REPORT No. 191

GEOLOGICAL SURVEY OF JAPAN

STUDIES OF PERMIAN FUSULINIDS IN THE EAST OF LAKE BIWA, CENTRAL JAPAN

By

Rokuro MORIKAWA & Hiroshi ISOMI

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Abstract

This paper concerns the paleontology of the fusulinids collected by the junior author, during 1951~1952, from the limestones distributed in the area of the Geological Map of Japan, Scale 1:50,000, "Ominagahama" Sheet.

Fusulinids described and illustrated in this report contain one previously described species of *Minojapanella*, one new species of *Schubertella*, an unnamed form of *Yangchienia*, an unnamed form of *Codonofusiella*, one new species of *Biwaella* gen. nov., one previously described species of *Pseudoschwagerina*, four known species of *Paraschwagerina*, one new and eleven previously described species of *Pseudofusulina*, one new species *Nagatoella*, one previously known and three new species of *Parafusulina*, one previously known species of *Misellina*, one previously known species of *Pseudodoliolina*, an unnamed form of *Verbeekina*, and two previously described and an unnamed forms of *Neoschwagerina*. These fossils belong to the zones of *Pseudoschwagerina* (early Permian) and *Parafusulina-Neoschwagerina* (middle Permian).

I. Introduction

The late Paleozoic rocks distributed in the east of Lake Biwa (around Mt. Ibukiyama) are rich in fusulinid limestones, and have been stratigraphically studied by many geologists. Especially T. Seki (1938, 1939) and T. Yamada and H. Fujimoto (1951) studied these fusulinid fossils, but did not describe them. H. Hujimoto's report (1941) on *Pseudoschwagerina* from Samegai was the only contribution of paleontological interest, till the recent publication of M. Kobayashi's work (1957) on the fusulinids from the limestone of Mt. Ibukiyama.

H. Isomi, the junior author of this paper was engaged in a geological and stratigraphical research of this district during 1951~1952, and collected numerous fusulinid fossils. His geological results obtained were reported at some length in the geological map of Japan, scale 1:50,000 Ominagahama sheet and its explanatory text in 1956. However, the fusulinids collected by him were left undescribed.

We studied these fusulinids from the localities except Mt. Ibukiyama, and recognized many interesting species. These fusulinids indicate two fusulinid zones, namely, the zone of *Pseudoschwagerina* (early Permian) and of *Parafusulina-Neoschwagerina* (middle Permian). Among them, the following forms were discriminated; one new species of *Schubertella*, a form of *Yangchienia*, one previously described species of *Minojapanella*, a form of *Codonofusiella*, one new species of *Biwaella*, one previously

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Fig. 1 Index Map
Rectangle denotes the area of the Permian yielding the studied fusulinids.

described species of *Pseudoschwagerina*, four known species of *Paraschwagerina* including *Acervoschwagerina*, two new and eleven previously known species of *Pseudofusulina*, one new species of *Nagatoella*, one previously known and three new species of *Parafusulina*, one previously described species of *Misellina*, one previously known species of *Pseudodoliolina*, a form of *Verbeekina*, and two previously described and an unnamed forms of *Neoschwagerina*. These species will be described in the present report.

We wish to express our hearty thanks to Dr. Riuji Endo, President of the Saitama University, and Dr. Haruyoshi Fujimoto, Professor Emeritus of the Tokyo University of Education, for their continuous encouragements. Their thanks also due to Dr. Kotora Hatai, Professor of the Tohoku University for reading of this manuscript.

II. Summary of the Stratigraphy

Paleozoic strata of this area are divided into two major complexes of distinctive facies, namely the calcareous and the non-calcareous. Both are synchronous with each other, however, they are separated by major tectonic lines.

I. The non-calcareous complex

This complex, which is distributed extensively in the northern mountainland and the southern hills within the area under question, is generally unfossiliferous except for the occurrence of sporadic limestones.

It is folded and faulted complicatedly into many blocks, thus making the correlation between the blocks very difficult. However, on the general lithofacies and structural feature, this complex is divided into many formations of local extention as follows:

A. The eastern part of the northern mountainland:
Kasuga group (unfossiliferous)
Kasukawa formation (slightly fossiliferous, middle Permian)
Oishi formation (fossiliferous, early Permian)
Otaki formation (fossiliferous, middle Carboniferous)

B. The middle part of the northern mountainland:
Ashimatagawa group (unfossiliferous)
Itanami group (unfossiliferous)

C. The western part of the northern mountainland:
Kusanogawa group (fossiliferous, early to middle Permian)

D. The southern hills:
Matsuoyama formation (unfossiliferous)

Among the strata above mentioned, the middle Carboniferous Otaki and the early Permian Oishi formations in the eastern part (A) and the early Permian Kusanogawa group in the western part (C) contain some fusulinid limestones. Others lack age indicators, however, their probable Permian age is safely concluded from the stratigraphical features.

In the present report, the fusulinids of the Kusanogawa group will be treated, along with ones of the calcareous complex.

II. The calcareous complex

This complex occupies a rather wide area in the southwest, and constitutes the ridge of Mt. Ibukiyama in the north.

The lowermost division of the complex is the Kiyotaki formation, composed of predominant chert and interbedded clayslate. This formation is non-fossiliferous.

The lower division is named the Samegai formation. It is composed mainly of basic pyroclastics with many lenticules or beds of limestone. The limestone yields *Pseudoschwagerina, Paraschwagerina, Pseudofusulina* etc. in abundance. These fossils indicate the early Permian age.

The Onogi formation, the Ishida formation and the lower part of the Ibukiyama limestone formation are characterized by the shale facies, by the chert facies, and by the limestone facies, respectively. They constitute the middle division of the complex, and are almost contemporaneous with each other. The Onogi formation contains limestone. The limestone which belongs to the Ibukiyama limestone formation and the Onogi formation yields abundantly fusulinids. Among them, *Parafusulina* is dominant in some limestones, however, *Pseudofusulina* is predominant in the others. Besides them, some primitive forms of *Neoschwagerina* are found. So, the geological age is early to middle Permian. The Ishida formation is unfossiliferous.

The Ibukiyama limestone formation exhibits the most typical limestone facies. The upper division of the calcareous complex is observed only in the upper part of the Ibukiyama limestone formation, which forms the high steep ridge of Mt. Ibukiyama. The fusulinids from Mt. Ibukiyama are left outside the scope of our study.

Lately, the Ibukiyama limestone is divided by M. Kobayashi (1957) into four zones, two of which are in turn subdivided into two subzones, as follows:

Yabeina zone ..... *Yabeina* subzone

Neoschwagerina zone ..... { *Neoschwagerina margaritae* subzone / *Neoschwagerina craticulifera* subzone

Parafusulina zone ..... { *Parafusulina sapperi* subzone / *Pseudofusulina ambigua* subzone

Pseudoschwagerina zone ..... *Paraschwagerina* (*Acervoschwagerina*) subzone

III. Faunal Summary

Fusulinids are contained in the Kusanogawa group belonging to the non-calcareous complex and in the formations of the calcareous complex.

Nearly all fusulinids from the Kusanogawa group represent the early Permian (zone of *Pseudoschwagerina*) but *Neoschwagerina nipponica* occurs in the limestone of Ikenooku, accordingly some parts of the Kusanogawa group may correspond to the middle Permian*.

The Samegai formation yields abundant fusulinids of the early Permian (*Pseudoschwagerina* zone), i.e., *Schubertella yadaniensis* n. sp., *Minojapanella elongata*, *Biwaella omiensis*, *Pseudoschwagerina* (*Zellia*) *nunosei*, *Paraschwagerina akiyoshiensis*, *Paras.* aff. *kansasensis*, *Paras. gigantea*, *Paras.* (*Acervoschwagerina*) *endoi*, *Pseudofusulina okafujii*, *Psf. bacca* n. sp., *Psf. regularis*, *Psf. vulgaris*, *Psf. globosa*, *Psf. cushmani*, *Psf. krotowi*, *Psf. fusiformis*, *Psf. kraffti*, *Psf. norikurensis*, and *Misellina ibukiensis*.

As above cited, many species of *Pseudofusulina* are abundant in number and associated with *Pseudoschwagerina* and *Paraschwagerina*.

The early Permian limestone of the Samegai formation is located at many places as follows: Sukawa, Muraki, Manganji, Nagaoka, Hongo, Yadani, Minamitoba, Horibe, Itando, and Kaigome.

The Onogi formation is also rich in fusulinid fossils. As a whole, the faunal assemblage of the Onogi formation is the same as that of the Samegai formation. However, in a part of the limestone at Onogi, *Neoschwagerina rotunda* is found in abundance. Therefore, a part of the Onogi formation may belong to the *Parafusulina-Neoschwagerina* zone.

From the limestone at Iwasayama, which belongs to the lower part of the Ibukiyama limestone formation, many fusulinids of the middle Permian age were collected: *Yangchienia* sp., *Codonofusiella* sp., *Pseudofusulina lepida*, *Parafusulina exilis*, *Paraf. parakinosakii*, n. sp., *Paraf. takeyamai*, n. sp., *Paraf. iwasensis*, n. sp., *Pseudodoliolina ozawai*, *Verbeekina* sp., *Neoschwagerina* sp. (cf. *colaniae*), and *Neoschwagerina nipponica*. These fossils indicate the zone of *Parafusulina-Neoschwagerina*.

IV. Collection Localities

Kusanogawa group

Ikenooku (I):

Pseudofusulina regularis, *Nagatoella ikenoensis*, *Misellina ibukiensis*

Ikenooku (II):

Yangchienia sp., *Parafusulina* cf. *parakinosakii*, *Neoschwagerina nipponica*

Sengokudani:

Pseudofusulina vulgaris

Daimon:

Schubertella yadaniensis, *Biwaella omiensis*, *Pseudofusulina* sp.

* Besides this locality, some parts of the limestones of Kio, Taniguchi, Nosekura, and Sabutani rarely yield the primitive forms of *Neoschwagerina*, though few in number.

Onogi formation

Onogi (I):

Yangchienia sp., *Misellina ibukiensis*, *Neoschwagerina rotunda*

Onogi (II):

Schubertella sp., *Pseudofusulina* aff. *valida*, *Psf.* aff. *subtilis*, *Psf. okafujii*, *Psf. bacca*, *Psf. vulgaris*, *Psf. cushmani*, *Psf. fusiformis*, *Psf. kraffti*, *Psf. norikurensis*, *Misellina ibukiensis*

Lower part of Ibukiyama limestone formation

Iwasayama:

Yangchienia sp., *Codonofusiella* sp., *Biwaella omiensis*, *Pseudofusulina lepida*, *Parafusulina exilis*, *Paraf. parakinosakii*, *Paraf. takeyamai*, *Paraf. iwasensis*, *Verbeekina* sp., *Pseudodoliolina ozawai*, *Neoschwagerina nipponica*, *Neoschwagerina* sp. (cf. *colaniae*)

Iwakurayama:

Paraschwagerina gigantea, *Parafusulina parakinosakii*

Samegai formation

Sukawa:

Schubertella yadaniensis, *Paraschwagerina gigantea*, *Paras.* (*Acervoschwagerina*) *endoi*, *Pseudofusulina vulgaris*, *Psf. cushmani*, *Psf. fusiformis*, *Psf. kraffti*, *Psf. norikurensis*, *Misellina ibukiensis*

Muraki:

Pseudoschwagerina sp., *Pseudofusulina vulgaris*, *Psf. fusiformis*, *Psf. kraffti*, *Misellina ibukiensis*

Manganji:

Schubertella yadaniensis, *Paraschwagerina gigantea*, *Pseudofusulina okafujii*, *Psf. bacca*, *Psf. regularis*, *Psf. vulgaris*, *Psf. cushmani*, *Psf. krotowi*, *Psf. fusiformis*, *Psf. kraffti*, *Psf. norikurensis*, *Misellina ibukiensis*

Nagaoka:

Schubertella yadaniensis, *Biwaella omiensis*, *Pseudofusulina okafujii*, *Psf. bacca*, *Psf. vulgaris*, *Psf. cushmani*, *Psf. krotowi*, *Psf. fusiformis*, *Psf. kraffti*, *Psf. norikurensis*, *Misellina ibukiensis*

Hongo:

Schubertella yadaniensis, *Biwaella omiensis*, *Pseudoschwagerina* (*Zellia*) *nunosei*, *Paraschwagerina* (*Acervoschwagerina*) *endoi*, *Pseudofusulina okafujii*, *Psf. bacca*, *Psf. regularis*, *Psf. vulgaris*, *Psf. fusiformis*, *Psf. norikurensis*

Yadani:

Schubertella yadaniensis, *Biwaella omiensis*, *Paraschwagerina* (*Acervoschwagerina*) *endoi*, *Pseudofusulina vulgaris*, *Psf. cushmani*, *Psf. fusiformis*, *Psf. kraffti*, *Psf. norikurensis*

Minamitoba:

Minojapanella elongata, *Schubertella yadaniensis*, *Biwaella omiensis*, *Paraschwagerina* (*Acervoschwagerina*) *endoi*, *Pseudofusulina okafujii*, *Psf. vulgaris*, *Psf. globosa*, *Psf. cushmani*, *Psf. fusiformis*, *Psf. kraffti*

Horibe:

Paraschwagerina akiyoshiensis, *Pseudofusulina vulgaris*

Itando:

Pseudoschwagerina sp., *Paraschwagerina akiyoshiensis*, *Paras.* aff. *kansasensis*

Kaigome:

Pseudofusulina sp.

In the geological sheet map "Ominagahama" and its explanatory text by the junior author (ISOMI, H., 1956), each fossil locality is numbered. The place-names of the localities of fusulinids described in the present report correspond to those numbers, in the way as follows:

Locality names in the present report	Locality numbers in the geological sheet map "Ominagahama"
Ikenooku (I)	8,9
Ikenooku (II)	10
Sengokudani	2
Daimon	17,18
Onogi (I) }	41
Onogi (II) }	
Iwasayama	43,44
Iwakurayama	45
Sukawa	40
Muraki	39,38
Manganji	36,37
Nagaoka	34,35
Hongo	31,32,33
Yadani	28,29,30
Minamitoba	27
Horibe	23
Itando	21,22
Kaigome	20

Therefore, concerning the exact location of fusulinid-limestones, the reader is refered also to the geological sheet map "Ominagahama".

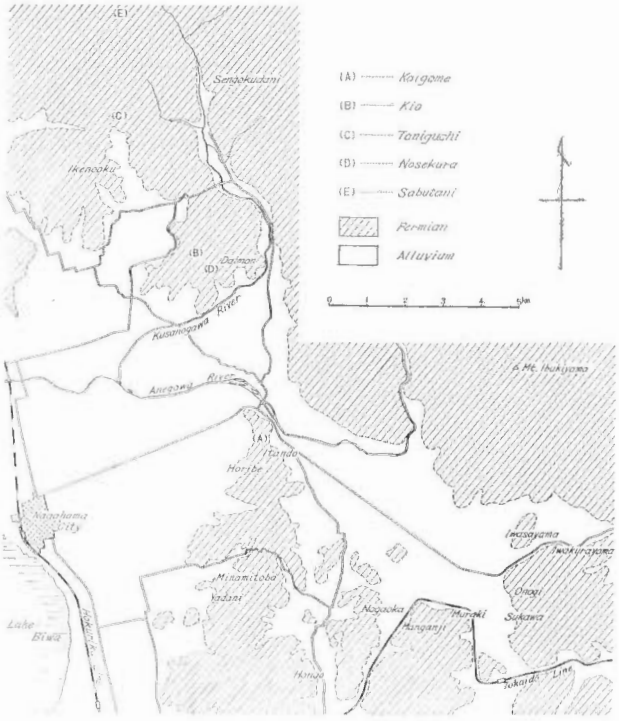

Fig. 2 Finding Map of the Localities of the Studied Fusulinids

V. Description of Species

Minojapanella elongata FUJIMOTO et KANUMA
(Plate II, Figures 10~15)

1953. *Minojapanella elongata*, FUJIMOTO et KANUMA; Jour. Paleontology, Vol. 27, No. 1, p. 152, Pl. 19, figs. 1–11

Description: Shell small, elongate fusiform, with almost straight to slightly shifting axis of coiling, sharply pointed poles, and slightly convex to concave lateral surfaces. Mature speciments of four to six volutions 1.8 to 2.8 mm long and 0.34 to 0.50 mm wide, with form ratios of 3.6 to 6.6. First volution elongate fusiform, and shell of closely similar shape throughout growth.

Proloculus small, with outside diameter of about 0.03 to 0.04 mm, commonly 0.04 mm. Shell remains tightly coiled throughout. Chambers almost uniform in height in central part of shell but become slightly higher as poles are approached. Average height of chambers above tunnel in first to fourth volution in seven specimens is 0.03, 0.06, 0.07 and 0.05 mm, respectively.

Spirotheca very thin and composed of a single dark and transparent layer. Average thickness of spirotheca less than 0.03 mm.

Septa closely spaced and highly fluted throughout length of shell. Fluting forms with closed-packed chamberlets for at least half height of chambers. Septa in some specimens seen less highly fluted across center of shell, other specimens show fluting extending completely to tops of chambers even at center of shell.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify.

Chomata low and discontinuous.

Axial deposit slightly fills chambers along axis from near middle to ends.

The measurements of this species are given in Table 1.

Remarks: *Minojapanella elongata* is characterized by the packed chamberlets. The present form is referable to the original type specimen.

Neofusulinella pseudoprisca COLANI 1924 (Pl. XXIX, fig. 18) associated with *Fusulina chamchitensis* COLANI may be refered to this species.

One unnamed specimen, *Neofusulinella* sp. α from Akasaka (OZAWA 1927, Pl. XXXVIII, fig. 1b) may be refered to *Minojapanella*.

Occurrence: *Minojapanella* is abundant at Minamitoba and is associated with *Schubertella yadaniensis*, *Paraschwagerina* (*Acervoschwagerina*) *endoi*, *Pseudofusulina cushmani*, *Psf. fusiformis* etc.

Schubertella yadaniensis MORIKAWA et ISOMI, n. sp.
(Plate II, Figures 1~9, 16)

Description: Shell minute, somewhat elongate fusiform, with straight, curved, or irregular axis of coiling, slightly inflated central region, convex lateral slopes, and blunt polar ends. Mature shells of four to five volutions 0.8 to 0.6 mm long and 0.5 to 0.6 mm wide, having form ratios of 1.3 to 2.7. First two volutions rather tightly coiled, axis of coiling perpendicular to that of outer volutions which expand rather rapidly.

Proloculus minute, spherical, with diameter ranging from 0.02 to 0.06 mm, commonly

0.04 mm. Height of chambers increases slowly to ultimate volution. Averages of chamber heights above tunnel in first to fifth volutions of eight specimens are 0.02, 0.05, 0.06, 0.08 and 0.12 mm, respectively. Chambers lowest above tunnel in outer two volutions, but increase in height sharply in polar regions.

Septa closely spaced, very thin, unfluted throughout, and almost normal to curvature of volutions.

Spirotheca very thin, composed of tectum and a lower less dense layer observed only in outer volutions of some specimens. Total thickness for both layers in axial sections of a few specimens, 0.02 to 0.03 mm in ultimate volution.

Tunnel moderately wide and about half as high as chambers in outer volutions. Chomata not evident in asymmetrical early part of shell but very prominent and highly asymmetrical in outer volutions, where they have steep to overhanging tunnel sides and low broad polar slopes. Average of tunnel angles in first to third volution 50, 60, and 70 degrees, respectively.

Measurements of this species are given in Table 2.

Remarks: The present species is characterised by its endothyroid juvenarium, thin spirotheca composed of tectum and lower less dense layer, and unfluted septa even in polar region.

Occurrence: This species is widely distributed in this area, especially in the zone of *Pseudoschwagerina*.

Yangchienia sp.
(Plate IX, Figures 12~14)

The specimens obtained from Iwasayama resemble LEE's original in form, size, massive chomata, fluted septa in the polar region and so on. However, its wall structure is too obscure for specific identification. The measurements are given in Table 3.

Codonofusiella sp.
(Plate XXI, Figure 19)

Codonofusiella was originally described by DUNBAR and SKINNER from the Capitan limestone and its equivalent rocks of the upper Guadalupian age of South-central United States. We collected only one *Codonofusiella* specimen from Iwasayama. However, the few number of specimens at hand does not permit specific identification.

Codonofusiella is associated with *Yabeina* and *Neoshwagerina* in other localities of Japan. Here, it is associated with *Neoschwagerina* and *Parafusulina*.

Biwaella omiensis MORIKAWA et ISOMI, n. sp.
(Plate I, Figures 1~16)

Description: Shell small, elongate fusiform, with straight, curved, or irregular axis of coiling, slightly inflated central region, convex to concave lateral slopes, and blunt to pointed polar ends. Shell of four to five volutions, 1.8 to 3.2 mm long and 0.5 to 0.9 mm wide, having form ratio of 2.1 to 4.2. Considerable variation in shell shape appears at maturity (short inflated shells associated with elongate, very slender shells —Pl. 1, fig. 1, 3). First two volutions only slightly involute, with deeply umbilicate polar ends and short axis of coiling disposed at large angles to later volutions. Poles beyond first volution become extended rapidly.

Proloculus minute, having outside diameter of 0.02 to 0.06 mm, commonly 0.04 mm. Height of chambers increases slowly to fourth volution, and in some specimens sharply in fourth or fifth volution. Average of chamber heights above tunnel in first to fifth volutions of 12 specimens, 0.03, 0.04, 0.06, 0.10 and 0.12 mm, respectively. Chambers lowest above tunnel in outer two volutions, but increase in height sharply in polar regions.

Septa closely spaced and unfluted throughout shell. Almost normal to curvature of volutions.

Spirotheca thin, composed of a tectum and a keriotheca observed only in outer volutions of some specimens. Total thickness for both layers in axial section of a few specimens, 0.03 to 0.04 mm.

Tunnel moderately wide and about half as high as chambers in other volutions. Chomata not evident in asymmetrical early part of shell but very prominent and highly asymmetrical in outer volutions, where they have steep to overhanging tunnel sides and low broad polar slopes. Average of tunnel angles in third volution 60–70°.

