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On Some Fusulinids and Other Foraminifera from the Permian of Pahang, Malaya*

(Notes on the Geology and Palaeontology of Malaya-V)

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(With 1 Table and 2 Plates)

Between Temerloh and Maran in Pahang, Malaya there are two Middle Permian limestone localities. The one is located near the Jengka Pass (loc. M40) and the other is at the Kompong Awah Quarry (loc. M36). As pointed out in Notes IV, loc. M40 is located a little to ENE of the Jengka Pass between 107 and 108 mile points from Kuala Lumpur along the Temerloh-Maran Road in Pahang. There, limestones are interbedded within the highly inclined sequence (the alternation of sandstone and mudstone with a thin layer of conglomerate). The limestone bodies are small, lenticular and are mostly less than 5m thick. The limestones show dark gray colour, the matrix consists of lime-mud, and the texture is mostly of pelmicrite. Another Permian limestone (loc. M36) is located at the quarry near Kompong Awah along the Temerloh-Maran Road between 100 and 101 mile points. The limestones are dark gray or light gray and are included within the thick andesitic pyroclastic-volcanic series as patches of several to ten and several cm in dimension. The limestone patches are mostly fossiliferous calcilutite and are partly recrystallized secondarily into sparry calcite.

Following species have been identified by the writer :

1. Limestone at loc. M40 (Jengka Pass)
   Yabeina asiatica ISHII, sp. nov.
   Yabeina sp., cfr. *Y. columbiana* THOMPSON & WHEELER
   Sumatrina annae VOLZ
   Verbeekina verbeeki (GEINITZ)
   Schwagerina sp., cfr. *S. gümbeli* DUNBAR & SKINNER
   Schwagerina sp.
   Climacammina sp.
   and some others,

2. Limestone at loc. M36 (Kompong Awah Quarry)
   Yabeina asiatica ISHII, sp. nov.
   Neoschwagerina cheni SHENG
   Neoschwagerina douvillei OZAWA
   Neoschwagerina sp.
   Sumatrina annae VOLZ

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* Contribution from the OCUSEA 1964-65, No. 8.

Verbeekina verbeeki (GEINITZ)
Kahlerina sp.
Staffella sp.
Dunbarula ? sp.
Pachyphloia sp.
Tetrataxis sp.
Climacammina sp.
Hemigordiopsis sp.
Glomospira sp.
and some others.

Yabeina asiatica (pl. V, figs. 1, 2, 5, 6) is the important fossil to decide the horizon of Jengka Pass and Kompong Awah Quarry limestones. This species resembles *Neoschwagerina douvillei* morphologically and its morphological characters show intermediate elements between *Neoschwagerina douvillei* and *Yabeina multiseptata* as will be discussed in this paper.

In Japan the Middle Permian is divided into the Zone of *Neoschwagerina* (below) and the Zone of *Yabeina*. The upper part of the Zone of *Neoschwagerina* is represented by *Neoschwagerina douvillei–N. margaritae* subzone, and the Zone of *Yabeina* is divided into two subzones at Atetsu, Southwest Japan, (NOGAMI, 1961) ; the lower part is the *Y. multiseptata shiraiwensis–Y.* sp. A subzone and the upper part is the *Y. multiseptata shiraiwensis* subzone. In the *Y. multiseptata shiraiwensis–Y.* sp. A subzone *Yabeina* is associated with a few species of *Neoschwagerina* occuring the *N. douvillei–N. margaritae* subzone. Although many fusulinids from the above-mentioned two localities resemble those of the *N. douvillei–N. margaritae* subzone of Japan, *Yabeina asiatica* belongs the primitive form of the genus *Yabeina* and may be most probably evoluted from *N. douvillei*. *Y. asiatica* has not been found from Japan hitherto.

The writer has discovered. *Y. asiatica* from the lowest part of the *Yabeina* limestone in Western Cambodia, where he divided this limestone into three fusulinid zones, viz. (from below), the *Y. asiatica–Sumatrina annae longissima* zone, the *Y. multiseptata–S. annae longissima* zone and the *Y. multiseptata* zone (ISHII, 1966). The fusulinid assemblage of the Jengka Pass and Kompong Awah Quarry limestones of Malaya closely resembles that of the *Y. asiatica–S. annae longissima* zone of Cambodia.

Yabeina sp. cfr. *Y. columbiana* (pl. VI, fig. 1) is more advanced form than *Y. asiatica* and is compared with *Y. columbiana* occuring commonly in the Zone of *Yabeina* of Japan.

The shell character of *Neoschwagerina douvillei* (pl. V, fig. 4) from Malaya closely resembles that of *N. douvillei*, which occurs dominantly in the *N. douvillei* subzone, the upper part of the Zone of *Neoschwagerina* in Akiyoshi (OZAWA, 1925, TORIYAMA, 1954) and the equivalent in other districts of Japan. Although *N. douvillei* resembles *Y. asiatica* in some respects, they are specifically distinct from each other, as will be discussed in the description of *Y. asiatica*.

Neoschwagerina sp. (pl. V, figs. 5, 6) from Malaya resembles a certain specimen of *N. margaritae* in NOGAMI (1961, pl. 4, fig. 4), which is associated with *N. cheni*, *N. margaritae* (typical specimens), *N. douvillei* and *S. annae* in the *N. douvillei–N. margaritae* subzone of Atetsu, Japan. However, the Malayan specimens

are smaller and less inflated than the NOGAMI's specimen as well as the holotype of *N. margaritae* DEPRAT from Tonkin.

Neoschwagerina cheni (pl. V, fig. 3) can be surely identified with the holotype from the Maokou limestone of Northwest China (SHENG, 1958) and the specimens from the *N. douvillei–N. margaritae* subzone of Atetsu, Japan.

