Gotlandian Deposits of Northwest Korea*

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With 11 Plates

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INTRODUCTION

In 1932, when two of the authors, Shimizu and Ozaki, were surveying the environs of the Heizyô[1] Coal-field, Ozaki visited the Sindô[2] area, about 2 km. northeast of Ken-niho[3], to collect some fossils. Notwithstanding the very short time spent there (two days, both in inclement weather), Ozaki collected many fossils, such as those of corals, cephalopods, brachiopods[4], gastropods[4], bryozoa[4], hydrozoa[4], etc.; all supposed to be Gotlandian.

Since no Gotlandian deposits were hitherto believed to be present in North China and Korea, the discovery of such a fossil group in Korea is of great interest in connection with the historical geology of Eastern Asia. In the following summer, 1933, Shimizu and Ozaki revisited the region, but the latter having unfortunately contracted dysentery shortly after the arrival there, the geology of the district, to our great regret, could not be studied in detail.

* J. Shanghai Sci. Ins., Sect. II, Vol. I, No. 6, 1934, p. 59.

1) 平壤
2) 新洞
3) 黍二浦
4) Ozaki's description is now in preparation.

I. STRATIGRAPHY; By S. SHIMIZU and K. OZAKI

The formation from which these fossils were collected is exposed in the environs of Sindô and Keihori[1], about 2 km. northeast of Ken-niho, Kôsyûgun, Kôkaidô[2], Korea. We propose here to call it the "Ken-niho limestone-conglomerate," which, untill our discovery of Gotlandian fossils there, had been believed to be of Lower Jurassic age (?).

Both S. SHIMAMURA[3] and T. KOBAYASHI[4], who studied the geology of the district in detail, considered the formation to be the base of the Daidô Formation. The Formation was divided into two main parts, the Lower (Lower Jurassic ?) and the Upper (Cretaceous). The Lower Daidô Formation, furthermore, was classified by SHIMAMURA into the three groups: Tûdô, Syôrinzan, and Goson; and the Upper also into the three groups: Goryûzan, Kanhôzan, and Honanri Groups.

According to them, the lowest or Tûdô Group consists of conglomerate and sandstone intercalated with black shale. From the black shale intercalated in the relatively upper horizon of the group, SHIMAMURA collected *Estheria* sp. The pebbles of the conglomerate are almost always limestone, rarely quartzite or clay slate of small size; the diameter of the former reaching 20 cm. or more. KOBAYASHI considered them to be Ordovician.

In our opinion, this Tûdô Group may be classified into two horizons, the Upper and the Lower. The Upper, from which *Estheria* sp. collected by SHIMAMURA, is named here the Sindô Group, while the Lower is correlated with the "Ken-niho limestone-conglomerate."

Since the area surveyed by us is very small, it is not known whether the Ken-niho limestone-conglomerate is confined to this region or not, but so far as we have surveyed, the district in which the Ken-niho limestone-conglomerate is exposed may be divided into the two areas of Sindô and Ryûsenri[5].

The Ken-niho limestone-conglomerate in the Ryûsenri area rests disconformably on Ordovician limestone (near Ryûsenri), while its upper part seems to change transitionally into the overlying Syôrinzan

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1) 系浦里

2) 黃海道黃州郡

3) S. SHIMAMURA: Geological Atlas of Chôsen, Geol. Surv., Govt.-Gen., Chôsen, No. 8, Kenjiho Shariin and Sainei Sheets, 1929.

4) T. KOBAYASHI: On the Ordovician Formations in South Manchuria and North Korea, Jour. Geol. Soc. Tokyo, Vol. XXXVII, 1930, p. 77 (in Japanese).

5) 龍川里

Group (on the southern pass of Tekkôzan[1] Hill). This group, which is sometimes tufaceous, consists of sandstone and shale, and in its upper horizon is intercalated with marl nodules containing some gastropods. The apparent transition of the Ken-niho limestone-conglomerate in this area into the Syôrinzan Group is noteworthy.

In the Sindô area, the Ken-niho limestone-conglomerate and the Ordovician limestone are bounded by a fault trending N.E.—S.W. The upper horizon of the conglomerate is overlain by the Syôrinzan Group, in the basal part of which the lithologic characters change in places into green marl at Sindô and into dark red shale on the hill near Keihori.

The Syôrinzan Group, which is wanting in the Ryûsenri area, is represented in the Sindô area by a thick, dark-red conglomerate which is intercalated with dark, reddish purple sandstone and sandy shale. The conglomerate consists of sandy matrix and various kinds of pebbles, such as sandstone, shale, and very rarely limestone. The most interesting of these, however, are the limestone pebbles containing *Girvanella manchurica* YABE and OZAKI, and Cryptozoon (?). *Girvanella manchurica* YABE and OZAKI is found in the Lower Cambrian Formation of South Manchuria, while its occurrence in Korea has been reported by KOBAYASHI. Our present knowledge with regard to *Cryptozoon* (?) is rather meagre. SHIMAMURA states, however, that there are three horizons of *Cryptozoon* in the Masanri Group near Masanri[2]. The conglomerate of the Syôrinzan Group is, therefore, readily distinguishable from the Ken-niho limestone-conglomerate by the lithologic characters just mentioned.

As will be seen from the preceeding descriptions, the stratigraphical relation between the Gotlandian deposits and the overlying formation is unknown. Judging, however, from the resemblance of the lithologic character of the Sindô Group to the Mesozoic coal-bearing formations of northern Korea, and from the fresh-water gastropods collected from the marl nodules of the Sindô Group, and also from SHIMAMURA's discovery of *Estheria* sp. in the black shale which may be correlated to the Sindô Group, there seems to be no objection to the conclusion that a boundary must exist between the Ken-niho limestone-conglomerate and the sandstone and shale groups.

The results of our stratigraphical observations compared with those of SHIMAMURA and KOBAYASHI may then be tabulated as follows:

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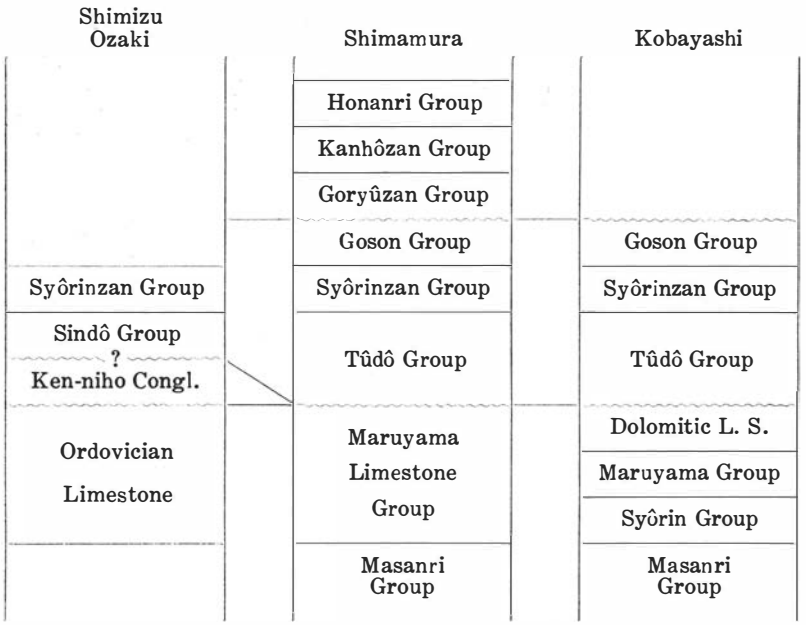
1) 鉄鏃山
2) 馬山里



II. DESCRIPTION OF FOSSILS

A. CORALS; by K. OZAKI

Family *Zaphrentidae*

Genus *Amplexus* Sow.

Amplexus sp. indet. a

Pl. IX, Figs. 1, 2

Corallum simple or bushy, cylindrical; surface marking as well as calycal feature unknown. Simple corallum or corallites broad. About 9 tablae in space of 1 cm., complete, regularly arranged, horizontal or sometimes slightly convex upwards, thinner than the wall. Septa also thin, 22 in number, rather long, but never reaching the centrum of corallum; secondary septa rare.

Amplexus sp. indet. b

Pl. IX, Figs. 3–5

Corallum simple, conical; at broadest part 1.3 cm. Calice and surface marking unknown. Tabulae complete, horizontal except near

wall where they slope down steeply posteriorly in acute angle with wall. Tabulae in younger part of corallum spaced in groups with intervals of three; separated by interspaces about three times as wide as space occupied by each group. Septa rather short, never as long as 1/6 diameter of corallum; secondary septa present.

Calophyllum **?** sp. indet.

Pl. IX, Fig. 6

Corallum simple, cylindrical, 1 cm. broad; calice and surface marking unknown. Peripheral zone composed of small vesicles in single row (about 6 in 1 cm.) which show steeper slope towards apex than towards calix. Tabulae either simple and horizontal or splitting irregularly; convex upwards in very rare cases; 14 counted in 1 cm. No septa traceable.

Remarks.—A single very fragmental specimen is here assigned with doubt to the genus *Calophyllum* on account of its peripheral zone having the thickness of one cell instead of two as in *Diphyphyllum*, which it also somewhat resembles. The latter genus is characterised further by having regularly disposed tabulae.

Family *Cyathophillidae*

Genus *Storthygophyllum* Weiss.

Storthygophyllum **?** sp. nov.

Pl. IX, Figs. 7–10

Corallum forms astraeiform or bushy colonies; corallites polygonal and prismatic, with deep calix. Nature of bottom of calical fossa unknown owing to recrystallisation.

Walls between two corallites undulated, rather thick and two or three times as thick as tabulae. Corallite composed of two parts; tabulated inner and dissepimented outer. Tabulae mostly complete, usually disposed horizontally, but occassionally either concave upwards or flat; 10 or more counted in 5 mm. Dissepiments relatively large, slightly convex and arranged in a few rows acutely conical. Septa very short, spinose, visible only on innermost dissepiments in transverse section.

Remarks.—This genus was established by WEISSERMEL[1] in 1894 on *S. megalocystis* WEISSERMEL, who described it as follows:

"Stock astraeoidisch order bundelförmig. Die Septen werden durch in zwei Ordnung entwickelte Reihen von Dornen vertreten. Die Dissepimente bestehen in wenigen Reihen grösser Blasen und wohlentwickelten Boden. Die Vermehrung erfolgt durch Kelchsprossung."

In this specimen septal spines are hardly traceable, owing perhaps to recrystallisation, excepting a very short spinose septa still preserved on innermost dissepiments.

The specimen also more or less resembles *Xiphelasma* SMITH[2], but in the latter the corallum is always fasciculate, while the corallites, which are never in contact with the wall are rounded in transverse section. Therefore, until more perfectly preserved specimens are available, this specimen is provisionally referred to *Storthygophyllum*.

Family *Cystiphyllidae*

Genus *Cystiphyllum* LONSDALE

Cystiphyllum cfr. *siluriense* LONSDALE

Pl. IX, Fig. 13; Pl. X, Figs. 1, 2

1839. *Cystiphyllum siluriense* LONSDALE: in Murchison's Silurian System, p. 691, Pl. XVI, Figs. 1, 1a, 2.
1902. *Cystiphyllum bohemicus* FOCTA: Systeme Sil. du Centre de la Boheme, Vol. VIII, Tome II, p. 164, Pls. XXXV–XXXVIII.
1927. *Cystiphyllum siluriense* LANG and SMITH: A Critical Revision of the Rugose Corals Described by W. Lonsdale in Murchison's Silurian System, Quart. Jour. Geol. Soc., Vol. 83, Pt. 3, p. 476.
1927. *Cystiphyllum siluriense* WEDEKIND: Die Zoantharia Rugosa von Gotland (Bes. Nordgotland), Sveriges Geologiska Undersökning Ser. Ca, No. 19, S. 65, Taf. 19, Figs. 3–5.

Species represented by a single specimen. Corallum simple, turbinate; epitheca apparently bearing faint longitudinal striae as well as strong and irregular annulations.

As specimen lacks its upper portion, nothing is known about calice. Internal structure of corallum sufficiently well-preserved for examina-

1) W. WEISSERMEL: Die Korallen der Silurgeschiebe Ostpreussens und des östlichen Westpreussens, Zeits. deut. geol. Gesell., Bd. XLVI, 1894, S. 618.

2) S. SMITH and W. D. LANG: Silurian Corals. The Genera *Xiphelasma*, gen. nov., and *Acervularia*, Schwager, with Special Reference to *Tubiporites tabulatus*, Schlotheim, and *Diplophyllum caespitosum*, Hall. Ann. Mag. Nat. Hist., Vol. 8, 1831, p. 89.

tion in thin section notwithstanding crystallization of matrix deposited in interspaces. In transverse section, vesicular tissue exhibits concentrical arrangement, though very irregularly; vesicules vary in size, always convex towards interior of corallum. In longitudinal section, vesicular tissue appears to be arranged parallel to base of calice; those near periphery of corallum being narrow but elongated, while those at inner part are short. Spines on convex sides of vesicules invisible, probably obscured by recrystallization of matrix.