The measurements of this species are given in Table 4.

Remarks: The inner endothyroid juvenarium represents the characters of *Schubertella*, but the wall consisting of a tectum and a keriotheca is not seen in *Schubertella*. In the latter respect, this species is said to resemble *Triticites*. The distinctive features above mentioned characterize *Biwaella* MORIKAWA and ISOMI gen. nov.*.

Occurrence: Abundant in Minamitoba and Yadani, and rare in Nagaoka, Hongo, Daimon and Iwasayama.

Pseudoschwagerina (Zellia) nunosei HANZAWA
(Plate III, Figures 1~2)

1939. *Pseudoschwagerina (Zellia) nunosei* HANZAWA; Jap. Jour. Geol. Geogr., Vol. XVI, p. 72-73, Pl. IV, figs. 4-6

Description: Shell large, usually spherical, with rarely straight to slightly shifting axis of coiling, sharply pointed poles, and convex lateral surfaces. Large specimens of four to six volutions 7.0 to 7.9 mm long and 4.2 to 5.7 mm wide, giving form ratios of 1.3 to 1.9, First volution spherical, and shell remains closely similar throughout growth.

Proloculus rather large, with outside diameter of about 0.24 to 0.44 mm, averaging 0.30 mm for three specimens. Shell remains loosely coiled throughout. Chambers almost uniform in height in central two-thirds of length of the shell but become slightly high as poles are approached.

Spirotheca thick and coarsely alveolar in final volution, although alveoli indistinct in inner volutions. Septa thin and plane, their intervals in outer volutions about 0.6–0.8 mm.

Tunnel narrow with slightly irregular path. Lacking of chomata makes tunnel sides difficult to identify in all specimens.

Axial deposit not seen.

The measurements of this species are given in Table 5.

Remarks: This species is marked by its ellipsoidal shape, rapidly expanding volutions, large proloculus and thick spirotheca of outer volutions.

P. (Z.) nunosei resembles *Pseudoschwagerina muongthensis* from Akiyoshi and *P. miharanoensis* from Taishaku in its large proloculus. However, *P. (Z.) nunosei* is

* MORIKAWA, R. & ISOMI, H., 1960. A New Genus, *Biwaella*, *Schwagerina*-like *Schubertella*, Sci. Rep. Saitama Univ., Ser. B, Vol. III, No. 3, p. 301~305, Pl. 54

distinguished by its weaker septal fluting and thinner spirotheca from *P. miharanoensis* and from *P. muongthensis*. *P. muongthensis* also differs in its slightly stronger fluting of septa and in its slightly larger thickness of septa from *P. miharanoensis*.

Distinctive differences of *P.* (*Z.*) *nunosei*, *P. muongthensis* and *P. miharanoensis* are shown in the following table.

	P. muongthensis	*P. miharanoensis*	*P.* (*Z.*) *nunosei*
Thickness of spirotheca	thick	thick	thin
Septal fluting	become stronger <		

Occurrence: This species occurs at Hongo without other fusulinids.

Paraschwagerina akiyoshiensis TORIYAMA
(Plate III, Figures 3~5)

1958. *Paraschwagerina akiyoshiensis*, TORIYAMA; Mem. Fac. Sci., Kyushu Univ., Ser. D, Geology., Vol. VII, p. 155–158, Pl. 18, figs. 1–14

Description: Shell large, inflated fusiform, with nearly straight axis of coiling, bluntly pointed poles, and convex lateral surfaces. Specimens of six to eight volutions 7.0 to 7.05 mm long and 4.0 to 4.1 mm wide, giving a form ratio of 1.8. Inner two volutions subcylindrical fusiform, and shell becomes inflated fusiform towards outer volutions.

Proloculus small with outside diameter of about 0.03 to 0.12 mm. Inner three or four volutions relatively tightly coiled, but beyond third of fourth volutions shell expands very rapidly. Chambers almost uniform in height. Average height of chambers above tunnel in first to fifth volutions in three specimens is 0.05, 0.08, 0.16, 0.55 and 0.75 mm, respectively.

Spirotheca very thin and finely alveolar in outer volutions, although alveoli indistinct in inner three or four volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirotheca in first to fifth volution in two specimens is 0.01, 0.03, 0.04, 0.04 and 0.06 mm, respectively. Spirotheca from the sixth to eight volutions measures 0.10, 0.14 and 0.12 mm, respectively in one specimens.

Septa thin, closely spaced and highly, but irregularly fluted throughout length of shell. Fluting brings septa in contact with each other to top of chambers.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in specimens.

Chomata very slight even in inner volutions and indistinct in outer volutions.

Axial deposit not developed.

The measurements of this species are given in Table 6.

Remarks: Although the present from is not well preserved, it is characterized by its subglobular shape, small proloculus, rapid expanding of volutions and mode of septal fluting, so it is considered conspecific with TORIYAMA's original. This species can be distinguished by its subglobular shape from *Paraschwagerina* (*Acervoschwagerina*) *endoi*.

Occurrence: This species is common at Horibe and rare at Itando.

Paraschwagerina aff. *kansasensis* (BEEDE et KNIKER)
(Plate V, Figure 4)

1924. *Schwagerina kansasensis*, BEEDE et KNIKER; Texas Univ. Bull., 2433, p. 30–32, Pl. V, figs. 1–5; Pl. VIII, fig. 4
1928. *Schwagerina kansasensis*, DUNBAR et CONDRA; Nebraska Geol. Surv., Bull., 2, 2nd Ser., p. 117–119, Pl. 12, figs. 1–3
1936. *Paraschwagerina kansasensis*, DUNBAR et SKINNER; Jour. Paleontology, Vol. 10, No. 2, Pl. 11, figs. 4–5
1937. *Paraschwagerina kansasensis*, DUNBAR et SKINNER; Texas Univ. Bull., 3701, p. 668–670, Pl. 54, figs. 8–13
1954. *Paraschwagerina kansasensis*, THOMPSON; Univ. Kansas, Paleontological Contributions, Protozoa Art. 5, p. 11–12, Pl. 45, figs. 1–7; Pl. 46, figs. 5–7

Remarks: Only one specimen was collected from Itando and its section is not typically axial, but slightly tangential. However, its large spherical form, rapidly expanding of volutions and intensive fluting of septa serve to distinguish it from most of the other Japanese fusulinids. Such form of *Paraschwagerina* is the first discovery in Japan.

The present form resembles the type specimens from Kansas, but differs in its higher volutions.

The measurements of this species are given in Table 7.

Paraschwagerina gigantea (WHITE)
(Plate V, Figures 1~3)

1932. *Schwagerina gigantea*, WHITE; Texas Univ. Bull., 3221, p. 82, 83, Pl. VIII, figs. 13–15
1936. *Paraschwagerina gigantea*, DUNBAR et SKINNER; Jour. Paleontology, Vol. 10, No. 2, Pl. 11, figs. 1–3
1937. *Paraschwagerina gigantea* DUNBAR et SKINNER; Texas Univ. Bull., 3701, p. 666–668, Pl. 55, figs. 1–10
1954. *Paraschwagerina gigantea*, THOMPSON; Univ. Kansas, Paleontological Contributions, Protozoa Art. 5, Pl. 45, fig. 8; Pl. 46, figs. 1–4, 8

Description: Shell gigantic, inflated fusiform, with straight axis of coiling, sharply pointed poles, and slightly convex lateral surfaces. Large specimens of eight to ten volutions about 15.0 mm long and 7.0 mm wide, giving form ratio of about 2.0. First volution fusiform, and shell remains closely similar in shape throughout growth.

Proloculus small, with outside diameter of about 0.04 mm. Shell remains loosely coiled throughout. Chambers almost uniform in height in central two-thirds of shell but becomes slightly higher as poles are approached.

Spirotheca, thin, finely alveolar in outer volutions, alveoli indistinct in inner volutions.

Septa closely spaced and highly fluted throughout shell length. Fluting brings septa in contact with each other for about half their height.

Axial deposit commonly fills chambers completely along axis from middle to ends.

The measurements of this species are given in Table 8.

Remarks: These specimens closely resemble *Paraschwagerina gigantea* among the American forms which were illustrated by Dunbar and Skinner (1936) and Thompson

(1954) in its most important characters, namely, its large inflated form, rapid expansion of shell, small proloculus and intense fluting of septa.

Occurrence: *Paraschwagerina gigantea* is scarce in Iwakurayama, Sukawa and Manganji. In Iwakurayama, no other fusulinid is found in association with it. At Sukawa it is associated with abundant *Pseudofusulina fusiformis*, *Psf. norikurensis* and *Misellina ibukiensis*, and with a few *Schubertella yadaniensis*, *Paraschwagerina* (*Acervoshwagevina*) *endoi*, *Psf. cushmani* and *Psf. kraffti*. At Manganji, it is associated with a few *Psf. vulgaris*, *Psf. regularis*, *Psf. fusiformis*, *Psf. norikurensis* and *Misellina ibukiensis*.

Paraschwagerina (*Acervoschwagerina*) *endoi* HANZAWA
(Plate IV, Figures 1~6)

1949. *Paraschwagerina* (*Acervoschwagerina*) *endoi*, HANZAWA; Jour. Paleontology, Vol. 23, No. 2, p. 205–209, Pl. 43, figs. 1–4

1955. *Paraschwagerina* (*Acervoschwagerina*) *endoi*, MORIKAWA; Sci. Rept., Saitama Univ., Ser. B, Vol. II, No. 1, p. 78–79, Pl. V, figs. 1–4; Pl. VIII, fig. 7

Description: Shell gigantic, inflated fusiform, with nearly straight to slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Large specimens of six volutions are 8.3 to 16.0 mm long and 3.8 to 5.7 mm wide, giving form ratios of 2.0 to 5.7. First volutions elongate fusiform, and shell becomes inflated towards outer volutions.

Proloculus small with outside diameter of about 0.08 to 0.2 mm, averaging 0.15 mm for nine specimens. Inner two or three volutions tightly coiled but shell expands sharply beyond third to fifth volutions and outer volutions inflated. However in most specimens ultimate volution more tightly coiled than penultimate. Chambers uniform in height through length of shell. Average height of chambers above tunnel in first to sixth volution in nine speciments is 0.06, 0.08, 0.20, 0.70, 0.80, 0.60 mm, respectively.

Spirotheca thin for shell, finely alveolar in outer volutions, alveoli indistinct in inner volutions. Spirotheca thickest above tunnel. In some specimens, spirotheca in sixth volution attains thickenss of 0.16 mm.

Septa thin, closely spaced and highly fluted throughout shell length. Septa somewhat regularly and highly fluted in inner volutions, but beyond third or fourth volution irregularly fluted completely to tops of chambers. Fluting is so distinctly irregular that it is difficult to find a single septum reaching completely from top to base of a volution.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight in inner volutions.

Axial deposit indistinct.

The measurements of this species are given in Table 9.

Remarks: The present species can be distinguished from *Paraschwagerina akiyoshiensis* by its larger and elongate form.

Paraschwagerina (*Acervoschwagerina*) *endoi* is characterised by its discontinuous forward-extending chamberlets formed within a chamber both vertically and laterally, and presence of the peculiar enclosing thin layers around the tunnel. The above cited characters accord with HANZAWA'S original from Gombo, Hida Plateau.

Occurrence: This species is a representative in the limestones of Minamitoba and Yadani, and is scarce in Sukawa and Hongo.

It is associated with *Schubertella yadaniensis*, *Biwaella omiensis*, *Minojapanella elongata*, *Pseudofusulina cushmani*, and *Psf. fusiformis* at Minamitoba.

This species may be one of the leading fossils of the zone of *Pseudoschwagerina*.

Pseudofusulina aff. *valida* (LEE)
(Plate VI, Figure 16)

1927. *Schellwienia valida*, LEE; Palaeontologia Sinica, Ser. B, Vol. 4, Fasc. 1, p. 69–70, Pl. VIII, figs. 1–3, 10

Description: Shell large elongate fusiform, with nearly straight axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Specimen of four volutions 9.0 mm long and 2.0 mm wide, giving a form ratio of 4.5. First volution elongate fusiform, and shell remains closely similar throughout growth.

Proloculus considerably large, with outside diameter of about 0.82 mm.

Shell remains tightly coiled throughout. Chambers almost uniform in height in central two-thirds of length of shell. Height of chambers above tunnel in first to fourth volutions is 0.12, 0.16, 0.26, and 0.32 mm, respectively.

Spirotheca moderately thin, and finely alveolar in outer volutions, alveoli indistinct in inner volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirotheca in first to fourth volution is 0.02, 0.04, 0.08, and 0.10 mm, respectively.

Septa closely spaced and highly fluted throughout shell length. Fluting brings septa in contact with each other for about half their height.

Tunnel rather broad with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight even in inner volutions.

Axial deposit commonly fills chambers completely along axis from near middle to ends.

The measurements of this species are given in Table 10.

Remarks: The present species closely resembles the type species of North China which has a similar shape and a similar development of secondary deposits along the axial zone, but the former has a larger proloculus than the type.

Occurrence: This species was collected from Onogi associated with *Psf.* aff. *subtilis*.

Pseudofusulina aff. *subtilis* (SCHELLWIEN)
(Plate VI, Figure 15)

1908. *Fusulina subtilis*, SCHELLWIEN; Palaeontographica, Bd. LV, p. 178, Pl. XVIII, figs. 1–3

Description: Shell large subcylindrical fusiform, with slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Specimen of seven volutions 9.3 mm long and 3.5 mm wide, giving a form ratio of 2.7. First volution elongate fusiform, and shell remains closely similar in shape throughout growth.

Proloculus small with outside diameter of about 0.04 mm. Inner three volutions relatively tightly coiled, but beyond third volution shell becomes loosely coiled. Chambers nearly uniform in height through length of shell. Height of chambers above tunnel in first to seventh volutions 0.03, 0.04, 0.04, 0.10, 0.20, 0.42 and 0.62 mm, respectively.

Spirotheca rather thin and finely alveolar in outer volution. Thickness of spirotheca

in first to seven volutions is 0.01, 0.01, 0.02, 0.03, 0.07, 0.08 and 0.12 mm, respectively.

Septa thin and highly fluted throughout length of shell. Fluting brings septa in contact with each other for about half their height.

Chomata very slight and axial deposit indistinct.

The measurements of this species are given in Table 11.

Remarks: The present form is characterised by its thin spirotheca and septa, mode of septal fluting, and lack of axial fillings. It resembles the type species in its general appearance, but differs by its smaller proloculus. However this difference in size of the proloculus may be due to the orientation of the slice.

It resembles *Schwagerina franklinesis* but differs by its weaker septal fluting.

Occurrence: The present form occurred only from Onogi where it is associated with *Pseudofusulina fusiformis* and *Psf.* aff. *valida*.

Pseudofusulina okafujii (TORIYAMA)
(Plate VI, Figures 1~8; Plate XV, Figures 7, 8)

1958. *Schwagerina okafujii*, TORIYAMA; Mem. Fac. Sci., Kyushu Univ., Ser. D, Geology, Vol. VII, p. 126-129, Pl. 14, figs. 1-16

Description: Shell medium, inflated fusiform, with nearly straight to slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Large specimens of five to six volutions 4.6 to 5.4 mm long and 1.8 to 2.7 mm wide, giving form ratios of 1.5 to 2.2. First volution fusiform, and shell remains closely similar in shape throughout growth.

Proloculus medium in size with outside diameter of about 0.20 to 0.46 mm, averaging 0.30 mm for ten specimens. Shell remains loosely coiled throughout. Chambers nearly uniform in height. Average height of the chambers above tunnel in first to sixth volutions in ten specimens is 0.08, 0.13, 0.20, 0.29, 0.31 and 0.39 mm, respectively.

Spirotheca thick and alveolar in outer volutions, alveoli indistinct in inner volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirotheca in first to sixth volutions in ten specimens 0.03, 0.04, 0.07, 0.09, 0.11 and 0.11 mm, respctively.

Septa closely spaced and irregularly and highly fluted throughout length of shell. Fluting brings septa in contact with each other for about half their height.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight even in inner volutions.

Axial deposit slight, if present.

The measurements of this species are given in Table 12.

Remarks: The present form resembles *Pseudofusulina bacca*, and *Psf. regularis*, but differs by its larger proloculus and loosely coiled inner volutions from the former, and by its shorter form from the latter.

Occurrence: This species is abundant in Manganji, Nagaoka, and Hongo. At Manganji, it occurs in association with abundant *Schubertella yadaniensis*, *Pseudofusulina bacca*, *Psf. regularis*, *Psf. vulgaris* and *Psf. fusiformis*.

Pseudofusulina bacca MORIKAWA et ISOMI, n. sp.
(Plate VI, Figures 9~14)

Description: Shell small, fusiform, with nearly straight axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Large specimens of six to seven volutions 4.0 to 5.8 mm long and 1.9 to 2.5 mm wide, giving form ratios of 2.0 to 2.6. First volution fusiform, and shell remains closely similar in shape throughout growth.

Proloculus small with outside diameter of about 0.13 to 0.20 mm, averaging 0.18 mm for four specimens. Shell remains loosely coiled throughout. Chambers nearly uniform in height. Average height of chambers above tunnel in first to six volutions in four specimens 0.06, 0.10, 0.16, 0.18, 0.24 and 0.26 mm, respectively.

Spirotheca thin and coarsely alveolar in outer volutions, alveoli indistinct in inner volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirotheca in first to sixth volutions in five specimens 0.01, 0.03, 0.05, 0.06, 0.07 and 0.08 mm, respectively.

Septa closely spaced and irregularly and highly fluted throughout length of shell. Fluting brings septa in contact with each other for about half their height.

Tunnel narrow with slightly irregular path.

Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight even in inner volutions.

Axial deposit commonly slightly fills chambers along axis from near middle to ends.

The measurements of this species are given in Table 13.

Remarks: The present form is characterized by its short fusiform, small proloculus and tightly coiled volutions.

Pseudofusulina bacca differs from *Psf. okafujii* by its smaller proloculus and tightly coiled volutions.

One specimen (Pl. VI, fig. 13) rather closely resembles *Psf. regularis* but is distinguished by its bluntly rounded poles and smaller proloculus.

The holotype of this species was collected from Onogi.

Occurrence: *Pseudofusulina bacca* is common in the limestones of Hongo, Manganji and Nagaoka, which belong to the zone of *Pseudoschwagerina*, and is associated with many species of *Pseudofusulina*.

Pseudofusulina regularis (SCHELLWIEN)
(Plate VII, Figures 1~10)

1898. *Fusulina regularis*, SCHELLWIEN; Palaeontographica, Bd. XLIV, p. 250–251, Pl. XIX, figs. 1–6
1912. *Fusulina regularis*, DEPRAT; Mém. Sérv. Géol. l'Indochine, Vol. I, Fasc. III, p. 28–29, Pl. VII, figs. 14, 15
1927. *Schellwienia regularis*, LEE; Palaeontologia Sinica, Ser. B, Vol. 4, Fasc. 1, p. 50–52, Pl. VII, figs. 8–10
1936. *Pseudofusulina regularis*, HUZIMOTO; Sci. Rept., Tokyo Bunrika Daigaku, Sec. C, Vol. 1, No. 2, p. 94–95, Pl. X, figs. 9–11; Pl. XVIII, fig. 1
1958. *Pseudofusulina regularis*, KANMERA; Mem. Fac. Sci., Kyushu Univ., Ser. D, Geology, Vol. VI, No. 3, p. 194–196, Pl. 33, figs. 1–10

1958. *Schwagerina regularis*, TORIYAMA; Mem. Fac. Sci., Kyushu Univ., Ser. D, Geology, Vol. VII, p. 140–143, Pl. 16, figs. 8–15

Description: Shell large, elongate fusiform, with nearly straight axis of coiling, sharply pointed poles, and slightly convex lateral surfaces. Large specimens of four to six volutions 6.2 to 8.2 mm long and 1.8 to 4.0 mm wide, giving form ratios of 2.1 to 3.4. First volution elongate fusiform, and shell remains closely similar in shape throughout growth.

Proloculus large, with outside diameter of about 0.30 to 0.40 mm, averaging 0.40 mm for six specimens. Shell remains loosely coiled throughout. Chambers nearly uniform in height in central one-third of length of shell but becomes slightly heigher as poles are approached. Average height of chambers above tunnel in first to sixth volutions in six specimens 0.08, 0.15, 0.18, 0.27, 0.37 and 0.32 mm, respectively.

Spirotheca thick and coarsely alveolar in outer volutions, alveoli indistinct in inner volutions. Average thickness of spirotheca in first to fifth volutions in six specimens 0.02, 0.03, 0.04, 0.08 and 0.09 mm, respectively. In some specimens, spirotheca in fifth volution attains thickness of 0.14 mm.

Septa closely spaced and highly fluted throughout shell length. Fluting brings septa in contact with each other for about a half their height.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight even in inner volutions.

Axial deposit commonly faintly fills chambers along axis from near middle to ends.

The measurements of this species are given in Table 14.

Remarks: The present form is almost identical with the original types from the Carnic Alps.

This species resembles *Psf. fusiformis* but the latter has stronger axial deposit which fills the chambers along the axis.

Pseufusulina regularis is readily distinguished from *Psf. okafujii* by its elongate fusuform.

Rugosofusulina alpina described by IGO from Fukuji (not SCHELLWIEN's original) can be distinguished from this species by its weaker septal fluting and rugosity of spirotheca.

Occurrence: It is common in Ikenooku and associated with *Nagatoella ikenoensis* and *Misellina* sp., and rare in Manganji and Hongo.

Pseudofusulina regularis is common in the lower Permian.

