibunophyllum vaughni* GARWOOD and GOODYEAR, one of the most characteristic corals of the European *Dibunophyllum* zone.

EXPLANATION OF THE PLATE XXVIII

Yuanophyllum (Kesenella) yabei NAGAO and MINATO nov.

- Figs. 1, 1a. A vertical section. 1×2, 1a×3.
Figs. 2-7. Horizontal sections. 2, 3, 4, 5, 6, 7×2, 2a×3.
Figs. 8. The corallum. Natural size.
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Kumano photo, and Minato del.