

STENOPORIDAE FROM UPPER PALAEOZOIC OF CHINA

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INTRODUCTION

The specimens dealt with here were sent by the geological parties in 1956 to the writer for study. They were collected from the Carboniferous and Permian of eight provinces: Szechuan, Hupeh, Hunan, Kiangsi, Kwangsi, Sinkiang, Kansu and Inner Mongolia. Eleven species in five genera are described and studied; they are *Stenodiscus undulatus* (sp. nov.), *S. granularis* (sp. nov.), *S. varians* (sp. nov.), *S. giganteus* (sp. nov.); *Stenopora angulata* (sp. nov.), *S. permiana* (sp. nov.), *S. sp.*, *S.?* sp.; *Leioclema? problema* (sp. nov.); *Eridotrypella? carbonaria* (sp. nov.); and *Tabulipora kansuensis* (sp. nov.).

The genus *Stenodiscus* created in 1945 by Crockford looks very much like *Stenopora*, except that thin complete diaphragms occur fairly frequently in the zooecial tubes. This kind of bryozoan had been found in several localities of China and had been put by Girty, and Yabe and Sugiyama under *Batostomella* and *Geinitzella*. These two genera have been a source of much nomenclatural and taxonomic confusion.

Batostomella was founded in 1882 by Ulrich from the Ordovician rock of the United States of America. No type species was named for the genus at the time of original description, but in 1890 and 1893 when Ulrich described the species from the Chester formation of Kentucky, he assigned *Batostomella spinolosa* as the type. In the meantime Miller (1889) designated *Chaetetes gracilis* Nicholson, which had been put under the genus *Batostomella* by Ulrich in 1882, as the genotype. Hence two different genotypes of different geological ages are included in one genus. Most authors have failed to note Miller's designation four years antedating Ulrich's, and have used *Batostomella spinolosa* Ulrich as the genotype representing the Upper Palaeozoic forms. In 1949, Duncan pointed out that Miller's conception should be noted, i.e., using *Batostomella gracilis* (Nicholson) as the genotype of the genus *Batostomella*, which is related to the Lower Palaeozoic Heterotrypidae. Bassler in 1953 accepted Duncan's conception, put this genus under the family Batostomellidae and restricted it from the Ordovician to the Devonian.

The genus *Geinitzella* has also been a source of much nomenclatural and taxonomic confusion. Most palaeontologists have recognized *Coralliolites columnaris* Schlotheim as the genotype. Schlotheim mentioned that *Coralliolites columnaris* belongs probably to the Devonian, but he also included some Zechstein forms. It is very clear, just as Geinitz had pointed out, that the genotype was composed of more than one species or even more than one genus.

Coralliolites columnaris had been referred by King in 1850 to *Stenopora* Lonsdale. When Waagen and Wentzel (1886) studied some of the fossils from the Permian of the Salt Range, they stated that their new genus, *Geinitzella*, was founded on *Stenopora columnaris* but did not specifically designate this species as the genotype. In 1912 Lee selected *Geinitzella ramosa* var. *incrustans* (= *Geinitzella incrustans*) as the genoelectotype. Crockford in 1947 observed that Waagen and Wentzel's *Geinitzella columnaris* var. *incrustans* should probably be referred to *Stenopora*. From these we know that *Geinitzella* is probably a synonym of *Stenopora*, Duncan (1949)

pointed out that Waagen and Wentzel's figures "show part of a ramose stenoporoid 'incrusted' with a layer of renewed growth of some species. The feature of renewed growth in one or more layers is rather common among the stony bryozoans, including ramose and bifoliate species as well as those having massive and laminar zoaria, and certainly is not of sufficient zoological significance to differentiate a 'variety' (in the sense of subspecies)". The writer quite agrees with Duncan's interpretation. This kind of zoarium has been found in several localities of China.

In 1942 Yabe and Sugiyama assigned *Geinitzella* as a subgenus of *Batostomella*. Surely these two forms in the old sense are very similar in many characters. It was difficult to separate them, but from the statements mentioned in the preceding paragraphs (i.e. *Geinitzella* is a synonymy of *Stenopora*) these two forms are easily distinguishable.

Stenopora is a genus of stenoporoids without diaphragms both in the zooecial tubes and in the mesopores, while in *Stenodiscus*, as have been stated, diaphragms occur fairly frequently in the zooecial tubes. Several thin diaphragms inserting the zooecial tubes in the Chinese species is described in the present paper and these species should be included in the *Stenodiscus*. Even those, *Geinitzella chinensis* described by Girty (1907), and *Batostomella* (*Geinitzella*) *hayasakai*, *B.* (*Geinitzella*) *yunnanensis* and *B.* (*Geinitzella*) *manchuriensis* described by Yabe and Sugiyama, from the Lower Permian of China, as Duncan had pointed out, should also be put under the genus *Stenodiscus*. The writer wonders if all the species described by Yabe and Sugiyama bear several thin diaphragms, yet the zooecial wall which is an important character of *Stenodiscus* is not beaded. And the writer also wonders if the species described by Girty exhibits beaded wall and numerous mesopores but the zooecial apertures are irregular in size and shape.

DESCRIPTION OF SPECIES

Order Trepostomata Ulrich

Family Stenoporidae Waagen et Wentzel

Genus *Stenodiscus* Crockford

Stenodiscus undulatus Yang (sp. nov.)

(Pl. I, Figs. 1—4)

This species is represented by two hollow, cylindrical and fragmentary specimens from 15 to 19 mm in diameter and more than 40 mm in length. The thickness of the zoarium preserved varies from 1.5 to 2.0 mm. It cannot be determined whether the original shape was incrusting or hollow cylindrical. So far as can be observed, there is no epitheca upon the inner surface, nor is there any flexing of the cells toward a point of origin. From this circumstance it can perhaps be inferred that the original form was a solid cylinder, of which the axial portion including the immature region of the cells has by some means been destroyed. The surface could not be free from the matrix, so that the development of monticules or maculae is not shown, but their occurrence is indicated in thin sections by the presence of small areas, their centres are 2.5 mm apart in which mesopores are more in number and zooecia larger in size.

The tangential sections show that the zooecia are polygonal or angular where they are thin-walled, and oval usually at the level of the thick-walled part. The diameter of the ordinary zooecial apertures ranges from 0.24 to 0.26 mm, at the monticules or maculae the diameter varies from 0.25 to 0.28 mm. Mesopores few to moderate in number, small in size usually circular to oval sometimes irregular in shape. Acanthopores few and small, most frequently developed at the angle of the zooecia,

The immature zone has been worn out, only the mature zone is shown in longitudinal section. The zooecial walls are intermittently thickened; in some parts they are fused together or much thickened. Diaphragms are moderate in number and disposed at rather regular intervals through the mature region. No diaphragms occur in the mesopores.