This seems to be closely allied to, if not identical with, *Cystiphyllum siluriense* LONSDALE from the Wenlock limestone of Wenlock, Shropshire, and the E_2 horizon in Bohemia.

Cystiphyllum sp. indet.

Pl. IX, Figs. 11, 12

Two fragmental specimens believed to represent another species of the same genus.

Corallum rather small, straight, and turbinate; details of the surface ornamentation obscured by recrystallization of its epitheca. Vesicular tissue of central part occupying 1/3 or more of entire corallum, horizontal, vesicules coarser than those of outer part, which are always convex and slope down steeply towards interior.

Family *Heliolitidae*

Genus *Heliolites* LINDOSTRÖM

Heliolites sp. indet.

Pl. X, Fig. 3

A fragmental specimen, which undoubtedly belongs to the genus *Heliolites*, consists of divergent tubes. Corallites 1.6 or less in diameter and about 1 to 3.5 mm. apart, bordered by thin wall and irregularly tabulated. Tabulae horizontal or concave upwards; 9 or less in a space of 5 mm. Coenenchymal tubuli differ greatly in size, measuring from 0.25 to 0.5 mm., horizontally tabulated. Tabulae 13 or more in 5 mm.

Remarks.—The foreign species most closely resembling this is *Heliolites decipiens* MCCOY[1], specific identification being impossible, however, because of the too fragmental nature of our material.

1) G. LINDSTRÖM: Remarks on the Heliolidae, 1899, p. 48, Pl. II, Figs. 3–22.

Genus *Plasmopora* EDWARDS and HAIME

Plasmopora follis EDWARDS and HAIME

Pl. X, Figs. 4–6

1873. *Plasmopora follis* ROMINGER: Geology of Lower Peninsula, Geol. Surv. Mich., Vol. III, Pt. II, p. 14, Pl. III, Fig. 2.

1899. *Plasmopora follis* LAMBE: A Revision of the Genera and Species of Canadian Palaeozoic Corals, Contributions to Canadian Palaeontology, Vol. V, Pt. I, p. 83, Pl. II, Figs. 8, 8a.

Specimen composed of corallites with no trace of septal spinules, quite circular in transverse section, uniform diameter of about 1 mm., closely set, 8 in space of 1 cm., divided by numerous, well-developed tabulae at irregular spaces that are concave upwards with 11 or more in a space of 5 mm.

Coenenchyma consist of numerous short polygonal prismatic cells formed by short vertical parietes and horizontal dissepiments meeting at right angles; vertical parietes therefore appear zigzag in longitudinal section. Eighteen or more horizontal dissepiments in a space of 5 mm.

Plasmopora nakamurai sp. nov.

Pl. X, Figs. 7, 8

Corallum discoidal, rather small; 3.5 cm. or less in diameter, elevated along margin, also slightly elevated in its central part.

Corallites with pseudosepta and of same dimension, apparently quite circular in transverse section; bordered by thin wall and divided by numerous well-developed tabulae; number of tabulae 10 or less in space of 5 mm., mostly horizontal, but sometimes concave upwards and coalescing with the next one.

Coenenchyma entirely made up of short rather irregularly arranged polygonal prismatic cells; 15 or less horizontal dissepiments in 5 mm.

Remarks.—Specimen greatly resembles *Plasmopora follis* E. and H. mentioned above, but distinguishable from it by larger coenenchymal cells, larger corallites, and irregularly arranged horizontal dissepiments.

Genus *Propora* EDWARDS and HAIME

Propora cfr. *magnifica* POCTA

Pl. X, Figs. 9, 10; Pl. XI, Fig. 1

1902. *Propora magnifica* POCTA: Systeme Sil. du Centre de la Boheme, Vol. VIII, Tome II, p. 299, Pl. CVII, Figs. 1–4.

Corallum small, spherical; corallites circular or crenulate in transverse section, all of same size, about 1.3 mm. broad; coenenchyma vesicular, abundant. Tabulae in corallites concave upwards, closely but rather irregularly distributed, about 17 in space of 5 mm. No septal spine preserved. Coenenchymal cells more densely crowded near tabulae in corallites at rate of about 1.5:1; horizontal dissepiments rather irregularly spaced, crowded at horizons where tabulae in corallite are crowded.

This form well agrees with *Propora magnifica* POCTA in all other features except in the absence of septal spines, which may be ascribed to recrystallisation as in the case of *Halysites escharoides* in the present collection.

The specimen also recalls *Propora tubulata*[1] from Bohemia and "*Heliolites interstincta*"[2] from Timan. But the first is distinguished from the second in having tabulae rather regularly distributed and the vesicules more flattened. The third form, it seems, should be assigned to the genus *Propora* rather than to *Heliolites*. It, moreover, greatly resembles the Korean specimen. *Propora magnifica* has been reported by POCTA from the E_2 horizon of the Upper Salopian, Bohemia.

Propora yabei sp. nov.

Pl. XI, Figs. 2, 3

Corallites closely set, rarely in contact, generally separated by interspaces not exceeding 1/4 diameter of corallites; in transverse section uniformly broad and circular, or sometimes so slightly crenulated as to be scarcely observable unless carefully examined. Septal spine apparently absent.

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1) P. POCTA: loc. cit., p. 300, Pl. CVII, Fig. 5.

2) N. LEBEDEFF: Obersilurische Fauna des Timan, Mém. Com. Géol., Vol. XXII, No. 2, 1892, S. 13, Taf. I, Fig. 3.

Tabulae rather thin, horizontal or slightly convex upwards, and apparently regularly arranged. Vesicular tissue composed of vesicules highly arched upwards and as thick as tabulae in corallites.

Remarks. — The nearest species to this is *Propora tubulata* LONSDALE[1]. Apart from the septal spines, which are not traceable, the former differs from the latter in its corallites being more closely set, and tabulae being well spaced and regularly arranged.

Another allied species is *Propora magnifica* already refered to above, which, however, is also easily distinguished from the present specimen by the differently shaped vesicules of the vesicular tissue.

Genus *Koreanopora* gen. nov.

Genotype: ***Koreanopora proporoides*** sp. nov.

Corallum massive, consisting of tubular corallites and interstitial vesicular tissue. Corallites crenulated in cross section, but lacking distinct septal spines. Tabulae in corallites almost horizontal, but slightly elevated at center to form slender discontinuous (?) columella. Coenosteum vesicular, vesicles more crowded than tabulae in corallites.

Remarks.—This genus is most closely related to *Propora E. H.*, from which it is, however, distinguished by the possession of corallites slightly crenulated, but not provided with typical septal spines, and by the columella, which is slender and discontinuous (?). It resembles certain species of *Heliolites* and *Plasmopora* in having a slender columella, but its coenosteum in the latter two genera is not distinctly tubular.

Koreanopora proporoides sp. nov.

Pl. XI, Figs. 4-6

Corallites crenulated, composed almost always of twelve arc-segments with their convex sides directed outwards. They are all of same size, about 1.7 mm. in diameter, 25 counted in a square centimeter. Tabulae complete, horizontal, rather regularly arranged, but slightly elevated at centrum of corallites. Tabulae thinner than walls; 15 in space of 5 mm. Columella linear, as thick as walls. Vesicular tissue rather irregular, but more closely set than tabulae. Vesicule not so expanded as in *Propora yabei* described in this paper.

1) P. POCTA: op. cit., p. 300, Pl. CVII, Fig. 5.

Family *Favositidae*

Genus *Favosites* Lam.

Favosites cfr. *gotlandicus* Lam.

Pl. XII, Figs. 1–6

1854. Favosites gotlandicus EDWARDS and HAIME: Brit. Fossil Corals, p. 256, Pl. XL, Figs. 1, 1a.
1876. Calamopora gotlandica ROEMER: Lethaea Geognostica, I Theil, Bd. I, S. 421, Taf. IX, Figs. 4a, b.
1894. Favosites gotlandicus WEISSERMEL: Die Korallen der Silurgeschiebe Ostpreussens und des östlichen Westpreussens, Zeits. deut. geol. Gesell., Bd. XLVI, S. 647, Taf. LI, Fig. 8.
1902. Favosites gotlandicus POCTA: Systeme Sil. du Centre de la Boheme, Vol. VIII, Tome II, p. 230, Pl. LXXVI, Figs. 1–12.
1908. Favosites goltlandica MANSUY: Contribution à la Carte Géologique de l'Indo-Chine, Palaeontologique, p. 32, Pl. IV, Figs. 7, 7a; Pl. V, Fig. 3.
1915. Favosites gotlandicus YABE and HAYASAKA: Palaeozoic Corals from Japan, Korea, and China, Jour. Goel. Soc. Tokyo, Vol. XXII, p. 66.
1920. Favosites gotlandicus YABE and HAYASAKA: Palaeontology of Southern China, p. 85, Pl. IX, Fig. 6.

Corallum massive, composed of prismatic corallites radiating from small basal part. Corallites polygonal, generally hexagonal, but rarely pentagonal or heptagonal. Diameter somewhat unequal, from 2.5 to 1.5 mm. Walls thin, remarkably wrinkled in both directions, but more so longitudinally than transversely. Septa as thick as wall, rarely observable. Tabulae, which are very thin, complete, usually horizontal, but sometimes slightly concave or convex, are numerous, ranging from 5 to 7 in 5 mm. Mural pores large, circular, and arranged in two alternate rows near corners of wall.

Neither EDWARDS and HAIME[1] nor YABE and HAYASAKA[2] have mentioned the number of tabulae in this species, but there are probably only a few in a unit length. The Bohemian species have 6 to 8 in 10 mm., while the specimen from Malung limestone, described by GRABAU[3], had 30 in the same length. The latter, therefore, does not seem to be correlated with this species.

In Eastern Asia, this species was reported from Tonkin by MANSUY in 1919; Lo-jo-ping, Ichang District, W. Hupei, by YABE and HAYASAKA in 1915 and 1920, and by HSIEH and CHAO in 1925; also in Shiberia,

1) EDWARDS and HAIME: loc. cit.
2) YABE and HAYASAKA: loc. cit.
3) A. W. GRABAU: Silurian Fauna of Eastern Yunnan, 1926, p. 21, Pl. I, Figs. 1, 2.

from New Siberian Islands by Toll and from the Irkutsk basin by others. All these authors consider it to be of Gotlandian age.

Favosites cfr. *forbesi* EDWARDS and HAIME

Pl. XIII, Fig. 1

1854. Favosites forbesi EDWARDS and HAIME: Brit. Fossil Corals, p. 258, Pl. LX, Figs. 2, 2a–g.
1876. Calamopora forbesi ROEMER: Lethaea Geognostica, I Theil, Bd. I, S. 421, Taf. IX, Figs. 5a–c.
1892. Favosites forbesi LEBEDEFF: Obersilurische Fauna des Timan, Mém. Com. Géol., Vol. XII, No. 2, p. 10.
1894. Favosites forbesi WEISSERMEL: Die Korallen der Silurgeschiebe Ostpreussens und östlichen Westpreussens, Zeits. deut. geol. Gesell., Bd. XLVI, S. 648, Taf. LII, Fig. 1.
1902. Favosites forbesi POCTA: Anthozoaires et Alcyonaires, Systeme Silurinen du Centre de la Boheme, Vol. VIII, Tome II, p. 236, Pl. LXXVII, Figs. 5–9; Pl. C, Figs. 1–16.
1915. Favosites aff. forbesi YABE and HAYASAKA: Palaeozoic Corals from Japan, Korea, and China, p. 67.
1915. Favosites forbesi MANSUY: Contribution a l'Etude des Faunes de l'Ordovicien et du Gothlandien de Tonkin, p. 16, Pl. III, Figs. 1–16.
1926. Favosites cfr. forbesi GRABAU: Silurian Faunas of Eastern Yunnan, Palaeont. Sinica, Ser. B, Vol. III, Fasc. 2, p. 22, Pl. I, Figs. 3, 4a, b.

Corallum hemispherical. Corallites vary in size, large ones usually scattered among small, nearly circular. The large relatively few, ranging from 2.5 mm. to 3, while the small vary much in size, smallest one measuring less than 0.5 mm. in diameter, though some as large as 2 mm. or more found among them. Mural pores not shown. No septal spine traceable.

Species represented by a single specimen; but characteristics of this species so obvious that it is easy to distinguish it from its allied forms.

The specimens from Eastern Asia, that have been referred to this species came from three localities; from Tonkin by MANSUY, from Ping-yi-pu, Pin-wu-hsien, Kiangsi, by YABE and HAYASAKA, and from Yilung, Malung District, E. Yunnan, by GABAU; and from Siberia, from the Irkutsk basin, associated with the following corals: *Favosites gotlandicus*, *Favosites hisingeri*, *Favosites aspera*, *Favosites lonsdalli*, *Halysites catenularius*, *Calopoecia cribriformis*, *Columnaria alveolata*, *Cyathophyllum articulatum*, *Zaphrentis conulus*, etc.

Favosites coreanicus sp. nov.

Pl. XIII, Figs. 4, 5

Species represented by two very fragmental but well-preserved specimens, but unfortunately impossible to say whether it is a fragment of the cylindrical species or of a branch of the dendroidal.