Sumatrina annae has been found in the upper part of the Zone of *Neoschwagerina* and *S. longissima* has been found from the upper part of the Zone of *Neoschwagerina* to the lower part of the Zone of *Yabeina* (the *Y. m. shiraiwensis–Y.* sp. A subzone) in Japan. There is no sufficient morphological feature which enables one to separate *S. annae* from *S. longissima*, as the morphological feature changes gradually from the variety with smaller form ratio (*S. annae* type) to another with larger form ratio (*S. longissima* type) as a result of examination of a lot of specimens of *Sumatrina*. Therefore, as pointed out by HANZAWA (1954, p. 8), it is better to regard *S. longissima* as a subspecies of *S. annae*, although the type specimen of *S. longissima* has a slender form and slightly smaller proloculus than that of *S. annae*. Malayan specimens (pl. VI, figs. 10, 11) may be intermediate form between *S. annae* and *S. longissima*.

Verbeekina verbeeki occurs commonly in the Zone of *Neoschwagerina* and the Zone of *Yabeina* in Asia (pl. VI, fig. 9).

Other smaller foraminifera in these limestones resemble closely those occuring commonly in the Middle and Upper Permian of Japan, Cambodia and Cyprus, but are not useful for the determination of more detailed age.

Considering these facts, especially the appearence of primitive *Yabeina*, it is concluded that limestones at Kompong Awah Quarry and at Jengka Pass should best be correlated to the lower part of the Zone of *Yabeina* in Japan, China and other districts of Southeast Asia.

Recently, IGO (1963) described several fusulinids from Ulu Sungei Atok in Pahang. *Yabeina* cfr. *tobleri** in IGO may be considered as a synonym of *Y. asiatica*, although unfortunately fossils of Ulu Sungei Atok is not well preserved. The *Yabeina* limestone of Ulu Sungei Atok is correlated with the *Y. asiatica* limestone of the above two localities by the presence of *Y. asiatica*. The assemblage of other foraminifera is also resembling among these localities

Description of Fusulinids

Family Fusulinidae MÖLLER, 1878

Subfamily Neoschwagerininae DUNBAR & CONDRA, 1928

Genus *Yabeina* DEPRAT, 1914

Yabeina asiatica ISHII, new species

(Plate V, Figs. 1, 2, 5, 6)

? *Yabeina* sp., cfr. *Yabeina tobleri* (LANGE), IGO, 1963, Japan. Jour. Geol. Geor.

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* ISHII & NOGAMI (1964) considered *Y. tobleri* (LANGE) to be conspecific with *Y. multiseptata* (DEPART).

vol. 34, p. 64, 65, pl. 2, fig. 4.

Description :—Shell medium sized, inflated fusiform. Inner 2 or 3 volutions spherical or subspherical, and beyond 5th volution shell form resembles its mature shape. Mature specimens of 13½ volutions to 15½ volution are 4.9 to 5.9 mm long and 3.3 to 5.0 mm wide ; form ratio 1.2 to 1.5.

Proloculus moderate ; its outside diameter 197 to 344 microns. Height of volution increasing rather rapidly.

Spirotheca thin, composed of a tectum and a keriotheca with very fine alveoli. Thickness of spirotheca 20 to 29 microns in all stages but seems to be slightly small in later stage. Septa, axial septula and transverse septula present throughout shell and slender. Axial septula appear from 2nd or 3rd volution ; there are commonly 2–3 septula in 5th volution, 4 rarely 6 septula in 8th volution and 5–6 septula in 10th volution. Septa and primary transverse septula are slender and are consolidated in their one half.

Secondary transverse septula appear rarely from 5th volution or 7th volution, and become distinct in 10th to 11th volution, there is commonly septulum between two adjacent primary ones ; there are very rarely 2 septula in 14th or 15th volution. Secondary transverse septula are low in comparison with broad bases in early and middle stage and they are in embryo of the development of secondary transverse septula.

Foramina small in cross section. Parachomata small, semicircular in cross section.

Material :—Holotype, Reg. no. PF 1446, loc. M36, Kompong Awah Quarry ; PF 1445, loc. M40, Jengka Pass ; PF 1447, loc. ditto. All specimens are deposited in Department of Geosciences, Osaka City University.

Remarks :—This species are associated with the advanced species of *Neoschwagerina* such as *N. douvillei*, *N. cheni* and *N.* sp. from Malaya.

This species resembles *N. douvillei* in the shell form, proloculus size and comparatively slender septa and septula. However, the former can be distinguished from the latter in the appearance of the distinct secondary transverse septulu in the middle and later stages of individual development.

While the above shell characters of this species resemble also those of *Yabeina multiseptata*, this species is easily distinguishable from *Y. multiseptata* in the later appearance of the secondary transverse septula than *Y. multiseptata*. Furthermore, the former has the smaller size of proloculus, thicker spirotheca, smaller number of volution and thicker septa and septula than that of the latter.

This species is regarded as the intermediate form between *Neoschwagerina douvillei* and *Y. multiseptata* in the morphological feature.

Occurrence :—This species occurs abundantly in Jengka Pass limestone and Kompong Awah Quarry along Temerloh–Maran Road in Pahang, Malaya.

Horizon :—This species was discovered also in the lowest part of the *Yabeina* limestone of Cambodia by ISHII. There the appearance of this species is earlier than that of *Y. multiseptata*. Therefore this species indicates the age of the lower part of the upper Middle Permian (the lowest part of the Zone of *Yabeina*) (ISHII, 1966).

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Table 1. Measurements of *Yabeina asiatica* Ishii, sp. nov.

Specimen	Pl. Fig.	L.	W.	R.	P.	Radius vector (mm)													
						1	2	3	4	5	6	7	8	9	10	11	12	13	14
PF 1446*	V. 5	5.043	4.182	1.2	.246	.164	.246	.344	.361	.574	.738	.885	1.049	1.213	1.476	1.640	1.845	2.050	
PF 1445	V. 2	5.863	4.961	1.2	.279	.230	.344	.426	.541	.672	.787	.967	1.131	1.295	1.517	1.722	1.927	2.173	2.149
PF 1447	V. 1	5.248	3.895?	1.3	.262	.197	.262	.377	.458	.557	.672	.787	.934	1.098	1.271	1.476	1.681	1.886	

Specimen	Form ratio of volution													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PF 1446*	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	
PF 1445	1.1	1.1	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.2?
PF 1447	1.0	1.1	1.1	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	?	