The polygonal zooecia, intermittently thickening of zooecial walls and few acanthopores, seen in tangential sections, and the thin and sometimes fused zooecial walls in longitudinal sections make this species readily distinguishable from the genotype *Stenodiscus moniliformis* Crockford from the Permian Berriedal limestone of Tasmania, Australia. The walls of *Stenodiscus moniliformis* Crockford is typically moniliform, the zooecia are circular to sub-circular in cross section and the acanthopores are very small and fairly abundant.

Horizon and locality: The specimen was collected from a black crystalline limestone by Mr. Y. C. Hu of the Non-metallic Prospecting Company at the place Houtzeshih, Pinghsiang County, Kiangsi Province. The limestone bearing *stenodiscus undulatus* belongs to the Lower Permian Yangsin limestone.

***Stenodiscus granularis* Yang (sp. nov.)**

(Pl. II, Figs. 2—8)

The zoarium is a solid, cylindrical stem about 8 to 10 mm in diameter and more than 30 mm in length, without conspicuous maculae on the surface. Zooecia are oval to irregular and usually indented by acanthopores. The diameter of the zooecial apertures ranges from 0.10 to 0.20 mm.

Tangential thin sections show the usual structural variation where different stages of development are examined. The section through the early part of the mature region shows small rounded to oval mesopores and small to fairly large numerous granulose acanthopores. As growth proceeds the acanthopores increase in size and number to the exclusion of the mesopores; so that near the surface the latter are few and inconspicuous. The zooecial apertures are oval to irregular in outline, 7 to 8 in a distance of 2 mm.

Longitudinal sections show thin-walled, narrow untabulated tubes in the central part of the branch curving gently on their way to the surface and becoming abruptly greatly thickened with the occasional development of one or two complete diaphragms in the transitional and early mature regions. Here the acanthopores transverse the walls as distinct tubes of denser tissue with a central canal well developed. The mesopores without diaphragms are slightly narrower than the zooecial tubes. A well marked difference and a sharp line occur between the mature and the immature regions.

The tangential section of this species is closely related with *Stenodiscus chinensis* (Girty) especially figure 11 and 12, plate 28, from the Wushan limestone (probably the Yangsin limestone), but differs from it in the absence of beaded walls at the early mature or late immature regions seen in longitudinal sections. This species may also be compared with '*Batastomella*' *sinigera* Bassler in tangential section, from the Permian of Thie near Baac, island of Rotti, Timor. In longitudinal section the present species bearing an abrupt change from the mature toward the immature regions, may clearly be separated from that exhibiting a gradual change from the immature to the mature regions.

Horizon and locality: The specimen of the holotype of *Stenodiscus granularis* was collected by Ho Yen from the Maokou limestone, upper part of Lower Permian, at Tzuchuya of Peichuan

county, Szechuan Province. Another specimen shown in Pl. II, figs. 4, 5, 7, 8 embedded in dark grey limestone bearing many numerous calcite veins, was collected in 1956 by Messrs. Y. C. Hu and P. N. Li of the Non-metallic Prospecting Company from the Yangsin limestone at Laohutung, Pinghsiang County, Kiangsi Province.

***Stenodiscus varians* Yang (sp. nov.)**

(Pl. I, Figs. 5—7)

This species has not been found free, and the following description has been drawn up from thin sections. It evidently occurs as cylindrical stem, 8 to 10 mm in diameter and more than 20 mm in length.

In tangential thin sections this species shows the usual structural variation where different stages of development are examined. The zooecial apertures are various in size and shape, with their longer diameter parallel to the length of the branch, and from 0.18 to 0.26 mm long and from 0.14 to 0.18 mm wide, 7 occur in 2 mm. Acanthopores are small and numerous. Mesopores are moderate in number; they are oval, subcircular or irregular with their long axes parallel to the length of the branch. The size of the mesopores varies considerably, some are very small, while others are quite large. Maculae gathered with larger than the average zooecia and mesopores, are disposed 2 to 2.5 mm apart measured from centre to centre.

Longitudinal sections show that the zooecial walls thin in the axial zone, thick in the peripheral zone, bend gradually from the axial toward the peripheral zone. The zooecial tubes are rather closely tabulated in the mature region about one or less than one tube diameter apart; in the immature region no diaphragms have ever been detected. In some part of the mature region the zooecial walls are fused or confluent; the mesopores and acanthopores are clearly shown; monilae which characterize the family Stenoporidae, have not been seen in this specimen.

The tangential section of this species in many respects resembles *Geinitzella chinensis* Girty from the Yangsin limestone at Taningho, Szechuan. In longitudinal section the closer spacing of the diaphragms in the mature zone, and the absence of beaded zooecial walls both in the mature and in the immature zones distinguish this species from the latter.

Horizon and locality: This species was collected in 1956 by the 435 geological party of the Ministry of Geology, People's Republic of China from the Yangsin limestone at Pengchiaho, east of Panchiaoping, Nanchang County, northern Hupeh. The specimens are embedded in fine, dense and greyish black limestone associated with fragments of gastropoda, brachiopoda and fusulinid. The age is assigned to the upper part of the Lower Permian.

***Stenodiscus giganteus* Yang (sp. nov.)**

(Pl. II, Fig. 1; Pl. III, Figs. 1—3)

The large zoarium is a solid cylindrical stem about 30 mm in diameter. The incomplete specimen is up to 50 mm in length. The surface of the zoarium exhibits rather conspicuous monticules gathered by slightly larger than the average zooecia and few mesopores, and spaced at 6 to 7 mm apart measured from centre to centre. The acanthopores seen at the surface are prominent and highly raised.

Tangential thin sections show that the zooecial walls are typically amalgamated; they are not uniform in thickness, thin at ordinary areas, thick when the sections cut through the monticules.

Zooecial apertures are subcircular to polygonal in cross section bearing a diameter ranging from 0.21 to 0.30 mm, and 5 to 6 in a distance of 2 mm. Mesopores are few or absent at the ordinary areas, more at the monticules. Acanthopores commonly very large and conspicuous; they are usually hollow and situated at the junction of angles, usually 2 sometimes 3 rarely 4 around each zooecia; a few of these acanthopores are very much smaller than the majority.

In longitudinal sections, the zooecial tubes of the type specimen bend gradually from the immature zone toward the mature zone; the walls are thin in the immature region, thick and beaded, in some part fused, at the mature region. Thin, slightly concave, complete diaphragms are frequently developed in the tubes.