Calice almost always filled with secondary deposits which may be mistaken for wall of corallum. Corallites prismatic, differ greatly in size. They ascend along the axis of the corallum and seem to bend rapidly towards the surface, where they meet obliquely; are rather closely set, but irregularly tabulated. Tabulae flat, rarely more or less convex or concave. Wall of corallites rather thin and undulate transversely. Mural pores small and situated, in cross section, near corner of polygon.

Remarks.—The species that most closely resembles this specimen is *Favosites* sp.[1], which differs, however, from my present species in having large mural pores, coarsely set tabulae, and corallites, the interior of which are striated longitudinally by about 12 linear shallow furrows.

Another species to be examined is *Favosites marylandicus* PROUTY[2]. Its corallites, however, are provided with tabulae that are spaced with distances the thickness of the diameter of the corallites or one-half of them. My present specimen is, therefore, easily distinguished from *Favosites marylandicus* PROUTY by the features just mentioned.

Favosites kennihoensis sp. nov.

Pl. XII, Fig. 7; Pl. XIII, Figs. 2, 3

Corallum massive, composed of numerous polygonal corallites of rather uniform size, 2 mm. or more in diameter, which are sometimes closely and sometimes coarsely tabulated, causing two alternate zones. Where they are closely tabulated 4 to 6 were counted in a space of 1 mm., and in the coarsely tabulated 3 or less. Wall thin, sometimes wrinkled longitudinally; mural pores irregularly distributed.

Remarks.—This species closely resembles *Favosites fidelis* BARR[3]. The latter is, however, distinguished from the former by its smaller

1) C. K. SWARTZ and W. F. PROUTY: Systematic Palaeontology, Silurian, Coelenterata, Maryland Geol. Surv., Silurian, 1929, p. 398, Pl. X, Figs. 1, 2.

2) C. K. SWARTZ and W. F. PROUTY: ibid., p. 397, Pl. X, Figs. 4, 5.

3) P. POCTA: op. cit., p. 227.

corallites and fewer tabulae. The wall of the corallite, moreover, is ornamented with 3 or 5 rows of small mural pores.

Favosites kennihoensis var. *regularis* var. nov.

Pl. XIII, Figs. 6–8

Corallum massive; corallite polygonal, rather regularly tabulated, 11 or less horizontal tabulae in space of 5 mm., the longest diameter not exceeding 2.1 mm. Wall thin, wrinkled neither transversely nor longitudinally; in rare cases the small short hollow tube, which will be mentioned in detail in the description of *Favosites shimizui* sp. nov., occurs at the junctions of their walls.

Remarks.—This variety is distinguished from *Favosites kennihoensis* sp. nov. by the corallites being less closely tabulated than the latter and by being provided with the hollow tubes just mentioned at the junction of their walls.

Favosites shimizui sp. nov.

Pl. XIV, Figs. 1–4

Only fragments were found in the locality mentioned, but, as will be described later, a remarkable character that it possesses easily distinguishes it from all its affinities.

Corallites prismatic or subcylindrical, closely tabulated, unequal in size; large ones usually scattered among the small, nearly circular. The large, about 2 mm. in diameter, rather few, but small numerous; rather polygonal and variable in diameter. Wall wrinkled neither transversely nor longitudinally. Tabulae very thin, horizontal, but sometimes slightly convex or concave, with 15 or more in space of 2 mm. Mural pores may be irregularly distributed. No septal spine traceable.

The outstanding character on which this species is based is the small hollow tubes at the junction, or rarely at the middle part, of the wall of corallites. These tubes very small, cylindrical, rather regular in size, but not more than three or four times thickness of wall even in largest diameter. They occur at from 2 to 6 of the corners of each corallite. Judging from its various characters, the small hollow tube may be a younger gemmation stage of the corallites.

Favosites minor sp. nov.

Pl. XIV, Figs. 5–7

Although my specimen is very fragmental, this species is easily distinguished from all allied forms of the genus by the corallites having the following characters:

1. Very small diameter.
2. Polygonal, but not so angular as in those of *Favosites* cfr. *gotlandicus*, *Favosites kennihoensis*, etc.

But the corallites of this species, as has already been mentioned, are not so large nor so angular as the allied forms; septa and spinules frequently traceable. Tabulae rather regularly and closely set, but thinner than walls of corallites. Walls not wrinkled in any direction. Mural pores situated near corner of wall.

Dimensions:

Largest diameter of corallites	ca. 1.5 mm.
Smallest diameter of corallites	ca. 0.7 mm.
Number of tabulae in a space of 5 mm.	17

Genus *Palaeofavosites* TWENHOFEL

Palaeofavosites aspera d'Ord ?

Pl. XIV, Figs. 8, 9; Pl. XV, Fig. 1

1855. Favosites aspera EDWARDS and HAIME: Brit. Fossil Corals, p. 257, Pl. LX, Figs. 3, 3a.
1892. Favosites asper LEBEDEFF: Obersilurische Fauna des Timan, Mém. Com. Géol., Vol. XII, S. 8, Taf. I, Figs. 1a–c.
1894. Favosites aspera WEISSERMEL: Die Korallen der Silurgeschiebe Ostpreussens und des östlichen Westpreussens, Zeits. deut. geol. Gesell., Bd. XLVI, S. 648, Taf. LI, Fig. 9.
1902. Favosites aspera POCTA: Anthozoaires et Alcyonaires, Systeme Sil. du Centre de la Boheme, Vol. VIII, Tome II, p. 237, Pl. LXXXII, Figs. 1–11; Pl. LXXXIV, Figs. 1–24.

Corallum massive, composed of numerous prismatic corallites, all of about same size, less than 2 mm., diverging radially from base upwards. The corallite seems to be provided with numerous small tubercles on its corners. These tubercles, which may be regarded as relics of mural pores, are arranged in two alternate rows on two adjoining corners of a corallite, but joined together on the corner where

two corallites are in contact with each other. Tabulae very thin, complete, usually horizontal and rather regularly arranged, 21 or more occuring in a space of 5 mm. No septa observable.

Remarks.—From other descriptions, the species may be divided into the following two types:

One, described by POCTA, is provided with two kinds of corallites of different size, the large ones being comparatively few but distributed rather regularly among the small ones which are numerous and vary greatly in size; the other, to which LEBEDEFF's and WEISSEMEL's specimens belong, has the corallites not differentiated into two kinds as in POCTA's type. My specimen belongs rather to the latter type.

This species is reported from the Caradoc sandstone and Wenlock limestone, England, and from the Gotlandian formation in Timan.

Genus *Alveolites* Lam.

Alveolites ? sp.

Pl. XV, Figs. 2–4

Corallum massive, composed of slightly compressed, thin-walled polygonal corallites, with semilunar calices. Calix provided with spinule protruding from basal part. Corallites irregularly tabulated, 10 in a space of 3 mm. In transverse section corallites polygonal, but no septal spines observed. Wall thin, but twice as thick as tabulae. No mural pores.

Genus *Sapporipora* gen. nov.

Genotype: ***Sapporipora favositoides*** sp. nov.

Corallum massive, corallites small, rather uniformly polygonal, prismatic, and united by their walls which are perforated by very large pores arranged in single row. Size of pores, which are almost always situated in the middle of walls, attains to 1/3 or more of width of wall. Walls of corallites rather thick. Tabulae seem numerous; complete, horizontal, situated at regular intervals.

Increase of corallites almost always at junction of four walls; junction expands to hollow tube, which increases in diameter upwards until it becomes a new corallite perforated by large pores in single row.

Remarks.—From the foregoing description, this genus obviously must be assigned to the family Favositidae EDWARDS and HAIME. In Favositidae, the genus most closely resembling the specimen in

question is *Favosites* Lam. The present specimen, however, differs from the genus referred to in the size and number of corallites, the size of the former not attaining to 1/3 that of *Fovasites* cfr. *gotlandicus* E. and H., *Favosites kennihoensis* sp. nov., etc., the walls of which are perforated by very large pores, while the number of corallites are large because of expansion of wall-junction.

Sapporipora favositoides sp. nov.

Pl. XV, Figs. 5–7

Genus *Sapporipora* is established by means of a number of fragmental specimens. Corallites very small, hexagonal, sometimes pentagonal, very rarely heptagonal in cross section. Septa entirely absent. About 9 corallites in space of 5 mm. Walls rather thick, pierced by large pores arranged in single row and 9 in space of 3 mm. Tabulae appear rather thin, complete, and horizontal; about 9 or more in space of 3 mm. Although not invariably, gemmation of corallites takes place at the corners where four walls intersect.

Family *Auloporidae*

Genus *Syringopora* Goldf.

Syringopora bifurcata d'Ord.

Pl. XV, Figs. 8–10

1854. Syringopora bifurcata EDWARDS and HAIME: Brit. Fossil Corals, p. 271. Pl. LXIV, Figs. 3, 3a, b,

1894. Syringopora bifurcata WEISSERMEL: Die Korallen der Silurgeschiebe Ostpreussens und des östlichen Westpreussens, S. 658, Taf. LIII, Fig. 3.

1926. Syringopora cfr. bifurcata GRABAU: Silurian Faunas of Eastern Yunnan, Palaeont. Sinica, Ser. B, Vol. III, Fasc. 2, p. 25, Pl. I, Figs. 8, 9; Pl. II, Figs. 1a, b.

Corallum massive, consisting of many fasciculated corallites rather closely set. Corallites small, connected by hollow tubes. Maximum diameter of corallites 2 mm., but even minimum not smaller than 1.5 mm. Intervals between two contiguous corallites range from actual contact to 1.5 mm., rarely 2, apart. Corallites round or sometimes elliptical in cross section, provided with funnel-shaped tabulae. Tabulae rather regularly arranged, six in space of 2 mm.

Remarks.—The diameter of *Syringopora* cfr. *bifurcata*, described by Dr. GRABAU, is smaller than those of specimen described by other authors. My specimen, however, is not so small as Grabau's.

Comparison of size :

Author	Diameter of corallites (in mm.)
EDWARDS and HAIME	2–2.1
WEISSERMEL	2.3–3
GRABAU	1 or less
OZAKI	1.8–2

Syringopora sp. nov. ?

Pl. XV, Fig. 11 ; Pl. XVI, Figs. 1, 2

Corallum massive, consisting of many fasciculated corallites not so closely set, hence space between two contiguous corallites rather broad, although those between two corallites connected by a small hollow tube are mostly close to one another. Wall rather thick, marked with coarse annulations of growth. Corallites round in cross section, provided with reticulated tabulae, which are thin and slope rapidly inwards. Maximum diameter of corallites about 3 mm.

Remarks.—The present species differs from *Syringopora bifurcata* d'Orb. described in this paper in having stout corallites and irregularly set tabulae.

Family *Halysitidae*

Genus *Halysites* Fischer

Halysites escharoides Fischer-Benzon

Pl. XVI, Figs. 3, 4 ; Pl. XVII, Fig. 1 ; Pl. XVIII, Figs. 1, 2

1854. Halysites escharoides EDWARDS and HAIME : British Fossil Corals, p. 272, Pl. LXIV, Figs. 2, 2a.

1894. Halysites escharoides WEISSERMEL : Die Korallen der Silurgeschiebe Ostpreussens und des östlichen Westpreussens, Zeits. deut. geol. Gesell., Bd. XLVI, S. 663, Taf. LIII, Fig. 2.

1915. Halysites escharoides YABE : Einige Bemerkungen ueber die Halysites-Arten, Sci. Rep. Tôhoku Imp. Univ., Sec. Ser. (Geol.), Vol. IV, p. 34, Pl. VI, Figs. 3, 4.

Corallum massive, large, composed of distinctly diverging corallites as if rising from a single origin below. Fenestrules, one side of which is composed of from 1 to 8 corallites without interstitial tube, rather irregular polygons, different in size. Ornamentation on external walls of corallites not observable. Corallites elliptical, about 1.2 × 1.5 mm.

large, ornamented with numerous thin tabulae. Tabulae complete, concave upwards, but concavities irregular; 12 or less in space of 5 mm. Wall of corallites thicker than tabulae. No septal spine traceable.

Dimensions:

Size of corallites	ca. 1.2 × 1.5 mm.
Largest width of fenestrules	ca. 11.5 mm.
Smallest width of fenestrules	ca. 2.5 mm.
Number of tabulae per 5 mm.	12

This species is recorded from the Gotlandian of all Isle of Gotland, North America, etc.

Halysites sindoensis sp. nov.

Pl. XVI, Figs. 5–7; Pl. XVII, Figs. 2, 3

Some well-preserved specimens in my collection. Species easily distinguishable from allied forms owing to one side of its fenestrules being almost invariably composed of a single corallite, although not always joined to another at the restricted edges.

Fenestrules rather regularly polygonal, but differ in size, largest one composed of 8 corallites, smallest of 5. In my specimen, ornamentation of surface of walls not observable owing to recrystallisation. Corallites oval in cross section, about 1 × 1.5 mm., traversed by numerous thin tabulae regularly distributed and concave upwards; 14 or more tabulae in space of 5 mm. Wall of corallites thicker than tabulae. No septal spine traceable. Interstitial tube absent.