Specimen	Height of volution (mm)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PF 1446*	.066	.082	.098	.114	.131	.148	.180	.164	.164	.197	.197	.197	.197	
PF 1445	.082	.098	.082	.114	.114	.131	.164	.164	.164	.197	.197	.213	.262	.230
PF 1447	.082	.082	.098	.098	.114	.114	.131	.148	.164	.180	.164	.213	?	

* Holotype ; L. Length (mm) ; W. width (mm) ; R. ratio of length to width ; P. proloculus diameter (mm)

Plate V

Explanation of Plate V

Yabeina asiatica ISHII sp. nov.

Figs. 1, 2. Axial sections, loc. M40, Jengka Pass along the Temerloh-Maran Road in Pahang, Malaya, Reg. no. PF 1447 ; PF 1445, × ca. 10.

Fig. 5. Axial section of the holotype, loc. M36, Kompong Awah Quarry near Kompong Awah on Temerloh-Maran Road in Pahang, Malaya, Reg. no. PF 1446. × ca. 10.

Fig. 6. Enlarged part of Fig. 1, × ca. 60.

Neoschwagerina cheni SHENG

Fig. 3. Axial section, loc. M36. Reg. no. PF 1453, × ca. 10.

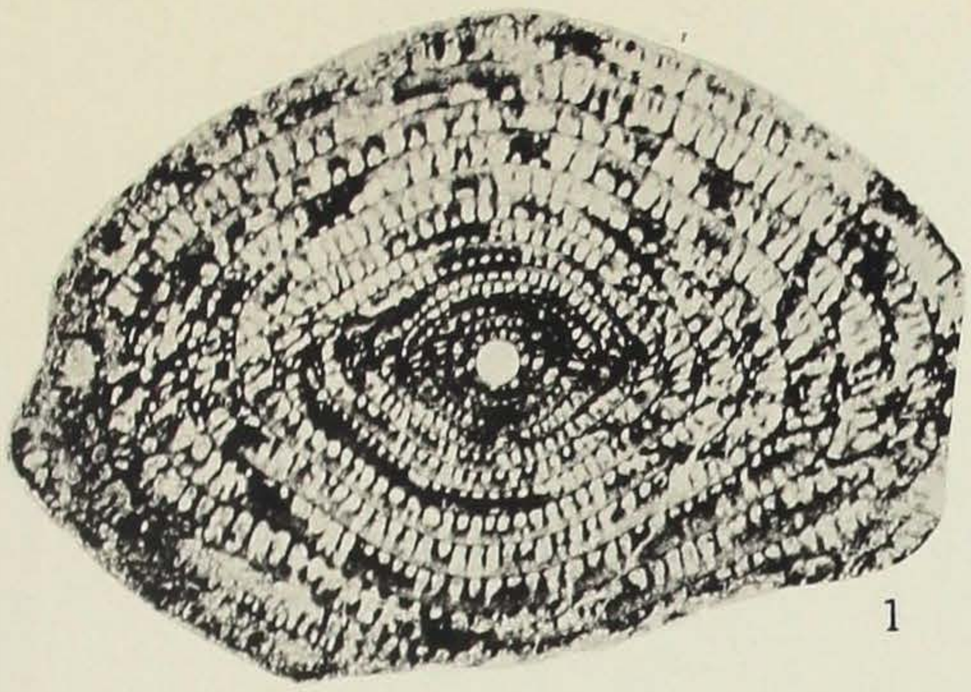
Neoschwagerina douvillei OZAWA

Fig. 4. Axial section, loc. *ditto.*, Reg. no. PF 1448, × ca. 10.

Neoschwagerina sp.

Figs. ~~5~~ 7, ~~6~~ 8. Tangential sections, loc. *ditto.*, Reg. no. PF 1451 ; PF 1452, × ca. 10.

Photos by ISHII



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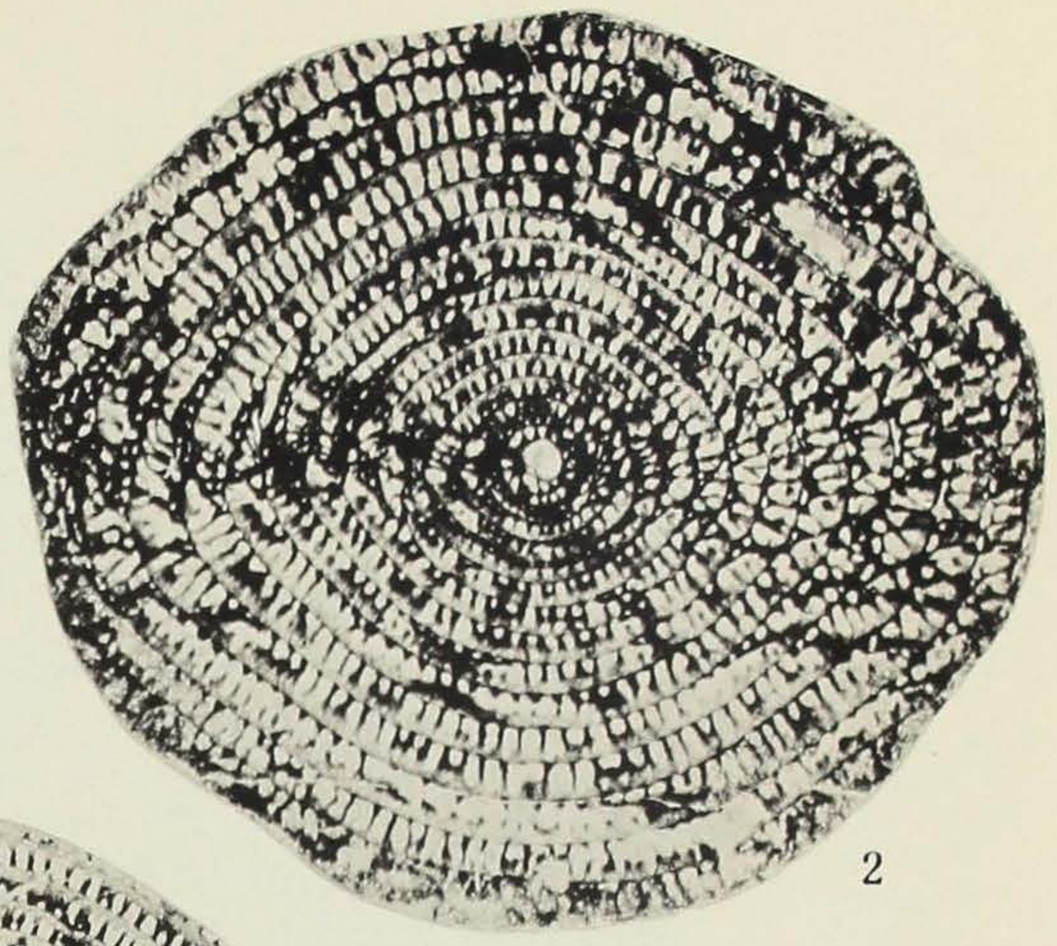