The size of the zoarium of this species is much larger than the genotype, *Stenodiscus moniliformis* Crockford from the Berriedale limestone of Tasmania, Australia given by Crockford. The longitudinal section of this species may be compared with *Stenodiscus moniliformis* Crockford, but their tangential sections are quite different; the size of the acanthopores of the latter are very small and more numerous, the shape of the zooecia are commonly subcircular in cross section, while the acanthopores of the present species are quite large and very conspicuous, and the shape of the zooecia are usually polygonal. From these characters stated above it is easily separated from other species of the genus described in this paper. The tangential sections are very closely related to *Rhombotrypella* Nikiforova, they are separated by the presence of quadrate cross section of the zooecia in the axial region, and perforated diaphragms of the latter.

Horizon and locality: The exact horizon of this species is not known, it probably belongs to the Carboniferous. It was obtained in 1956 by the 682 geological party of the Ministry of Geology from Matsungshan, Sian County, Kansu Province.

Genus *Stenopora* Lonsdale

Stenopora angulata Yang (sp. nov.)

(Pl. III, Figs. 4—7)

This species is represented by a fragmentary, ramose zoarium 13 mm in diameter and more than 30 mm in length. A part of the surface of the zoarium has been worn out and other part has not been free from the rock matrix. The surface character is therefore not known.

Tangential sections show that the zooecial apertures are polygonal in outline, and that the walls are not uniform in thickness. Numerous acanthopores present at the junction-angles, their size are variable from small to large. They are hollow centrally with laminated or double layered walls. Mesopores present, few in number, subrounded in outline and irregular in size. There are 6 or 7 zooecial apertures in a distance of 2 mm.

In longitudinal sections the zooecial tubes bend gradually from the axial region toward the peripheral zone. The walls are thin in the immature region, and intermittently thickened, in some part fused, in the mature region. The monilae-form structures which characterize this genus are not developed. No diaphragms are detected both in the mature and in the immature regions.

This species may be compared with *Stenopora permiana* (sp. nov.) in tangential sections. They are separated by longitudinal sections.

Horizon and locality: The specimen was collected in 1955 from Hami, Sinkiang by the 102 geological party of the Ministry of Oil Industry. The age is probably Carboniferous.

***Stenopora permiana* Yang (sp. nov.)**

(Pl. V, figs. 1—3)

This species is described from a fragmentary zoarium inserted in a dark grey impure limestone. The diameter of the zoarium is about 20 mm; the length and the surface character are unknown.

Tangential sections reveal that the zooecial apertures are rounded to polygonal in outline and the walls are not uniform in thickness. When the sections cut near the zoarial surface the walls are thin and the apertures are polygonal; the sections cut a little deeper from the surface, the walls become thick and the zooecial apertures are usually round. Mesopores few and very small present only at the maculial areas. Acanthopores are very numerous varying in size from very small to considerably large, they appear commonly at the junction-angles. Usually 7 occasionally 6 zooecia occur in a distance of 2 mm.

In longitudinal sections the zooecial tubes bend gradually from the immature toward the mature regions and the walls vary from very thin in the former to quite thick and sometimes fused together in the latter region. No diaphragms have been observed in most of the zooecial tubes, one delicate diaphragm may be detected in few tubes. Mesopores may be seen in some parts, acanthopores appear very clear. The moniliated walls are not conspicuous, they are occasionally intermittently thickened.

The present species bears a close relationship to *Stenopora angulata* (sp. nov.). The measurements of this species in tangential sections are almost same as in *S. angulata*, only the acanthopores are slightly different. In *S. angulata* most of the acanthopores are hollow, while the acanthopores of this species are mostly laminated. Diaphragms are completely absent in longitudinal sections in the former, yet thin or delicate diaphragms may be seen in few tubes of the latter species.

Horizon and locality: This species was collected by Mr. P. L. Liang of the 487 geological party of the Ministry of Geology from the Lower Permian at Sintsun, Liuho, Ishan County of Kwangsi Province.

***Stenopora* sp.**

(Pl. IV, Figs. 1—4)

This species is represented by two sections, one tangential and one longitudinal. The complete zoarium is not observed. From the longitudinal section we know that the zoarium is ramose and bears a diameter about 4 mm.

In tangential sections the zooecia, 6 or 7 in a distance of 2 mm, are subpolygonal and thick-walled. Acanthopores are more numerous and more conspicuous when the sections are cut near the zoarial surface, less so when the sections are cut farther from the zoarial surface. They appear not only at the junction angles but also at the mid-way of the zooecial walls. Their size varies from very small to considerably large, all of them are hollow in appearance. There are few mesopores which are irregular in size and shape.

Longitudinal sections show that the zooecial tubes in the early mature region are wider than in the late mature region. The zooecial walls are thin in the axial region and thickened in the peripheral region, where some of them are beaded or intermittently thickened. The zooecial tubes bend gradually from the immature toward the mature region and direct to the zoarial surface. Diaphragms characterizing other species of this genus have not ever been detected in both regions.

Only two thin sections are observed, and characters of complete zoarium are unknown,

Other specific characters need further material to prove.

Horizon and locality: This form occurs in association with *Neoschwagerina* sp. in the Chinghsichung limestone (=Maokou Limestone, Lower Permian), Hutien, Hsianghsiang County, Hunan Province.

***Stenopora?* sp.**

(Pl. IV, Figs. 5—7)

No free specimens have been observed, the following descriptions are based on thin sections only.

In tangential sections the zooecia are rounded to oval, in some parts even polygonal in outline, 6 in a distance of 2 mm. The zooecial walls are not uniform in thickness even in the same section. Acanthopores, not very conspicuous, are restricted to the junction-angles. They are numerous in number and their sizes vary from small granules to considerable large. Mesopores usually present, irregular in size, oval or subrounded in outline.

The zooecial walls, as seen in longitudinal sections, are very thin in the axial region. In the peripheral region they are thickened and fused in some parts, monilae may occasionally be detected. Both the peripheral and the axial regions are lacking diaphragms. But in transverse sections one or two delicate diaphragms surely appear in some of the zooecial tubes in the mature region.

The zoarium and surface characters are not known, only three thin sections are observed. No diaphragms have been observed in the longitudinal sections, yet one or two diaphragms surely appear in some of the zooecial tubes in the transverse sections. The writer, therefore, hesitates to decide whether the identification of the genus of the present form is correct.

Horizon and locality: This species was collected from the vicinity of Lalaotoo, 35 km northwest of Beiyin Obo, Inner Mongolia of China. It is associated with *Triticites* sp. and the age is assigned to the lower part of the Upper Carboniferous.