Dimensions:

Size of corallite	ca. 1 × 1.5 mm.
Largest width of fenestrule	ca. 4 mm.
Smallest width of fenestrule	ca. 1 mm.
Number of tabulae per 5 mm.	14

Halysites sapporiensis sp. nov.

Pl. XVII, Fig. 4; Pl. XVIII, Figs. 3, 4

Specimen smallest of the 3 species described in this paper. Fenestrules somewhat irregularly polygonal, unequal in size; circum-

ference of fenestrules composed of 5 to 8 corallites and one side of 1 to 2. Corallites elongated oval in cross section, about 0.7 × 1 mm. large and closely tabulated.

Tabulae rather thick, slightly concave upwards, 5 in a space of 1 mm. No septal spine traceable. Interstitial tube absent.

Dimensions :

Size of corallite	ca. 0.7 × 1 mm.
Largest width of fenestrule	ca. 2.5 mm.
Smallest width of fenestrule	ca. 1 mm.
Number of tabulae per 3 mm.	15

B. CEPHALOPODA ; By S. SHIMIZU and T. OBATA

Family *Kionoceratidae*

Genus *Spyroceras* HYATT

Spyroceras cfr. *microtextile* FOERSTE

Pl. XVIII, Fig. 5

1923. Spyroceras microtextile FOERSTE : Notes on Medinan, Niagaran, and Chester Fossils, Denison Univ. Bull., Jour. Sci. Lab., Vol. XX, p. 87, Pl. XV, Fig. 2c.

A slightly curved fragment of phragmocone, length 27 mm. Section, though partly crushed, seems nearly circular, about 8 mm. in diameter. Rate of increase in diameter of shell very slow, about 1 in 22 at one part of fragment. Septal concavity 1 in 7, septal distance about 2 mm., corresponding to nearly 1/4 diameter. Siphuncle nearly central, about 1.8 mm. diameter, corresponding to about 1/4 diameter of shell.

Surface of conch distinctly annulated, five annulations as long as diameter of conch at point where annulations are counted. Total length of annulation together with that of groove above about 2 mm., height of annulation from bottom of adjacent groove 1 mm. Annulations more angular than groove, and former narrower than latter.

Surface of shell ornamented also with very fine vertical lines; because of weathering could only count 6 in a width of 1.5 mm.

Remarks.—Our specimen closely resembles the *Spyroceras microtextile* FOERSTE from quarry, half-a-mile northeast of Centerville, Ohio, in argillaceous strata (Basal Gotlandian) immediatedly beneath the

Brassifield limestone ; differing only in the number of vertical lines on surface of shell.

It is also allied to *Dawsonoceras dulce* (BARR.), figured by J. BARRANDE[1]; both of his two figures being finely striated vertically and not frilled transversely on surface of shell. These characteristic features indicate that they belong to the genus *Spyroceras*.

BARRANDE's two figures differ, however, from our specimen in having less numerous vertical lines, more numerous annulations on surface of shell, higher rate of conch taper (1 in 20), and body size.

Spyroceras microtextile FOERSTE has been reported from the Basal Gotlandian of Ohio, N. America, and *Dawsonoceras dulce* (BARR.) from the E_2 stage (Salopian) of Bohemia. Our specimen differs slightly from them in ornamentation.

Family *Sactoceratidae*

Genus *Sactoceras* HYATT

Sactoceras ozakii sp. nov.

Pl. XVIII, Fig. 6

A fragment of orthoceraconic phragmocone, smooth, not annulated ; 17.5 mm. long and 11.5 mm. to 9.5 mm. in diameter. Section nearly circular, rate of taper 1 in 6. Septal concavity above 1 in 4.6, septal distance about 2.5 mm., number of camerae in length equal to diameter of conch about 4. Siphuncle central, with elongated nummuloidal segments ; height of segment 3 mm. to 3.5, maximum diameter 3 mm., corresponding to little less than 1/4 diameter of conch.

Remarks.—Specimen resembles *Sactoceras richteri* (BARR.) from the E_2 stage (Salopian) of Bohemia, but former smaller, and nummuloidal segments of siphuncle more elongated than that of latter.

HYATT[2] established in 1883 the genus *Sactoceras*, desginating *Orthoceras richteri* BARR. as the genotype, which he, however[3], in 1900 placed in the genus *Loxoceras* MCCOY, considering the former to be congeneric with the latter.

Following his designation, we provisionally placed the present specimen under the generic name of *Loxoceras* in our previous paper[4].

1) J. BARRANDE: Systeme Silurien du Centre de la Boheme, Vol. II, 3 Ser., 1868, Pl. 294, Fig. 9; Pl. 295, Fig. 5.
2) A. HYATT: Genera of Fossil Cephalopods, Proc. Boston Soc. Nat. Hist., Vol. XXII, 1883, p. 273.
3) ZITTLE-EASTMAN: Text-Book of Palaeontology, Vol. I, 1900, p. 527.
4) S. SHIMIZU, K. OZAKI, and T. OBATA: Discovery of Gotlandian Formation of Korea, Jour. Geol. Soc. Tokyo, Vol. XL, 1933, p. 359 (in Japanese).

A. F. FOERSTE[1], however, emended the generic definitions of the two genera and separated them, designating *Loxoceras distans* MCCOY as the genotype of *Loxoceras* MCCOY and *Orthoceras richteri* BARR. as the genotype of *Sactoceras* HYATT.

According to FOERSTE, whereas genus *Loxoceras* is characterised by the oval outline of the conch in section, waved oblique sutures, and excentric siphuncle of actinoceroid structure, genus *Sactoceras* has the following characteristics: " Orthoceracones with relatively small siphuncles, the segments of the latter nearly spherical or slightly elongated. Septal neck short, enveloped on the interior of the siphuncle by lunate calcareous deposits, which enlarge as in other Actinoceroids. Sutures of the septa directly transverse. Described from the Silurian, etc."

Since our specimen deos not show any waved oblique sutures nor oval outline in section nor excentric siphuncle, it cannot be placed in the genus *Loxoceras* of FOERSTE's emended definition.

Accepting FOERSTE's definition, we now correct the generic name of the specimen to *Sactoceras*.

The specific name is given in honour of K. OZAKI, who collected the present specimens so important to the Gotlandian geology of Korea.

Sactoceras richteri (BARR.) has been reported from the E_2 stage (Salopian) of Bohemia, but the geological age of the genus ranges from Richmondian (Uppermost Ordovician) to Salopian.

Family *Huroniidae*

Genus *Huronia* STOKES

Huronia sp.

Pl. XVIII, Fig. 7

An orthoceraconic fragment, 18 mm. long and 14 mm. in diameter; rate of taper 1 in 11. Surface of conch smooth, not annulated, with straight transverse septal sutures. Septal concavity 1 in 7, septal distance little less than 2 mm., which corresponds to about 1/7 diameter of conch.

Siphuncle slightly annulated at upper extremity of segment, diameter of which is about 4 mm. at inflated rim beneath its top, and little less than 3.5 at its bottom.

1) A. F. FOERSTE: Notes on American Palaeozoic Cephalopods, Denison Univ. Bull., Jour. Sci. Lab., Vol. XX, 1924, p. 226.

Height of siphunclar segment about 2 mm., being shorter than diameter. These characteristics of siphunclar segment seem to indicate that it belongs in the genus *Huronia*, eapecially in its kinship with *Huronia vertebralis* STOKES[1] from the Niagara Group (Salopian) of Drummond Island, Lake Huron, N. America, but in our specimen the shape of the body is far more slender and the septal concavity shallower.

Our specimen unfortunately is too badly preserved to enable us to single out further detailed characters for specific determination.

Huronia vertebralis STOCKES has been reported from the Niagaran (Salopian) of N. America.

This genus is chiefly distributed in the Silurian, but has been met with sporadically in the Richmondian (Uppermost Ordovicain) of Arctic America.

Family *Phragmoceratidae*

Genus *Gomphoceras* SOWERBY

Gomphoceras sp.

Pl. XVIII, Fig. 8

Breviconic fragment about 14 mm. long. Provisionally referred to *Gomphoceras*. Section elliptical with its major axis in lateral direction, diameters of lateral and dorso-ventral 18 mm. and 12 respectively.

Rate of taper 1 in 2.5 to 1 in 3, from which rapid increase in the rate of approach to apex may be inferred. Siphuncle appears to be tubular and exogastric, curved dorsally, moderate in size, 3.5 mm. diameter at upper part of shell and 3 mm. at lower. Internal wall of siphuncle striated longitudinally, siphuncle filled with what is known as radiating deposit. Septal concavity 1 in 8, septal distance about 1/9 of longer diameter.

Remarks.—Such breviconic forms are found in the genera *Cyrtoceras*, *Phragmoceras*, and *Gomphoceras*. In *Cyrtoccras* and *Phagmoceras*, siphuncle, situated ventrally or dorsally, has curvature corresponding with its ventral outline, while in *Gomphoceras* the exogastric siphuncle curves gradually toward dorsal side of shell on approaching apex.

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1) J. BARRANDE: Systeme Silurien du Centre de la Boheme, Vol. II, 4 Ser., 1870, Pl. 436, Figs. 5–7.

A. F. FOERSTE: Silurian Cephalopods of Northern Michigan, Contr. Mus. Geol., Univ. Michigan, Vol. II, 1924, p. 46, Pl. V, Figs. 1, 5; Pl. IV, Figs. 2, 3; Pl. XI, Fig. 2.

In our specimen, rate of taper of ventral side of shell unknown, but siphuncle curved rather toward dorsal side on approaching apex. This certainly indicates convex outline of dorsal side.

Unfortunately, the more important characters, such as apertural opening, living chamber, and external outline, cannot be seen in the weathered specimen.

The genus has its main distribution in the middle Gotlandian, but is met with sporadically in the Lower and Upper Gotlandian to Lower Devonian.

III. GEOLOGICAL AGE

Judging from the foregoing descriptions of these corals, it will be seen that the corals that predominate in the Ken-niho limestone conglomerate are Favositidae and Halysitidae, followed by Tetracoralla. But, with regards to the remaining fossils, such as brachiopods, gastropods, bryozoa, and hydozoa, they are rather rare in species as well as in numbers of species.

Of the 27 species of corals described in this paper, 11 are new forms hitherto undescribed, while 8, represented by fragmental specimens, admit of no specific determination. There are, however, 8 species whose geological ages can be stated, namely,

Cystiphyllum cfr. *siluriense Lons.*

England (Shropshire)	Wenlock Limestone
Bohemia	E_2 (= Upper Salopian)

Plasmopora follis EDWARDS and HAIME

North America

Propora cfr. *magnifica* POCTA

Bohemia	E_2

Favosites cfr. *gotlandicus* Lam.

England	Wenlock Limestone
Isle of Gothland	Llandoverian
Bohemia	E_2
New South Wales	Yeringian (= Wenlockian)
Russia	Pentamerus-esthonus Zone
Tonkin	(= Upper Valentian)

South China (Prov. of Hupeh)	Gotlandian
North America	Niagara Shale and Limestone (= Wenlockian or Upper Llandoverian)

Favosites cfr. *forbesi* EDWARDS and HAIME

England	Wenlock Limestone
Isle of Gothland	Llandoverian
Prussia	Gotland Zone
Bohemia	E_2
	F_2

Palaeofavosites aspera d'Orb.

England	Caradoc Sandstone and Wenlock Limestone
Prussia	Gotland Zone C
Timan	Upper Gotlandian

Syringopora bifurcata d'Orb.

England	
Prussia	
China (Prov. of Yunnan)	Malung Limestone

Halysites escharoides Fischer-Benzon

England	
Prussia	
Russia	Upp. and Low. Gotlandian
North America	

As will be seen from the table, it may be said that the faunal group represents in age the upper parts of the Valentian to Upper Salopian.

The species of this faunal group and their localities in Eastern Asia are as follows:

Northeastern Tonkin, Anam

Heliolites megastoma
Heliolites grayi
Favosites gotlandicus
Halysites sp.
Syringopora tonkinensis

Chü-ching, Yunnan, China

Favosites cfr. *gotlandicus*
Favosites malungensis
Syringopora cfr. *bifurcata*

Chien-shui, Ssuchuan, China

Alveolites sp.
Heliolites interstinctus
Plasmopora tubularia
Halysites catenularia
Amplexus appendiculata
Cyathophyllum sp.
Ptychophyllum sp.
Platyphyllum sp.
Cystiphylum sp.

Lojoping, Hupeh ("No-jo-ping," in YABE's report), China

Favosites gotlandicus
Heliolites bohemicus
Halysites sp.

Irkutsk basin, Siberia

Favosites forbesi
Favosites gotlandicus
Favosites lonsdallii
Halysites catenularius
Calopoecia cribriformis

Of these localities, the Silurian deposits in China are divided into three groups:

In Ssuchuan,

3. Chaotien formation
2. Chienshui limestone
1. Huangpay formation

In Hupeh,

3. Upper division
2. Middle division
1. Lower division

This faunal group, moreover, is reported from the middle division, or Chienshui limestone, in the two localities just referred to.

Four species of cephalopods described in this paper also agree with the above geological conclusions.