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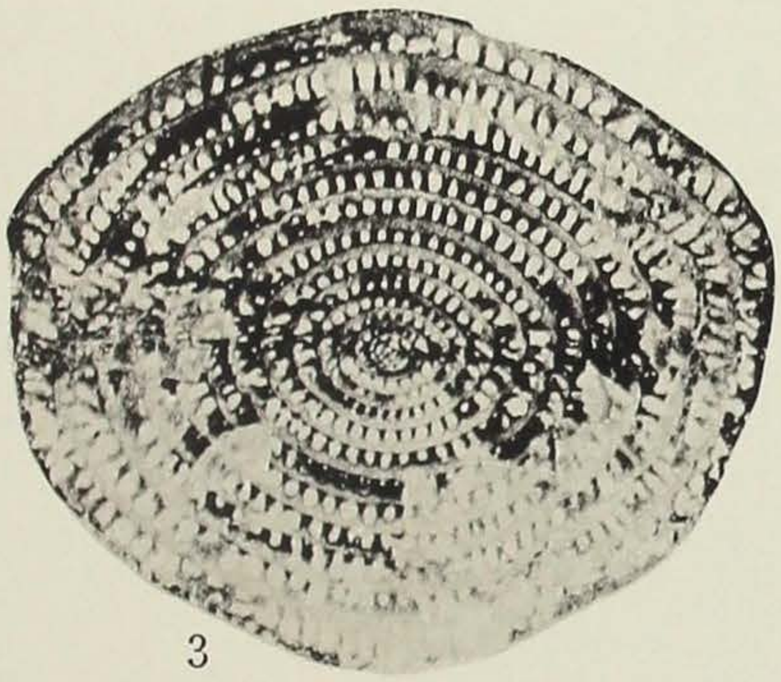

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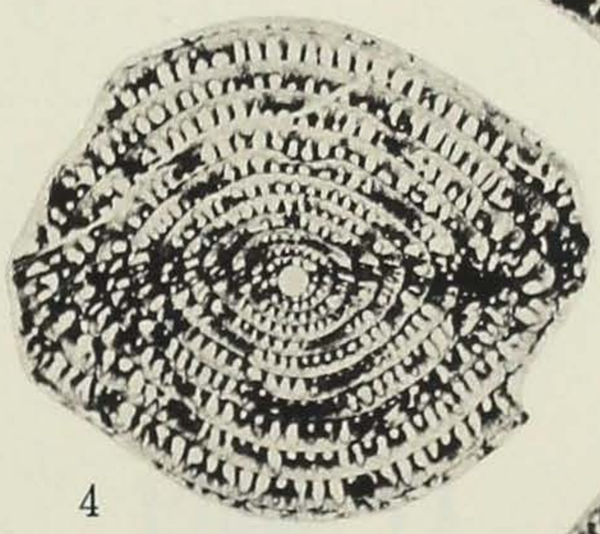

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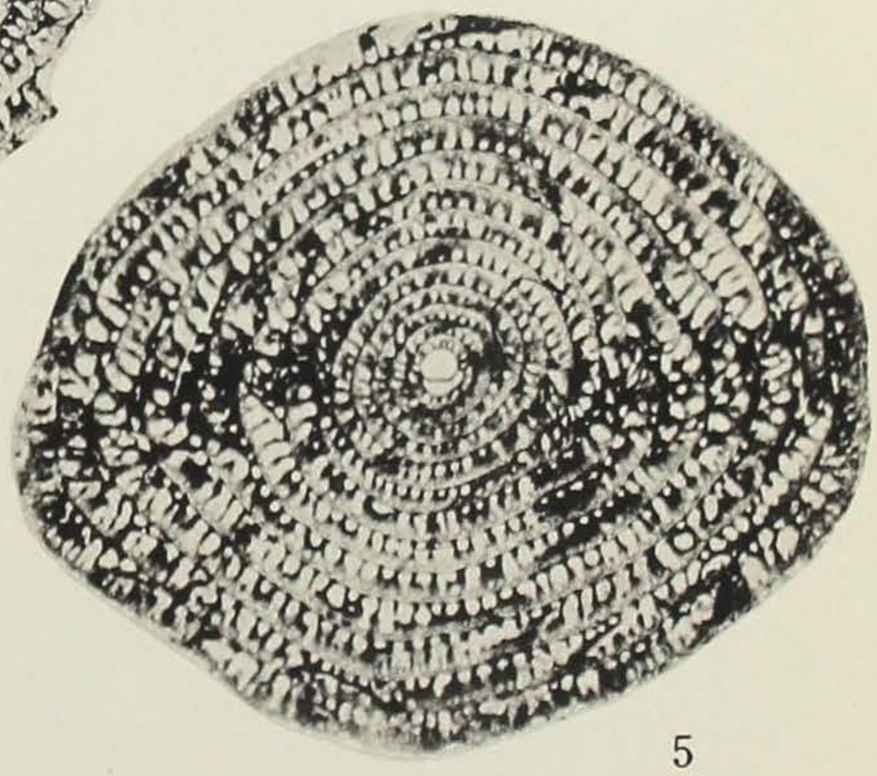