Genus *Tabulipora* Young

***Tabulipora kansuensis* Yang (sp. nov.)**

(Pl. V, Figs. 6—8)

This species is represented by a single zoarium ramose, subcylindrical, about 15 mm in length, and 12 mm in diameter. The surface of the zoarium, roughly speaking, is smooth, no monticules have ever been detected, but maculae gathered by zooecia smaller than the average are observed.

In tangential sections the zooecial apertures are normally polygonal in cross section and irregular in size, average 5 to 6 in a distance of 2 mm. The zooecial walls are not uniform in thickness even at the same level. A black line usually occurs between the adjoining zooecia, it looks like the walls of an *Integrata*. Mesopores are commonly absent at the ordinary portions, but in the vicinity of the maculae they may be present in a considerable extent but not numerous. Acanthopores small and inconspicuous, can generally be seen at the junction-angles.

Longitudinal sections show that the peripheral, thick-walled portion of the zooecia is at right angles to the surface. The walls which are usually very thin in the axial region, are intermittently thickened, instead of moniliate, in the peripheral region. Some of the diaphragms bear a central perforation, while others are complete. They are separated at one half to one tube diameter

apart in the peripheral mature region. No diaphragms have been observed in the central immature region.

The black line appearing between the adjoining zooecia in tangential sections of the present species may be compared with *Tabulipora tschumyschensis* Nekhoroshev from the Lower Carboniferous of the Kuznetsk Basin, Soviet Union, but differs in the size of the zooecia and in the number of mesopores. In the present species, 5 or 6 zooecia are detected in a distance of 2 mm, and a moderate number of mesopores has been observed in the vicinity of the maculae, while in *T. tschumyschensis* 8 to 8.5 zooecia occur in the same distance and no mesopores have been secured both in the ordinary portions and in the maculated areas.

Horizon and locality: The specimen was collected by the geological party of the Ministry of Oil Industry from the Carboniferous (probably Lower Carboniferous) of Minlo, Kansu.

Genus *Leioclema* Ulrich

Leioclema? *problema* Yang (sp. nov.)

(Pl. V, Figs. 4—5)

A single, solid, cylindrical, fragmentary specimen is attributed to this species, 15 to 20 mm in diameter and more than 50 mm in length. The zoarium is partly covered by rock matrix, the other part has been worn out, the surface character is therefore not known.

Groups of larger than the average zooecia spaced at 2.5 mm apart are seen in tangential sections. These groups of zooecia represent the presence of monticules or maculae. The zooecia are subcircular to polygonal in outline; the walls representing typically amalgamate in character are laminated. The diameter of the ordinary zooecial apertures varies from 0.23 to 0.25 mm, and that of the larger ones ranges from 0.27 to 0.32 mm, 6 to 7 occur in 2 mm. Mesopores are numerous and irregular in size and shape. Acanthopores very few and moderate in size, are developed at the angle of junctions.

Longitudinal sections show that the zooecial walls are thin and crenulated in the immature region, and thick in the mature region; they bend very gradually from the axial zone toward the peripheral region and direct to the surface. Several complete diaphragms insert the zooecial tubes in the late immature and early mature regions from one half to one tube diameter apart. No diaphragms have ever been detected in the tubes of the mesopore, though the latter is very clearly developed in the mature region, where most of the walls are fused and laminated.

This species is closely related to *Leioclema* in bearing amalgamate laminated walls, polygonal to subcircular zooecial apertures separated by numerous irregular mesopores, seen in tangential sections. Most of the species of *Leioclema* exhibit numerous acanthopores, and the diaphragms are more numerous in the mesopores than in the zooecial tubes, while in the present species only few acanthopores are detected, no diaphragms have been observed in the mesopores, though several complete diaphragms have been detected in the zooecial tubes. For these reasons the generic identification is questionable. The writer, for a long time, hesitates to put this species under a new generic name because the material studied is too poorly preserved and fragmentary. This species differs from *Stenodiscus* Crockford and from *Stenopora* Lonsdale in having numerous mesopores, from *Amphiporella* Girty in the absence of perforated diaphragms and beaded walls.

Horizon and locality: The specimen was obtained from a fine, dense, grey limestone. It was collected in 1956 by the 121 geological party of the Ministry of Oil Industry from Wanshengchang, Chungking city, Szechuan Province. The species belongs to the Lower Permian Yangsin limestone,

Genus *Eridotrypella* Duncan****Eridotrypella? carbonaria* Yang (sp. nov.)**

(Pl. IV, Figs. 8—10)

This species is represented by a single incomplete ramose zoarium with bifurcating cylindrical stems, 3 to 5 mm in diameter and more than 50 mm in length. The upper surface has been worn out, other surfaces have not been removed from the rock matrix, so that the characters of the zoarial surface are not known.

In tangential sections, the zooecia bearing thick walls appear to be oval to subcircular in cross section with their longer diameter ranging from 0.20 to 0.23 mm, parallel to the length of the zoarium, and their shorter diameter ranging from 0.18 to 0.20 mm, parallel to the transverse section of the zoarium. There are 6 to 7 zooecial apertures longitudinally and 7 to 8 horizontally, in a space of 2 mm. Tangential thin sections show well the peculiarities of this species which consists of very granulose walls, pierced by numerous acanthopores. The acanthopores containing 2 sizes differ however from the typical clear cut structures built up of laminated tissue in being composed of darker, coarser granules radiately arranged around definite point. No mesopores have ever been observed.

Longitudinal sections show that the zooecial tubes are slightly tortuous, opening slightly obliquely upon the surface; their walls are thin in the axial region, rather thick in the peripheral zone. Usually one rarely 2 diaphragms are developed just before the tubes enter the peripheral region, and one or two also developed in some tubes at the late mature region, near the surface of the zoarium. The mature region is rather narrow in contrast with the immature zone.

The granulose walls, pierced by numerous acanthopores seen in tangential sections of the present species are closely related to *Stenopora* and *Tabulipora*. It differs from the latter in lacking perforated diaphragms, from the former in lacking beaded walls. In some respects it may be compared with the Devonian genus *Eridotrypella*, especially with *E. devonica* Duncan in tangential sections, but in longitudinal sections the zooecial tube of the latter is oblique to the zoarial surface and this is one of the important generic characters of this genus; the tubes of the present species are nearly at right angles to the zoarial surface. Only one specimen has been found and this species was collected from the Carboniferous of Kansu; it is surely different from that of the Devonian. We put it under this genus with an interrogative mark and wait for more material to prove it.

Horizon and locality: The specimen was embedded in a grey crystalline limestone associated with *Lithostrotion* sp., *Lophophyllum* sp. and fragments of brachiopods belonging to the Lower Carboniferous. It was collected from Yenchihwan, Supei, Kansu Province.

*This genus belongs to Heterotrypidae, for convenient we put it here.