Pseudofusulina vulgaris (SCHELLWIEN)
(Plate XIII, Figures 1~4)

1909. *Fusulina vulgaris*, SCHELLWIEN; Palaeontographica, Bd. LVI, p. 163, Pl. XIV, figs. 1, 2

1925. *Schellwienia vulgaris*, OZAWA; Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. XLV, Art. 6, p. 23, 24, Pl. VII, fig. 3

1927. *Schellwienia vulgaris*, LEE; Palaeontologia Sinica, Ser. B, Vol. 4, Fasc. 1, p. 59–64, Pl. VIII, figs. 6–9, 11, 12; Pl. IX, fig. 9

1934. *Pseudofusulina vulgaris*, CHEN; Palaeontologia Sinica, Ser. B, Vol. IV, Fasc. 2, p. 67, 68, Pl. VI, fig. 10

1936. *Pseudofusulina vulgaris*, HUZIMOTO; Sci. Rept., Tokyo Bunrika Daigaku, Sec. C, Vol. 1, No. 2, p. 75–77, Pl. XI, figs. 1–7

1955. *Pseudofusulina vulgaris*, MORIKAWA; Sci. Rept., Saitama Univ., Ser. B, Vol. II, No. 1, p. 89, 90, Pl. IX, figs. 1–6

1958. *Pseudofusulina vulgaris*, TORIYAMA; Mem. Fac. Sci., Kyushu Univ., Sec. D, Geology, Vol. VII, p. 164–168, Pl. 20, figs. 12–18; Pl. 21, figs. 1–15

Description: Shell large, highly inflated fusiform, with straight to slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Large specimens of five to six volutions 5.2 to 9.1 mm long and 3.0 to 5.2 mm wide, giving form ratios of 1.4 to 2.1. First volution vaulted form, shell remains closely similar in shape throughout growth.

Proloculus large, with outside diameter of about 0.23 to 0.54 mm, averaging 0.50 mm for eight specimens. Shall remains loosely coiled throughout. Chambers nearly uniform in height in central one-third of length of shell, but become slightly higher as poles are approached. Average height of chambers above tunnel in first to sixth volutions in four specimens is 0.14, 0.22, 0.35, 0.40, 0.50 and 0.38 mm, respectively.

Spirotheca thick and coarsely alveolar in outer volutions, alveoli indistinct in inner volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirotheca in first to sixth volutions in six specimens 0.04, 0.06, 0.08, 0.12, 0.14 and 0.13 mm, respectively. In some specimens, spirotheca in fifth volutions attains thickness of 0.18 mm.

Septa closely spaced and highly fluted throughout shell length. Fluting brings septa in contact with each other for about half their height.

Tunnel narrow with slightly irregular path. Intense flutting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight, if present.

Axial deposit faintly fills chambers along axis from near middle to ends, if present.

The measurements of this species are given in Table 15.

Remarks: It is characterized by its vaulted form, large proloculus and thick spirotheca. Considerable variations in its mode of septal fluting are seen; one specimen (Pl. 13, fig. 2) shows rather strong fluting which resembles *Psf. hawkinsi* described by KOBAYASHI from Ibukiyama in its larger proloculus, less numerous volutions and thicker spirotheca.

Occurrence: It is common in Manganji, Minamitoba, Hongo, Muraki, Nagaoka, Onogi, Sukawa and Sengokudani.

Pseudofusulina globosa (DEPRAT)
(Plate XIII, Figures 6~11)

1912. *Fusulina globosa*, DEPRAT; Mém. Sérv. Géol. l'Indochine, Vol. I, Fasc. III, p. 22–24, Pl. VI, figs. 5–10; Pl. VII, fig. 1

It rather closely resembles *Pseudofusulina vulgaris* but the former is readily distinguished from the latter by its thinner septa and weaker fluting of septa. The spirotheca of this species is the thickest above the tunnel and becomes thin gradually towards the poles.

The measurements of this species are given in Table 16.

Occurrence: Abundant in Minamitoba.

Pseudofusulina cushmani CHEN
(Plate IX, Figures 1~11)

1934. *Pseudofusulina cushmani*, CHEN; Paleontologia Sinica, Ser. B, Vol. IV, Fasc. 2, p. 72–73, Pl. IV, figs. 4–6

Description: Shell large, highly inflated fusiform, with nearly straight axis of coiling, sharply pointed poles, and slightly convex lateral surfaces. Large specimens of six to nine volutions 4.9 to 8.2 mm long and 2.6 to 4.0 mm wide, giving from ratios of 1.7 to 2.3. First volution fusiform, but changes gradually from fusiform in first volution to inflated shape with convex slopes in last volution.

Proloculus small, with outside diameter of about 0.16 to 0.30 mm, averaging 0.24 mm for fourteen specimens.

Chambers increase in height nearly uniform to ultimate volution but change very slightly at maturity. Chambers nearly uniform in height in central part of shell but become slightly higher as poles are approached. Average height of chambers above tunnel in first to nineth volution in fourteen specimens 0.06, 0.08, 0.12, 0.16, 0.22, 0.26, 0.26, 0.30 and 0.30 mm, respectively.

Spirotheca thin and finely alveolar in outer volutions, alveoli indistinct in inner two or three volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirotheca in first to eight volutions in fourteen specimens 0.01, 0.02, 0.03, 0.04, 0.06, 0.06, 0.07, and 0.08 mm, respectively but in some speciments spirotheca in eighth volution exceeds 0.11 mm.

Septa thin, loosely spaced and highly fluted throughout shell length. Fluting brings septa in contact with each other for about half their height.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight even in inner volutions.

Axial daposit develops faintly if present at all.

The measurements of this species are given in Table 17.

Remarks: It is characterized by its inflated form, small proloculus and tightly coiled volutions.

It can be distinguished from *Psf. krotowi* by its inflated fusiform, thinner spirotheca, and lack of phrenotheca.

Occurrence: It is widely distributed, and is especially abundant in Yadani, Manganji, and Minamitoba. It is associated with many species of *Pseudofusulina*.

Pseudofusulina krotowi (SCHELLWIEN)
(Plate VIII, Figures 1~11)

1908. *Fusulina krotowi*, SCHELLWIEN; Palaeontographica, Bd. LV, p. 190–192, Pl. XX, figs. 1–10

1925. *Schellwienia krotowi*, OZAWA; Jour. Coll. Sci., Imp. Univ. Tokyo, Vol. XLV, Art. 6, p. 27–28, Pl. VII, figs. 3–6

1936. *Pseudofusulina krotowi*, HUZIMOTO; Sci. Rept., Tokyo Bunrika Daigaku, Sec. C, Vol. 1, No. 2, p. 82–84, Pl. XV, figs. 1–5, 9–15

1955. *Pseudofusulina krotowi*, MORIKAWA; Sci. Rept., Saitama Univ., Ser. B, Vol. II, No. 1, p. 8–6, Pl. XIV, figs. 5–6

1958. *Schwagerina krotowi*, TORIYAMA; Mem. Fac. Sci., Kyushu Univ., Ser. D, Geology, Vol. VII, p. 134–138, Pl. 15, figs. 8–19

Description: Shell large, spherical form, with almost straight axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Mature specimens of six to eight volutions 4.0 to 5.5 mm long and 2.6 to 4.2 mm wide, giving form ratios of 1.3 to 1.5. First volution inflated fusiform, and shell remains closely similar in shape throughout growth.

Proloculus small, with outside diameter of about 0.12 to 0.24 mm, averaging 0.20 mm for nine specimens. Shell remains tightly coiled in inner two or three volutions and becomes loosely towards outer volutions. Chambers nearly uniform in height. Average height of chambers above tunnel in first to seventh volution in nine specimens 0.08, 0.12, 0.22, 0.30, 0.40, 0.40 and 0.40 mm, respectively.

Spirotheca thick and coarsely alveolar in outer volutions, alveoli indistinct in inner volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirotheca in first to seventh volutions in nine specimens 0.03, 0.04, 0.06, 0.08, 0.10, 0.12 and 0.10 mm, respectively.

Septa thin, closely spaced and highly fluted throughout shell length. Fluting brings septa in contact with each other for about two-thirds their height. Phrenotheca develops weakly in outer volutions.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes the tunnel sides difficult to identify in all specimens.

Chomata very slight even in inner volutions.

Axial deposit not developed.

The measurements of this species are given in Table 18.

Remarks: It is characterized by its spherical form, small proloculus and tightly coiled volutions of inner part.

It can be distinguished from *Psf. vulgaris* by its thinner spirotheca, smaller proloculus, and tightly coiled volutions.

It also differs from *Psf. cushmani* by its spherical form and presence of phrenothoca.

Occurrence: It is abundant in Manganji where it is associated with *Pseudofusulina fusiformis*, and *Psf. cushmani*.

Pseudofusulina fusiformis (SCHELLWIEN et DYHERENFURTH)

(Plate VII, Figures 11, 12; Plate VIII, Figures 12, 13; Plate X, Figures 1~10; Plate XI, Figures 1~10; Plate XII, Figures 1~10; Plate XIII, Figure 5)

1909. *Fusulina vulgaris* var. *fusiformis*, SCHELLWIEN et DYHRENFURTH; Palaeontographica, Bd. LVI, p. 165, Pl. XV, figs. 1–4

1955. *Pseudofusulina fusiformis*, MORIKAWA; Sci. Rept., Saitama Univ., Ser. B, Vol. II, No. 1, p. 98–99, Pl. XIII, figs. 1–7

Description: Shell commonly elongate fusiform, often subcylindrical fusiform, with nearly straight to slightly shifting axis of coiling, sharply pointed poles, and slightly convex lateral surfaces.

Large specimens of five to seven volutions 9.0 to 12.5 mm long and 2.5 to 3.2 mm wide, giving form ratios of 3.1 to 5.0. First volution fusiform, and shell remains closely similar in shape throughout growth, however it often becomes elongate form.

Proloculus large, with outside diameter of about 0.30 to 0.40 mm, averaging 0.32 mm

for five specimens. Shell remains loosely coiled throughout. Chambers about uniform in height in central one third to two thirds of shell length but become slightly higher as poles are approached. Average height of chambers above tunnel in first to sixth volutions in five specimens 0.10, 0.18, 0.20, 0.24, 0.24 and 0.23 mm, respectively.

Spirotheca thick and coarsely alveolar in outer volutions, alveoli indistinct in first to second volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirotheca in first to sixth volutions in five specimens 0.02, 0.04, 0.06, 0.08, 0.07 and 0.05 mm, respectively. In some specimens, spirotheca in fifth volution is 0.12 mm in thickness.

Septa closely spaced, and highly fluted throughout length of shell. Fluting brings septa in contact with each other for about half their height.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight even in inner volutions. Axial deposit commonly fills completely chambers along axis from near middle to ends.

The measurements of this species are given in Table 19.

Remarks: Considerable variation in shell shape appears at maturity, for one finds subcylindrical forms (Pl. 10, fig. 2; Pl. 11, fig. 3) associated with the normal form of elongate fusiform (Pl. 11, fig. 4).

It can be distinguished from *Psf. regularis* by its strong axial filling, and also from *Psf.* aff. *valida* by its weaker axial filling.

It differs from *Psf. kraffti* by its elongate fusiform, the latter being cylindrical.

Occurrence: It is widely distributed in this area, notably in Manganji, Yadani, Sukawa and Minamitoba. It is associated with many species of *Pseudofusulina*.

Pseudofusulina kraffti (SCHELLWIEN)
(Plate XIV, Figures 1~10; Plate XV, Figures 5, 6)

1909. *Fusulina kraffti*, SCHELLWIEN; Palaeontographica, Bd. LVI, p. 169, Pl. XVI, figs. 1–9

1936. *Pseudofusulina kraffti*, HUZIMOTO; Sci. Rept., Tokyo Bunrika Daigaku, Sec. C, Vol. 1, No. 2, p. 80–81, Pl. XIV, figs. 3–8

1955. *Pseudofusulina kraffti*, MORIKAWA; Sci. Rept., Saitama Univ., Ser. B, Vol. II, No. 1, p. 94–95, Pl. VII, figs. 15–17

Description: Shell subcylindrical fusiform, with nearly straight to slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Large specimens of six to eight volutions 5.7 to 8.5 mm long and 2.8 to 5.0 mm wide, giving form ratios of 1.6 to 2.3. First volution elongate fusiform, and shell remains closely similar throughout growth.

Proloculus large, and spherical but irregular in some with outside diameter of about 0.20 to 0.40 mm, commonly 0.30 mm for ten specimens. Shell remains loosely coiled throughout. Chambers nearly uniform in height in central one third of length of shell but becomes slightly higher as poles are approached. Average height of chambers above tunnel in first to seventh volutions in ten specimens 0.10, 0.12, 0.18, 0.20, 0.24, 0.30 and 0.33 mm, respectively.

Spirotheca thick and coarsely alveolar in outer volutions, alveoli indistinct in inner volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average

thickness of spirotheca in first to seventh volutions in ten specimen 0.02, 0.04, 0.06, 0.08, 0.10, 0.12 and 0.12 mm, respectively. In some specimens, the spirotheca in seventh volution attains 0.18 mm in thickness.

Septa closely spaced and highly fluted throughout shell length. Fluting brings septa in contact with each other for about half their height.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight even in inner volutions. Axial deposit commonly fills chambers completely along axis from near middle to ends.

The measurements of this species are given in Table 20.

Remarks: The species can be distinguished from *Psf. fusiformis* by its cylindrical form.

Some specimens, having large proloculus measuring 0.7 to 0.8 mm, may be referable to TORIYAMA's *Pseudofusulina kraffti magna*.

Pseudofusulina norikurensis resembles *Psf. kraffti*, but the former has larger fusiform, and thicker spirotheca than the latter.

Occurrence: This species is widely distributed in this area, being especially common in Sukawa, Muraki, Yadani, Nagaoka and Onogi, and rare in Minamitoba.

Pseudofusulina norikurensis IGÔ em. MORIKAWA et ISOMI
(Plate XV, Figures 1~4; Plate XVI, Figures 1~7)

1959. *Pseudofusulina kraffti norikurensis*, IGO; Sci. Rept., Tokyo Kyoiku Daigaku, Sec. C, Vol. 6, No. 56, p. 244-245, P . II, figs. 1-3

Remarks: *Pseudofusulina norikurensis* closely resembles *Psf. kraffti* in general appearance, but the former has larger shell, a greater number of whorls and thicker spirotheca, and its proloculus is smaller for the size. The distinctive differences between *Psf. kraffti* and *Psf. norikurensis* are shown in the following table.

	Psf. kraffti	*Psf. norikurensis*
Form	subcylindrical	fusiform
Length	6.2–9.5 mm	9.5–11.0 (10.0) mm
Width	3.8–5.0 mm	3.2–5.2 (5.2) mm
Form ratio	1.6–2.3	1.7–2.2
Number of volutions	6–8	8–9
Diameter of proloculus	0.20–0.80 mm	0.22–0.40 (0.30) mm

The measurements of this species are given in Table 21.

Occurrence: This species is abundant in Sukawa and is associated with *Pseudofusulina fusiformis*.

Pseudofusulina lepida (DEPRAT)
(Plate XX, Figures 1~5)

1914. *Fusulina lepida*, DEPRAT; Mém. Sérv. Géol. l'Indochine, Vol. III, Fasc. I, p. 15–16, Pl. II, fig. 5

1958. *Pseudofusulina lepida*, MORIKAWA; Sci. Rept. Saitama Univ., Ser. B, Vol. 3, No. 1, p. 102–103, Pl. 12, figs. 4–9

Description: Shell small fusiform, with straight to slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Large specimens of five to seven volutions 3.5 to 4.4 mm long and 1.1 to 2.2 mm wide, giving from ratios of 2.1 to 3.0. First volution elongate fusiform, and shell remains closely similar throughout growth.

Proloculus small, with outside diameter of about 0.08 to 0.12 mm, averaging 0.10 mm for six specimens. Inner three or four volutions relatively tightly coiled, but beyond third or fourth volutions shell becomes rather loosely coiled. Chambers nearly uniform in height in central one third of length of shell but becomes slightly higher as poles are approached. Average height of chambers above the tunnel in first to sixth volutions in six specimens 0.03, 0.06, 0.06, 0.10, 0.16 and 0.24 mm, respectively.

Spirotheca very thin and finely alveolar in outer volutions, alveoli indistinct in inner volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirotheca in first to sixth volutions in six specimens 0.01, 0.01, 0.02, 0.03, 0.04 and 0.06 mm, respectively. Spirotheca in some specimens, in fifth volution attains 0.08 mm in thickness.

Septa closely spaced and highly fluted throughout shell length. Fluting brings septa in contact with each other for about half their height.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight in inner volutions.

Axial deposit commonly fills chamber completely along axis from near middle to ends.

The measurements of this species are given in Table 22.

Remarks: This species is characterized by its small form, small proloculus, and tightly coiled volutions in the inner part. It resembles *Psf. bacca*, but differs from the latter by its smaller proloculus and strong axial deposit.

Occurrence: This is common in Iwasayama and is associated with *Neoschwagerina* and *Parafusulina* spp.

Nagatoella ikenoensis MORIKAWA et ISOMI, n. sp.
(Plate XX, Figures 6~13)

Description: Shell small, ellipsoidal fusiform, with nearly straight to slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Large specimens of six to nine volutions 2.8 to 4.4 mm long and 1.4 to 2.2 mm wide, giving form ratios of 1.3 to 2.0. First volution fusiform, and shell remains closely similar throughout growth.

Proloculus small, with outside diameter of about 0.08 to 0.14 mm, averaging 0.10 mm for five specimens. Shell tightly coiled throughout. Chambers almost uniform in height through length of shell. Average height of chambers above tunnel in first to seventh volutions in five specimens 0.02, 0.04, 0.04, 0.06, 0.10, 0.12 and 0.14 mm, respectively. Spirotheca very thin and finely alveolar structure is seen in outer volutions, alveoli indistinct in inner volutions. Average thickness of spirotheca in first to seventh volutions in five specimens 0.01, 0.01, 0.01, 0.02, 0.02, 0.03 and 0.04 mm, respectively.

Septa closely spaced almost throughout growth of shell. Fluting of septa not seen.

Tunnel norrow with slightly irregular path, its angle about 30° on average, and

becomes wider towards outer volutions.

Chomata very massive throughout and often reach spirotheca above them.

Axial deposit commonly indistinct.

The measurements of this species are given in Table 23.

Remarks: This new species is characterized by its small ellipsoidal shape. It can be distinguished from *Nagatoella fujimotoi* by its smaller form and thin spirotheca.

Occurrence: It is common in Ikenooku, and is associated with *Pseudofusulina regularis* and *Misellina ibukiensis*.

Parafusulina exilis (SCHWAGER)
(Plate XVIII, Figures 8, 9)

1883. *Fusulina exilis*, SCHWAGER; RICHTHOFEN's China, Vol. IV, Pl. XV, fig. 18; Pl. XVI, figs. 4, 5

1914. *Fusulina exilis*, DEPRAT; Mém. Sérv. Géol. l'Indochine, Vol. III, Fasc. I, p. 17, Pl. II, figs. 6-8

1956. *Schwagerina exilis*, CHEN; Palaeontologia Sinica, New Ser. B, No. 6, p. 30-31, Pl. III, figs. 6, 7

1958. *Schwagerina exilis*, MORIKAWA; Sci. Rept., Saitama Univ., Ser. B, Vol. 3, No. 1, p. 105-106, Pl. 15, figs. 1-8

Remarks: The specimens of the present form are not abundant in number, and was collected only from Iwasayama. However, its general appearance resembles closely the type species from Akasaka, namely, in its large fufiform, large proloculus, rather regular fluting of septa and axial deposit developing near the proloculus.

The measurements of this species are given in Table 24.

Occurrence: This species is rare in Iwasayama.

Parafusulina parakinosakii MORIKAWA et ISOMI, n. sp.
(Plate XVII, Figures 1~9)

Description: Shell large, fusiform, with almost straight to slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Large specimens of five to eight volutions, commonly of seven, 6.5 to 9.0 mm long and 2.2 to 4.0 mm wide, giving form ratios of 1.8 to 3.2, averaging 2.2. First volution elongate fusiform, and shell remains closely similar throughout growth.

Proloculus large, with outside diameter of about 0.18 to 0.52 mm, averaging 0.45 mm for tweleve specimens. Shell tightly coiled throughout. Chamber almost uniform in height in central one-third of length of shell but becomes slightly higher as poles are approached. Average height of chambers above tunnel in first to six volutions in twelve specimens 0.06, 0.12, 0.20, 0.30, 0.40 and 0.40 mm, respectively.

Spirotheca thin and finely alveolar in outer volutions, alveoli indistinct in inner one or two volutions. Spirotheca thickest above tunnel and thins gradually poleward. Average thickness of spirhotheca in first to seventh volutions in tweleve specimens 0.20, 0.04, 0.04, 0.06, 0.08, 0.10 and 0.09 mm, respectively. In some specimens, spirotheca in fifth volutions attains thickness of 0.12 mm.

Septa closely spaced and regularly and highly fluted throughout shell length. Fluting brings septa in contact with each other for about two-thirds their height. Chamberlets form closed-packed and inverted U-shape. Septal intervals in outer volutions about 0.2 mm.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all specimens.

Chomata very slight even in first volution.

Axial deposit fills chamberlets throughout whole shell.

The measurements of this species are given in Table 25.

Remarks: This new species is characterized by its regular septal fluting forming closed-packed chamberlets. It resembles *Parafusulina kinosakii* from Akasaka in its closed-packed chamberlets but differs in its thicker septa.

Parafusulina parakinosakii can be distinguished from *Parafusulina schucherti* DUNBAR and SKINNER by its short form, larger proloculus and thicker septa which form closed-packed chamberlets.

Occurrence: It is abundant in Iwasayama and is associated with *Neoschwagerina*, and rare in Iwakurayama.

Parafusulina takeyamai MORIKAWA et ISOMI, n. sp.
(Plate VII, Figure 13; Plate XIX, Figures 1~8)

Description: Shell large, elongate fusiform, with almost straight to slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Large specimens of six to eight volutions 7.0 to 14.2 mm long and 2.7 to 3.7 mm wide, giving form ratios of 2.1 to 3.8, commonly 3.2. First volution elongate fusiform, and shell remains closely similar throughout growth.