Spyroceras microtextile FOERSTE was hitherto known only from the Basal Gotlandian of Ohio, N. America, but allied specimens have been reported from the E_2 stage (Salopian) of Bohemia, and Carnic-Alps[1], both of them under the different generic and specific name of *Dawsonoceras dulce* BARR.

Genus *Sactoceras* ranges from Richmondian (Uppermost Ordovician) to Salopian, of which *S. richteri* (BARR.), which has some kinship with *S. ozakii sp. nov.*, has been reported from the E_2 stage (Salopian) of Bohemia.

Genus *Huronia* is mainly a Gotlandian genus, but has been met with sporadically in the Uppermost Ordovician formations of N. and Arctic America.

H. vertebralis STOCKES, which has some relation to our specimen, has been reported from the Niagaran (Salopian) of N. America.

Genus *Gomphoceras* also mainly distributed in the Middle Gotlandian, has been met with sporadically in the Lower and Upper Silurian to Lower Devonian.

From the foregoing data it may be inferred that the Chinese Gotlandian Sea must have extended eastwards as far as the locality in Korea, which so far as our field-observations go, seems to have been the eastern end of the Sea, though much research will be necessary before this assumption can be confirmed.

In conclusion, we wish to express our gratefull thanks to Prof. H. YABE, of the Institute of Geology and Palaeontology, Tôhoku Imperial University, and Mr. T. TOMITA, of our Institute, for their kind advice in the course of this study.

1) F. HERITSCH: Faunen aus dem Silur der Ostalpen, Abh. geol. Bundes., Bd. XXIII, Heft. 2, 1929, S. 62, Taf. VI, Fig. 625.

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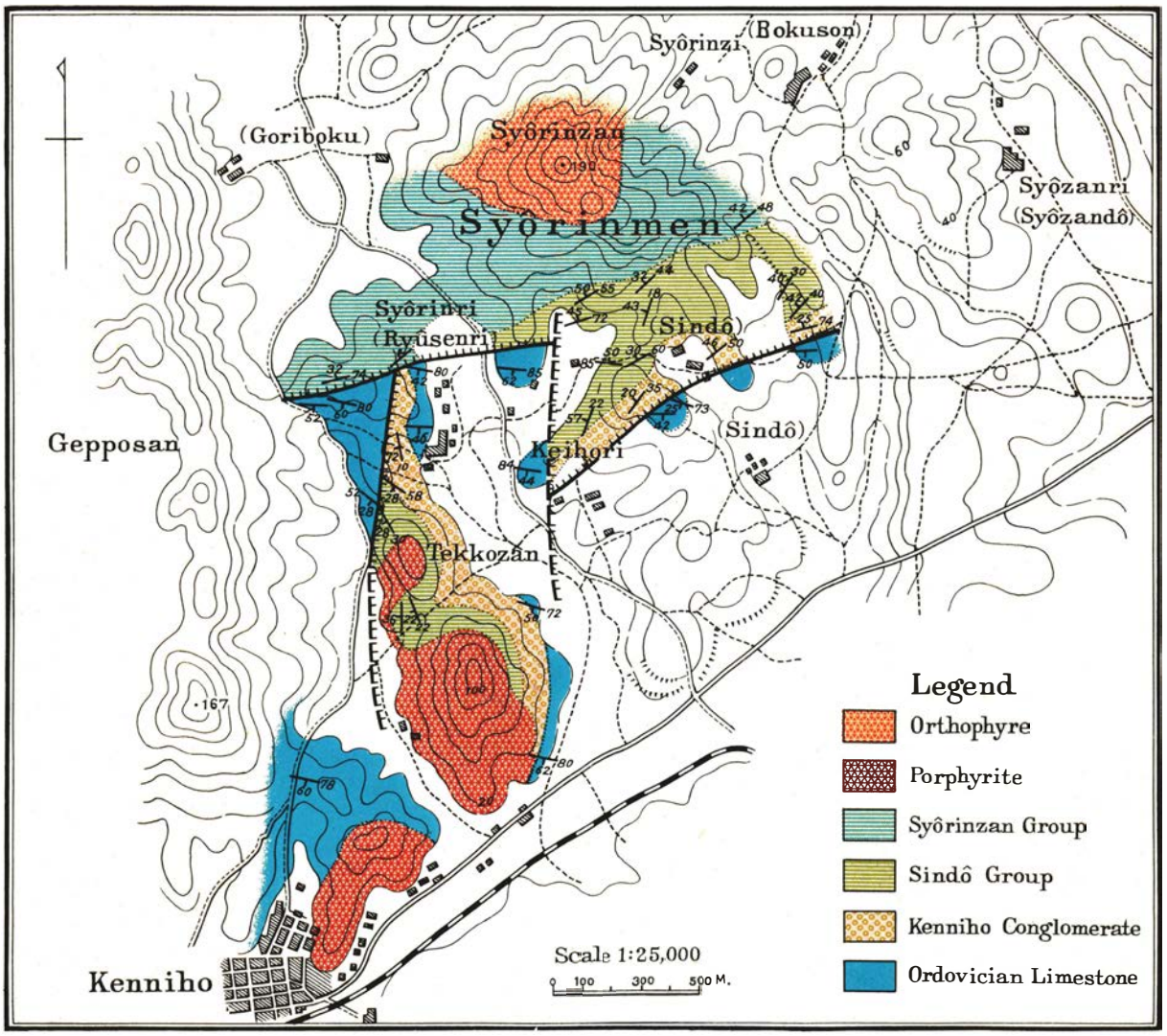

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PLATE IX

Explanation of Plate IX

Fig. 1. Amplexus sp. indet. a. Transverse section. × 2. P. 62.

Fig. 2. Amplexus sp. indet. a. Longitudinal section. × 2. P. 62.

Fig. 3. Amplexus sp. indet. b. Transverse section. × 2. P. 62.

Fig. 4. Amplexus sp. indet. b. Longitudinal section of the same specimen. × 2. P. 62.

Fig. 5. Amplexus sp. indet. b. Longitudinal section of other fragmental specimen. × 2. P. 62.

Fig. 6. Calophyllum ? sp. indet. Longitudinal section of a fragmental specimen. × 2. P. 63.

Fig. 7. Storthygophyllum ? sp. nov. Surface view of a specimen showing some calicles. Natural size. P. 63.

Fig. 8. Storthygophyllum ? sp. nov. Surface view of another specimen. Natural size. P. 63.

Fig. 9. Storthygophyllum ? sp. nov. Transverse section of Fig. 7. × 2. P. 63.

Fig. 10. Storthygophyllum ? sp. nov. Longitudinal section of Fig. 7. × 2. P. 63.

Fig. 11. Cystiphyllum sp. indet. Longitudinal section. × 2. P. 65.

Fig. 12. Cystiphyllum sp. indet. Longitudinal section of other specimen. × 2. P. 65.

Fig. 13. Cystiphyllum cfr. siluriense Lons. Side view of corallum, showing annulation. Natural size. P. 64.

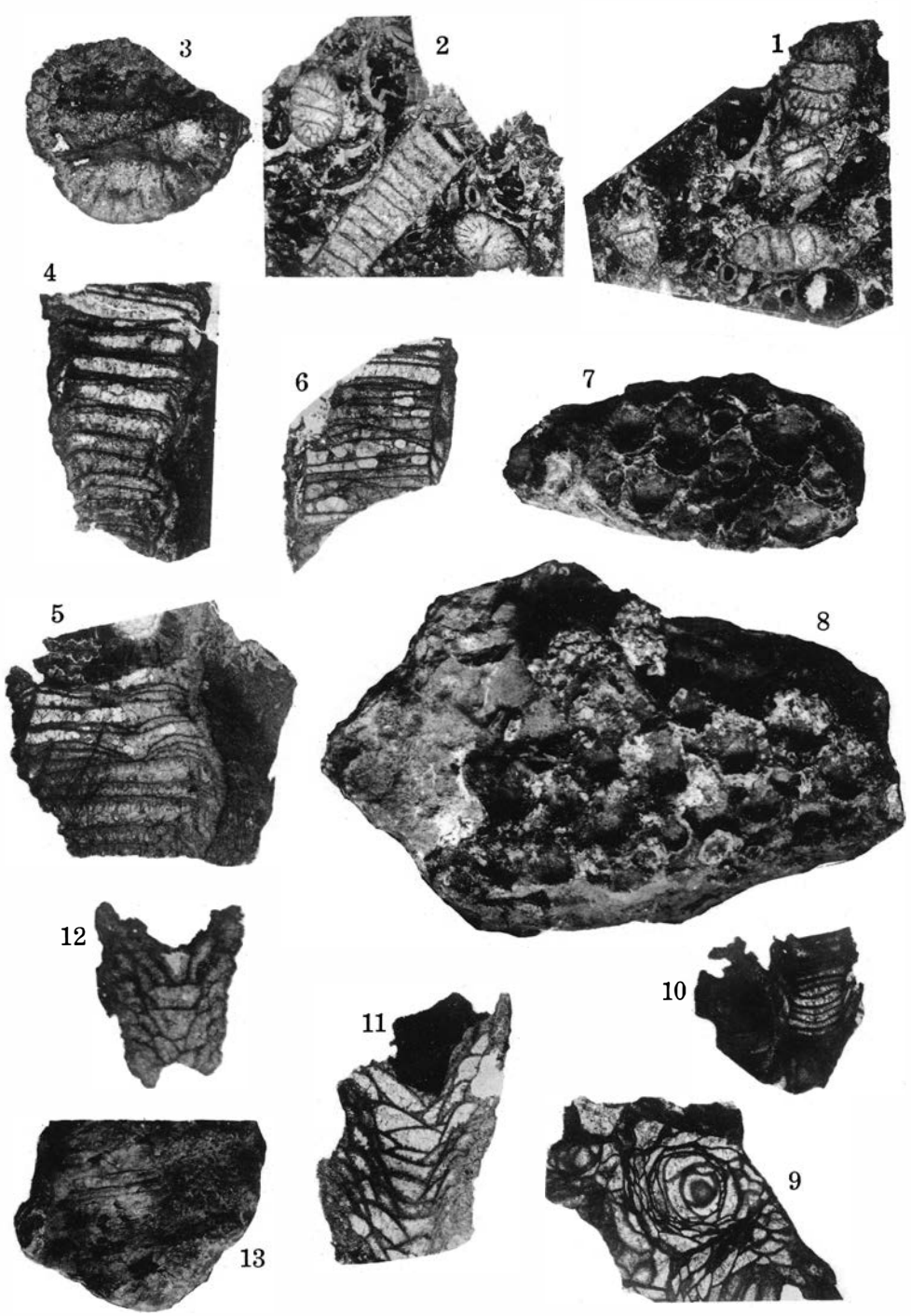

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PLATE X

Explanation of Plate X

Fig. 1. Cystiphyllum cfr. siluriense Lons. Transverse section. × 2. P. 64.

Fig. 2. Cystiphyllum cfr. siluriense Lons. Longitudinal section of same specimen. × 2. P. 64.

Fig. 3. Heliolites sp. indet. Longitudinal section of fragmental specimen. × 3. P. 65.

Fig. 4. Plasmopora follis Milne-Edwards. Surface view of a specimen. Natural size. P. 66.

Fig. 5. Plasmopora follis Milne-Edwards. Transverse section of same specimen. × 3. P. 66.

Fig. 6. Plasmopora follis Milne-Edwards. Longitudinal section of same specimen. × 3. P. 66.

Fig. 7. Plasmopora nakamurai sp. nov. Weathered surface of a discoidal specimen. Natural size. P. 66.

Fig. 8. Plasmopora nakamurai sp. nov. Oblique section of same specimen. × 3. P. 66.

Fig. 9. Propora cfr. magnifica Pocta. Natural longitudinal section of a spherical specimen. Natural size. P. 67.

Fig. 10. Propora cfr. magnifica Pocta. Slightly oblique section. × 3. P. 67.