圖版說明

標本保存在中國科學院古生物研究所。龐茂芳同志攝影。計承道同志磨製薄片。

圖版 I

圖 1—4. *Stenodiscus undulatus* Yang (新種)

1. 弦切面, 表示蟲室的形狀和大小。刺孔小, 中空, $\times 20$ 。
 2. 同一弦切面, $\times 40$ 。更清楚地表示蟲室的特徵。間隙孔少。
 3. 縱切面, $\times 10$, 表示層狀體壁及橫板分佈情況。
 4. 同一縱切面, $\times 20$, 更清楚地表示體壁的特徵和橫板分佈情況。
- 登記號: 9345, 全型。

圖 5—7. *Stenodiscus varians* Yang (新種)

5. 弦切面, 表示蟲室的大小和形狀, 間隙孔數目很多, 形狀和大小都不規則。刺孔很小, $\times 20$ 。
 6. 同一弦切面, $\times 40$ 。更清楚的表示蟲室, 間隙孔和刺孔的特徵。
 7. 縱切面, 表示體壁的融合現象和橫板的分佈狀況。 $\times 20$ 。
- 登記號: 9348, 全型。

EXPLANATION OF PLATES

(All the specimens are deposited in the Institute of Paleontology, Academia Sinica)

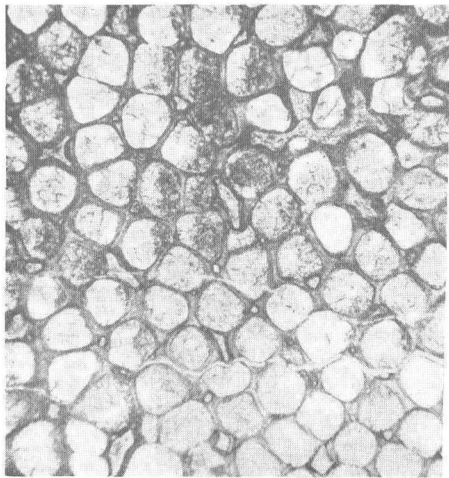
Plate I

Figs. 1—4. *Stenodiscus undulatus* Yang (sp. nov.).

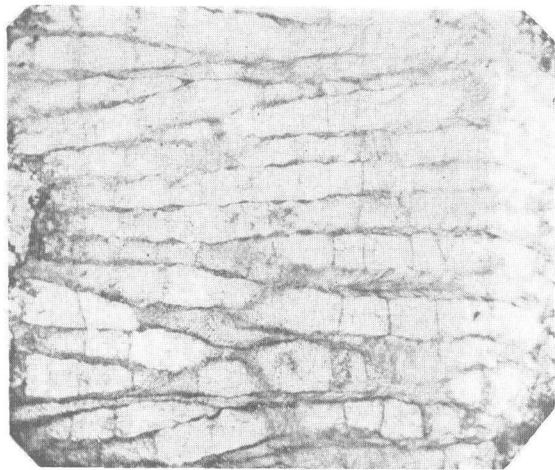
1. Tangential section, showing the size and shape of the zooecia. The acanthopores are hollow and small. $\times 20$.
 2. Tangential section, of the same, showing the characters more in detail. Mesopores present, but few in number. $\times 40$.
 3. Longitudinal sections, $\times 10$, showing the laminated zooecial walls, and the distribution of diaphragms.
 4. Longitudinal section of the same, $\times 20$, showing the structures more in detail.
- Cat. No. 9345, Holotype. From Houtzeshih, Pinghsiang, Kiangsi, Lower Permian, Yangsin limestone.

Figs. 5—7. *Stenodiscus varians* Yang (sp. nov.)

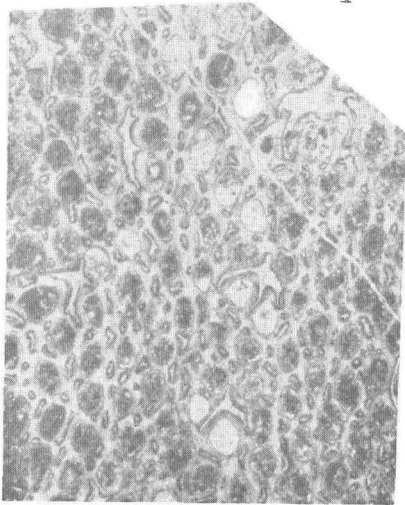
5. Tangential section, showing the size and shape of the zooecia. The mesopores are numerous in number, irregular in size and shape. Acanthopores small and numerous. $\times 20$.
 6. Tangential section of the same, showing the structures more in detail, $\times 40$.
 7. Longitudinal section, showing fused zooecial walls and the distribution of diaphragms. $\times 20$.
- Cat. No. 9348, Holotype. From Pengchiaho, Nanchang, Hupeh, Yangsin limestone.