Proloculus medium, with outside diameter of about 0.24 to 0.47 mm, averaging 0.34 mm for six specim ns. Shell loosely coiled throughout. Chambers almost uniform in height in central part of shell but become slightly higher as poles are approached. Average height of chambers above tunnel in first to seventh volutions in six specimens 0.12, 0.10, 0.16, 0.30, 0.26, 0.30, and 0.34 mm, respectively.

Spirotheca thin and coarsely alveolar in outer volutions, alveoli indistinct in inner volutions. Average thickness of spirotheca in first to seventh volutions in six specimens 0.02, 0.04, 0.04, 0.05, 0.08, 0.08 and 0.08 mm, respectively.

Septa closely spaced and regularly and highly fluted throughout shell length. Fluting brings septa in contact with each other for about half their height. Chamberlets small.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all parts of all specimens.

Chomata very slight even in first volution.

Axial deposit commonly fills chambers along axis from near middle to ends.

The measurements of this species are given in Table 26.

Remarks: This species resembles *Schwagerina gifuensis* but can be distinguished by its longer form. It also can be distinguished by its thicker septa from *Parafusulina kawaii*.

Occurrence: It is common at Iwasayama.

Parafusulina iwasensis MORIKAWA et ISOMI, n. sp.
(Plate XVIII, Figures 1~7)

Description: Shell large, elongate subcylindrical fusiform, with almost straight to slightly shifting axis of coiling, bluntly pointed poles, and slightly convex lateral surfaces. Mature specimens of six to seven volutions 10.4 to 13.0 mm long and 2.7 to 4.0 mm wide,

giving form ratios of 2.7 to 3.7.

First volution fusiform, and shell remains closely similar throughout growth.

Proloculus medium, with outside diameter of about 0.20 to 0.34 mm, averaging 0.25 mm for four specimens. Shell remains loosely coild throughout. Chambers almost uniform in height in central part of shell but become slightly higher as poles are approached. Average height of chambers above tunnel in first to sixth volutions in four specimens 0.08, 0.10, 0.20, 0.26, 0.40 and 0.43 mm, respectively.

Spirotheca thin and finely alveolar in outer volutions, alveoli indistinct in inner volutions. Average thickness of spirotheca in first to seventh volutions in four specimens 0.02, 0.02, 0.03, 0.04, 0.06, 0.06 and 0.06 mm, respectively.

Septa closely spaced, regularly and highly fluted throughout shell length. Fluting brings septa in contact with each other about top of their height. Chamberlet high and narrow, showing inverted U-shape.

Tunnel narrow with slightly irregular path. Intense fluting of septa makes tunnel sides difficult to identify in all parts of all specimens.

Chomata very slight even in inner volutions.

Axial deposit very slight.

The measurements of this species are given in Table 27.

Remarks: The distinctive characters of this species are the thin spirotheca and septa, and the regular fluting of septa. This species resembles *Parafusulina truncata* but can be distinguished by its regular fluting of septa.

The specimen assigned to *Fusulina annamitica* (from Akasaka by Deprat) may be conspecific with this species. *Schwagerina franklinensis* resembles this species but can be distinguished by its proloculus being smaller than the latter.

Occurrence: This species is common In Iwasayama.

Misellina ibukiensis KOBAYASHI
(Plate XXI, Figures 1~18)

1957. *Misellina ibukiensis*, KOBAYASHI; Sci. Rept., Tokyo Kyoiku Daigaku, Sec. C, Vol. 5, No. 48, p. 297–298, Pl. I, figs. 20–28.

Description: Shell small, subspherical, with almost straight axis of coiling, bluntly rounded poles, and slightly convex lateral surfaces. Large specimens of five to seven volutions, commonly of six, 1.2 to 1.8 mm long and 0.9 to 1.2 mm wide, giving form ratios of 1.2 to 1.5. First volution spherical, and shell remains closely similar throughout growth.

Proloculus small, with outside diameter of about 0.04 to 0.08 mm, commonly 0.04 mm for six specimens. Shell remains loosely coiled throughout. Chambers almost uniform in height. Average height of chambers above tunnel in the first to sixth volutions in six specimens 0.04, 0.04, 0.06, 0.11, 0.12 and 0.12 mm, respectively.

Spirotheca very thin and coarsely alveolar in outer volutions, alveoli indistinct in inner volutions. Average thickness of spirotheca in first to sixth volutions less than 0.03 mm. Septal intervals in outer volutions about 0.14 mm.

Parachomata low and broad and its number is commonly seven or eight in outer volutions.

The measurements of this species are given in Table 28.

Remarks: This species can be distinguished from *M. claudiae* by its thinner spiro-

theca and smaller size.

Most of *Misellina, M. claudiae* and so on, occur in the zone of *Neoschwagerina* but here, *Misellina ibukiensis* is common in the zone of *Pseudoschwagerina*. This evidence is important in consideration on the phylogeny of Neoschwagerininae.

Occurrence: It is abundant in Manganji, Muraki, Ikenooku, Sukawa and Nagaoka.

Pseudodoliolina ozawai YABE et HANZAWA
(Plate XVIII, Figures 10~12)

1914. *Doliolina lepida*, DEPRAT; Mém. Sérv. Géol. l'Indochine, Vol. III, Fasc. I, p. 22, Pl. III, figs. 12–14
1932. *Pseudodolilina ozawai*, YABE et HANZAWA; Proc. Imp. Acad. Japan, Vol. VIII, No. 2, p. 40–42
1934. *Pseudodoliolina ozawai*, CHEN; Palaeontologia Sinica, Ser. B, Vol. IV, Fasc. 2, p. 100, 101, Pl. XVI, figs. 3, 4
1936. *Pseudodoliolina ozawai*, HUZIMOTO; Sci. Rept., Tokyo Bunrika Daigaku, Sec. C, Vol. 1, No. 2, p. 108–110, Pl. XXI, figs. 13–18
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1956. *Pseodododoliolina ozawai*, CHEN; Palaeontologia Sinica, New Ser. B, No. 6, p. 53, 54, Pl. IV, figs. 12–14
1957. *Pseudodoliolina ozawai*, KOBAYASHI; Sci. Rept., Tokyo Kyoiku Daigaku, Sec. C, Vol. 5, No. 48, p. 298–300, Pl. VIII, figs. 1, 2; Pl. IX, figs. 1–4
1958. *Pseudodoliolina ozawai*, TORIYAMA; Mem. Fac. Sci., Kyushu Univ., Ser. D, Geology, Vol. VII, p. 213–215, Pl. 39, figs. 26–32

The specimen under question resembles *Pseudodoliolina ozawai* in important respects, however, it is smaller than the type. Unfortunately, we could get only a few specimens of this form. We tentatively refer them to *P. ozawai*.

Occurrence: The present species is found in Iwasayama.

Neoschwagerina nipponica (OZAWA)
(Plate XX, Figures 15~19)

1927. *Cancellina nipponica*, OZAWA; Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. II, Vol. II, Pt. 3, p. 160–161, Pl. XXXIV, figs. 12–17; Pl. XXXV, figs. 8b, 10a; Pl. XLIV, fig. 1a; Pl. XLV, figs. 4, 5

Description: Shell small, its external form short ellipsoidal, with almost straight axis of coiling, bluntly rounded poles, and slightly convex lateral surfaces. Mature specimens of ten to eleven volutions 3.2 mm long and 2.0 to 2.1 mm wide, giving form ratio of 1.5. First volution spherical, beyond which shell becomes ellipsoidal and remains similar throughout growth.

Proloculus small, with outside diameter of 0.08 to 0.12 mm.

Height of chambers increases gradually from first volution and average height of outer volutions about 0.15 mm.

Spirotheca rather thin, measuring about 0.02 mm in outer whorls. Alveoli of spirotheca very fine throughout its growth.

Septa thin, and sometimes axial septula are seen. Transverse septula present in all volutions, and their thickness about 0.06 mm and their intervals are about 0.08 mm in

outer whorls.

Transverse septula formed by downward deflection of lower surface of keriotheca.

Protrusions of keriotheca short, and come into contact with top of parachomata near middle of chamber though disjoined with each other in some cases.

Apparent secondary transverse septula seen but very short.

Remarks: The small shape and transverse septula of this species are the important characteristics.

Occurrence: Common in Iwasayama in association with *Neoschwagerina* sp., *Parafusulina iwasensis*, *Paraf. takeyamai*, *Paraf. parakinosakii*, *Paraf. exilis* and so on.

Neoschwagerina sp.
(Plate III, Figures 6~8)

Shell medium, inflated form, of about ten volutions.

Protrusions of keriotheca rather long and become thin towards ends and contact with low parachomata.

We could not get well-oriented sections, and thus the specific determination is reserved. However, this form from Iwasayama may be conspecific with *Neoschwagerina colaniae* OZAWA from Akasaka.

Neoschwagerina rotunda (DEPRAT) em. MORIKAWA
(Plate II, Figures 17~20)

1914. *Neoschwagerina craticulifera* var. *rotunda*, DEPRAT; Mém. Géol. Serv. l'Indochine, Vol. III, Fasc. I, p. 26, Pl. VIII, figs. 6–13

1927. *Neoschwagerina simplex*, OZAWA; Jour. Fac. Sci., Imp. Univ. Tokyo, Sec. II, Vol. II, Pt. 3, p. 153–154, Pl. XXXIV, figs. 7–11, 22, 23; Pl. XXXVII, figs. 3a, 6a

Description: Shell medium size, its external form nearly spherical. Lateral slopes distinctively convex throughout. Axis of coiling almost straight.

Mature shell with ten to tweleve volutions, about 2.5 mm wide and 3.0 mm long. Form ratio of shell about 1.1 to 1.3.

Proloculus small, irregularly spherical, with outside diameter of 0.03 to 0.05 mm, about 0.04 mm on average.

Height of chambers increases slowly from first volution, and average height about 0.18 to 0.20 mm in outer volutions. Spirotheca rather thick, measuring about 0.05 to 0.07 mm in outer part of shell.

Spirotheca changes greatly in thickness from first volution to maturity. Alveoli of spirotheca very fine from first volution.

Primary transverse septula present throughout, and their thickness about 0.05 to 0.08 mm. Intervals of septula vary from 0.12 to 0.14 mm in outer volutions.

Protrusions of keriotheca rather long and reach top of parachomata but rarely appear to become disjoined in axial sections.

Parachomata broad, high, and extend to center of chamber.

Transverse septula formed by downward deflection of lower surfaces of keriotheca and essentially at right angle to spirotheca.

Secondary transverse septula short and rarely present. Axial septula rarely appear in sagittal sections.

Remarks: *N. rotunda* can be distinguished from *N. craticulifera* described by Deprat and by Ozawa (not SCHELLWIEN's original) by its spherical form, smaller proloculus, and thicker spirotheca and transverse septula formed by downward deflection of lower surfaces of keriotheca, so that we recognized the former as a species. *N. rotunda* has no sufficient characteristics to be separated from *Neoschwagerina simplex* in its external form, and small proloculus and transverse septula. Therefore, both are considered to be conspecific.

Occurrence: Abundant in Onogi.

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要　旨

琵琶湖東方地域二疊系の紡錘虫の研究

森川　六郎・礒見　博

5万分の1地質図幅「近江長浜」地域内の含化石二疊系（草野川層群・醒ケ井層・大野木層・伊吹山石灰岩層下部）の石灰岩から産する紡錘虫化石を検討した結果，14属，34種が識別された。うち，5種は新種である。本論文において，これら 34 種の化石を記載する。

本地域の紡錘虫化石は，二疊紀前期の化石群（*Pseudoschwagerina* 帯）と，二疊紀中期前半の化石群 *Parafusulina-Neoschwagerina* 帯）とに，2分される。

他の属に較べて個体数においても種数においても圧倒的に多い *Pseudofusulina* の種の大部分は，*Pseudoschwagerina* や *Paraschwagerina* と共存していて，二疊紀前期の地質時代を指示する。こゝでとくに興味あることは，この化石群に *Nagatoella* および *Misellina* の加わっていることである。これらの出現時期に関する新事実は，紡錘虫の系統発生史を考えるうえに重要である。なお，その他，*Minojapanella* や *Schubertella* がみいだされる。また，後者の仲間の新属 *Biwaella* がみとめられた。

一方，*Parafusulina* が優勢であって *Neoschwagerina* の primitive forms を伴なう別の化石群は，二疊紀中期前半の地質時代を指示する。この化石群には，少数の *Pseudodoliolina* や *Yangchienia* も含まれている。*Codonofusiella* の稀にみとめられるのも注目に値する。*Biwaella* や *Misellina* も産するが，下部二疊系におけるほどには多くはない。

PLATES, TABLES OF MEASUREMENTS AND EXPLANATIONS

(with 21 Plates)

PLATE I

Figs. 1~16 *Biwaella omiensis* MORIKAWA et ISOMI, n. sp.
1~8, 12, 13, 16, axial sections; 1, holotype; 2, 5, 7, 13, enlargements of 1, 4, 6, 12, respectively; 14, 15, oblique axial sections; 9~11, sagittal sections
1, 3, 4, 6, 8~10, 12, 14~16, all ×20; 2, 5, 7, 11, 13, all ×50

Loc. 1~3, 6, 7, 12, 13, Minamitoba; 4, 5, 8~11, Yadani; 14, Iwasayama; 15, 16, Nagaoka

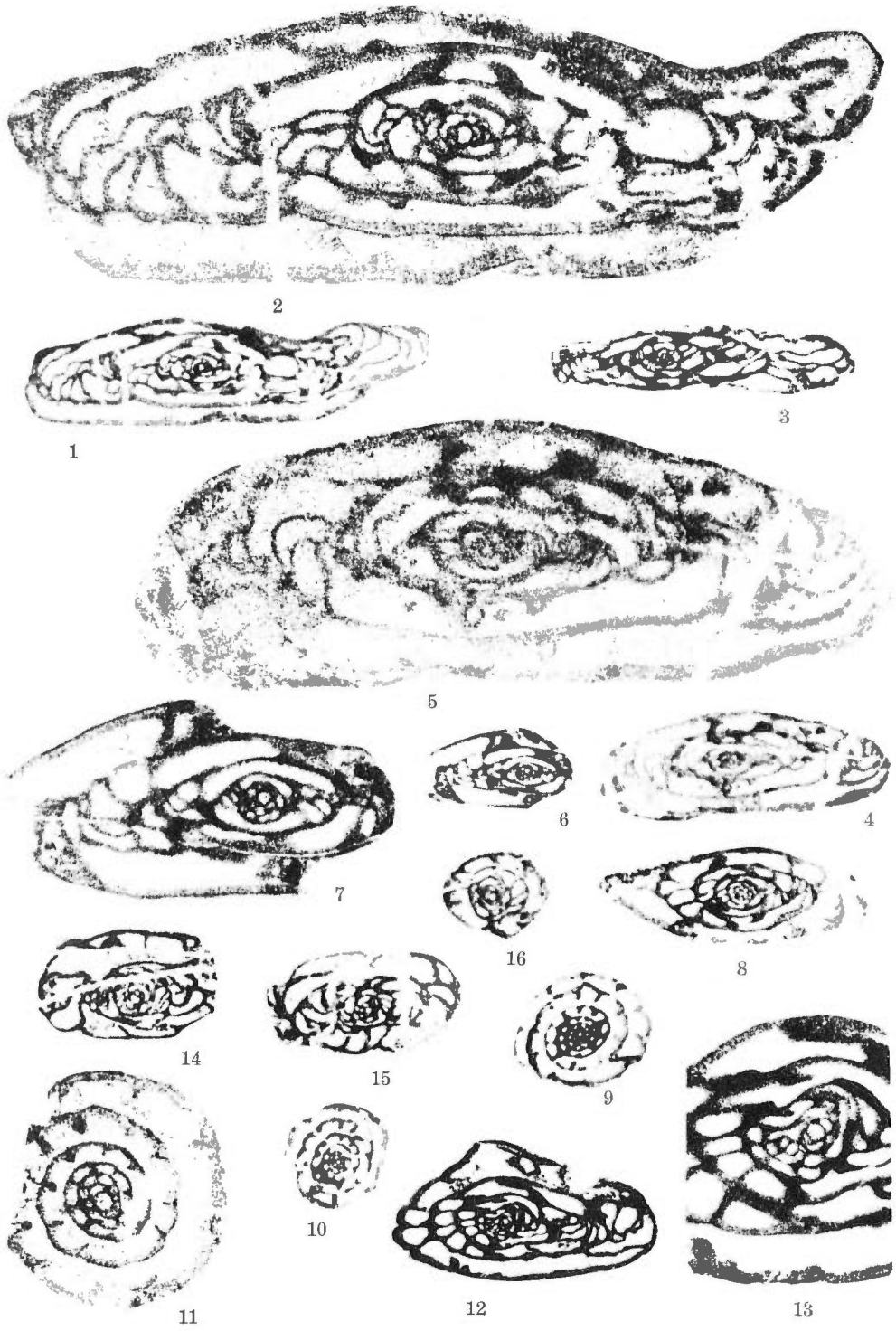
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PLATE II

Figs. 1~9, 16 *Schubertella yadaniensis* MORIKAWA et ISOMI, n. sp.
1~5, 9, axial sections; 1, holotype; 2, enlargement of 1; 7, 16, sagittal sections
1, 3, 4, 6~9, all ×20; 2, 5, 16, all ×50
Loc. 1~5, 7, 16, Yadani; 6, Sukawa; 8, Manganji; 9, Hongo

Figs. 10~15 *Minojapanella elongata* FUJIMOTO et KANUMA
10~12, axial sections; 11, enlargement of 1; 13, tangential section; 14, 15, sagittal sections
10, 12~15, all ×20; 11, ×50
Loc. 10~15, Minamitoba

Figs. 17~20 *Neoschwagerina rotunda* (DEPRAT)
18, 19, axial sections; 20, sagittal section; 17, sagittal section of small form;
all ×10
Loc. 17~20, Onogi


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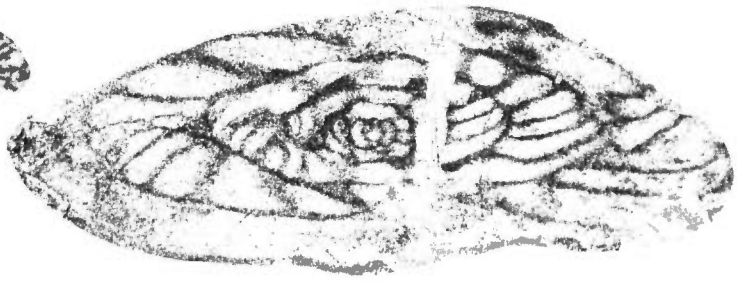
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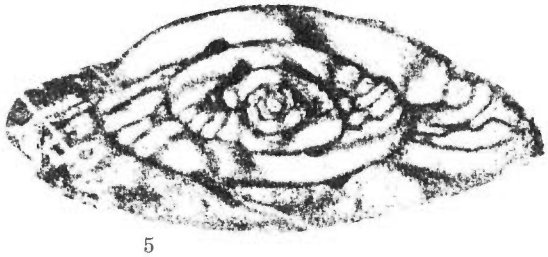
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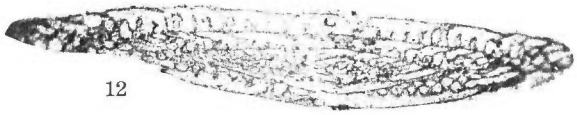
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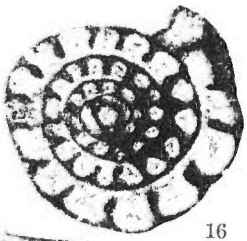
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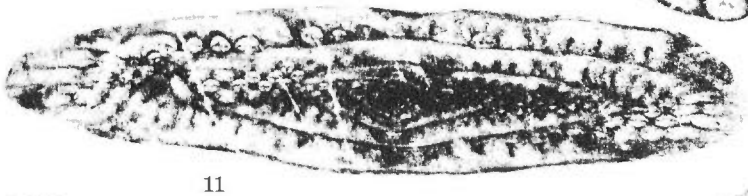
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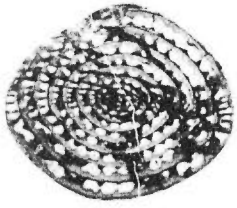
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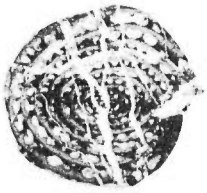
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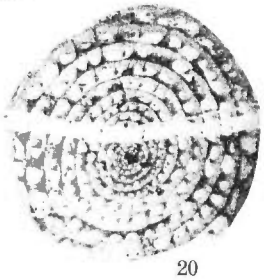
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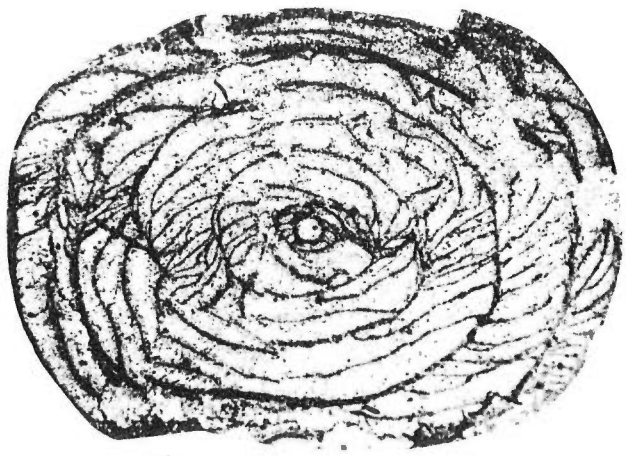
PLATE III

Figs. 1, 2 *Pseudoschwagerina* (*Zellia*) *nunosei* HANZAWA
1, axial section; 2, sagittal section
both ×10
Loc. 1, 2, Hongo

Figs. 3~5 *Paraschwagerina akiyoshiensis* TORIYAMA
3, 4, axial sections; 5, sagittal section
all ×10
Loc. 3, Itando; 4, 5, Horibe

Figs. 6~8 *Neoschwagerina* sp.
6, 8, axial sections; 7, tangential section
all ×10
Loc. 6~8, Iwasayama



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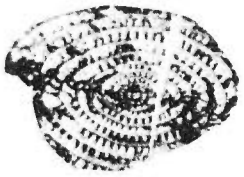