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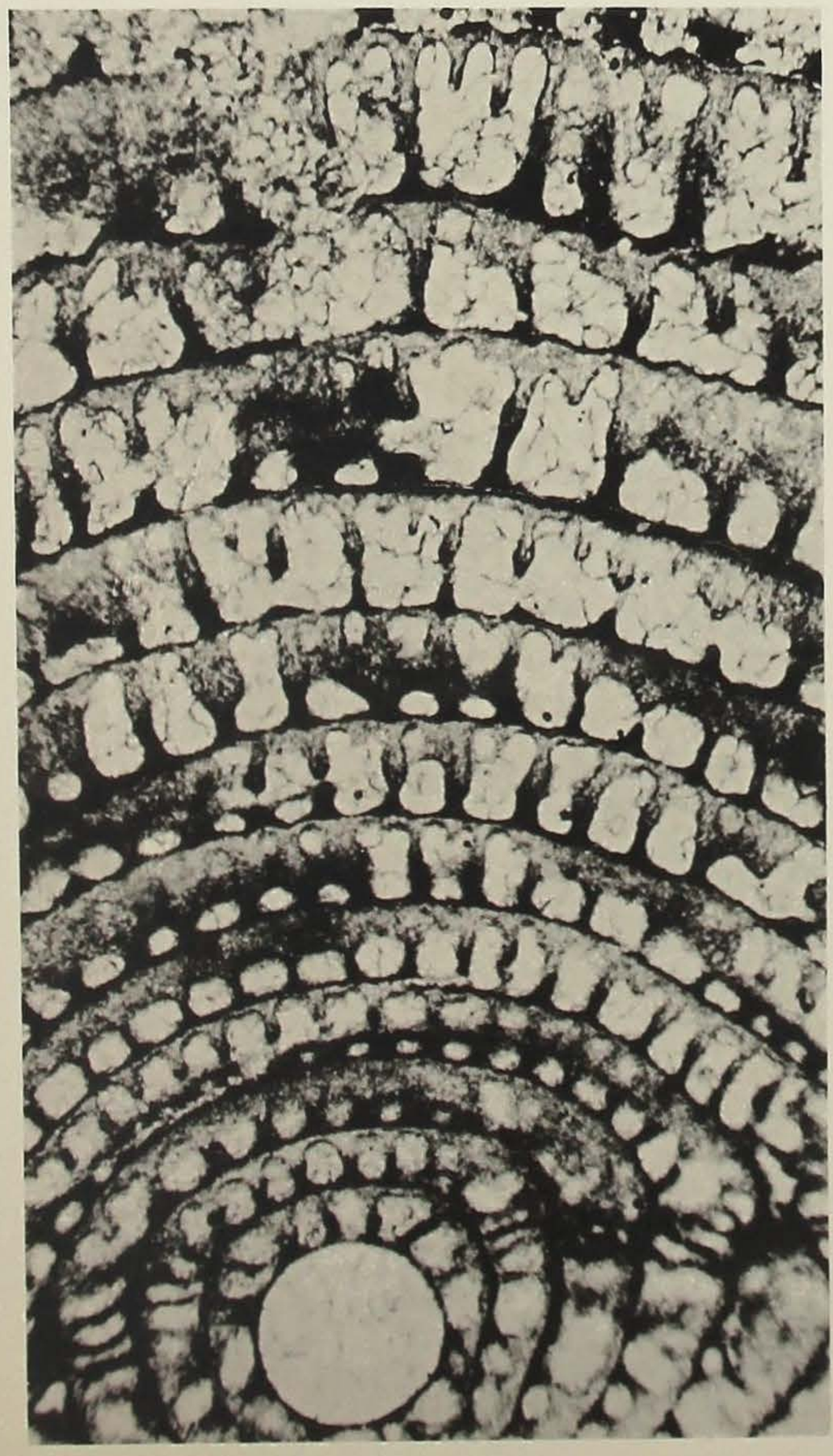

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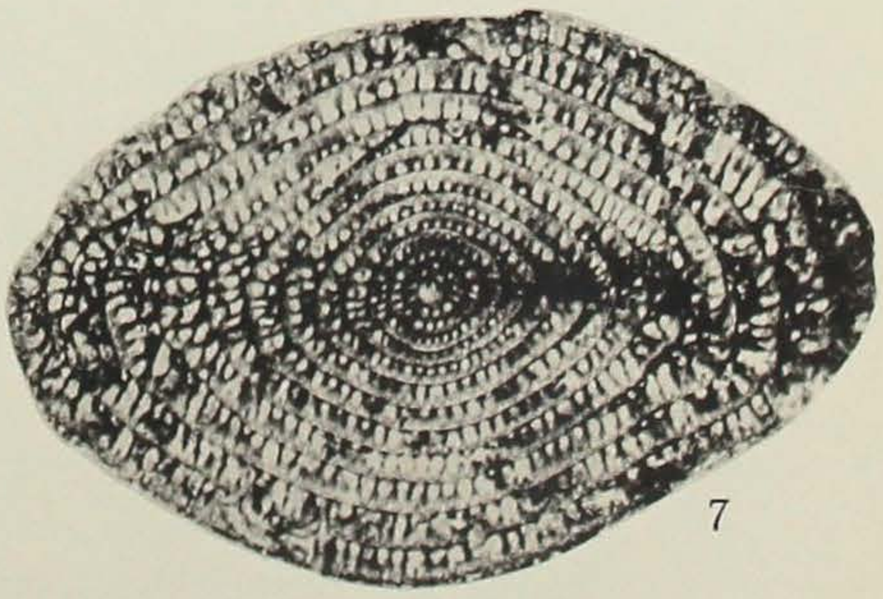