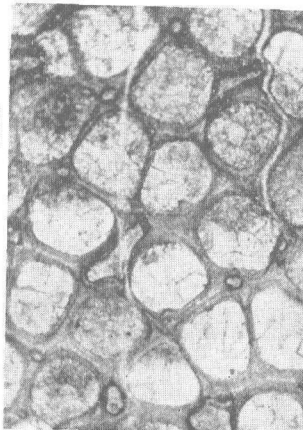
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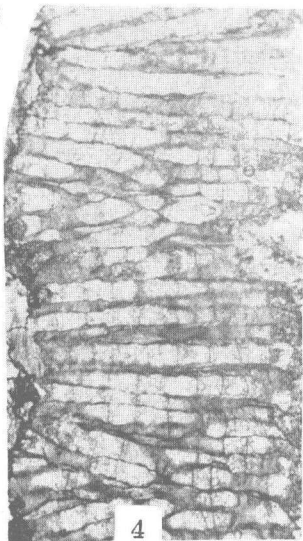
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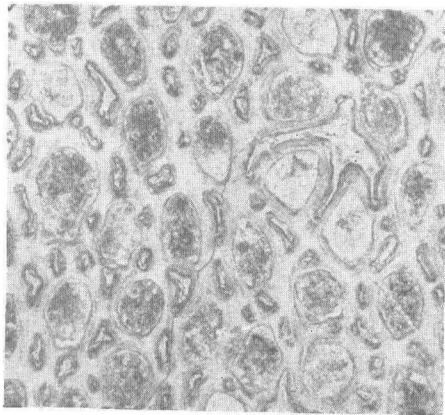
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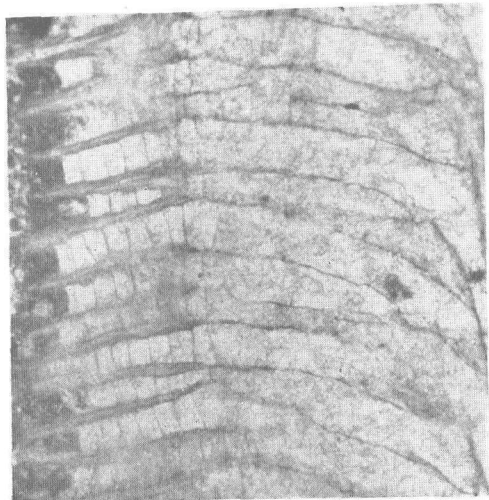
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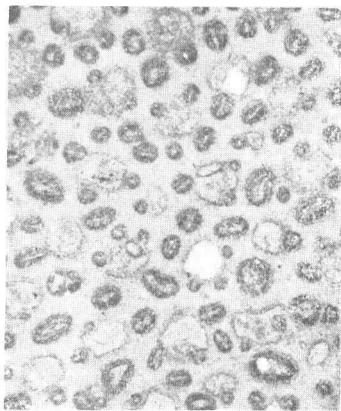
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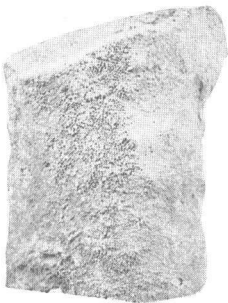
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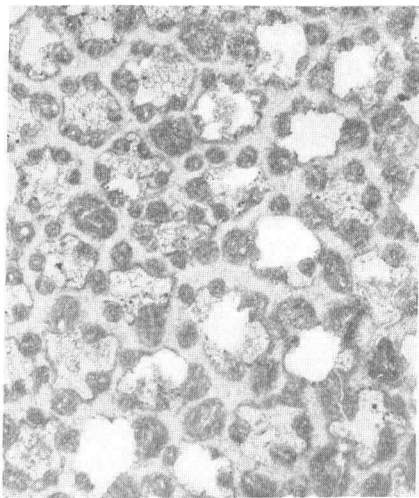
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2



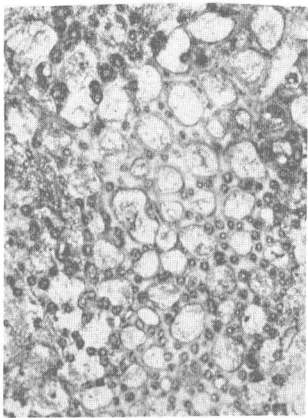
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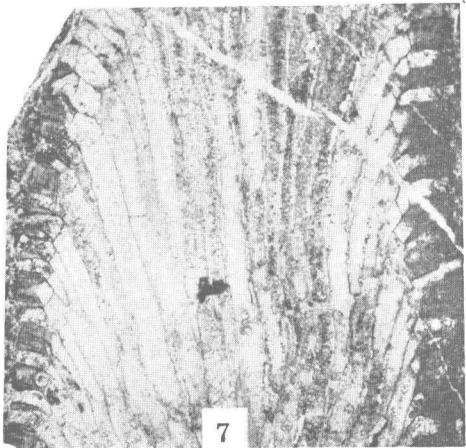
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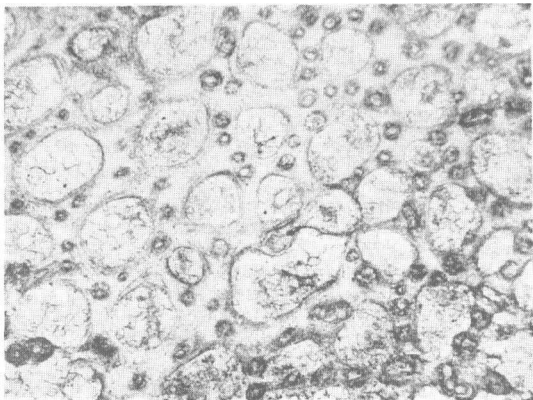
4



8



7



5

圖版 II

圖 1. *Stenodiscus giganteus* Yang (sp. nov.) 一個不完整的硬體, 原大。登記號: 9349。

圖 2—8. *Stenodiscus granularis* Yang (新種)

2. 弦切面接近硬體表面, 表示蟲室、間隙孔和刺孔的排列形狀, $\times 40$ 。
 3. 弦切面, 距硬體表面稍遠, $\times 40$ 。
 4. 另一標本的弦切面, 表示蟲室、間隙孔和刺孔的形狀和大小, $\times 20$ 。
 5. 和圖 4 是同一弦切面, $\times 40$ 。更清楚地表示蟲室、間隙孔和刺孔的形狀。
 6. 縱切面, 表明蟲管內有橫板, $\times 20$ 。
 7. 縱切面, $\times 10$ 。
 8. 和圖 7 是同一縱切面, $\times 20$ 。
- 2, 3, 6, 是全型, 登記號: 9346。4, 5, 7, 8 的登記號: 9347。

Plate II

Fig. 1. *Stenodiscus giganteus* Yang (sp. nov.)

A fragment of the zoarium, natural size.

Cat. No. 9349 Holotype, from Matsungshan, Sian, Kansu. Carboniferous?

Figs. 2—8. *Stenodiscus granularis* Yang (sp. nov.)

2. Tangential section, cutting near the surface, showing the distribution of the zooecia, mesopores and acanthopores, $\times 40$.
 3. Tangential section, cutting farther from the surface, $\times 40$.
 4. Tangential section of another specimen, showing the size and shape of the zooecia, mesopores and acanthopores, $\times 20$.
 5. Tangential section of the same of figure 4, $\times 40$, showing the structures more in detail.
 6. Longitudinal section, showing zooecial tubes inserted by a few diaphragms, $\times 20$.
 7. Longitudinal section, $\times 10$.
 8. Longitudinal section of the same, showing the structures more in detail, $\times 20$.
- 2, 3, 6, the holotype, Cat. No. 9347, from Tzuchuya, Peichuan, Szechuan. Maokou limestone, Lower Permian.
- 4, 5, 7, 8 from Laohutung, Pinghsiang, Kiangsi, Lower Permian. Cat. No. 9348.

圖版 III

圖 1—3. *Stenodiscus giganteus* Yang (sp. nov.)