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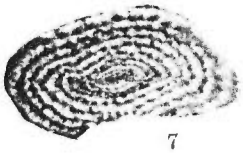

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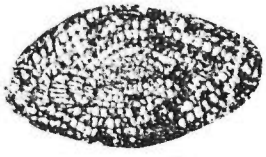

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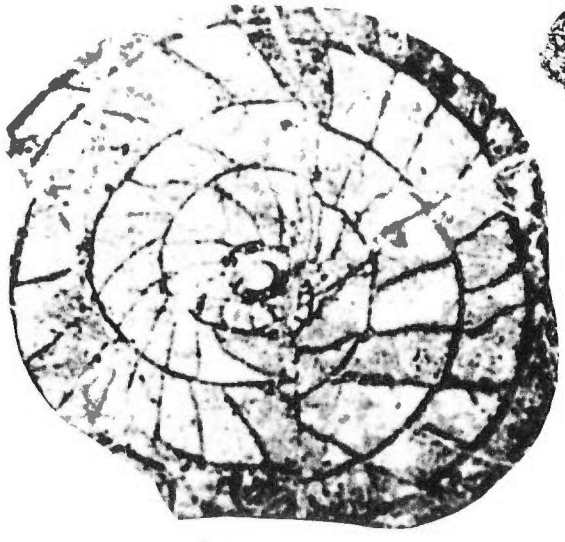

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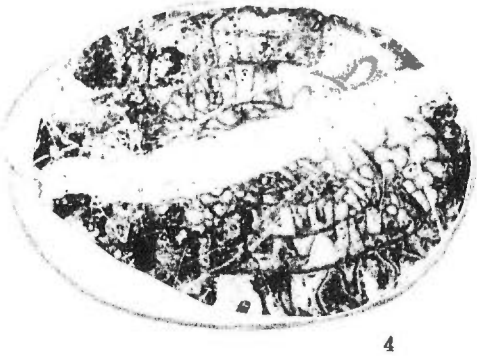

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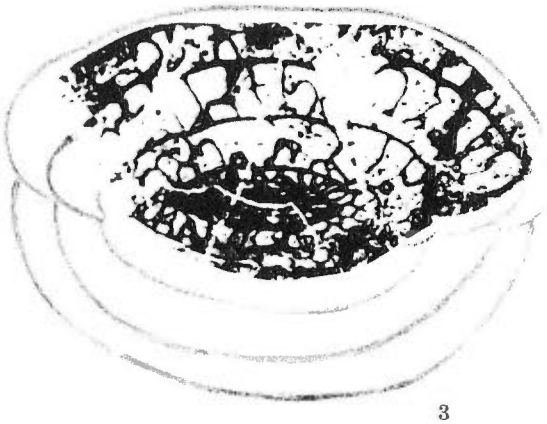

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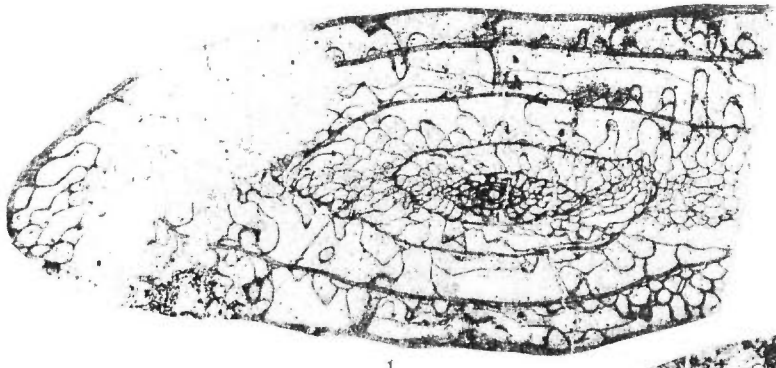
PLATE IV

Figs. 1~6 *Paraschwagerina* (*Acervoschwagerina*) *endoi* HANZAWA
1~4, axial sections; 5, 6, sagittal sections
all ×10

Loc. 1, Minamitoba; 2~6, Yadani



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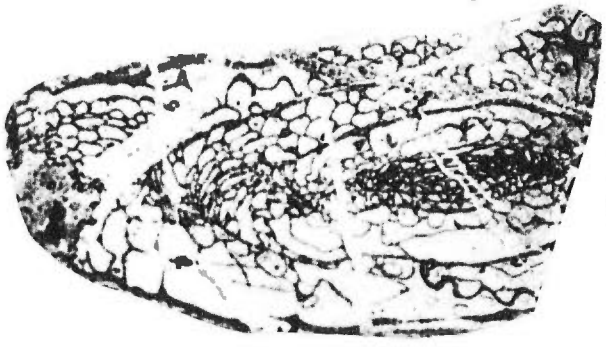

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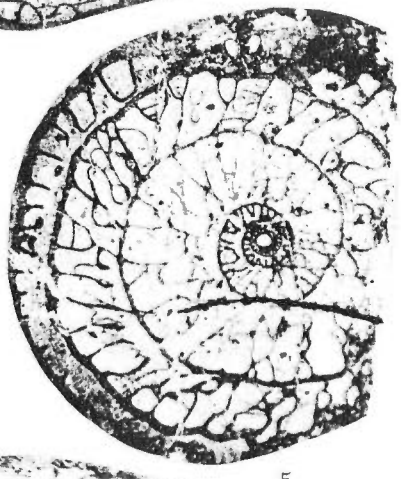

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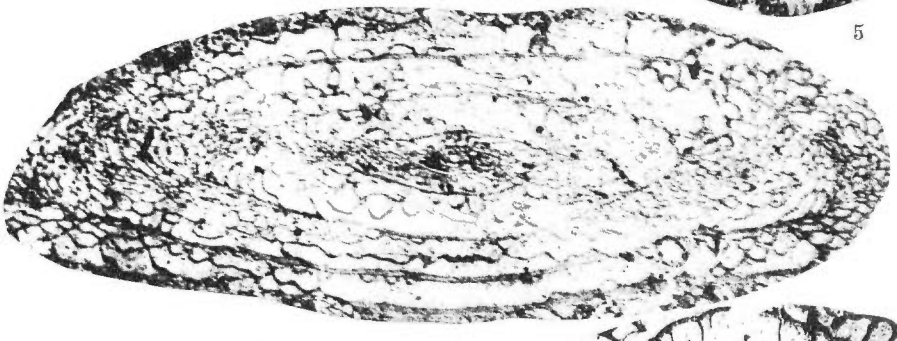

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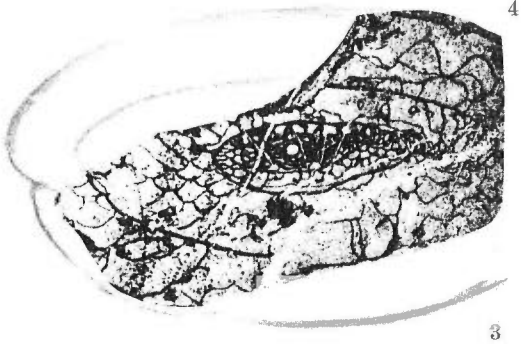

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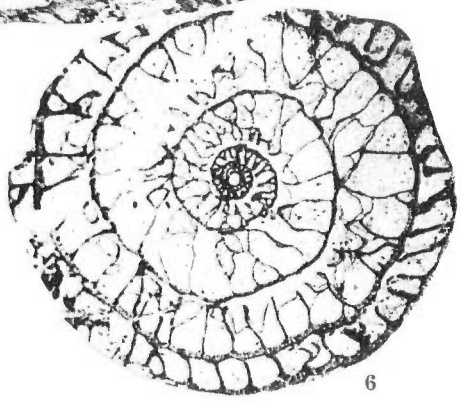

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PLATE V

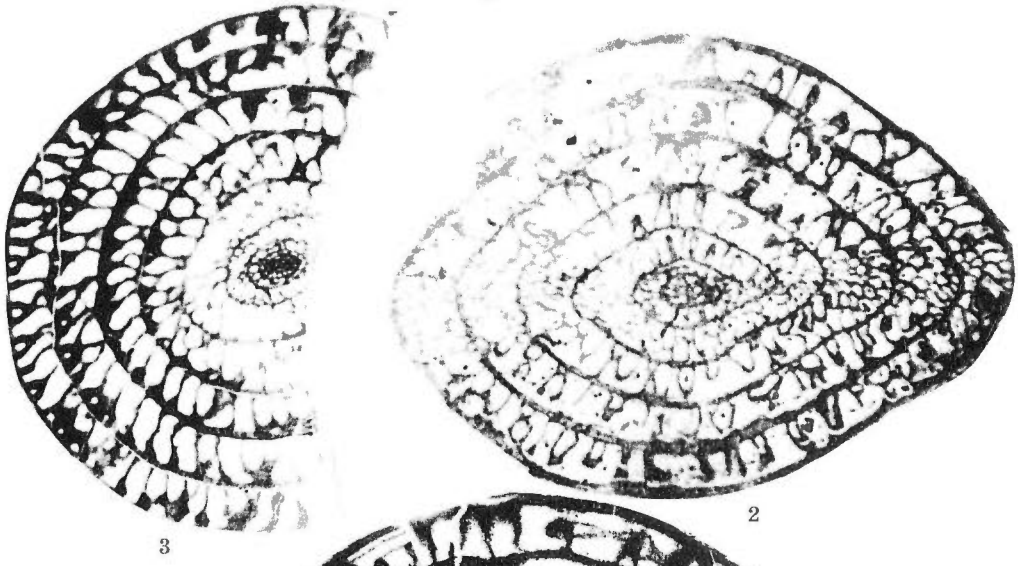
Figs. 1~3 *Paraschwagerina gigantea* (WHITE)
1, 2, slightly tangential axial sections; 3, sagittal section
all ×10

Loc. 1, Iwakurayama; 2, Sukawa; 3, Manganji

Fig. 4 *Paraschwagerina* aff. *kansasensis* (BEEDE et KNIKER)
4, oblique axial section
×10

Loc. 4, Itando

1



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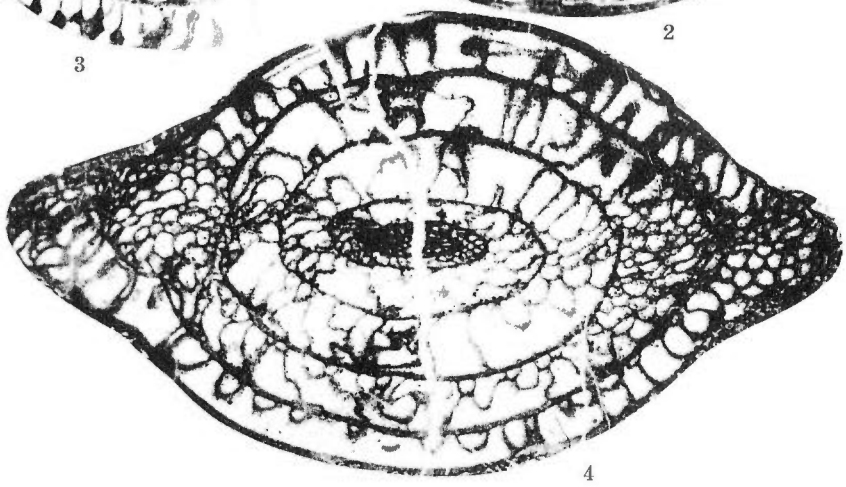

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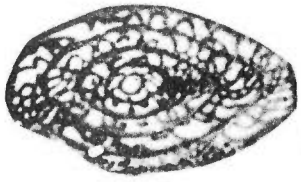
PLATE VI

Figs. 1~8 *Pseudofusulina okafujii* (TORIYAMA)
(See also Pl. XV)
1~3, 6, 7, axial sections; 4, 5, oblique axial sections; 8, sagittal section
all ×10
Loc. 1, 3~6, 8, Manganji; 2, Nagaoka; 7, Hongo

Figs. 9~14 *Pseudofusulina bacca* MORIKAWA et ISOMI, n. sp.
10~14, axial sections; 11, holotype; 9, sagittal section
all ×10
Loc. 9, 10, Manganji; 11, 12, Onogi; 13, Hongo; 14, Nagaoka

Fig. 15 *Pseudofusulina* aff. *subtilis* (SCHELLWIEN)
15, axial section
×10
Loc. 15, Onogi

Fig. 16 *Pseudofusulina* aff. *valida* (LEE)
16, axial section
×10
Loc. 16, Onogi



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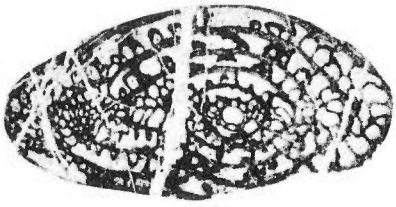

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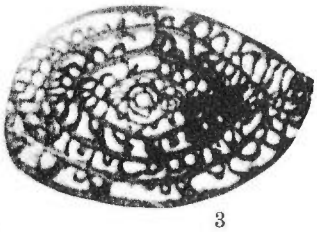

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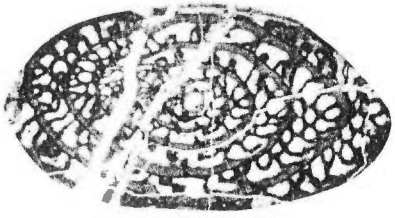

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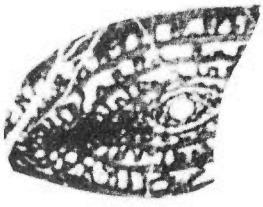

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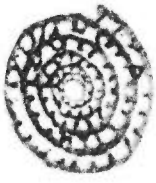

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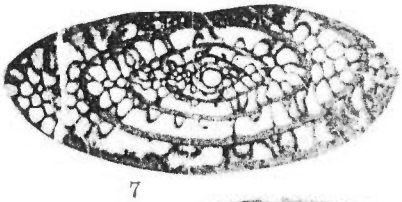

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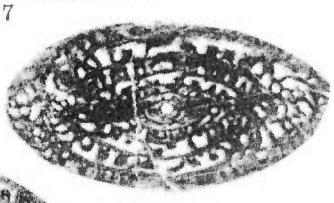

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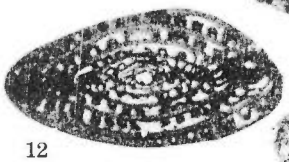

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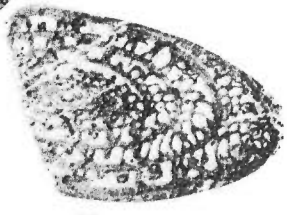

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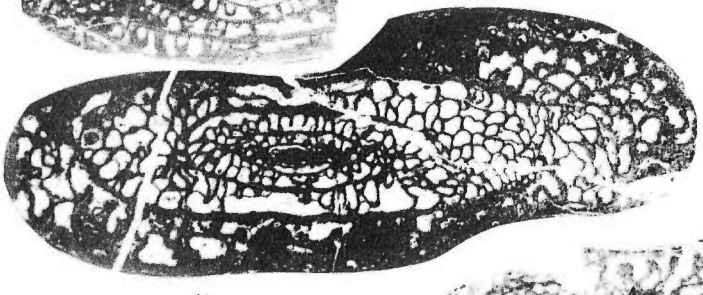

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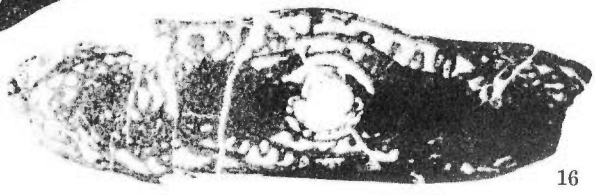

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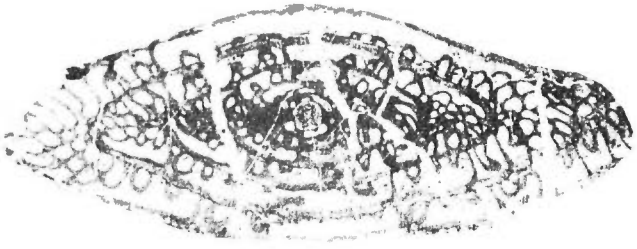
PLATE VII

Figs. 1~10 *Pseudofusulina regularis* (SCHELLWIEN)
1~3, axial sections; 4, 5, axial sections of short forms; 8, axial section of small form; 6, 7, oblique sections; 9, 10, sagittal sections
all ×10
Loc. 1, 2, 5, 6, 8~10, Ikenooku; 3, 7, Manganji; 4, Hongo

Figs. 11, 12 *Pseudofusulina fusiformis* (SCHELLWIEN et DYHRENFURTH)
(See also Pl. VII, VIII, X~XIII)
11, 12, axial sections of small forms
both ×10
Loc. 11, 12, Sukawa

Fig. 13 *Parafusulina takeyamai* MORIKAWA et ISOMI, n. sp.
(See also Pl. XIX)
13, axial section
×10
Loc. 13, Iwasayama



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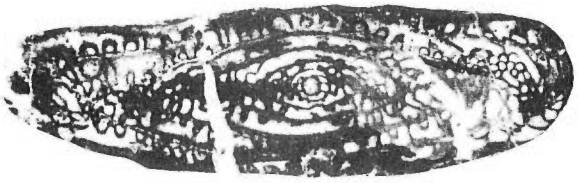

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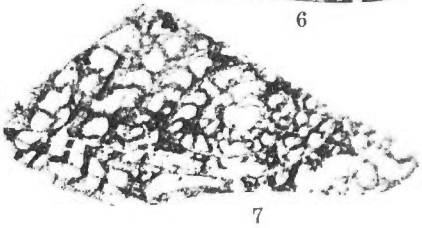

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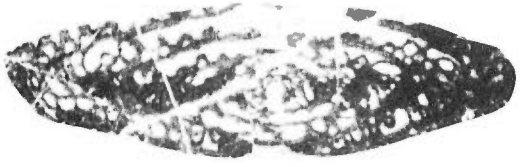

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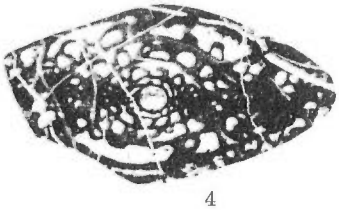

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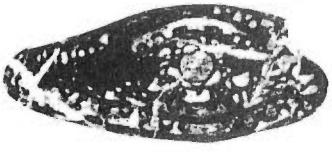

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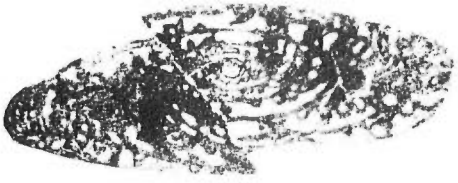

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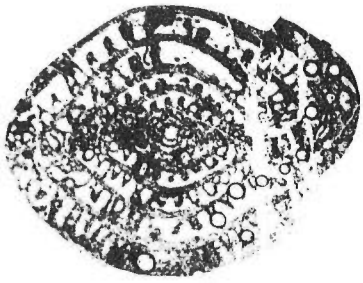
PLATE VIII

Figs. 1~11 *Pseudofusulina krotowi* (SCHELLWIEN)
1~6, axial sections; 7, 8, slightly tangential sections; 9~11, sagittal sections
all ×10
Loc. 1~5, 7~10, Manganji; 6, 11, Nagaoka

Figs. 12, 13 *Pseudofusulina fusiformis* (SCHELLWIEN et DYHRENFURTH)
(See also Pl. VII, X~XIII)
12, 13, sagittal sections
both ×10
Loc. 12, 13, Minamitoba



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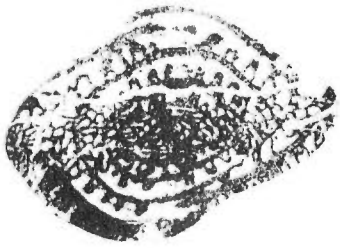

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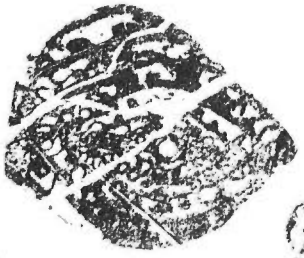

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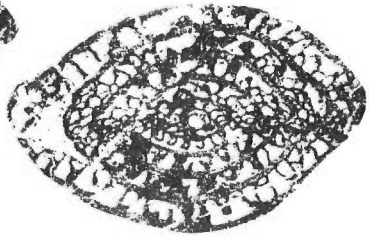

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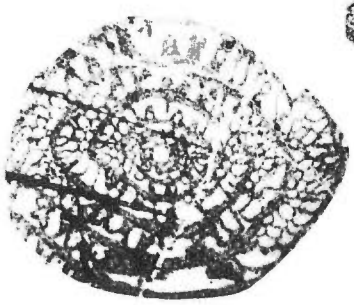

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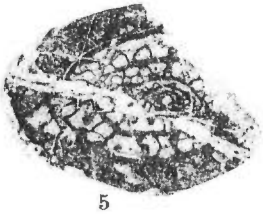

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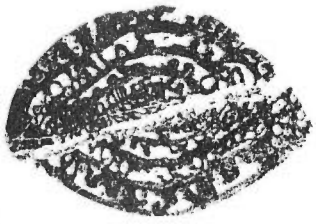

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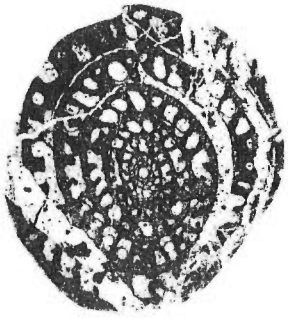

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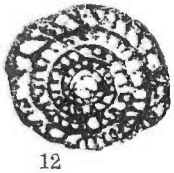

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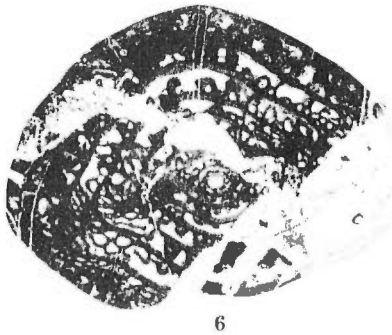

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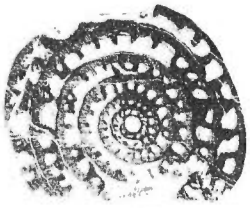

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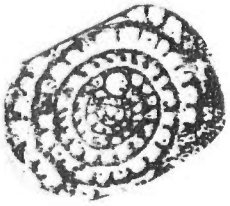

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PLATE IX

Figs. 1~11 *Pseudofusulina cushmani* CHEN

1~5, axial sections; 6, 7, axial sections of young forms; 8, 9, 11, sagittal sections; 10, oblique section

all ×10

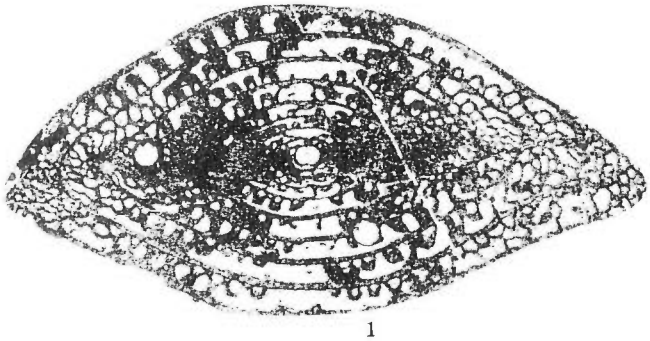
Loc. 1, 10, Manganji; 3, 5~7, 9, 11, Yadani; 2, 4, 8, Minamitoba

Figs. 12~14 *Yangchienia* sp.