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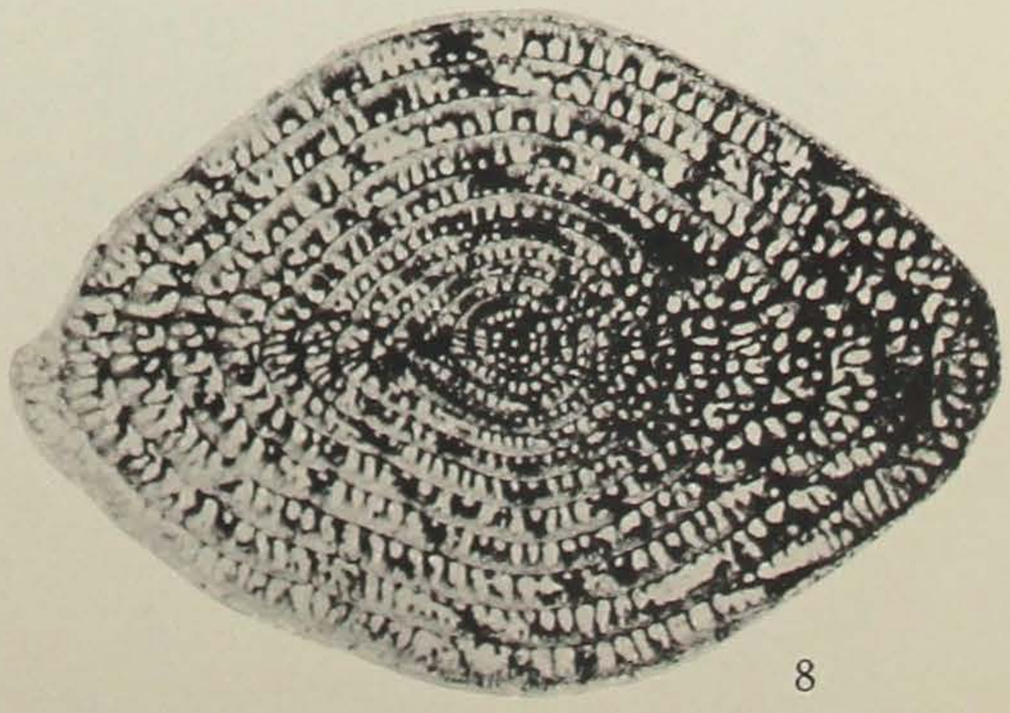

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Plate VI

Explanation of Plate VI

Yabeina sp., cfr. *Y. columbiana* THOMPSON & WHEELER

Fig. 1. Oblique section, loc. M40, Jengka Pass along the Temerloh-Maran Road in Pahang, Malaya, Reg. no. PF 1460, × ca. 10.

Kahlerina. sp.

Fig. 2. Axial section, loc. M36, Kompong Awah Quarry near Kompong Awah on Temerloh-Maran Road in Pahang, Malaya, Reg. no. PF 1470, × ca. 20.

Dunbarula ? sp.

Fig. 3. Oblique section, loc. *ditto*. Reg. no. PF 1469, × ca. 60.

Climacammina sp.

Fig. 4. Longitudinal axial section, loc. *ditto*. Reg. no. PF 1461, × ca. 15.

Schwagerina sp., cfr. *S. gümbeli* DUNBAR & SKINNER

Fig. 5. Axial section, loc. M40, Jengka Pass along the Temerloh-Maran Road in Pahang, Malaya, Reg. no. PF 1455, × ca. 10.

Pachyphloia sp.

Fig. 6. Transverse section, loc. M36, Kompong Awah Quarry near Kompong Awah on Temerloh-Maran Road in Pahang, Malaya, Reg. no. 1456, × ca. 30.

Fig. 7. Oblique longitudinal section, loc. *ditto*. Reg. no. PF 1457, × ca. 30.

Fig. 8. Lateral section, loc. *ditto*. Reg. no. PF 1458, × ca. 30.

Verbeekina verbeeki (GEINITZ)

Fig. 9. Axial section, loc. *ditto*. Reg. no. 1450, × ca. 10.

Sumatrina annae VOLZ

Figs. 10, 11. Axial sections, loc. M40, Jengka Pass along the Temerloh-Maran Road in Pahang, Malaya, Reg. no. PF 1454 ; PF 1449, × ca. 10.

Hemigordiopsis sp.

Fig. 12. Axial section, loc. M36, Kompong Awah Quarry near Kompong Awah on the Temerloh-Maran Road in Pahang, Malaya, Reg. no. PF 1459 × ca. 15.

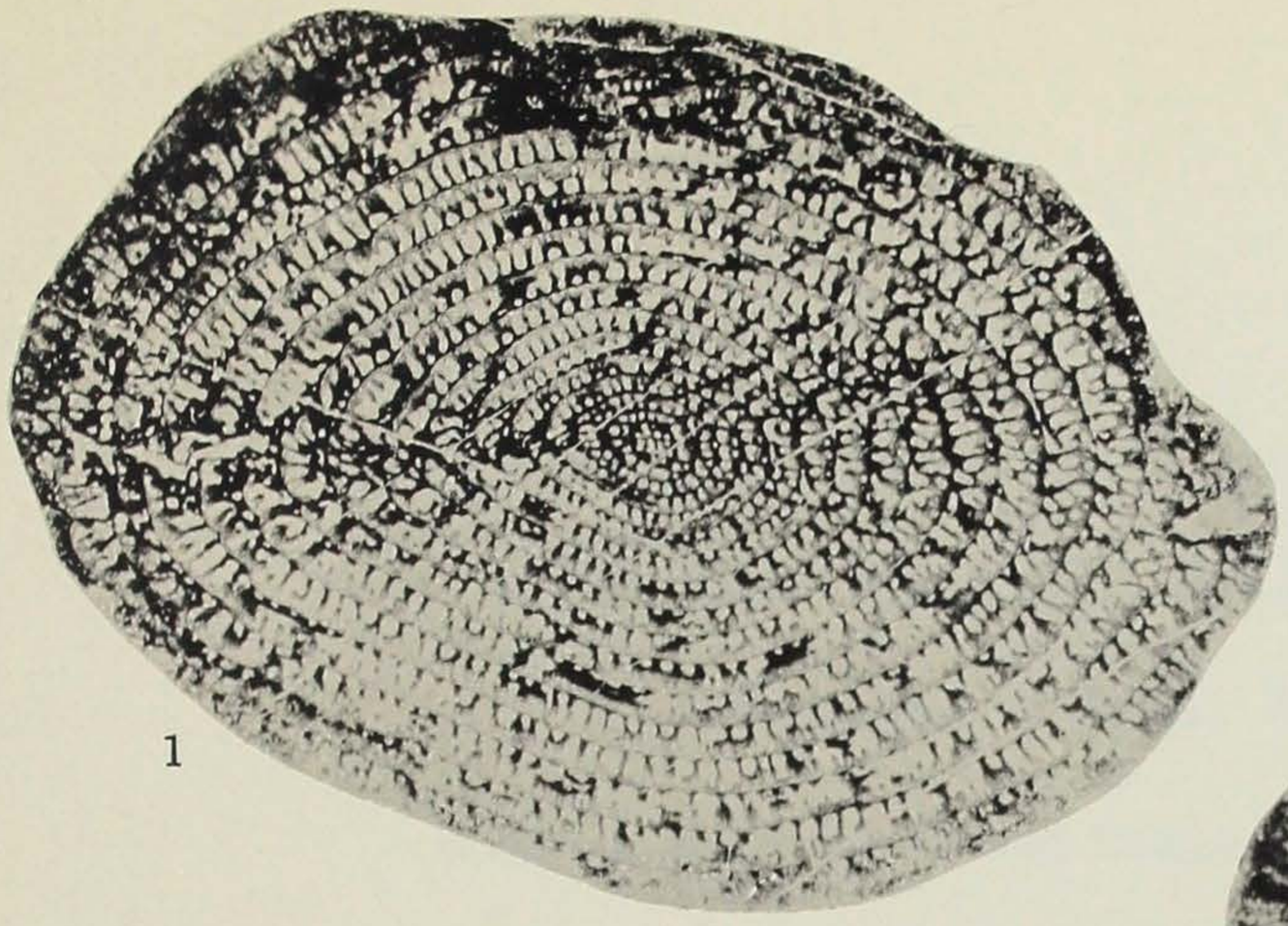
Glomospira sp.