1. 縱切面, $\times 20$, 表示體壁局部珠狀, 有融合現象。
 2. 另一標本的縱切面, $\times 10$, 表示體壁在成熟區和未成熟區之間界限顯明。登記號: 9349a, 副型。
 3. 弦切面, 和圖 1 是同一標本, $\times 20$, 表示刺孔形狀很大很顯著。
- 登記號: 9349。全型。

圖 4—7. *Stenopora angulata* Yang (新種)

4. 縱切面, 表示體壁的特徵, 蟲管內無橫板, $\times 10$ 。
 5. 同一縱切面, $\times 20$, 更清楚地表示體壁的特徵。
 6. 弦切面, 表示蟲室和刺孔的特徵, $\times 20$ 。
 7. 同一弦切面, $\times 40$, 更清楚地表示蟲室和刺孔的特徵。
- 登記號: 9350。全型。

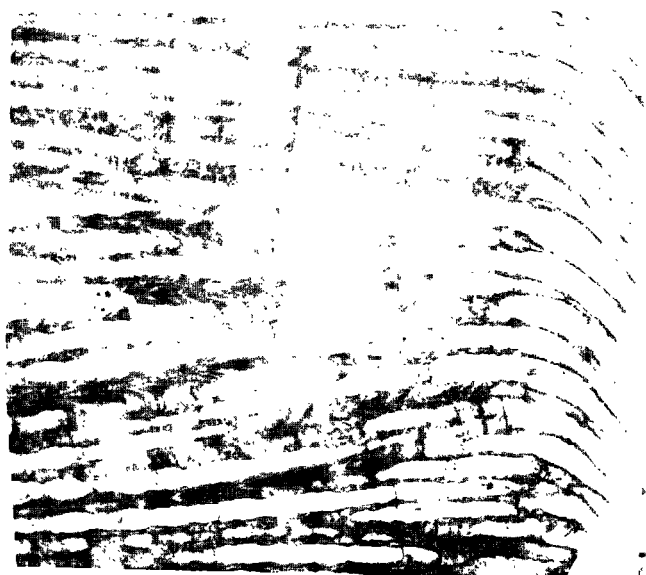
Plate III

Figs. 1—3. *Stenodiscus giganteus* Yang (sp. nov.)

1. Longitudinal section, showing the beaded and fused zooecial walls, $\times 20$.
 2. Longitudinal section of another specimen, showing a sharp boundary line lying between the mature and immature regions. $\times 10$.
 3. Tangential section, showing the very large and prominent acanthopores, $\times 20$.
- Cat. No. 9349, Holotype, from Matsungshan, Sian, Kansu. Carboniferous?

Figs. 4—7. *Stenopora angulata* Yang (sp. nov.)

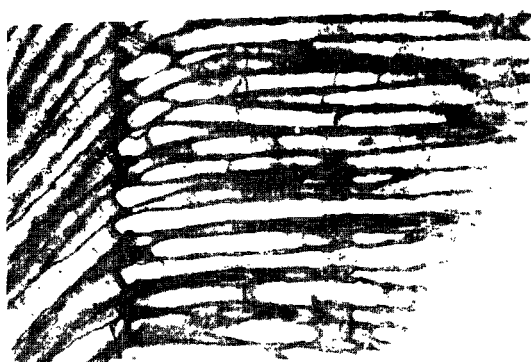
4. Longitudinal section, showing the character of the zooecial walls and zooecial tubes without diaphragm $\times 10$.
 5. Longitudinal section of the same, showing the characters more in detail. $\times 20$.
 6. Tangential section, illustrating the character of the zooecia and acanthopores. $\times 20$.
 7. Tangential section of the same, showing the character more in detail. $\times 40$.
- Cat. No. 9350, Holotype, from Hami, Sinkiang, Carboniferous.



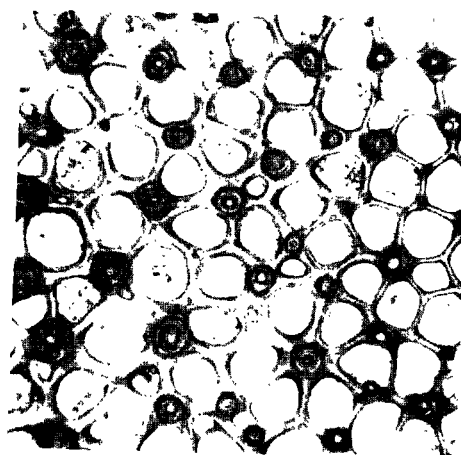
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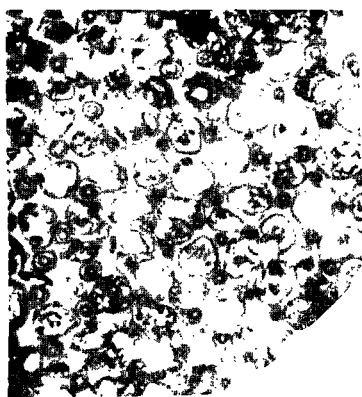
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3