14, axial section; 12, oblique section; 13, sagittal section

14, ×20; 12, 13, both ×10

Loc. 12, 13, Iwasayama; 14, Onogi



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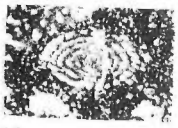

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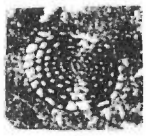

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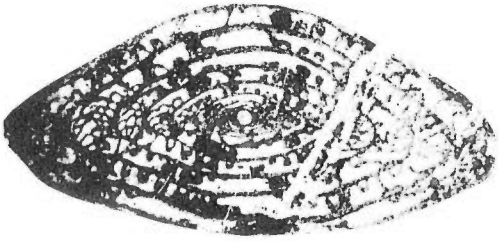

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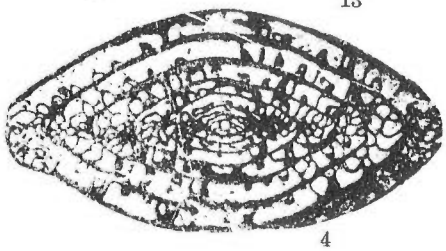

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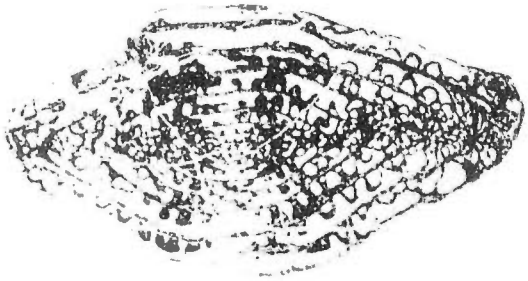

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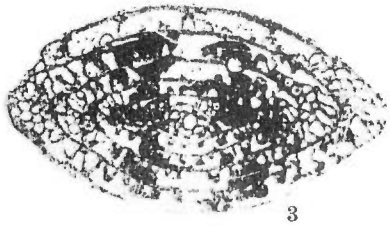

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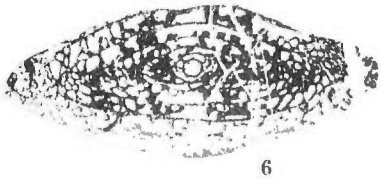

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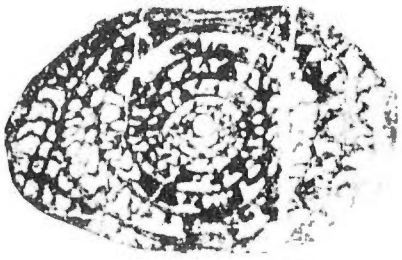

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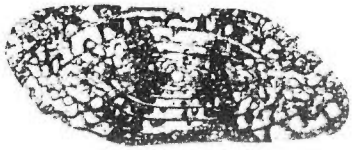

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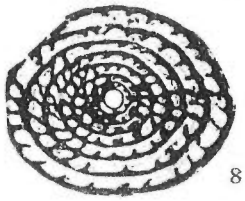

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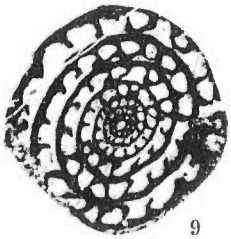

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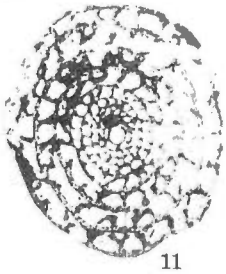

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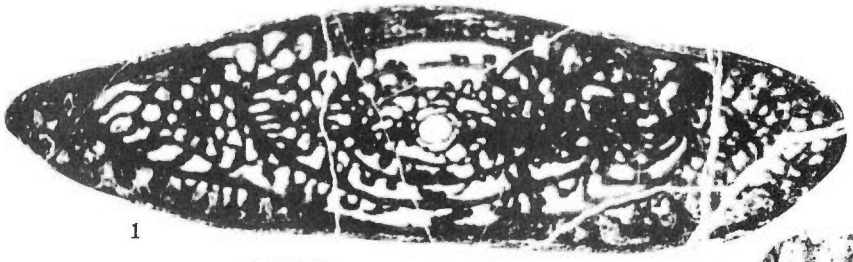
PLATE X

Figs. 1~10 *Pseudofusulina fusiformis* (SCHELLWIEN et DYHRENFURTH)
(See also Pl. VII, VIII, XI~XIII)
1~6, axial sections; 7, axial section of young form; 8~10, sagittal sections
all ×10

Loc. 1, 6, Manganji; 2~5, 8, 9, Yadani; 7, Sukawa; 10, Minamitoba



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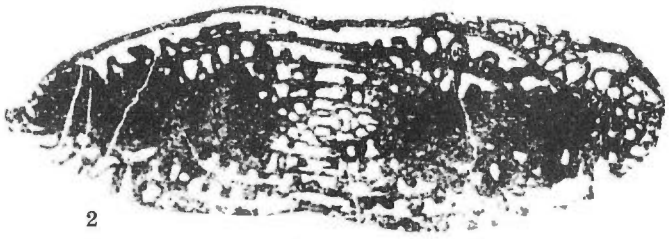

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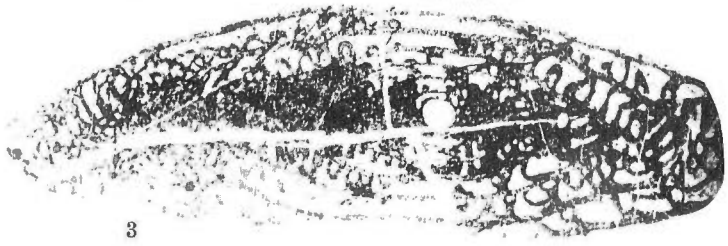

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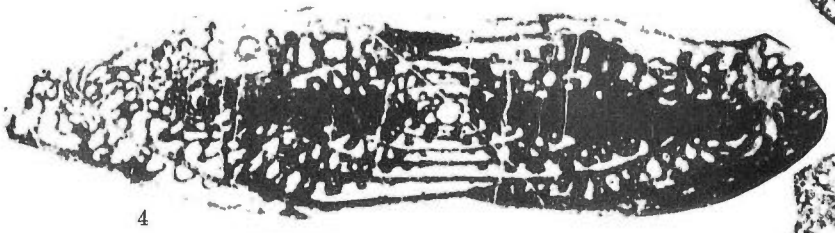

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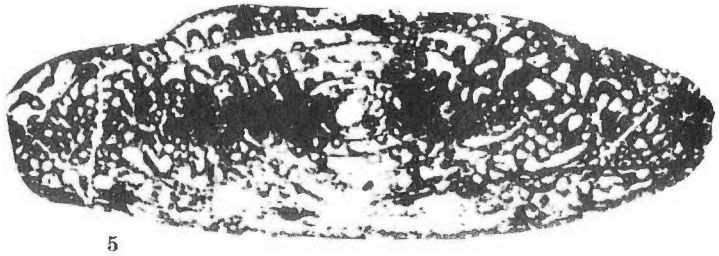

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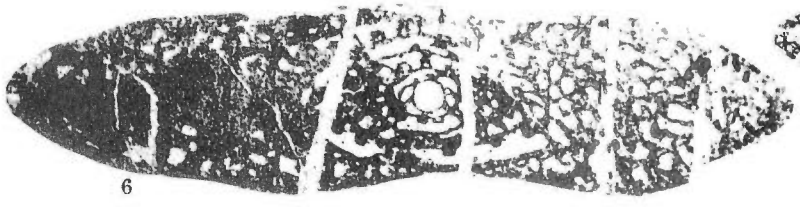

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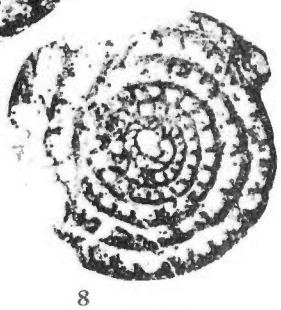

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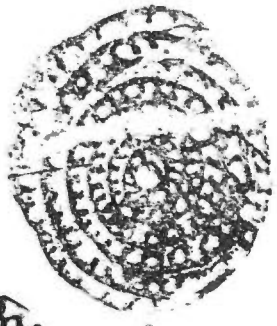

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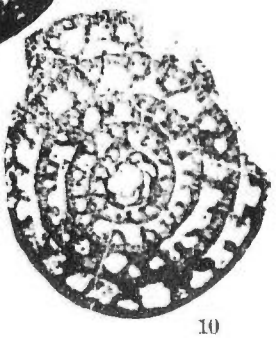

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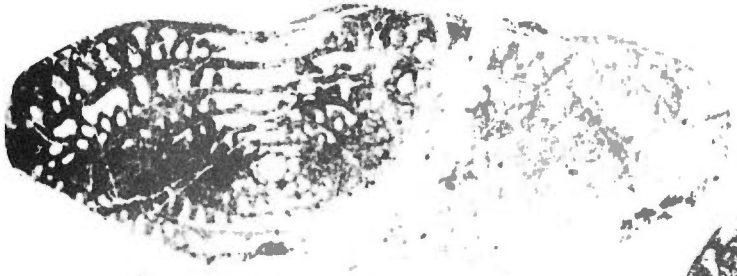
PLATE XI

Figs. 1~10 *Pseudofusulina fusiformis* (SCHELLWIEN et DYHRENFURTH)
(See also Pl. VII, VIII, X, XII, XIII)
1~3, axial sections; 4~7, axial sections of small forms; 8, 9, axial sections of young forms; 10, sagittal section
all ×10

Loc. 1~4, Yadani; 5, 7, Minamitoba; 6, Sukawa; 8, Onogi; 9, 10, Manganji


1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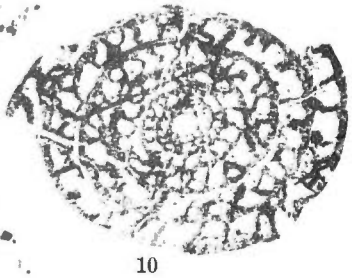
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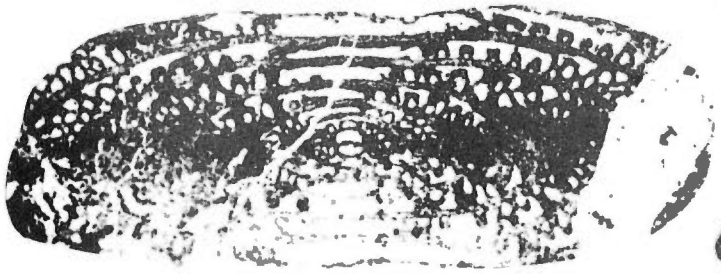
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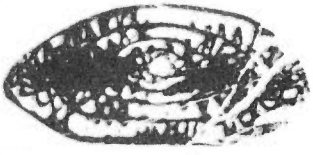
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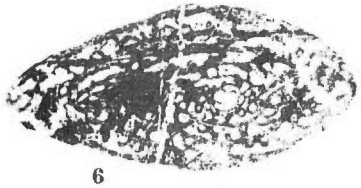
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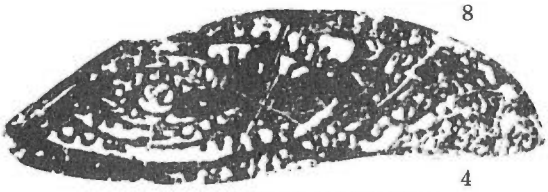
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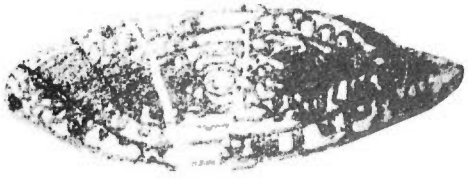
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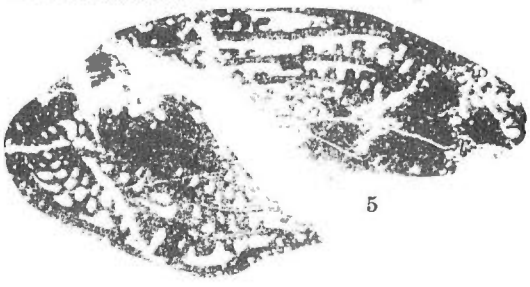
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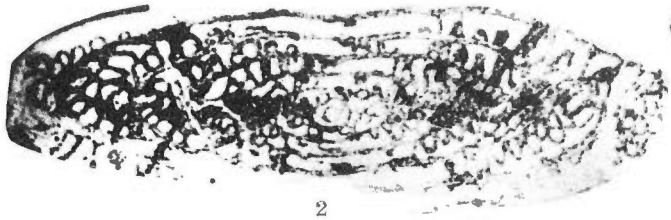
PLATE XII

Figs. 1~10 *Pseudofusulina fusiformis* (SCHELLWIEN et DYHRENFURTH)
(See also Pl. VII, VIII, X, XI, XIII)
1~5, 9, axial sections; 6~8, axial sections of young forms; 10, sagittal section
all ×10

Loc. 1~3, 5, 6, 9, Yadani; 4, 10, Minamitoba; 7, 8, Sukawa

1



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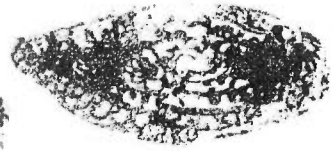

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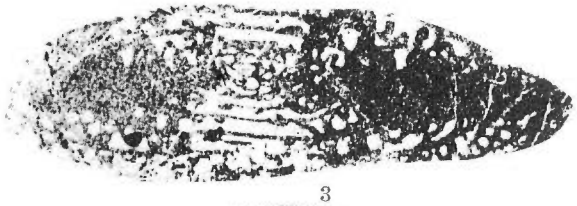

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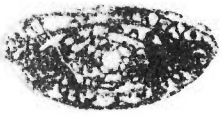

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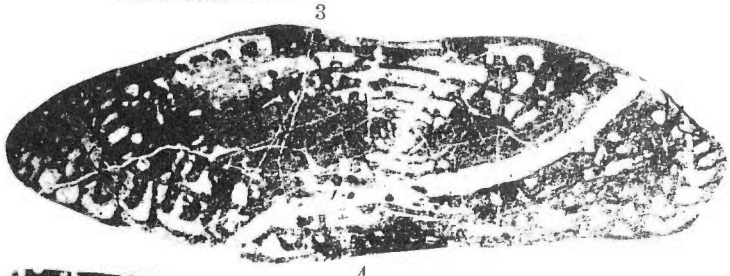

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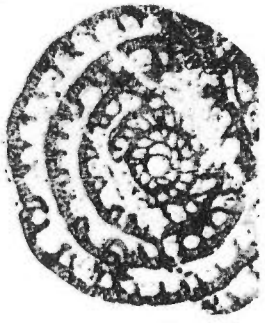

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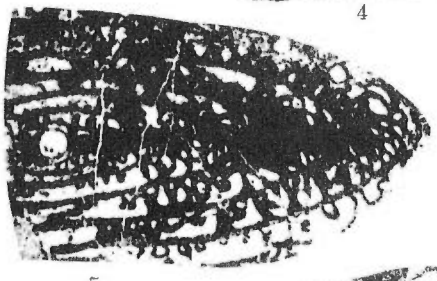

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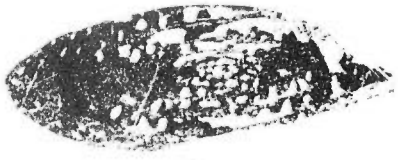

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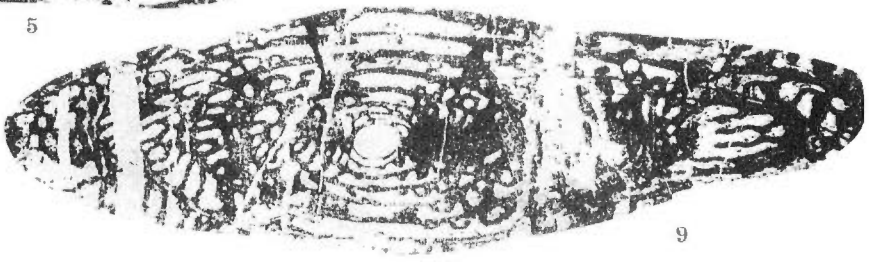

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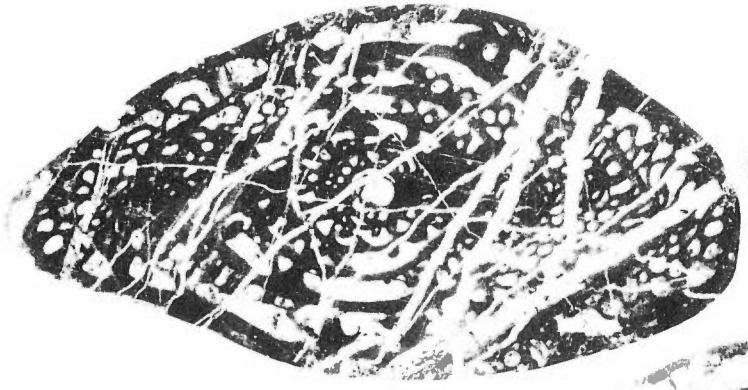
PLATE XIII

Figs. 1~4 *Pseudofusulina vulgaris* (SCHELLWIEN)
1~4, axial sections
all ×10
Loc. 1, Hongo; 2, Sukawa; 3, Sengokudani; 4, Horibe

Fig. 5 *Pseudofusulina fusiformis* (SCHELLWIEN et DYHRENFURTH)
(See also Pl. VII, VIII, X~XII)
5, sagittal section
×10
Loc. 5, Manganji

Figs. 6~11 *Pseudofusulina globosa* (DEPRAT)
6~8, axial sections; 9, axial section of young form; 10, 11, sagittal sections
all ×10
Loc. 6~11, Minamitoba



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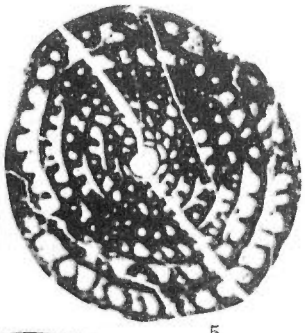

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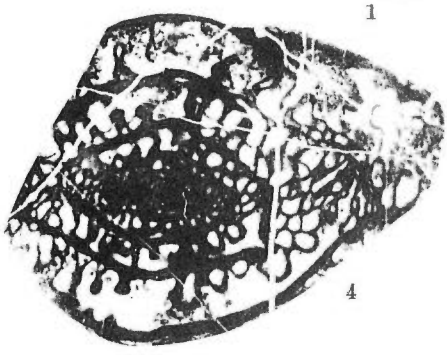

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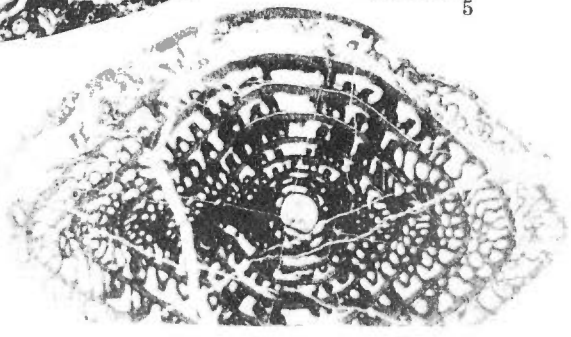

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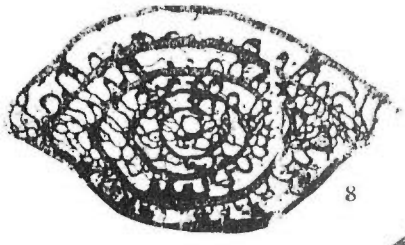

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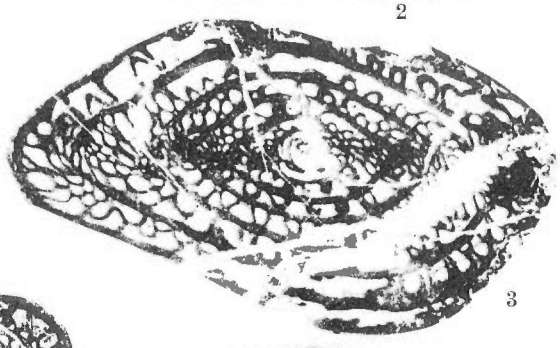

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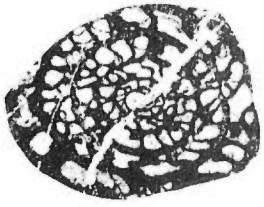