Fig. 13. Axial section ? loc. *ditto*. Reg. no. PF 1463. × ca. 30.

Tetrataxis sp.

Fig. 14. Longitudinal axial section, loc. *ditto*. Reg. no. PF 1462, × ca. 30.

Photos by ISHII



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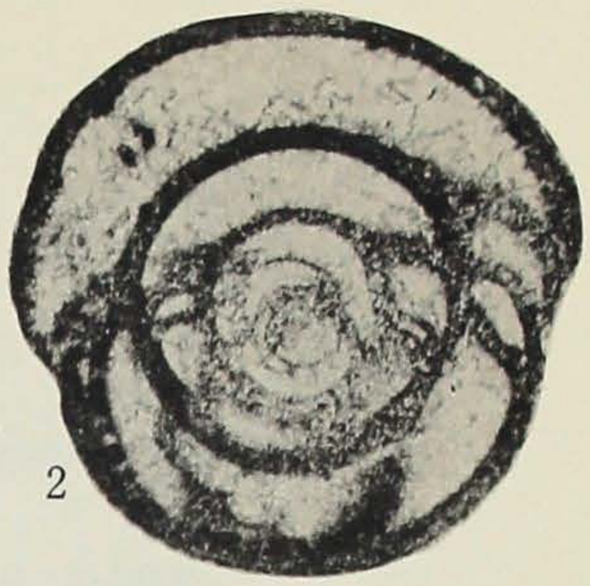

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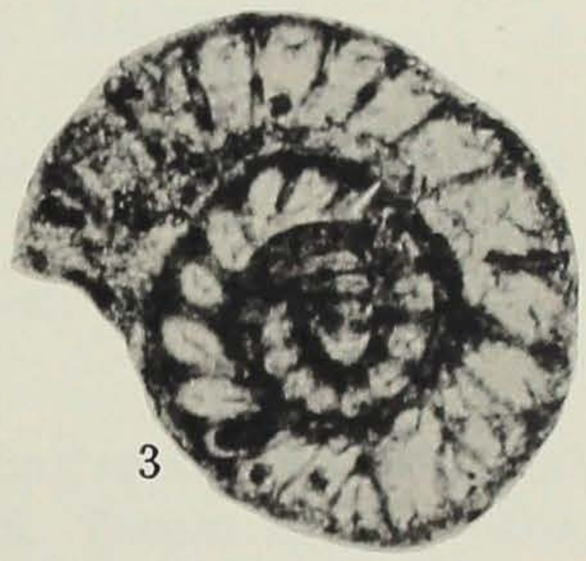

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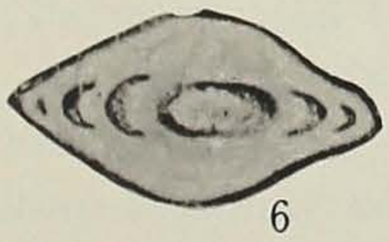

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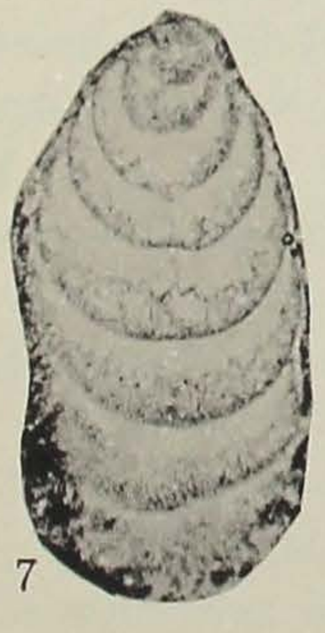