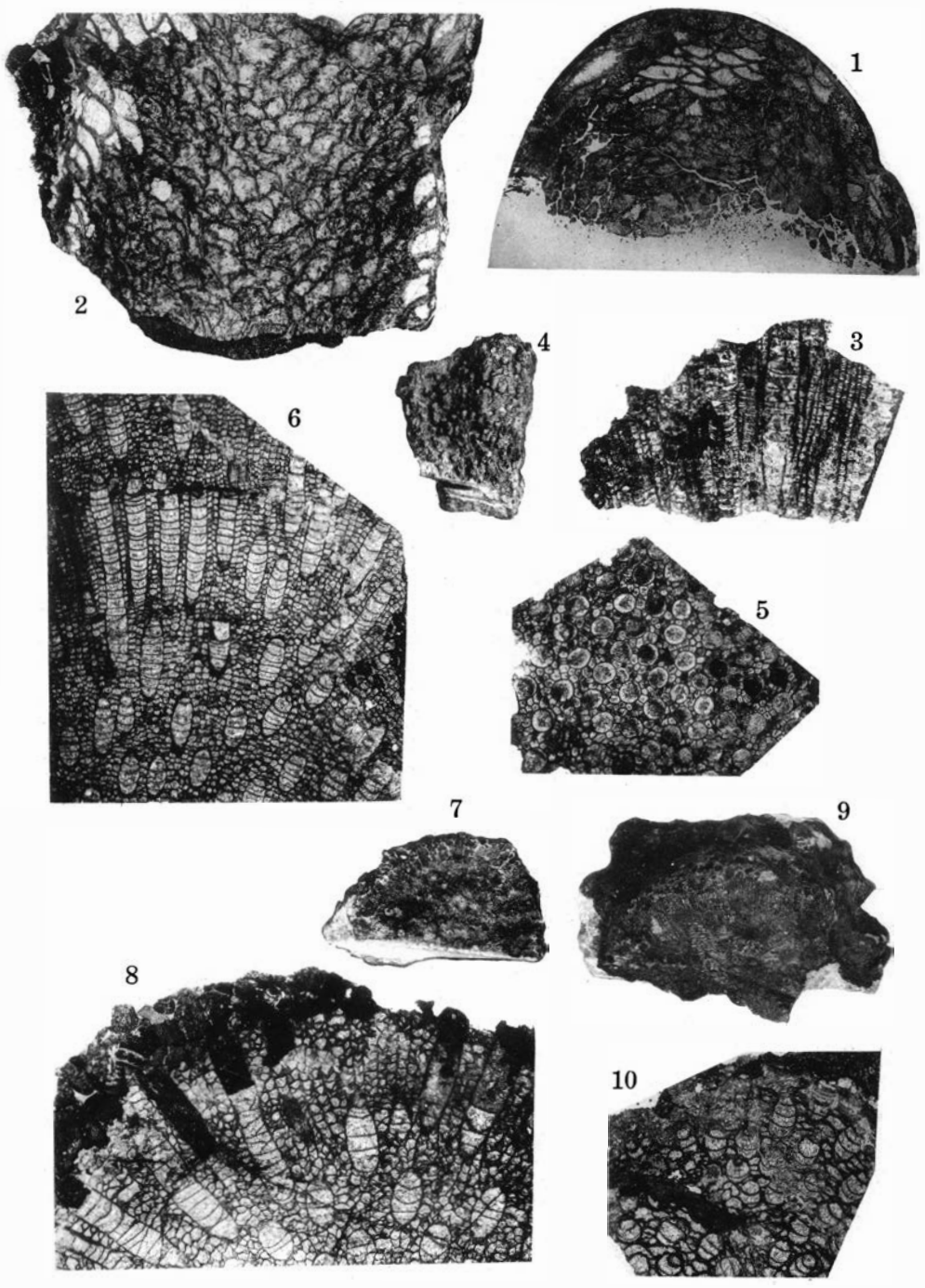

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PLATE XI

Explanation of Plate XI

Fig. 1. Propora cfr. magnifica Pocta. Longitudinal section of another specimen. × 3. P. 67.

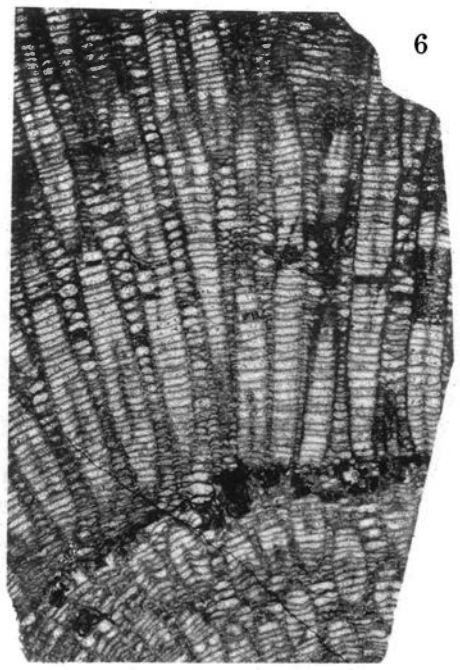
Fig. 2. Propora yabei sp. nov. Oblique section of a specimen. × 3. P. 67.

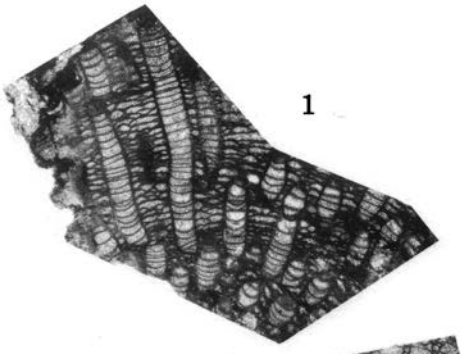
Fig. 3. Propora yabei sp. nov. Transverse section of same specimen. ×3. P. 67.

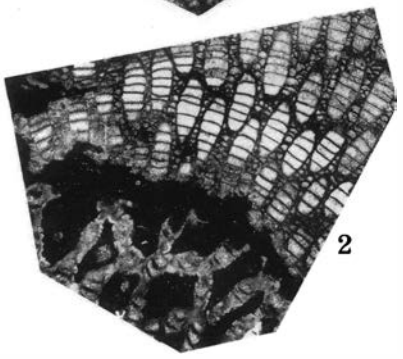
Fig. 4. Koreanopora proporoides sp. nov. Side view of weathered surface. Natural size. P. 68.

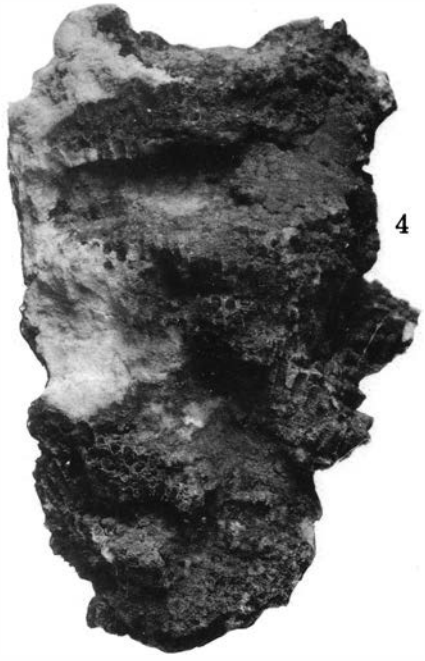
Fig. 5. Koreanopora proporoides sp. nov. Transverse section of same specimen. × 3. P. 68.

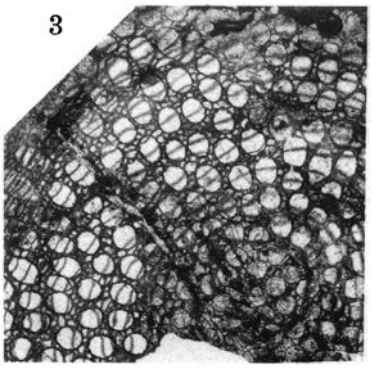
Fig. 6. Koreanopora proporoides sp. nov. Longitudinal section of same specimen. × 3. P. 68.











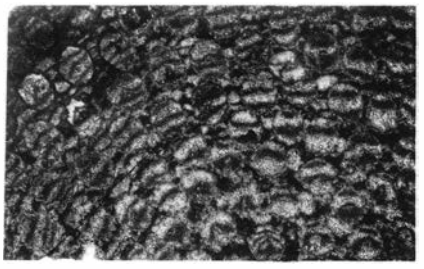


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PLATE XII

Explanation of Plate XII

Fig. 1. Favosites cfr. gotlandicus Lam. Natural transverse section. Natural size. P. 69.

Fig. 2. Favosites cfr. gotlandicus Lam. Natural longitudinal section of another specimen. Natural size. P. 69.

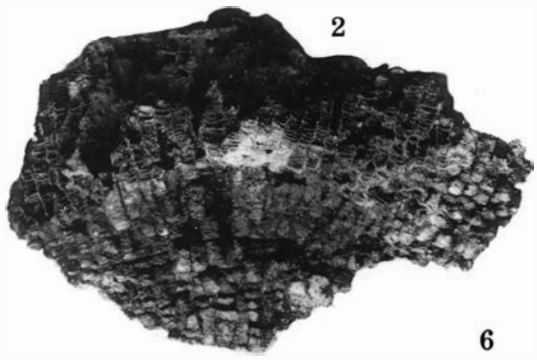
Fig. 3. Favosites cfr. gotlandicus Lam. Natural longitudinal section of another specimen, showing the longitudinal wrinkles of the wall of corallites. × 3. P. 69.

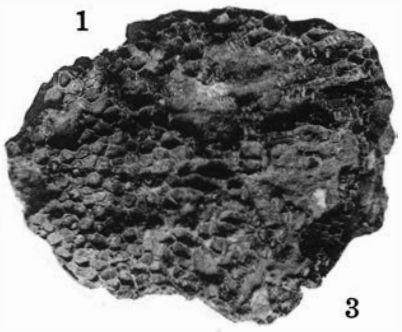
Fig. 4. Favosites cfr. gotlandicus Lam. Transverse section. × 3. P. 69.

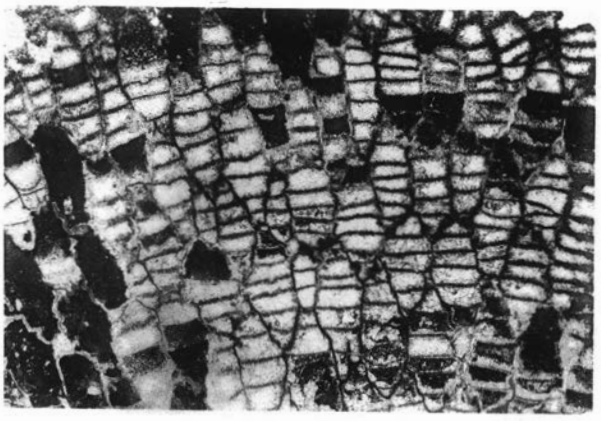
Fig. 5. Favosites cfr. gotlandicus Lam. Transverse section. × 3. P. 69.

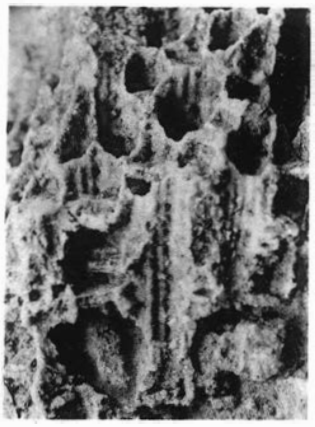
Fig. 6. Favosites cfr. gotlandicus Lam. Longitudinal section of same specimen. × 3. P. 69.

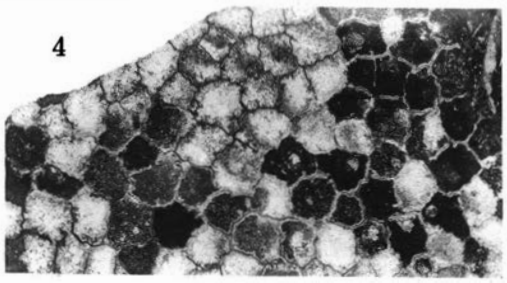
Fig. 7. Favosites kennihoensis sp. nov. Weathered surface, showing the mural pores. × 3. P. 71.

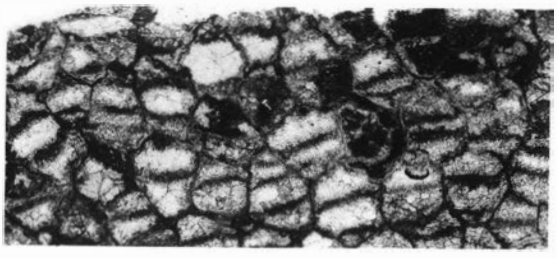












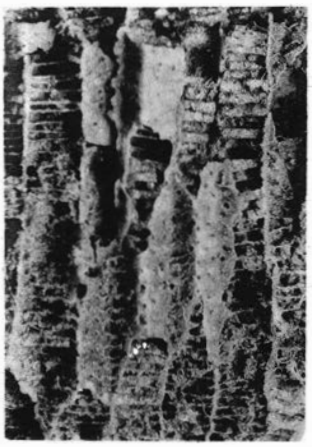


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PLATE XIII

Explanation of Plate XIII

Fig. 1. Favosites cfr. forbesi Edwards et Haime. Natural size. P. 70.

Fig. 2. Favosites kennihoensis sp. nov. Transverse section. × 3. P. 71.

Fig. 3. Favosites kennihoensis sp. nov. Longitudinal section of same specimen. × 3. P. 71.

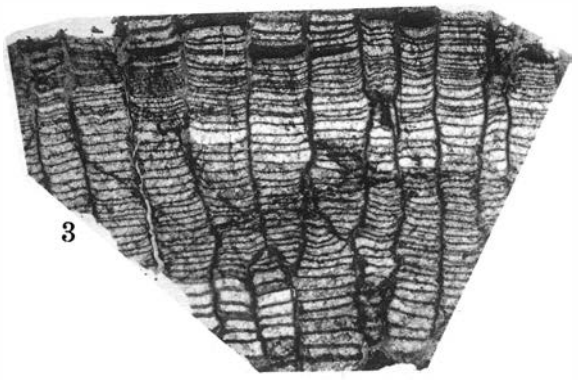
Fig. 4. Favosites coreanicus sp. nov. Transverse section of cylindrical corallum. × 3. P. 71.