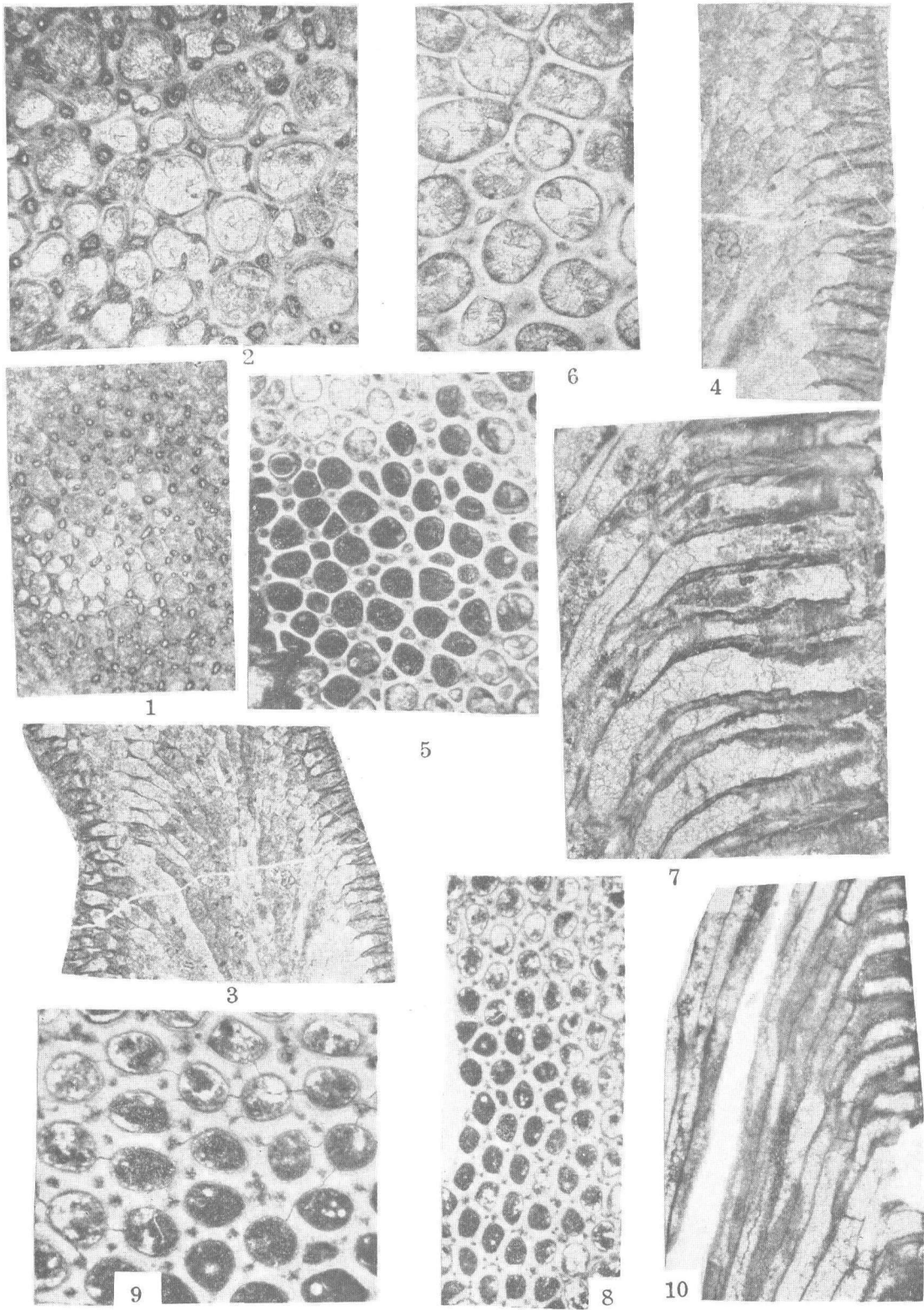
6



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5



圖版 IV

圖 1—4. *Stenopora* sp.

1. 弦切面, 表示蟲室、間隙孔和刺孔的形狀和大小, $\times 20$ 。
2. 同一弦切面, $\times 40$, 更清楚地表示蟲室、間隙孔和刺孔的特徵。
3. 縱切面, $\times 10$, 表示蟲管內無橫板。
4. 同一縱切面, $\times 20$, 表示體壁的特徵。

登記號: 9352。

圖 5—7. *Stenopora?* sp.

5. 弦切面, $\times 20$, 表示蟲室、間隙孔和刺孔的排列狀況。
6. 同一弦切面, $\times 40$ 。
7. 縱切面, $\times 20$, 表示細層狀和融合狀的體壁。無橫板。

登記號: 9353。

圖 8—10. *Eridotrypella? carbonaria* Yang (新種)

8. 弦切面, $\times 20$, 表示蟲室和刺孔的形狀。
9. 同一弦切面, $\times 40$, 特徵表示得更清楚。
10. 縱切面, $\times 15$, 蟲管內有一、二條橫板。

登記號: 9356, 全型。

Plate IV

Figs. 1—4. *Stenopora* sp.

1. Tangential section, illustrating the size and shape of the zooecia, mesopores and acanthopores. $\times 20$.
2. Tangential section of the same, showing the characters more in detail. $\times 40$.
3. Longitudinal section, showing the absence of diaphragms. $\times 10$.
4. Longitudinal section of the same, showing the character of the zooecial walls more in detail. $\times 20$.

Cat. No. 9352, Holotype, From Hutien, Hsianghsiang, Hunan, Lower Permian, Maokou limestone.

Figs. 5—7. *Stenopora?* sp.

5. Tangential section, illustrating the arrangement of the zooecia, mesopores and acanthopores. $\times 20$.
6. Tangential section of the same, illustrating the characters more in detail. $\times 40$.
7. Longitudinal section, showing the laminated fused zooecial walls. No diaphragms insert the zooecial tubes. $\times 20$.

Cat. No. 9353, Holotype, from Lalaotou, Beiyin Obo, Inner Mongolia, Upper Carboniferous.

Figs. 8—10. *Eridotrypella? carbonaria* Yang (sp. nov.)

8. Tangential section, showing the zooecial forms and acanthopores. $\times 20$.
9. Tangential section of the same, showing the characters more in detail. $\times 40$.
10. Longitudinal section, illustrating the zooecial tubes crossed by one or two diaphragms. $\times 15$.

Cat. No. 9356, Holotype, From Yenchihwan, Supei, Kansu, Carboniferous.

圖版 V

圖 1—3. *Stenopora permiana* Yang (新種)

1. 弦切面, $\times 20$, 表示蟲室和刺孔的特徵。
2. 同一弦切面, $\times 40$, 更清楚地表示蟲室和刺孔的特徵。
3. 縱切面, $\times 20$, 蟲管內無橫板。
登記號: 9351。全型。

圖 4—5. *Leioclema? problema* Yang (新種)

4. 縱切面, $\times 20$, 表示蟲管的特徵, 內有橫板。
5. 弦切面, $\times 20$, 表示蟲室和間隙孔的形狀和大小, 刺孔很小。
登記號: 9355。全型。

圖 6—8. *Tabulipora kansuensis* Yang (新種)

6. 弦切面, $\times 20$, 表示蟲室和間隙孔的特徵。
7. 同一弦切面, $\times 40$, 蟲室和間隙孔的特徵表示得更清楚。
8. 縱切面, $\times 20$, 表示蟲管內有完整的橫板, 同時也有穿孔橫板。
登記號: 9354。全型。

Plate V

Figs. 1—3. *Stenopora permiana* Yang (sp. nov.)

1. Tangential section, showing the character of the zooecia and acanthopores. $\times 20$.
2. Tangential section of the same, showing the characters more in detail. $\times 40$.
3. Longitudinal section, showing the absence of diaphragms in the zooecial tubes. $\times 20$.
Cat. No. 9351, Holotype. From Sintsun, Liuhuo, Ishan, Kwangsi, Lower Permian.

Figs. 4—5. *Leioclema? problema* Yang (sp. nov.)

4. Longitudinal section, showing the characters of the zooecial tubes crossed by few diaphragms. $\times 20$.
5. Tangential section, illustrating the size and shape of the zooecia and mesopores. Acanthopores are very small, $\times 20$.
Cat. No. 9355, Holotype. From Wanshengchang, Chungking, Szechuan, Lower Permian, Yangsirr Limestone.

Figs. 6—8. *Tabulipora kansuensis* Yang (sp. nov.)

7. Tangential section, showing the characters of the zooecia and acanthopores. $\times 20$.
6. Tangential section of the same, showing the characters more in detail. $\times 40$.
8. Longitudinal section, showing the zooecial tubes inserted by both complete and perforated diaphragms, $\times 20$.
Cat. No. 9356, Holotype. From Minlo, Kansu, Carboniferous.