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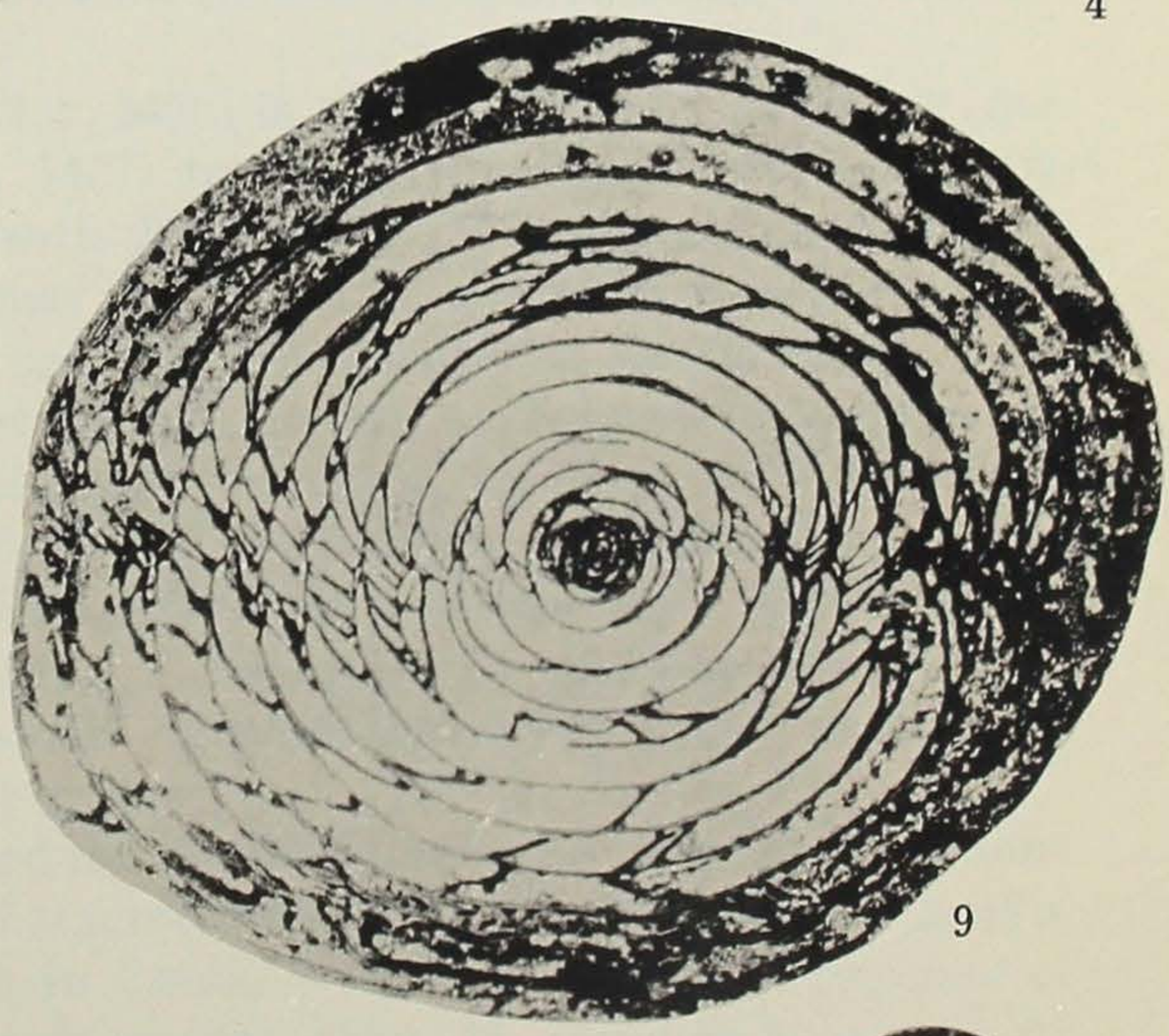

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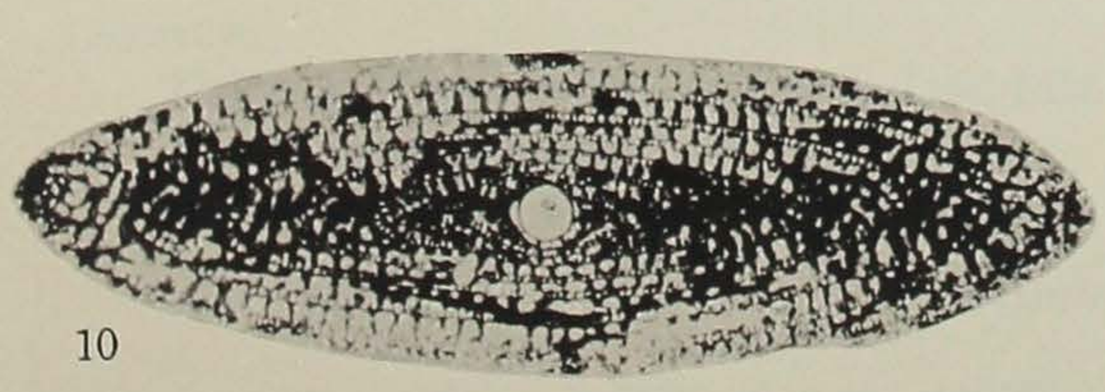

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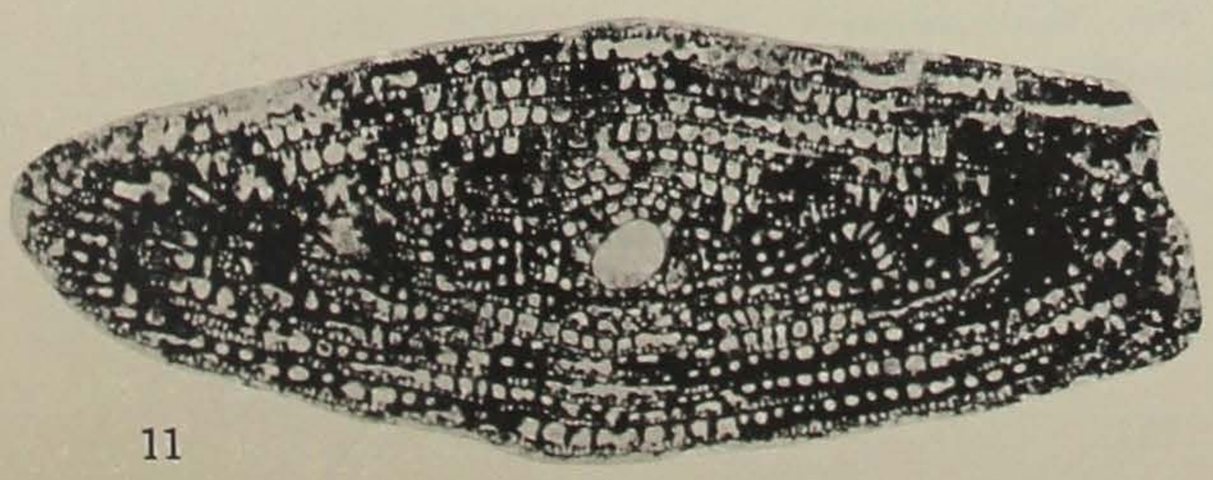

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