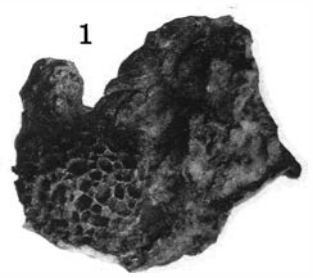
Fig. 5. Favosites coreanicus sp. nov. Transverse section of another corallum. × 3. P. 71.

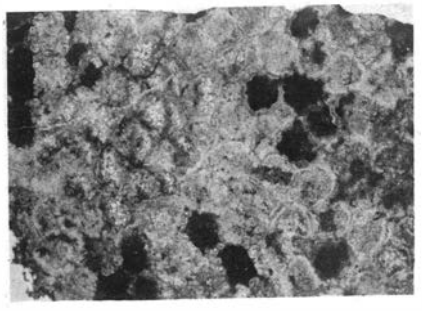
Fig. 6. Favosites kennihoensis var. regularis var. nov. Natural longitudinal section of specimen. Natural size. P. 72.

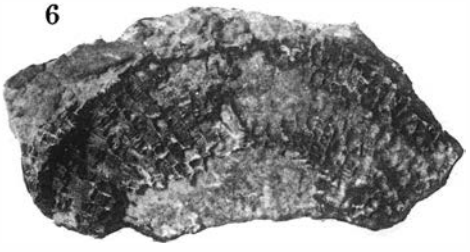
Fig. 7. Favosites kennihoensis var. regularis var. nov. Transverse section of another specimen. × 3. P. 72.

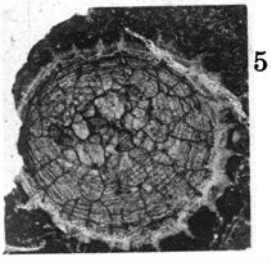
Fig. 8. Favosites kennihoensis var. regularis var. nov. Longitudinal section. × 3. P. 72.

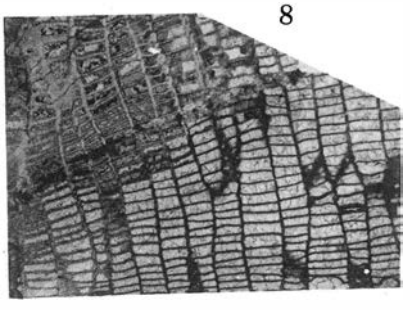












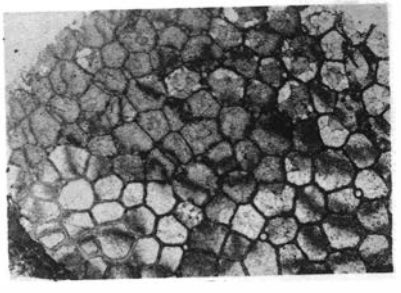


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PLATE XIV

Explanation of Plate XIV

Fig. 1. Favosites shimizui sp. nov. Transverse section. × 3. P. 72.

Fig. 2. Favosites shimizui sp. nov. Slightly oblique section. × 3. P. 72.

Fig. 3. Favosites shimizui sp. nov. Longitudinal section of another specimen. × 3. P. 72.

Fig. 4. Favosites shimizui sp. nov. Longitudinal section. × 3. P. 72.

Fig. 5. Favosites minor sp. nov. Natural size. P. 73.

Fig. 6. Favosites minor sp. nov. Transverse section of another specimen. × 3. P. 73.

Fig. 7. Favosites minor sp. nov. Longitudinal section of same specimen. × 3. P. 73.

Fig. 8. Palaeofavosites aspera d'Orb. ? Part of corallum, showing tubercles on the corner of corallites. × 3. P. 73.

Fig. 9. Palaeofavosites aspera d'Orb. ? Transverse section of same section. × 3. P. 73.

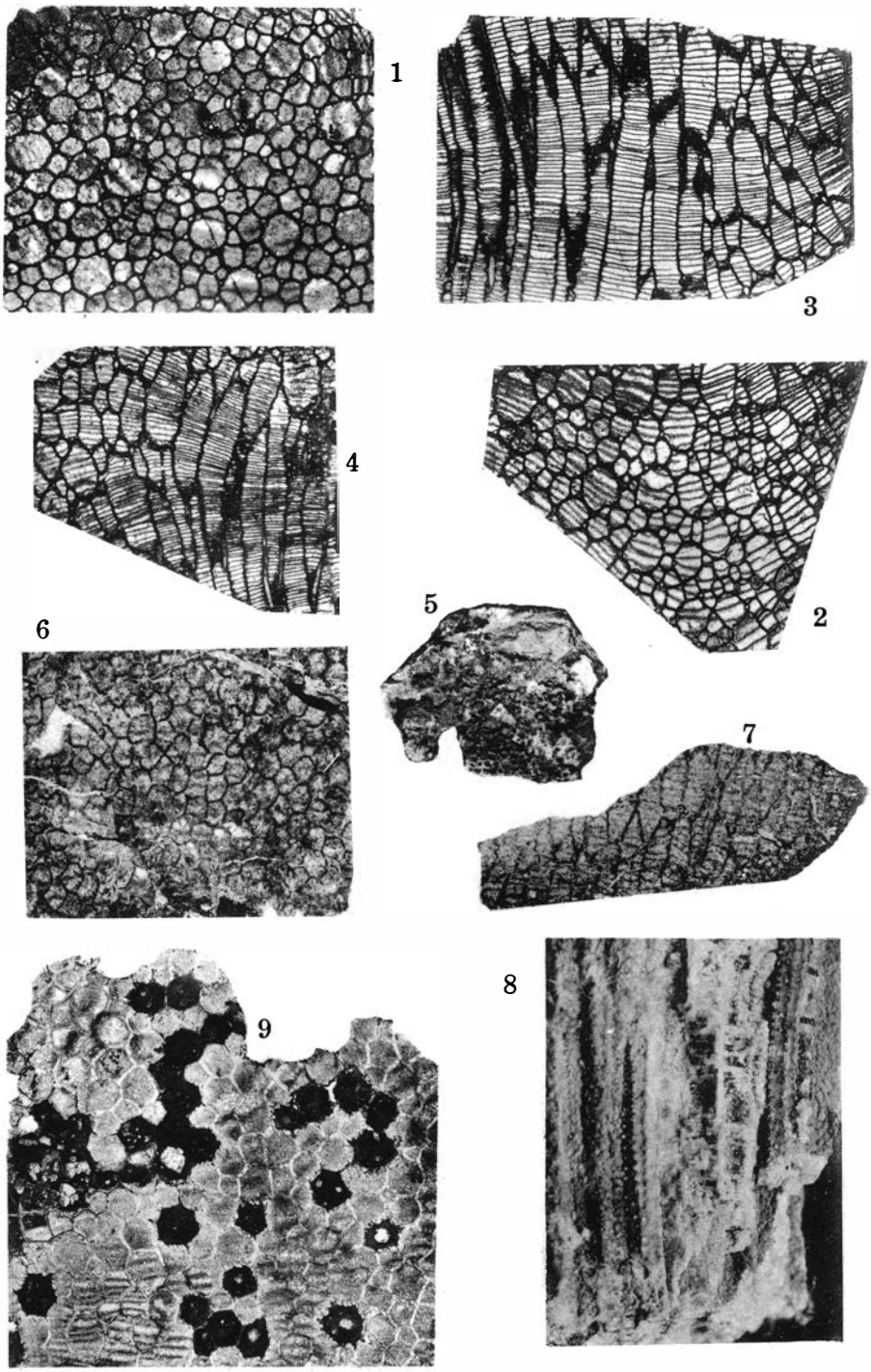

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PLATE XV

Explanation of Plate XV

Fig. 1. Palaeofavosites aspera d'Orb. ? Longitudinal section of same specimen. × 3. P. 73.

Fig. 2. Alveolites ? sp. A fragmental specimen, showing semilunar calices. Natural size. P. 74.

Fig. 3. Alveolites ? sp. Transverse section of same specimen. × 3. P. 74.

Fig. 4. Alveolites ? sp. Longitudinal section of same specimen. × 3. P. 74.

Fig. 5. Sapporipora favositoides sp. nov. Natural size. P. 75.

Fig. 6. Sapporipora favositoides sp. nov. Transverse section. × 3. P. 75.

Fig. 7. Sapporipora favositoides sp. nov. Longitudinal section of same specimen. × 3. P. 75.

Fig. 8. Syringopora bifurcata d'Orb. A fragmental specimen. Natural size. P. 75.

Fig. 9. Syringopora bifurcata d'Orb. Transverse section of another specimen. × 3. P. 75.

Fig. 10. Syringopora bifurcata d'Orb. Longitudinal section of same specimen. × 3. P. 75.

Fig. 11. Syringopora sp. nov. ? Natural transverse section. Natural size. P. 76.

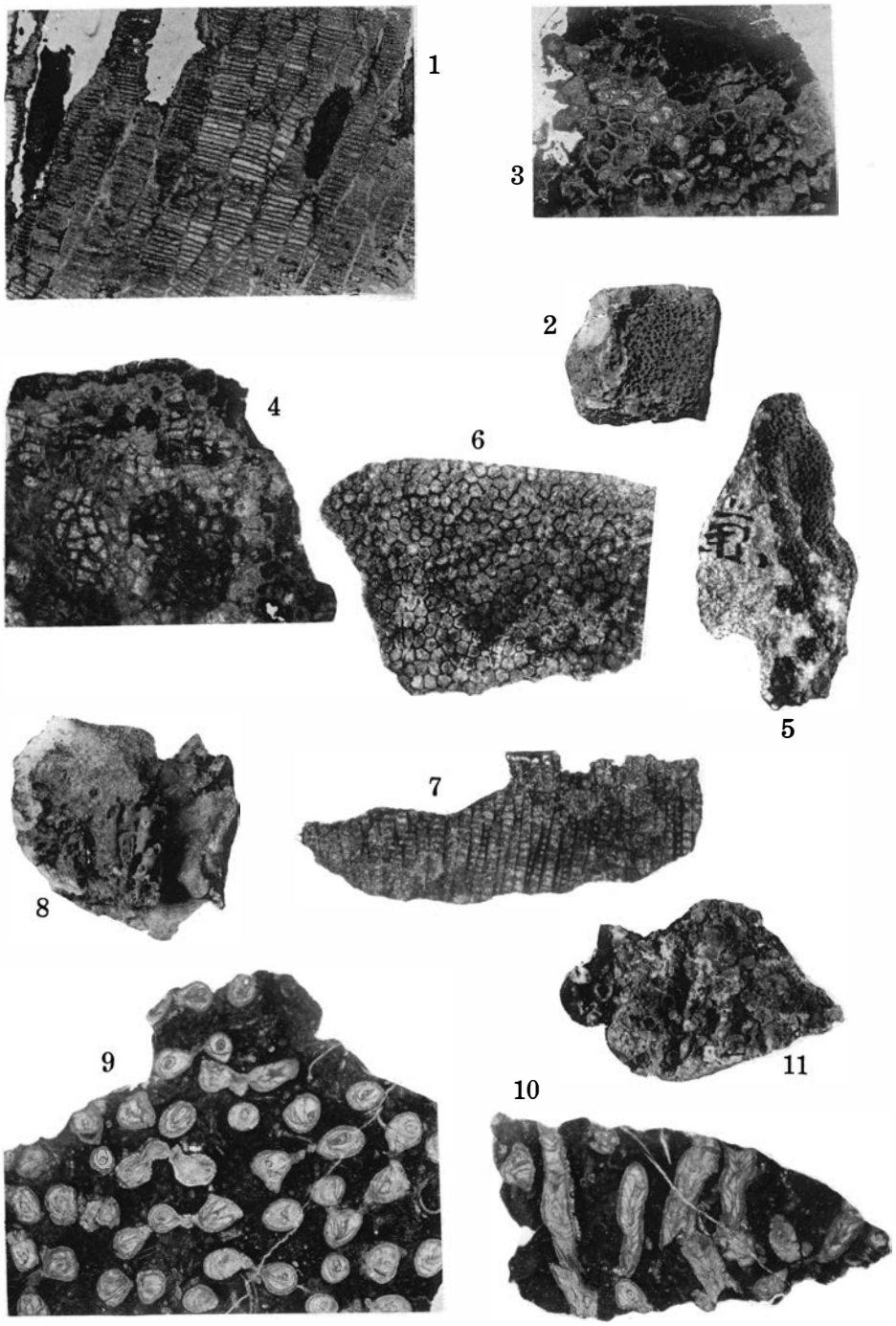

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PLATE XVI

Explanation of Plate XVI

Fig. 1. Syringopora sp. nov.? Transverse section. × 3. P. 76.

Fig. 2. Syringopora sp. nov.? Oblique section. × 3. P. 76.

Fig. 3. Halysites escharoides Fischer-Benzon. Natural size. P. 76.

Fig. 4. Halysites escharoides Fischer-Benzon. Natural size. P. 76.