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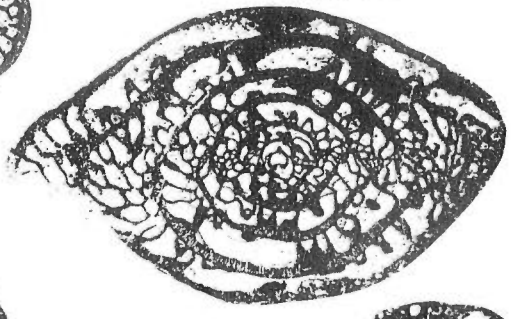

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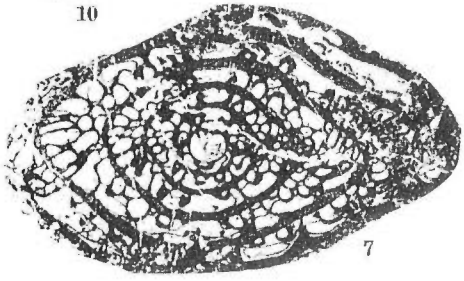

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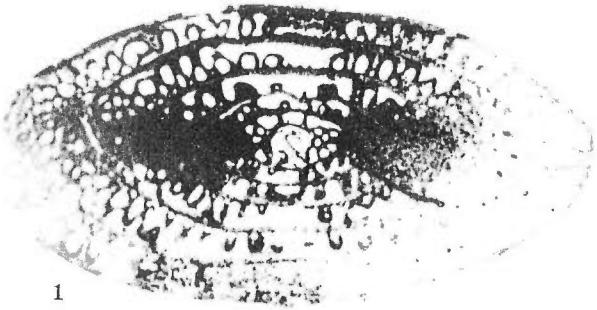
PLATE XIV

Figs. 1~10 *Pseudofusulina kraffti* (SCHELLWIEN)
(See also Pl. XV)
1~8, axial sections; 9, 10, sagittal sections
all ×10

Loc. 1, Sukawa; 2, 4, Onogi; 3, 6, 7, Yadani; 5, 8~10, Nagaoka



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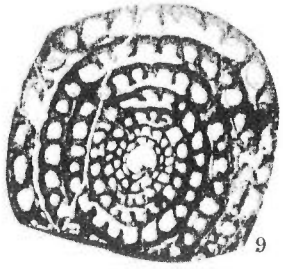

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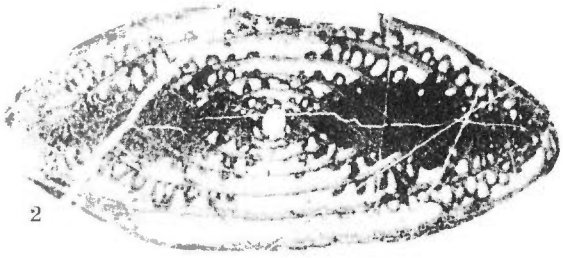

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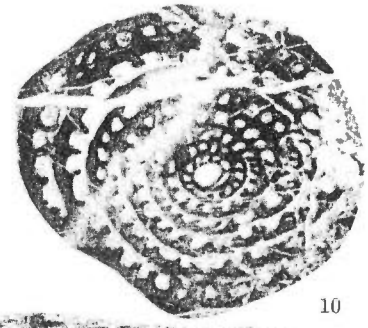

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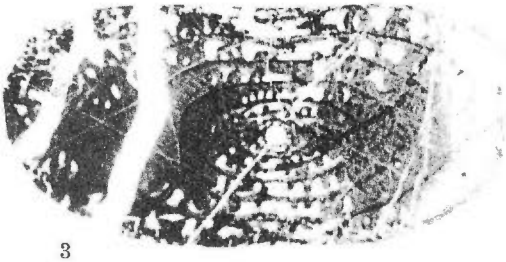

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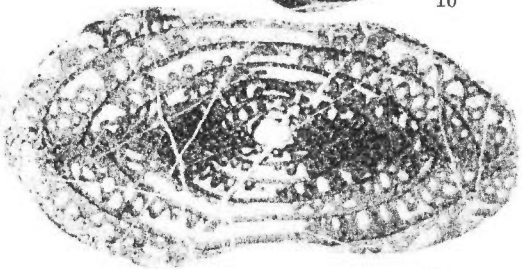

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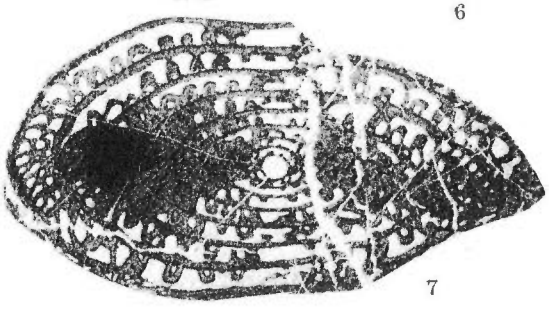

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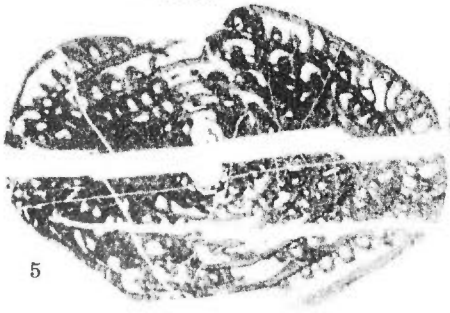

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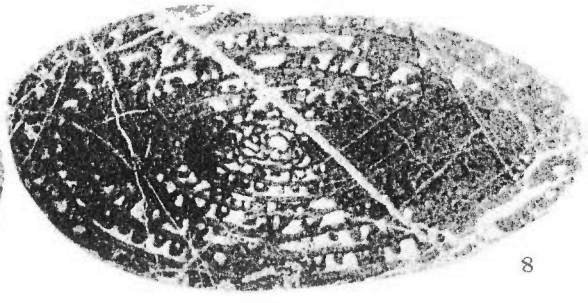

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PLATE XV

Figs. 1~4 *Pseudofusulina norikurensis* IGÔ
(See also Pl. XVI)
1~3, axial sections; 4, oblique axial section
all ×10
Loc. 1~4, Sukawa

Figs. 5, 6 *Pseudofusulina kraffti* (SCHELLWIEN)
(See also Pl. XIV)
5, 6, axial sections of specimens having large proloculus
both ×10
Loc. 5, 6, Sukawa

Figs. 7, 8 *Pseudofusulina okafujii* (TORIYAMA)
(See also Pl. VI)
8, axial section; 7, sagittal section
both ×10
Loc. 7, 8, Manganji

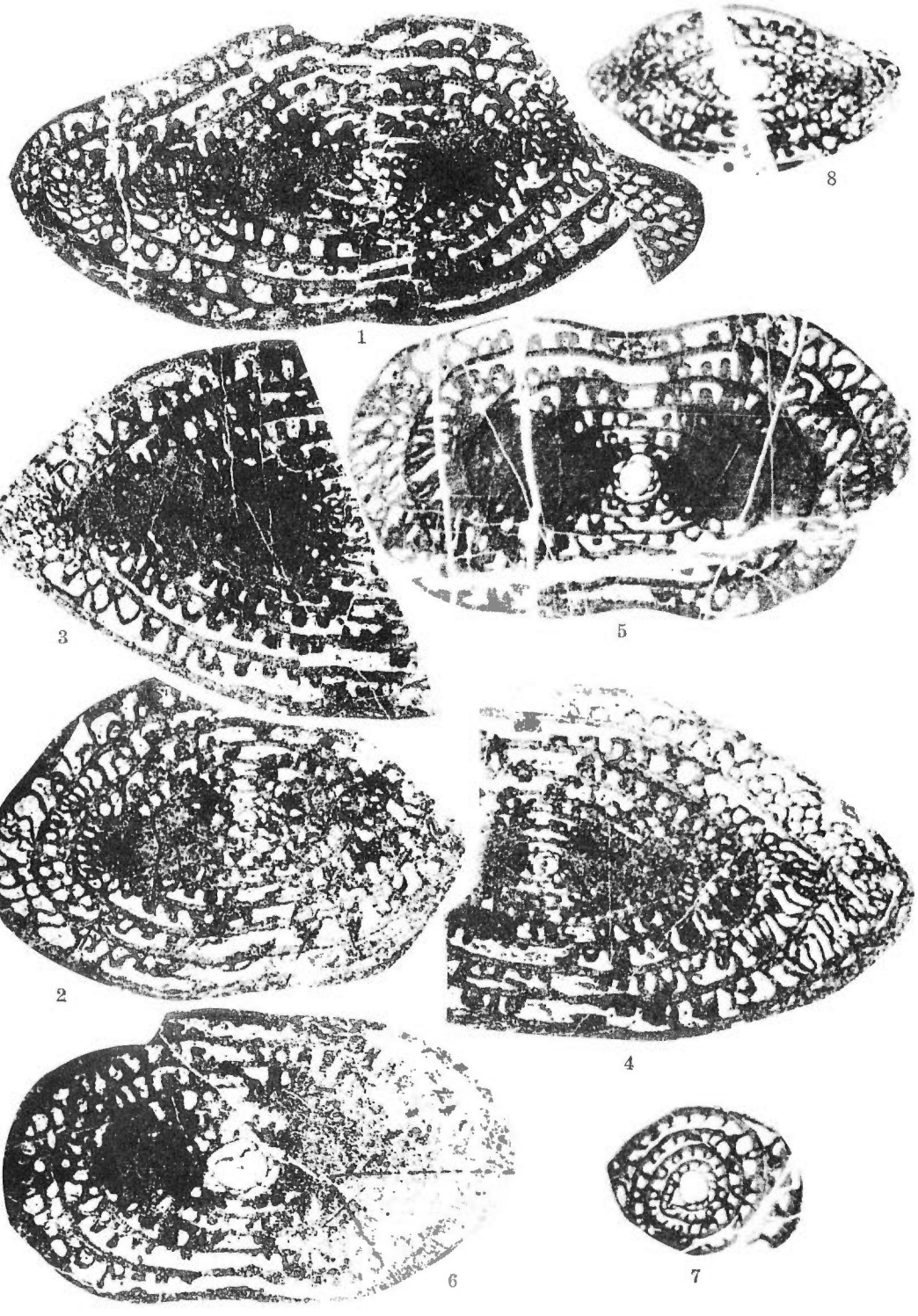


PLATE XVI

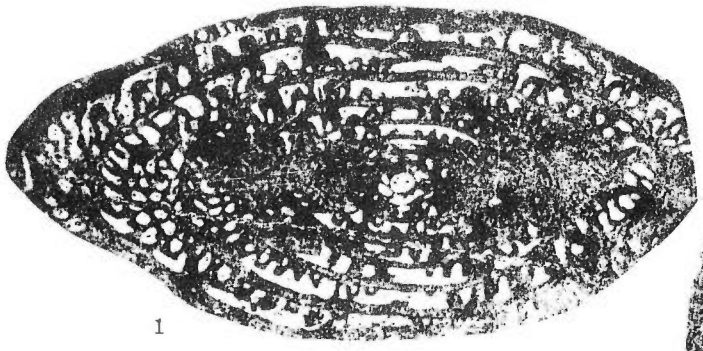
Figs. 1~7 *Pseudofusulina norikurensis* IGÔ

(See also Pl. XV)

1~4, 7, axial sections; 5, 6, sagittal sections

all ×10

Loc. 1~7, Sukawa



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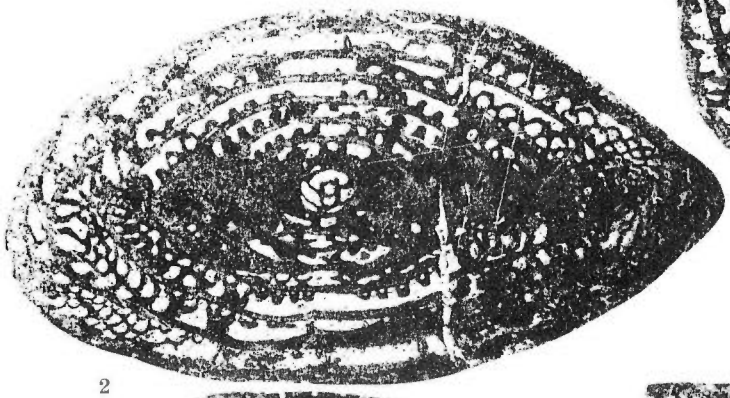

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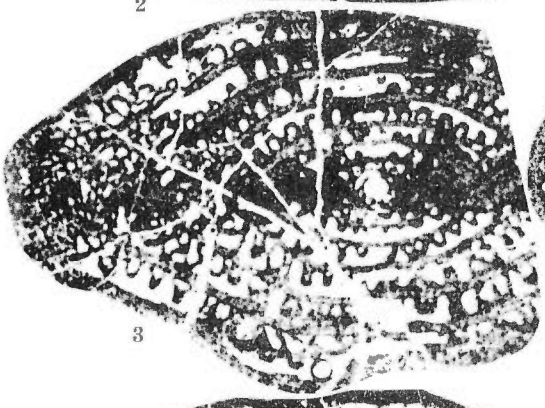

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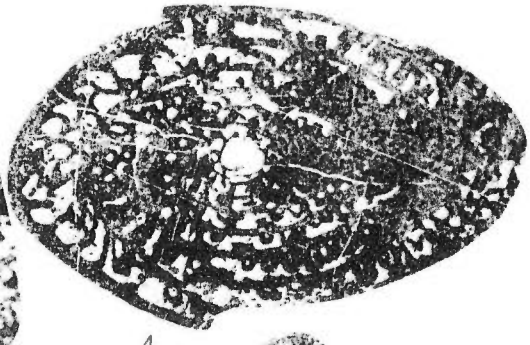

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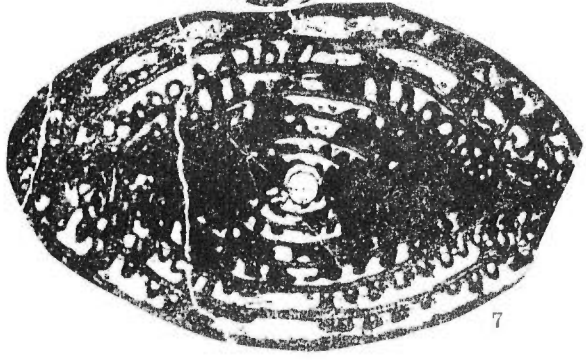

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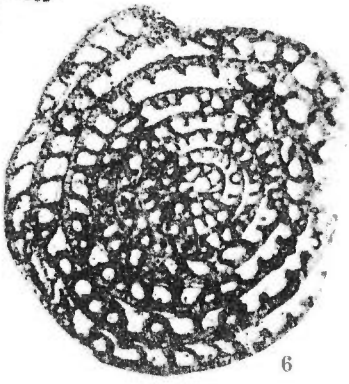

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PLATE XVII

Figs. 1～9 *Parafusulina parakinosakii* MORIKAWA et ISOMI, n. sp.
1～6, 8, axial sections; 1, holotype; 7, axial section of young form; 9, sagittal section
all ×10

Loc. 1～9, Iwasayama

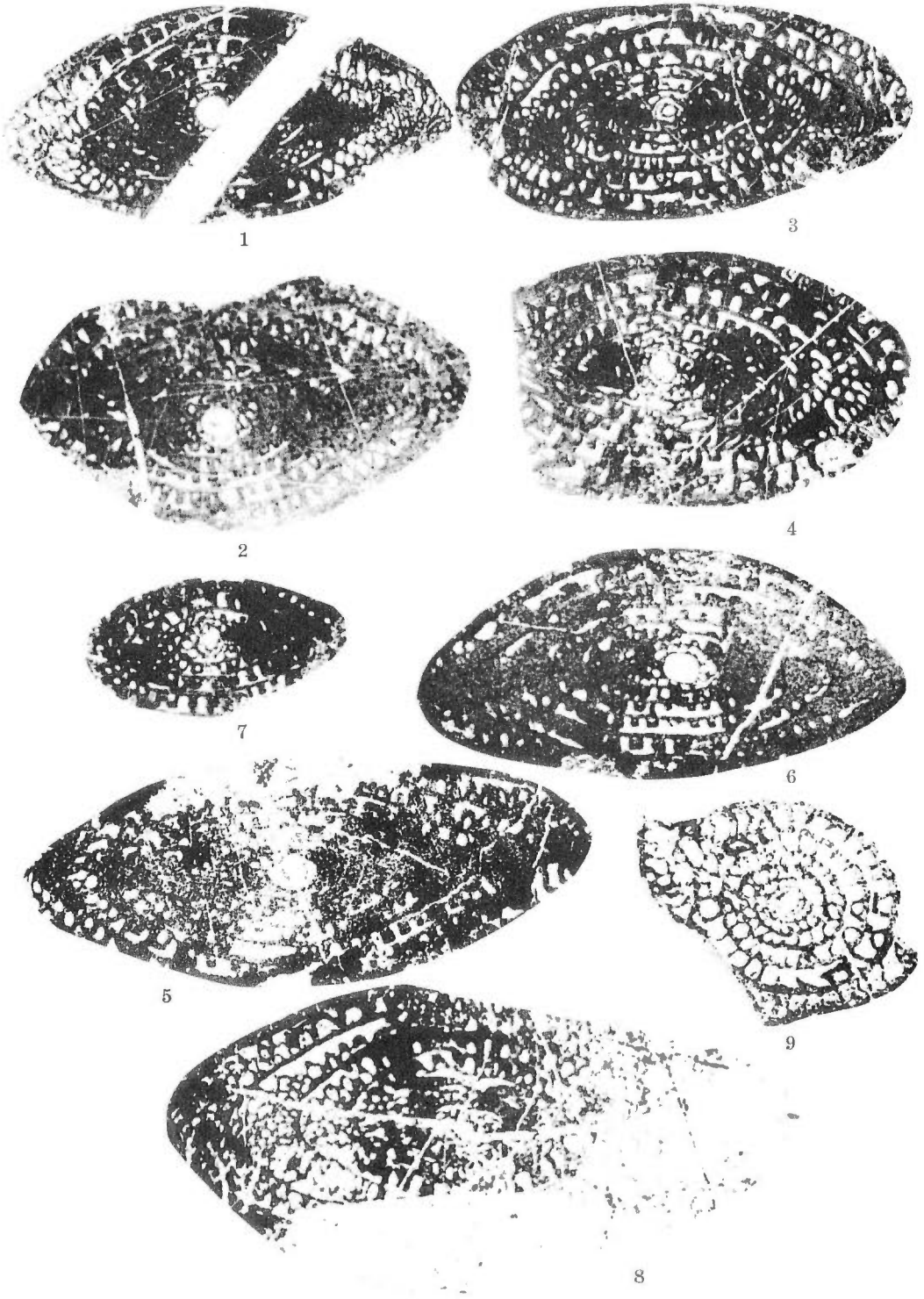

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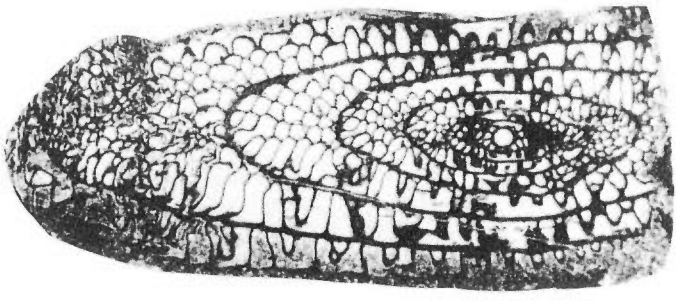
PLATE XVIII

Figs. 1~7 *Parafusulina iwasensis* MORIKAWA et ISOMI, n. sp.
1~3, axial sections; 1, holotype; 4, 5, oblique sagittal sections; 6, sagittal section of young form; 7, axial section of inflated form
all ×10
Loc. 1~7, Iwasayama

Figs. 8, 9 *Parafusulina exilis* (SCHWAGER)
8, 9, axial sections
both ×10
Loc. 8, 9, Iwasayama

Figs. 10~12 *Pseudodoliolina ozawai* YABE et HANZAWA
10~12, axial sections
all ×10
Loc. 10~12, Iwasayama



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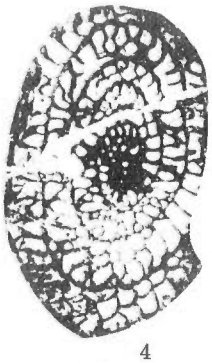

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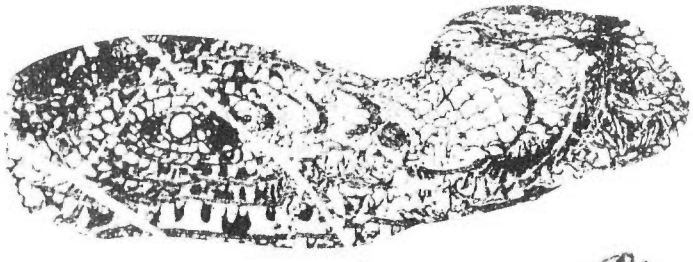

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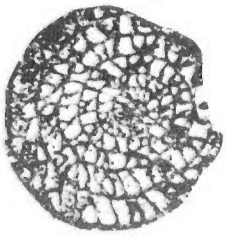

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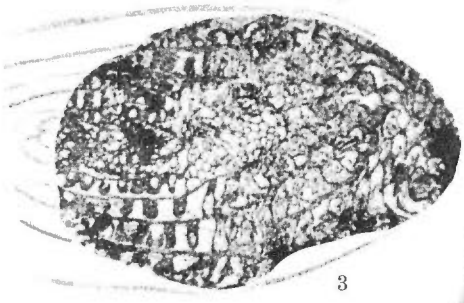

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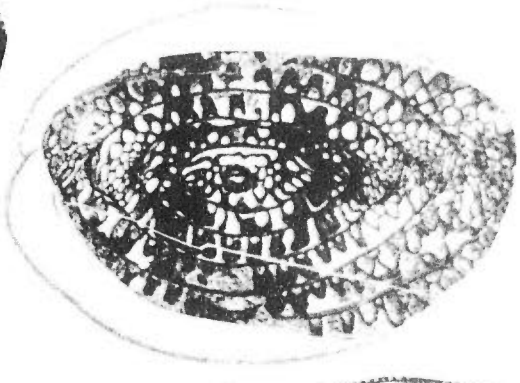

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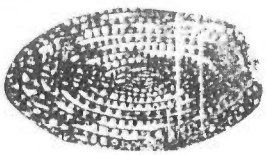

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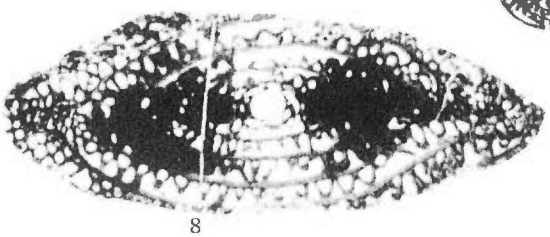

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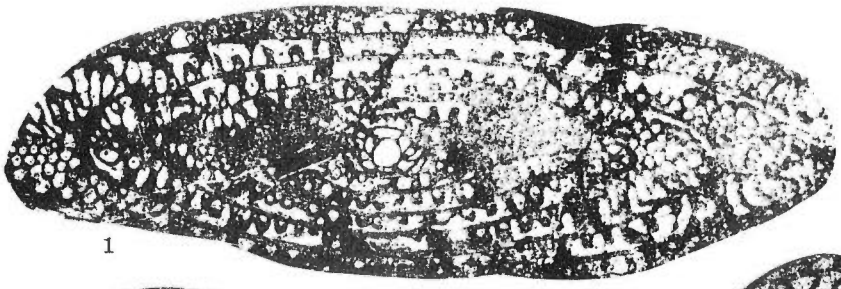
PLATE XIX

Figs. 1~8 *Parafusulina takeyamai* MORIKAWA et ISOMI, n. sp.
(See also Pl. VII)
1~5, axial sections; 1, holotype; 6~8, sagittal sections
all ×10

Loc. 1~8, Iwasayama



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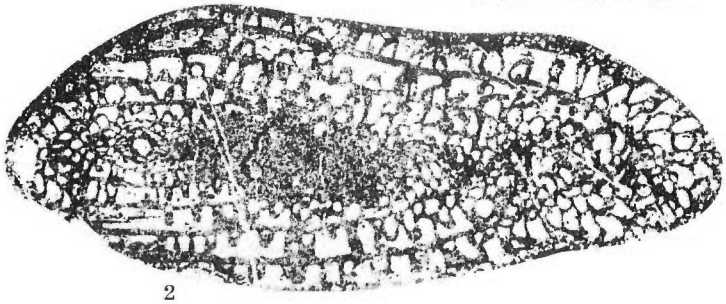

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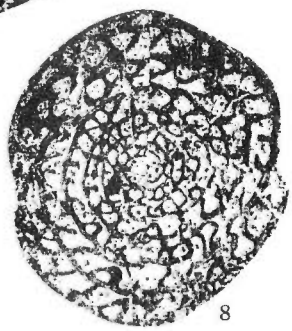

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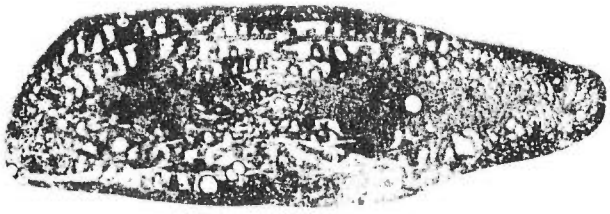

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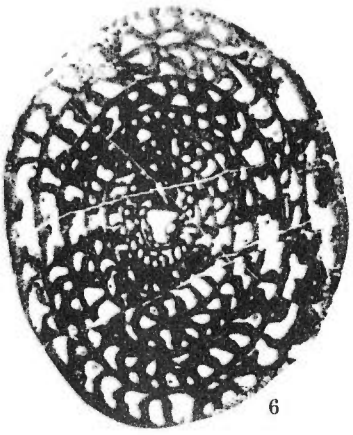

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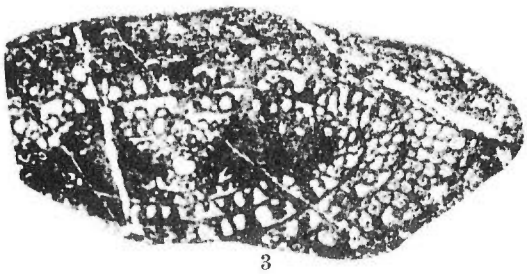

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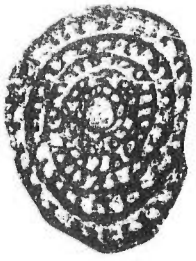

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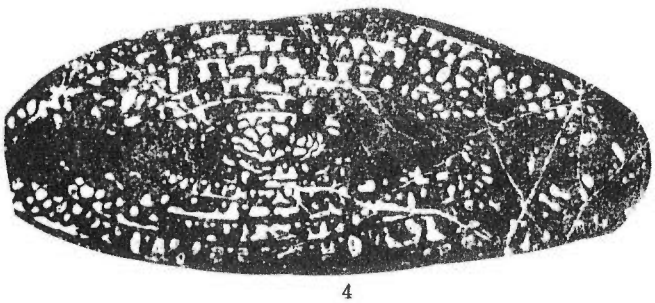

4

PLATE XX

Figs. 1~5 *Pseudofusulina lepida* (DEPRAT)
1~3, axial sections; 4, tangential section; 5, sagittal section
all ×10
Loc. 1~5, Iwasayama

Figs. 6~13 *Nagatoella ikenoensis* MORIKAWA et ISOMI, n. sp.
6~9, axial sections; 6, holotype; 7, enlargement of the holotype; 10, 13, oblique sagittal sections; 11, 12, sagittal sections
6, 8~13, all ×10; 7, ×50
Loc. 6~13, Ikenooku

Fig. 14 *Verbeekina* sp.
14, tangential section
×10
Loc. 14, Iwasayama

Figs. 15~19 *Neoschwagerina nipponica* (OZAWA)
15~18, axial sections; 19, sagittal section
all ×10
Loc. 15~19, Iwasayama


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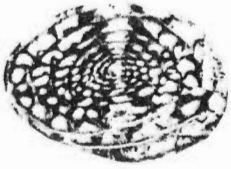
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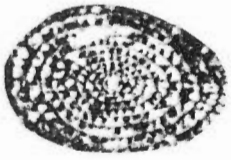
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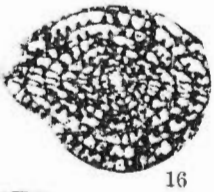
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PLATE XXI

Figs. 1~18 *Misellina ibukiensis* KOBAYASHI

1~6, 12, 13, axial sections; 17, enlargement of 2; 14, 15, axial sections of small forms; 16, tangential section; 7~11, sagittal sections; 18, thin section of limestone containing *Misellina ibukiensis* associated with *Pseudofusulina*

1~16, all ×20; 17, ×50; 18, ×10

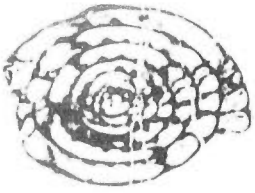
Loc. 1, 2, 10, 13, 16~18, Muraki; 3, 4, Nagaoka; 5~9, 11, 12, Manganji; 14, 15, Sukawa

Fig. 19 *Codonofusiella* sp.

19, axial section

×10

Loc. 19, Iwasayama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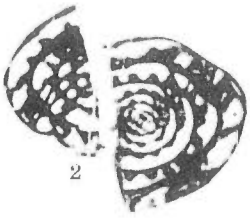
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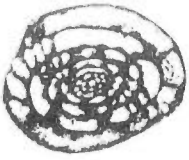
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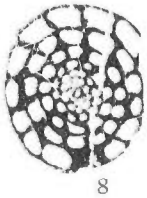
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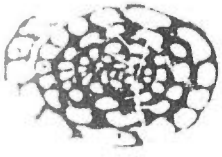
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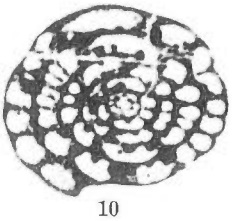
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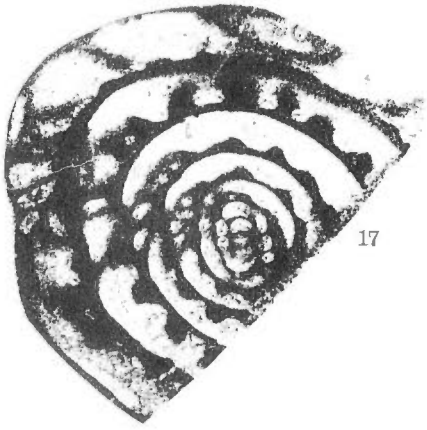
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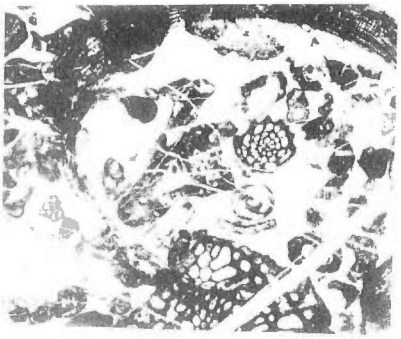
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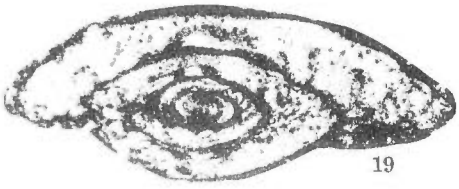
19

Registered Number of the Illustrated Slides

Schubertella yadaniensis MORIKAWA et ISOMI, n. sp.

Pl.	Fig.	Slide No.	Loc.
2	1	ON468–2e	Yadani
2	2	ON468–2e	〃
2	3	ON468b	〃
2	4	ON508a	〃
2	5	ON318a	〃
2	6	ON145a	Sukawa
2	7	OM318c	Yadani
2	8	ON514–2b	Manganji
2	9	OM392	Hongo
2	16	ON318b	Yadani

Yangchienia sp.

Pl.	Fig.	Slide No.	Loc.
9	12	Og6–26	Iwasayama
9	13	Og6–40	〃
9	14	ON364	Onogi

Minojapanella elongata FUJIMOTO et KANUMA

Pl.	Fig.	Slide No.	Loc.
2	10	ON492a	Minamitoba
2	11	ON492a	〃
2	12	ON492b	〃
2	13	ON422	〃
2	14	Og27–23	〃
2	15	Og27–5	〃

Codonofusiella sp.

Pl.	Fig.	Slide No.	Loc.
21	19	ON279	Iwasayama

Biwaella omiensis MORIKAWA et ISOMI, n. sp.

Pl.	Fig.	Slide No.	Loc.
1	1*	ON492–B	Minamitoba
1	2	ON492–B	〃
1	3	ON492a	Minamitoba
1	4	ON468–2h	Yadani
1	5	ON468–2h	〃
1	6	ON248a	Minamitoba
1	7	ON248a	〃
1	8	ON468e	Yadani
1	9	ON315b	〃
1	10	ON315a	〃
1	11	ON468c	〃
1	12	ON467a	Minamitoba
1	13	ON467a	〃
1	14	ON360	Iwasayama
1	15	ON266a	Nagaoka
1	16	ON266b	〃

Pseudoschwagerina (*Zellia*) *nunosei* HANZAWA

Pl.	Fig.	Slide No.	Loc.
3	1	Og29–5a	Hongo
3	2	Og34–3	〃

Paraschwagerina akiyoshiensis TORIYAMA

Pl.	Fig.	Slide No.	Loc.
3	3	Og16–4	Itando
3	4	ON314b	Horibe
3	5	Og32–1	〃

Paraschwagerina aff. *kansasensis* (BEEDE et KNIKER)

Pl.	Fig.	Slide No.	Loc.
5	4	ON157	Itando

Paraschwagerina gigantea (WHITE)

Pl.	Fig.	Slide No.	Loc.
5	1	ON192	Iwakurayama
5	2	Og26–3	Sukawa
5	3	ON–267	Manganji

Paraschwagerina (*Acervoschwagerina*) *endoi* HANZAWA

Pl.	Fig.	Slide No.	Loc.
4	1	Og27–16	Minamitoba
4	2	Og2–6–10a	Yadani
4	3	Og2–6–10b	〃
4	4	Og2–6–9a	〃
4	5	Og2–6–3	〃
4	6	Og2–6–5	〃

Pseudofusulina aff. *valida* (LEE)

Pl.	Fig.	Slide No.	Loc.
6	16	ON526–1	Onogi

Pseudofusulina aff. *subtilis* (SCHELLWIEN)

Pl.	Fig.	Slide No.	Loc.
6	15	ON526–2	Onogi

Pseudofusulina okafujii (TORIYAMA)

Pl.	Fig.	Slide No.	Loc.
6	1	ON432a	Manganji
6	2	ON424	Nagaoka
6	3	ON458	Manganji
6	4	ON436b	〃
6	5	ON436d	〃
6	6	ON432b	〃
6	7	ON478a	Hongo
6	8	ON406	Manganji
15	7	ON436e	〃
15	8	ON436f	〃

Pseudofusulina bacca MORIKAWA et ISOMI, n. sp.

Pl.	Fig.	Slide No.	Loc.
6	9	ON407b	Manganji
6	10	ON407a	〃
6	11*	ON462	Onogi
6	12	ON368	〃
6	13	ON478b	Hongo
6	14	ON427	Nagaoka

Pseudofusulina regularis (SCHELLWIEN)

Pl.	Fig.	Slide No.	Loc.
7	1	ON70–1	Ikenooku
7	2	ON331Da	〃
7	3	ON514–2–a	Manganji
7	4	ON498	Hongo
7	5	ON331Db	Ikenooku
7	6	ON331e	〃
7	7	Og1–156	Manganji
7	8	ON331d	Ikenooku
7	9	ON331b	〃
7	10	ON331c	〃

Pseudofusulina vulgaris (SCHELLWIEN)

Pl.	Fig.	Slide No.	Loc.
13	1	ON292	Hongo
13	2	ON500	Sukawa
13	3	ON6	Sengokudani
13	4	ON314	Horibe

Pseudofusulina globosa (DEPRAT)

Pl.	Fig.	Slide No.	Loc.
13	6	Og4–15b	Minamitoba
13	7	Og4–15a	〃
13	8	Og4–13a	〃
13	9	Og4–21	〃
13	10	Og4–13c	〃
13	11	Og4–13b	〃

Pseudofusulina cushmani CHEN

Pl.	Fig.	Slide No.	Loc.
9	1	Og1–17	Manganji
9	2	Og4–14c	Minamitoba
9	3	Og2B–11a	Yadani
9	4	Og4–10	Minamitoba
9	5	Og2B–6	Yadani
9	6	Og2B–5	〃
9	7	Og2B–15	〃
9	8	ON467b	Minamitoba
9	9	ON257b	Yadani
9	10	Og1–20d	Manganji
9	11	Og2B–6b	Yadani

Pseudofusulina krotowi (SCHELLWIEN)

Pl.	Fig.	Slide No.	Loc.
8	1	Og1–9a	Manganji
8	2	Og1–11b	〃
8	3	Og1–9b	〃
8	4	Og1–10	〃
8	5	Og1–9f	〃
8	6	ON275b	Nagaoka
8	7	Og1–9c	Manganji
8	8	Og1–14	〃
8	9	Og1–9e	〃
8	10	Og1–8	〃
8	11	ON274	Nagaoka

Pseudofusulina fusiformis (SCHELLWIEN et DYHRENFURTH)

Pl.	Fig.	Slide No.	Loc.
7	11	Og3–11a	Sukawa
7	12	Og3–11b	〃
8	12	Og4–3c	Minamitoba
8	13	Og4–3d	〃
10	1	ON241	Manganji
10	2	Og2c–9b	Yadani
10	3	Og2B–10	〃
10	4	Og2c–4a	〃
10	5	Og2c–9b	〃
10	6	Og1～15a	Manganji
10	7	Og3–16	Sukawa
10	8	Og–2c–7	Yadani
10	9	Og2c–8	〃
10	10	Og4–5	Minamitoba
11	1	Og2c–2a	Yadani
11	2	Og2c–10a	〃
11	3	Og2c–9a	〃
11	4	Og2c–10c	〃
11	5	Og4–3a	Minamitoba
11	6	Og3–3a	Sukawa
11	7	Og4–19a	Minamitoba
11	8	ON493	Onogi
11	9	ON461	Manganji
11	10	Og1–11a	〃
12	1	Og2c–1a	Yadani
12	2	Og2c–10d	〃
12	3	Og2B–13a	Yadani
12	4	Og4–19b	Minamitoba
12	5	Og2c–9d	Yadani
12	6	Og2B–3a	〃
12	7	Og3–3c	Sukawa
12	8	Og3–3b	〃
12	9	Og2–13b	Yadani
12	10	Og4–15c	Minamitoba
13	5	ON468	Manganji

Pseudofusulina kraffti (SCHELLWIEN)

Pl.	Fig.	Slide No.	Loc.
14	1	ON537	Sukawa
14	2	ON34	Onogi
14	3	ON257a	Yadani
14	4	ON140	Onogi
14	5	ON499a	Nagaoka
14	6	ON468–2a	Yadani
14	7	ON468a	〃
14	8	ON429	Nagaoka
14	9	ON499b	〃
14	10	ON499c	〃
15	5	Og3–12	Sukawa
15	6	ON376	〃

Pseudofusulina norikurensis IGÔ

Pl.	Fig.	Slide No.	Loc.
15	1	Og5–23	Sukawa
15	2	Og5–17	〃
15	3	Og5–27	〃
15	4	Og5–5	〃
16	1	Og5–20	〃
16	2	Og5–16	〃
16	3	Og5–21	〃
16	4	Og5–8	〃
16	5	Og5–22	〃
16	6	Og5–22	〃
16	7	Og5–25	〃

Pseudofusulina lepida (DEPRAT)

Pl.	Fig.	Slide No.	Loc.
20	1	ON390a	Iwasayama
20	2	ON290B	〃
20	3	ON525b	〃
20	4	ON380	〃
20	5	ON348b	〃

Nagatoella ikenoensis MORIKAWA et ISOMI, n. sp.

Pl.	Fig.	Slide No.	Loc.
20	6*	ON70c	Ikenooku
20	7	ON70c	〃
20	8	ON331Aa	〃
20	9	ON331Aa	〃
20	10	ON345	〃
20	11	ON331Dc	〃
20	12	ON331a	〃
20	13	ON331c	〃

Parafusulina exilis (SCHWAGER)

Pl.	Fig.	Slide No.	Loc.
18	8	ON525a	Iwasayama
18	9	Og6–29	〃

Parafusulina parakinosakii MORIKAWA et ISOMI, n. sp.

Pl.	Fig.	Slide No.	Loc.
17	1*	ON390c	Iwasayama
17	2	ON263Aa	〃
17	3	ON290A	〃
17	4	ON263Ab	〃
17	5	Og6–39	〃
17	6	Og6–44	〃
17	7	ON296B	〃
17	8	Og6–15a	〃
17	9	Og6–8a	〃

Parafusulina takeyamai MORIKAWA et ISOMI, n. sp.

Pl.	Fig.	Slide No.	Loc.
7	13	Og6–19	Iwasayama
19	1*	Og6–27	〃
19	2	Og6–25	〃
19	3	Og6–5a	〃
19	4	Og6–12	〃
19	5	Og6–22a	〃
19	6	ON296–1b	〃
19	7	Og6–28	〃
19	8	Og6–29	〃

Parafusulina iwasensis MORIKAWA et ISOMI, n. sp.

Pl.	Fig.	Slide No.	Loc.
18	1*	ON385	Iwasayama
18	2	Og6–37a	〃
18	3	Og6–36b	〃
18	4	Og6–37b	〃
18	5	Og6–35	〃
18	6	Og6–37c	〃
18	7	ON390b	〃

Misellina ibukiensis KOBAYASHI

Pl.	Fig.	Slide No.	Loc.
21	1	ON378e	Muraki
21	2	ON378c	〃
21	3	ON447a	Nagaoka
21	4	ON447b	〃
21	5	ON259d	Manganji
21	6	ON259a	〃
21	7	ON259f	〃
21	8	ON259b	〃
21	9	ON259c	〃
21	10	ON378g	Muraki
21	11	ON259	Manganji
21	12	ON259	〃
21	13	ON378–1	Muraki
21	14	ON145b	Sukawa
21	15	ON145c	〃
21	16	ON378h	Muraki
21	17	ON378c	〃

Pseudodoliolina ozawai YABE et HANZAWA

Pl.	Fig.	Slide No.	Loc.
18	10	ON279Bd	Iwasayama
18	11	ON279Bc	〃
18	12	Og7-2b	〃

Verbeekina sp.

Pl.	Fig.	Slide No.	Loc.
20	14	Og6-7	Iwasayama

Neoschwagerina nipponica OZAWA

Pl.	Fig.	Slide No.	Loc.
20	15	ON296Bb	Iwasayama
20	16	Og6-34	〃
20	17	ON413a	〃
20	18	ON279Bc	〃
20	19	Og6-5b	〃

Neoschwagerina rotunda (DEPRAT)

Pl.	Fig.	Slide No.	Loc.
2	17	ON530b	Onogi
2	18	ON142	〃
2	19	ON366	〃
2	20	ON530a	〃

Neoschwagerina sp.

Pl.	Fig.	Slide No.	Loc.
3	6	ON279Bb	Iwasayama
3	7	ON279Be	〃
3	8	ON279Aa	〃

* Holotype

Morikawa, R.
Isomi, H.

Studies of Permian Fusulinids in the East of Lake Biwa, Central Japan

Rokuro Morikawa & Hiroshi Isomi

地質調査所報告, No. 191, p. 1～30, 1961
2 illus, 21 pl., 29 tab.

The present report deals with the paleontological study of the Fusulinid fossils from the lower to middle Permian limestones in the east of Lake Biwa, central Japan.

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