Fig. 5. Halysites sindoensis sp. nov. Natural size. P. 77.

Fig. 6. Halysites sindoensis sp. nov. Transverse section. × 3. P. 77.

Fig. 7. Halysites sindoensis sp. nov. Longitudinal section of same specimen. × 3. P. 77.

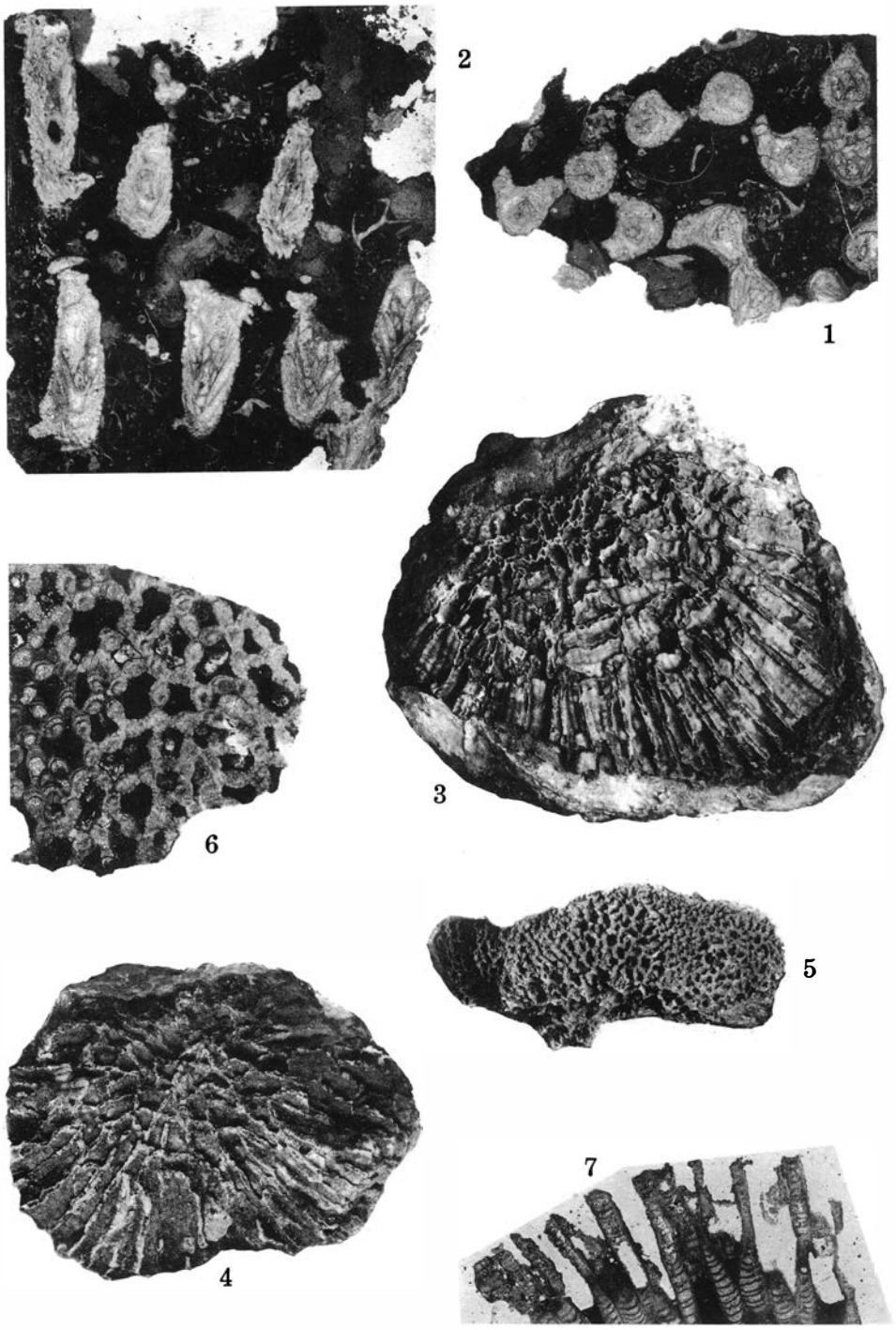

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PLATE XVII

Explanation of Plate XVII

Fig. 1. Halysites escharoides Fischer-Benson. Natural size. P. 76.

Fig. 2. Halysites sindoensis sp. nov. Natural size. P. 77.

Fig. 3. Halysites sindoensis sp. nov. Natural size. P. 77.

Fig. 4. Halysites sapporiensis sp. nov. Side view of corallum. Natural size. P. 77.

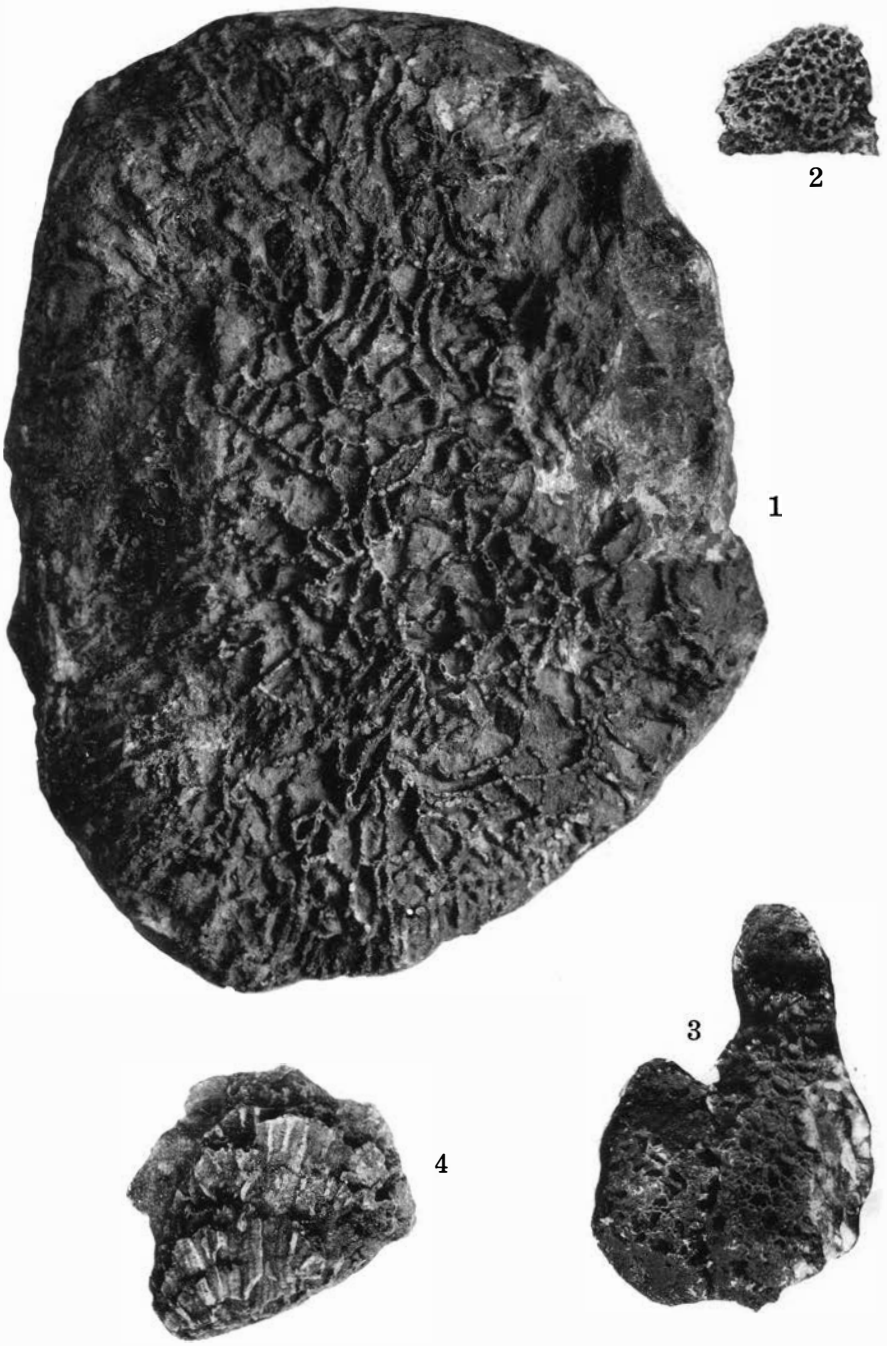

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PLATE XVIII

Explanation of Plate XVIII

Fig. 1. Halysites escharoides Fischer-Benzon. Transverse section. × 3. P. 76.

Fig. 2. Halysites escharoides Fischer-Benzon. Longitudinal section of the same specimen. × 3. P. 76.

Fig. 3. Halysites sapporiensis sp. nov. Transverse section. × 3. P. 77.

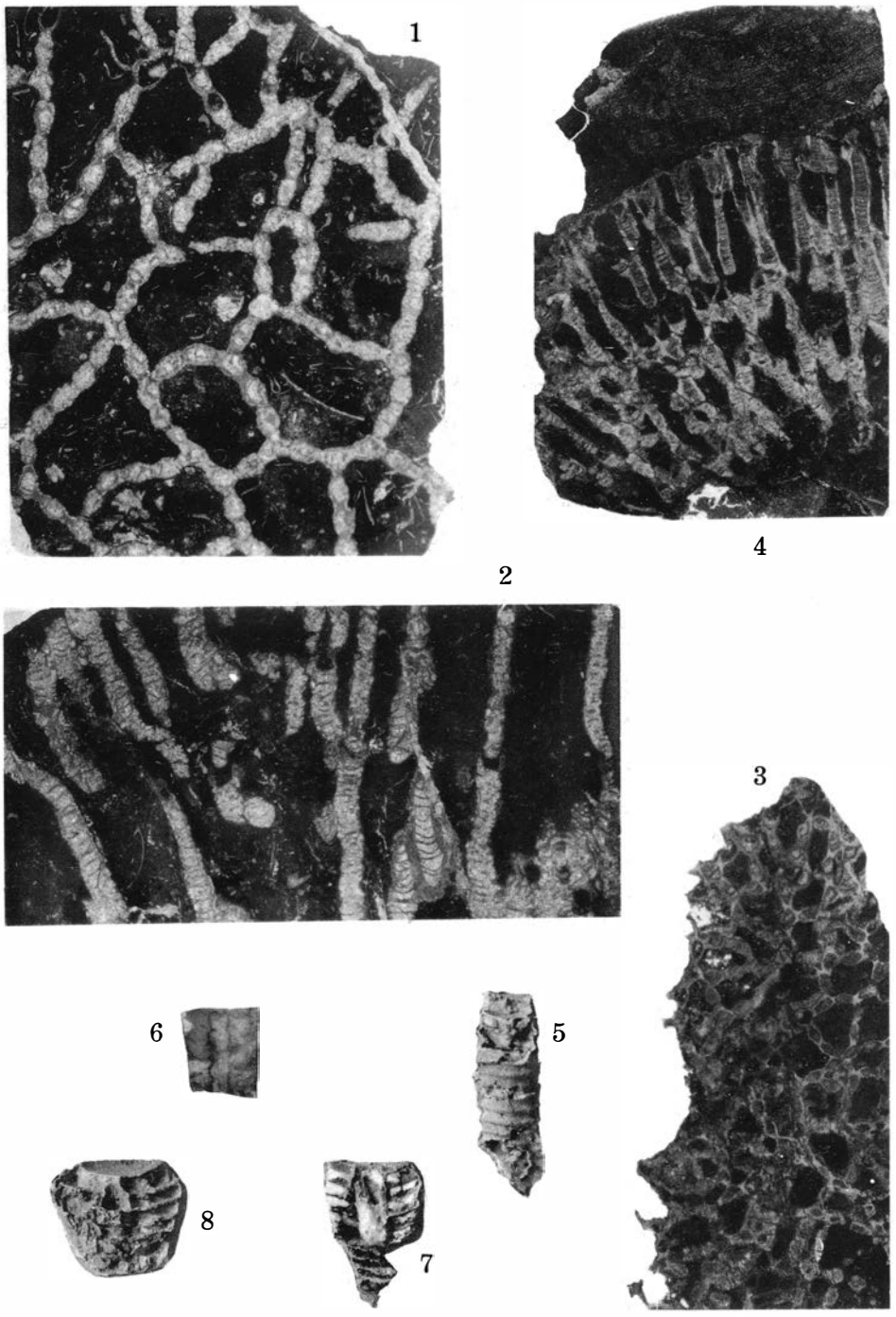
Fig. 4. Halysites sapporiensis sp. nov. Longitndinal section of the same specimen. × 3. P. 77.

Fig. 5. Spyroceras cfr. microtextile Foerste. Surface view, being upper portion weathered so as to show the inner part of the conch. Natural size. P. 78.

Fig. 6. Sactoceras ozakii sp. nov. Polished vertical section, showing the structure of the siphuncle. Natural size. P. 79.

Fig. 7. Huronia sp. Specimen weathered so as to show the inner part of the conch. Natural size. P. 80.

Fig. 8. Gomphoceras sp. Specimen weathered so as to show the ventral side of the siphuncle. Natural size. P. 81.



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